ADVANTEST CORPORATION

INSTRUCTION MANUAL

TR2731/2741

Computing Data Logger

VOL 1

MANUAL NUMBER EH01 9205

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SECTION 1
GENERAL INFORMATION

1-1. TR2731/2741 SERIES INTRODUCTION AND FEATURES

The TR2731/2741 Computing Data Logger with versatile, flexible processing capability provides high-speed, high-precision measurement of a wide range of physical and electrical data by combining appropriate sensor terminals and optional input cards. The instrument can be configured in many ways to assure a broad application. The principle features are as follows:

(1) High-speed and high-precision measurement: The high-precision, high-speed A/D conversion technique enables measurements on up to 320 channels in only four seconds, with resolutions of 1 μV for DC voltage measurement, 0.1°C for temperature measurement using thermocouples, and 0.01°C for temperature measurement using platinum RTDs (Resistive Temperature Detector).

(2) Distributed configuration system: Up to four sensor terminals can be distributed to install remotely from the mainframe. This permits close sensor connections to the measurement objects. The digital transmission method ensures high noise rejection and allows the cable length of up to 500 meters from the mainframe for remote signal connections.

(3) Intermixed inputs acceptability: The instruments can accept up to 8 types of thermocouples, 3 ranges of platinum RTDs, 4 ranges of DC voltage, contact signals, digital data, pulse trains, and so forth in a combined form.

(4) Various data logging modes: Data logging mode is selectable from four different scan modes, multi-user mode (permitting up to four users to simultaneously access the instrument), input skip, high-speed buffering, and some other modes. This allows the user to selectively log only his necessary data.

(5) Ample arithmetic functions: The eight standard arithmetic functions such as scaling, upper and lower limits identification and differential calculation between two or more channels are provided. In addition, nine types of secondary arithmetic operation functions are optionally available.

(6) Monitor and alarm functions: The monitor and alarm functions include the scanning monitor (which operates independently of regular logging), alarm relay output, alarm print, continuous single-channel monitoring, alarm comment, and auto-restart function.

(7) Simple programming: The item-independent programming keys and large fluorescent display facilitate programming of measurement parameters. The direct item specification and automatic rearrangement functions permit easy programming, insertion, and deletion of measurement parameters even for grouped items. Furthermore, external programming through GPIB interface is also enabled.

(8) Expandability assured by various options: The mainframe has four slots to accommodate optional I/O cards. The eight optional cards such as GPIB, parallel/serial data transfer, analog output, data buffer memory, etc. can be installed to match application requirements.

1-2. CONFIGURATION

The configuration of the TR2731/2741 Series Computing Data Logger is shown below for selection of the optimum system configuration:

TR2731	Computing Data Logger mainframe
TR2741A	Sensor Terminal (40 channels of thermocouple/DC voltage inputs)
TR2741B	Sensor Terminal (80 channels of thermocouple/DC voltage inputs)
TR2741C	Sensor Terminal (20 channels of platinum RTD/DC voltage inputs)
TR2741D	Sensor Terminal (40 channels of platinum RTD/DC voltage inputs)
TR2741E	Sensor Terminal (40 channels of thermocouple/DC voltage inputs or 20 channels of platinum RTD/DC voltage inputs)

TR2730-010 Memory/Aux. Function option card
TR2730-510 GPIB Interface option card
TR2730-520 BCD Output/External Control option card
TR2730-530 BCD Input option card
TR2730-540 Relay Output option card
TR2730-550 Analog Output option card
TR2730-560 Serial Data Output option card
TR2730-570 Data Buffer Memory option card
TR2730-580 Pulse Counter option card

Figure 1-1 shows the configuration of the TR2731/2741, and Figure 1-2 gives a selection guide.

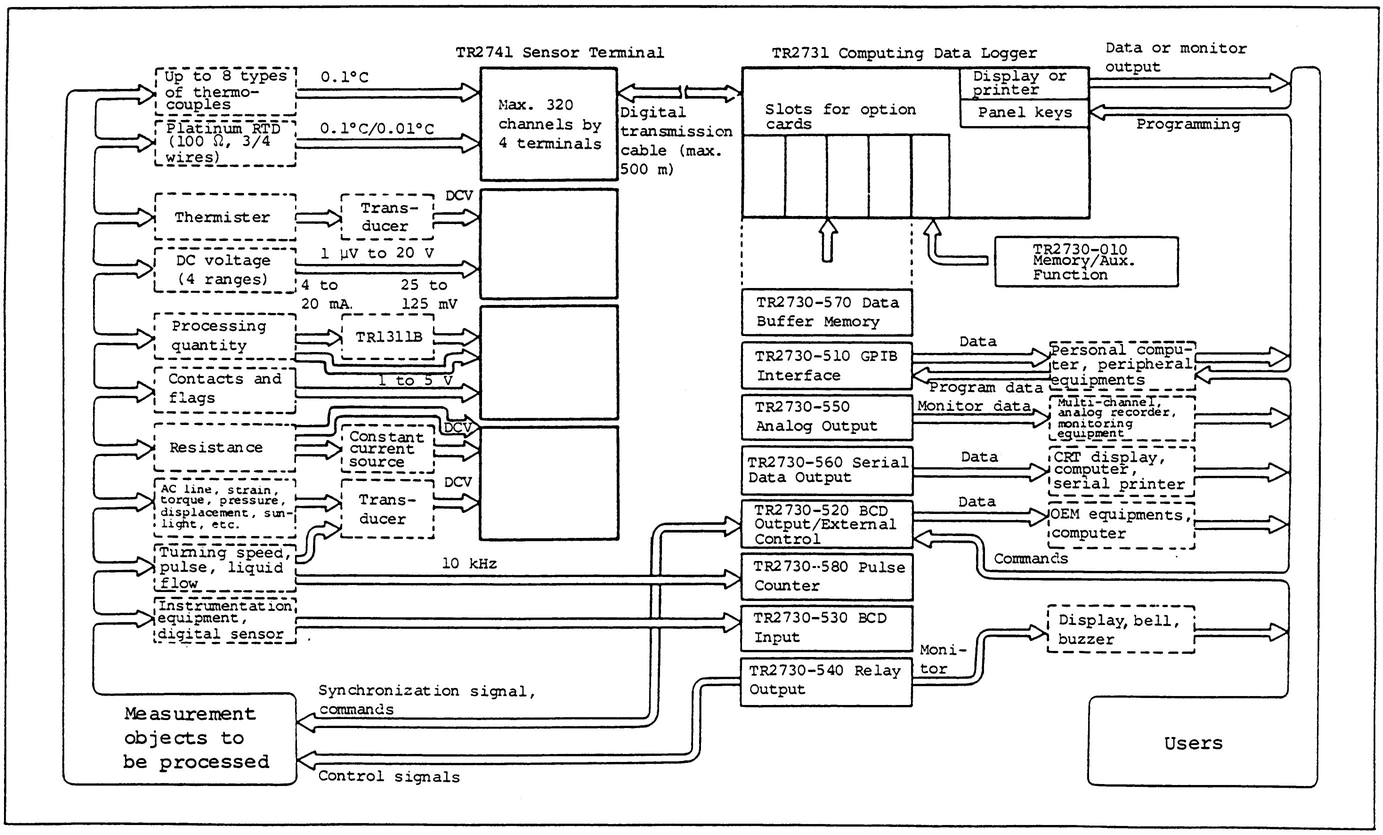


Fig. 1-1 TR2731/2741 system configuration

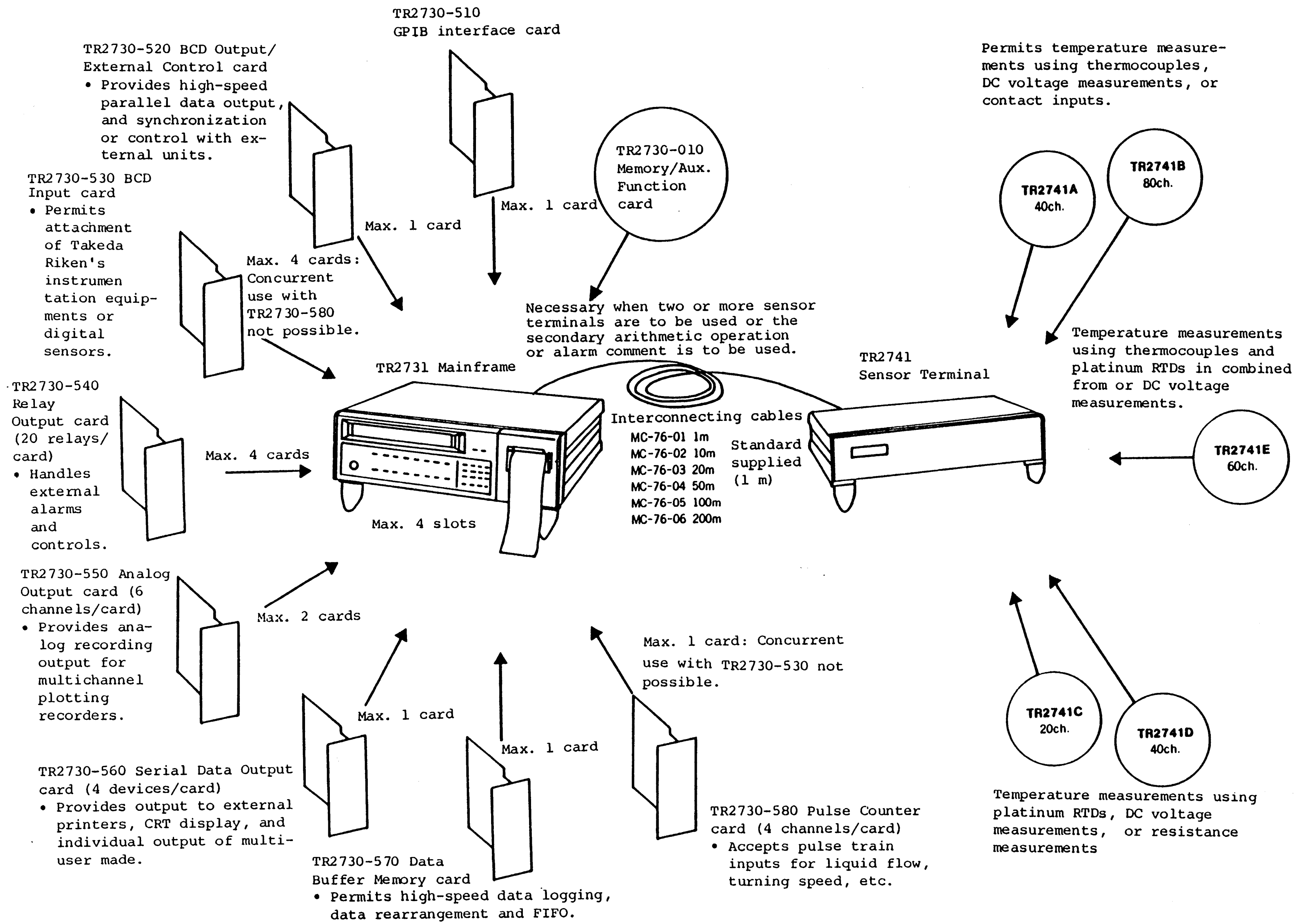


Fig. 1-2 Selection guide

1-3. GENERAL PRECAUTIONS

1-3-1. Unpacking and Transportation

Each instrument is carefully inspected and packed in a shock-absorbing package. Upon receiving the instrument, an examination should be made for the following points:

(1) Unpack and remove the instrument.

(2) Check the instrument for any damage sustained in transit, especially for the panel switches and terminals.

(3) Check the quantities and specifications of the supplied accessories against the following tables:

TR2731

Item	Product code	Quantity
Recording paper	9993-013	5
Number sticker (to be stuck on TR2741)		2
Fuse (EAWK 2.5 A)*		2
Operation & Maintenance Manual		1

* 1.25 A for 200, 220, 240 Vac

TR2741

Item	Product code	Quantity
Interconnecting cable (1 m)	MC-76-01	1
Fuse (EAWK 0.4 A)		2
Plug (JCP-AX002JX01-1)	SI-7502	1

If damage is found or any accessory part is missing, notify your nearest ADVANTEST representative.

(4) Transportation

If it should become necessary to repack the instrument for transportation, use the original packing material. If the original packing material is lost or discarded, pack the instrument as follows:

a. Wrap the instrument with a vinyl sheet.

b. Pack the instrument in a cardboard box having a thickness of more than 5 mm, with filler placed all around the instrument to a thickness of more than 50 mm.

c. Place accessories on filler, then cover them with additional filler. Close and bind the cardboard box.

1-3-2. Preparations and General Precautions

(1) Battery charging

When the TR2731 is switched on after initial installation or after it is left unused for more than one month, "LOW BAT." may be displayed for approximately three seconds. This message indicates that the internal battery requires recharging and hence the instrument must remain powered for more than eight hours for recharging. If the instrument is operated with its battery uncharged, part or all of the memory contents will be destroyed when the instrument is switched off.

(2) Power supply

The AC line voltage at which the instrument should be operated is indicated near the power cable outlet on the rear panel. The allowable power voltage is 100, 120, 200, 220 Vac ±10% or 240 Vac $^{+4\%}_{-10\%}$ with the frequency of 50 or 60 Hz.

The line frequency can be switched between 50 and 60 Hz with a 50Hz/60Hz selector switch provided on the rear panel of the TR2741 Sensor Terminal. Before connecting the power cable to the instrument, make sure that the POWER switch is set to OFF. If a private power generator or DC-AC inverter is to be used as a power source, pay attention to the output frequency displacement and waveform. (Since wave is required.)

(3) Power cable

The power cable has a 3-prong plug and the round prong in the center is for grounding.

If the KPR-13 plug adapter is used for power connection, make sure to connect the ground lead (Figure 1-3) of the adapter or the GND terminal on the rear panel to the ground.

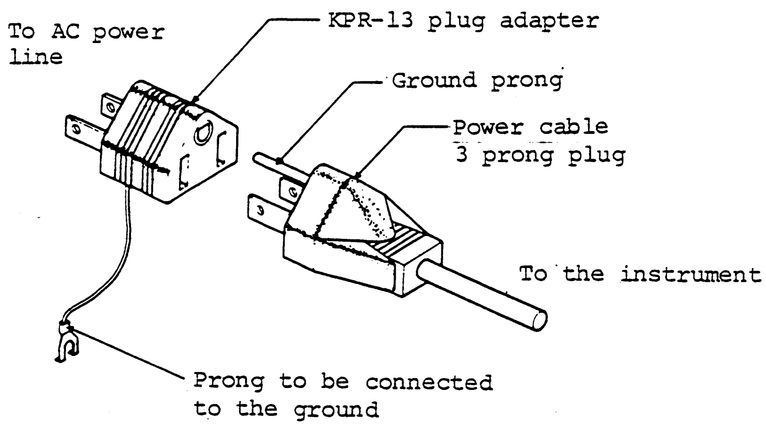


Fig. 1-3 Power cable plug and adapter

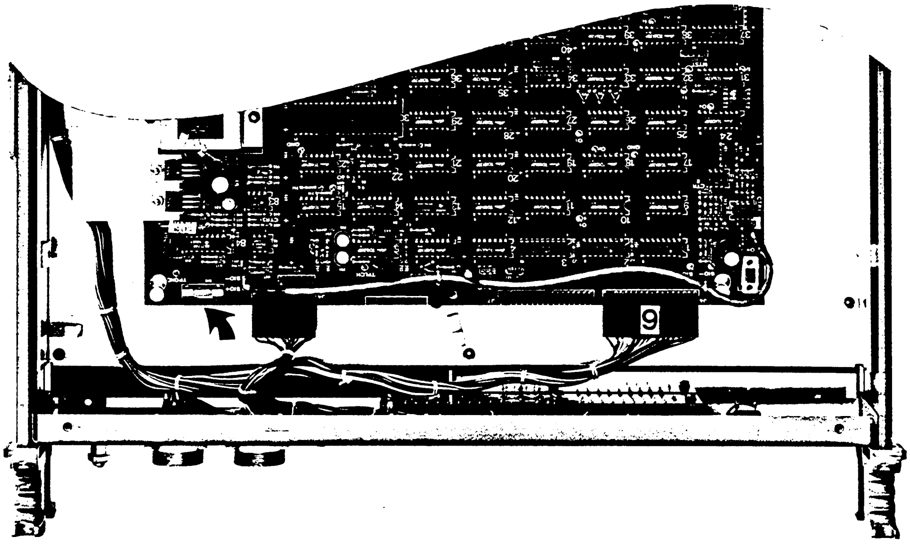
(4) Fuse replacement

The power line fuse is contained in a fuse holder on the TR2731 rear panel. If fuse replacement is required, turn the fuse holder cap in the arrow direction and replace it with the same rating fuse as the original one.

On TR2741, the line fuse is placed on its internal circuit board (Figure 1-4). The fuse can be pulled out from or pushed down into its metal holder.

CAUTION

Before replacing the fuse, make sure to disconnect the power cable from the AC outlet.



(Loosen 5 pieces of the screw of the bottom cover.)

Fig. 1-4 TR2741 line fuse location

(5) Chassis grounding

To prevent noise interference and electrical shock, ground the GND terminals on both TR2731 and TR2741 rear panel with a thick copper wire.

(6) Line noise

The instruments are insensitive to AC power line noise. If a problem occurs due to power line noise, however, use a noise filter in the primary power circuit.

(7) Operating environment

The instruments should be operated in a place free from direct sunlight, corrosive gas, and excessive dust. Do not expose the instrument to natural wind, or cool/hot air flow from air conditioning units as this may cause a temperature difference between input terminals and hence a measurement error.

The ambient temperature should be between $0^{\circ}C$ and $+40^{\circ}C$ for TR2731, and between $0^{\circ}C$ and $+50^{\circ}C$ for TR2741 with a relative humidity of less than 85% for both models.

(8) Ventilation (TR2731 only)

The TR2731 is forced air-cooled with an inhaling cooling fan on the rear panel. And the air is exhausted through the ventilators provided in the top and bottom covers. To ensure adequate ventilation, allow sufficient space around the instrument.

(9) Shock and vibration

The instrument contains precision mechanical units such as a printer. It should not be operated under excessive mechanical shock or constant vibration.

(10) Storage

The storage temperature range for TR2731 should be between $-20^{\circ}C$ and $+60^{\circ}C$, with relative humidity of 90% or lower, and that for TR2741 should be between $-25^{\circ}C$ and $+70^{\circ}C$, with relative humidity of 95% or lower.

When the instruments are to be left unused for a long period of time, wrap them with a vinyl sheet or store in a cardboard box to keep in a dry and cool place free from direct sunlight.

(11) Recording paper

Avoid the following treatment for recording paper:

a. Storage in an environment of high temperature or humidity.
b. Exposure to direct sunlight for a long period of time.
c. Use of solvent adhesives (such as rubber bonds, thinner bonds, PIT stick glue, etc.) for splicing.
d. Contact with diazotized copy paper immediately after recording.
e. Contact with plastic film containing plasticizer over a long period of time.

(12) Before measurement operation

Before attempting the operation of the instrument, be sure to carefully read 3-8 "Operating Instructions".

MEMO

SECTION 2

TR2741 SENSOR TERMINAL

2-1. GENERAL

The TR2741 Sensor Terminal is a compact input terminal board which can be installed independently of the TR2731 Computing Data Logger.
It contains a high-precision integration A/D converter of 20 samples per second and uses microprocessor to control calibration, room temperature compensation, linearization, and error detection, etc. Up to four sensor terminals can be attached to the TR2731 Computing Data Logger. Upon receiving a command from the TR2731 mainframe, attached sensor terminals simultaneously start scanning and transfer processed data to the TR2731 data logger. The sensor terminal has the following features:

(1) High-speed and high-precision measurement
In addition to high-speed data logging of 20 samples per second, high-resolutions of 1 μV for DC voltage measurements, 0.01°C for temperature measurements using platinum RTDs, and 0.1°C for temperature measurements using thermocouples is attained.

(2) Distributed configuration
Data and commands are transferred to and from remote sensor terminals in digitally-coded, bit-serial format via a pair of signal lines. This transmission method exhibits higher noise rejection and better data reliability than the low-level analog transmission method. The digital transmission method does not require high quality cables for transmission paths and permits a maximum cable length of 500 meters (up to two output ports are provided).

(3) Intermixed inputs handling capability
Each TR2741 can handle up to 16 types of intermixed sensor outputs.
Thermocouples: T(CC), J(IC), E(CRC), K(CA), S(PR10%), R(PR13%), B(PR30%), PR12.8%
Platinum RTD : 100 Ω 3-wire, 4-wire, and 4-wire high resolution
Voltage input: ±20 mV, ±200 mV, ±2 V, ±20 V
Contact input: Relay make/break status detection

(4) High-speed measurement

High-speed measurement of up to 320 channels per 4 seconds ensures real time processing of data logging.

(5) Five types of sensor terminals

The sensor terminal can accept up to 40 groups of various types of input signals. Five models are available depending on input signal types or number of channels:

Configuration / Model	Thermocouple/voltage measurement Number of units (40 channels/unit)	Platinum RTD/voltage measurement Number of units (40 channels/unit)	Total channels
TR2741A	1 (40 channels)	-	40
TR2741B	2 (40 channels)	-	80
TR2741C	-	1 (20 channels)	20
TR2741D	-	2 (20 channels)	40
TR2741E	1 (40 channels)	1 (20 channels)	60

The thermocouple/voltage measurement unit is capable of measuring the following items:

Up to 8 types of thermocouples, 4 ranges of voltage and contact signal.

The platinum RTD/voltage measurement unit is capable of measuring the following items:

Up to 3 ranges of platinum RTDs and 4 ranges of voltage.

(6) The sensor terminal consumes only a very little power and is supplied from the TR2731 mainframe. It can, therefore, be installed in sites where commercial AC power is not available.

2-2. SPECIFICATIONS

Configuration and Input Channels

The following five types of sensor terminals are configured with two types of terminal board units:

Configuration / Model	Thermocouple/voltage measurement units	Platinum RTD/voltage measurement units	Total channels
TR2741A	1	-	40
TR2741B	2	-	80
TR2741C	-	1	20
TR2741D	-	2	40
TR2741E	1	1	60

Note: Each sensor terminal configuration is not modifiable after delivery.

Thermocouple/Voltage Measurement Unit Specifications

Input signal types:

Thermocouple : T(CC), J(IC), E(CRC), K(CA), S(PR10%), R(PR13%), B(PR30%), PR12.8% (All comply with JIS Standard C1602-1981.)

DC voltage : ±20 mV, ±200 mV, ±2 V, ±20 V

Non-voltage contact input: ON for 2 kΩ or less, OFF for 30 kΩ or more.
Detectable current: Approx. 42 μA with a pulse width of approx. 300 μs

Input channels : 40 channels/unit

Scanning speed : 50 ms/channel

Input system : 2-wire switching system using electromechanical relays.

Input terminals : Top-plane type, two-terminals two-wire system using screw (M4x8) termination

Input impedance : 50 MΩ or more (approx. 11 MΩ for 20 V range)

Thermocouple fault detection: Normal if 2 kΩ or less;
Error if 30 kΩ or more
Detectable current: Approx. 42 μA with a pulse width of approx. 300 μs

Measurement range and accuracy: Guaranteed for six months under an ambient temperature of +23°C ±5°C with relative humidity of 85% or lower

Temperature measurement	Type	Measurement range (°C)	Resolution (°C)	Measurement accuracy ±(% of rdg+°C)	Temperature coefficient (0°C to +50°C) ±(% of rdg+°C)/°C
	T (CC)	- 270.0 to - 250.0	0.1	±(0.6+4.0)	±(0.0393+0.0010)/°C
		- 250.0 to - 200.0		±(0.1+1.0)	±(0.0064+0.0010)/°C
		- 200.0 to 0.0		±(0.05+0.5)	±(0.0028+0.0010)/°C
		0.0 to + 400.0		±(0.03+0.3)	±(0.0015+0.0010)/°C
	J (IC)	- 210.0 to 0.0	0.1	±(0.05+0.5)	±(0.0029+0.0008)/°C
		0.0 to +1200.0		±(0.03+0.3)	±(0.0013+0.0008)/°C
	E (CRC)	- 270.0 to - 250.0	0.1	±(0.6+3.0)	±(0.0352+0.0007)/°C
		- 250.0 to - 200.0		±(0.1+0.7)	±(0.0059+0.0007)/°C
		- 200.0 to 0.0		±(0.05+0.5)	±(0.0024+0.0007)/°C
		0.0 to +1000.0		±(0.03+0.3)	±(0.0013+0.0007)/°C
	K (CA)	- 270.0 to - 226.0	0.1	±(1+6.0)	±(0.0553+0.0012)/°C
		- 226.0 to - 200.0		±(0.07+0.7)	±(0.0042+0.0012)/°C
		- 200.0 to 0.0		±(0.05+0.5)	±(0.0028+0.0012)/°C
		0.0 to +1372.0		±(0.03+0.3)	±(0.0013+0.0012)/°C
	S (PR10%)	- 50.0 to 0.0	0.1	±(0.03+1.4)	±(0.0067+0.0074)/°C
		0.0 to + 538.0		±(0.01+1.0)	±(0.0018+0.0074)/°C
		+ 538.0 to +1769.0		±(0.03+0.6)	±(0.0010+0.0040)/°C
	R (PR13%)	- 50.0 to 0.0	0.1	±(0.03+1.4)	±(0.0079+0.0076)/°C
		0.0 to + 338.0		±(0.01+1.0)	±(0.0018+0.0076)/°C
		+ 338.0 to +1769.0		±(0.03+0.6)	±(0.0012+0.0040)/°C
	B (PR30%)	+ 50.0 to +1139.0	0.1	±(0.03+1.0)	±(0.0085+0.0113)/°C
		+1139.0 to + 182.0		±(0.03+0.6)	±(0.0123+0.0323)/°C
	PR 12.8%	0.0 to + 340.0	0.1	±(0.01+1.0)	±(0.0017+0.0076)/°C
		+ 340.0 to +1770.0		±(0.03+0.6)	±(0.0012+0.0040)/°C

Note: Calibration conforms to JIS C1602-1981. Type PR12.8% conforms to the PR of JIS C1602-1974, however. Compensation accuracy and temperature coefficient of the reference junction and the error of thermocouples and compensating wires are not included.

	Range	Measurement range	Res-olu-tion	Measurement accuracy ±(% of rdg+μV)	Temperature coefficient (0°C to +50°C) ±(% of rdg+μV)/°C
Voltage measure-ment	20mV	-19.999mV to +19.999mV	1μV	±(0.03+ 5μV)	±(0.0015+0.04μV)/°C
	200mV	-199.99mV to +199.99mV	10μV	±(0.03+ 20μV)	±(0.0015+ 0.4μV)/°C
	2V	-1.9999 V to +1.9999 V	100μV	±(0.03+200μV)	±(0.0015+ 4μV)/°C
	20V	-19.999 V to +19.999 V	1mV	±(0.04+ 2mV)	±(0.0015+ 40μV)/°C

Linearization : Digital compensation (8 types are contained for individual thermocouples)
Linearization on/off is programmable for each group.

Reference junction compensation: Internal and external (programmable for each group)

Internal : Terminal board temperature measurement using platinum RTDs
Compensation accuracy: ±0.5°C (Including terminal board temperature distribution. Guaranteed for 6 months under an ambient temperature of +23°C ±5°C with relative humidity of 85% or lower, input terminal temperature balanced.)
Temperature coefficient: ±0.004°C (under ambient temperature of 0°C to 18°C or +28°C to +50°C with relative humidity of 85% or lower)

External : A cold junction thermocouple is to be connected to each channel. (TR7021 Automatic Reference Cold Junction unit is optionally available.)

Platinum RTD Voltage Measurement Unit Specifications

Input signal types:

Platinum RTD : Nominal resistance 100 Ω, 3/4 wire system

DC voltage : ±20 mV, ±200 mV, ±2 V, ±20 V

Input channels : 20 channels/unit

Scanning speed : 50 ms/channel (100 ms/channel for 3-wire platinum RTD)

Input system : 4-wire switching system using electromechanical relays (the negative current terminal is common to all channels).

Input terminal : Top plane, 4-terminal, 4-wire system using screw (M4x8) termination

Input impedance : 50 MΩ or more (approx. 11 MΩ for 20 V range)

Measurement range and accuracy: Guaranteed for six months under an ambient temperature of +23°C +5°C with relative humidity of 85% or lower

Temperature measurement	Type	Measurement range (°C)	Resolution	Measurement accuracy ±(% of rdg+°C)	Temperature coefficient (0°C to +50°C) ±(% of rdg+°C)/°C
	3-wire RTD	-200.0 to +649.0	0.1°C	±(0.03+0.3)	±(0.0006+0.0015)/°C
	4-wire RTD	-200.0 to +649.0	0.1°C	±(0.02+0.3)	±(0.0006+0.0015)/°C
		- 50.00 to +200.00	0.01°C	±(0.01+0.1)	±(0.0006+0.0015)/°C

Note: Calibration conforms to JIS C1604-1989. Nominal resistance 100 Ω. Sensor's error not included.

	Range	Measurement range	Resolution	Measurement accuracy ±(% of rdg+μV)	Temperature coefficient (0°C to +50°C) ±(% of rdg+μV)/°C
Voltage measurement	20mV	-19.999mV to +19.999mV	1μV	±(0.03+ 5μV)	±(0.0015+0.04μV)/°C
	200mV	-199.99mV to +199.99mV	10μV	±(0.03+ 20μV)	±(0.0015+ 0.4μV)/°C
	2V	-1.9999 V to +1.9999 V	100μV	±(0.03+200μV)	±(0.0015+ 4μV)/°C
	20V	-19.999 V to +19.999 V	1mV	±(0.04+ 2mV)	±(0.0015+ 40μV)/°C

Linearization : Digital compensation
Linearization on/off is programmable for each group.

Platinum RTD measuring current: Approx. 1 mA (open circuit voltage: 15 V or less)

Allowable conductor resistance: 10 Ω or less per conductor for 3-wire system

100 Ω or less per conductor for 4-wire system

Calibration Time

Minimum: 0.30 second

Maximum: 1.05 second

Noise Rejection Ratio

Effective CMRR for AC: Not less than 100 dB (at 50/60 Hz ±0.2 Hz AC with imbalanced input of 1 kΩ)

Effective CMRR for DC: Not less than 140 dB (for imbalanced input of 1 kΩ)

NMRR : Not less than 45 dB (at 50/60 Hz ±0.2 Hz AC)

Crosstalk

Interchannel crosstalk: Better than 120 dB (for DC voltage)

Maximum Voltage Application Range

Voltages applied across input terminals must not exceed the following range under any circumstances:

Item \ Unit	Thermocouple/voltage measurement unit	RTD/voltage measurement unit
Across co-channel input terminals	±50 V	±40 V
Across inter-channel input terminals	±100 V	0 V (±100 V at voltage terminals)
Across input terminals and chassis	±200 V	±200 V

Note: DC level or AC peak value

General Specifications

A/D conversion : Dual slope integration

Zero and full scale calibration: Automatic calibration by program

Calibration timing: At the beginning of each scan and at approx. 15 second intervals

Warm-up time : Less than 30 minutes to meet the specifications (after storage under the same temperature as the operating temperature)

Operating temperature: $0^{\circ}C$ to $+50^{\circ}C$ with relative humidity of 85% or lower

Storage temperature: -25°C to +70°C with relative humidity of 95% or
lower

Power supply : Supplied from the TR2731 mainframe (approx. 30 Vdc, not more than 10 W)

External dimensions: Approx. 424(W) x 88(H) x 450(D) mm

Weight :	TR2741A	7.5 kg or less
	TR2741B	9.0 kg or less
	TR2741C	7.5 kg or less
	TR2741D	9.0 kg or less
	TR2741E	9.0 kg or less

Accessories supplied:

(1) Fuse (EAWK 0.4 A)	2
(2) Connecting cable MC-76-01 (1 m)	1
(3) Plug (for external start/stop) SI-7502	1

2-3. PANEL DESCRIPTION

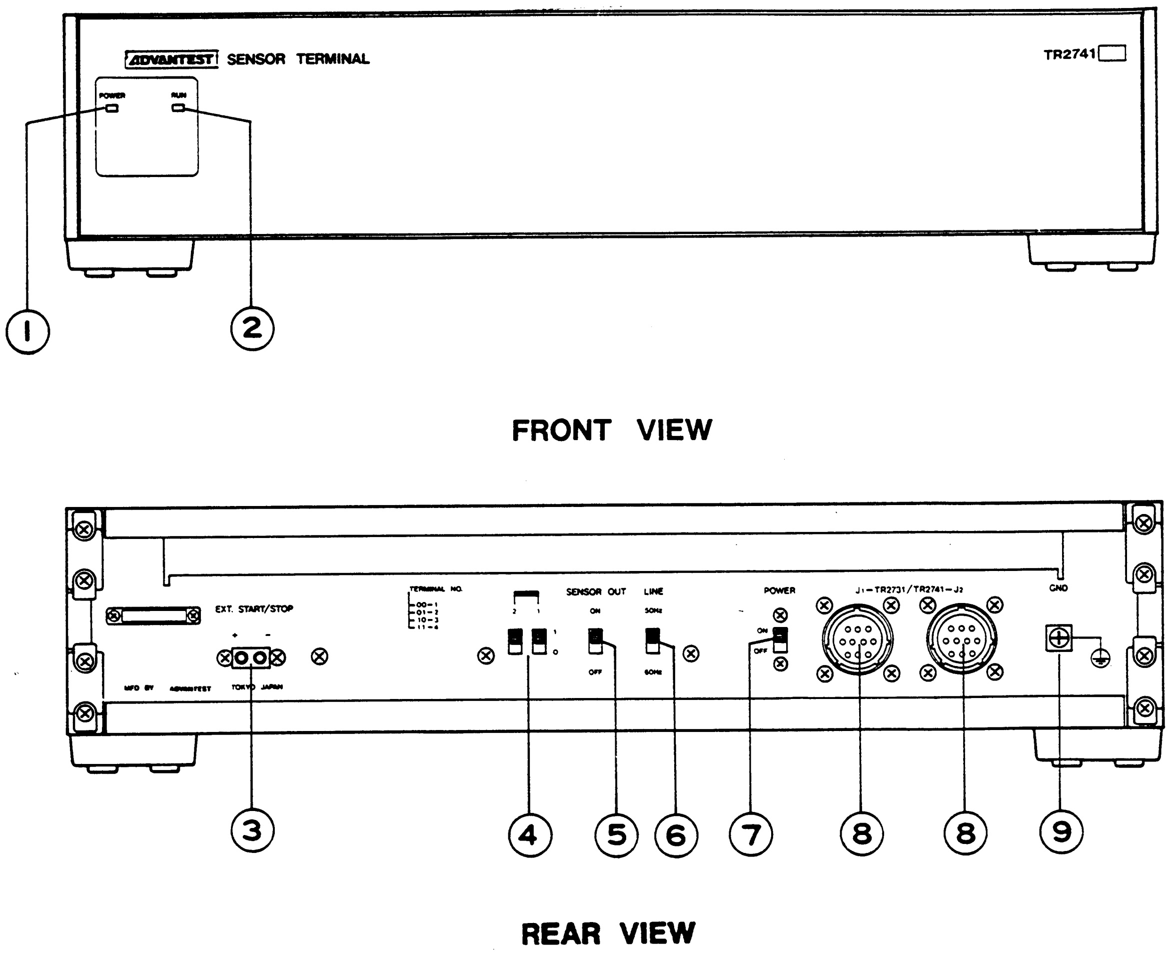


Fig. 2-1 TR2741 panel description

2-3-1. Front Panel Description

① POWER indicator lamp
Lights when the TR2741 is powered.

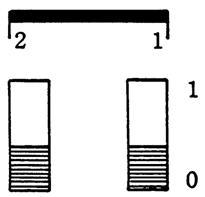
② RUN indicator lamp
Lights during measurement or calibration.

2-3-2. Rear Panel Description

③ EXT. START/STOP connector
Accepts an external start/stop signal. Each time the "+" and "-" terminals of this connector are shorted through a relay contact, the instrument repeats start and stop alternately (this function is the same as the LOG START/STOP key on the TR2731.). In the multi-user log scan mode, however, this input accepts no external start/stop signal.
The ratings of the input relay signal are as follows:

Contact resistance: 50 Ω or less
Chattering: 20 ms or less
Current capacity: 10 mA or more
Voltage capacity: 7 V or more

④ TERM. NO switches
These switches assign a terminal number to the TR2741 as shown in the following:



Terminal No.	Switch status	
	2	1
1	0	0
2	0	1
3	1	0
4	1	1

Fig. 2-2 Terminal number assignment

⑤ SENSOR OUT switch

Determines whether sensor fault is to be detected or not. When this switch is set to ON, sensor fault is detected only for the channels for which the thermocouple range is specified. This switch should be set to ON whenever a contact input is to be used.

⑥ LINE switch

Selects line frequency between 50 and 60 Hz. Set this switch to 50 Hz or 60 Hz according to the local line frequency.

⑦ POWER switch

This POWER switch is provided for maintenance purposes and should usually be left at the ON position. When this switch is set to the ON position, the power to the TR2741 can be controlled by the POWER switch on the TR2731 mainframe.

⑧ Connectors J1 and J2

Accept an interconnecting cable to the TR2731 mainframe or to another TR2741 Sensor Terminal. All power supply and data transfer are made through these connectors.

⑨ GND terminal

This terminal is internally connected to the instrument's chassis. To prevent noise interference, this terminal should be grounded through a thick copper wire.

2-3-3. Terminal Board

Figure 2-3 shows the TR2741E terminal board.
The terminal board for the TR2741 series has the following configuration:

Model	Thermocouple/voltage measurement unit	Platinum RTD/voltage measurement unit
TR2741A	1	-
TR2741B	2	-
TR2741C	-	1
TR2741D	-	2
TR2741E	1	1

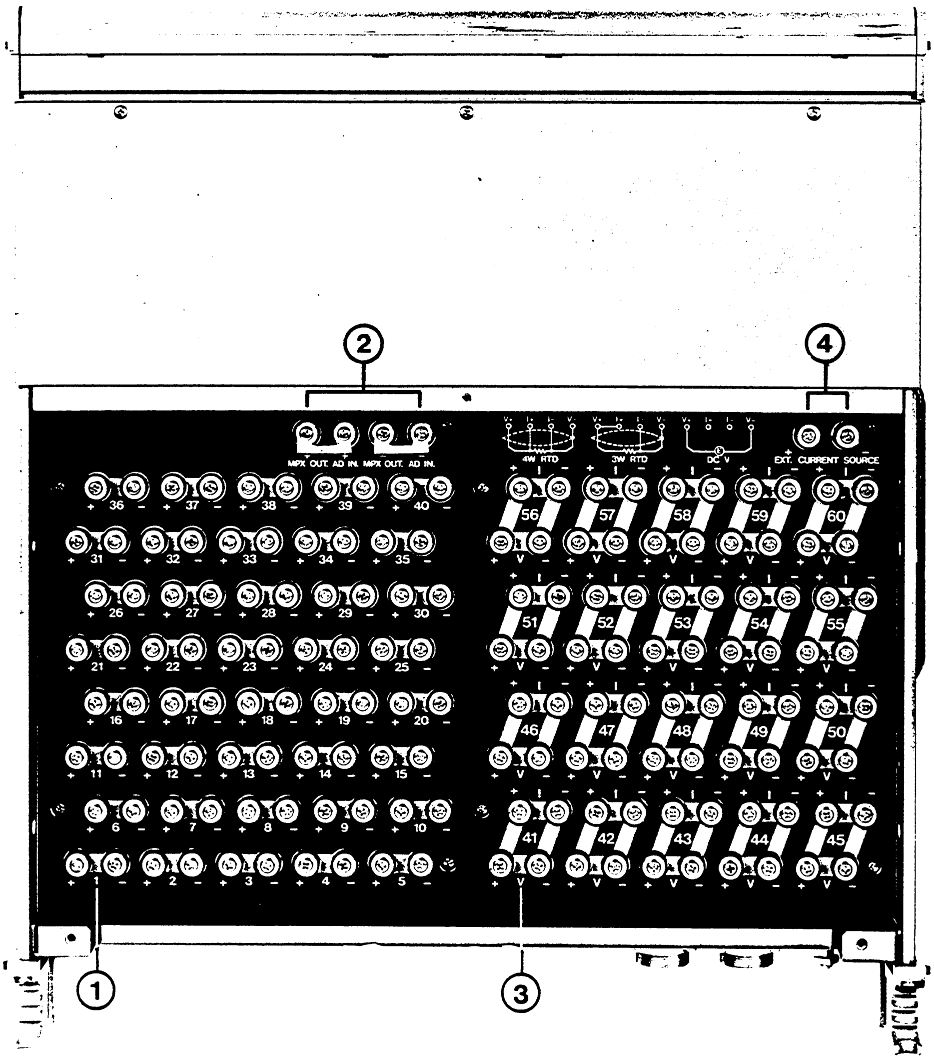


Fig. 2-3 TR2741E terminal board

① Thermocouple/voltage input terminals

These terminals accept thermocouple output (for temperature measurements), DC voltage, or contact signal.

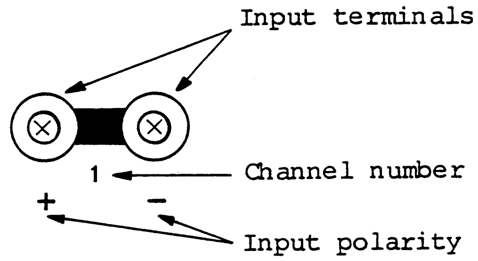


Fig. 2-4 Thermocouple/voltage input terminals

② MPX OUT./AD IN. terminals

Accept scanner output (MPX OUT.+ and MPX OUT.-) and A/D converter input (AD IN.+ and AD IN.-). Normally, shorting bars are provided across the MPX OUT.+ and AD IN.+ terminals and across the MPX OUT.- and AD IN.- terminals. Use of these terminals is described in item 2-5-2, (4).

③ Platinum RTD/voltage input terminals

Accept platinum RTD output (for temperature measurements) or DC voltage.

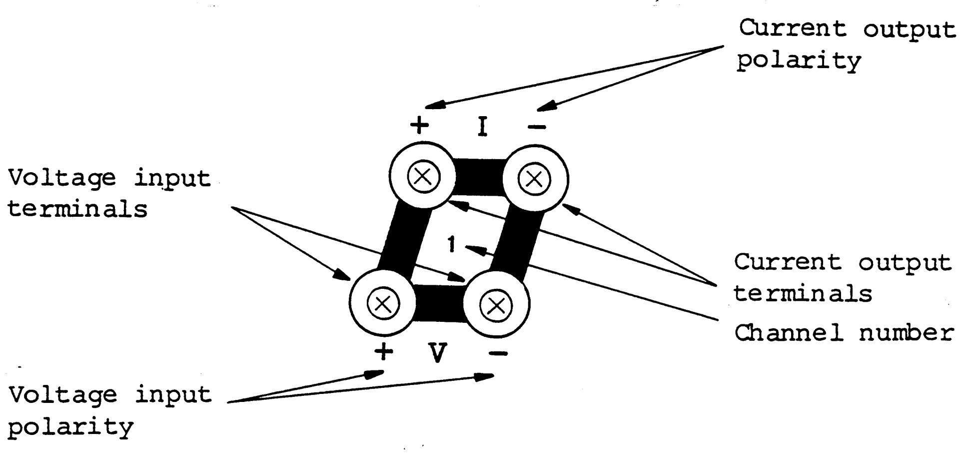


Fig. 2-5 Platinum RTD/voltage input terminals

④ External DC voltage/current source input terminals

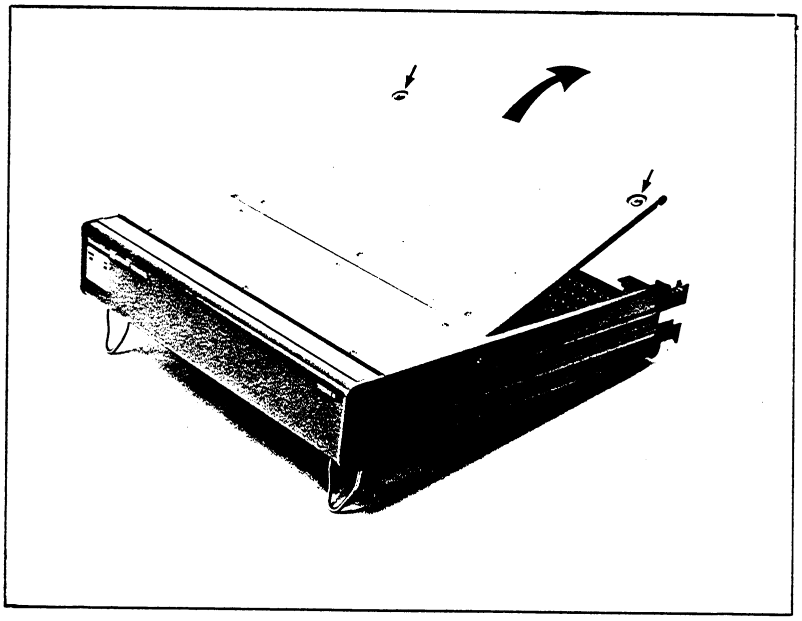
If an external DC voltage or current source is connected across these terminals, it is output to the current output terminals of the channel for which a voltage range is selected. The input voltage/current polarity is duplicated on the output terminals. The input voltage or current source is not output to current terminals, however, if a range other than the voltage range is selected. In this case, therefore, the terminals can provide a resistance measurement network of four-wire system.

Use of these terminals is described in item 2-5-3, (3) d and e.

⑤ Terminal board cover removal

Terminal board cover is terminated by two fasteners. To remove terminal board cover, turn them by 90° from it's locked position (⊖→⦶) and lift the cover up.

To install it again, be sure to check the fastener is ⦶ position and then turn by 90° to the former lock position.



2-4. PRINCIPLES OF OPERATION

2-4-1. Outlines of Sensor Terminal Operation

TR2741 Series Sensor Terminals are compact input terminal boards that can be distributed to install remotely from the TR2731 Computing Data Logger mainframe. Their functions and configuration are shown in Figure 2-6.

The Sensor Terminal integrates a microprocessor to control input scanning and appropriate measurement range selection according to commands sent from the mainframe, and a high-precision integration A/D converter converts input signals into the corresponding digital coded data. The sensor terminal also performs calibrating calculation, reference junction compensation for thermocouples, linearization arithmetic for sensors.

Up to four sensor terminals can be attached to the Data Logger mainframe. Upon receiving a start command, all attached sensor terminals simultaneously start input scanning and send data to the mainframe in bit serial format through a pair of signal lines.

As shown in Figure 2-6, the sensor terminal is connected to the Data Logger mainframe via a pair of serial data lines, power supply lines, and start/stop control lines, yet is electrically isolated from the mainframe.

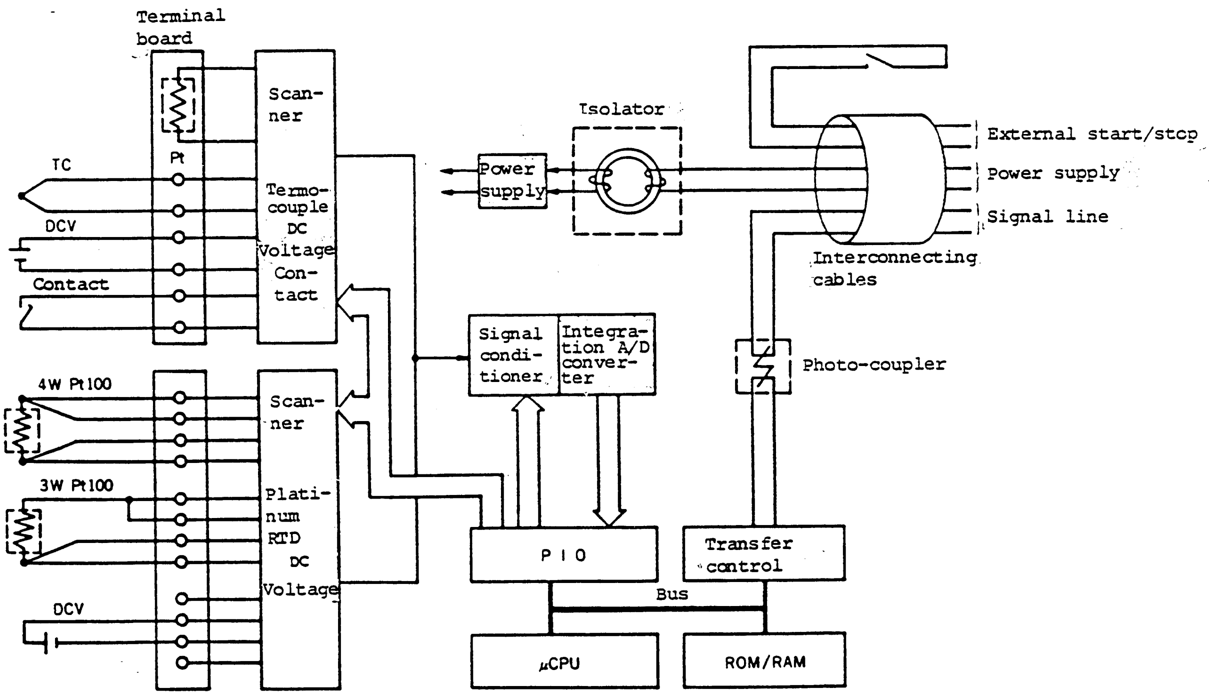


Fig. 2-6 TR2741 Sensor Terminal configuration

The sensor terminal can be configured by up to two different terminal board units, so that five different models are available depending on the combinations.

The thermocouple/voltage measurement unit accepts up to 40 channels of thermocouples (8 types), DC voltage inputs (4 ranges) and contact signals in combined form (up to 80 channels with two units). For reference junction compensation for temperature measurements using thermocouples, the temperature at the center of the top-plane terminal board is detected by the platinum RTDs to convert it into electromotive forces corresponding to each sensor, then the difference between the RTD output and each sensor output is determined for room temperature compensation. The high-precision, high-stability digital compensation technique is used to linearize thermoelectromotive forces to temperature for thermocouple output. Consequently this permits high-precision temperature measurements over a wide temperature range from 0°C to +50°C.

Contact signals are used to identify value on/off or level switch status. They utilize the sensor fault detecting function for thermocouples. While contact signal status is displayed or printed as ON and OFF, it is internally processed as binary numbers of 0 and 1. It may, therefore, be used for GO/NOGO decision against preset upper or lower limits.

The platinum RTD/voltage measurement unit accepts up to 20 channels of platinum RTDs (nominal resistance 100 Ω, 3 or 4 wire system) and DC voltage (4 ranges) in combined form. For temperature measurements using 3-wire platinum RTD, the measurement is performed twice to compensate for the resistance of cable conductors (Figure 2-7). As a result, the measurement time requires 100 ms per channel, twice that for ordinary measurement.

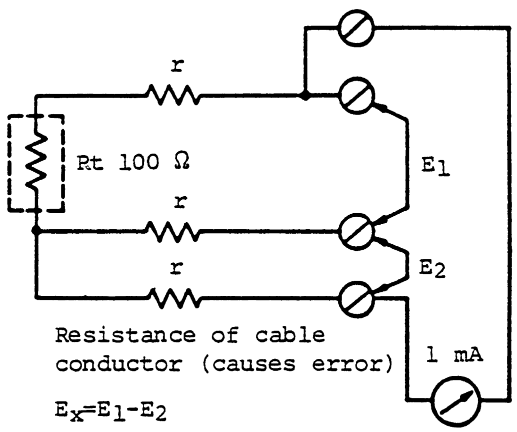


Fig. 2-7 Compensation for cable conductor resistance in temperature measurements using a 3-wire platinum RTD

The terminal board is top-plane type, which ensures simple lead connection and prevents uneven temperature distribution over the terminal board which may cause errors in temperature measurements using thermocouples (Figure 2-8). The independent screw-type terminal as shown in Figure 2-9 assures positive, safe lead connection.

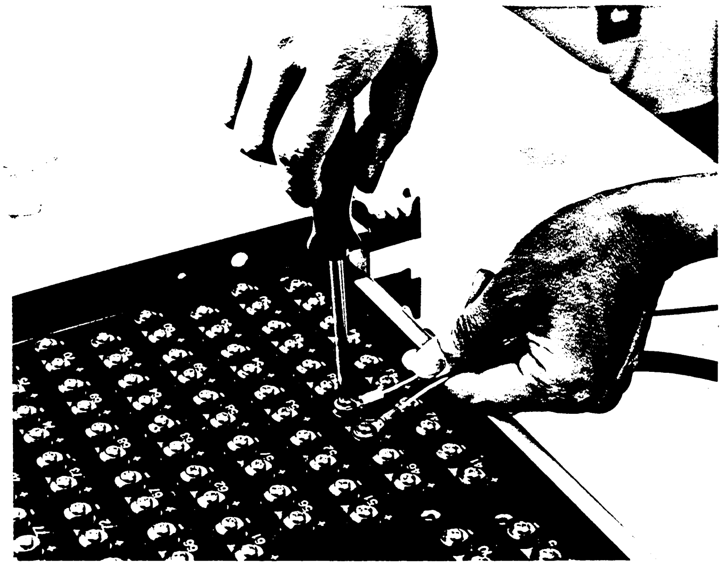


Fig. 2-8 Top-plane terminal board for sensor terminal

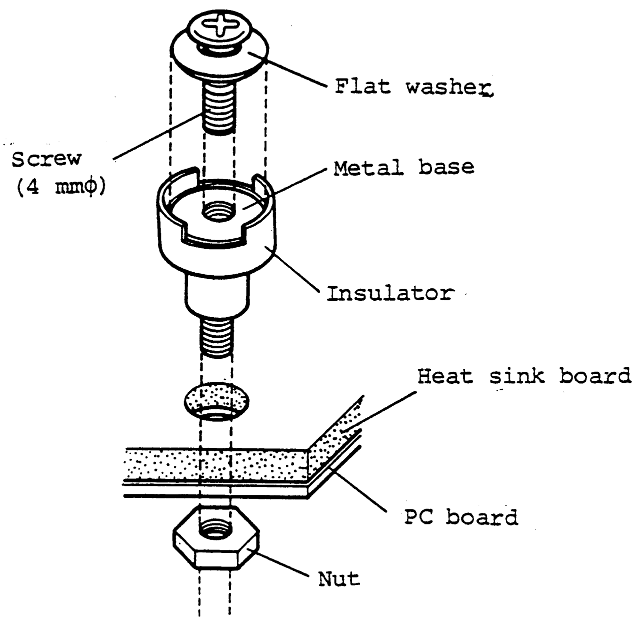


Fig. 2-9 Input screw-type terminal

2-4-2. Calibration

In general, digital voltmeters or data loggers use the auto-zero circuit to calibrate the A/D converter, in which an offset voltage charged across a capacitor is decremented in analog form. This technique can compensate only for zero-point, however, and may affect measurement speed.

In contrast, the TR2741 has a reference resistance or voltage value for each input range and the built-in microprocessor compensates for the offset level and gain of the measurement system by referencing the reference value. This permits calibrating both full-scale value and zero-point without affecting scanning speed (Figure 2-10).

Measurement for this calibration technique is performed at the beginning of each input scan, as shown in Figure 2-11. The times required for calibration measurement depends on input types, ranging from approximately 0.30 second to approximately 1.05 second (when all types of inputs are intermixed. Since the actual input scanning simultaneously starts after the longest calibration time, the measurement will remain simultaneous.

The zero-point value and gain in each range are stored in the microprocessor during calibration measurement, and are compensated for all channels to be scanned.

Terminal board temperature measurements for reference junction compensation for thermocouples is also performed during calibration measurement.

If the log scan period is specified continuous, calibration measurement is performed at a timing other than the beginning of each scan, to ensure high-speed data logging. If scanning time is enlongated due to averaging arithmetic, calibration measurement interrupts at approximately 15 second intervals.

Compensation for calibration may cause deviation of measurement results due to accumulated calculation errors. To prevent this, the A/D converter of the TR2741 has a dynamic range approximately 4 times as large as the range shown in the specifications.

The time required for calibration are as follows:

Range	Calibration counts	Remarks
20 mV 200 mV 2 V 20 V	3 2 2 2	Performed regardless of the selected range. When both ranges are simultaneously used, calibration is required once for each range.
Thermocouple (1)	2	4 types of T(CC), J(IC), E(CRC) and K(CA) Calibration is always performed twice even if the 4 types are simultaneously used.
Thermocouple (2)	2	4 types of S(PR10%), R(CP13%), B(PR30%), and PR12.8% Calibration is always performed twice even if the 4 types are simultaneously used.
3-wire RTD 4-wire RTD High-resolution RTD	2/unit 2/unit 2/unit	For TR2741D, calibration is performed independently for channels 1 to 20 and 21 to 40. Therefore, calculation is also performed independently for channels 1 to 20 and 21 to 40 for platinum RTD measurement only. If both the 3-wire RTD and 4-wire RTD are used at the same time, calibration is required once for each range.
Thermocouple's internal reference junction compensation	3/unit	If internal reference junction compensation is to be performed for only one channel in the thermocouple range, this counts should be added. For TR2741B, calibration must be performed six times as it consists of two units.

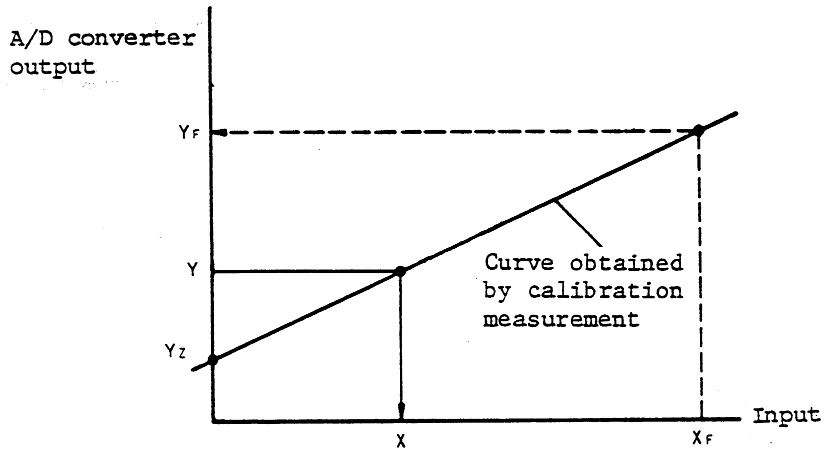
Although dependent on the number of channels, the required calibration time is generally given by:

$$[(\text{sum of calibration counts for range}) \times 50\ \text{ms}] + \left\{ \begin{matrix} 150 \\ \wr \\ 200 \end{matrix} \right\} \text{ms}$$

For example, if the TR2741A is used and ranges of 20 mV, 2 V, internal reference junction compensation for T(CC), and external reference junction compensation for K(CA) are selected:

20 mV → 3, 2 V → 2, T(CC), K(CA) → 2, internal reference junction compensation → 3

$$[(3 + 2 + 2 + 3) \times 50\ \text{ms}] + \left\{ \begin{matrix} 150 \\ \wr \\ 200 \end{matrix} \right\} \text{ms} = \left\{ \begin{matrix} 650 \\ \wr \\ 700 \end{matrix} \right\} \text{ms}$$



$$X = \frac{Y - Y_Z}{Y_F - Y_Z} \cdot X_F$$

Fig. 2-10 Input compensation by calibration measurement

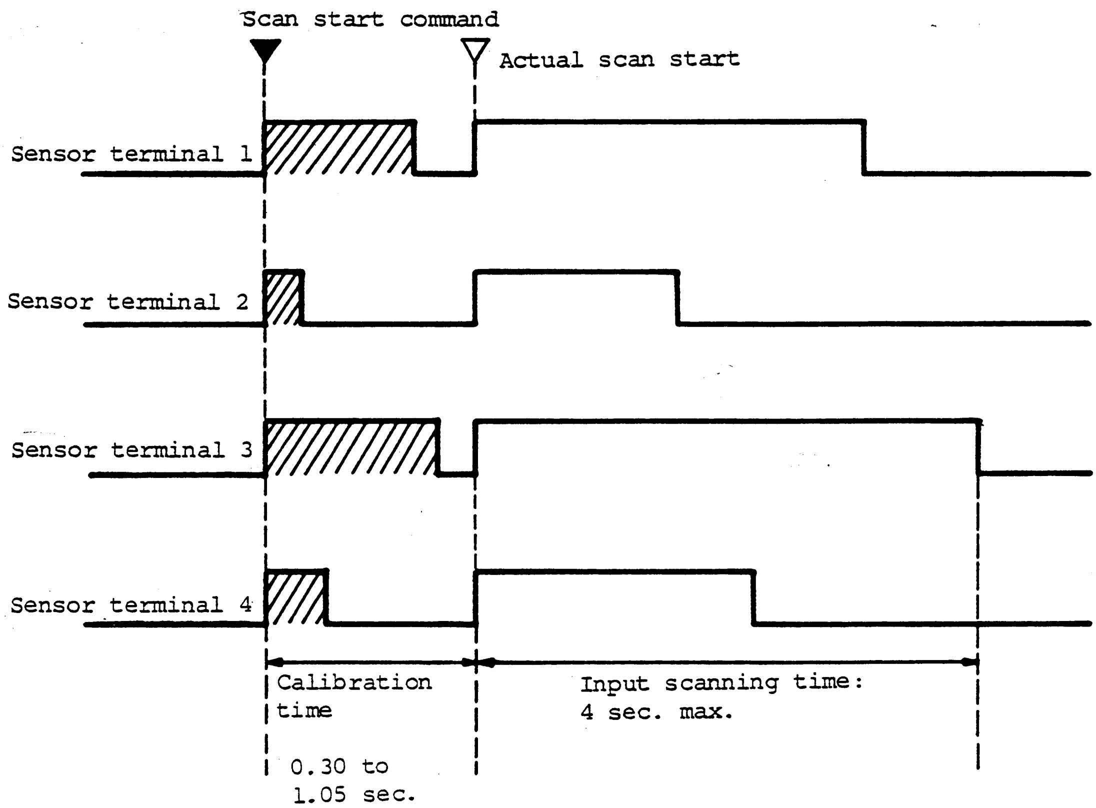


Fig. 2-11 Sensor terminal calibration sequence

2-4-3. Operation and Data Transfer

All data and command to and from the TR2741 Sensor Terminal is transferred in synchronous, bit-serial form via a pair of signal lines. Figure 2-12 gives a typical operation example in which input channels are specified and digitally-coded measurement data is transferred.

Commands and data are transferred in each 10 ms, one fifth the time slot of 50 ms. As shown in Figure 2-12, the input channels and measurement ranges for sensor terminal 1 are specified during the first 10 ms interval, those for sensor terminal 2 are specified during the second 10 ms interval, and so forth. When channel and range are specified, the input signal is integrated for 20 ms (when line frequency is 50 Hz) and is then subject to A/D conversion after a delay due to the settling time of the relay scanners. The output of the A/D converter is subject to arithmetic operations such as calibration and linearization. The end of these operations is in the next time slot, and measurement data is transferred in the 3rd time slot.

Since mutually overlapped advance control is performed during measurement sequence on the sensor terminals, the data currently being transferred corresponds to the input channel specified two time slots or more before. A time lag of 10 ms actually exists between measurement starts on each sensor terminal, although they appear to be started simultaneously.

Sensor terminals can be installed up to 500 meters away from the data logger mainframe. Parity, frame, and comparison checks are performed on transferred data to ensure data reliability. If an error is detected, the sensor terminal or mainframe requests data resend up to three times. If the error still persists, the mainframe sends a transfer error (TRANS ERR) message. Upon receiving the TRANS ERR message, the pertinent sensor terminal suspends measurement until the next specified time is reached.

Transfer signals use +12 V isolated by photocouplers. The transfer rate is approx. 20 k bits/sec.

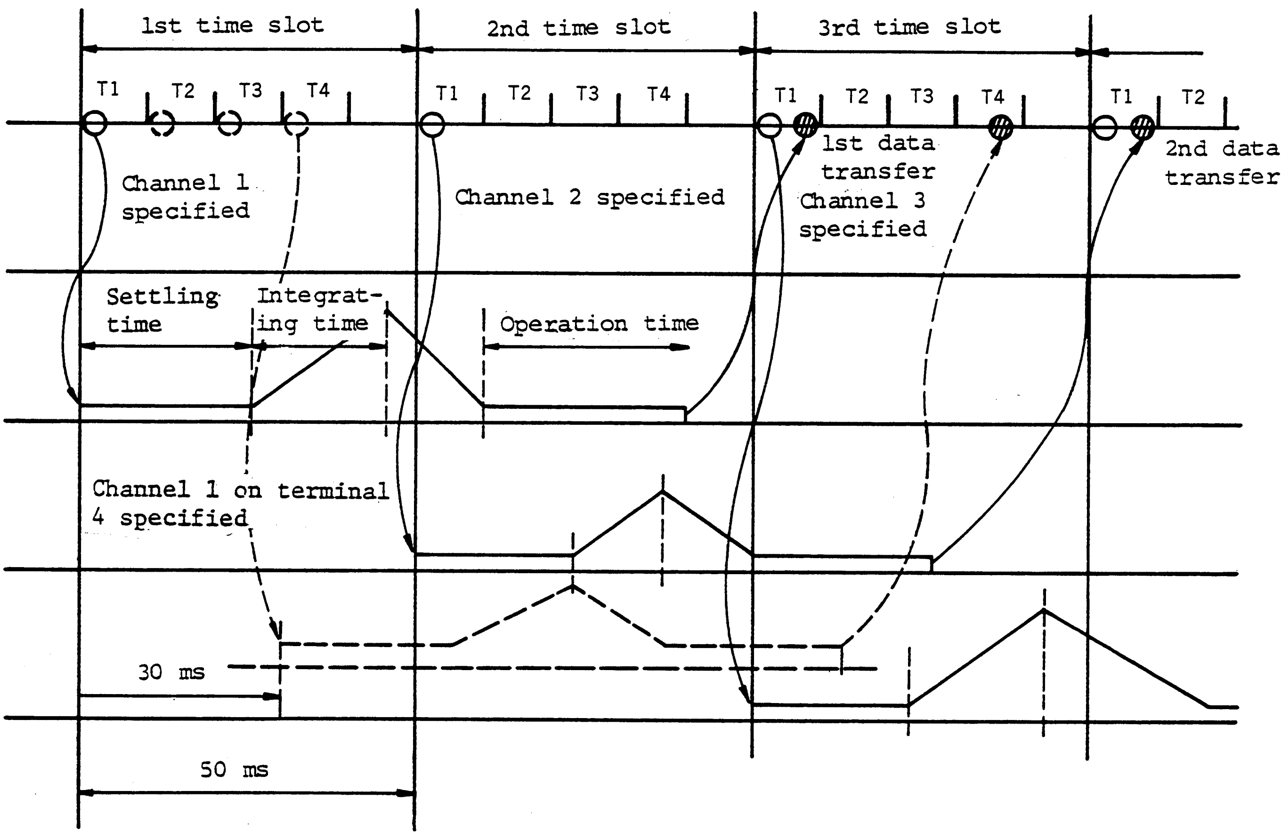


Fig. 2-12 Sensor terminal operation and data transfer sequence

2-5. OPERATING INSTRUCTIONS

2-5-1. Connection

This paragraph describes how to connect the TR2741 Sensor Terminal(s) to the TR2731 Data Logger mainframe.

① Make sure that the POWER switch on the TR2731 is set to OFF.

② As shown in Figure 2-13, connect the TR2741 to TR2731 and/or to another TR2741 with the supplied interconnecting cable(s). Either of the two rear connectors may be used for this connection since the two connectors are internally connected in parallel. Two sensor terminals may be connected to the TR2731 mainframe in either radial or daisy-chain configuration. Connection examples are shown in Figure 2-14.

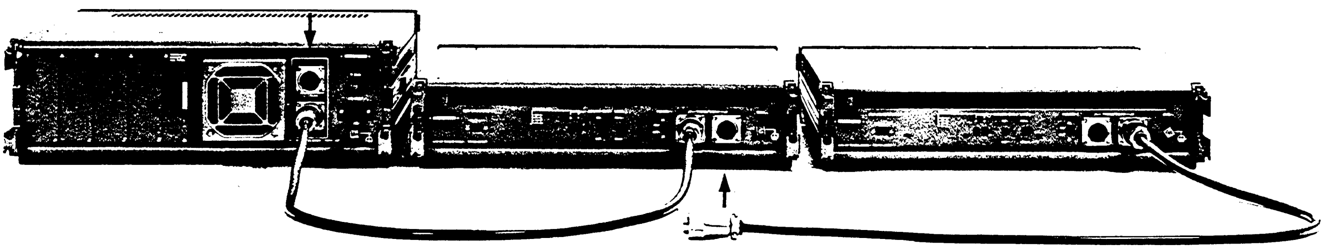
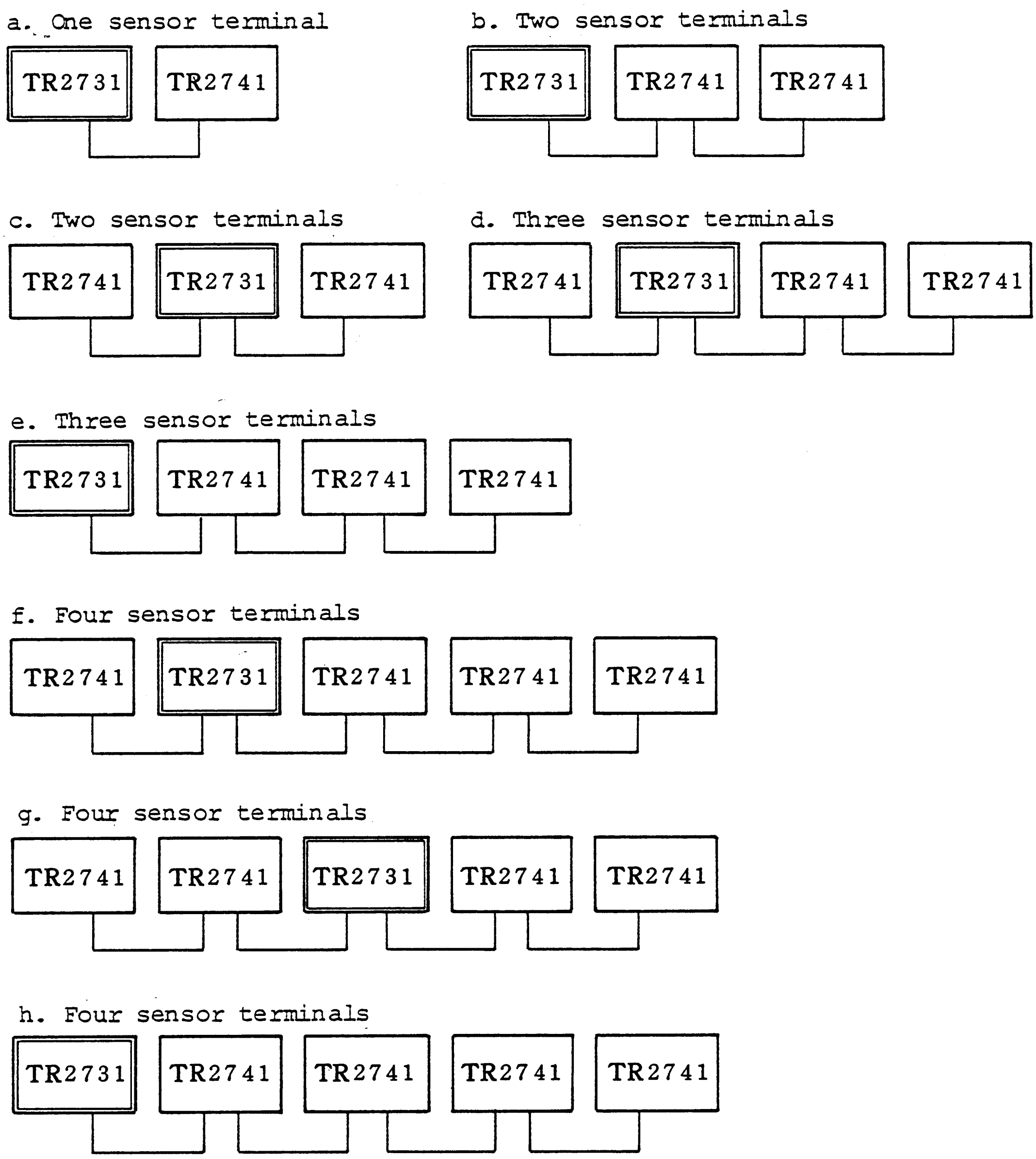


Fig. 2-13 Connecting TR2741 to TR2731



CAUTION

If an interconnecting cable exceeds 100 meters in length, check the total cable length and the number of attached sensor terminals according to item 2-5-4. If the requirements given in item 2-5-4 are not met, correct system operation may not be guaranteed.

Fig. 2-14 TR2741-TR2731 connection examples

③ Set the switches on the TR2741 rear panel as follows:

POWER switch: Normally set to ON.

LINE switch : Set to 50 Hz or 60 Hz according to the local line frequency (which affects the integrating time of the A/D converter).

SENSOR OUT switch: Determines whether or not thermocouple sensor burn-out detection is to be performed. If this switch is set to ON after one of the eight thermocouple ranges is selected, a SENS. OUT message is displayed on the TR2731 if the resistance of the pertinent sensor go over 30 kΩ. A sensor resistance below 2 kΩ is defined as normal, and that between 2 kΩ and 30 kΩ is defined as irregular.
When the TR2741 is used as contact input, this switch must be set to ON.
While the output of thermocouples does not affect the sensor burn-out detecting function, an OVER message may be delivered to the TR2731's display or printer instead of a SENS. OUT message if the output of a thermocouple exceeds several tens millivolts due to an error. The OVER message will also be output if the objective temperature exceeds the temperature range of the thermocouple. In either case, the sensor and leads should be checked.

TERMINAL NO. switch: This switch is used to assign a terminal number to the local TR2741. When more than one sensor terminal is attached, each terminal number must be unique. The numbering scheme should always begin from 1; for instance, 1, 2, and 3 for three terminals, and 1, 2, 3, and 4 for four terminals. After terminal number assignment is completed, seal the supplied terminal number stickers on the appropriate location of the corresponding sensor terminals.

The connection and rear panel switches settings for the TR2741 are now completed. The POWER switch setting (to ON) and TERMINAL NO. assignment should be completed before the TR2731 mainframe is powered.

2-5-2. Connecting Input Signal Leads to the Thermocouple/Voltage Measurement Unit.

Figure 2-15 is the photograph of the thermocouple/voltage measurement unit (TC unit). Each TC unit has 40 input channels; the one shown in Figure 2-15 consists of two units and has 80 channels.

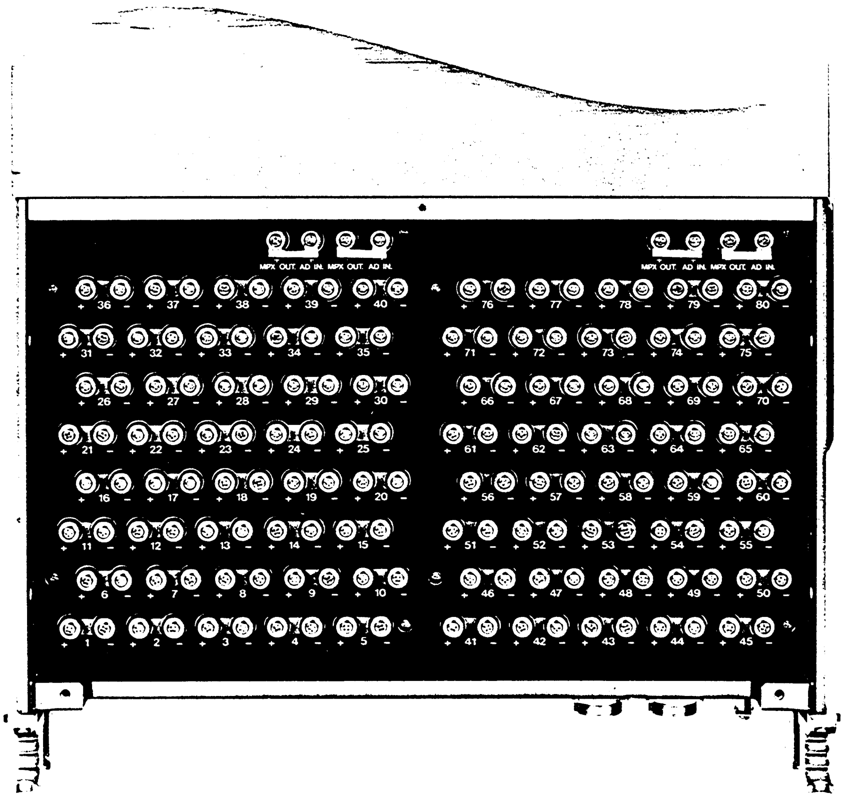


Fig. 2-15 Thermocouple/voltage measurement unit terminal board (TR2741B)

(1) Terminal board description

The number provided just below each input terminal pair indicates a channel number. Symbols "+" and "-" indicate the input polarity. For voltage measurement, positive data is output (but no polarity sign is displayed) when the hot and cold leads of the input signal are coupled to the "+" and "-" terminals, respectively. If the input polarity is reversed, the output data is preceded by a negative sign (-). In general, the input lead with lower signal-source impedance should be connected to the "-" terminal.

When connecting a thermocouple or compensating conductors to terminals, their positive and negative leads must be connected to the "+" and "-" terminals, respectively.

If the polarity is reversed, the correct measurement result won't be obtained.

The four terminals grouped at the top right corner of the unit will be described in item (4) below. They should normally be shorted with shorting bars as shown in the photograph.

(2) Connecting input signal lines

The output leads of a thermocouple or compensating conductor should be firmly secured across the positive and negative terminals by either directly crimping the end of the leads or using solderless terminals (Figure 2-16). It is recommended that the same type of thermocouples be connected to terminals with consecutive numbering. This practice will be convenient for measurement using group function.

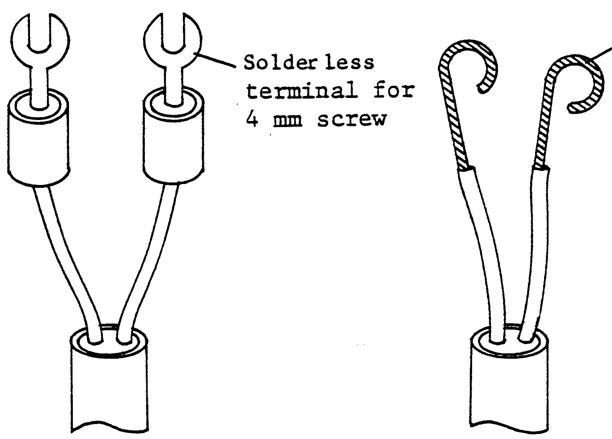


Fig. 2-16 Input signal line termination

Note the following points to avoid noise interference. Refer to 2-5-5 "Noise Interference Countermeasures".

- o Ground the GND terminal of the TR2741 rear panel with a thick copper wire.
- o Ground the chassis or frame of the object under measurement to the same earth point as the TR2741 with a thick copper wire.
- o Using an oscilloscope, measure the potentials of the thermocouples connected to the sensor terminal with reference to the GND terminal of the TR2741, and ground the object under measurement or shield the thermocouples or compensating conductors so that the potential (especially its AC component) is minimized. If this potential exceeds ±200 V, not only make measurement errors increase but result malfunction of or damage to the measuring system.
- o When using an external reference junction compensation, the thermocouple for the reference junction should be non-grounding type (Figure 2-17).

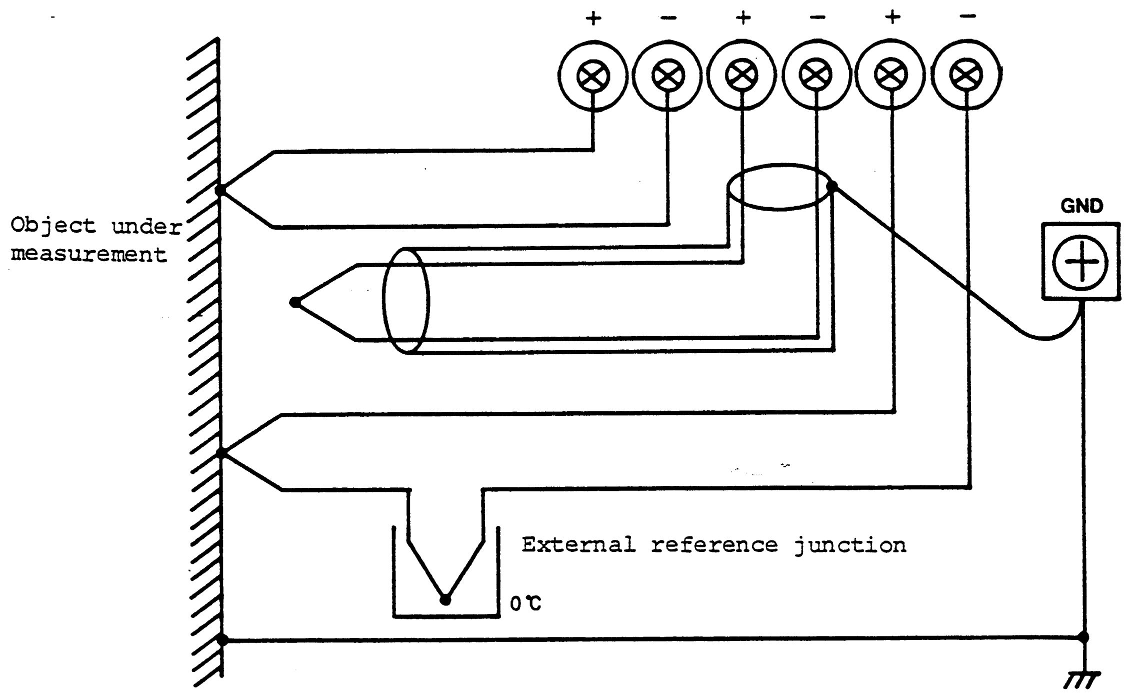


Fig. 2-17 Thermocouple connection example

When using a voltage standard for calibration or check, connect it to the TR2741 as shown in Figure 2-18.

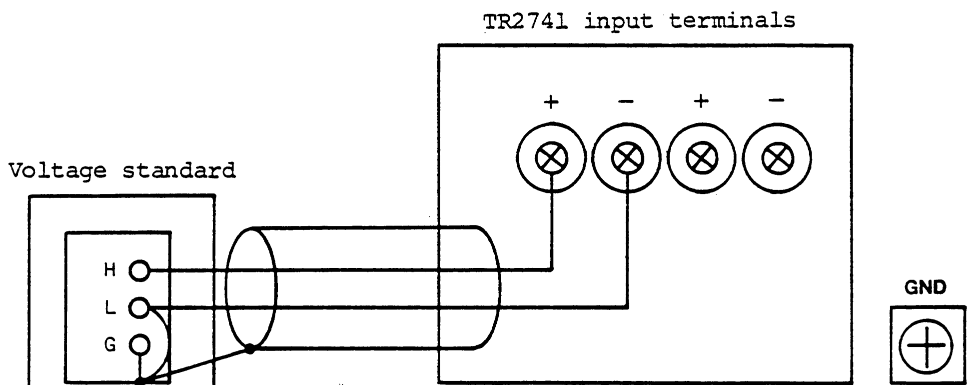


Fig. 2-18 Connecting a voltage standard to the TR2741

CAUTIONS

1. Exercise utmost care when handling input signal leads as they may induce high potentials.
2. Do not expose input terminals to natural wind or airflow from air conditioning units or to direct contact with bare hands. If a terminal is touched, allow several minutes before starting measurement.
3. When connecting thermocouple leads or compensating conductors to sensor terminals, make sure that their polarity is correct and secure firmly.

(3) Connecting various types of sensors

Connection examples for various types of sensors are shown in Figure 2-19.

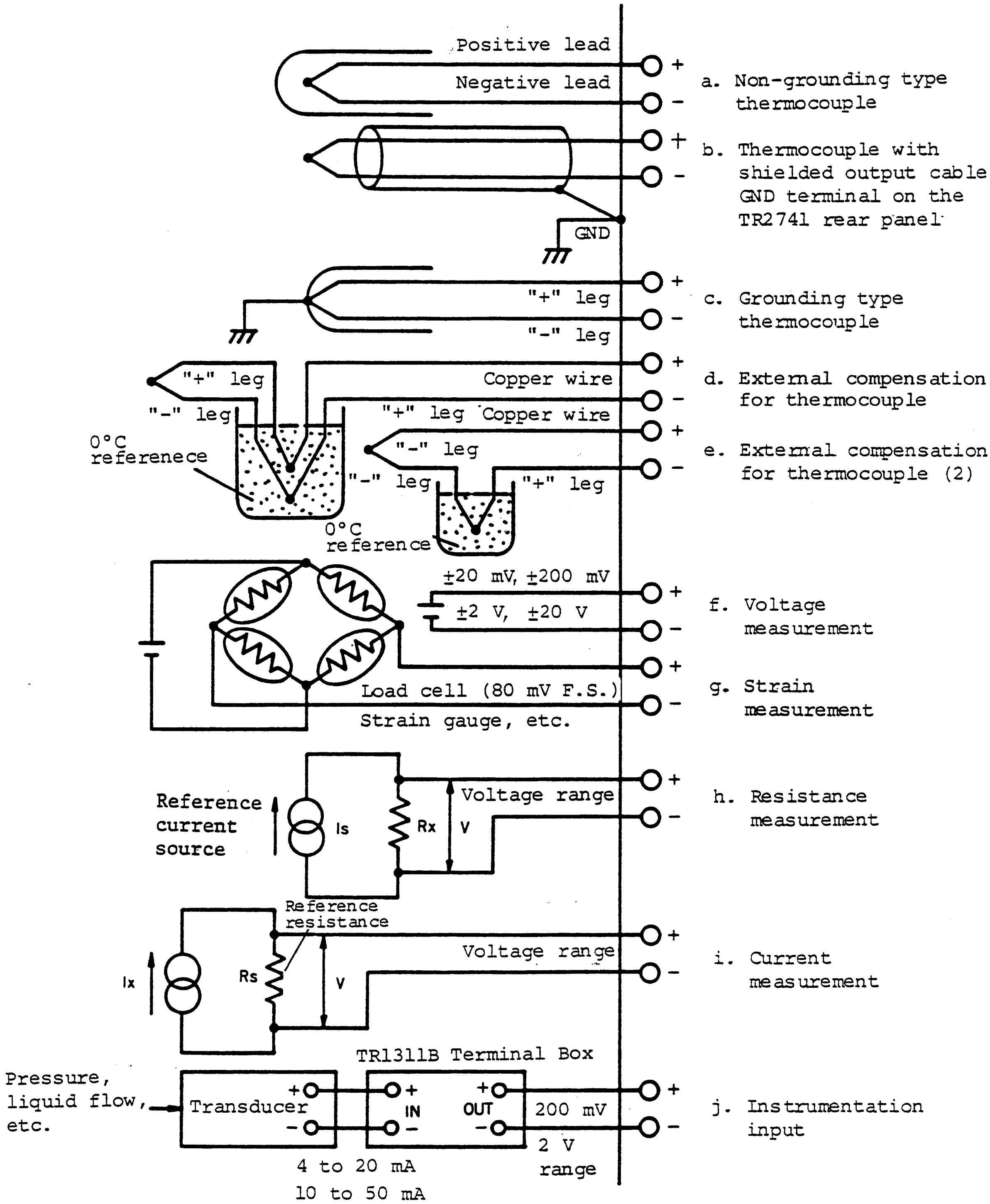


Fig. 2-19 Connecting various sensors to the TC terminal

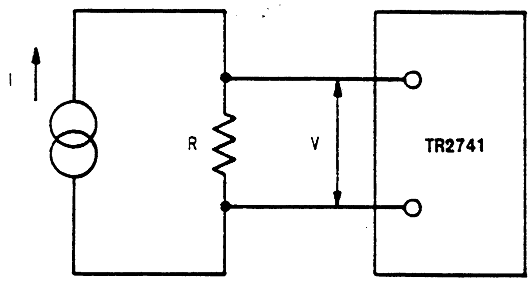
a. Non-grounding type thermocouple (1)
   Common method for temperature measurements.
b. Non-grounding type thermocouple (2)
   The outer shield conductor should be connected to the GND terminal on the TR2741 rear panel.
c. Grounding type thermocouple
   This type requires special care as it is sensitive to noise interference. See 2-5-5 "Noise Interference Countermeasures".
d. External compensation for thermocouple (1)
   Common method for temperature measurements using external reference junction compensation (two-channel compensation).
e. External compensation for thermocouple (2)
   Common method for temperature measurements using external reference junction compensation (single-channel compensation).
f. DC voltage measurement
   Common method for DC voltage measurement
g. Strain measurement, etc.
   When a broad dynamic range is required for a strain gauge or load cell, a range between -10 mV and +80 mV (with 1 µV resolution) can be selected. This dynamic range can be obtained by specifying external compensation and linearization to OFF in one of the ranges T(CC), J(IC), E(CPC), or K(CA). Measurement accuracy is, however, reduced by around twice as poor as that in the 20 mV range for DC voltage measurement. If measurement results are deviated, they may be averaged up to 40 times by means of the filter function of the TR2731.

h. Resistance measurement

Resistance can be measured by using a reference current source external to the instrument.

The maximum value of measurable resistance depends on environment conditions such as noise, induction, etc. Influence of noise interference and induction can be reduced by using a measuring current as large as possible and a voltage range as high as possible. It should be noted, however, that when the 20 V range is selected the input impedance of the TR2741 is approximately 11 MΩ and is connected in parallel with the resistor under measurement. The reference current source to be referenced must have an output accuracy equivalent to or better than the measurement accuracy.

The resistance can be determined as shown in Figure 2-20. The scaling function of the TR2731 permits direct readout of resistance.



$$R = \frac{V}{I}$$

Fig. 2-20 Resistance measurement (1)

If an external current source having adequate output accuracy is not available, the measuring setup shown in Figure 2-21 may be used. However, the current value must remain constant during a single scan.

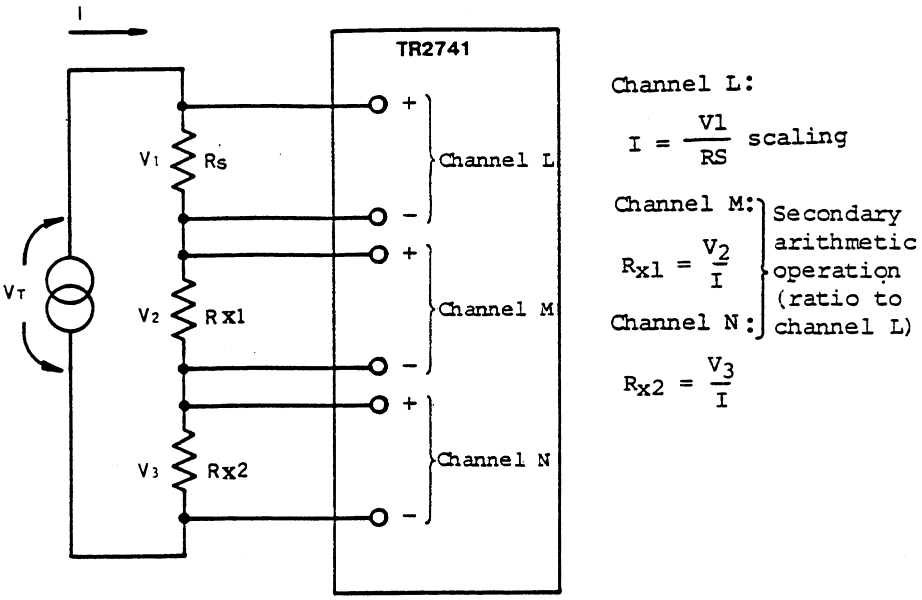


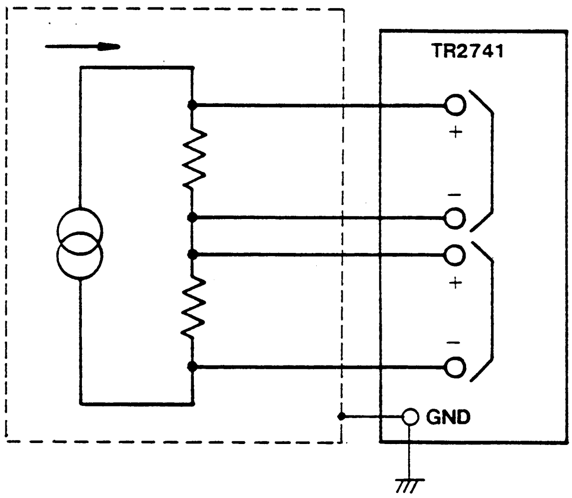
Fig. 2-21 Resistance measurement (2)

Rs on channel L is a reference resistor having a known value. Resistances RX_1 and RX_2 and current I can be determined by scaling and secondary arithmetic operation. See item 3-6-3 for the setting procedure.

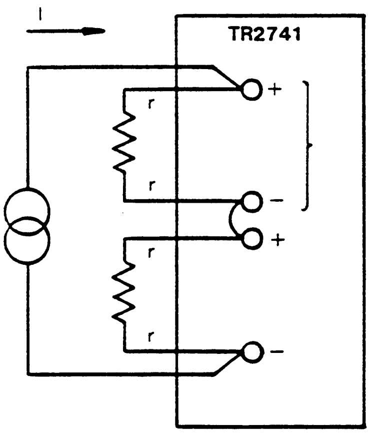
The voltage (V_T) across the constant current source must not exceed 100 V.

Figure 2-22 A shows a measuring setup with less error probability. When the resistance under measurement is relatively large, the current source, resistor under measurement, and cables should be shielded and connected to GND terminal to prevent noise interference.

A. Setup for less error probability



B. Setup with greater error probability



Cable resistance r affects measurement results.

Fig. 2-22 Resistance measurement setup

i. Current measurement

Current is measured if an external reference resistance (Rs) is used. The current value is determined from the following equation:

$$Ix = \frac{V}{Rs}$$

j. Instrumentation input

Instrumentation input of 4-20 mA or 10-50 mA circuit requires the TR1311B Terminal Box (option) and the TR2731's scaling function. The TR1311B can convert a current input of 4-20 mA to a corresponding voltage output of 25-125 mV, and 10-50 mA to 62.5-312.5 mV. This voltage output may be measured with the 200 mV or 2 V range and then converted into other engineering units, such as 0% to 100%, by the scaling function.

(4) Use of scanner output terminals

The four terminals provided at the top right corner of the unit (Figure 2-15) provide the user with the common input and output of the scanner for extended application of the TC unit.

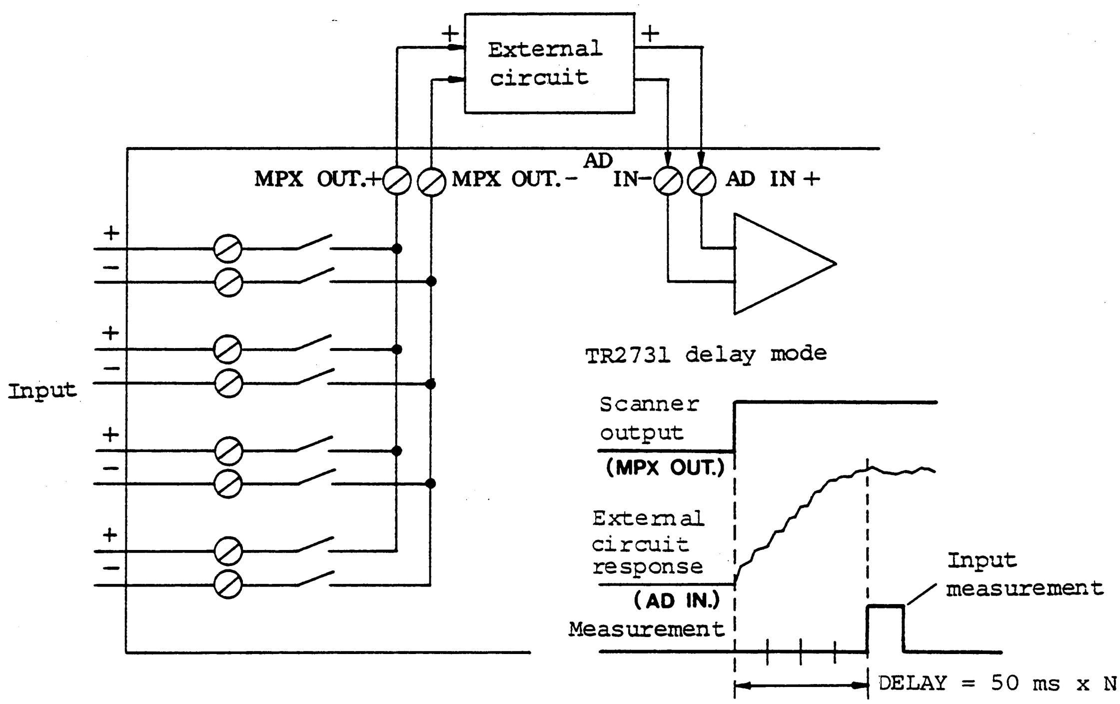
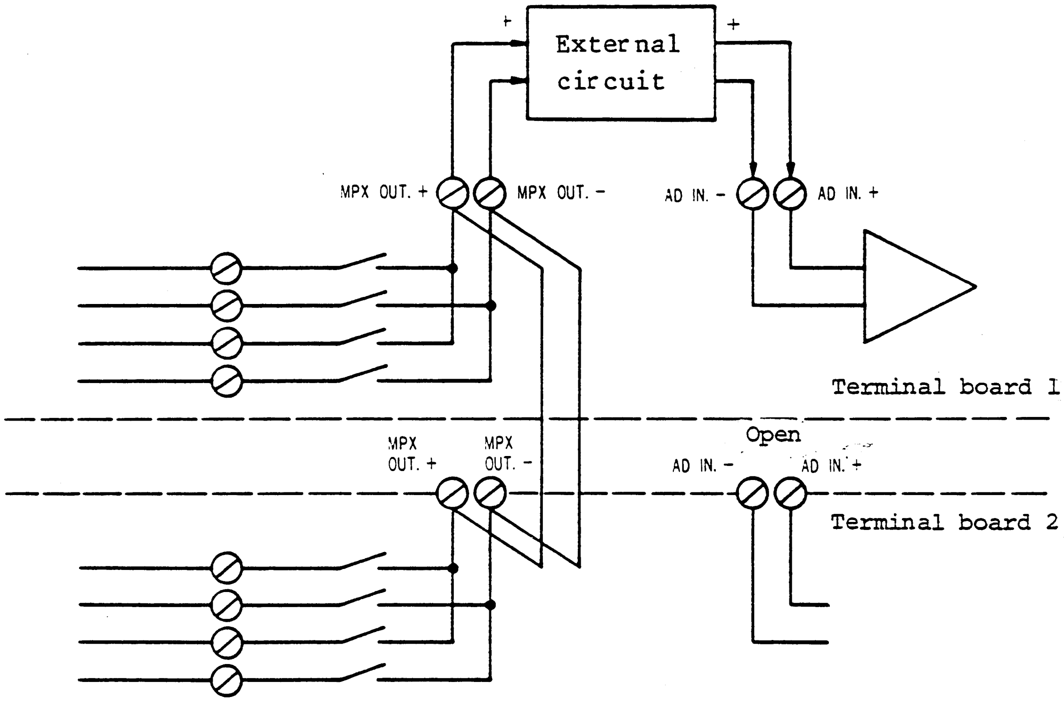


Fig. 2-23 Use of thermocouple/voltage measurement terminal board unit (TR2741A)



The MPX OUT.+ and MPX OUT.- terminals on terminal board 2 should be connected in pararell to those on terminal board 1, respectively. It should be noted that the TR2741B cannot be used with an external circuit provided in only one of the terminal boards.

Fig. 2-23' Use of thermocouple/voltage measurement terminal board unit (TR2741B)

As shown in Figure 2-23, the scanner output is usually coupled to the input side of the measurement system. An arbitrary analog circuit can be inserted in between the scanner output and measuring system input by using the four terminals (MPX OUT.+, MPX OUT.-, AD IN-, and AD IN+).

Included in those analog circuits are a linearization circuit for temperature measurements using thermisters, RC filter to reject random noise, reference resistor for current measurements, AC/DC converter, voltage attenuator, and so forth. Since those analog circuits have their specific settling times, the delay mode, one of the TR2731's filter functions, must be used. By using the delay mode, measurement timing can be delayed by a specified number of multiples of 50 ms (Figure 2-23). It should be noted, however, that this method affects all sensor terminals to increase measurement times.

Notes: The delay mode is not applied to the temperature/ voltage measurement unit of the TR2741E.

(5) Temperature measurement range

In the temperature measurement ranges of the TR2731, up to eight types of thermocouples, linearization ON/OFF, and external/internal reference junction compensation can be specified.

Linearization ON: After external/internal reference junction compensation corresponding to the 8 types of thermocouples is performed, the result is linearized and displayed in temperature (^{o}C).

Linearization OFF: After external/internal reference junction compensation corresponding to the 8 types of thermocouple is performed, the result is not linearized and displayed in voltage (mV).

External reference junction compensation: No internal reference junction compensation is performed for voltage input from thermocouples.

Internal reference junction compensation: Reference junction compensation corresponding to each thermocouple type is performed for voltage input from thermocouples. (Thermoelectromotive forces are compensated based on the measured temperature of the terminal board.)

Since the -10 mV to +80 mV range is selected for thermocouple types T(CC), J(IC), E(CRC), and K(CA) (the 20 mV range is selected for all other types), the system can be used as a voltmeter with a measurable range of -10.000 mV to +80.000 mV (1 μV resolution) if linearization OFF and external reference junction compensation is specified. The measurement accuracy is, however, reduced to around twice as poor as that of the voltage measurement 20 mV range with deviation of measurement results slightly increased.

2-5-3. Connecting Input Signal Leads to the Platinum RTD/Voltage Measurement Unit

Figure 2-24 is the photograph of the platinum RTD/voltage measurement unit (RTD unit). Each RTD unit has 20 input channels; the one shown in the photograph is combined with a TC unit.

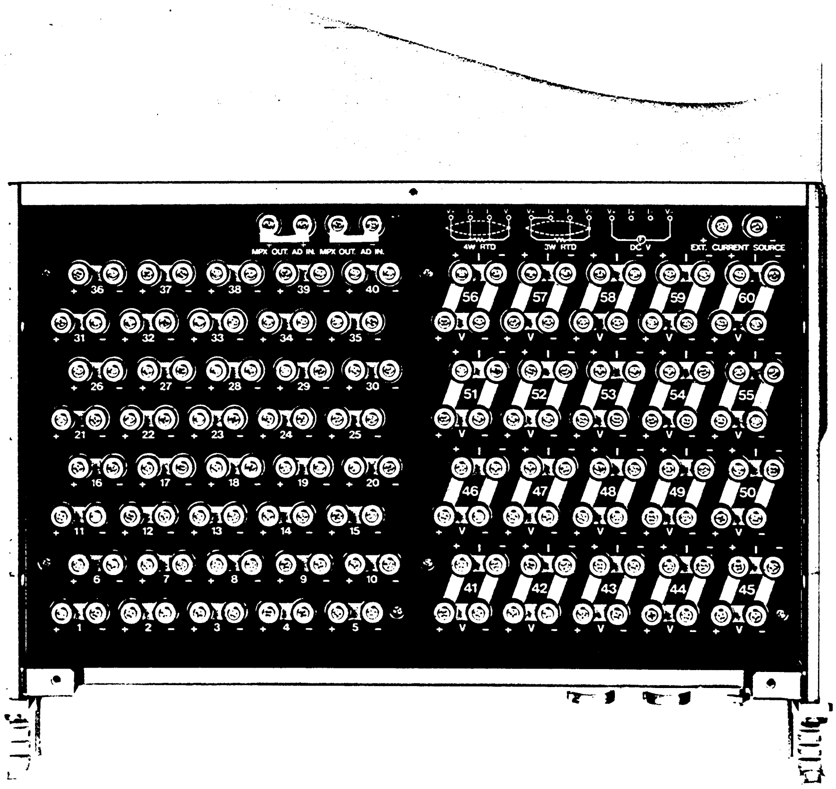


Fig. 2-24 Platinum RTD/voltage measurement unit terminal board (TR2741E)

(1) Terminal board description

Input terminals for a single channel are shown in Figure 2-25. The number at the center of the four terminals indicates the channel number. Currents are output from the upper two terminals which is internally connected to a current source. The current drains through the "+" terminal and sinks into the "-" terminal. The lower two terminals are for voltage input. When the hot and cold leads of an object under measurement are coupled to the "+" and "-" terminals respectively, the measured data is positive in polarity. (No sign is given to the data output or display.) If the input signal polarity is reversed, the measured result is negative. (A minus sign precedes the data output and display.)

The paired terminals shown at the top right corner of the RTD unit are external current terminals, which will be described in item (3)-d below.

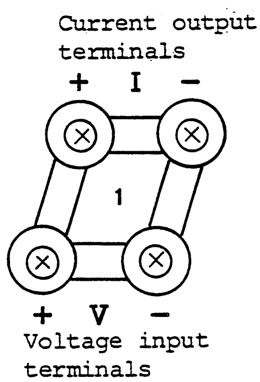


Fig. 2-25 Input terminals

(2) Connecting input signal leads

Figure 2-26 illustrates how to connect platinum RTD output leads to the terminal board.

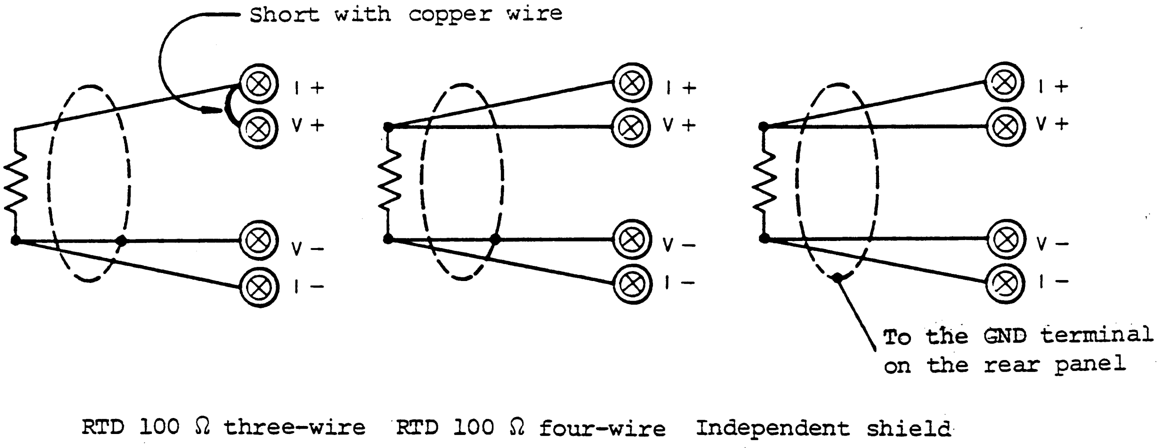


Fig. 2-26 Connecting RTD to the terminal board

The RTDs to be used should conform to the JIS standard and have nominal resistance of 100 Ω.
Note that RTDs with the nominal resistance other than 100 Ω cannot be used.
If shielded wires are used for input cables, connect the outer shield conductors to the V- terminal. If the outer shield conductor is isolated from the RTD, it should be connected to the GND terminal on the TR2741 rear panel.

CAUTION

On the RTD unit, the I- terminal is common to all channels to compensate for cable resistance of the three-wire system.
Therefore, an error may result if the sensor's insulation is deteriorated when the three-wire system is used. Care must be exercised regarding to insulation of the sensors. (See Figure 2-27.)

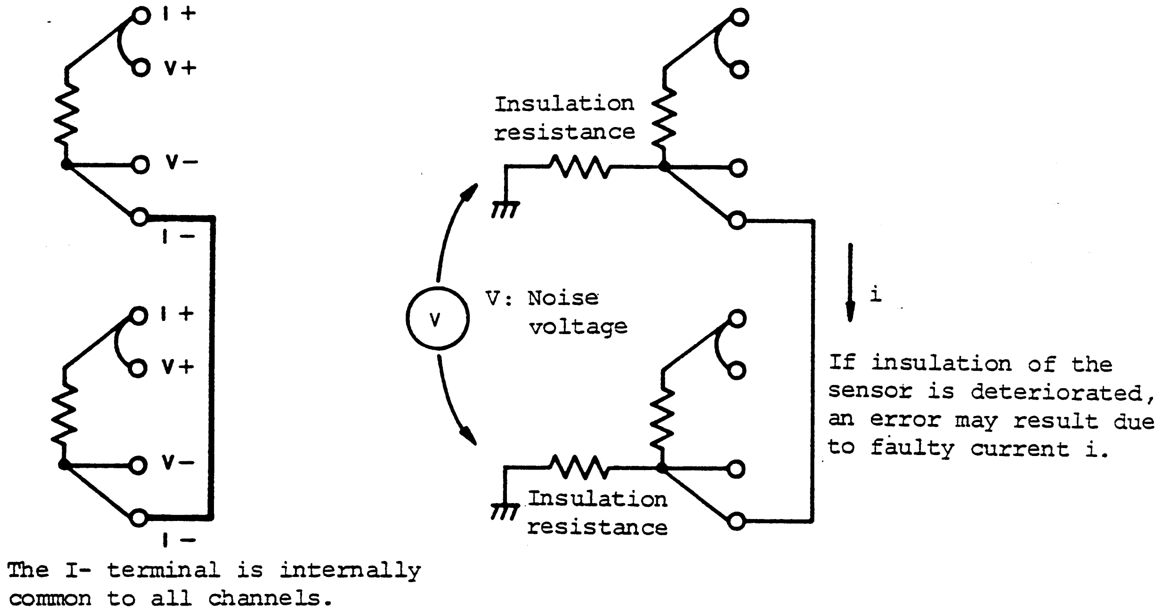
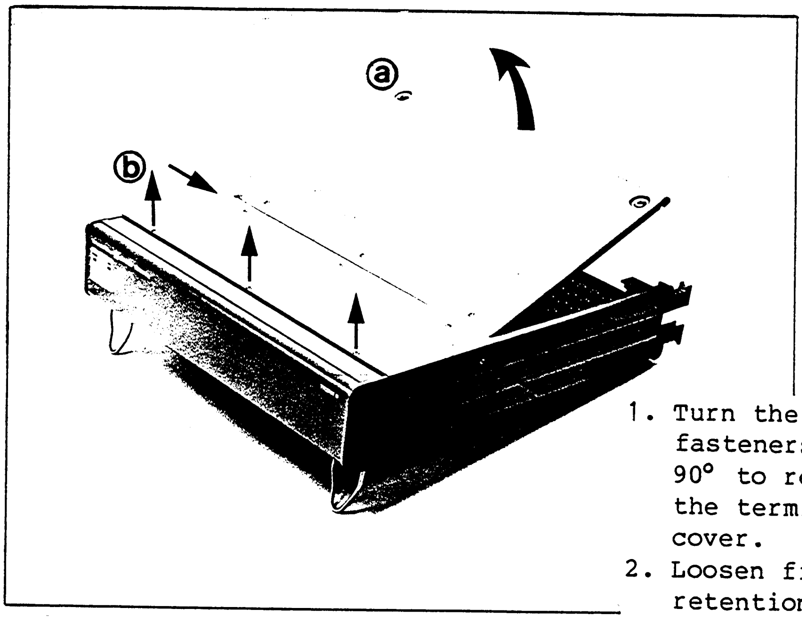


Fig. 2-27 Internal connection for temperature measurement using RTDs

Measurement error due to deteriorated insulation of the sensor will not occur in the four-wire system. Each sensor can be isolated from other sensors by cutting the jumper wires as instructed below:

① Remove the top cover from the TR2741.



1. Turn the two fasteners ⓐ by 90° to remove the terminal board cover.
2. Loosen five pieces of retention screw ⓑ to remove the top cover.

Fig. 2-28 Top cover removal

② Cut the tinned jumper wires of the pertinent channel. Jumper wire location is indicated by an arrow in Figure 2-29.

③ Remount the top cover on the TR2741.

④ The schematic diagram for sensor connection is shown in Figure 2-30.

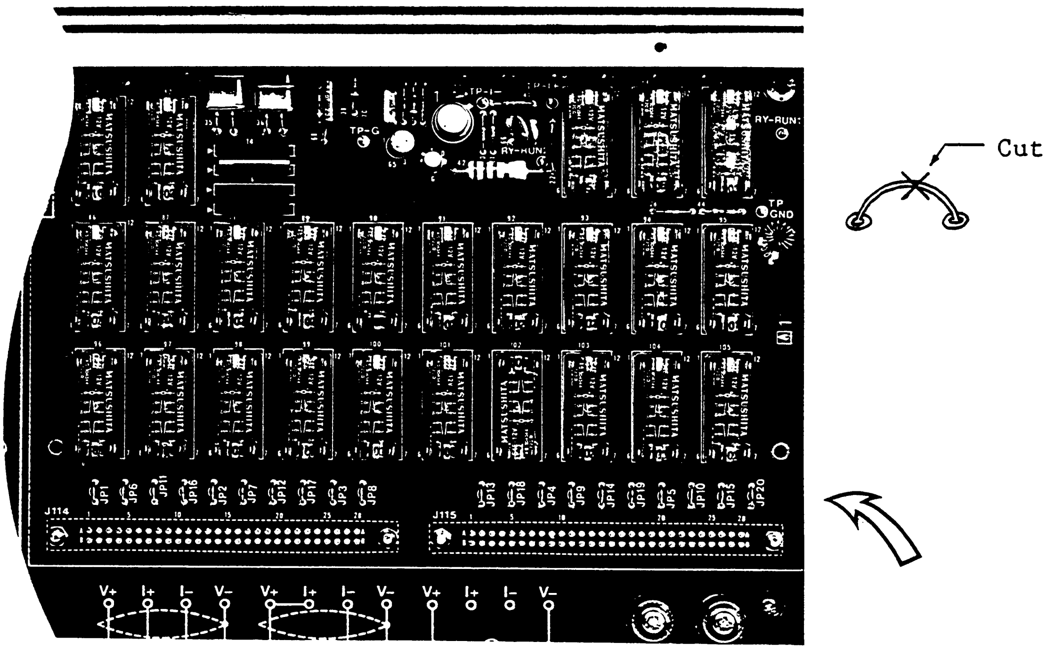


Fig. 2-29 Location of jumper wires

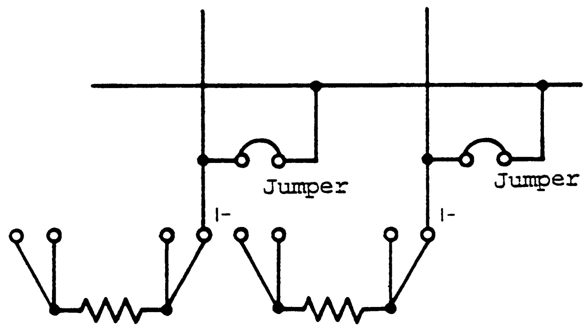


Fig. 2-30 Schematic diagram for sensor connection

For voltage measurement, apply the objective voltage across the V+ and V- terminals. At that time nothing should be connected across terminals I+ and I-.

Note the following points to minimize noise interference:

- o Ground the GND terminal on the TR2741 rear panel to the earth with a thick copper wire.
- o Ground the chassis or frame of the object under measurement to the same earth point as the TR2741 with a thick copper wire.
- o Using an oscilloscope, measure the potentials of the RTDs or other sensors connected to the sensor terminal by referencing the TR2741 GND terminal, and ground the object under measurement or shield the RTDs so that the potential (especially its AC component) is minimized. If this potential exceeds ±200 V, not only make measurement errors increase but result malfunction of or damage to the measuring system.

When using a voltage standard for calibration or check, connect it to the TR2741 as shown in Figure 2-18.

CAUTIONS

1. Exercise the utmost care when handling input signal lines as they may induce high potentials due to induction or deteriorated insulation.
2. Firmly secure the end of RTD sensor cables to the input terminals.

(3) Connecting various types of sensors

Connection examples for various types of sensors are shown in Figure 2-31.

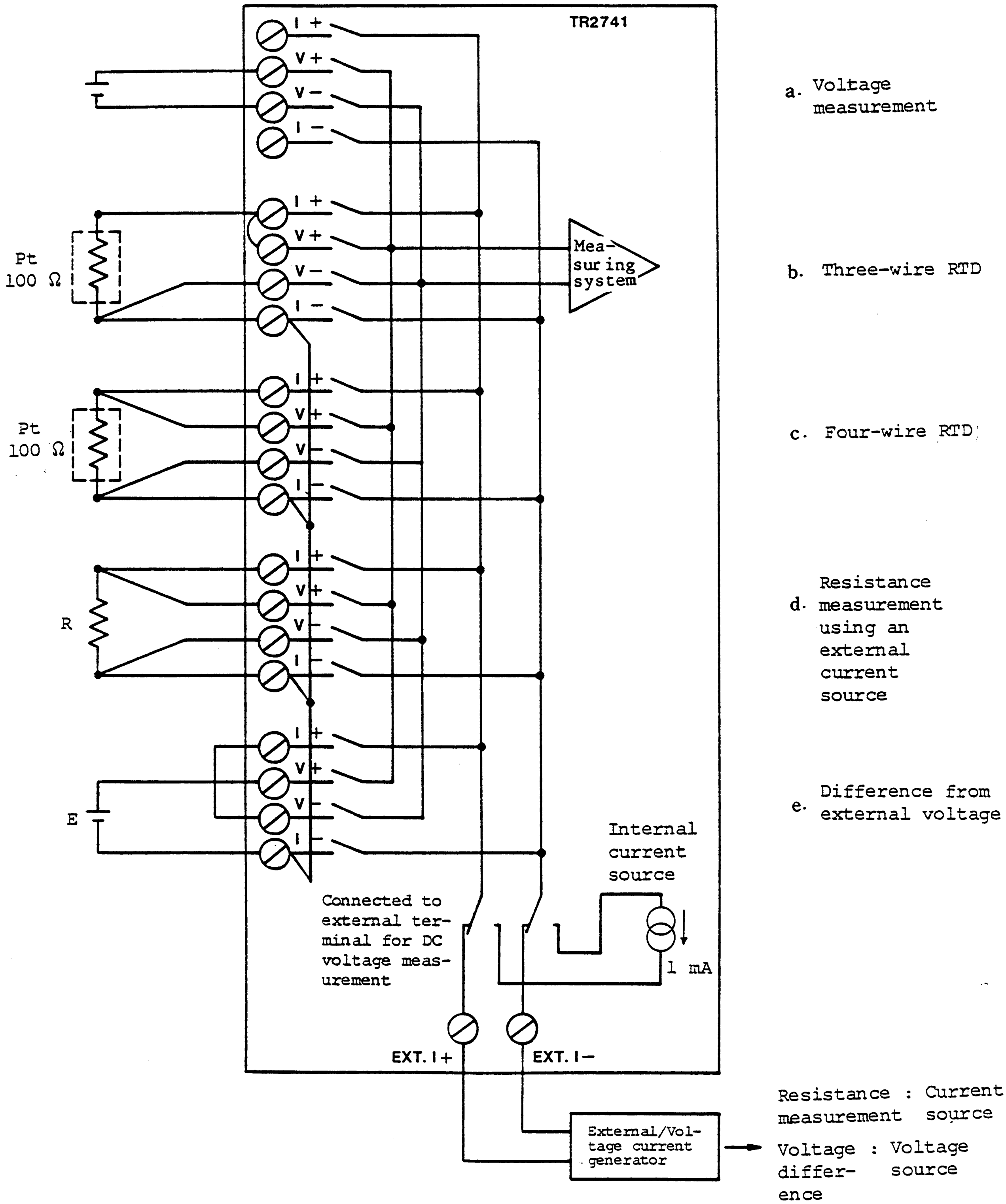


Fig. 2-31 Connecting various sensors to the RTD terminal

a. Voltage measurement

Common method for voltage measurement

b. 3-wire RTD

Common setup for temperature measurements using a 3-wire RTD

c. 4-wire RTD

Common setup for temperature measurements using a 3-wire RTD

Note: If linearization OFF is specified for the 3- or 4-wire RTD by the TR2731, direct readout of resistance can be obtained.
As a result, this function permits resistance measurement in the following ranges:

Range	Measurable resistance	Resolution
3-wire RTD	0.00 Ω to 400.00 Ω	0.01 Ω
4-wire RTD	0.00 Ω to 400.00 Ω	0.01 Ω
4-wire RTD, high-resolution	80.00 Ω to 180.00 Ω	0.01 Ω

The measurement accuracy and temperature coefficient are the same as those for RTD unit measurement.

d. Resistance measurement using an external power source

External voltage/current source terminals are provided at the top right corner of the terminal board. When a voltage range is specified, the EXT. I+ and EXT. I- terminals are connected to terminals I+ and I- of the specified channel, respectively. Therefore, resistance can be measured by connecting as shown in Figure 2-31 d.

The maximum value of measurable resistance depends on environmental conditions such as noise, induction, etc. Influence of noise or induction interference can be reduced by using a measuring current as large as possible and a voltage range as high as possible. It should be noted, however, that when the 20 V range is selected the input impedance of the TR2741 is approximately 11 MΩ and is connected in parallel with the resistance under measurement. The reference current source used must have an output accuracy equivalent to or better than the measurement accuracy. The resistance can be determined by Rx = V/Is, where V is a measuring voltage and Is is an external current source. Using the TR2731's scaling function, direct readout of resistance is obtained.

e. Measurement of voltage difference

The difference between an input voltage and an external voltage can be measured by connecting a voltage source to the external voltage input terminals. In this case both input and external voltages should not exceed the rated maximum value (±40 V).

The instrument can also be used for a strain gauge excitation for strain or pressure measurement.

2-5-4. Number of Attachable Sensor Terminals vs. Cable Lengths

The number of attachable TR2741 Sensor Terminals versus allowable cable lengths is shown in Figure 2-32. The total length of cables must meet the following two conditions:

(1) Multiply the cable length between the TR2731 and the nearest TR2741 by the number of subsequent TR2741 terminals on the daisy chain (including the nearest TR2741 itself) (50 m x 4 = 200 m in the following example). Multiply the cable length (expressed by meters) between the first TR2741 and second TR2741 by the number of subsequent TR2741 terminals on the daisy chain (including the second TR2741 itself) (20 m x 3 = 60 m in the following example). Perform similar calculation for the third and forth TR2741 terminals as well, and totalize the multiplication results.

Condition I: The totalized result must not exceed 500.

The TR2731 is provided with two connectors, which can distribute individual line system. In this case, each line system must meet Condition I.

(2) Condition II: The total length of all cables must not exceed 600 meters (including cables not terminated by the TR2741 as well).

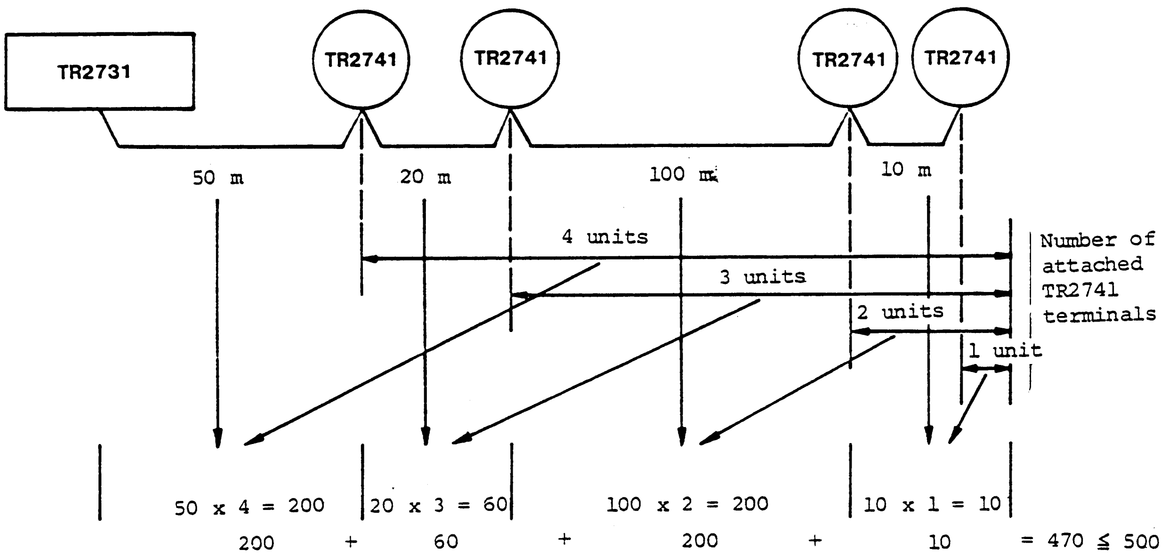
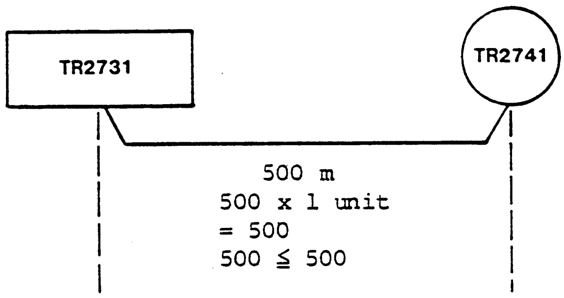


Fig. 2-32 Calculating cable lengths

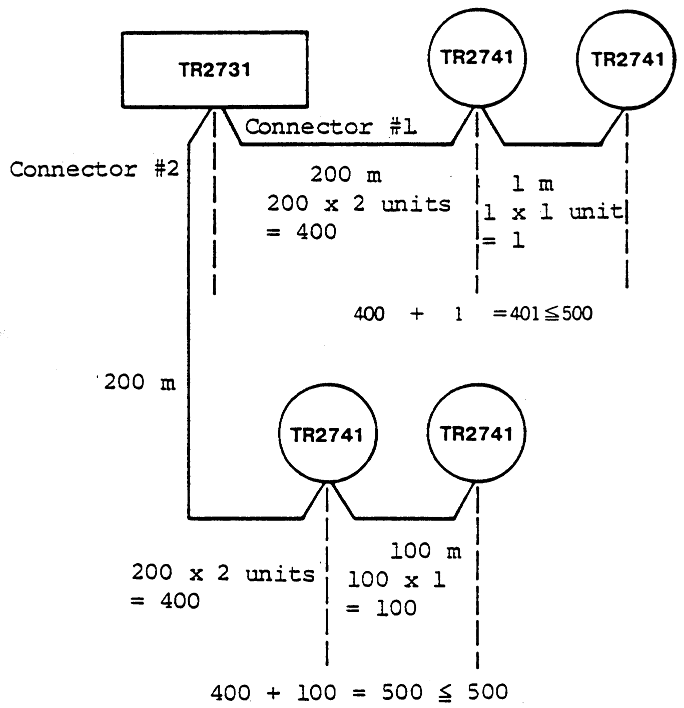
Some calculation examples are shown below:



Condition I ---- Pass

Condition II (600 meters or less) ---- Pass

Fig. 2-33 Connection example-1



Condition I: Indexes of each path ≦ 500 ---- Pass

Condition II: 501 m ≦ 600 m ---- Pass

Fig. 2-34 Connection example-2

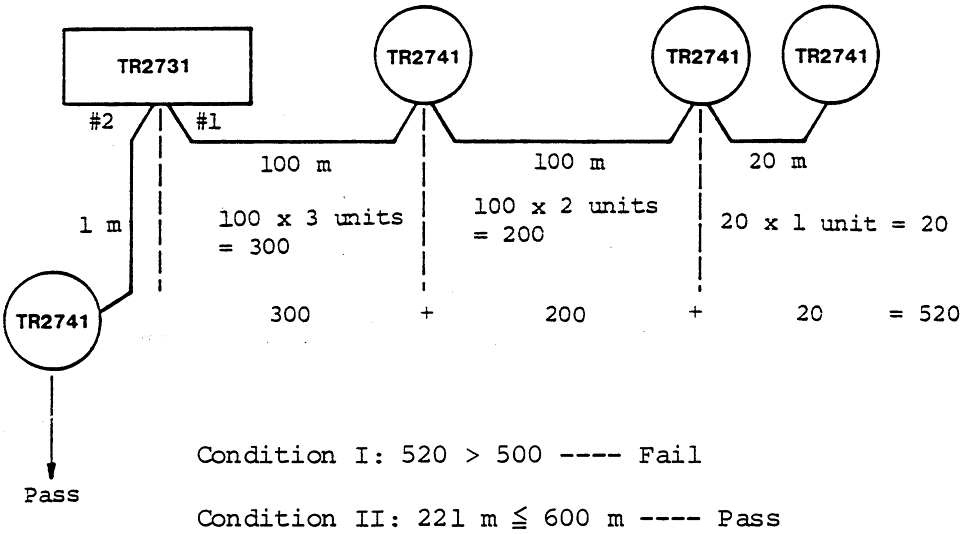


Fig. 2-35 Connection example-3

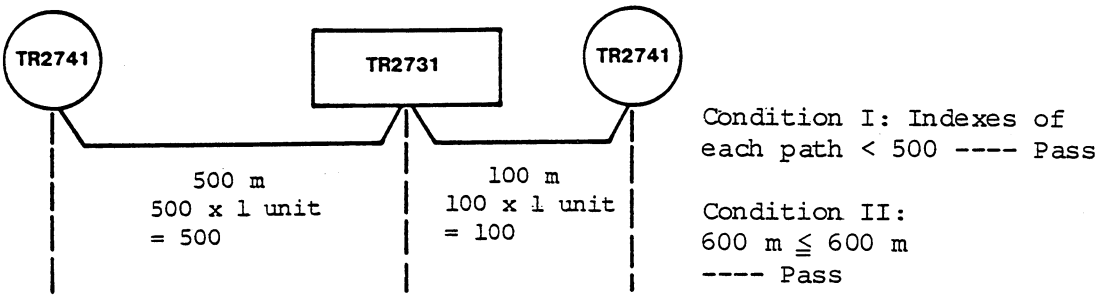


Fig. 2-36 Connection example-4

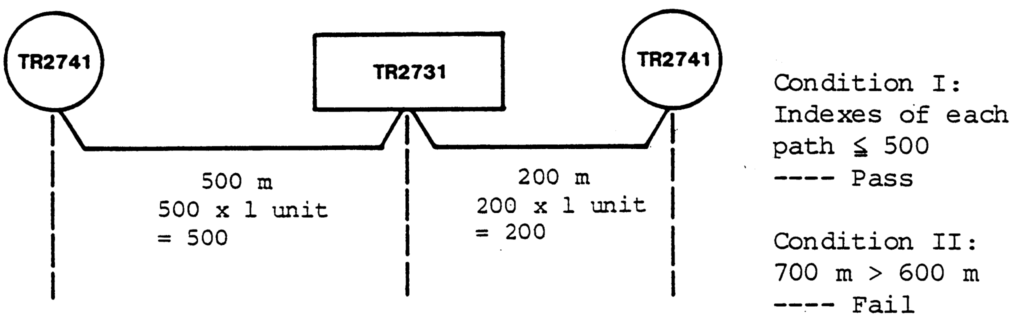


Fig. 2-37 Connection example-5

2-5-5. Noise Interference Countermeasures

The TR2741 Sensor Terminal is designed to be affected least noise interference. If the measurement result is not stable or measurement error is unusually large, employ the following countermeasures:

(1) Major types of noise

a. Normal mode voltage

If a voltage source (V_{NMV}) exists in series to a signal source voltage Vs, it is called a normal mode voltage, which can cause measurement error. (See Figure 2-38.)

The degree of influence of this normal mode voltage on a measurement result is referred to as normal mode rejection ratio (NMRR), which is expressed as follows:

$$NMRR = \left| \frac{V_{NMV}}{\text{Measured value} - Vs} \right|$$

In most cases, the NMV is induced by AC line to a signal source or input cables and has line frequency of 50, 60, or 400 Hz. In the above equation, V_{NMV} is the peak noise voltage level (effective value x $\sqrt{2}$ when sine wave).

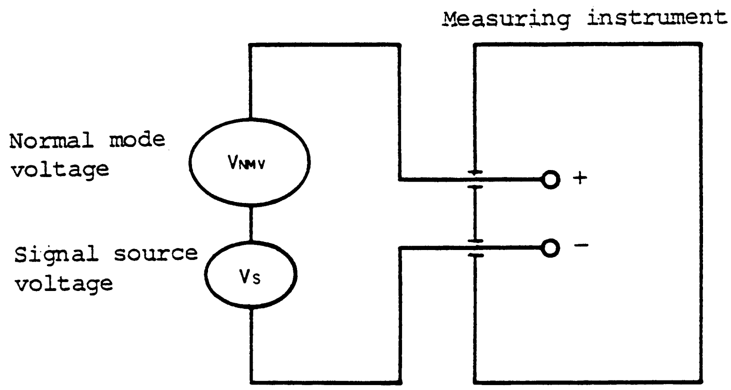


Fig. 2-38 Normal mode voltage

b. Common mode voltage

As shown in Figure 2-39, if the same voltage as referenced to the ground is induced to the hot and cold signal lines, the voltage is called a common mode voltage (CMV).

If a measuring instrument is connected to the signal source, the total setup is expressed by the equivalent circuit as shown in Figure 2-40. In this equivalent circuit, the common mode voltage causes a generation of normal mode voltage Ve due to R and Z, which eventually causes measurement error. The degree of influence of this common mode voltage on the measurement result is expressed by the common mode rejection ratio (CMRR), which is given by the following equation:

$$CMRR = \left| \frac{V_{CMV}}{\text{Measured value} - Vs} \right|$$

The CMV is a particularly significant problem when resistance R is increased due to a long input cable or large signal source impedance. (See Figure 2-40.) The major component of the CMV is induced by an earth-to-earth current generated by the AC line. In the above equation, V_{CMV} is a peak noise voltage level.

As mentioned just above, the major component of the NMV or CMV is the line frequency (50, 60, or 400 Hz). If a higher noise frequency of several tens kilohertz is induced to the signal line, however, it may cause nonlinearity in amplifiers or semiconductor switches within the measuring instrument used and may eventually result in a much greater measurement error.

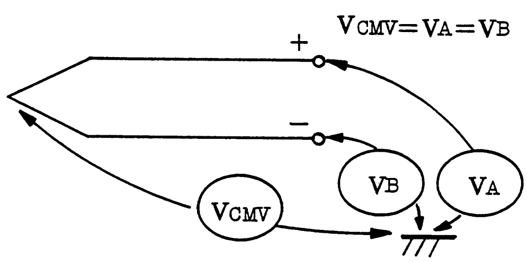


Fig. 2-39 Common mode voltage

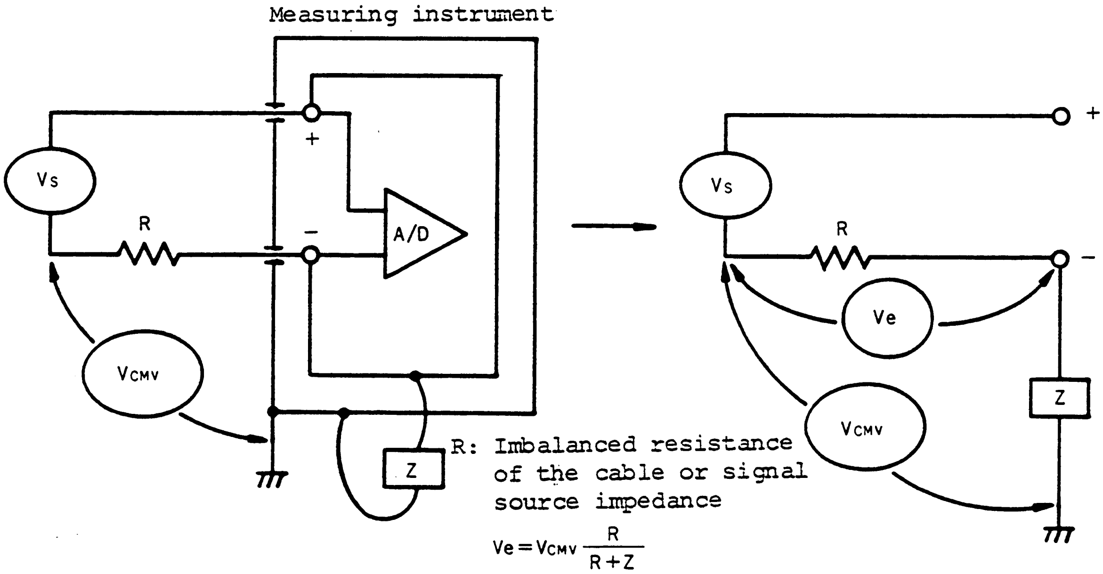


Fig. 2-40 Influence of common mode voltage

(2) Preliminary investigation of noise sources

Noise sources which may have considerable affect on the temperature measurements using the TR2731/2741 system will include the following:

- o High voltage equipment
- o Large current handling equipment
- o RF or pulse equipment

If the temperature or voltages of these equipments itself or those in the vicinity of them are to be measured, careful preliminary investigation is required to determine the possible influences to be expected from the equipment and the necessary countermeasures.

a. Measuring the CMV

To determine the CMV of the measuring setup, measure the voltage across the cold lead (at the end of the output cable) of the sensor and the ground line for the TR2741 sensor terminal with an oscilloscope (with a frequency response better than 10 MHz, input impedance higher than 1 MΩ). See Figure 2-41.

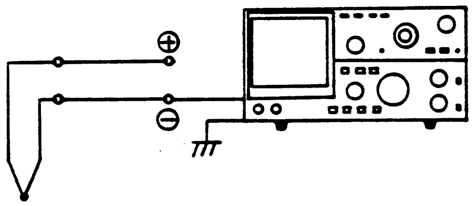


Fig. 2-41 CMV measurement setup

b. Measuring the NMV

To determine the NMV of the measuring setup, measure the voltage across the hot and cold leads of the sensor at the end of the output cable with a floating type oscilloscope. The floating type oscilloscope has one or more inputs which are completely isolated from the primary AC power source or the earth. Usually, it is a battery-driven oscilloscope. See Figure 2-42.

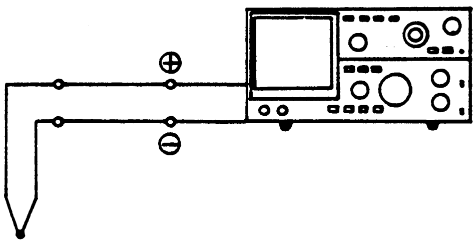


Fig. 2-42 NMV measurement setup

(3) Noise interference countermeasures

Depending on the type or level of noise interference, the noise rejection characteristic inherent to the instrument may not be sufficient to completely eliminate the noise. In such a case, employ the following countermeasures:

a. Selecting the appropriate type of thermocouple

Where possible, use non-grounding type thermocouples for measurement and isolate them from the objects under measurement.

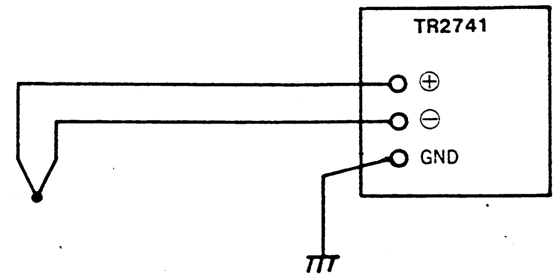


Fig. 2-43 Use of non-grounding type thermocouple

If a grounding type thermocouple is unavoidable to use or it is not isolated from the object under measurement or from the earth, use an input cable as short as possible.
If measurement is seriously affected by high-frequency CMV noise when grounding type thermocouples are used, connect a ceramic capacitor of 0.001 μF to 0.01 μF across the input terminals (both hot and cold) of each channel and the GND terminal on the rear panel of the instrument.

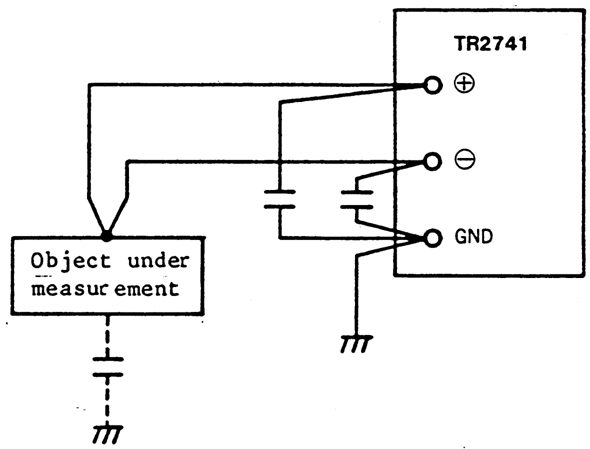


Fig. 2-44 Action against RF noise problem for grounding type thermocouples

b. Grounding of the object under measurement
To prevent noise transfer from the object under measurement to the thermocouple, connect the object to the GND terminal on the rear panel of the instrument with a thick, short wire.

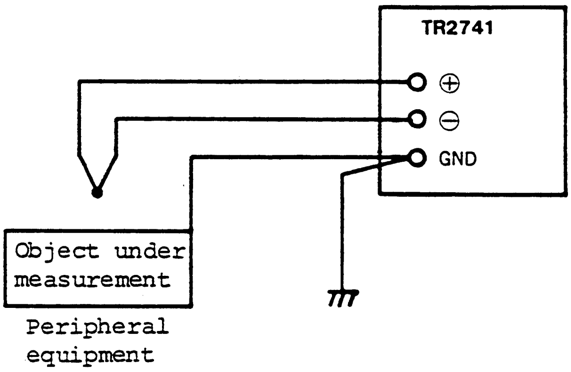


Fig. 2-45 Grounding the object under measurement

c. Use of electrostatic shield

To prevent the input signal lines from electrostatic coupling with adjacent noise sources, use a shielded cable for the input line. The outer shield conductor of the cable should be connected to the GND terminal on the rear panel of the instrument.

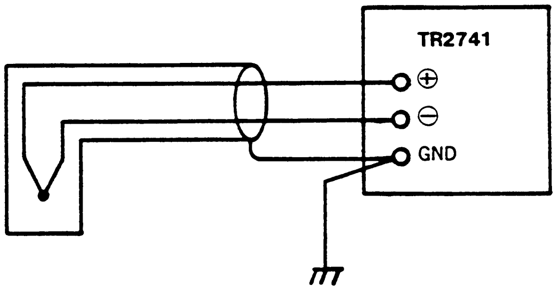


Fig. 2-46 Input connection using a shielded cable

d. Use of a twisted pair cable

If a large-current power cable is layed near the input signal line, NMV noise interference may generate due to electromagnetic coupling. If this is expected, twisted pair cables should be used for input signal lines.

Since those power cables usually have high potentials, it is recommended that the twisted pair cable should be provided with an electrostatic shield as well.

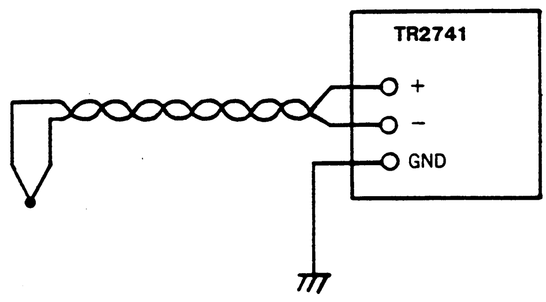


Fig. 2-47 Input connection using twisted pair cable

MEMO

SECTION 3

TR2731 COMPUTING DATA LOGGER

3-1. GENERAL

The TR2731 Computing Data Logger provides various measurement modes for selective data acquisition from intermixed input signals, and is capable of various data logging through the TR2741 Sensor Terminals or optional input cards. It has the following features:

(1) Since the TR2731 contains arithmetic functions often used for data logging, a complete data acquisition system can be configured only with the TR2731 and TR2741. The standard arithmetic functions include 8 types, such as the linear scaling arithmetic for engineering units conversion, statistic operations on the time axis, differential operations between multiple input channels, and so forth. In addition, nine types of secondary arithmetic functions are optionally available.

(2) Along with the data logging function, the TR2731 also provides continuous operation and monitoring functions. These functions include the scanning monitor that operates independently of regular logging, relay outputs for over-limits alarm, continuous single-channel display, alarm print which outputs data only for unusual measurement result, up to 12 channels of analog output permitting monitoring with an analog recorder.

(3) The TR2731 permits the user simple entry of measuring parameters with its categorized input keys and a large fluorescent display. For group programming, the direct item specification and automatic rearrangement functions permits easy programming, readouts, addition, insertion and deletion of group numbers. Remote programming through the GPIB interface is also possible in complete form.

(4) A wide variety of input/output options are available. They include the GPIB interface, BCD output/external control, BCD input, relay output, analog output, serial data output, pulse counter, etc.

(5) The multi-user log mode permits independent execution of up to four types of data logging.

3-2. SPECIFICATIONS

Input Section

Analog input (temperature, voltage, resistance) and contact input

Attachable sensor terminals: Up to four TR2741's (up to 320 input channels)

Attachment format : Synchronous, serial transfer using a six conductor cable (signal, power supply, and external start/stop)

Maximum interconnecting cable length: 500 meters (if any one of the cables exceeds 100 meters in length, the total cable length must conform to the restriction given in item 2-5-4.)

Input scanning time: Max. 4 seconds (including no calibration time)

Maximum scanning speed: 80 channels/sec. (when four TR2741's are attached)

Digital input : Available with the TR2730-530 option card. (Concurrent use with TR2730-580 is not possible.)

Input condition : TTL level or +12 V to +18 V, 6 digit BCD, max. 4 channels

Pulse counter : Available with the TR2730-580 option card. (Concurrent use with TR2730-530 is not possible.)

Input condition : Contact or TTL level, 4 digits, max. 4 channels

Measurement Operations

Measurement modes : The following 4 modes are selectable:

o Log scan mode : Automatically scans the inputs at the specified intervals to log data.

o Multi-user log scan mode: Permits independent command for up to 4 scan groups.

o Single scan mode: Permits manual command for a single scan.

o Monitor scan mode: Monitors scanning while making log scan.

Log interval : The following 4 intervals are selectable (in the log scan mode only):

o Single interval : Permits arbitrary interval setting between continuous and 24 hours 00 minute 00 second (basic interval).

o Variable interval: Measuring intervals can be specified for each of up to 6 time divisions.

Time to be divided: 00 day 00 hour 00 minute to 99 days 23 hours 59 minutes

Division interval: Up to 200 times the basic interval (up to 24 hours 00 minute 00 second which is N times the basic interval)

o Multi-interval : Data is logged at different intervals for each input channel group. Up to 8 groups can be specified.

Interval : Up to 200 times the basic interval (maximum 24 hours 00 minute 00 second which is N times the basic interval)

o External interval: Data is logged at the interval of an external contact signal (TR2730-520 option card is necessary.)

Scan channel : Start/stop channels can be arbitrarily specified for up to 10 channel groups.

Monitor interval : Specifiable between continuous and 60 minutes 00 second (in monitor scan mode only).

Monitor channel : All channels specified by scan channel or selected 12 channels max.

Filter function : In average mode, the filter function executes data averaging of all input channels by the specified number of times (up to 40 times). In delay mode, the value at the specified number of times (up to 40) is the measured data. The measurement time per channel is 50 ms x N + 200 ms (N: specified number of times).

Label : A label of up to 8 alphanumeric characters can be printed out for each log scan. In the ID mode, the least significant 3 digits of a label are incremented by one at each log scan up to 999. In multi-user log scan mode, the ID mode cannot be used.

Auto start/stop : Permits automatic log-scan start/stop.
00 day 00 hour 00 minute to 99 days 23 hours 59 minutes.

(1) Specified with the elapsed time from the measurement start for the timer mode.
(2) Specified with the real clock time for the clock mode.
(3) Unusable for the multi-user log scan mode.

Time : Permits presetting date, hour and minute (specifiable in the clock or timer mode).
Display: 00 day 00 hour 00 minute 00 second to 99 days 23 hours 59 minutes 59 seconds
Reference signal stability: At least ±5 seconds/day (under the specified operating environment)

Continuous single-channel display: Continuously displays the data of one specific channel (after scaling operation) at an approximately one second interval. A specified engineering unit is attached to the measured data.

Arithmetic Processing and Setting

Processable input channels: 80 channels (analog) plus 4 channels (for TR2730-530/580 option cards). When two or more sensor terminals are used, the TR2730-010 (Memory/Aux. Function option card is necessary; processable input channels are extended to 320 + 4.

Processable groups:

Function : 40 groups

Upper/lower limit setting: 40 groups

Function setting : The following functions are specifiable for each group:

o Input range : 8 types of thermocouples; T(CC), J(IC), E(CRC), K(CA), S(PR10%), R(PR13%), B(PR30%), PR12.8%
(Internal/external reference junction compensation and linearization ON/OFF can be specified for each type.)
4 ranges of DC voltage; 20 mV, 200 mV, 2 V, 20 V
Non-voltage contact input
3 types of 100 Ω platinum RTD; 3-wire, 4-wire, 4-wire high resolution (Linearization ON/OFF can be specified for each type.)

o Scaling : (X - A)/B operation
A and B can be specified between 0.0000 and ±99999 (B = 0)
The number of decimal places of operation results is as follows:
$1 \leqq |B| < 10$ --- Same as the number of decimal places of the input data.
$10 \leqq |B|$ ----- The number of decimal places is increased by (number of integral digits of B - 1).
$1 > |B|$ ------ The number of decimal places is decreased by (the number of zeros in decimal places of B + 1).

o Engineering units: Specifiable by up to 4 characters.

o Arithmetic operation: Any one of the following operations can be specified for each group:

(1) Difference from arbitrary input channel data (ΔN)
(2) Difference from the initial data (ΔI)
(3) Difference from the preceding data (Δt)
(4) Maximum of data logged in a certain period of time (MX)
(5) Minimum of data logged in a certain period of time (MN)
(6) Average of data logged in a certain period of time (AV)
(7) Total of data logged in a certain period of time (TL)

Note: Items (2) through (7) are arithmetic operations for the same channel. The time intervals for items (4) through (7) can be specified up to 127 times the log interval. However, if the total value in item (7) exceeds 7 digits, the least significant 7 digits are totalized.

If the total value exceeds 7 digits for average operation (6), the least significant 7 digits are averaged. Therefore, the operation result is not guaranteed.

Operations (2) through (7) can not apply to the data resulting from monitor scan mode.

Upper/lower limit value setting: An upper/lower limit (0.0000 to ±99999), alarm contact output and log/monitor scan can be specified for each group.

Secondary arithmetic operation: Nine types of operations on logged data, inhibition of non-processed data output and alarm comment display are available with the TR2730-010 (Memory/Aux. Function option card).

o Operation types:

(1) Difference from other input channel (SUB) X - Y

(2) Product with other input channel (MUL) X•Y

(3) Ratio to other input channel (DIV) X/Y

(4) Maximum data in one group (Max.)

(5) Minimum data in one group (Min.)

(6) Average of one group (Ave.)

(7) Difference between the maximum and minimum data within one group (p-p)

(8) Standard deviation within one group (SD) $\sqrt{\frac{1}{N}(Xn-\bar{X})^2}$

(9) Deviation within one group (Dev.) $Xn - \bar{X}$

o Number of digits and decimal point location of operation results:

For addition and subtraction, the number of digits of operation results is identical to that of the input data having a smaller number of decimal places. For multiplication, the number of decimal places of an operation result is identical to that of the multiplicand. If an operation result exceeds seven digits, the most significant seven digits are output.

For division, the position of the decimal point of a division result depends on the divider as in the case of scaling operation.
For standard deviation, operation results have up to four decimal places. If an operation result exceeds seven digits, however, the most significant seven digits are output.

o Alarm comment : Up to 4 different comments (up to 12 characters each) can be specified for upper and lower limit groups.
Those comments can be printed out upon upper or lower limit identification.

Programming : Can be specified with FUNCTION keys, numeric keyboard, or control keys.
Programming contents can be recalled at random.
One-line deletion/insertion possible.
Automatic rearrangement function provided. GPIB remote programming possible with the TR2730-510 GPIB Interface option card.

Output Section

Display panel : 5 x 7 do matrix alphanumeric display using 16 digits large fluorescent display tubes (green indication).
Character size: Approx. 11 mm in height

o Displayable data: Time, data (channel, data, units), programmed parameters, error messages, etc.

o Indicator lamps : Scan busy, monitor scan busy, log missed, alarm, multi-user run status, and GPIB status

Internal printer : Thermal printer with 20 characters/line

o Printing speed : Approx. 0.5 second/line

o Recording paper : Folded paper in approx. 60(W) x 127(L) x 300 pages, with approx. 8000 lines capacity

Print mode:

o Log data print mode: Measured data is printed at each logging interval.

o Alarm print mode: Only the pertinent data is printed during monitor scan identification, fault generation or recovery from fault.
The entire logged data during error generation is printed once when log scan identification is made.

o Program list print mode: Programming contents are printed to list in a fixed format.

Alarm output : Max. 80 channels of contact output (using TR2730-540 Relay Output option card) is capable of driving alarm indicator lamp and/or electronic buzzer (approx. 2 seconds).
Alarm comment display (using TR2730-010 Memory/Aux. Function option card)

External data output: Logged data can be output to an external unit in the BCD parallel format (using TR2730-520 BCD Output/External Control option card) or serial format (using TR2730-560 Serial Data Output option card or TR2730-510 GPIB Interface option card).

Analog output : Up to 12 channels of logged data (digital form) can be converted into corresponding analog data and output to external units (with TR2730-550 Analog Output option card).

<u>General Specifications</u>

Optional card slots: 4 slots (slot for TR2730-010 not included)

Power failure processing: Programming contents and clock are protected against power failure (in LOCK position only)

o Back-up battery : Ni-Cd battery

o Back-up period : More than one month (when fully charged)
The maximum clock back-up period is 18 hours.

o Auto restart : When the line power is recovered, the instrument initializes itself, prints the time of power failure generation, then automatically restarts data logging. If arithmetic operation was specified before power failure, the first operation made after power recovery is the initial operation.

Self diagnosis function: Includes back-up battery voltage check, memory read/write check, program memory readout check, attached terminal configuration check, installed option configuration check, etc.

External start/stop: Non-voltage make contact (chattering less than 30 ms, make time more than 100 ms)

Panel lock : When the POWER key switch is set to the LOCK position, all controls and keys on the front panel are disabled.

Operating temperature: $0^{\circ}C$ to $+40^{\circ}C$ with relative humidity of 85% or lower

Storage temperature: $-20^{\circ}C$ to $+60^{\circ}C$ with relative humidity of 90% or lower

Power supply : 100, 120, 200, 220 Vac ±10% or 240 Vac $^{+4\%}_{-10\%}$, with frequency of 50/60 Hz, sine wave, less than 150 VA

External dimensions: Approx. 424(W) x 132(H) x 450(D) mm

Weight : 15 kg or less

Accessories supplied:

(1)	Operation & Maintenance Manual	1 copy
(2)	Recording paper (9993-013)	5 volumes
(3)	Numbering sticker (for TR2741/30)	2
(4)	Fuse (EAWK2.5 A)*	2

* 1.25 A for 200, 220, 240 Vac.

3-3. PANEL DESCRIPTION

3-3-1. Front Panel Description

This paragraph describes the TR2731 front panel features in the order of encircled reference numbers shown in Figure 3-1.

① POWER switch

Supplies AC power to the instrument if set to ON. When this switch is set to the LOCK position, all control key functions on the front panel are disabled and programming contents and clock are protected against power failure and automatic restart upon power recovery is made available.

② LOG SCAN lamp

Lights during log scan busy.

③ MONIT. SCAN lamp

Lights during monitor scan busy.

④ LOG MISSED lamp

Lights if log scan interval is specified too short or the continuous scan mode is selected.

⑤ LOG key

This key controls log scan start/stop. The first operation of this key starts a log scan sequence; the lamp in the key lights. The second operation of this key stops the log scan sequence; the lamp in the key goes off. Each time this key is pressed, the instrument repeats log scan start and stop alternately.

⑥ SINGLE key

This key starts a single scan manually.

⑦ MONITOR key

This key controls monitor scan start/stop. The first operation of this key starts a monitor scan sequence; the lamp in the key lights. The second operation of this key stops the monitor scan sequence; the lamp in the key goes off. Each time this key is pressed, the instrument repeats monitor scan start and stop alternately.

⑧ LOG DATA key

This key activates a logged data print command. The first operation of this key outputs log scan data to the internal printer; the lamp in the key lights. The second operation of this key inhibits data output to the internal printer; the key lamp goes off. Each time this key is pressed, the instruments repeats the print enable and disable states alternately.

⑨ ALM DATA key

This key controls alarm print mode. Operation of this key outputs alarm data to the internal printer; the lamp in the key lights. For example, if data exceeding an upper or lower limit setting is generated in the log scan mode, the entire log scan channel data can be printed once. Alternatively, if an error is generated in the monitor scan mode, the pertinent channel data can be printed each time upon the error generation and recovery from the error. The alarm print mode is, however, can not be used with the single scan mode.

⑩ PROGRAM LIST key

This key is used to output programming contents to the internal thermal printer or an external units in the specified format. When this key is activated, the lamp in the key lights. Each time this key is pressed, the program list output enable/disable status is repeated alternately.

⑪ OUTPUT ENABLE key

This key controls output of logged data and programming contents to external units. Operation of this key outputs logged data to the BCD Output option card (TR2730-520) and GPIB Interface option card (TR2730-510), and logged data and programming contents to the Serial Data Output option card (TR2730-560); the key lamp lights. Each time this key is operated, the output enable/disable status is repeated alternately.

(12) AUX. FUNCTION key

This key is used for alarm comment or secondary arithmetic operation setting. When the SCAN FORMAT (upper row) is selected, operation of this key permits alarm comment setting. When the GROUP PROGRAM (lower row) is selected, operation of this key permits secondary arithmetic operation type setting (TR2730-010 Memory/Aux. Function option card is necessary. When this key is activated, the lamp in the key lights.

(13) This key determines whether parameter keys (16) through (23) select SCAN FORMAT parameters or GROUP PROGRAM parameters. Each time this key is operated, the SCAN FORMAT and GROUP PROGRAM parameters are selected alternately; the currently selected status is indicated by lamps (14) or (15).

(14) SCAN FORMAT lamp

Lights when the SCAN FORMAT keys are selected to program parameter.

(15) GROUP PROGRAM lamp

Lights when the GROUP PROGRAM keys are selected to program parameters.

(16) LOG INTL/CHANNEL key

<u>LOG INTL (Log Interval)</u>

Used to specify data logging conditions such as interval modes and interval time for log scan. When this key is pressed, the lamp in the key lights.

<u>CHANNEL</u>

Used to specify channel numbers which denote channel-group boundaries. Up to 40 groups can be specified and the RANGE, SCALE, UNIT and MODE can be specified for each group. If the GROUP PROGRAM status is selected with key (13), the CHANNEL mode is initially selected and the lamp in this key lights.

⑰ SCAN CH./RANGE key

SCAN CH. (Scan Channel)

Used to specify the range of input channels from which data is to be logged during log scan. Up to 10 groups can be specified. When this key is activated, the lamp in the key lights.

RANGE

Used to specify the input measurement function range. When this key is activated, the lamp in the key lights.

⑱ MONIT. INTL/SCALE key

MONIT. INTL (Monitor Interval)

Used to specify scan interval for monitor scan mode; the lamp in the key lights.

SCALE

Used to specify linear scaling operation such as engineering unit conversion; the lamp in the key lights. When this key is activated, values A and B for formula (X - A)/B can be entered in signed five digits (±0.0001 to 99999).

⑲ FILTER/UNIT key

FILTER

Used to smooth input noise. Up to 40 measurement repetitions for averaging or the number of delays in the delay mode is specified with this key. When activated, the lamp in the key lights.

UNIT

Used to specify an engineering unit or physical unit using a combination of up to four alphanumeric characters. When activated, the lamp in the key lights.

⑳ AUTO TIME/MODE key

AUTO TIME

Used to execute automatic log-scan start/stop for the single user mode according to real clock time or elapsed timer time selected by the clock mode; the lamp in the key lights.

MODE

Used to specify a primary arithmetic operation type (from 7 types) and its associated parameters; the lamp in the key lights.

(21) LABEL/CHANNEL key

<u>LABEL</u>

Used to enter a label with a combination of up to eight alphanumeric characters. This key also permits output of numeric data which is automatically incremented (up to 999) for each log scan by the automatic index function. When this key is pressed, the lamp in the key lights.

<u>CHANNEL</u>

Used to specify channel group boundaries for upper/lower limits setting. Upper/lower limits can be specified for up to 40 groups each. Upper/lower limits can also be specified for log scan data after being subjected to primary arithmetic operation. When this key is pressed, the lamp in the key lights.

(22) CLOCK/HIGH key

<u>CLOCK</u>

Used to specify display and setting of time, and selection of clock/timer modes. The instrument integrates a precision digital clock providing readout of date, hour, minute and second. In the Clock mode, the clock always displays the real clock time. In the Timer mode, the clock usually displays the real clock time, but once log scan is started, it provides elapsed time readout.

When the SCAN FORMAT is selected with key (13), the lamp in this key lights to indicate initial settings.

<u>HIGH</u>

Used to specify an upper limit of data with a signed five-digit number with a decimal point. This key also permits entry of a relay output number and alarm comment number that are output if data exceeds the specified upper limit. When this key is pressed, the lamp in the key lights.

㉓ CALL CH./LOW key

CALL CH. (Call Channel)

Used to activate continuous single channel display. An arbitrary input channel can be selected to display data on that channel, after being subjected to engineering unit conversion by scaling operation at approximately one second interval. When this key is activated, the lamp in the key lights.

LOW

Used to specify a lower limit of data with up to five digits of signed number with a decimal point. It also permits entry of a relay output number and alarm comment number which are output if data exceeds the specified lower limit. When this key is activated, the lamp in the key lights.

> Note: The indicator lamps each provided in keys ⑯ through ㉓ indicate that the SCAN FORMAT parameter (lamp ⑭ lights) or the GROUP PROGRAM parameter (lamp ⑮ lights) selected with key ⑬ is valid.

㉔ CLEAR key

This key is used to clear or modify the entry data which is currently shown in the display. To delete the entry data, press the SET/NEXT key ㉗ after operating the CLEAR key.

㉕ BACK (#) key

This is a random access key. For parameters having one or more groups, displayed data can be returned by one line by pressing this key twice. To directry access the programming contents for a specific channel group, press the BACK (#) key, enter the pertinent channel group number, and then activate a parameter selection key. When logging for a certain user number is to be started or stopped, operate [# (BACK)] [G. No] [▭ LOG] START/STOP

㉖ Comma (,) key

This key is used to specify one or more additional functions. If an additional function is desired during parameter programming, operate [,] [0-9] [SET/NEXT] , for example.

㉗ SET/NEXT key

This key is used for parameter programming or to advance objective item (group) of measurement to the next and display it.

㉘ ALPHA (-) key

This key permits entry of a minus sign, uppercase/lowercase alphabet and special characters. To enter an uppercase alphabetic letter or special character of □ or %, or a space, press this key once, then press the desired key for the pertinent character or symbol which is indicated at the bottom right of each key. To enter a lowercase alphabetic letter or special character of μ, Ω, or / (slash), press this key twice, then press the pertinent key for the desired character or symbol which is indicated at the bottom right of each key.

㉙ Numeric (0-9) keys and decimal point (.) key

These keys are used to enter numeric data with or without a decimal point. However, when the RANGE parameter is selected, the letters (red) indicated at the top left of each key are entered. When the MODE parameter is selected, the letters (green) indicated at the top right of each key are entered.

㉚ Display

The display consists of 16 digits of fluorescent display tubes each configured in 5 x 7 dot matrix to display alphanumeric characters (in green) with a character size approximately 11 mm in height.

㉛ User status lamps U1, U2, U3, and U4

In the Multi-user Log Scan mode, data of up to four users can be independently logged. These lamps indicate the user for which data logging is currently performed.

㉜ ALARM lamp and RESET key

The ALARM lamp lights if an alarm output is detected. It can be turned off by pressing the RESET key. The ALARM lamp also lights if recording paper for the internal printer goes out. In this case, load new paper in the printer and press the RESET key to turn the ALARM lamp off.

(33) GPIB status lamps

These lamps indicate the instrument's status when it is remotely controlled by a GPIB interface.

The REMOTE lamp lights when the instrument is controlled externally. While this lamp lights, all front panel key functions are disabled.

The SRQ lamp lights when the instrument is in request for service to an external controller.

The TALK lamp lights when the instrument is addressed to talk; the LISTEN lamp lights when the instrument is addressed to listen.

(34) LOCAL key

When the instrument is externally controlled (REMOTE lamp lights), operation of this key restores control from the external unit to the front panel keys of the instrument; the REMOTE lamp goes off.

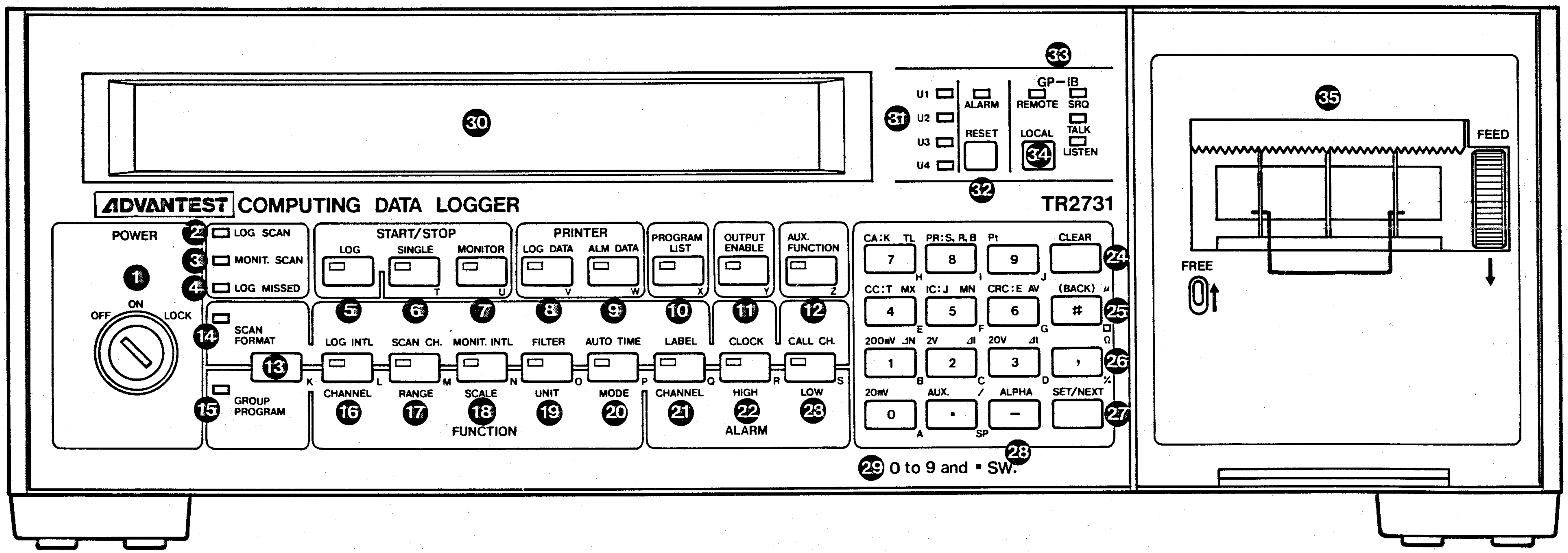
(35) Printer

The silent thermal printer can print 20 characters per line at a speed of approximately 0.5 second/line.

The recording paper can be manually pulled out of the printer by pushing up the FREE knob in the arrow direction.

The FREE knob should not be touched while the printer is operating.

The recording paper can be manually fed by turning the FEED knob in the arrow direction.



FRONT VIEW

Fig. 3-1 TR2731 front panel description

3-3-2. Rear Panel Description

This paragraph describes the TR2731 rear panel features in the order of encircled reference numbers shown in Figure 3-2.

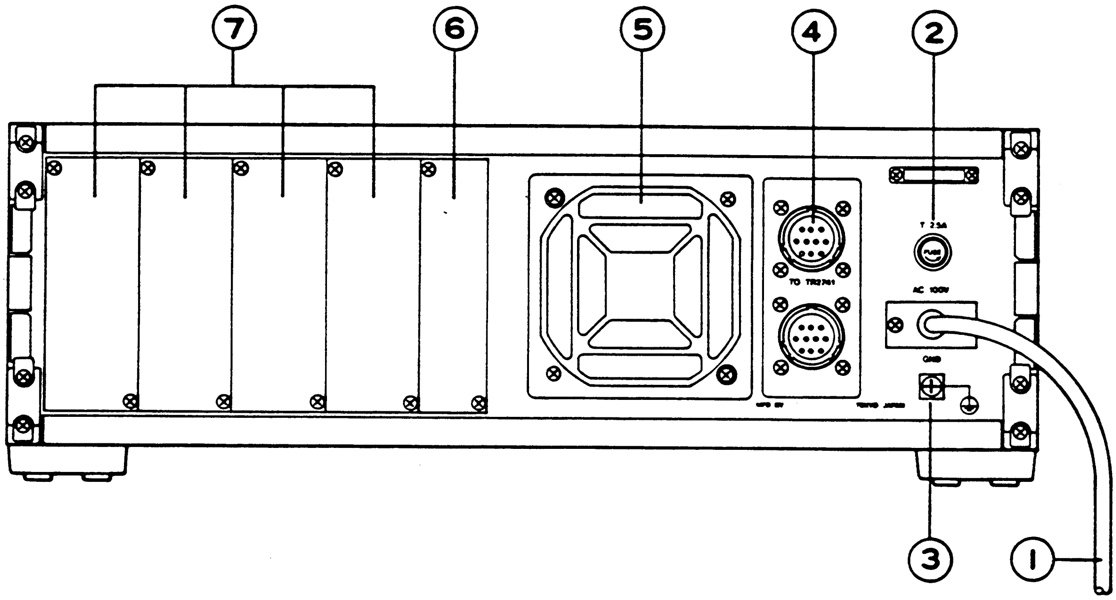


Fig. 3-2 TR2731 rear panel description

(1) Power cable

The power cable has 3-prong plug. The round prong in the center is to be grounded. The instrument should be plugged into an electrical outlet having an offset ground conductor if possible. If the instrument is to be plugged into a two-conductor outlet having no ground conductor, use the supplied plug adapter (KPR-13). In this case, be sure to connect the ground lead of the plug adapter or the GND terminal on the rear panel to the earth. If grounding is incomplete, noise may interface with measurement. See Figure 1-3.

② FUSE holder

This fuse holder contains a slow-blow fuse for the primary power circuit. The fuse holder cap can be removed by turning it in the arrow direction for replacement. The ratings of the fuse are as follows:

100, 120 Vac: 2.5 A

200, 220, 240 Vac: 1.25 A

CAUTION

When replacing the fuse, be sure to turn the POWER switch to OFF and unplug the power cable from the AC line receptacle.

③ GND terminal

When the supplied plug adapter is used for power connection, be sure to ground either the lead wire of the plug adapter or this GND terminal to the earth.

④ TO TR2741 connectors

These connectors accept an interconnecting cable that connects the instrument to deliver signal and supply powers to TR2741 Sensor Terminals. Either of the two connectors may be used. The dedicated interconnecting cable MC-76 Series is available.

⑤ Cooling fan

This inhaling type cooling fan exhausts air through the ventilators provided in the top and bottom covers of the instrument. Allow sufficient space around the instrument for adequate ventilation.

⑥ Slot for the Memory/Aux. Function option card

This slot accommodates the TR2730-010 Memory/Aux. Function option card. No other card can be installed in this slot.

⑦ Slots for I/O and Data Buffer Memory option cards

These slots accept the TR2730-510 through 580 option cards. Up to four cards can be accommodated in any of the four slots. It should be noted, however, that some optional cards cannot be operated concurrently in these slots.

3-4. OPERATION OUTLINE

3-4-1. Scan Mode

The TR2731 Computing Data Logger is capable of simultaneous, parallel execution of three measurement modes: log scan, monitor scan, and call channel modes. The outline of the measurement operation is illustrated in Figure 3-3.

In the Log Scan mode, the instrument scans input channels at a specified time interval, performs arithmetic and/or logical operations on measured data, outputs the operation results to an output unit, or transfers digitally-coded data to external units such as a computer.

In the Monitor Scan mode, the instrument usually scans input channels at a shorter interval, outputs data in analog form or uses data for GO/NOGO decision using upper/lower limit identification.

In the Call Channel mode, the instrument displays data of an arbitrary input channel for operator monitoring.

Measurement intervals and measurement start/stop commands can be independently specified for each of the three modes, and the necessary mode can be selectively activated at any time (the display interval in the Call Channel mode is fixed to 0.5 sec.).

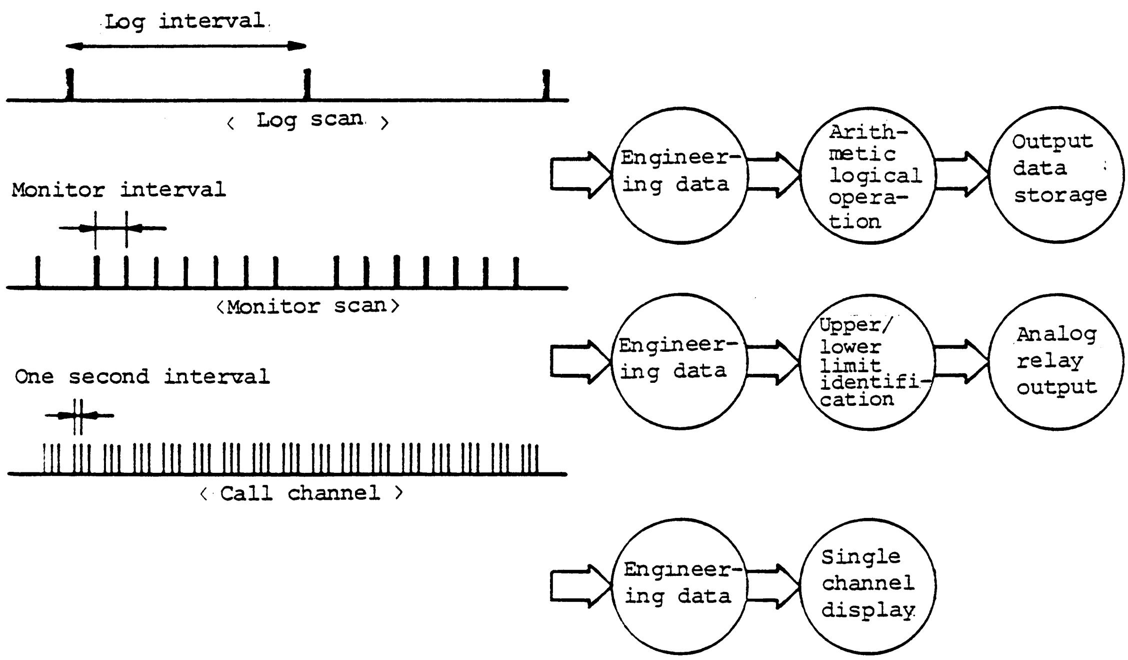


Fig. 3-3 Outline of TR2731 measurement operations

The detailed operation sequence in the Log Scan mode is shown in Figure 3-4. The data processing time refers to the time required for arithmetic or other operations, and may reach several seconds when many operations or channel groups are specified. When no operation is specified, a data processing requires for approximately one second. The output time is the time required to output data. Output data formats are available in the GPIB, BCD parallel, and character-serial formats, as well as that for the internal printer. If the log scan interval is gradually decreased until the next scan overlaps with the preceding output time (Figure 3-4), the LOG MISSED lamp on the front panel lights and log scan operation is ignored. If the LOG MISSED lamp lights, the log scan interval setting must be increased.

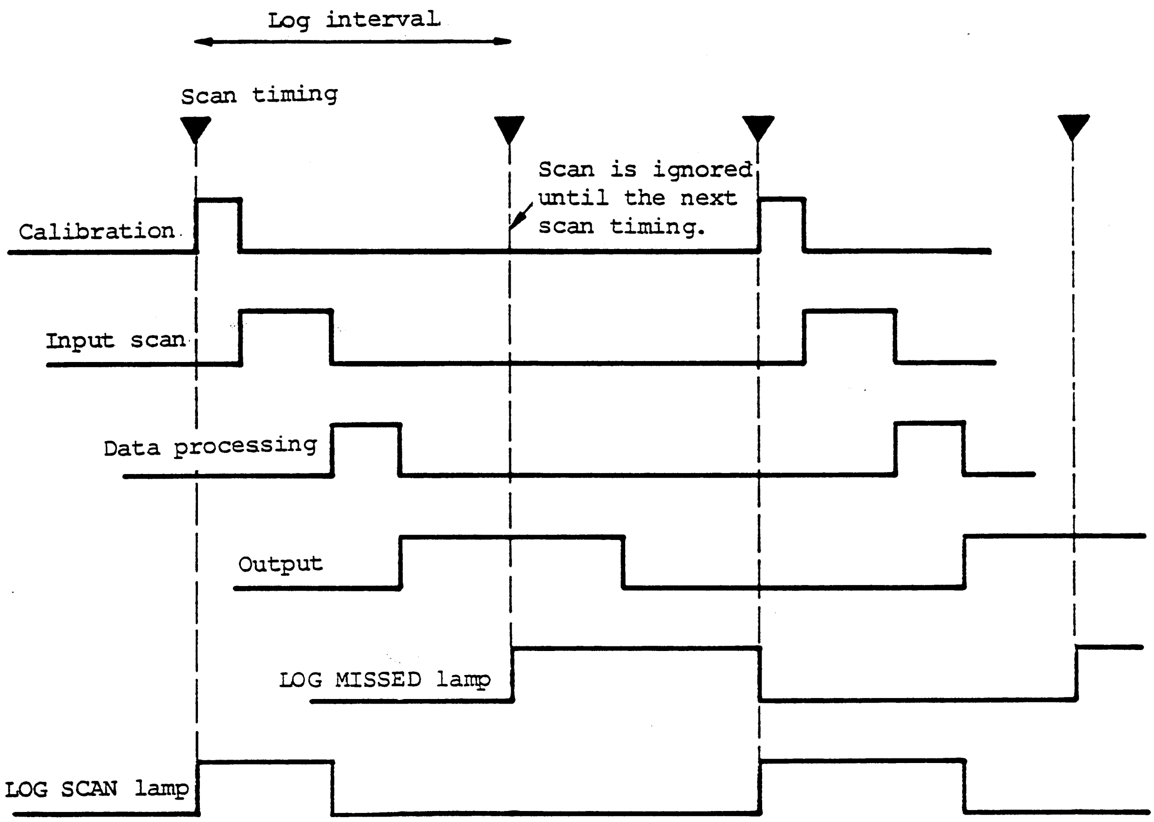


Fig. 3-4 Log scan timing sequence

If, as an extreme case, the log scan interval is set to zero (continuous scan), the next scan is started immediately following the preceding data output as shown in Figure 3-5. Since the purpose of continuous scan mode is to log input signals as fast as possible, calibration is, unlike other cases, not performed at the beginning of each scan but performed after scan is completed, during processing or output time.

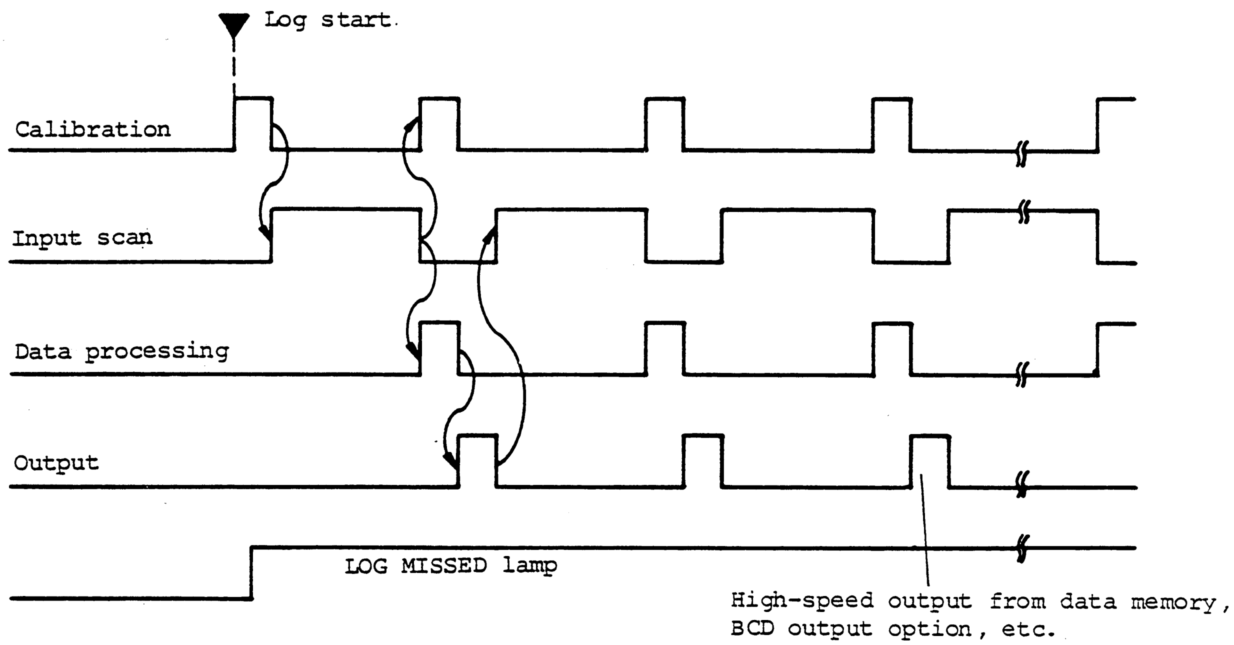


Fig. 3-5 Continuous log scan sequence

If the log scan, monitor scan and call channel modes are selected simultaneously, each mode is activated in the predetermined priority order. The log scan mode has the highest priority. As shown in Figure 3-6, the log scan mode is never ignored in any operation sequence. (Except when the start of log scan mode may be delayed due to data processing for monitor scan mode.)
There is no priority order between the monitor scan and call channel modes. They are executed during the periods when the log scan mode is not executed or log scan data is being output.

As the log scan interval decreases, there arise time regions in which the monitor scan or call channel mode cannot be executed. This requires special attention when performing analog data output in the monitor scan mode. As for call channel mode, a call channel can be displayed at each log scan so far as the specified call channel is included during log scan.

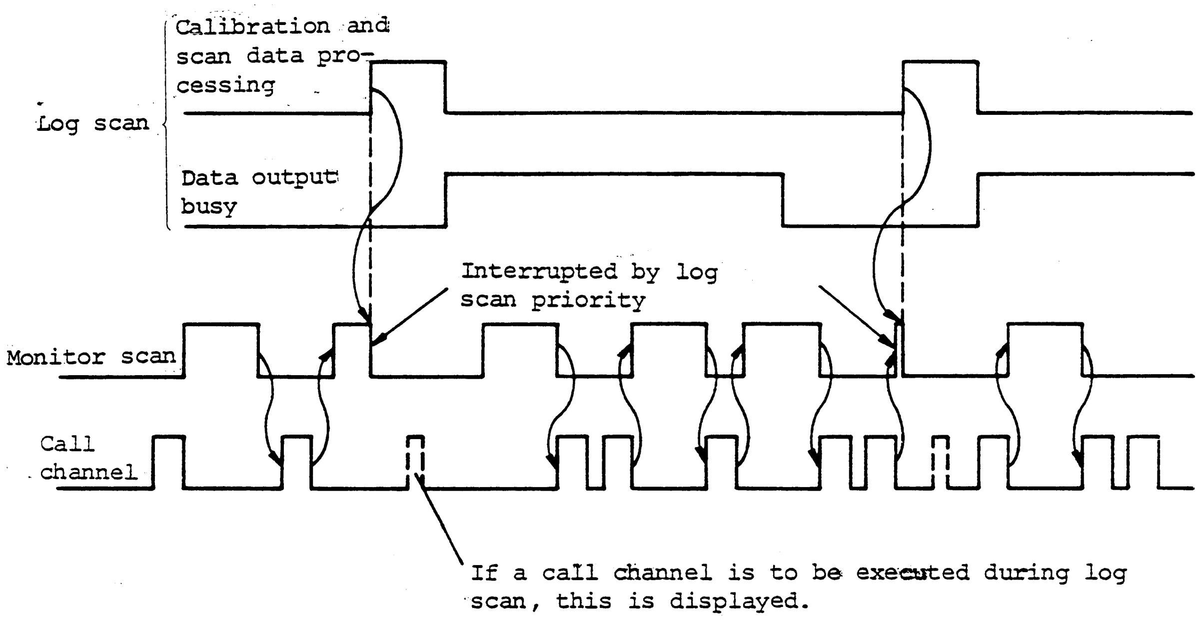


Fig. 3-6 Measurement sequence with shorter scan interval

3-4-2. Interval Mode

As shown in Figure 3-7, the log scan execution basically includes the conventional single-user log scan mode and the unique multi-user log scan mode (in which one or more users can share one data logger). In addition, the single-user log scan mode includes four selectable interval modes depending on its scan intervals.
The most basic single interval mode scans all the specified input channels at specified intervals to perform uniform measurement along the time axis. In contrast, the variable interval mode scans input channels at different intervals for each specified time division.
In the multi-interval mode, data is logged at different intervals for each specified input channel group.

The external interval mode scans all the specified input channels by applying an external scan signal to the TR2730-520 BCD Output/External Control card to permit data logging synchronous with external unit operation or status.
These operation modes are selectable either on the front panel of the instrument or from at external controller via the GPIB interface.
Concurrent use of these modes (such as specifying the variable interval mode for each input channel group) is not possible.

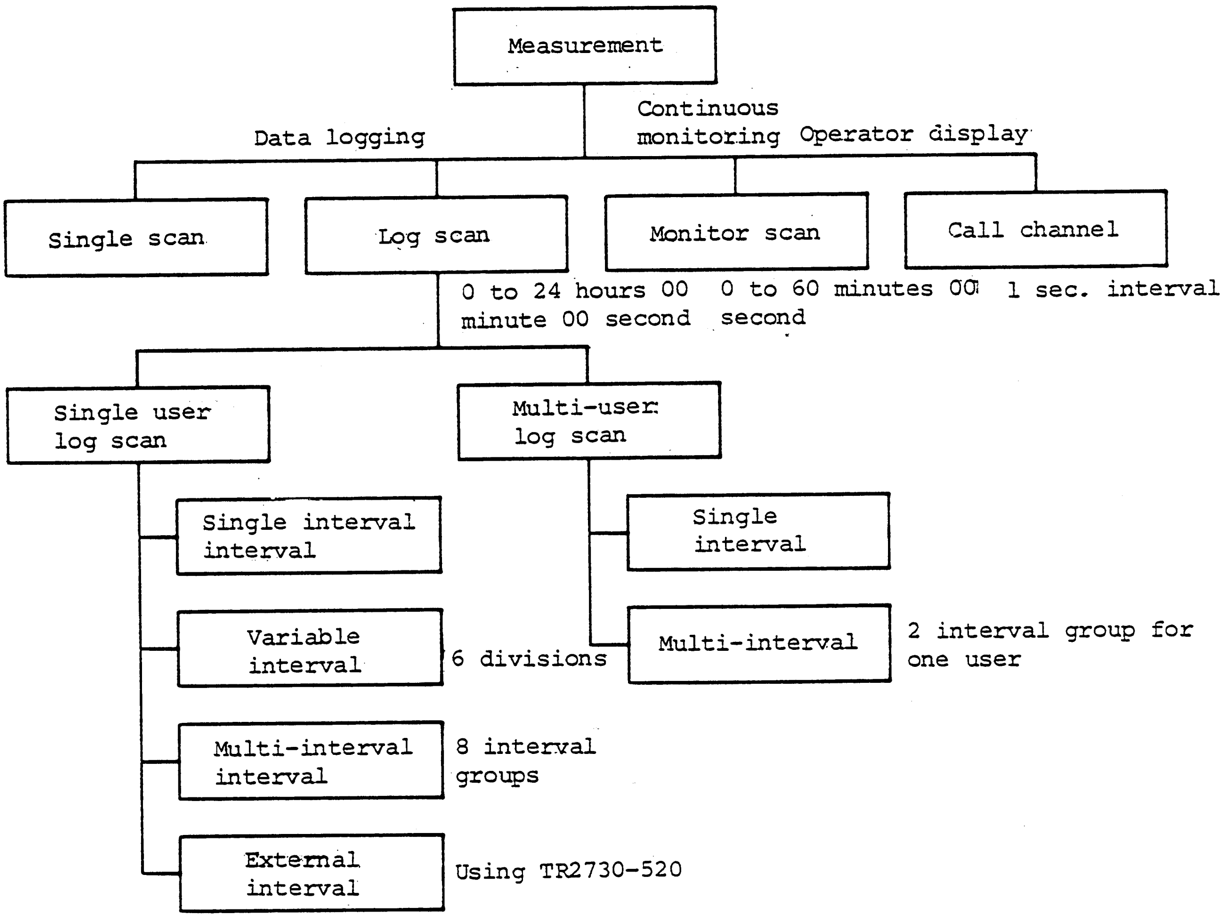


Fig. 3-7 Data logging modes

3-4-3. Single-User and Multi-User Log Scan Modes

The multi-user log scan mode is one of the unique functions of a data logger. It is useful to effectively use the data logger when a relatively long scan interval is selected. In this mode, log scan start/stop can be independently specified to permit independent data logging. Input channels can be assigned to individual users or jobs, adequate scan intervals can be specified for each of the users or jobs individually, and logged data can be output to different units as required.

In the multi-user log scan mode, the users can specify only the single interval mode and the multi-interval mode for up to two groups. Other interval modes are disabled to the users.

3-5. BASIC PROGRAMMING SUPPORT (SCAN FORMAT)

All measurement and arithmetic conditions for the TR2731 Data Logger are programmed with the parameter entry keys on the front panel (in local mode only). This paragraph describes the parameters and their entry procedures using the front panel keys.

Since all entry parameters are stored in micro-processor which is backed-up by batteries, they remain intact even when the instrument is switched off.

Parameter entry procedure is described in the following order:

3-5-1 Log Interval Mode (LOG INTL)

(1) Single interval mode programming (sgl)

(2) Multi-interval mode programming (mPl)

(3) Variable interval mode programming (var)

(4) External interval mode programming (ext)

3-5-2 Scan Channel Mode (SCAN CH.)

3-5-3 Monitor Interval Mode (MONIT. INTL)

(1) All channel scan mode programming (all)

(2) Selective channel scan mode programming (sel)

3-5-4 Filter Mode (FILTER)

3-5-5 Auto Start/Stop Mode (AUTO TIME) (t)

(1) Clock mode

(2) Timer mode

3-5-6 Label Mode (LABEL)

3-5-7 Clock (CLOCK), Clock Mode and Timer Mode ( )

3-5-8 Continuous Single-Channel Display Mode (CALL CH.)

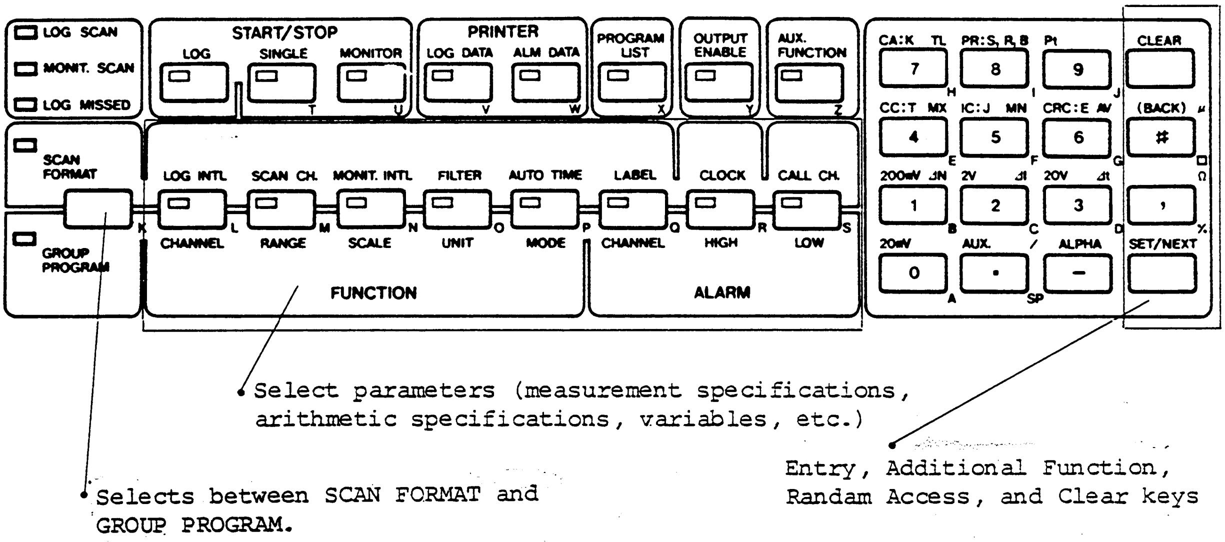


Fig. 3-8 Description of parameter entry keys

SET/NEXT : When this key is pressed, the data that is entered with the numeric keyboard after selecting desired parameter is stored in internal memory. If this key is pressed a second time successively, the next group is shown in the display when the selected parameter has one or more groups.

[,] : This key is used as a delimiter for one or more additional parameter functions.

[,] key, the standard value (standard parameter) predetermined for individual parameters or a constant is automatically entered.

(BACK) [#] : For a parameter having one or more groups, the contents of the parameter with any parameter number can be read out by operating the (BACK) [#] key, numeric key, and then the parameter key. Operations of (BACK) [#] [0-9] keys display the parameter of the preceding group. The (BACK) [#] key is also used to specify a user number upon start/stop of the multi-user log mode. Multi-user logging can be started or stopped by operating the [0-9] key, the numeric key, and the LOG [■] key.

CLEAR [ ] : An inadvertent data entry from the numeric keyboard can be cleared from the display and, instead, the preceding parameter data is shown in the display with the CLEAR [ ] key. If you wish to clear a previously programmed parameter, recall it to the display, then operate CLEAR [ ] SET/NEXT [ ] .

SCAN FORMAT / GROUP PROGRAM [ ] : The parameter selecting key alternately selects SCAN FORMAT (upper row) and GROUP PROGRAM (lower row) parameter assignments to each parameter key each time it is pressed.

[•] : This key is used to enter a decimal point for a scaling coefficient or an upper or lower limit data. It is also used as a delimiter between date, hour, minute, and second when log interval, monitor interval, auto time, or clock data is to be entered.
[e.g.] To enter 00 hour 30 minutes 00 second, operate:

[0] [•] [3] [0] [•] [0]

ALPHA [-] : This key is used to enter a negative sign for a scaling coefficient or an upper or lower limit data. It is also used to select the uppercase, lowercase, or symbol shift modes for each key. The symbols (orange), uppercase, and lowercase alphabetic letters indicated at the top right or bottom right of each key can be specified as follows:

ALPHA [-] [ ]	Selects uppercase alphabetic letters or lower symbols.
ALPHA [-] ALPHA [-] [ ]	Selects lowercase alphabetic letters or upper symbols.

[e.g.]

ALPHA [-] [0]A ALPHA [-] [1]B → AB

ALPHA [-] ALPHA [-] [.] ALPHA [-] ALPHA [-] [7]H → /h

Scan format programming procedure is described in the following paragraph:

3-5-1. Log Interval Mode (LOG INTL)

[Programming contents]

[Interval value] [,] [Interval mode]

(hour. minute. sec.)	
00 hour 00 min. 00 sec.	0: Single interval SgL [Normal]
|	1: Multi-interval MuL
	2: Variable interval VAr
24 hours 00 min. 00 sec.	3: External interval Ext

o Single Interval mode

The single interval mode requires only the above programming.

o Multi-Interval mode

After programming the interval value and mode, enter the following:

[Programming contents]

Group boundary channel	,	Multiple of basic interval
101 ~ Maximum channel number		1 (Normal) ~ 200
Up to 8 interval groups are programmable.		However, multiplication of the above mentioned basic interval by N times must not exceed 24 hours 00 minute 00 second.

o Variable Interval mode

After programming the interval value and mode, enter the following:

[Programming contents]

Interval change time	,	Multiple of basic interval
00 day 00 hour 00 minute ~ 99 days 23 hours 59 minutes		1 (Normal) ~ 200
		However, multiplication of the above mentioned basic interval by N times must not exceed 24 hours 00 minute 00 second.

o External Interval mode

The External Interval mode requires programming similar to the Single Interval mode, except that an entered interval value has no meaning (and hence any arbitrary interval value may be entered) and the mode is specified by the number 3.

(1) Single interval mode programming

[SCAN FORMAT] [LOG INTL]

Initial value (or currently programmed value)

`0h00m00s, sgl`

o To set the interval to 1 hour 30 minutes, enter:

[1] [.] [3] [0]
[.] [0] [,] [0]
[SET/NEXT]

`1h30m00s, sgl`

o To set the interval to 30 seconds, enter:

[0] [.] [0] [.]
[3] [0] [,] [0]
[SET/NEXT]

`0h00m30s, sgl`

[Simplified entry procedure]

a. [0] [.] → [.]

Entry of 0 hour, 0 minute or 0 second can be simplified by operation of the [.] key only.

b. [,] [0] [SET/NEXT] → [SET/NEXT]

In the single mode, entry of a comma (,) and the following zero is omittable.

[Example of simplified entry]

o To set the interval to 30 seconds, enter:

[.] [.] [3] [0]
[SET/NEXT]

`0h00m30s, sgl`

o To specify continuous scan, enter:

[•] [•] [•] [SET/NEXT] — Display: `0h00m00s, sg1`

(2) Multi-interval mode programming

[SCAN FORMAT] [LOG INTL] — Display: `0h00m30s, sg1`

(Initial value (or currently programmed value))

o To set the basic interval to 1 minute, enter:

[•] [1] [•] [0]

[,] [1] [SET/NEXT] — Display: `0h01m00s, mP1`

([1] — Specifies the multi-interval mode.)

[SET/NEXT] (Calls the next group.) — Display: `M1 ch, N`

o To scan channels 1 through 5 at 1-minute interval, enter:

[1] [0] [5] [,]

[1] [SET/NEXT] — Display: `M1 105ch, 1N`

[Simplified entry procedure]

a. [1] [0] [5] → [5]

When the terminal number is 1, it is omittable. When the channel number is between 1 and 9, it can be specified with a one digit number.

b. [,] [1] [SET/NEXT] → [SET/NEXT]

When the multiplication is 1, entry of [,] [1] is omittable.

[Example of simplified entry]

o To scan channels 1 through 5 at 1-minute interval, enter:

[5] [SET/NEXT]

`M1    105ch,    1N`

o To scan channels 6 through 20 at 10-minute intervals, enter:

[SET/NEXT] (Calls the next group.)

`M2       ch,     N`

[2] [0] [,] [1]

[0] [SET/NEXT]

`M2    120ch,   10N`

* If only one sensor terminal is attached to the instrument, the terminal number will be omitted from the readout as shown at right.

`M2     20ch,   10N`

o To scan channel 21 of terminal 1 through channel 40 of terminal 2 at 30-minute intervals, enter:

[SET/NEXT] (Calls the next group.)

`M3       ch,     N`

[2] [4] [0] [,]

[3] [0] [SET/NEXT]

`M3    240ch,   30N`

o To modify scan interval for channel 21 of terminal 1 through channel 20 of terminal 2 into 20 minutes, enter:

[2] [2] [0] [,]

[2] [0] [SET/NEXT]

`M3    220ch,   20N`

o To scan channel 21 through channel 40 of terminal 2 at 30-minute intervals, enter:

[SET/NEXT] (Calls the next group.) — Display: M4 ch, N

[2] [4] [0] [,]

[3] [0] [SET/NEXT] — Display: M4 240ch, 30N

o To recall the preceding entry data for checking, operate:

[# (BACK)] [# (BACK)] — Display: M3 220ch, 20N

o To directry read out group 5, operate:

[# (BACK)] [5] [LOG INTL] — Display: M5 ch, N

Programming Note

Boundary channel numbers must be allocated in ascending order to group numbers M1 through M8. If a smaller channel number is allocated to a greater group number, the entry will be unsuccessful, with an error message shown in the display.

The allowable multiple number is up to 200, (basic interval x multiple number) must not exceed 24 hours 00 minute 00 second. If log scan is performed with a multiplication of basic interval exceeding 24 hours, the interval time is not guaranteed.

o To delete the second boundary channel, operate:

[# (BACK)] [2] [LOG INTL] — Display: M2 120ch, 10N

(Calls the 2nd group.)

[CLEAR] [SET/NEXT] (Deletes it.) — Display: M2 ch, N o To scan up to channel 60 of terminal 2 in group 7 at 10-minute intervals, leaving group 5 and 6 unspecified, enter:

(BACK) [#] [7] LOG INTL [▬]

M7 ch, N

(Calls the 7th group.)

[2] [6] [0] [,]

[1] [0] SET/NEXT [ ]

M7 260ch, 10N

o To sequentially recall each group for checking, enter:

(BACK) [#] (BACK) [#]

M6 ch, N

(Calls the preceding group.)

(BACK) [#] (BACK) [#]

M5 ch, N

(Calls the preceding group.)

(BACK) [#] (BACK) [#]

M4 240ch, 30N

(Calls the preceding group.)

(BACK) [#] (BACK) [#]

M3 220ch, 20N

(Calls the preceding group.)

(BACK) [#] (BACK) [#]

M2 ch, N

(Calls the preceding group.)

(BACK) [#] (BACK) [#]

M1 105ch, 1N

(Calls the preceding group.)

(BACK) [#] (BACK) [#]

0h01m00s, mPl

(Calls the preceding group.)

(3) Variable interval mode programming

[SCAN FORMAT] [LOG INTL]

Display: `0h01m00s, mP L`

o To set the basic interval to 5 minutes, operate:

[.] [5] [.] [0]

[,] [2] [SET/NEXT]

Display: `0h05m00s, var`

└ Specifies the variable interval mode.

[SET/NEXT] (Calls the next group.)

Currently programmed value (or blank)

Display: `V1 d h m, N`

(When specified in the clock mode)

o To log data up to 14 days 10 hours 00 minute at 5-minute intervals, enter:

[1] [4] [.] [1]

[0] [.] [0] [,]

[1] [SET/NEXT]

└ Basic interval x 1

Display: `V1 14d10h00m, 1N`

o To log data up to 14 days 14 hours 00 minute at 30-minute intervals:

[SET/NEXT] (Calls the next group.)

Currently programmed value (or blank)

Display: `V2 d h m, N`

[1] [4] [.] [1]

[4] [.] [0] [,]

[6] [SET/NEXT]

└ Basic interval x 6

Display: `V2 14d14h00m, 6N`

o To log data up to 16 days 8 hours 00 minute at 2-hour intervals, operate:

[SET/NEXT] (Calls the next group.)

`V3 d h m, N`

[1] [6] [•] [0]
[8] [•] [0] [,]
[2] [4] [SET/NEXT]

`V3 16d08h00m, 24N`

└Basic interval x 24 (keys 2 4)

o To delete the boundary time setting for the 2nd group (V2), enter:

[# (BACK)] [2] [LOG INTL]

`V2 14d14h00m, 6N`

[CLEAR] [SET/NEXT]

`V2 d h m, N`

(When the timer mode is specified.)

For switching between the clock and timer modes, see the description for clock setting procedure.

o To log data for 2 hours from measurement start at 5-minute intervals, enter:

[# (BACK)] [# (BACK)]
[0] [•] [2] [•]
[0] [,] [1] [SET/NEXT]

Basic interval x 1 (key 1)

Currently programmed value (or blank)

`V1 14d10h00m, 1N`

`V1 0d02h00m, 1N`

[Simplified entry procedure]

a. [0] [•] → [•]

Entry of 0 day, 0 hour, or 0 minute can be simplified by the operation of the [•] key only.

b. [,] [1] [SET/NEXT] → [SET/NEXT]

When the coefficient is 1, entry of [,] [1] is omittable.

[•] [2] [•] [0] [SET/NEXT]

`V1   0d02h00m,   1N`

o To log data between 2 and 4 hours after measurement start at 15-minute intervals, enter:

[SET/NEXT] (Calls the next group.)

`V2      d   h   m,     N`

[•] [4] [•] [0]

[,] [3] [SET/NEXT]

`V2   0d04h00m,   3N`

o To log data for 2 days at 1 hour intervals, enter:

[SET/NEXT] (Calls the next group.)

`V3  16d08h00m,  24N`

[2] [•] [•] [0]

[,] [1] [2] [SET/NEXT]

`V3   2d00h00m,  12N`

o To log data for 3 days at 2 hour intervals enter:

[SET/NEXT] (Calls the next group.)

`V4      d   h   m,     N`

[3] [•] [•] [0]

[,] [2] [4] [SET/NEXT]

`V4   3d00h00m,  24N`

o To read the preceding group,

operate:

[(BACK) #] [(BACK) #]

V3 2d00h00m, 12N

o To call the next group, press:

[SET/NEXT]

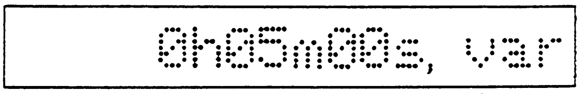
V4 3d00h00m, 24N

Programming Notes

1. Boundary times (in the timer mode, elapsed times from measurement start) must be arranged in ascending order according to group numbers V1 through V6. If they are arranged in the reversed order, time programming will not be entered, with an error message shown in the display.
   The maximum programmable boundary time is 99 days, 23 hours, and 59 minutes. While the maximum allowable multiple number is 200, (basic interval x multiple number) must not exceed 24 hours, 00 minute, and 00 second. If log scan is performed with a multiplication of basic interval exceeding 24 hours, the interval time will not be guaranteed.
2. A boundary time setting may indicate either elapsed times from measurement start or real clock time depending on whether the timer mode or clock mode is specified (to be described later).

(4) External interval mode programming

SCAN FORMAT [ ] LOG INTL [■]



o To select the external interval

mode, operate:

[•] [•] [•] [,]

Interval value is arbitrary.

[3] [SET/NEXT]

Specifies the external interval mode.

Programming Note

Although an interval value setting is meaningless in the external interval mode, it is necessary to operate keys [,] [3] [SET/NEXT] after setting an arbitrary interval value. It is not possible to directly specify the external interval mode.

3-5-2. Scan Channel Mode (SCAN CH.)

[Programming contents]

Start channels of sections	,	Stop channels of sections
101		101
|		|
Maximum channel number		Maximum channel number

In the Scan Channel mode, the start and stop channels of channel sections to be measured should be specified. Channels requiring no measurement are excluded from those channel sections. If only one channel is to be specified, it should be set up as a section start channel.

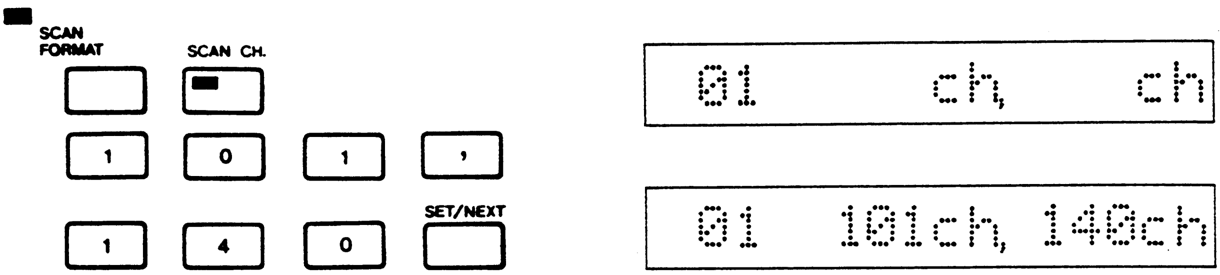
Up to 10 channel sections are programmable.

[Programming procedure]

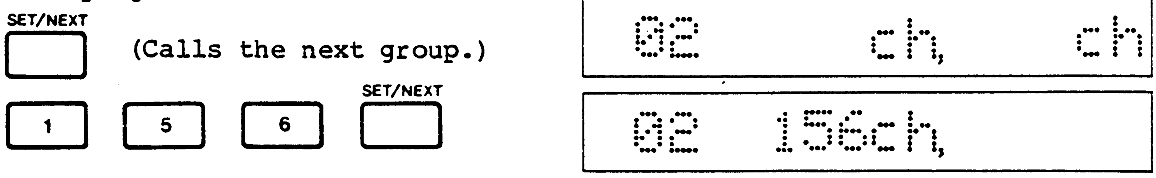
To scan channels 1 through 40 and 56 of terminal 1 and channels 1 through 20 of terminal 2:

o First program channels 101 through 140

with:



o Then program channel 156 with:



[Simplified entry procedure]

a. [1] [5] [6] → [5] [6]

When programming channel numbers of terminal 1, the terminal number can be omitted.

b. When programming a single channel, entry of only the start channel number is required.

o Next program channels 201 through 220 with:

[SET/NEXT] (Calls the next group.)

[2] [0] [1] [,]

[2] [2] [0] [SET/NEXT]

`03        ch,      ch`

`03  201ch, 220ch`

o To add channels 60 through 65 of terminal 1 to the above programming contents, follow either of the two programming procedures shown below.

[Procedure I]

[SET/NEXT] (Calls the next group.)

[6] [0] [,] [6]

[5] [SET/NEXT]

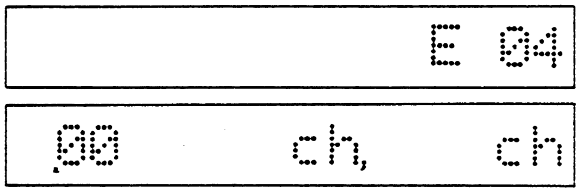
`04        ch,      ch`

`03  160ch, 165ch`

Indicates data is entered in the 3rd group.

- When channel numbers are newly programmed for the unspecified group, group numbers are automatically rearranged according to the order of channel numbers. However, if a channel section to be programmed overlaps with an already programmed channel section, this channel section programming causes error generation.

[Procedure II]



(BACK) [#] [0] SCAN CH. [■]

(Specify group number to add channels.)

[6] [0] [,] [6]

[5] SET/NEXT [ ]

Similar to procedure I, automatic rearrangement and error detection are performed.

o To skip channels 111 through 120 from the above programming:

[Procedure]

Call section 1 and modify channel section programming for channels 101-140 into channels 101-110, then add a channel section specification for channels 121-140.

[(BACK) #] [1] [SCAN CH.]

`01    101ch, 140ch`

(Calls the group for section 1.)

[1] [,] [1] [0]

`01    101ch, 110ch`

[SET/NEXT]

[(BACK) #] [0] [SCAN CH.]

`00       ch,     ch`

(To add channels, specify group number 0.)

[2] [1] [,] [4]

[0] [SET/NEXT]

`02    121ch, 140ch`

o Check that channel sections of 101–110, 121–140, 156, 160–165, 201–220 are eventually programmed:

[(BACK) #] [1] [SCAN CH.]

`01    101ch, 110ch`

(Calls group 1.)

[SET/NEXT] (Calls the next group.)

`02    121ch, 140ch`

[SET/NEXT] (Calls the next group.)

`03    156ch,`

[SET/NEXT] (Calls the next group.)

`04    160ch, 165ch`

[SET/NEXT] (Calls the next group.)

`05    201ch, 220ch`

o To skip channels 160 through 165,

enter:

(BACK) [#] [4] SCAN CH. [▬]

04 160ch, 165ch

(Calls group 4.)

CLEAR [ ] SET/NEXT [ ]

04 201ch, 220ch

(Deletes old group 4.)

The contents of group 5 are replaced to group 4.

o Check the contents of the preceding group with:

(BACK) [#] (BACK) [#]

03 156ch,

Programming Notes

1. Section start and stop channel numbers must not exceed the maximum channel number of the pertinent channel configuration. If specified, an error message will be shown in the display.

E 03

2. If the system consists only of one terminal, termial number 1 will not be shown in the display.

03 56ch

3. If start and stop channel numbers are specified in descending order, they are automatically reversed.

[e.g.]

[1] [0] [,]

01 10ch 1ch

[1] SET/NEXT [ ]

01 101ch 110ch

4. If the same channel number or numbers are already specified in another group or parts of channel sections overlap with each other, operation of the SET/NEXT key will cause an error generation with the invalid programming. In such a case, first delete the unnecessary section, then enter a new channel section.

3-5-3. Monitor Interval Mode (MONIT. INTL)

[Programming contents]

Interval value	,	Interval mode

[Minutes. second]

00 min. 00 sec.	0: All channel scan all (Normal)
~	1: Selective channel scan SEL
60 min. 00 sec.	

If output channel specification for analog output option is required in the all channel scan mode or if execution of selective channel scan is desired after completing the above setting, perform the following programming (max. number of channels: 12):

[Programming contents]

Channel number	,	Digit select code for analog output	,	With/without offset for analog output
101		0: Least significant 3 digits (0C) (Normal)		0: Without offset (Off)
|		1: Intermediate significant 3 digits (1C)		1: With offset (On)
Maximum channel number		2: Most significant 3 digits (2C)		

[Programming procedure]

SCAN FORMAT [ ] MONIT. INTL [ ]

0m00s, all

o To perform monitor scan in the all channel scan mode at 10-second intervals, enter:

[0] [.] [1] [0]
[,] [0] [SET/NEXT]

0m10s, all

[Simplified entry procedure]

a. [0] [.] → [.]

Entry of 0 minute can be simplified by operation of the [.] key.

b. [,] [0] [SET/NEXT] → [SET/NEXT]

Specification of the all channel mode can be simplified by operation of the [,] key.

o To set the interval to 10 seconds, enter:

[.] [1] [0] [SET/NEXT]

0m10s, all

o To specify continuous scan, enter:

[•] [0] [SET/NEXT]

`0m00s, all`

When making channel assignments to analog output option card, output the least significant 3 digits of channel 1 of terminal 1 to channel 1 of the analog output option card, and output least significant 3 digits of channel 10 of terminal 1 to channel 2 of the analog output option card, with offset.

o To assign channel 1 of terminal 1 to channel 1 of the analog output option card, enter:

[SET/NEXT] (Calls the next group.)

Currently programmed value (or blank)

`M01      ch,   c,`

Indicates analog output's channel number.

[1] [,] [0] [,]

Channel 1 — Least significant 3 digits

[0] [SET/NEXT]

No offset

`M01 101ch, 0c, off`

[Simplified entry procedure]

a. [,] [0] [,] [0] [SET/NEXT] → [SET/NEXT]

When the output digit positions and offset specification are both normal, key entry between the first [,] and last [0] is omittable.

o To assign channel 1 of the terminal 1 to channel 1 of the analog output option card, enter:

[1] [SET/NEXT]

```
M01 101ch, 0c, off
```

o To output the least significant 3 digits of channel 10 to channel 2 of the analog output option card with offset, enter:

[SET/NEXT] (Calls the next group.)

```
M02       ch,  c,
```

Currently programmed value (or blank)

Indicates analog output's channel number.

[1] [0] [,] [0]

CH.10 Least significant 3 digits

[,] [1] [SET/NEXT]

With offset

```
M02 110ch, 0c,  on
```

o To output the intermediate significant 3 digits of channel 10 of terminal 2 to channel 5 of the analog output option card with no offset, enter:

[# (BACK)] [5] [MONIT. INTL]

(Calls group 5.)

```
M05       ch,  c,
```

Indicates analog output's channel number.

[2] [1] [0] [,]

[1] [,] [0] [SET/NEXT]

```
M05 210ch, 1c, off
```

[Simplified entry procedure]

[,] [0] [SET/NEXT] → [SET/NEXT]

When no offset is specified, entry of [,] and [0] is omittable.

[2] [1] [0] [,]

[1] [SET/NEXT]

```
M05 210ch, 1c, off
```

o To cancel the specification of channel 2 of the analog output option card, enter:

Keys	Display
(BACK) [#] [2] MONIT. INTL [▬]	M02 110ch, 0c, on
CLEAR [ ] SET/NEXT [ ]	M02 ch, c,

o To perform monitor scan on only five channels of 5, 10, 15, 20, and 25 at 15-second intervals, and output their most significant 3 digits to channels 1 through 5 of the analog output option card, with no offset, enter:

Keys	Display
MONIT INTL [▬]	0m10s, all
[•] [1] [5] [,] [1] SET/NEXT [ ] (1 → Selective channel scan mode)	0m15s, sel
SET/NEXT [ ]	M01 101ch, 0c, off
[5] [,] [2] SET/NEXT [ ] (2 → Most significant 3 digits)	M01 105ch, 2c, off
SET/NEXT [ ]	M02 ch, c,
[1] [0] [,] [2] SET/NEXT [ ]	M02 110ch, 2c, off
SET/NEXT [ ]	M03 ch, c,
[1] [5] [,] [2] SET/NEXT [ ]	M03 115ch, 2c, off

Key entry	Display
[SET/NEXT]	M04 ch, c,
[2] [0] [,] [2] [SET/NEXT]	M04 120ch, 2c, off
[SET/NEXT]	M05 210ch, 1c, off
[2] [5] [,] [2] [SET/NEXT]	M05 125ch, 2c, off

3-5-4. Filter Mode (FILTER)

[Programming contents]

[Number of averaging or delay] [,] [Mode]

2 | 40 (Number of averaging or delay)

Normal 0: Input data average mode (AVE)

1: Delay mode (DLY)

(If 0, 1, or more than 41 is specified, "E03" will be shown in the display.)

[Programming procedure]

o To average the measurement results of ten times scanning repetition on each channel, enter:

Key entry	Display
[SCAN FORMAT] [FILTER]	FIL N, (Currently programmed value (or blank))
[1] [0] [,] [0] [SET/NEXT]	FIL 10N, AVE

[Simplified entry procedure]

[,] [0] [SET/NEXT] → [SET/NEXT]

When specifying the averaging mode, entry of [,] and [0] is omittable.

[1] [0] [SET/NEXT]

`FIL        10N, AVE`

o To clear the filter mode specification, press:

[CLEAR] [SET/NEXT]

`FIL          N,`

o To log the 40th measurement result for each channel (the delay mode), press:

[4] [0] [,] [1]

[SET/NEXT]

`FIL        40N, DLY`

3-5-5. Automatic Start/Stop Mode (AUTO TIME)

[Programming contents]

Measurement start or stop time

[Day, hour, minute]

00 day 00 hour 00 minute

|

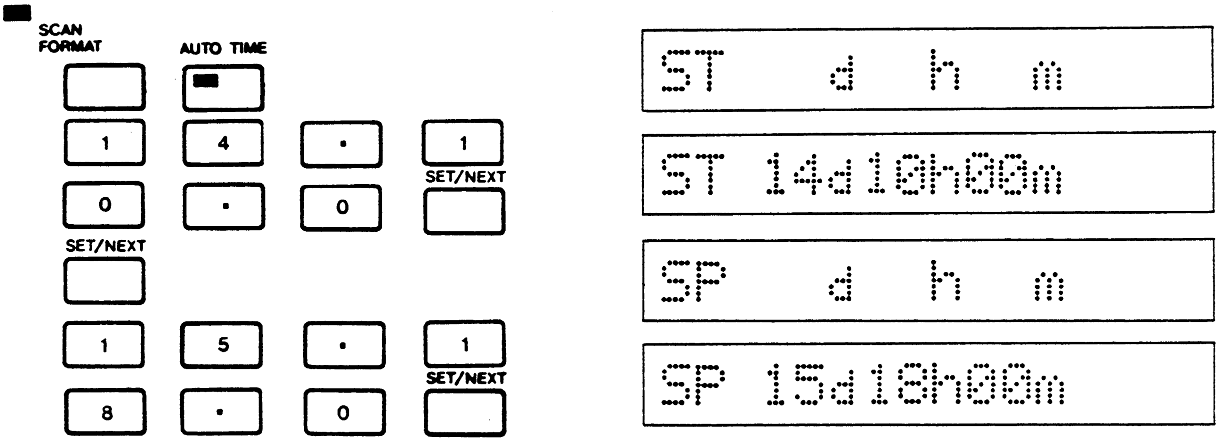
99 days 23 hours 59 minutes

Note: This mode is not available in the multi-user mode.

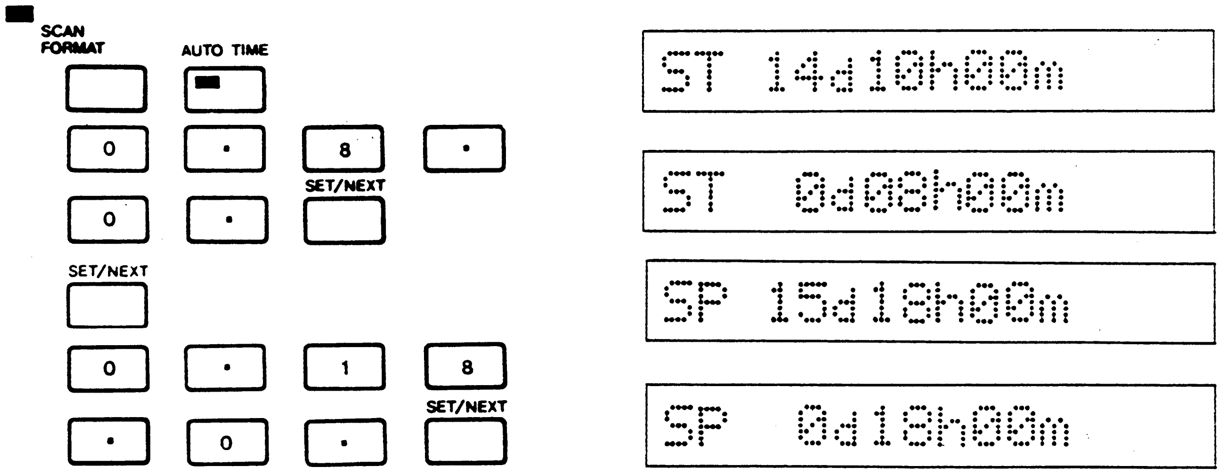
[Programming procedure]

(In the clock mode)

o To start scanning at 10 hours 00 minute of the 14th day and stop it at 18 hours 00 minute of 15th day, enter:



o To start scanning at 8 hours 00 minute and stop it at 18 hours 00 minute every day, enter:



If 0 day is specified in the clock mode, scanning is started and stopped at specified times every day.

(In the timer mode)

o To start scanning one hour after data logging start and stop it five hours later, enter:

Currently specified value (or blank)

Keys	Display
SCAN FORMAT, AUTO TIME	ST 0d08h00m
0, •, 1, • / 0, SET/NEXT	ST 0d01h00m
SET/NEXT	SP 0d18h00m
0, •, 5, • / 0, SET/NEXT	SP 0d05h00m

[Simplified entry procedure]

0 • → •

Entry of 0 day, 0 hour or 0 minute can be simplified with operation of the • key.

o To clear the start time, enter:

Keys	Display
SET/NEXT	ST 0d01h00m
CLEAR, SET/NEXT	ST d h m

o To check the stop time, enter:

Keys	Display
SET/NEXT	SP 0d05h00m

CAUTION

Start and stop times may indicate elapsed times or real clock time depending on whether the timer mode or clock mode is selected.

3-5-6. Label (LABEL)

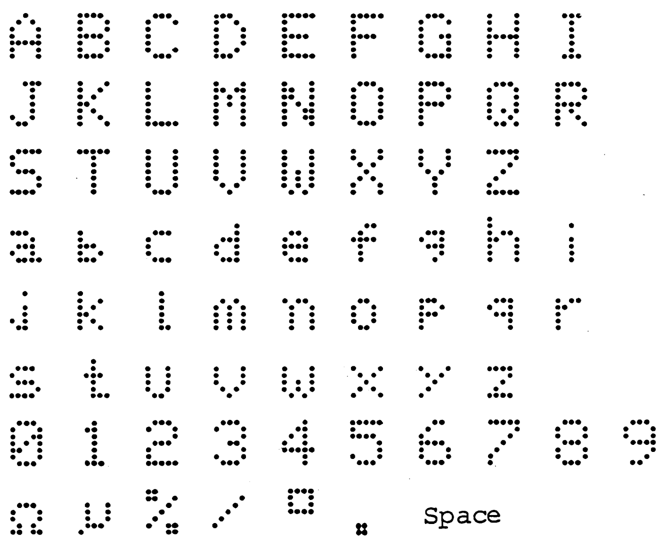
[Programming contents]

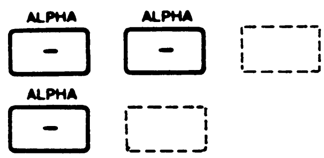
| Label characters | , | Mode |

Up to 8 characters
In the ID mode, up to 5 characters.

0: Normal mode — Normal
1: Index number mode — ID

Characters available for label





(ALPHA - ALPHA - [ ]) specifies lowercase alphabetic letters indicated at the top right of each key.

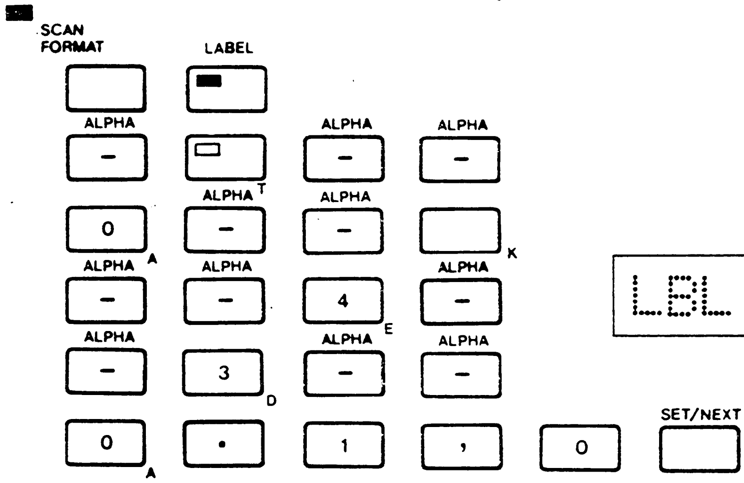
(ALPHA - [ ]) specifies uppercase alphabetic letters indicated at the bottom right of each key.

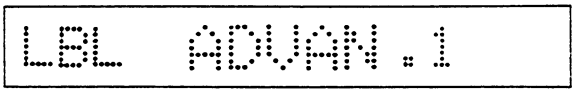
CAUTION

In the Multi-User mode, the Index Number mode is not activated.
On the listing output, a decimal point "." appears as space.
A zero (0) at the 8th character location in the normal mode and at the 5th character location in the Index Number mode appears as a space on the listing output.

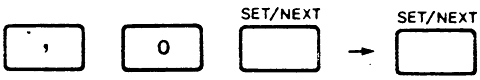
[Programming procedure]

o To specify label "ADVAN. 1", enter:





[Simplified entry procedure]

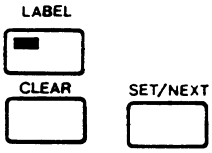


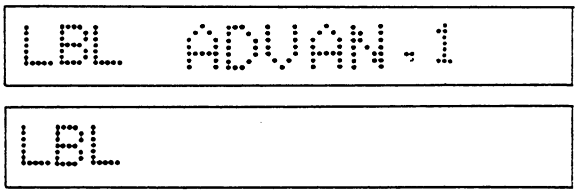
When specifying the normal mode,

entry of [,] [0] is

omittable.

o To delete the specified label, enter:

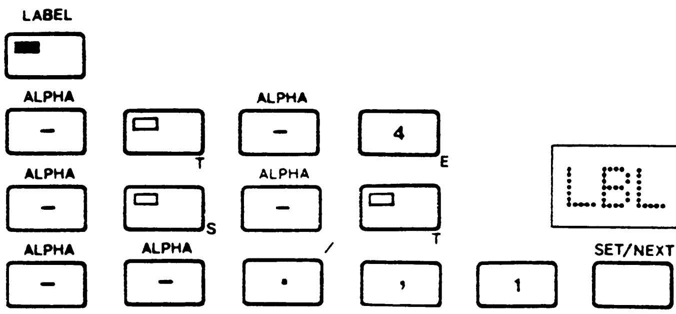


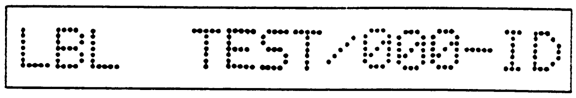


o To specify label "TEST/" and select

the Index Number mode, enter as

follows:





Programming Note

If five or more characters are specified before operation of the [,] [1] [SET/NEXT] keys in the Index Number mode, the least significant five characters are defined as a fixed label, which is followed by three digits number as an index number. The three digit number (000 to 999) is incremented upon each log scan when printed out.
In the Multi-User mode, however, the three digit number appears as a three-digit space on the printout.

3-5-7. Clock Mode (CLOCK)

[Programming contents]

[Time] [,] [Mode]

(Day, Hour, Minute)

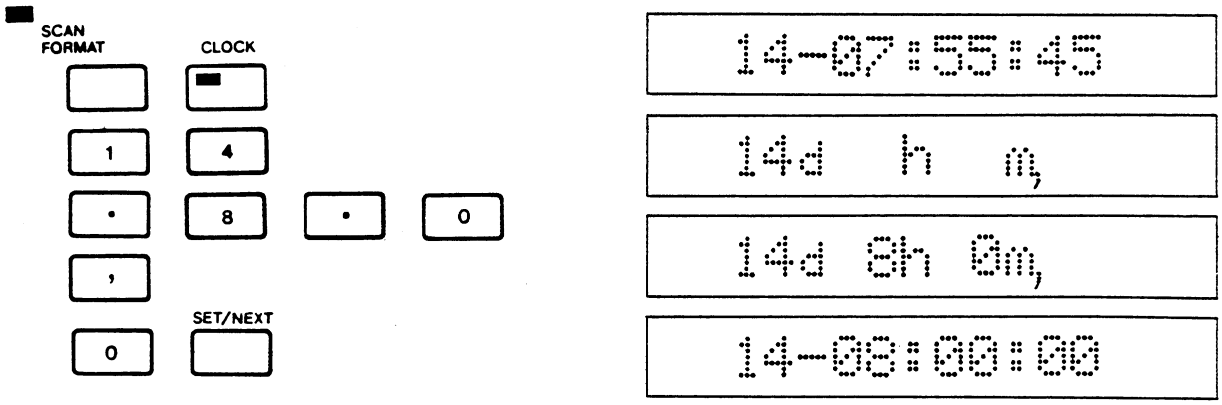
0 day 00 hour 00 minute — 0: Clock mode — Normal

| — 1: Timer mode ( )

99 days 23 hours 59 minutes

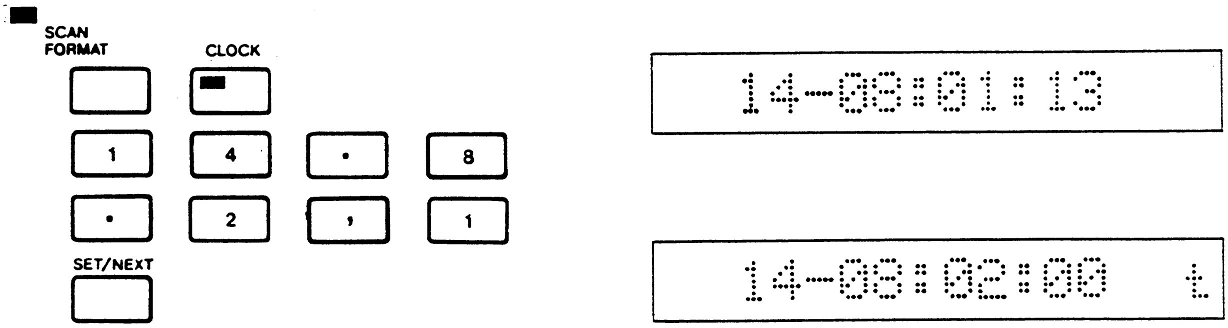
[Programming procedure]

o To set the clock to 14 days 8 hours 00 minute (in the clock mode), enter as follows:



The clock is reset to 00 second when the [SET/NEXT] key is pressed and then starts counting second by second.

o To select the timer mode, enter as follows:



[Simplified entry procedure]

When specifying the clock mode, entry of [,] [0] is omittable.

Programming Note

The clock is reset to 00 second when the [SET/NEXT] key is pressed after day, hour, and minute are corrected.

When switching operation mode from the timer into clock or vice versa, operate the [SET/NEXT] key (for the clock mode) or the [,] [1] [SET/NEXT] keys (for timer mode) after programming the desired time.

3-5-8. Call Channel Mode (CALL CH.)

[Programming contents]

Call channel number

101

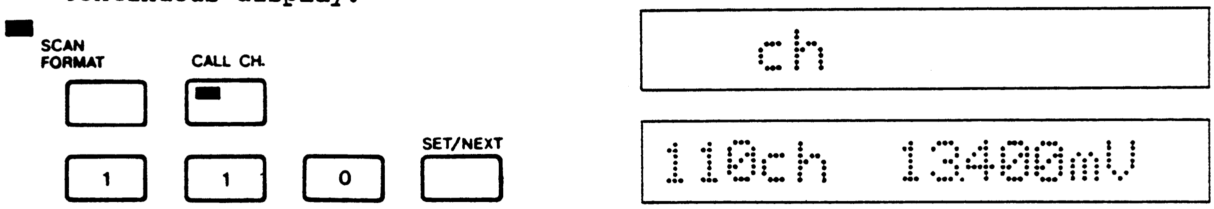
|

Maximum channel number

[Programming procedure]

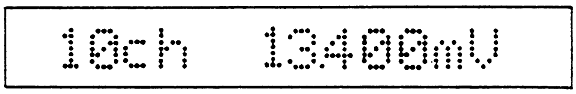
o To call channel 10 on terminal 1 for

continuous display:



[Simplified entry procedure]

Terminal number 1 is omittable. If the system consists of only one terminal, the terminal number is omitted from the readout.



CAUTIONS

1. If the specified call channel is not included in the log scan channel range, a blank or the preceding channel may be shown in the display when log scan is started in the continuous mode.
2. When the call channel operation is executed, the alarm lamp on the front panel of the instrument will go off.

3-6. BASIC PROGRAMMING PROCEDURE (FUNCTION)

This paragraph describes the function group programming procedure which is a part of group programming.

Group No.	Group channel	Range	Scaling coefficients A, B	Unit	Arithmetic operation mode	Secondary arithmetic operation
1	120CH.	T(CC)	-	-	N, 101CH.	
2	130CH.	200 mV	0, 1.1	-	-	Max. Min. Ave.
3	140CH.	20 mV	0.2, 1	kg	MAX, 5N	
4	220CH.	K(CA) External reference junction compensation	-	-	N, 201CH.	Dev. Source data output OFF
5	240CH.	Pt, 4W	-	-	I	
6	310CH.	R(PR) internal				
7						
8						
38						
39						
40						

The function group programming specifies boundary channels for each channel group, measurement range for a selected group, scaling operation coefficients if any, engineering units different from the selected measurement range, and primary or secondary arithmetic operation processings.

Channels having the same range but different scaling coefficients must be allocated to different groups.

Already programmed channel groups can be divided into smaller groups or united into larger groups with the channel insertion or deletion function. Up to 40 groups can be specified.

3-6-1. Group Channel (CHANNEL)

[Programming contents]

Group boundary channel

101

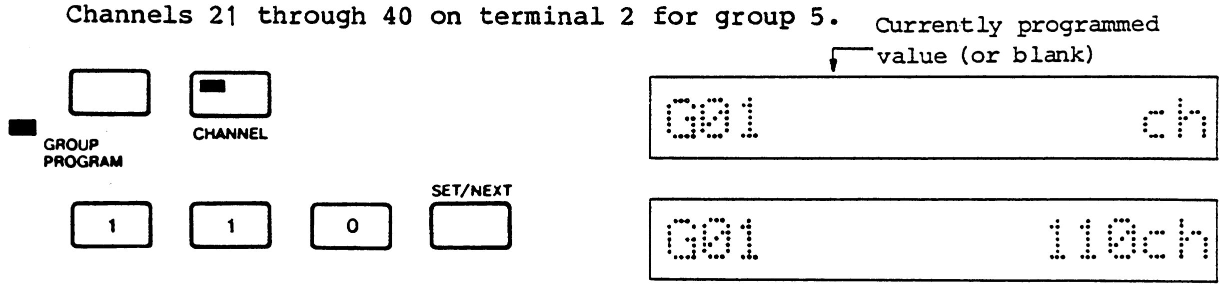
Maximum channel number

Channels having the same range, the same scaling coefficient, the same engineering unit and the same arithmetic are allocated to one group. Group channel programming specifies the boundary channels for each group.

[Programming procedure]

o The following programming example specifies:

Channels 1 through 10 on terminal 1 for group 1,
Channels 11 through 20 on terminal 1 for group 2,
Channels 21 through 40 on terminal 1 for group 3,
Channels 1 through 20 on terminal 2 for group 4, and
Channels 21 through 40 on terminal 2 for group 5.

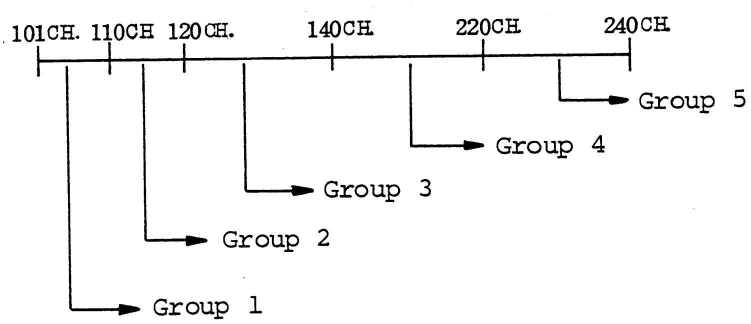


(Specifies channel 10.)

[Simplified entry procedure]

Terminal number 1 is omittable. If the system consists only of one terminal, the terminal number is omitted from the readout.

Key operation	Display
	G01 10ch
[SET/NEXT] (Calls the next group.)	G02 ch
[2] [0] [SET/NEXT] (Specifies channel 20.)	G02 120ch
[SET/NEXT] (Calls the next group.)	G03 ch
[4] [0] [SET/NEXT] (Specifies channel 40.)	G03 140ch
[SET/NEXT] (Calls the next group.)	G04 ch
[2] [2] [0] [SET/NEXT] (Specifies channel 220.)	G04 220ch
[SET/NEXT] (Calls the next group.)	G05 ch
[2] [4] [0] [SET/NEXT] (Specifies channel 240.)	G05 240ch



- When adding another group containing channels 21 through 30 on terminal 1 to the above channel groups, follow either of the following two adding procedures:

[Adding procedure I]

o Call the group which is unspecified yet for the additional group with [SET/NEXT] .

Blank

`G06                ch`

o Enter the boundary channel number for the additional group with [3] [0] [SET/NEXT] .

Inserted group number and channel

`G03             130ch`

[Adding procedure II]

o Specify the insert mode with [# (BACK)] [0] [▬ CHANNEL] .

Blank

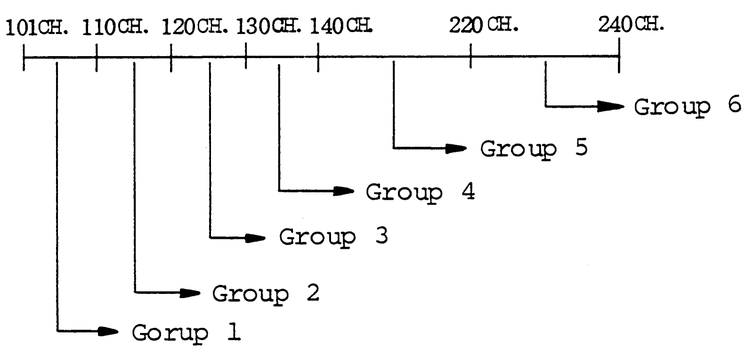
`G00                ch`

o Specify the boundary channel number for the additional group with [3] [0] [SET/NEXT] .

Inserted group number and channel

`G03             130ch`

The resulting channel group map is as follows:



o To sequentially call boundary channels for each group, enter as follows:

Call group 1 with [# (BACK)] [1] [CHANNEL] .   G01 110ch

Call group 2 with [SET/NEXT] .   G02 120ch

Call group 3 with [SET/NEXT] .   G03 130ch

Call group 4 with [SET/NEXT] .   G04 140ch

Call group 5 with [SET/NEXT] .   G05 220ch

Call group 6 with [SET/NEXT] .   G06 240ch

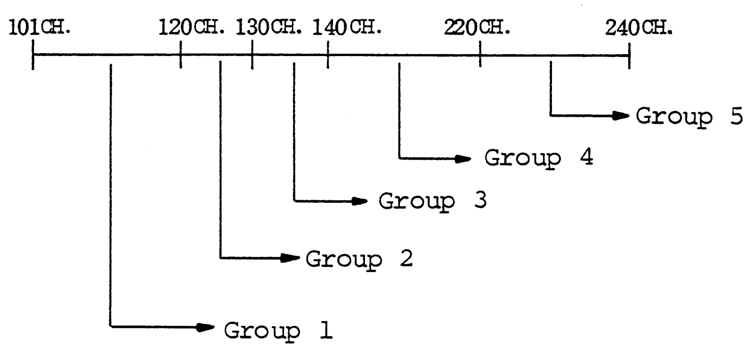
o To delete boundary channel 10 for group 1 and allocate up to channel 20 to group 1, enter:

[# (BACK)] [1] [CHANNEL]   G01 110ch

[CLEAR] [SET/NEXT] (Deletes group 1.)   G01 120ch

Displays the old group 2 contents.

The resulting channel group map is as follows:



Programming Notes

1. When one or more group boundary channels are deleted, the measurement ranges and scaling coefficients for the old adjacent group are allocated to the channels of the deleted group number. When a group is inserted, a measurement range of 20 mV is selected but no other parameters are specified for the new group.
2. If a group to be inserted has one or more channels of which numbers already exist in other group or groups, the inserting entry is invalid, with an error message (E 04.) shown in the display.
3. Measurement range and scaling coefficient can not be specified for groups for which no group boundary channels are specified. Group boundary channels must first be specified.

3-6-2. Measurement Range (RANGE)

[Programming contents]

(1) DC voltage range

Measurement range

Key	Range	
20mV [0]	20mV	Normal
200mV [1]	200mV	
2V [2]	2 V	
20V [3]	20 V	

(2) Thermocouple range

Measurement range [,] Internal/external specification for reference junction compensation [,] Linearization

Key	Range
CC:T [4]	T:CC
IC:J [5]	J:IC
CRC:E [6]	E:CRC
CA:K [7]	K:CA
PR:S, R, B [8]	PR:

Internal/external specification for reference junction compensation:

0: Internal (int)
1: External (ext)

Linearization:

0: Yes (On) Normal
1: Non (OFF)

PR: [,] Selection from S, R, B, and 12.8

0: 10% (S) Normal
1: 13% (R)
2: 30%/6% (B)
3: 12.8% (----)

(3) Platinum RTD range

Measurement range [,] Specification for 3-wire, 4-wire, 4-wire with high-resolution [,] Linearization

Pt [9] Pt

0: 3-wire system (3W)
1: 4-wire system (4W)
2: 4-wire system (4WH) high-resolution (0.01 °C)

0: Yes (On) Normal
1: No (OFF)

(4) Contact range

AUX. [•]

(5) Special range (linearization with special specifications, etc.)

[Measurement range] [,] [Specification for special range]

AUX. [•]　　　　　1

Each range is indicated at the top left of the numeric and decimal point (.) keys in red letters.

[Programming procedure]

o To specify measurement range of T(CC), internal reference junction compensation and linearization ON for group 1, enter as follows:

(BACK) [#] [1] [▬]

CC:T [4] [,] RANGE [0] [,]

[0] SET/NEXT [ ]

Currently specified value or standard value

G01 20mV

G01 CC:T, int, on

[Simplified entry procedure]

CC:T [4] [,] [0] [,]

[0] SET/NEXT [ ] → CC:T [4] SET/NEXT [ ]

If reference junction compensation is internal and linearization is to be done for thermocouple range, key entry between the first [,] and the last [0] is omittable.

o To specify the 200 mV range for group 2, enter:

SET/NEXT [ ] (Calls the next group.)

Currently specified value or standard value ↓

```
G02   20mV
```

200mV [1] SET/NEXT [ ]

```
G02  200mV
```

o To specify the 2 V range for group 3, enter:

SET/NEXT [ ] (Calls the next group.)

Currently specified value or standard value ↓

```
G03   20mV
```

2V [2] SET/NEXT [ ]

```
G03     2 V
```

o To specify the K(CA) range for group 4 and external reference junction compensation, enter:

SET/NEXT [ ] (Calls the next group.)

```
G04   20mV
```

CA:K [7] [,] [1] [,] [0] SET/NEXT [ ]

```
G04   CA:K, ext, on
```

[Simplified entry procedure]

CA:K [7] [,] [1] [,] [0] SET/NEXT [ ] → CA:K [7] [,] [1] SET/NEXT [ ]

If linearization is to be done for measurement using thermocouples, entry of the last [,] [0] is omittable.

o To specify the four-wire RTD range for group 5, enter:

SET/NEXT [ ] (Calls the next group.)

Currently specified value or standard value ↓

```
G05   20mV
```

Pt [9] [,] [1] [,] [0] SET/NEXT [ ]

```
G05     Pt,  4W, on
```

[Simplified entry procedure]

a. [9 (Pt)] [,] [1] [,] [0] [SET/NEXT] → [9 (Pt)] [,] [1] [SET/NEXT]

If linearization is to be specified when programming the RTD range, entry of the last [,] [0] is omittable.

b. If linearization is to be performed for the three-wire RTD range, key operation [,] [0] [,] [0] is omittable.

[9 (Pt)] [,] [0] [,] [0] [SET/NEXT] → [9 (Pt)] [SET/NEXT]

o To modify the range for group 3 into 20 V, enter:

[# (BACK)] [3] [▬ RANGE] — Display: G03 2V

[3 (20V)] [SET/NEXT] — Display: G03 20V

Programming Note

If no boundary channel is specified for a group number, "-------" will be shown in the display and the buzzer will sound. In such a case, first specify the group boundary channel.

Display: G06 ------------

[e.g.] [# (BACK)] [6] [▬ RANGE]

o To specify channel 310 as the boundary channel for group 6, enter:

Blank

G06 ch

[CHANNEL] (Calls the group channel.)

[3] [1] [0] [SET/NEXT]

G06 310ch

[RANGE] (Calls the range.)

G06 20mV

o To specify the R(PR13%) range for group 6, enter:

[PR:S, R, B 8] [,] [1] [,]
└→(R)

[0] [,] [0] [SET/NEXT]
└→ Internal compensation   └→ Linearization ON

G06 PR:R, int, on

[Simplified entry procedure]

If the (S) range, internal compensation and linearization are to be specified for the PR range of a thermocouple, the entry can be simplified as [PR:S, R, B 8] [SET/NEXT] .

G06 PR:S, int, on

Programming Notes

1. Operation of the [CLEAR] [SET/NEXT] keys will reset the range to the normal range of 20 mV.

2. When specifying a thermocouple or platinum RTD range for a group, make sure that the channel configuration of that group does not conflict with the sensor terminal configuration. If a platinum RTD range is specified for a thermocouple terminal or vice versa, the measured data will not be guaranteed.

3-6-3. Scaling Coefficient (SCALE)

In scaling operations, coefficient A is subtracted from input measurement data X, and the result is divided by another coefficient B to accomplish engineering unit conversion.

[Programming contents]

[Coefficient A value] [,] [Coefficient B value] $Y = \frac{X - A}{B}$

0.0000 to ±99999 (B ≠ 0)

[Programming procedure]

o To specify coefficients A=0 and B=1.1 for group 2, enter as follows:

[# (BACK)] [2] [■] → Display: G02 :

[0] [,] [1 (SCALE)] [.] [1] [SET/NEXT] → Display: G02 0: 1.1

o When no scaling operation is to be performed, clear already programmed coefficients. To clear the coefficients specified for group 2, enter [CLEAR] [SET/NEXT]. → Display: G02 :

o To specify coefficients A=0.2 and B=1 for group 3, enter:

[SET/NEXT] (Calls the next group.) → Display: G03 :

[0] [.] [2] [,] [1] [SET/NEXT] → Display: G03 02: 1.

[Simplified entry procedure]

If coefficient B is 1, its entry is omittable as follows:

[0] [.] [2] [,] [1] [SET/NEXT] → [0] [.] [2] [SET/NEXT]

3-6-4. Unit (UNIT)

Up to four alphanumeric characters or symbols can be specified for each group.

[Programming contents]

Alphanumeric characters or symbols

There are 69 types of available characters: 0 to 9, decimal point (.), A to Z, a to z, µ, Ω, %, □, slash (/), and space.

[Programming procedure]

o To specify the kilogram (kg) unit for group 3, enter:

[# (BACK)] [3] [▬ UNIT]

[ALPHA −] [ALPHA −] [ ]K [ALPHA −]

[ALPHA −] [6]G [SET/NEXT]

Programming Notes

1. If no unit is specified, the unit for the selected measurement range is automatically attached:

Range	Unit
20 mV, 200 mV	mV
2 V, 20 V	V
Thermocouple (with linearization), Platinum RTD (with linearization)	°C
Thermocouple (with no linearization)	mV
Platinum RTD (with no linearization)	Ω

2. Operation of ALPHA [-] ALPHA [-] [ ] keys specifies lowercase alphabetic letters or symbols indicated at the top right of each key. Operation of ALPHA [-] [ ] keys specifies uppercase alphabetic letters or symbols indicated at the bottom right of each key.
3. If the ALPHA [-] key is not operated, operation of the numeric keys (0-9) and decimal point key (.) enters the corresponding numeric data or a decimal point, whereas all other keys provide their specific functions.
4. Mark "." appears as a space on the listing printout.

o To specify the cubic meter (m^3) unit for group 4, enter:

SET/NEXT [ ] (Calls the next group.) — Display: G04

ALPHA [-] ALPHA [-] [M] [3] SET/NEXT [ ] — Display: G04 m3

o To check the boundary channel for group 4, enter:

[CHANNEL] — Display: G04 220ch

o To check the range for group 4, enter:

RANGE

G04 CA:K, ext, on

o To check the scaling coefficient for group 4, enter:

SCALE

G04 :

o To check the unit specified for group 4, enter:

UNIT

G04 m3

o To clear the unit specified for group 4, enter:

CLEAR SET/NEXT

G04

o To check the unit specified for group 3, enter:

(BACK) # (BACK) #

G03 kg

3-6-5. Arithmetic Modes (MODE)

Specifiable arithmetics include seven types of primary arithmetic operations, difference from other channels (N), difference from initial value (I), difference from the preceding measured data (t), maximum of the specified repetitions of scan, minimum of the specified repetitions of scan, average of the specified repetitions of scan, and total of the specified repetitions of scan. Those arithmetic operations are specified for each group individually to output result.

[Programming contents]

Type of arithmetic	,	Channel or number of repetitions
[1] (JN) ΔN		Other channel number to be subtracted
[2] (JI) ΔI		
[3] (Jt) Δt		
[4] (MX) MAX		Specified number of scanning repetitions (1 to 127)
[5] (MN) MIN		
[6] (AV) AVE		
[7] (TL) TTL		

[Programming procedure]

o To determine the differences between channel 1 and all other channels of group 1, enter:

[# (BACK)] [1] [▬] → G01

[1 (JN)] [,] [1 (MODE)] [0]
[1] [SET/NEXT] → G01 ΔN, 101ch

[Simplified entry procedure]

[1 (JN)] [,] [1] [0] [1] [SET/NEXT] → [1 (JN)] [,] [1] [SET/NEXT]

If the terminal number is 1, its entry is omittable. If the system consists only of one terminal, the terminal number is omitted from the readout. → G01 ΔN, 01ch o To determine the differences between channel 1 on terminal 2 and each channel of group 4, enter:

(BACK) [#] [4] [—]

ΔN [1] [,] MODE [2] [0]

[1] SET/NEXT [ ]

Display: G04

Display: G04 ΔN, 201ch

o To determine the differences between an initial value and each channel of group 5, enter:

SET/NEXT [ ] (Calls the next group.)

ΔI [2] SET/NEXT [ ]

Display: G05

Display: G05 ΔI

o To determine the maximum of five repetitions of sampling for group 3, enter as follows:

Call the preceding group with (BACK) [#] (BACK) [#] .

Display: G04 ΔN, 201ch

Call the preceding group with (BACK) [#] (BACK) [#] .

Display: G03

MX [4] [,] [5] SET/NEXT [ ] .

Display: G03 MAX, 5N

Programming Notes

1. If no arithmetic operation is specified for a group, the primary arithmetic operation processing for that group will not be executed.
2. If no boundary channel is specified for a group, "-------" will be shown in the display and the buzzer will sound. In such a case, first specify the group boundary channel.
3. If OVER or SENS. OUT takes place in a channel to be subtracted for N computation or in the initial measurement result of I computation, COMP ERR will be displayed.
4. If an OVER or SENS. OUT takes place even once in the results of the MAX., MIN., AVE., or TTL operations, OVER or SENS OUT will be displayed.

3-6-6. Secondary Arithmetic Operation (AUX. FUNCTION)

The function of the TR2730-010 Memory/Aux. Function option card includes the secondary arithmetic operation function, which enables statistical operations on the data logged at one time in a specified group. The operations include maximum (Max.), minimum (Min.), average (Ave.), difference between the maximum and minimum (p-p), standard deviation (SD), deviations between each channel (Dev.), difference from the specified channel (SUB), product with the specified channel (MUL), and ratio to the specified channel (DIV). This item describes programming procedures for the secondary arithmetic operations.

SUB (Difference from the specified channel)

MUL (Multiplication with the specified channel)

DIV (Ratio to the specified channel)

Max (Maximum of a group)

Min (Minimum of a group)

Ave (Average of a group)

P-P (Difference between the maximum and minimum of a group)

SD (Standard deviation in a group)

Dev (Difference between the average of a group and each channel of that group)

Of the above nine types of operations, up to three different operations can be simultaneously specified for the Max., Min., Ave., p-p, SD, and Dev. operations.

Source data output inhibit can also be specified.

[Programming contents]

(1) SUB, MUL and DIV operations

[Type of arithmetic operation] [,] [Channel number] [,] [Source data output inhibit specification]

Channel number: 101 | Maximum channel number

Source data output inhibit specification:

- \- Output enable (Normal)
- 0 Output inhibit

Type of arithmetic operation:

Key	Operation
1	SUB
2	MUL
3	DIV

(2) Max., Min., Ave., p-p, SD, and Dev operations

[Type of arithmetic operation] [,] [Type of arithmetic operation] [,] [Type of arithmetic operation] [,] [Source data output inhibit]

Up to 3 types specifiable at one time

Source data output inhibit:

- \- Output enable
- 0 Output inhibit

Type of arithmetic operation:

Key	Operation	Key	Operation
4	Max	7	p-p
5	Min	8	SD
6	Ave	9	Dev

[Programming procedure]

o To specify the maximum, minimum and average operations for group 2, enter as follows:

[ ] (■ GROUP PROGRAM) [#] (BACK) [2] [■] (AUX. FUNCTION)

`G02`

[4] [,] [5] [,] [6] [ ] (SET/NEXT)

`G02 MaxMinAve,`

o To specify the deviation operation for group 4 and inhibit source data output, enter as follows:

`G03`

Call the next group with [ ] (SET/NEXT)

`G04`

Call the next group with [ ] (SET/NEXT)

`G04 Dev,off`

Operate [9] [,] [0] [ ] (SET/NEXT).

`G04 Dev,            off`

Programming Notes

1. Be sure to specify source data output inhibit after specifying the types of arithmetic operation.
2. If the TR2730-010 option card is not installed, operation of the AUX. FUNCTION key will be ignored.

3-7. BASIC PROGRAMMING PROCEDURE (ALARM: Alarm group)

This paragraph describes the alarm group programming procedure for upper/lower limit identification and output of its results.

Group No.	Group channel and mode	Upper limit value (HIGH)			Lower limit value (LOW)		
			Relay No.	Comment No.		Relay No.	Comment No.
1	101 ch, Log	30°C	1	1	20°C	2	2
2	110 ch, Log	1.2°C	3		-1°C	4	
3	115 ch, mon	150 mV		3	100 mV	12	4
4	120 ch, mon	180 mV	13	3	150 mV	14	4
5	130 ch, Log	80 mV	17		20 mV	18	
6	135 ch, Log	0.8kg	19		0.5kg	20	
38							
39							
40							

In alarm group programming, group boundary channels, upper limit value, alarm output relay number, comment number for upper limit, lower limit value, alarm output relay number and comment number for lower limit are specified for each group.

Alarm groups are completely independent of function groups described in the preceding paragraph (3-6), and hence upper/lower limit identification can be performed on arbitrary specified alarm groups.

As shown in the following table, the channels to be scanned in scan channel mode are specified first, and the ranges, etc. for those channels are specified independently of the channels to be scanned. In addition, the upper and lower limit values for alarm output are also specified independently of function group specification.

Up to 40 alarm groups can be specified.

Scan channel	Function group: Channel	Range	Scaling operation	Unit	Primary arithmetic operation	Secondary arithmetic operation	Alarm group: Channel/mode	Upper limit value	Relay No.	Comment No.	Lower limit value	Relay No.	Comment No.
101	(G01)	CC (T) int Linear-ization ON		(°C)	ΔN, 101ch		(G01) 101, Log	30°C,	1,	1	20°C,	2,	2
105, 110							(G02) 110, Log	1.2°C,	3		−1.2°C	4	
115							(G03) 115, Log	150mV,		3	100mV		4
120	120						(G04) 120, mon	180mV,	13,	3	150mV	14	4
125, 130	(G02)	200mV	X−0 / 1.1	(mV)		Max. Min. Ave.	(G05) 130, Log	80mV	17		20mV	18	
135	(G03)	20V	X−0.2 / 1	kg	Max. 5N		(G06) 135, Log	0.8kg	19		0.5kg	20	
140	140												
201, 205, 210	(G04) … 220	CA (K) ext Linear-ization ON			ΔN 201ch	Dev Source data output OFF							

3-7-1. Group Channel (CHANNEL)

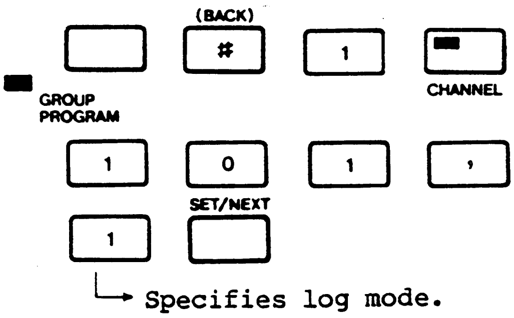
[Programming contents]

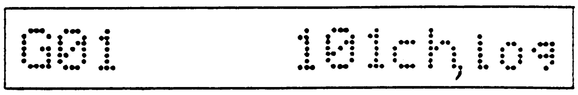
Group boundary channel	,	Scan mode to be compared
101 ∣ Maximum channel number		0: Monitor (mon) Normal 1: Log (log) 2: Monitor/log (m/l)

In group channel programming, channels having the same upper and lower limits are assigned to one group and its boundary channel is specified. At that time, it is possible to specify in which scan mode the upper and lower limit identification is to be done. If the monitor (0) is specified, upper/lower limit identification is made on the data obtained by monitor scan. If the log (1) is specified, upper/lower limit identification is made on the data obtained by log scan. If monitor/log (2) is specified, upper/lower limit identification is made during monitor scan. If over-limit data is detected, log scan is automatically initiated at that point. The log scan is stopped when data is found to be within the upper and lower limits as a result of limit identification during monitor scan.

[Programming procedure]

o To specify only channel 101 for group 1 and perform limit comparison during log scan, enter as follows:





[Simplified entry procedure]

[1] [0] [1] → [1]

If the terminal number is 1, its entry is omittable.

If the system consists only of one terminal, the terminal number is omitted from the readout.

`G01          01ch,log`

o To specify channels 102 through 110 for group 2 and perform limit comparison during log scan, enter:

Call the next group with [SET/NEXT].

`G02             ch,`

Operate [1] [0] [,] [1] [SET/NEXT].

`G02         110ch,log`

o To specify channels 111 through 115 for group 3 and perform limit comparison during monitor scan, enter:

Call the next group with [SET/NEXT].

`G03             ch,`

Operate [1] [5] [,] [0] [SET/NEXT].

↓ Specifies the monitor mode.

`G03         115ch,mon`

[Simplified entry procedure]

[,] [0] [SET/NEXT] → [SET/NEXT]

When specifying the monitor mode,

entry of [,] [0] is omittable.

o To specify channels 116 through 120 for group 4 and perform limit comparison during monitor scan, enter as follows:

Call the next group with [SET/NEXT] .

`G04          ch,`

Operate [2] [0] [SET/NEXT] .

`G04     120ch,mon`

o To specify channels 121 through 130 for group 5 and perform limit comparison during log scan, enter as follows:

Call the next group with [SET/NEXT] .

`G05`

Operate [3] [0] [,] [1] [SET/NEXT] .

`G05     130ch,log`

o To check the boundary channel for group 4, enter:

[(BACK) #] [(BACK) #]

`G04     120ch,mon`

o To specify channels 131 through 135 for group 6 and perform limit comparison during log scan, enter as follows:

[SET/NEXT] [SET/NEXT]

`G06          ch,`

[3] [5] [,] [1] [SET/NEXT]

`G06     135ch,log`

Programming Notes

1. Inadvertent entry of numerical data can be cleared by operating the CLEAR key; the preceding data will be shown in the display.

   [e.g.] To modify the boundary channel for group 5 from channel 130 into channel 128, enter as follows:

   Call the next group with [SET/NEXT] . — Display: `G05 130ch,Log`

   [3] (You have inadvertently entered number 3 instead of number 28.) — Display: `G05 3ch`

   Clear the wrong data with [CLEAR] . — Display: `G05 130ch,Log`

   Operate [2] [8] [,] [1] . — Display: `G05 28ch,Log`

   Press [SET/NEXT] . — Display: `G05 128ch,Log`

2. If you have noticed the entry of wrong data after pressing the [SET/NEXT] key, try correct data entry according to the usual modification procedure from the beginning.

3-7-2. Upper Limit Value (HIGH)

[Programming contents]

Upper limit value	,	Output relay No.	,	Alarm comment No.
0.0000		1		1
|		|		|
±99999		80		4
		20 channels/ TR2730-540 card		(TR2730-010)

[Programming procedure]

o To specify an upper-limit temperature of 30°C for group 1 and activate relay number 1 and print alarm comment 1 if the temperature exceeds this upper limit, enter as follows:

[GROUP PROGRAM] [# (BACK)] [1] [HIGH]

Display: G01 : :

[3] [0] [,] [1]

[,] [1] [SET/NEXT]

Display: G01 30: 1: 1

o To specify an upper-limit temperature of 1.2°C for group 2 and output relay number 3, enter as follows:

Call the next group with [SET/NEXT] .

Display: G02 : :

Operate [1] [.] [2]

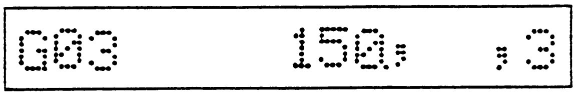
[,] [3] [SET/NEXT]

Display: G02 1.2: 3:

o To specify an upper-limit voltage of 150 mV for group 3 and alarm comment number 3 without specifying an output relay number, enter as follows:

Call the next group with [SET/NEXT].

Operate [1] [5] [0] [,] [,] [3] [SET/NEXT].



3-7-3. Lower Limit Value (LOW)

[Programming contents]

Lower limit value [,] Output relay No. [,] Alarm comment No.

Lower limit value	Output relay No.	Alarm comment No.
0.0000	1	1
|	|	|
±99999	80	4
	20 channels/ TR2730-540 card	(TR2730-010)

[Programming procedure]

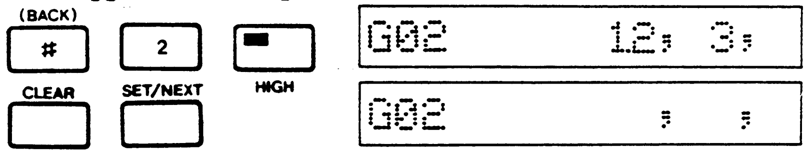
o Lower limits can be specified in much the same way as upper limits programming.

[GROUP PROGRAM] [(BACK) #] [1] [LOW]

Programming Notes

1. If the TR2730-540 card is not installed when specifying a relay number, an error message (E 07) will be displayed.
2. If the TR2730-010 card is not installed when specifying an alarm comment number, an error will result.
3. When specifying only an alarm comment number without specifying a relay number, operate keys [,] [,] [No] and [,] to skip the relay number.
4. To clear an upper limit specification, enter as follows:

[e.g.]

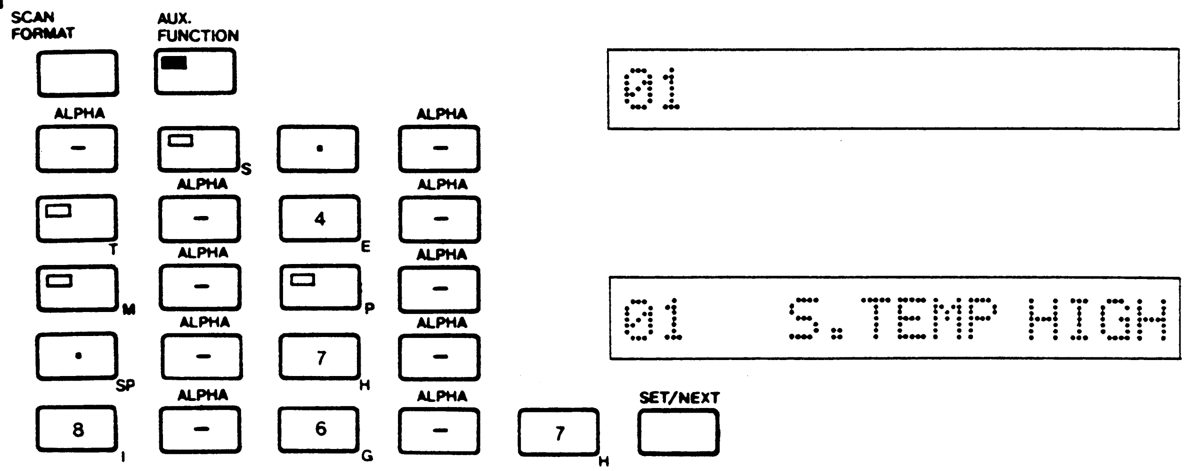


3-7-4. Alarm Comment

The functions of the TR2730-010 Memory/Aux. Function option card include the alarm comment printout function.
This item describes alarm comment programming procedure.
[Programming contents]

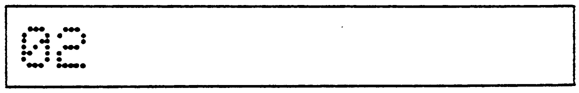
Character array of up to 12 characters

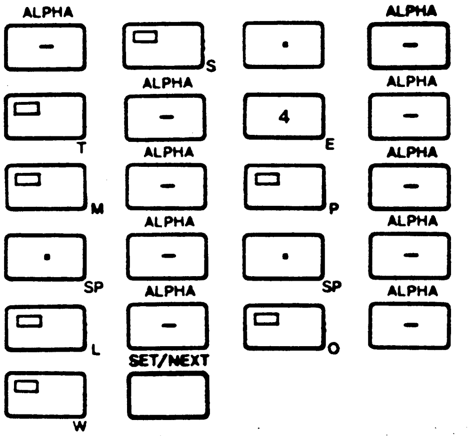
Up to 4 comments are programmable (with use of TR2730-010).
[Programming procedure]
o To specify "S. TEMP HIGH" for comment number 1, enter as follows:



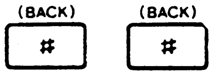
o To specify "S. TEMP LOW" for comment number 2, enter as follows:

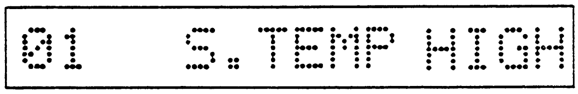
(Calls the next group.)



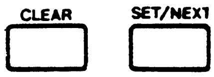


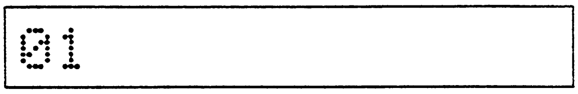
o To read out comment number 1, enter:





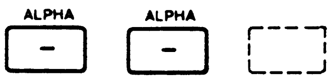
o To clear comment number 1, enter:





Programming Notes

1. Similar to label programming, up to 69 types of characters are available for alarm comments: 0 to 9, decimal point (.), uppercase alphabetic letters, lowercase alphabetic letters, Ω, μ, %, slash (/), / , and space.

    selects lowercase letters indicated at the top right of each key.

    selects uppercase letters indicated at the bottom right of each key.

2. If more than 12 characters are specified, the oldest characters (least significant digits) are discarded.

3-8. OPERATING INSTRUCTIONS

This paragraph describes operating instructions for the TR2731 Computing Data Logger. The descriptions covered in this paragraph may be used as a guidance to check if the instrument is properly operating.

3-8-1. Preparations

(1) Make sure that the local line voltage is identical to that indicated on the rear panel of the instrument.
After making sure that the POWER switch is in the OFF position, plug the power cable into an AC receptacle.

(2) Connect the TR2741 Sensor Terminals to the TR2731 Mainframe with the supplied or optional interconnecting cables. The details of cable connections are described in item 2-5-1.

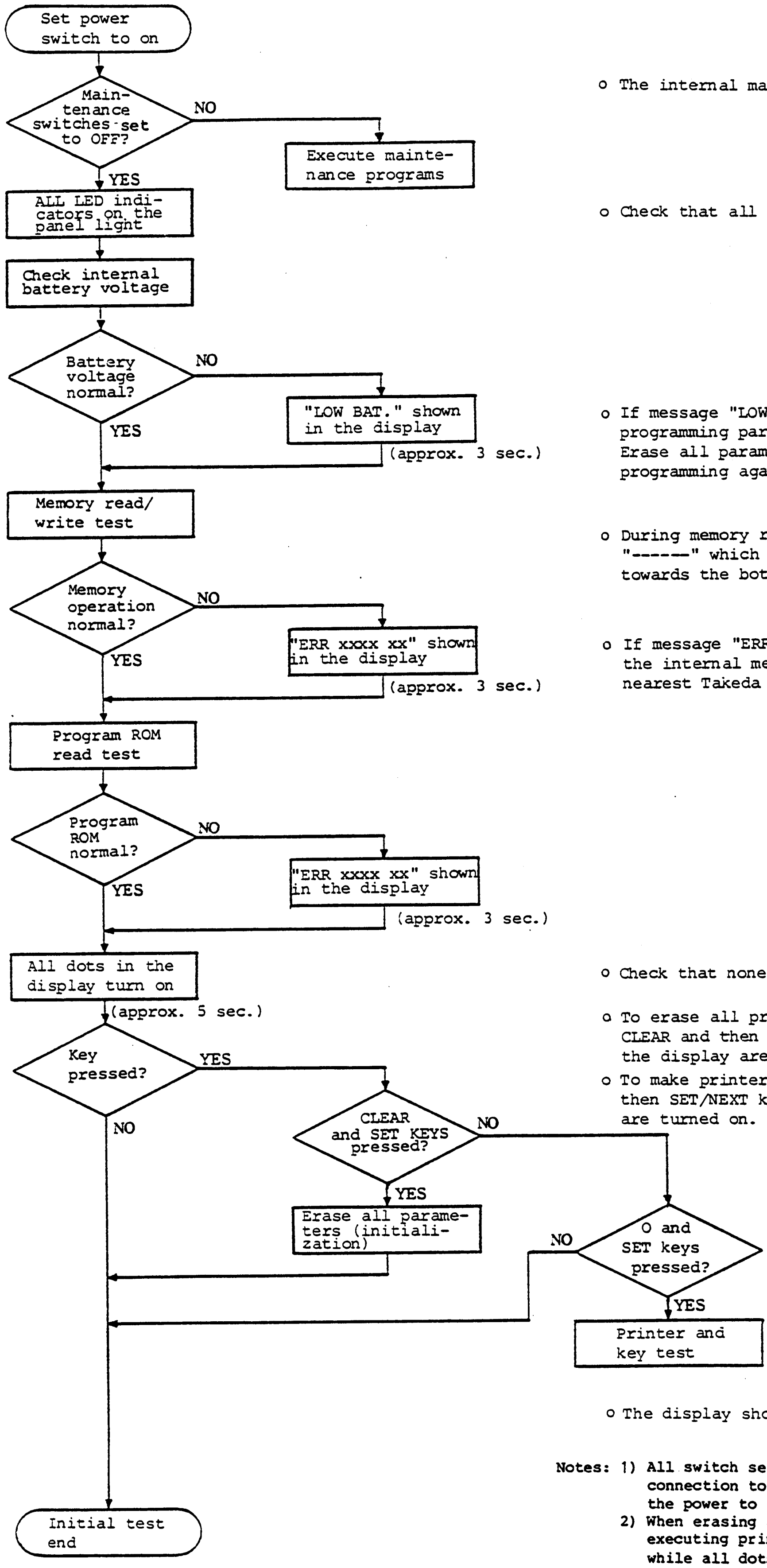
(3) Set the switches on the real panel of the TR2741 Sensor Terminals according to operating conditions. For the details of switch setting procedures, see item 2-5-3. All switch settings should be done leaving the POWER switch to OFF.
After establishing the above preliminary operations, turn the POWER switch to ON.

3-8-2. Operation Check after Power On

After powering the TR2731/2741 system, perform its operation check according to the flowchart shown in Figure 3-9.

CAUTION

When the TR2731 is to be operated for the first time, erase all internal parameters by pressing the [CLEAR] and then [SET/NEXT] keys for initialization while all dots in the display are turned on after operation check.



o The internal maintenance switch is normally set to OFF.

o Check that all LED indicators on the panel light.

o If message "LOW BAT." is shown in the display, programming parameters are not stored in memory. Erase all parameters and then enter parameter programming again.

o During memory read/write test, the display will show "------" which moves sequentially from the top towards the bottom of the display.

o If message "ERR xxxx xx" is shown in the display, the internal memory is defective. Notify your nearest Takeda Riken representive.

o Check that none of the display dots remains off.

o To erase all programming parameters, press the CLEAR and then SET/NEXT keys while all dots of the display are turned on.

o To make printer and key test, press the 0 and then SET/NEXT keys while all dots of the display are turned on.

Refer to the paragraph related to maintenance

o The display shows the internal clock time.

Notes: 1) All switch settings for the TR2741 rear panel and connection to the TR2731 should be done while the power to the entire system is not supplied.
2) When erasing all programming parameters or executing printer test, press the specified keys while all dots of the display are turned on.
3) About setting the paper, if the paper is pulled so hard, the paper is not fed well and the printer may not be operated.
(See "Recording replacement procedure", 3-11-5)

Fig. 3-9 TR2731/2741 system operation check

3-8-3. Basic Operating Procedures

(1) Measurement start and stop

a. Single user log mode

Operation of the LOG key (provided in the START/STOP section) will start log scan sequence; the lamp in the key lights.

A second operation of the LOG key will stop log scan; the lamp in the key goes off.

To externally control log scan measurement start/stop in the single user log mode, connect a start/stop command switch to the EXT. START/STOP connector on the rear panel of the TR2741.

The same control command are also enabled through the TR2730-520 BCD Output/External Control option card.

> Note: When the external start/stop command switch is used, a first operation starts log scan and a second operation stops log scan. The front LOG key, EXT. START/STOP connector, and start/stop command from the TR2730-520 card provide identical functions in parallel. Therefore, log scan started with one feature may be stopped with another feature.

b. Multi-user log mode

To initiate multi-user log scan, first specify the user number desired to be measured with [# (BACK)] [ ] (1-4) keys, then press the LOG key (provided in the START/STOP section). Log scan for the specified user is initiated, the lamp in the LOG key lights, and the specified user number (U1 through U4) is shown in the right end of the display.

To stop log scan, similarly specify the user number with the [# (BACK)] [ ] (1-4) keys and then press the LOG key.

The pertinent user number in the LED display goes off. If log scan for all users is stopped, the lamp in the LOG key also goes off.

Log scan measurement start/stop for individual users can be controlled by using the TR2730-520 BCD Output/External Control option card.

CAUTIONS

1. Similar to the single user log mode, the front panel start/stop key and external start/stop command provide identical functions in parallel for individual users. Therefore, utmost care should be exercised on the external start-to-stop and stop-to-start commands.
2. To specify simultaneous measurement start/stop for all users in the multi-user log mode, enter as follows:

   [# (BACK)] [0] [■ LOG] : Scan starts for all users.

   [# (BACK)] [0] [□ LOG] : Scan stops for all users.

3. Before initiating log scan in the multi-user log mode, the multi-interval mode must be selected and interval times (basic interval x multiple) must be specified for each channel group.

User 1	M1	OOOch,	OOON
	M2	OOOch,	OOON
User 2	M3	OOOch,	OOON
	M4	OOOch,	OOON
User 3	M5	OOOch,	OOON
	M6	OOOch,	OOON
User 4	M7	OOOch,	OOON
	M8	OOOch,	OOON

Since boundary channel numbers of multi-interval are specified for individual users, they must be programmed in advance according to users. See item 3-5-1.

c. Single log scan

Operation of the SINGLE key (provided in the START/STOP section) will initiate only a single log scan sequence and delivers the logged data; the lamp in the SINGLE key lights. After the data is output, the sequence automatically stops and the lamp in the key goes off.

d. Monitor scan

Operation of the MONITOR key (provided in the START/STOP section) will initiate monitor scan sequence; the lamp in the MONITOR key lights.

A second operation of the MONITOR key will stop the monitor scan; the lamp in the key goes off.

(2) Scan display and scan stop

The LOG SCAN, MONIT. SCAN and LOG MISSED lamps go on and off at the timings shown in Figure 3-10.

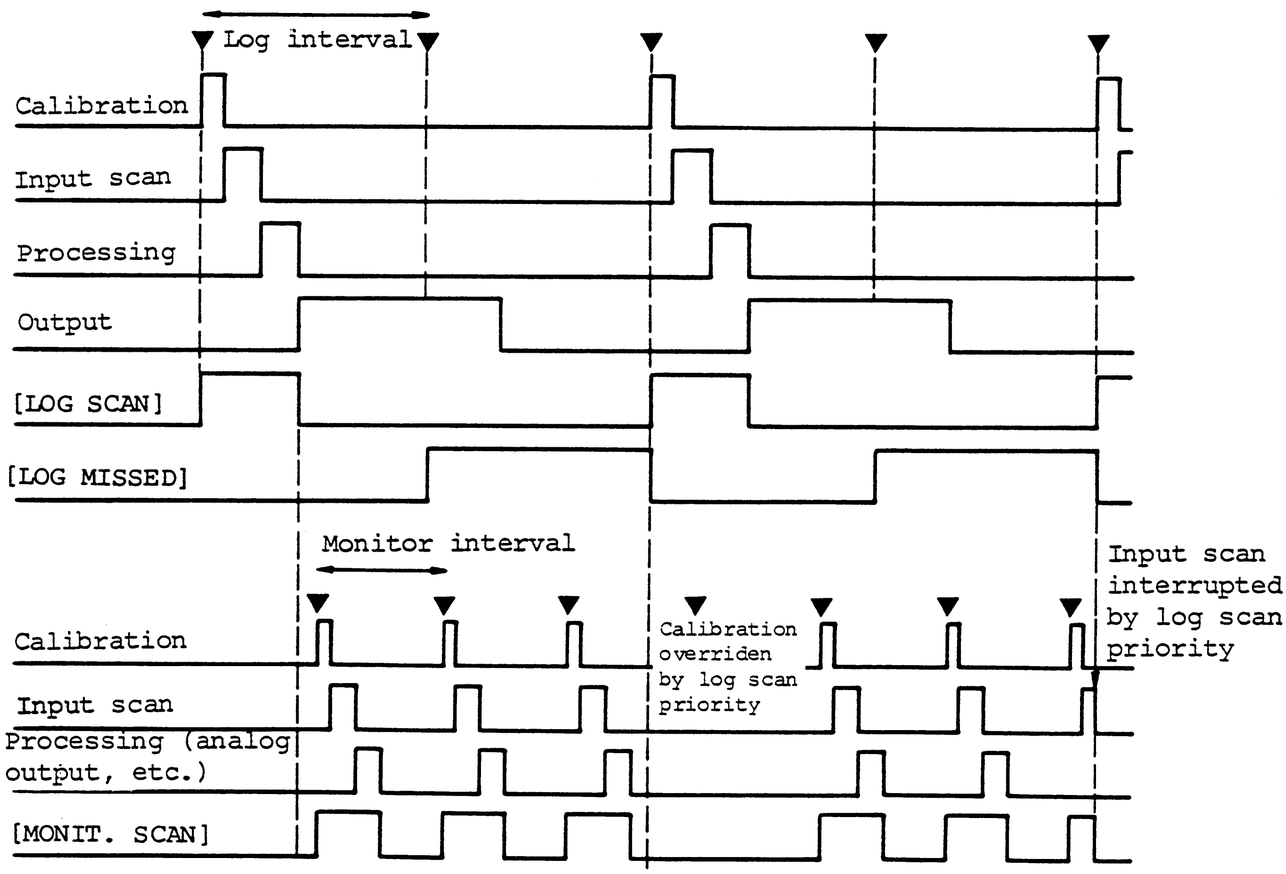


Fig. 3-10 Scan indicators on/off timings

While both log scan and monitor scan are immediately stopped if a stop command is issued during input scan, they are continued until the current data is output if a stop command is issued during data processing or output after input scan is completed.

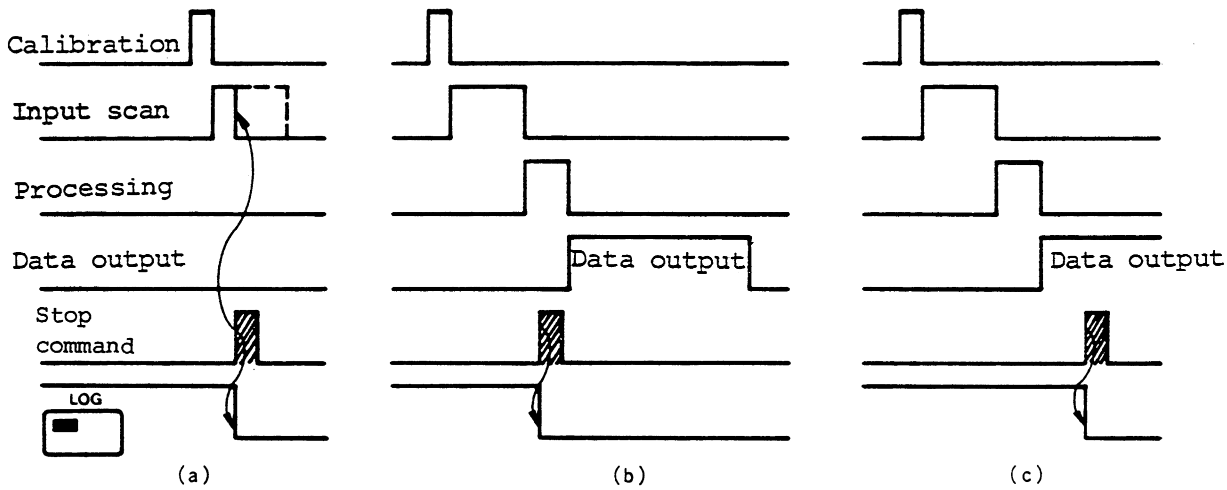


Fig. 3-11 Scan stop timing

(3) Print and alarm printout

Operation of the LOG DATA key (provided in the PRINTER section) will deliver log scan data in each mode to the internal printer; the lamp in the LOG DATA key lights. If data delivery to the internal printer is not required, press the LOG DATA key a second time to inhibit data output; the lamp in the key goes off. Operation of the ALM DATA key (provided in the PRINTER section) will deliver over-limit alarm data for log scan or monitor scan to the internal printer; the lamp in the ALM DATA key lights. If an over-limit measurement occurs during log scan, data of all scan channels are once delivered to the internal printer. If error data is generated during monitor scan, the data of the pertinent channel is delivered to the internal printer upon error generation and recovery from the error together with their generation times.

(4) Program listing

Operation of the PROGRAM LIST key will print out a list of programmed parameters; the lamp in the PROGRAM LIST key lights. Upon the end of listing, the output operation automatically stops and the lamp in the key goes off. To print out the scan format programming contents, activate the SCAN FORMAT indicator lamp before pressing the PROGRAM LIST key.

If the lamp in the OUTPUT ENABLE key is gone off, the program listing is delivered to the internal printer; if the lamp is come on, the program listing is delivered to an external unit via the TR2730-560 Serial Data Output option card.

To print out group programming contents, the FUNCTION programming contents and ALARM programming contents must be specified separately. For FUNCTION programming contents, first activate the GROUP PROGRAM indicator lamp, press the CHANNEL, RANGE, SCALE, UNIT, or MODE key to select the desired function, then press the PROGRAM LIST key. For ALARM programming contents, first activate the GROUP PROGRAM indicator lamp, press the CHANNEL, HIGH, or LOW key to select the desired alarm mode, then press the PROGRAM LIST key.

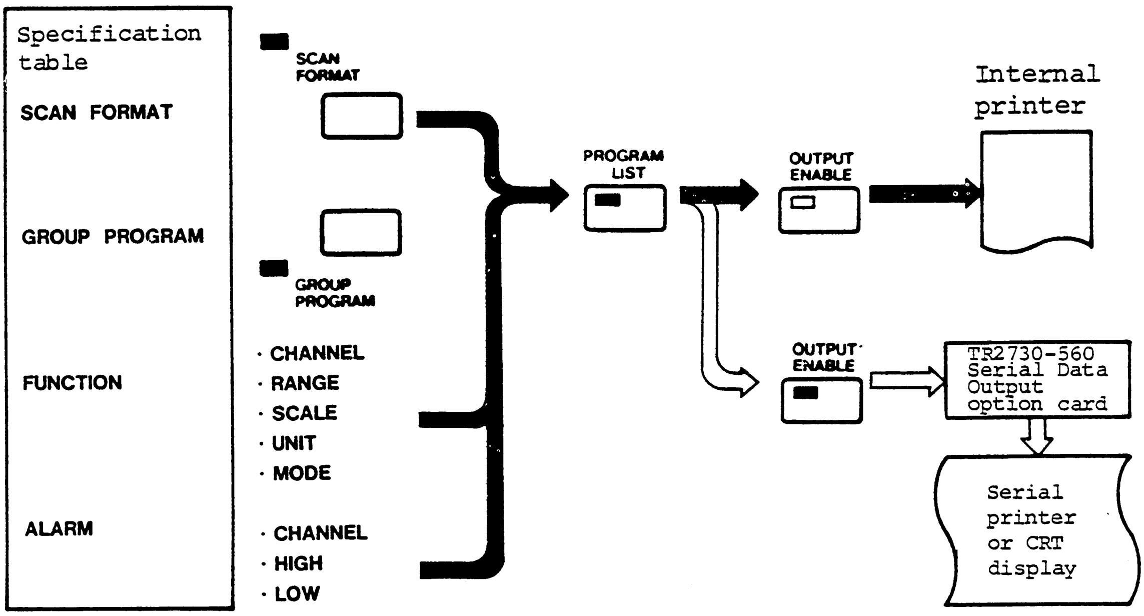


Fig. 3-12 Program listing outputs

(5) Output specification

Operation of the OUTPUT ENABLE key enables log scan data output to the TR2730-520 BCD Output/External Control option card, and log scan data and program listing output to the TR2730-560 Serial Data Output option card; the lamp in the key lights.

(6) Alarm/reset

If printout operation stops due to paper out or paper jam on the internal printer, the ALARM indicator lamp lights. Load a new paper stack or remove jammed paper, then press the RESET key to continue print operation.

The RESET key may also be used to manually clear the alarm output when the TR2730-540 Relay Output option card is installed in the instrument.

3-8-4. Specifications Required for Measurement

(1) Single user log scan

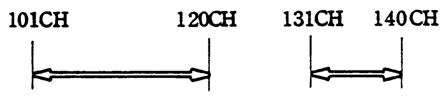
a. Single interval log scan

Specification of at least the following four items is required for this measurement mode:

Example:

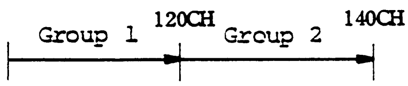
o Measuring interval

o Channels to be measured

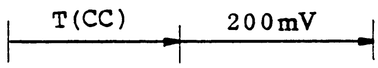


(Channel 121 through 130 are skipped)

o Group boundary channels



o Ranges for each group



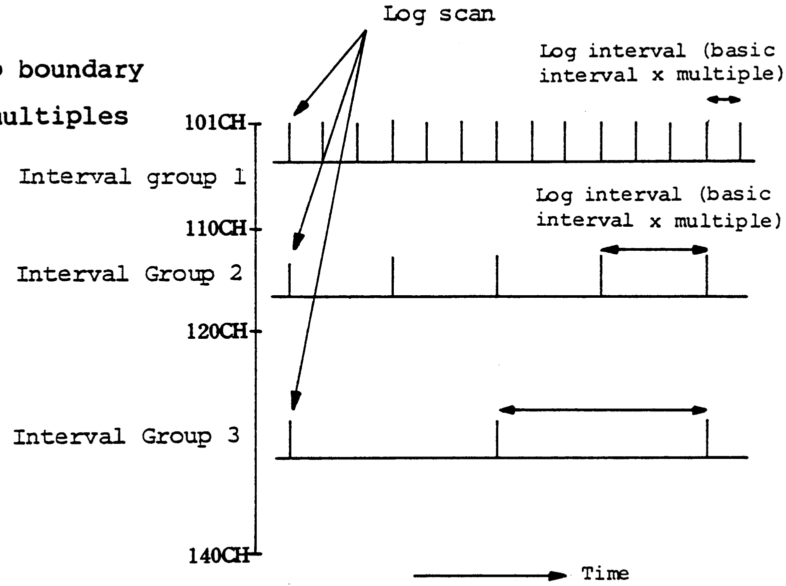
b. Multi-interval log scan

The following specification items are required:

Example:

o Basic interval and mode

o Interval group boundary channels and multiples



o Channels to be measured
o Group boundary channels
o Ranges for each group

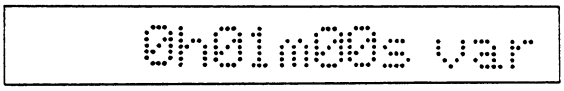
} Same as that for single interval.

c. Variable interval log scan

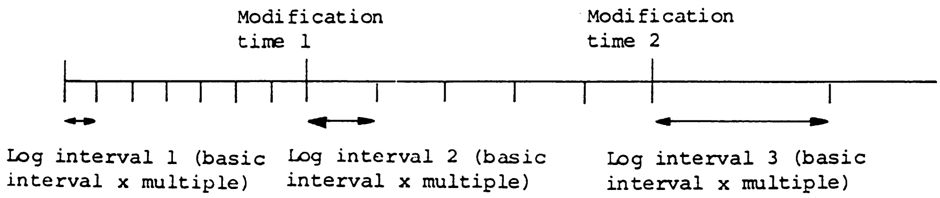
The following specification items are required:

Example:

o Basic interval and mode



o Interval modification time and multiples



o Channels to be measured
o Group boundary channels
o Ranges for each group

} Same as that for single interval.

(2) Multi-user log scan

In this mode the channels are divided for individual users in the multi-interval mode, and log intervals are specified for each channel group in terms of multiples of the basic interval. The relationships between user numbers and group numbers for channel boundary are specified as shown in Table 3-1.

Table 3-1 User numbers vs. group numbers

Basic interval		h m s	
User 1	M1	ch	N
	M2	ch	N
User 2	M3	ch	N
	M4	ch	N
User 3	M5	ch	N
	M6	ch	N
User 4	M7	ch	N
	M8	ch	N

Up to two multi-intervals can be specified for each user to perform log scan. If only one interval is used for each user, specify group number M1 for user 1, M3 for user 2, M5 for user 3, and M7 for user 4.

The required specification items are boundary channel numbers for each group and the multiples for the basic interval.

CAUTION

In the multi-user mode, the channels for each user should be divided in ascending order according to ascending user numbers. For example, two users cannot use both thermocouples and RTD's by using the TR2741E Sensor Terminal (containing 40 channels of thermocouple inputs and 20 channels of RTD inputs).

User A T/C	1CH to 20CH	Pt 41CH to 50CH	Disabled
User B T/C	21CH to 40CH	Pt 51CH to 60CH	

User 1	M1	1CH to 20CH	Programming disabled
	M2	41CH to 50CH	
User 2	M3	21CH to 40CH	
	M4	51CH to 60CH	

In the following case,

User 1	M1	1CH to 20CH	Used by user A	Enabled
User 2	M3	21CH to 40CH	Used by user B	
User 3	M5	41CH to 50CH		
User 4	M7	51CH to 60CH		

Or, the following configurations are enabled by using two TR2741E Sensor Terminals:

User 1	M1	101CH to 121CH	Enabled
	M2	141CH to 150CH	
User 2	M3	201CH to 221CH	
	M4	241CH to 250CH	

All other required programming procedure is the same as that for single user log scan.

(3) Monitor scan

a. All channel monitoring

In this mode the scan channels specified in the log scan mode are scanned at the specified monitor interval. The required specification items are as follows:

Example:

o Monitor interval and mode — 00m10s, all o Output channel, output digits, and with/without offset specifications when analog output is required.

M01 101ch, 0c, off

M01	101ch,	0c,	off
Analog output channel	Output channel	Least significant 3 digits	No offset

o Channels to be measured (Same as log scan channels)
o Group boundary channels
o Ranges for each group

} Same as that for single interval. (Unnecessary if already programmed during log scan programming.)

b. Selective channel monitoring

The following specification items are required:

Example:

o Monitor interval and mode: 00m10s, sel

o Selected channel numbers, analog output digits, and with/without offset specifications:

M01 101ch, 0c, off

M02 110ch, 1c, on

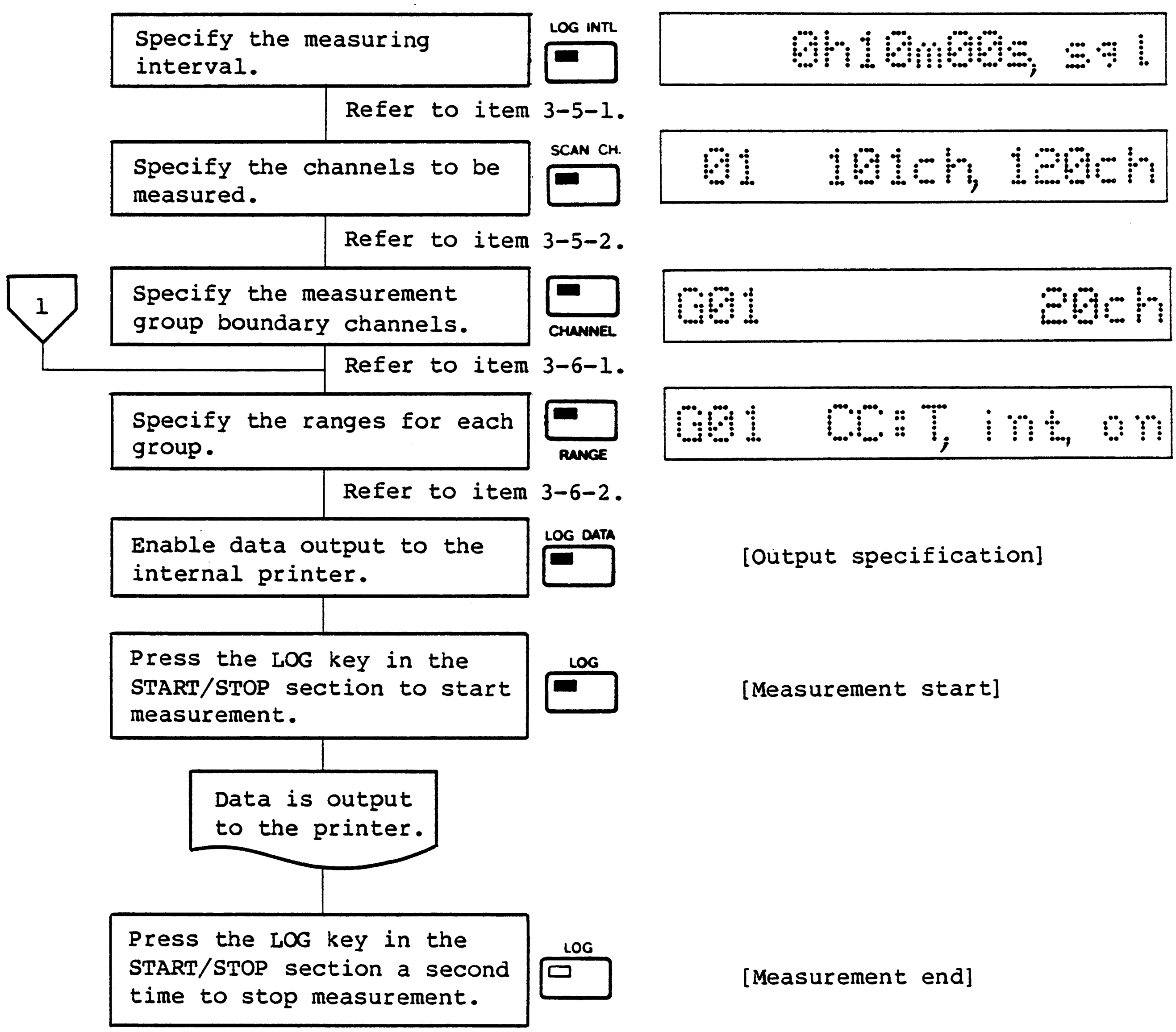
o Channels to be measured
o Group boundary channels
o Ranges for each group

} Same as that for single interval mode. (Unnecessary if already specified during log scan programming.)

3-8-5. Programming and Operation Examples

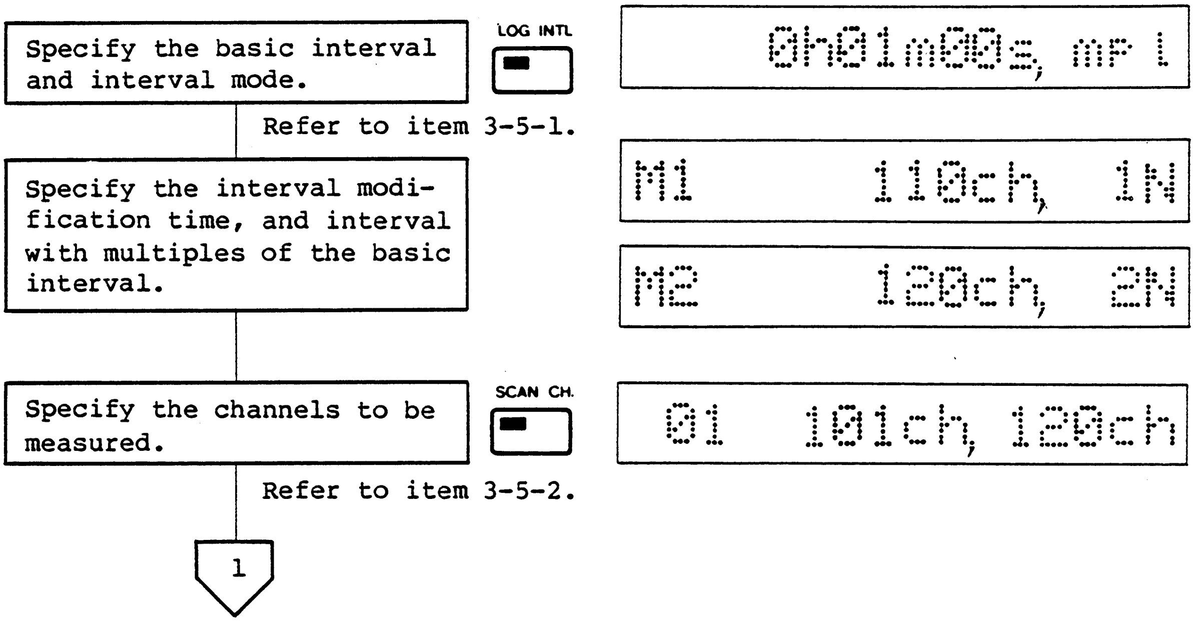
(1) Single user log scan example

a. Single interval



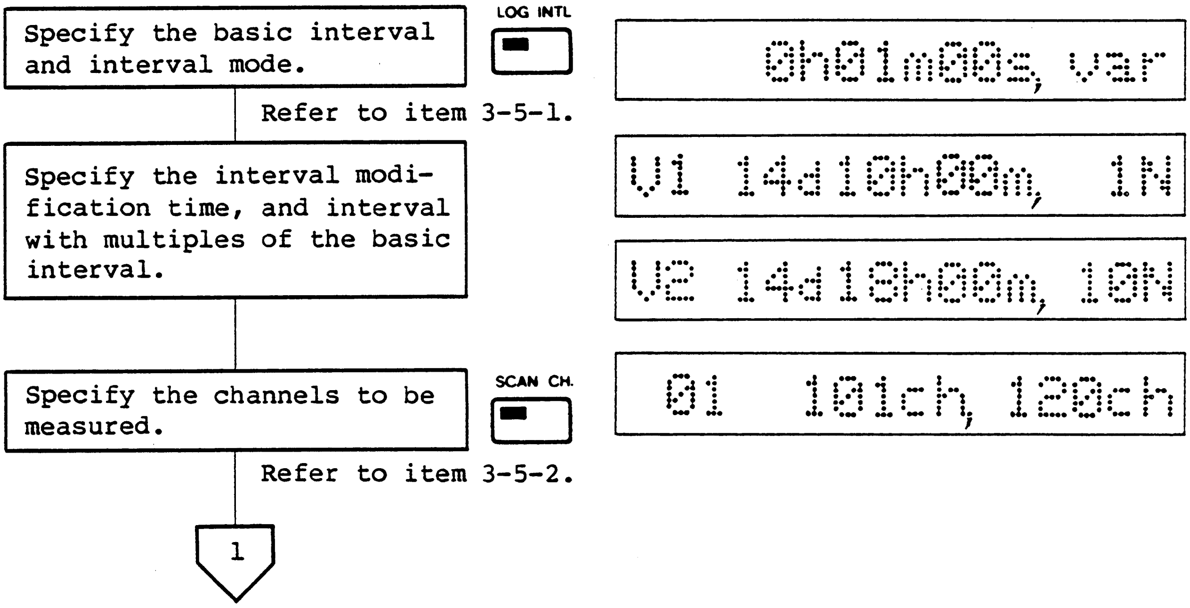
In the above example, channels 1 through 20 on terminal 1 are scanned at 10-minute intervals for temperature measurement using T(CC) type thermocouples and the measured data is delivered to the internal printer. Label and/or time setting may be done before log scan start.

b. Multi-interval



Note: Interval boundary channels and measurement channels can be independently specified. Measurement boundary channels are also specifiable independently.

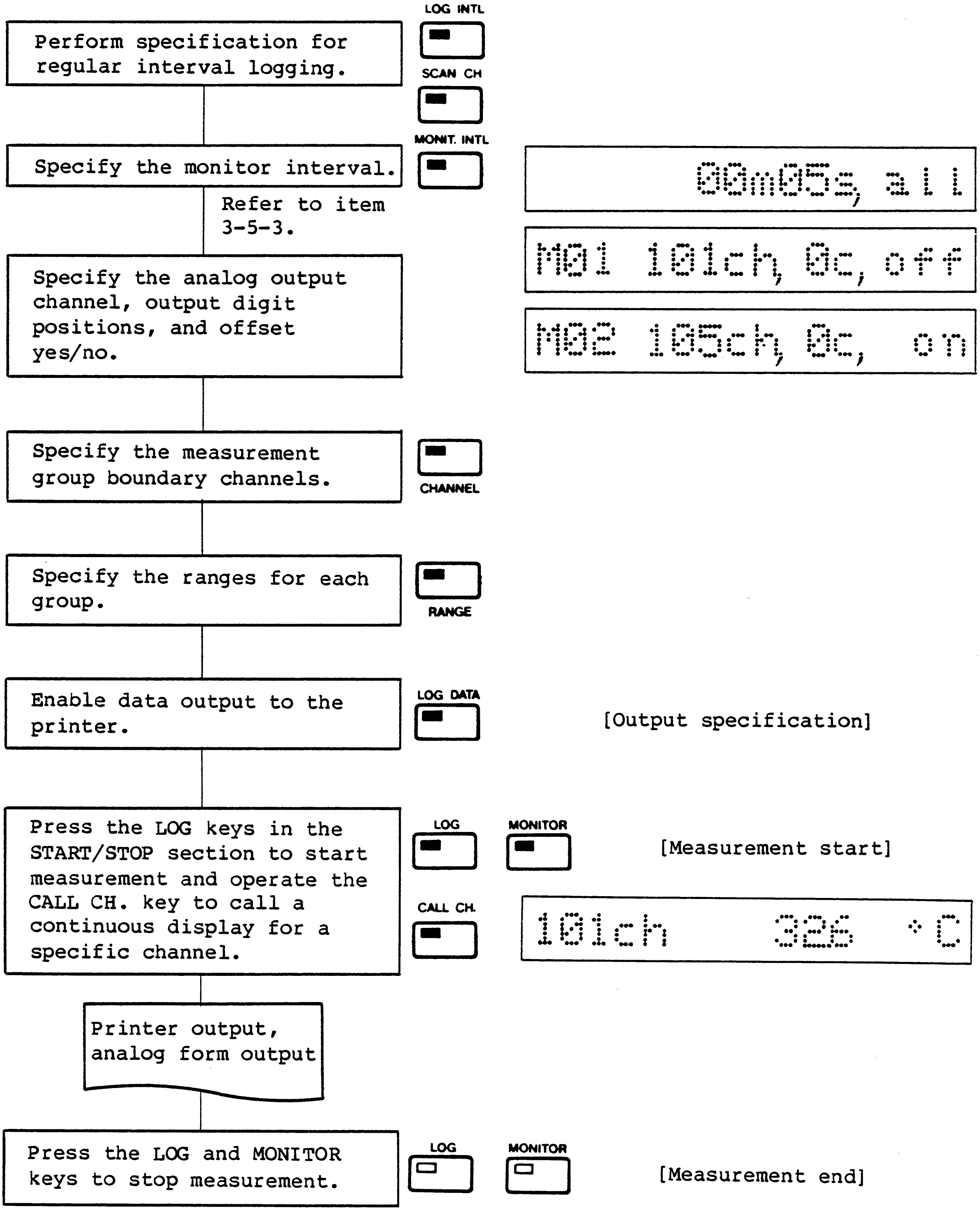
c. Variable interval



Note: The interval modification time should be specified in real clock time if the clock mode is specified.

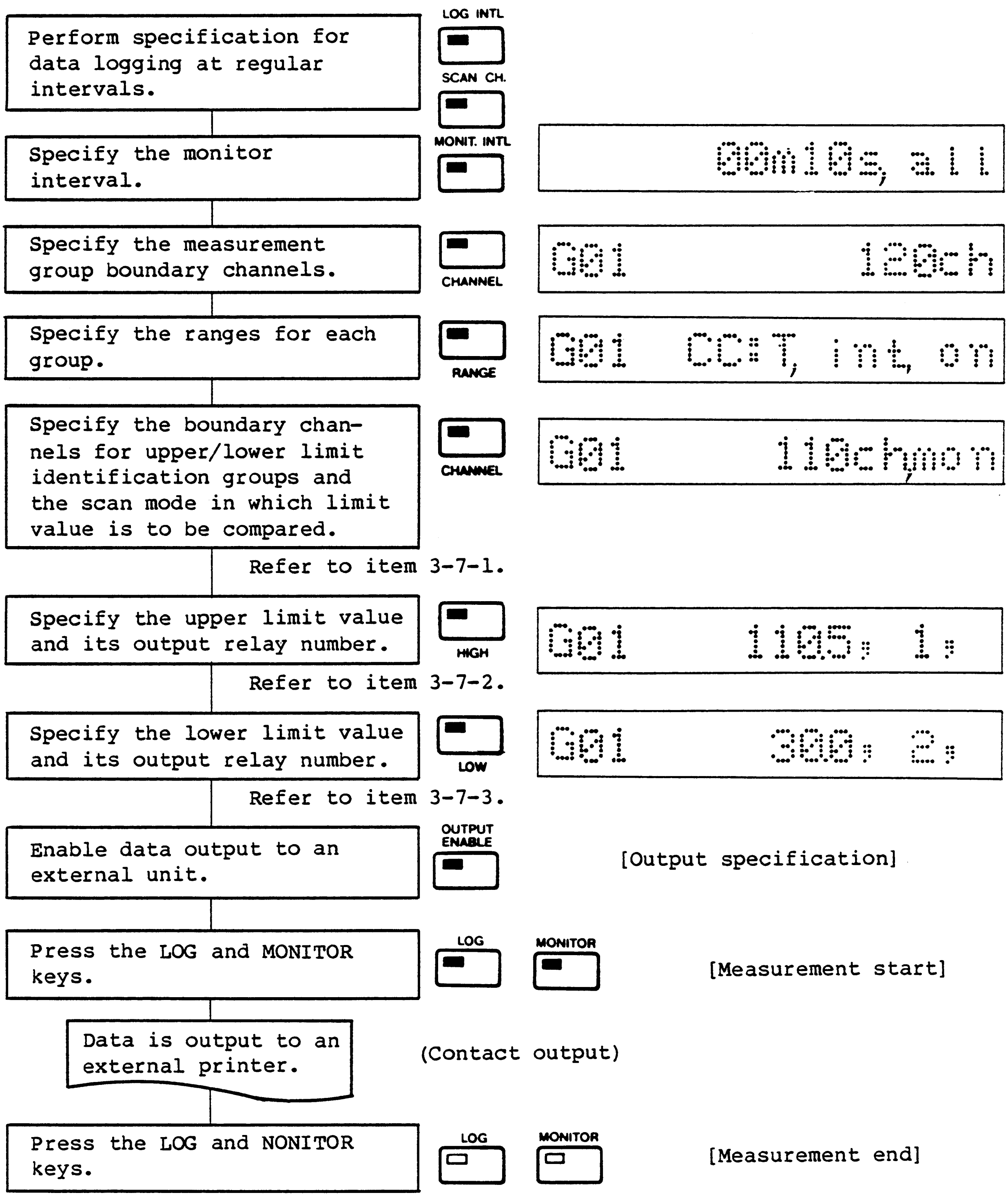
(2) Analog output example

In the following example, the analog form of logged data is output while data logging is made at regular intervals and, at the same time, continuous display is specified for a specific channel:



(3) Upper/lower limit identification example

In the following example, monitor scan is performed while data logging is made at regular intervals and the results of upper/lower limit identification are output through relays. Logged data is delivered to an external printer via the Serial Data Output option card:



(4) Scaling, engineering unit and arithmetic operation programming example

In the following example, logged data at regular intervals is subject to scaling operation, engineering unit conversion, and subtract operation with reference to a specific channel, then the results of upper/lower identification are output through relays:

Perform specification for data logging at regular intervals. — LOG INTL

Specify the measurement group boundary channels. — SCAN CH., CHANNEL — Display: G01 110ch

Refer to item 3-6-1.

Specify the ranges for each group. — RANGE — Display: G01 CC:T, int, on

Refer to item 3-6-2.

Specify scaling coefficients for each group. — SCALE — Display: G01 02: 0008

Refer to item 3-6-3.

Specify enginnering units for each group. — UNIT — Display: G01 kg/□

Refer to item 3-6-4.

Specify arithmetic modes for each group. — MODE — Display: G01 ⊿N, 101ch

Refer to item 3-6-5.

Specify the boundary channels for upper/lower limit value is to be compared. — CHANNEL — Display: G01 110ch,log

Refer to item 3-7-1.

Specify the upper and lower limit values and thier respective output relay numbers. — HIGH, LOW — Display: G01 125:10: / G01 003:11:

Refer to item 3-7-2 and 3-7-3.

Enable data output to the printer. — LOG DATA — [Output specification]

Press the LOG key to start measurement. — LOG — [Measurement start]

Printout

Press the LOG key a second time stop measurement. — LOG — [Measurement end]

(5) Multi-user log scan example

The programming procedure for the multi-user log scan is almost identical to that for the multi-interval mode for single user log scan, except for measurement start/stop command procedure.

In the following example:

Specify the basic interval and scan mode.

00h05m00s,mP 1

Specify the interval group boundary channels and the interval with multiples of the basic interval.

M1 140ch, 2N

M2 ch, N

M3 240ch, 2N

M4 ch, N

M5 340ch, 3N

M6 ch, N

M7 420ch, 2N

M8 440ch, 4N

Specify boundary channels for interval users.

Two channel group are allocated to each as follows:

- User 1 ----- M1 and M2
- User 2 ----- M3 and M4
- User 3 ----- M5 and M6
- User 4 ----- M7 and M8

User 1 scans up to channel 40 on terminal at 10-minute intervals.
User 2 scans up to channel 40 on terminal 2 at 10-minute intervals.
User 3 scans up to cahnnel 40 on terminal 3 at 15-minute intervals.
User 4 scans up to channel 20 on terminal 4 at 10-minute intervals and up to channel 40 the same terminal at 20-minute intervals at 20-minute interval.

Determines whether measurement channels for each user is delivered to internal or external output unit.

SCAN CH.

LOG DATA

Press the LOG key to initiate measurement.

(BACK) # 1 LOG [Measurement for user 1 started.]

(BACK) # 2 LOG [Measurement for user 2 started.]

Printout

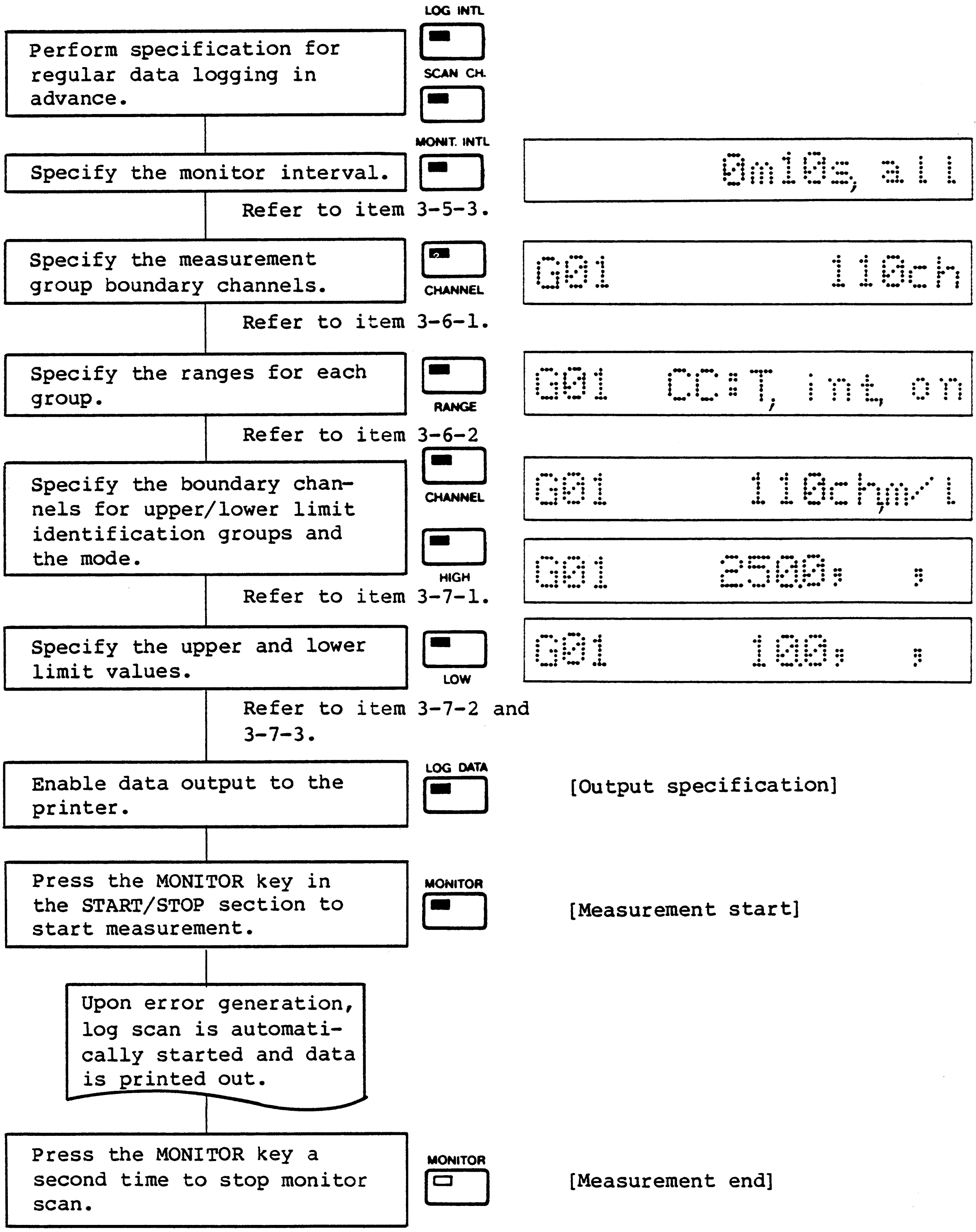
Press the LOG key a second time to stop measurement.

(BACK) # 1 LOG [Measurement for user 1 stopped.]

(BACK) # 2 LOG [Measurement for user 2 stopped.]

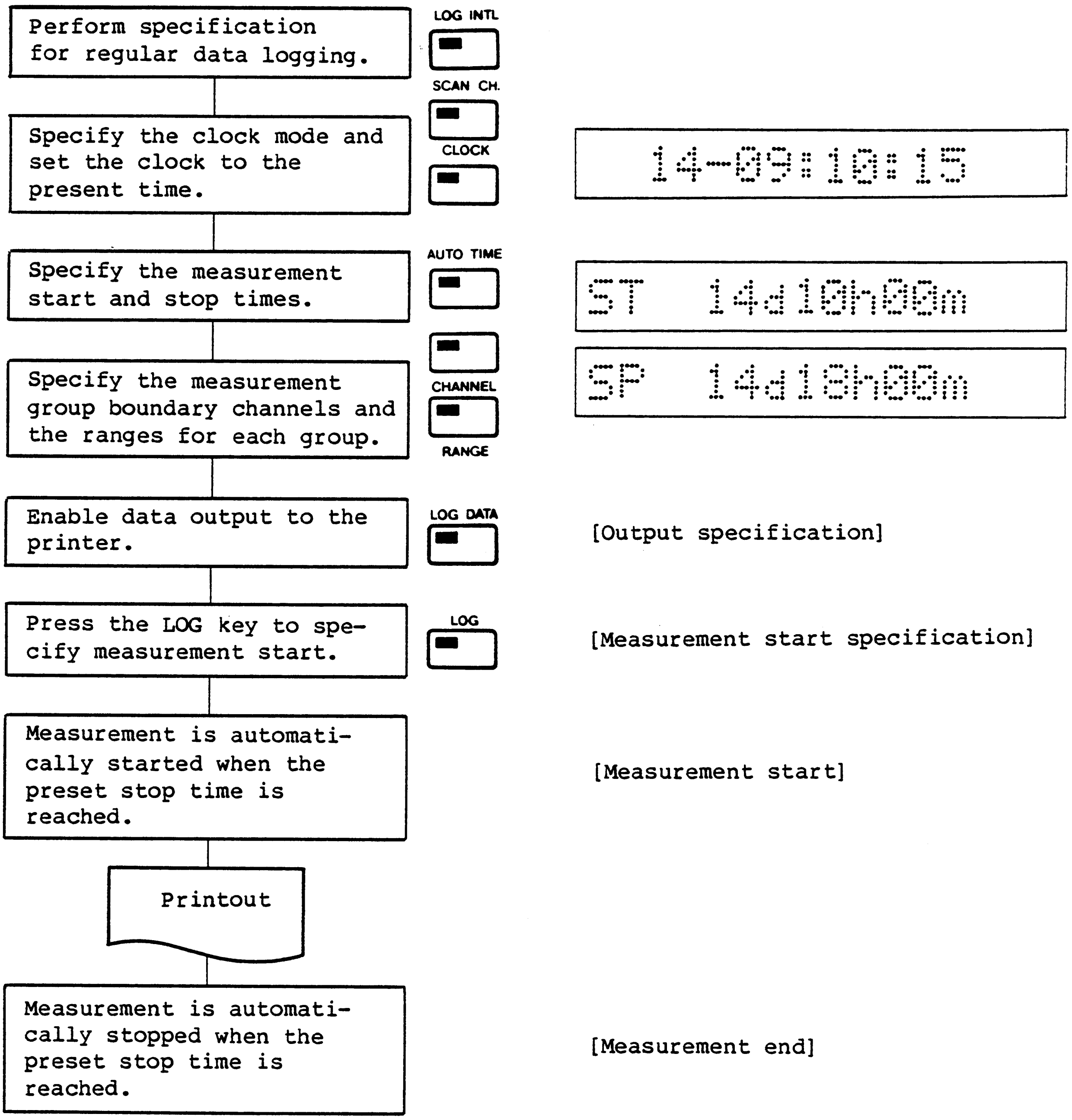
(6) Upper/lower limit identification (under log scan during error in monitor scan mode) example

In the following example, upper/lower limit identification is performed in the monitor scan mode, and regular log scan is executed to output data only during error generation:



(7) Automatic start/stop programming example

In the following example, regular-interval logging is performed by using the automatic start/stop function:

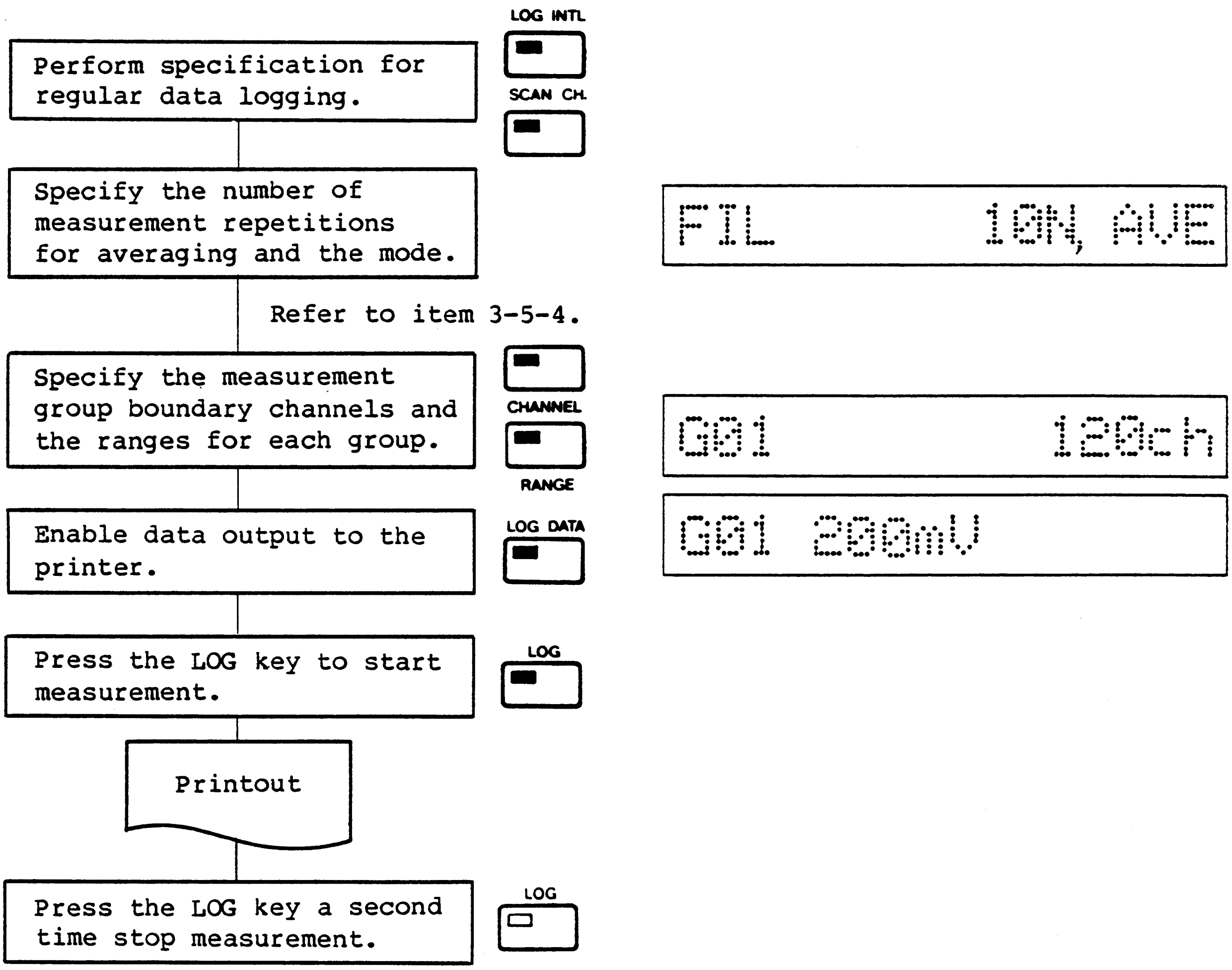


CAUTIONS

1. When the clock mode is specified, the measurement start and stop times should be specified in real clock time. Note that operation of the LOG key will not restart measurement once the top time has already passed (lamp in the LOG key remains off.)
2. In the clock mode, regular log scan can be performed in between XX hour XX minute and YY hour YY minute every day by starting log scan after specifying "ST 0dXXhXXm" and "SP 0dYYhYYm."
3. When the timer mode is specified, ST and SP should be specified in the elapsed times after the START/STOP LOG key is pressed.

(8) Filter function programming example

In the following example, measurement is repeated ten times to average data for each input channel by using the filter function:



CAUTIONS

1. When the average or delay mode is specified by using the filter function, measurement time of (repetitions of measurement for averaging or delay x 50 ms) + (processing time: 200 ms) is required for each channel.
2. When the scan step pulses are to be output via the TR2730-520 BCD Output/External Control option card, filter function is required to activate.

3-9. PRINCIPLES OF OPERATION

3-9-1. Single User Log Scan

The single user log scan is the most fundamental measurement mode for a data logger. In this mode, operation of the LOG key (provided in the START/STOP section) starts measurement on all the specified input channels at the interval specified with the LOG INTL key. The following four modes are selectable for the interval modes to determine log scan intervals to match input signals.

o Multi-interval mode

o Variable interval mode

o Single interval mode

o External interval mode

(1) Multi-interval mode

The multi-interval mode permits different log scan intervals for individual input channel groups. It requires specifications of group boundary channels and the multiples of the basic interval for each group. Up to eight channel groups can be defined and up to eight different scan intervals can be specified for each group. Measured data is output in sequential order at the intervals which are specified multiples of the basic interval. The multi-interval mode is also used when statistical operation on the time domain (primary arithmetic operation) is specified.

(2) Variable interval mode

In the variable interval mode, the measurement interval for all the specified input channels is changed with elapsed times. It requires specification of the times at which the measurement interval is to be changed and the intervals used up to each changeover time with multiples of the basic interval. Up to six interval changeover times can be specified. If the timer mode is specified, interval changeover takes place referencing the elapsed times from measurement start. When the last changeover time is passed, the basic interval is selected.

Figure 3-13 shows the outline of the variable interval mode used for temperature test in a thermostatic chamber, etc. If an interval changeover time does not agree with the multiples of the basic interval, interval changeover takes place when the preceding interval exceeds its interval changeover time. (See Figure 3-14.)

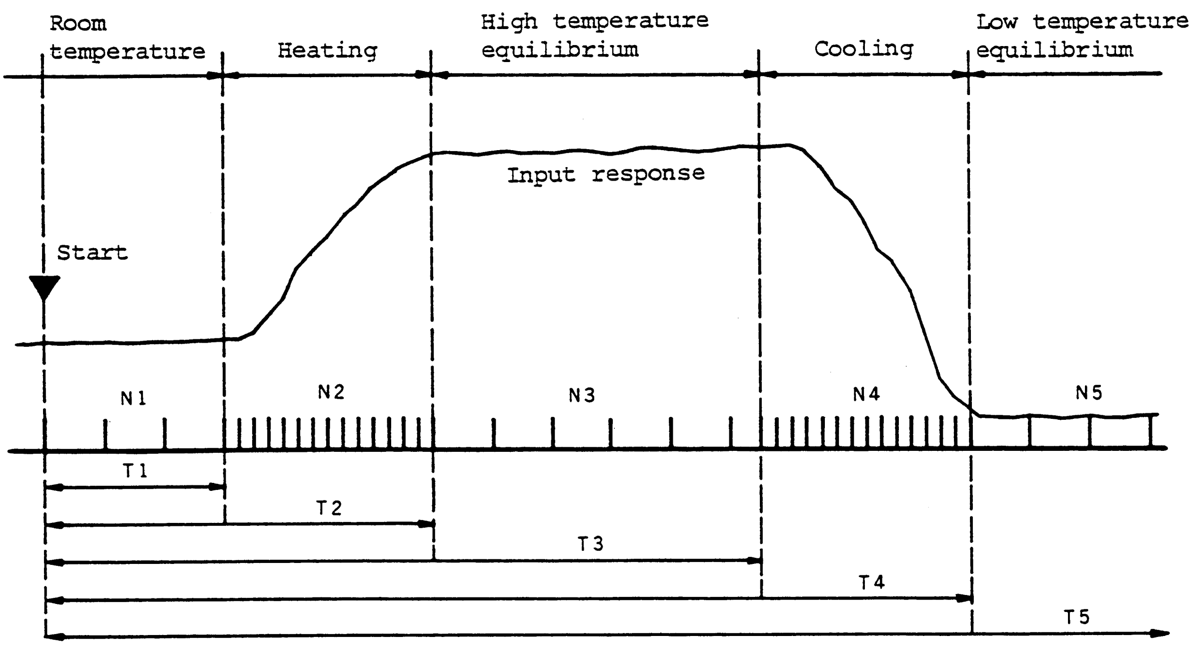


Fig. 3-13 Temperature test data logging using the variable interval mode

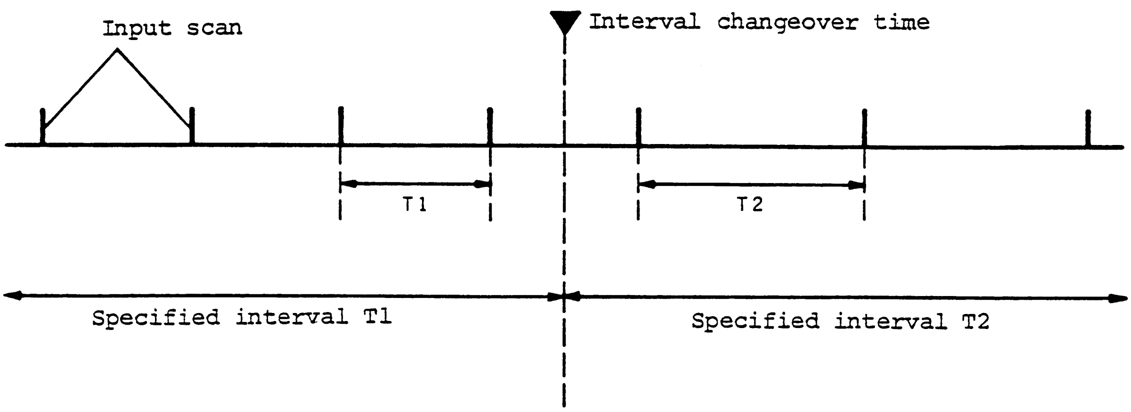


Fig. 3-14 Measurement interval changeover in the variable interval mode

(3) Single interval mode

The single interval mode is the most basic interval mode in which all the specified input channels are scanned at a specified interval. Similar to the two other modes just mentioned above, the single interval mode permits engineering unit conversion (scaling operation), 7 types or primary arithmetic operations, upper/lower limit identification, and secondary arithmetic operations.

(4) External interval mode

In the external interval mode, the measurement interval is determined by an external contact signal.

In the single log scan mode, all the specified input channels are scanned only once regardless of the interval modes described above and measured data can be delivered to the internal printer or external units. If log scan is activated during single scan, log scan start is held up until single-scan data output is completed. Conversely, a single scan activated during log scan is ignored. Arithmetic operations or upper/lower limit identification can not be executed for data obtained by single-scan operation, except for engineering unit conversion.

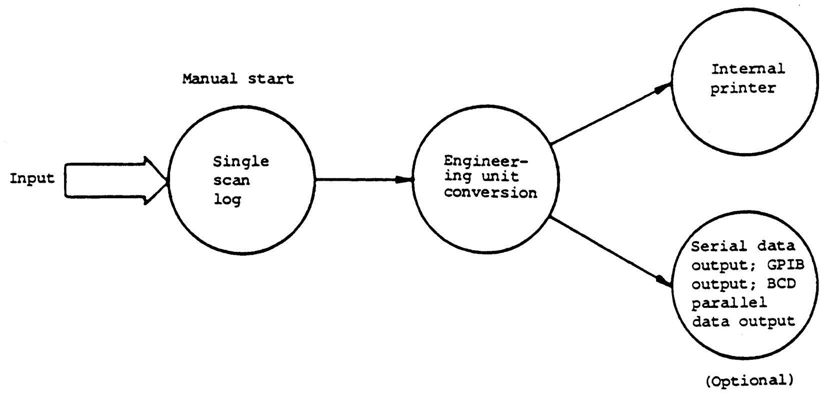


Fig. 3-15 Data logging using a single scan mode

3-9-2. Multi-user Log Scan

The multi-user log scan permits up to four independent data logging sequences to be performed. Input channels and scan intervals can be specified independently for individual users. Input channels are divided into groups in ascending order and a group is allocated to each user. Therefore, one sensor terminal can be shared by multiple users, whereas each user cannot use both platinum RTD and thermocouple sensors at a time. In fact, it would be more practical that each sensor terminal be allocated to individual users.
In the multi-user log scan mode, measurements for individual users can be started by simple key operation on the front panel of the instrument. It is also possible to start data logging for all users simultaneously if required. Once a start command is activated in the multi-user mode, the single user scan mode is not to be initiated until log scan for all users is stopped. The user for which measurement is currently carried out is indicated by the user status lamps on the front panel.
When synchronization with an external unit or local measurement control by individual users is required, the user-independent external start/stop contact command available with the TR2730-520 BCD Output/External Control option card may be used.
Since, in the multi-user log scan mode, data logging for individual users is performed at random timings, scan sequences for more than one user may overlap with each other. To prevent this, scan start for one user may be held up for the maximum scan plus data-processing time for another user even if the scan start time for the former is reached. (See Figure 3-16.) As a result, there may generate a time lag between the specified scan start timing and the actual scan start timing.

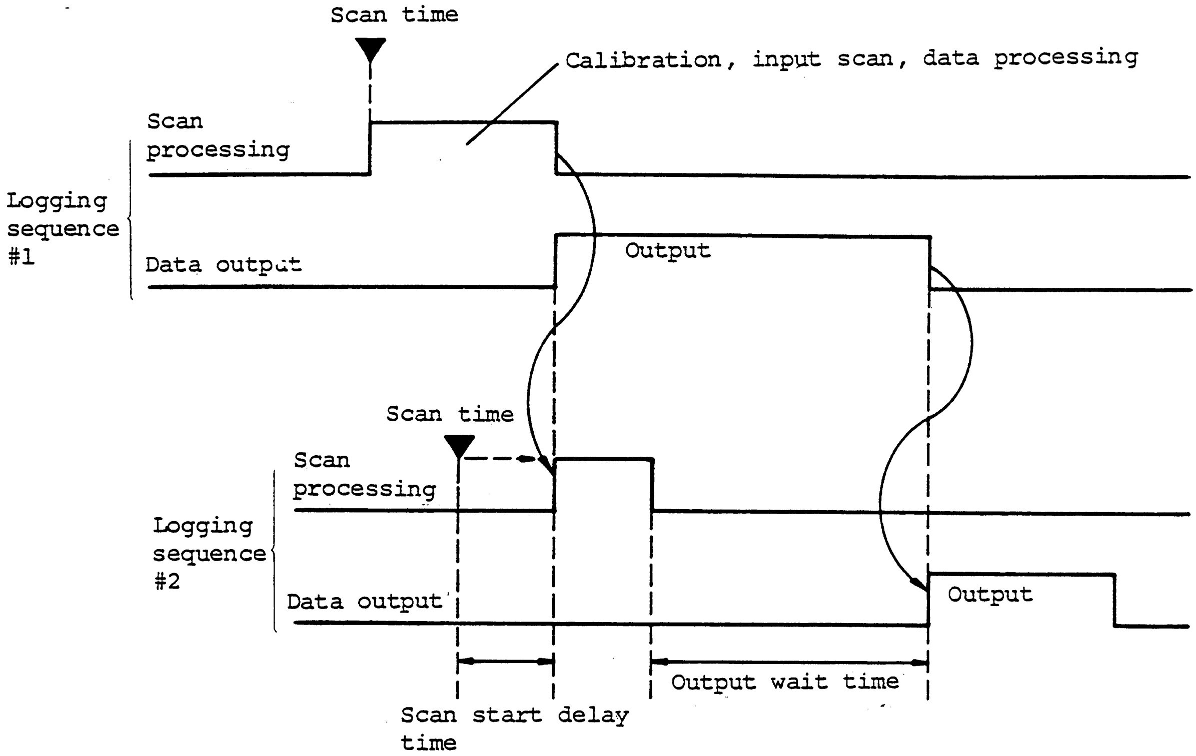


Fig. 3-16 Contention between two users in the multi-user log scan mode

Since measurement is performed independently for individual users in the multi-user log scan mode, special consideration is required for data output. When data of multiple users is only output to the internal printer or an external unit, data of different users is output in the time sequence order in which actual data logging for individual users has been performed. This output format may be useful especially when the amount of logged data is not very large or for data monitoring, as a single scan data for each user is printed at one time together with the user number.

When user-independent batch data output is desired, the TR2730-570 Data Buffer Memory option card is necessary. Multiple scan data for individual users can print out by using this option card. When this option card is used, it should be noted that data is not output until the data memory for the pertinent user becomes full or data logging is stopped, and that the next scan for a user is held up during data output for that user.

A more useful data output format is available with the TR2730-560 Serial Data Output option card which enables attachment of external output units that correspond to individual users. If the number of attached output units is smaller than the number of users, the data of the overflow user is output to the last unit. The outline of data output processing in the multi-user log scan mode is shown in Figure 3-17; application to multiple businesses is illustrated in Figure 3-18; and a printout example is shown in Figure 3-19.

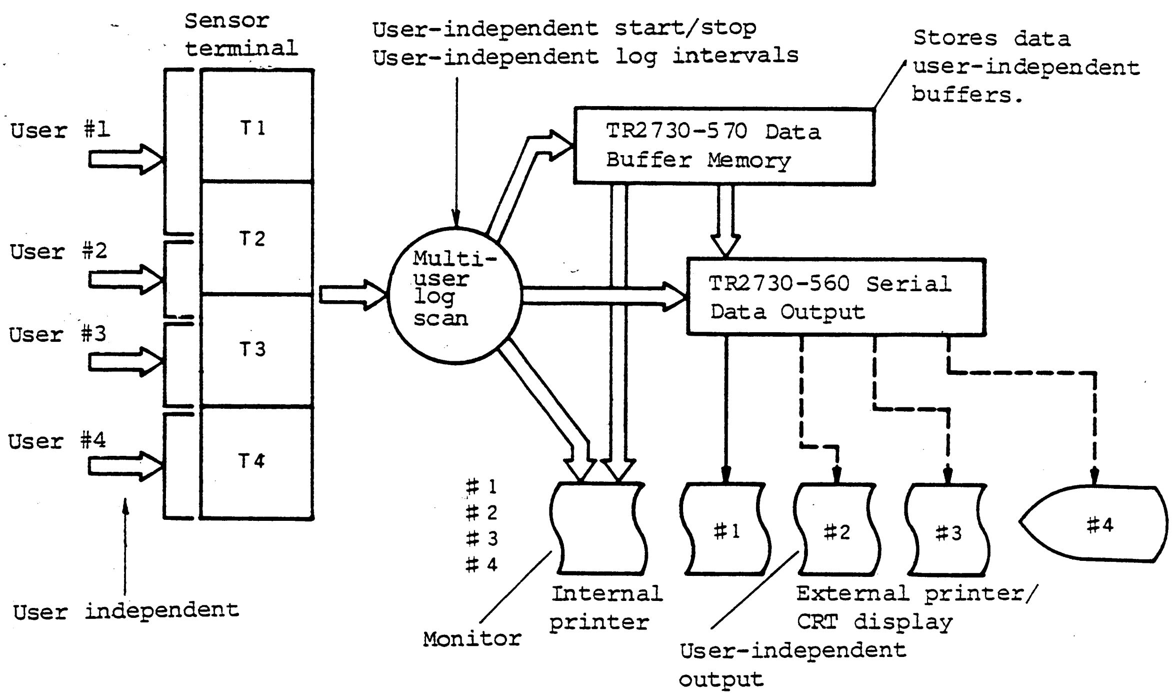


Fig. 3-17 Outline of data output processing in the multi-user log scan mode

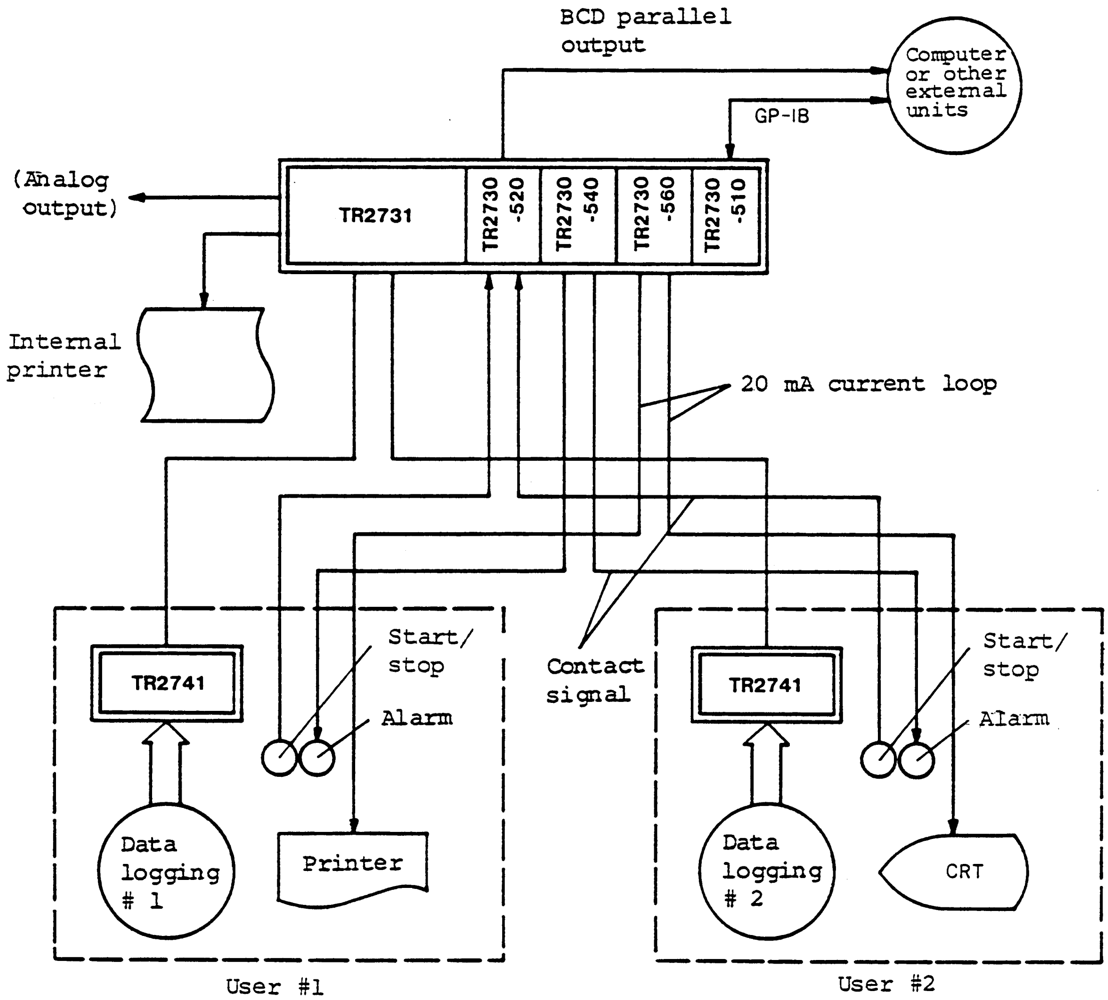


Fig. 3-18 Data logging application example in the multi-user log mode

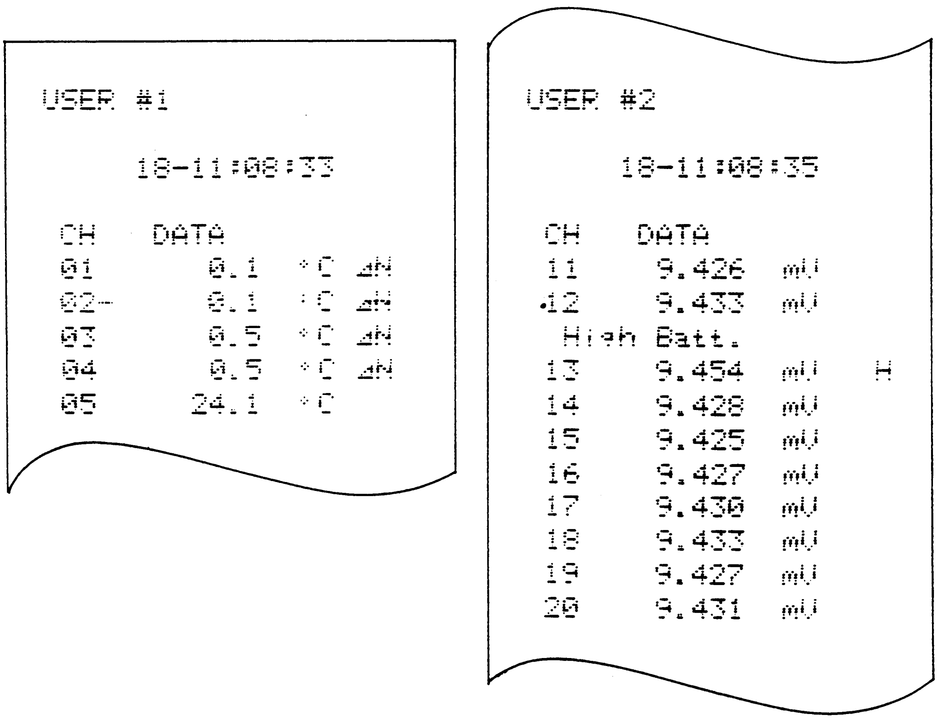


Fig. 3-19 Printout example

3-9-3. Monitor Scan and Call Channel

The monitor scan and call channel functions are useful for continuous monitoring of a specific input channel or operator service. Since these functions have a lower priority than log scan, they are executed during intervals between two log scan sequences. Similar to log scan, the monitor scan and call channel functions first performs calibration followed by input channel measurement, data processing and data output and/or display. (See Figure 3-20.) Neither of the two functions has priority between them. If monitor scan is specified continuous as shown in Figure 3-20, the monitor scan and call channel sequences are executed alternately.
Unlike log scan, calibration measurement is performed at the beginning of each scan even if continuous measurement is specified.

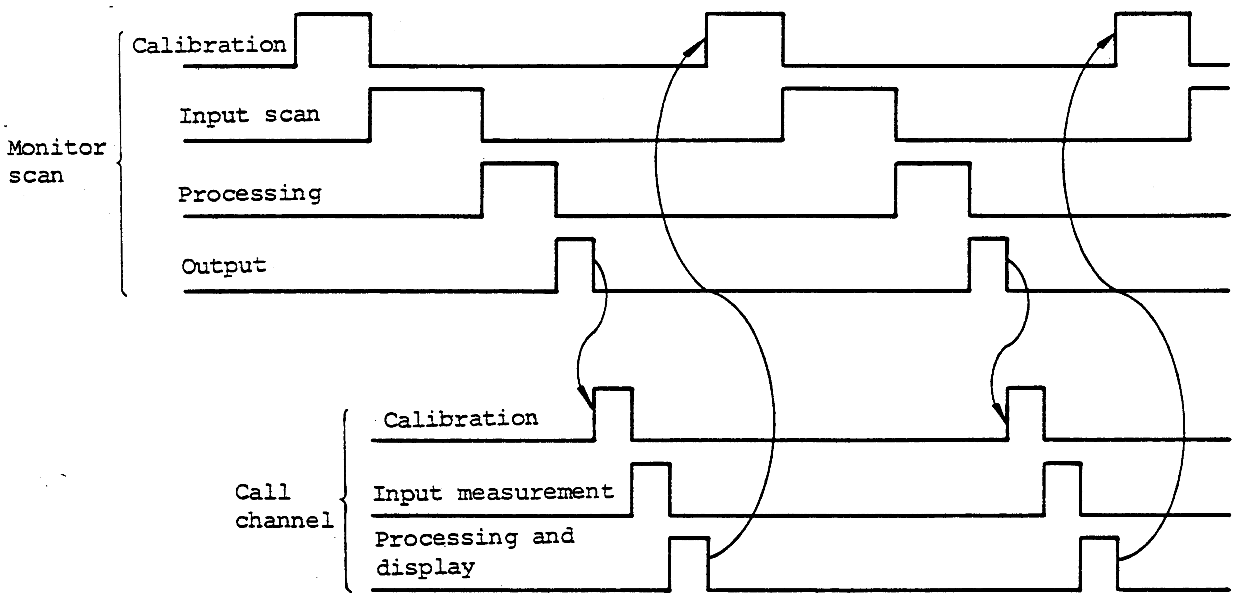


Fig. 3-20 Alternate execution of monitor scan (continuous interval) and call channel sequences

The channel to be displayed by the call channel function may be outside the channel range specified for log scan, provided that the measurement range for the channel is specified in advance. If linear scaling operation is specified, data after being subjected to engineering unit conversion is displayed at approximately one second intervals.

The input channels to be measured by the monitor scan function are usually identical to those specified for log scan, and are scanned at the specified monitor intervals. However, to cope with the case where the number of input channels to be monitored is smaller than the number of log scan channels or only analog output is required, the SEL mode, in which up to 12 input channels can be arbitrarily specified for scanning, is available.

For monitor scan data, subtract operation between two input channels is possible as well as engineering unit conversion.

As outlined in Figure 3-21, the output of monitor scan may be used in three ways different from the ways in which log scan output is used.

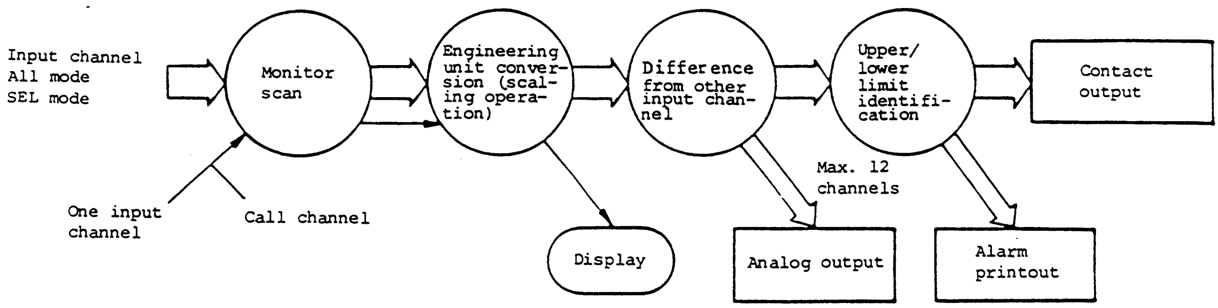


Fig. 3-21 Use of monitor scan data

If measured data after being subjected to engineering unit conversion exceeds the separately specified upper or lower limit values, an alarm signal (make) is output via the TR2730-540 Relay Output option card. Upper and lower limit values can be specified for each input channel group and relay numbers corresponding to each group are programmable.

The TR2730-540 Relay Output option card contains 20 relays per card which are arbitrarily selectable for over-limit alarm output.

In addition to the 20 relays, the card also has one common relay which may be used to provide a make signal if an over limit data is obtained on any of the input channels. The contact signal output modes include the three modes as shown in Figure 3-22, which are selectable on the front panel of the TR2730-540 for each card:

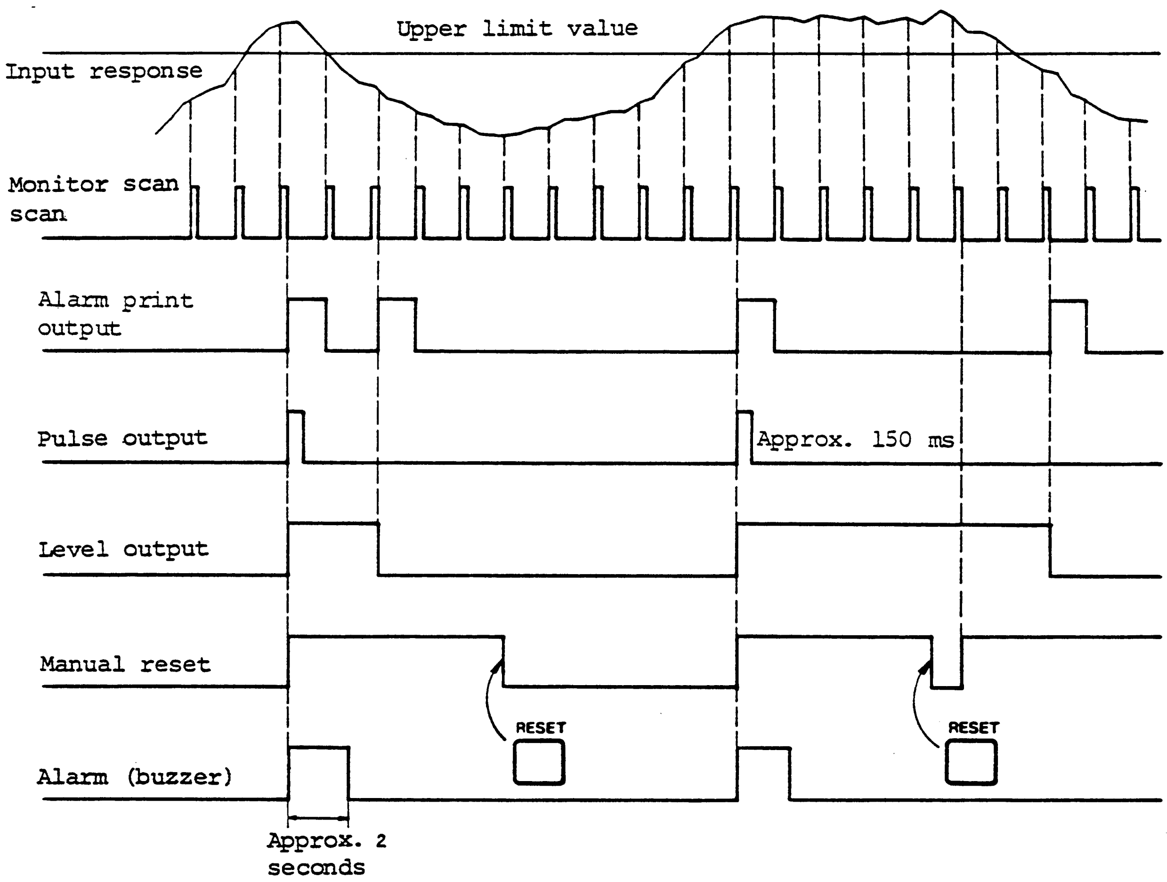


Fig. 3-22 Alarm contact signal output mode in monitor scan

In the pulse output mode, a pulse signal of approximately 150 ms in width is output only if data exceeds the specified limit value. The level output mode outputs a make signal if data exceeds the specified limit value and outputs a break signal when data returns within the limit value. The level output mode is useful when a short over-limit interval is not regarded as an error. In the manual reset mode, the alarm signal remains active until the RESET key on the front panel is pressed by the operator.

Other applications of the monitor scan function includes continuous trend monitoring using analog data output. Up to 12 arbitrary channels can be output in analog form by using two TR2730-550 Analog Output option cards. The analog data output obtained by the monitor scan is a step-like signal as shown in Figure 3-23. Therefore, it is necessary to specify the most adequate monitor interval depending on the type of the recorder to be used and chart feed speed.

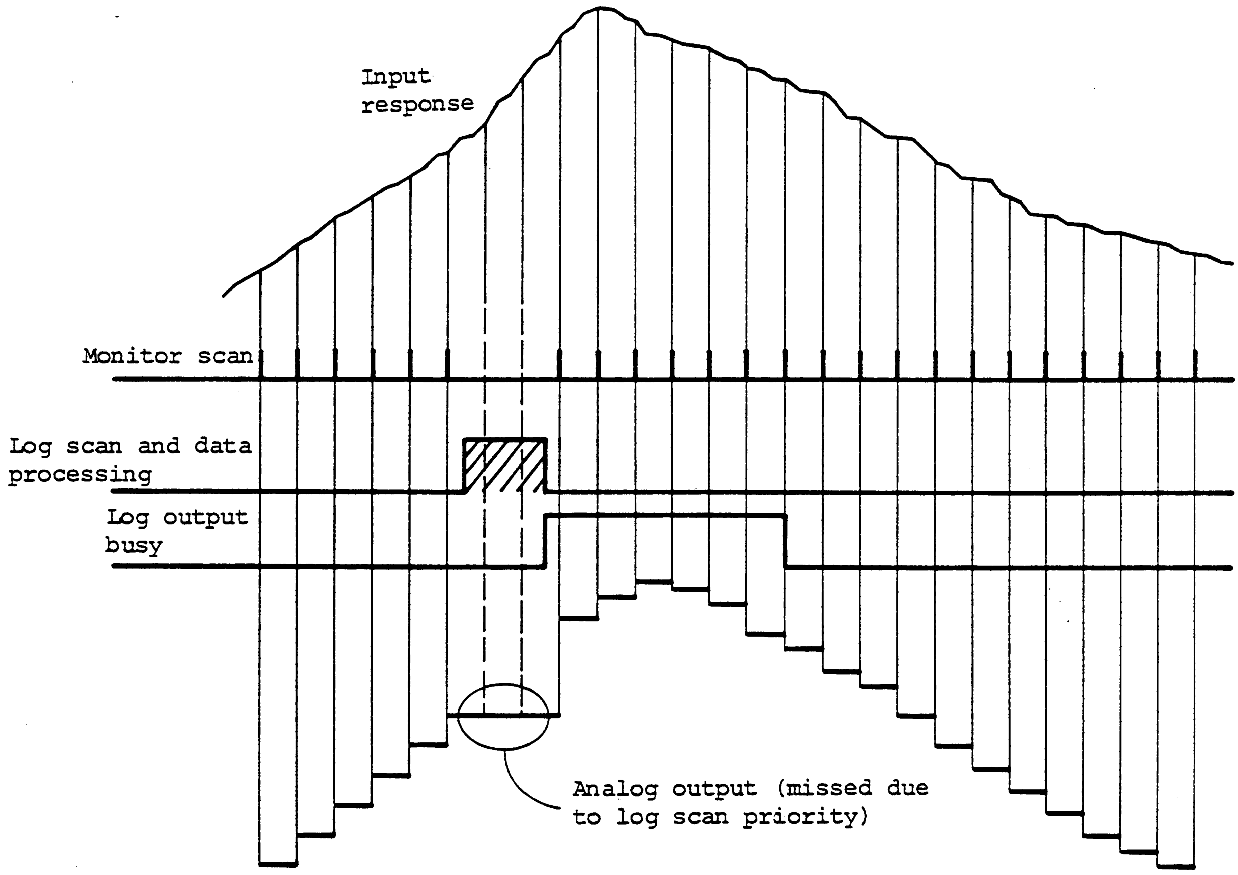


Fig. 3-23 Analog data output using the TR2730-550 option card

If log scan is activated during monitor scan, the monitor scan holds the preceding data level until log scan is completed. If monitor scan is to be performed only to obtain analog data output, it is recommended that the number of input channels to be scanned should be reduced by specifying the selective channel mode, instead of scanning all input channels.

The correspondence between input channels and analog data output channels is arbitrarily programmable, and in addition, that between measured data and analog full-scale value (digit specification) is also programmable. For example, small variations of input data can be recorded on an analog recorder by assigning the least significant three digits of measured data to the analog full-scale. If input data varies around the analog full-scale level, continuous data response will be lost once the input exceeds the full-scale because the recorder's pen will then reference the zero graticule on the chart for the excess. To prevent this, a 50% digital offset can be specified. Since these analog recording conditions are independent specification for up to 12 input channels, greater freedom is achieved in analog recording. Also the difference from the room temperature or a reference point can be continuously recorded by the differential analog output capability.

The alarm printout function is also one of the applications of the monitor scan mode. If data of an input channel exceeds the specified limit value during monitor scan, only the data of the pertinent channel is delivered to the internal printer together with the label and the time. When the data returns within the limit value, it is also printed out. This alarm printout function is very useful for error data recording and check, but is available only on the internal printer.

```
      18-11:13:20

CH    DATA
11      9.421   mV    L
14      9.422   mV    L
16      9.424   mV    L



      18-11:13:30

CH    DATA
11      9.425   mV
14      9.430   mV
16      9.430   mV



      18-11:13:40

CH    DATA
14      9.422   mV    L
15      9.424   mV    L
17      9.423   mV    L
        9.415   mV    L
```

Fig. 3-24 Alarm printout example

3-9-4. Upper/Lower Limit Identification for Log Scan and Automatic Log Start by Monitor Scan

As mentioned in the preceding item, input monitoring by upper/lower limit identification is, in principle, executed by monitor scan. However, this practice may be inconvenient if upper/lower limit identification is required on the operation results obtained as a result of log scan. To cope with this case, the TR2731 enables specification of whether upper/lower limit identification is to be done during monitor scan or log scan. This can be specified during alarm group programming. As a result, it is possible to compare operation results with the specified limit value and output the comparison result in the form of contact signals or to print error data with the alarm printout function.

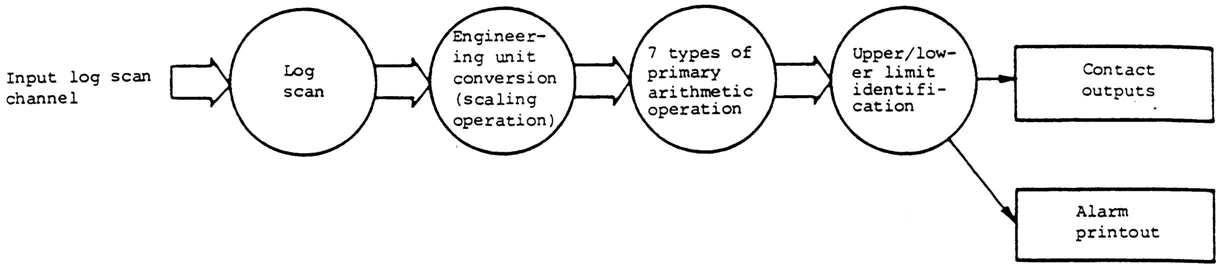


Fig. 3-25 Upper/lower limit identification for log scan data

Figure 3-25 shows the outline of input monitoring for log scan data. Limit identification is also enabled for data after it is subjected to primary arithmetic operations.

For example, upper/lower limit identification can be performed on differential data obtained by subtracting the preceding data from the present data as shown in Figure 3-26. The result of this limit identification may be used as a differential alarm.

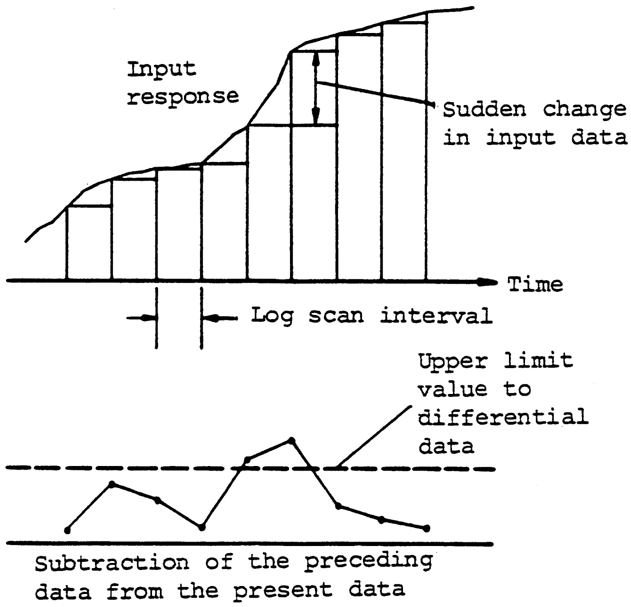


Fig. 3-26 Differential alarm detection for log scan data

If data exceeds the specified limit value during input channel scanning, it can activate an arbitrary contact on the TR2730-540 Relay Output option card, similar to the case with monitor scan. The alarm printout function for log scan data outputs data of all input channels to the internal printer, unlike the case with the monitor scan. In other words, if data of any input channel exceeds the specified limit value, data of all input channels is printed out only once. When the data of the pertinent channel returns within the limit value, no printout executes. The data exceeding the limit value is followed by H (High) or L(Low) on the printout. Similarly, letter H or L is also printed at the end of data lines depending on limit identification results during normal log-scan data printout. Since these upper/lower limit identification modes are selectable for each alarm group, one input channel may be identified by alarm scan while another input channel may be identified by log scan. All input channels specified for log scan are scanned for limit identification. The TR2731 also provides another alarm mode called monitor/log start mode. In this mode, log scan is automatically started only while data of any input channel specified for the monitor/log start mode exceeds the specified limit value. For example, it is possible to detect over-limit generation while making continuous monitoring on the object to be measured, start data logging from that point, and stop the data logging when the data of the pertinent channel returns within the limit value.

An automatic log start/stop sequence using monitor scan is shown in Figure 3-27. Since this sequence relies on the upper/lower limit identification mode for monitor scan, required programming contents are identical to those for monitor scan.

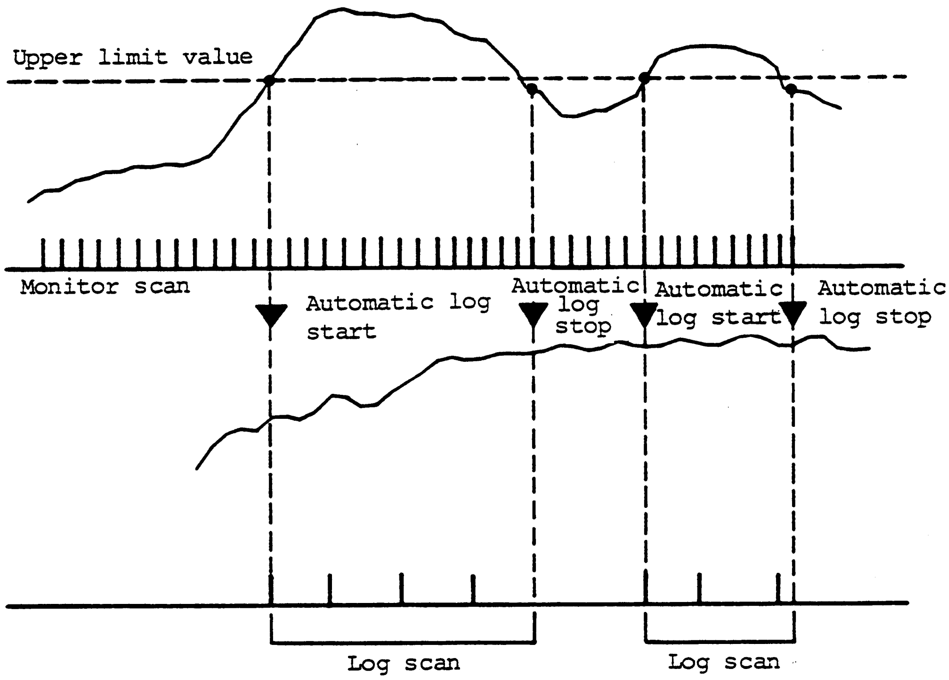
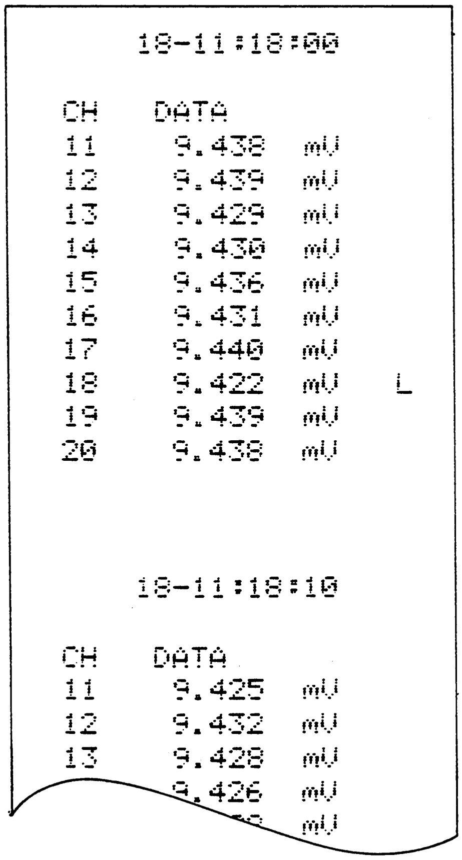


Fig. 3-27 Automatic log start/stop sequence using monitor scan



```
     18-11:18:00

CH   DATA
11     9.438   mV
12     9.439   mV
13     9.429   mV
14     9.430   mV
15     9.436   mV
16     9.431   mV
17     9.440   mV
18     9.422   mV    L
19     9.439   mV
20     9.438   mV


     18-11:18:10

CH   DATA
11     9.425   mV
12     9.432   mV
13     9.428   mV
       9.426   mV
               mV
```

Fig. 3-28 Alarm printout example

3-9-5. Other Instrumentation Support Functions

In addition to the data logging functions hitherto described, the TR2731 Data Logger provides various other support functions to meet a broad range of application requirements. These functions are also activated by simple operation of front panel keys for quick and easy check and modification of programming contents.

(1) Scan Channel (SCAN CH.)

The Scan Channel function is used to specify input channels (range) for log scan. Only the specified input channels are scanned during log scan. In addition to the 40 channel groups enabling input range programming, etc., up to 10 additional groups are definable to specify the actual scan ranges. Since the channels not specified are automatically skipped, the input channels to be measured can be selected at random. In the ALL mode of monitor scan in which input channels are not selectively specified, this function is also effective to select the pertinent channels for scanning.

(2) Filter (FILTER)

The filter function is used for arithmetic averaging of measured data for a specified number of repetitions. It is especially useful when the input signal is contaminated by noise. When the filter function is activated, each channel is repeatedly scanned by the specified times to average the results. (See Figure 3-29.) The measurement time required for each channel is a specified multiples of 50 ms. There is a time gap of approximately 200 ms between measurement end for one channel and measurement start for the next, however, due to sensor terminal precedence control.

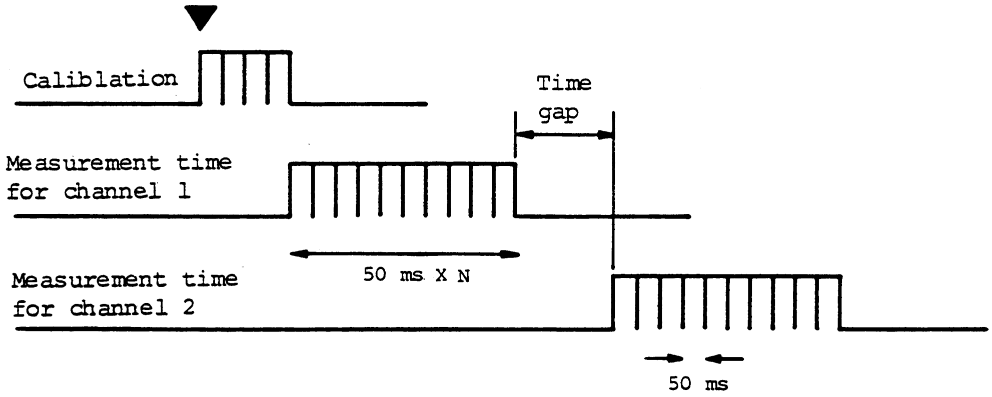


Fig. 3-29 Averaging by the filter function

In addition to the averaging mode, the filter function also provides the delay mode, with which measurement start can be delayed by 50 ms x (specified number - 1) for input data settling, etc. (See Figure 3-30.) In this case also, a time gap occurs between scan end for one channel and scan start for the next.

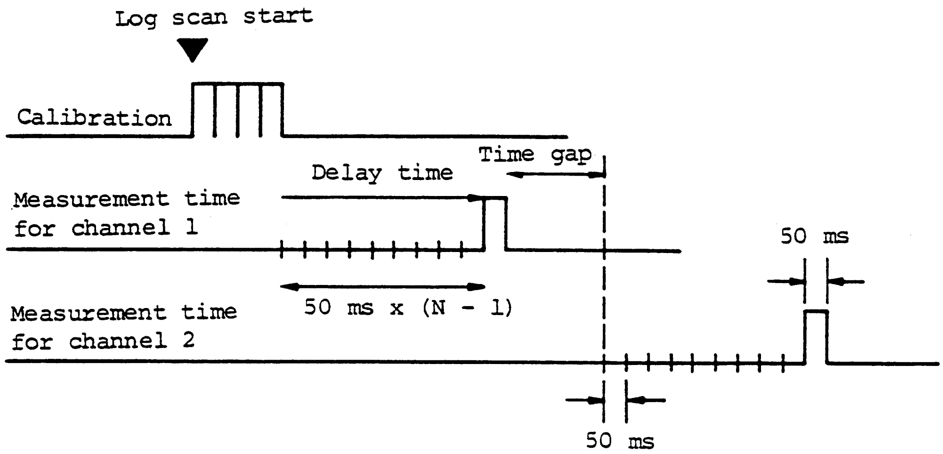


Fig. 3-30 Delay mode sequence by the filter function

The filter function is effective for all input channels. It is not possible to make it selectively effective for particular channels or sensor terminals. It is also effective in the log scan, monitor scan, and call channel modes.

(3) AUTO TIME

The Auto Time function will automatically start and/or stop log scan at specified start and/or stop times, which are specified in date, hour, and minute. The Auto Time function can be activated by operating the LOG key in the START/STOP section. In may, of course, be activated for only either of start and stop operations. If no date is specified, data logging can be started and stopped at specified times every day. (See Figure 3-31.) If the clock is selected in the timer mode, scan start and stop are controlled according to elapsed times from the measurement start.

The Auto Time function is not available for the multi-user log scan mode.

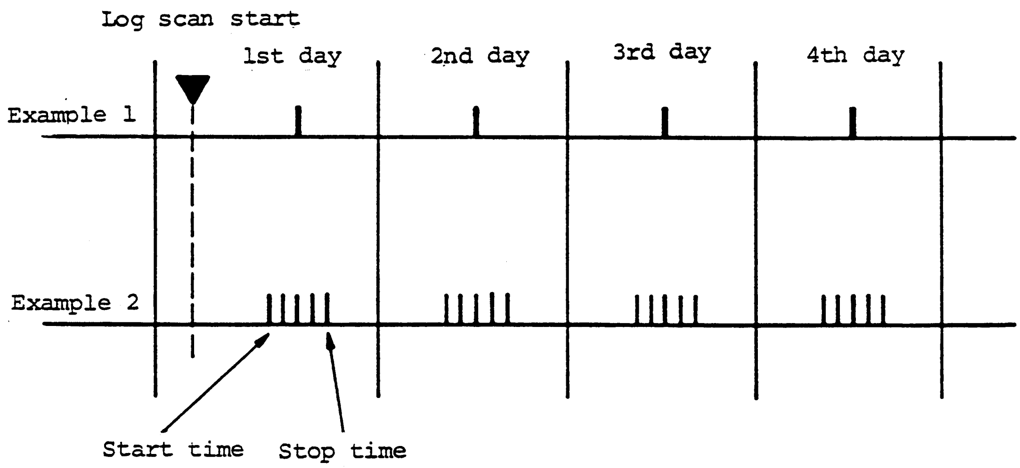


Fig. 3-31 Example of automatic log scan using the Auto Time function

(4) LABEL

Up to eight characters can be specified as a label and output upon each log scan together with time data. A label may denote an experimental number, tester's name, date of data acquisition, etc. and may be conveniently used as a data index. Specifiable characters are uppercase and lowercase alphabetic letters and numeric characters. They are output in the form of GPIB serial data stream other than BCD output. If the index number mode is specified, a label is followed by an index comprised of three digits of auto-incremental numeric characters. The index is incremented from 000 to 999 upon each log scan, so that data can be easily referenced by the index numbers.

The index is, however, not available for the multi-user log scan mode; the same label is attached to data of all user in this mode.

(5) CLOCK

The TR2731 contains a crystal-controlled clock to permit control or recording of the date, hour, minute, and second of data acquisition. Time information can be shown in the display or modify with front panel keys at any time. (Only date, hour, and minute are specifiable.)

The clock works in the clock mode or timer mode. When the timer mode is selected, the elapsed times from log scan start is delivered to the display and/or printer.

It is, therefore, usable for periodical data logging or elapsed time data acquisition synchronized with input signals. When the clock mode is selected, the clock indicates the present clock time except when log scan is busy, in which case the clock indicates the elapsed times from log start. If the timer mode is selected in the multi-user log scan mode, data logging can be controlled according to elapsed times for each user, while the elapsed time information is not displayed.

3-9-6. Data Output

The TR2731's data output functions are outlined inf Figure 3-32. Data logged by log scan or single scan can be output to external units such as a printer, CRT display or personal computer, at each scan in the BCD parallel form, serial character string or parallel character formats if required, as well as to the internal thermal printer.

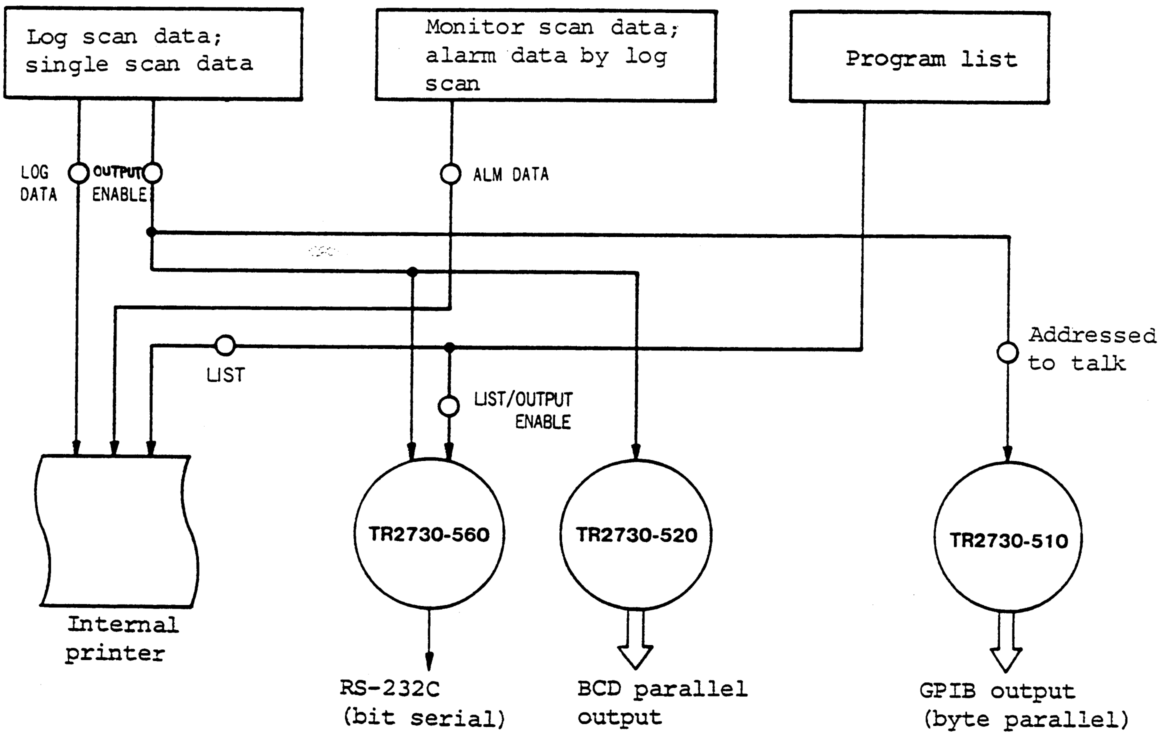


Fig. 3-32 Data output functions outline

While alarm printout data generated during monitor scan or log scan is delivered only to the internal printer, programming parameter lists can be output to an external unit via the serial output card. When more than one output unit is used simultaneously, data transfer is synchronized with the unit having the lowest speed.

The internal printer has a print speed of 2 lines per second and uses folded thermal paper. Figure 3-33 shows a printout example, wherein labels, measurement times, input channel numbers, data, units, and arithmetic types are printed in legible form. When continuous log scan is executed by using the TR2730-570 Data Buffer Memory option card, label, and time information are printed only at the beginning. While an input channel number printout contains one digit of terminal number and two digits of channel number, terminal number is not printed if the system uses only one terminal. In the multi-user log scan mode, a label printout is preceded by a user number, and paper feed automatically takes place after every printout of a single scan data.

Figure 3-34 shows an example of alarm printout obtained by monitor scan, wherein data of only the pertinent channel is printed when it exceeds the limit value and then returns to within the limit value.

Figure 3-35 shows a parameter printout example, in which the current programming information is printed in three categories.

If paper out is detected for the internal printer, the alarm lamp on the front panel of the instrument lights. After loading a new paper stack, press the RESET key to clear the alarm state.

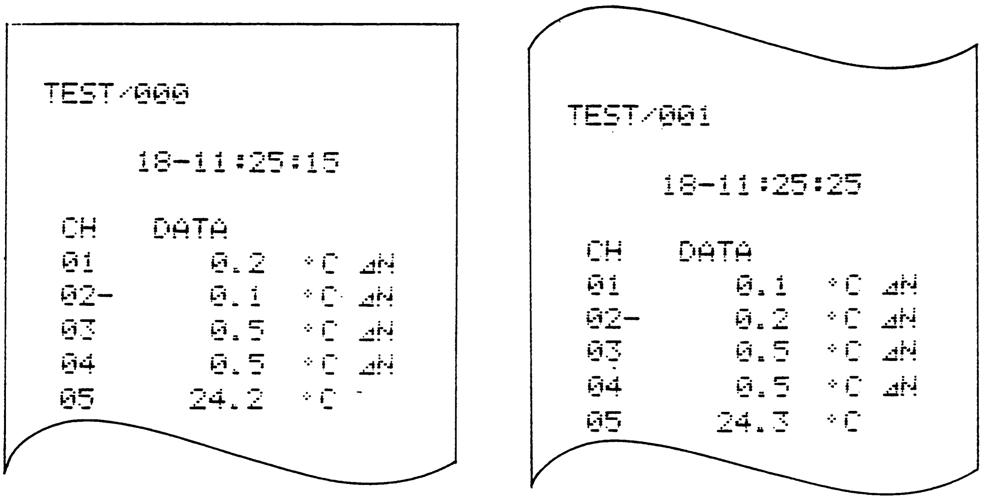


Fig. 3-33

```
TEST/

     18-11:38:30

 CH    DATA
 05      31.8   °C    H



TEST/

     18-11:39:10

 CH    DATA
 05      27.7   °C
```

Fig. 3-34

```
LOG INTERVAL
  00h00m30s    Single

SCAN CH.
  1      101ch-105ch

MONITOR INTERVAL
         00m10s All


FILTER
ST TIME         d  h  m
SP TIME         d  h  m
LABEL     TEST/
CLK/TMR         CLK
CALL CH         111
ALM COMMENT
   1      Low Batt.
   2     High Batt.


GROUP PROGRAM LIST

 1 105ch CC:T-int on
           ΔN    104
 2 110ch CC:T-int on

 3 120ch    20mV



LIMIT

  1 110ch MODE MON
     HI      30
  2 120ch MODE LOG
     HI   9.445
     LO   9.425
```

Fig. 3-35

3-9-7. Power Failure Countermeasures

When data logging encompasses a long time span or monitoring is the primary purpose, appropriate countermeasure against power failure is required. The TR2731 includes memory back-up for programming information and clock data and automatic restart upon power recovery. Programming information is kept intact for approximately one month by an internal battery. If the battery voltage drops below a certain level, message "LOW BAT." is shown in the display and delivered to the printer when the instrument is powered. And if power failure occurs when the POWER switch is set at LOCK position, the clock continues to work for up to 18 hours so that no reset in required within that period of time.

If power failure occurs during data logging and when the POWER switch is set at LOCK position, measurement is continued upon power recovery at the specified interval. (See Figure 3-36.) It should be noted, however, that a power failure will disturb continuity of computation since operation is restarted by assuming the data logged immediately after power recovery as the first data, if computation in the time domain was specified before the power failure.

If power failure occurs when the multi-interval, variable-interval or multi-user log scan mode is selected, measurement will restart upon recovering from power failure at the basic interval, instead of the programmed interval before the power failure occurred.

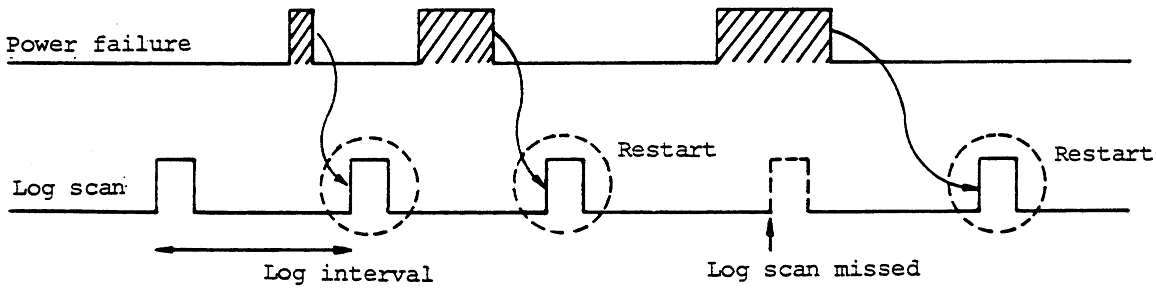


Fig. 3-36 Measurement restart sequence upon power recovery

3-10. COMPUTING FUNCTIONS

3-10-1. Computing Function Outline

The TR2731 Computing Data Logger provides three types of computing functions: i.e., linear scaling operation, primary arithmetic operation, and secondary arithmetic operation. These computing functions can be aribitrarily combined in tandem sequence.
Seven types of primary arithmetic operation and nine types of secondary arithmetic operation are available.
Any of these arithmetic types is selectable for individual input channel groups. In addition to the above arithmetic types, upper/lower limit identification operation is also available, which is used for over-limit channel detection or alarm printout.
Figure 3-37 shows the outline of computation processing for log scan data. Data linearized on the sensor terminal can be subjected to engineering unit conversion by scaling operation, primary arithmetic operation and/or secondary arithmetic operation. Processed data can be delivered to all output units at one time.
For example, it is possible to make time-domain operation on data which has been subjected to engineering unit conversion and then perform inter-channel computation using the secondary arithmetic operation. If upper/lower limit identification is specified for log scan, the identification is possible on the data after it is subjected to the primary arithmetic operation.

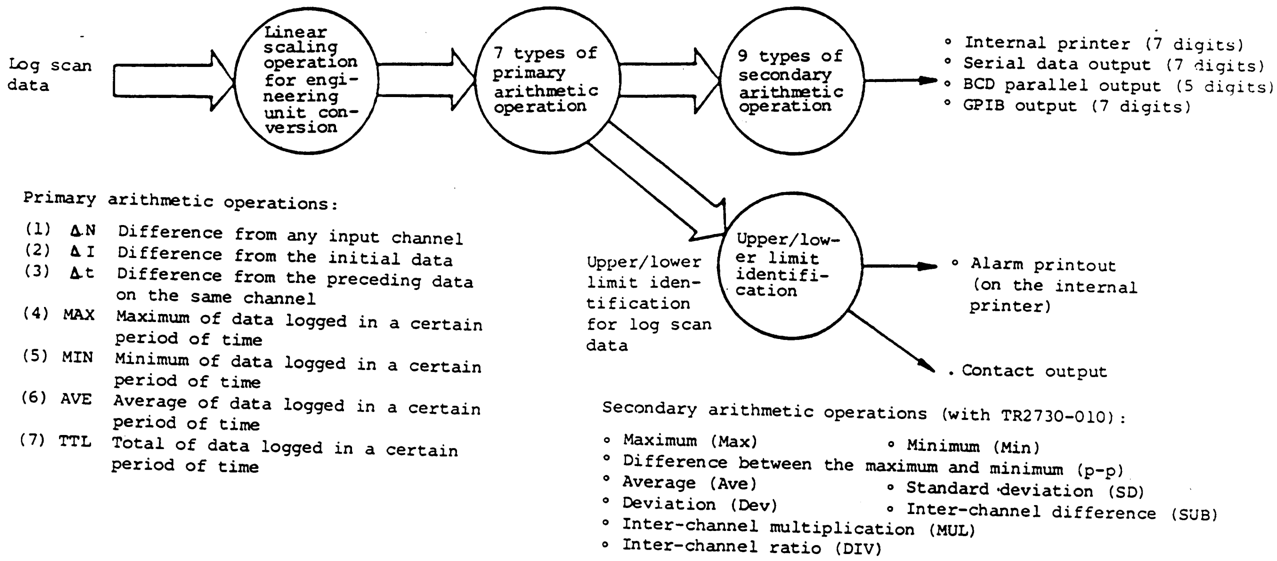


Fig. 3-37 Outline of computation on log scan data

Figure 3-38 shows an outline of computation processing for monitor scan data. In this case, the primary arithmetic operation is available only in inter-channel difference computation. The result of inter-channel difference computation can be output in the analog form or used for upper/lower limit identification.

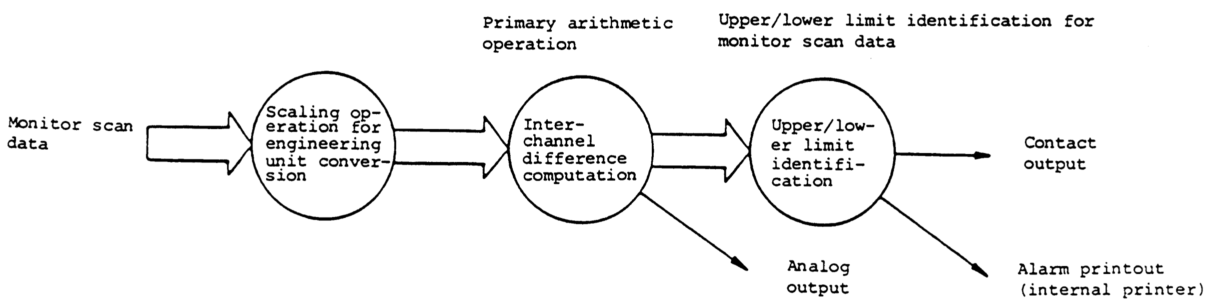


Fig. 3-38 Outline of computation on monitor scan data

Figure 3-39 shows the outline of input data display using the call channel function and of computation for single log scan data. While single log scan data can be output to all output units, it cannot be subjected to operations other than linear scaling.

Results of computation are, in principle, rearranged into the same number of significant digits as that of the measured input data (industrial quantities), with all insignificant digits rounded off. The number of significant digits or decimal places of data which has been subjected to computation may differ, however, from those of input data depending on the denominator (value B) for scaling operation or when the input data is subjected to multiplication or division for the secondary arithmetic operation. The maximum number of processable digits is seven. If the result of computation exceeds seven digits, only the most significant seven digits are output. A seven-digit output is not available for the display (up to 6 digits) or for BCD parallel output (up to 5 digits), however. Also for upper/lower limit identification, the most significant five digits of data are used for identification.

Special attention is required for computation of flag input or when the TR2730-520 BCD Output/External Control option card is to be used in the bit mode.

Since flag input is internally handled as 00001 for make contact and 00000 for break contact, it can be used for computation and upper/lower limit identification. Bit-pattern parallel input is internally processed as an eight bit binary number.

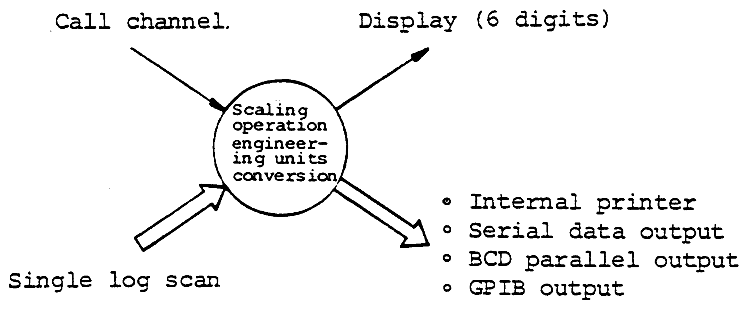


Fig. 3-39 Computation outline for single scan data and call channel function

For computation programming, input channels are sequentially divided into groups and then computation functions are specified for each of the groups. (See Figure 3-40.) For example, measurement range, linear scaling, engineering unit (up to 4 characters), primary arithmetic operation type, and secondary arithmetic operation types are specified for a specific channel group. Up to 40 groups can be specified. Specified computation are performed on all channels that belong to the same group.
Upper/lower limit identification can be performed on channel groups which are specified independently of the groups specified for computation.

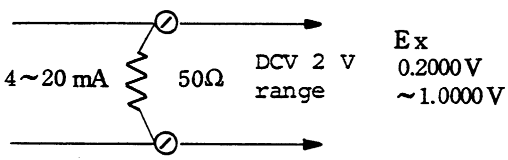
N−1						
Group number N	Boundary channel	Measure-ment range	Scaling operation	Engineer-ing unit specifi-cation	Primary arithmetic operation (mode)	Second-ary arith-metic op-eration
N+1						

Fig. 3-40 Group outline for computation programming

3-10-2. Linear Scaling Operation and Engineering Unit Conversion

For physical or chemical information acquisition, the input signal is generally converted into a normalized voltage or other instrumentation signal by sensors or transducers. The primary purpose of scaling operation is to express transduced signals in meaningful form having the engineering unit of the original input information. Scaling operation is executed by specifying constants A (offset) and B (span) for measured value X for equation (X-A)/B, where B must not be equal to zero. For example, if it is desired to express an instrumentation signal of 4 to 20 mA measured across a shunt resistor (50 Ω) in 0 to 100%, first specify constants A and B, then specify the unit of percent (%), as shown in Figure 3-41.

Scaling operation may also be used for arithmetic operations, cancellation of offset, enlargement of small signal variations or normalizing operation by selecting constants A and B appropriately. For example, sensitivity differences between sensors can be cancelled by first measuring the reference value (e.g. temperature) to determine the sensitivities of individual sensors and then selecting constants A and B according to the determined sensitivities. As shown in Figure 3-42, linearization characteristic can be corrected by scaling technique so far as the range to be corrected is small.



Scaling computation :

$$\frac{Ex - \overset{(A)}{0.2000}}{\underset{(B)}{0.0080}} = 0.00 \sim 100.00\,(\%)$$

Fig. 3-41 Instrumentation input measurement using the linear scaling function

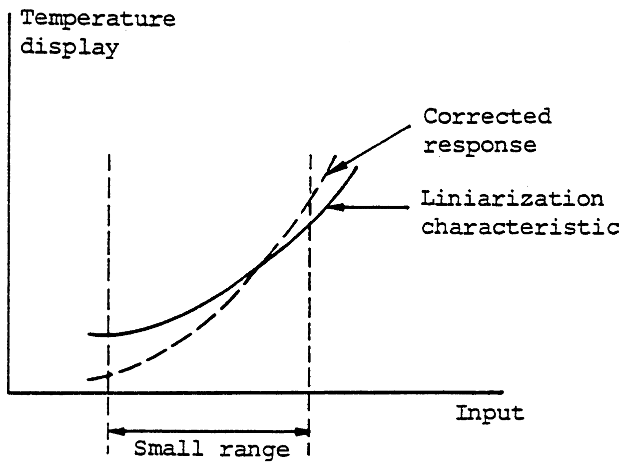


Fig. 3-42 Correction of small range of linearization characteristic using the scaling technique

For engineering unit specification, up to four uppercase or lowercase alphabetic letters and six types of symbols (Ω, slash (/), µ, %, µ˙, and space) can be used for each group. Specified engineering units are output to the GPIB Interface and Serial Data Output option cards if installed, as well as to the internal printer and display. Lowercase letters or special symbols, however, cannot be delivered to optional cards.
If the engineering units for each input group are apparent and need not be specified, programming characters may be used as tag names for input channels.

3-10-3. Primary Arithmetic Operation

The primary arithmetic operation includes seven types of operation: inter-channel difference (ΔN), difference from the preceding data (Δt), difference from the initial data (ΔI), maximum (MX), minimum (MN), average (AV), and total (TL). Any one of these operations can be specified for each input channel group. All operations other than the inter-channel difference operation refer to only one specific channel and performed in the time domain.

(1) Inter-channel difference computation (ΔN)
In the inter-channel difference computation, differences between all channels of a specified channel group and a reference channel are determined. The reference channel may belong to other channel group. In the multi-interval mode of multi-user log mode, however, difference from the previous data is determined. Care should be exercised if any operation is specified for the reference channel itself. When the reference channel is within the same channel group, the measured data itself is output. Inter-channel difference computation may be used to determine the differences from the room temperature or reference temperature, temperature difference between an inlet and exit, differential computation for thermal flow measurement or recognition of correlations.

For example, a sensitivity error of a temperature sensor can be determined by measuring the same temperature with the sensor to be tested and a calibrated sensor and computing the difference in the two sensor outputs. (See Figure 3-43.) It is possible to directly output error ratios by using the ratio calculation included in the secondary arithmetic operation.

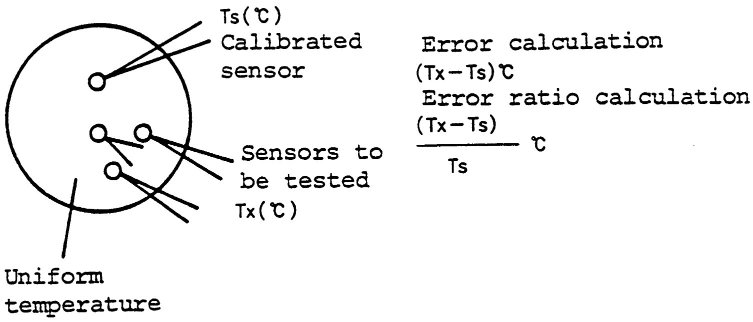


Fig. 3-43 Determining sensitivity error of a temperature sensor using the inter-channel difference computation

(2) Difference from the initial data (ΔI)

In this computation, difference between the first log scan data and the subsequent log scan data are determined. The initial output data is the measured data itself, and no upper/lower limit identification is performed on the data even if it is specified.

As shown in Figure 3-44, this computation may be effectively used for cancellation of offset, correction of input amplifier's imbalanced error, elimination of background, measurement of temperature difference after heating or cooling, and other similar cases where only variations from a reference start point are to be determined.

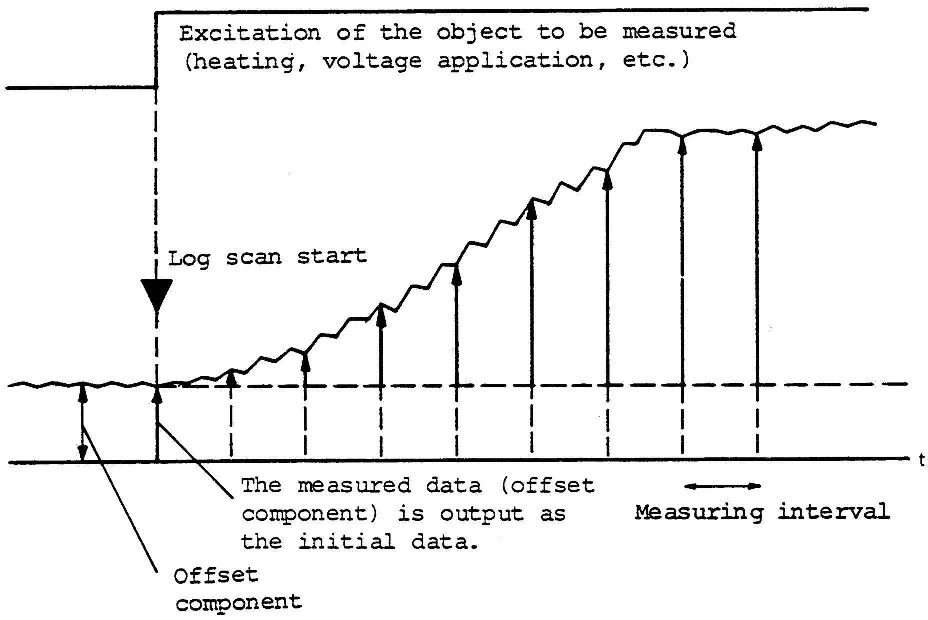


Fig. 3-44 Difference from initial data

(3) Difference from the preceding data (Δt)

In this computation, differences from the preceding data on the same channel are determined for all input channels of a specified group and time-differential data is output. If log scan interval is programmed appropriately, temperature variation per time unit, etc. can be determined. The Δt operation may also be advantageous for recognition of differential response or temperature gradient, evaluation of heating or cooling rate, or control response evaluation for temperature controllers. The first log scan data is output as the initial data which is not subjected to any operation, and no upper/lower limit identification is performed on the initial data.

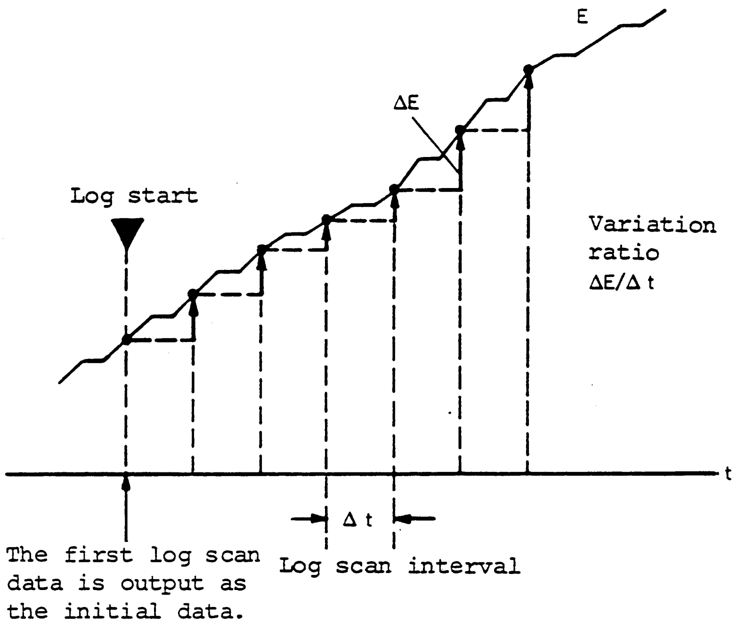


Fig. 3-45 Difference from the preceding data

(4) Maximum (MX), minimum (MN), average (AV), and total (TL) of data logged in a certain period of time
The MX, MN, AV, and TL computations are performed on the data obtained as a result of the specified number of log scan repetitions and for input channels of the same channel group.
As shown in Figure 3-46, a specific input channel is sampled by the specified number of times, and the operation result is output after the specified number of samplings is completed. No computation result is output during sampling and sampled data is not output. The first log scan data is exempted from the computation. If the sampling interval is short, the next sampling may be started before output of the operation result for the preceding sampling is completed. (See Figure 3-46.) To prevent this, sampling is halted during data output and is then restarted after data output is completed.
While sampling is halted, the data during that period will be lost. This will be avoided by buffering the data using the TR2730-570 Data Buffer Memory option card. Data output timing can be synchronized with other input channel groups with the multi-interval mode.

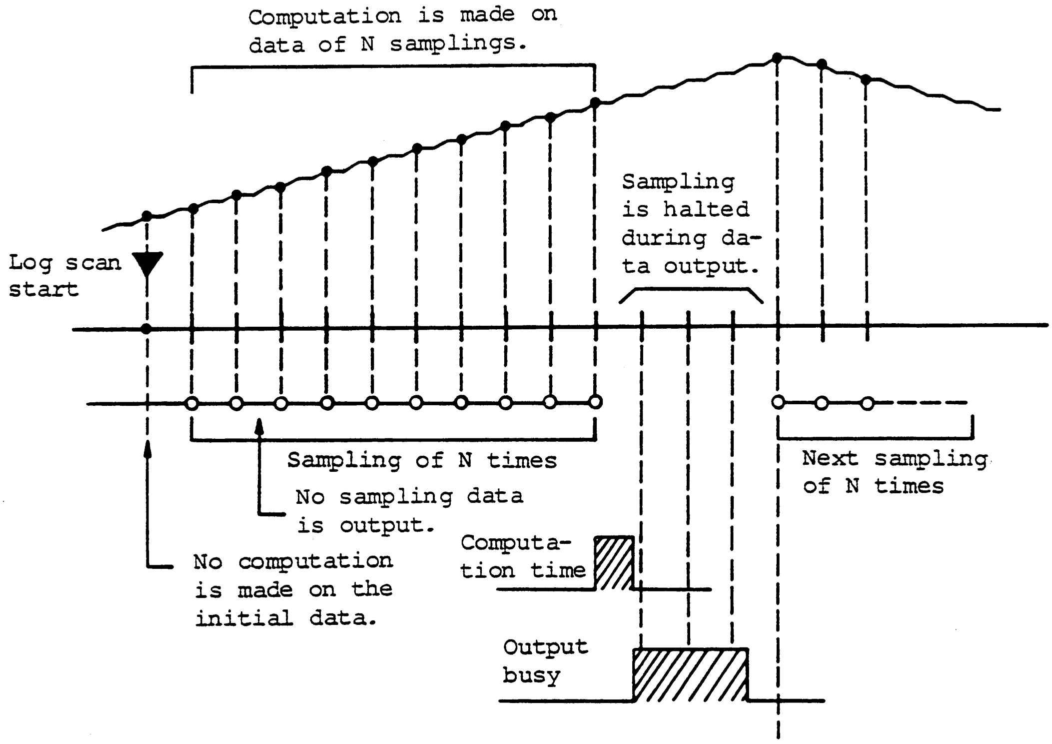


Fig. 3-46 Outline of the MX, MN, AV, and TL computations

The MX, MN, AV, and TL computations may be effectively used for measurement of peak and average values, sunlight or fluid flow, recognition of control response of temperature controllers, etc., or detection of data deviation or center value.

Only one operation can be performed on each channel group. If more than one type of operation (e.g. MX, MN, and AV) is desired for one channel group, the channel group must be treated as different groups for each computation type by connecting it in parallel to the sensor terminal.

Figure 3-47 shows an example of control response measurement for an electric foot warmer; Figure 3-48 shows an example of saturation point data logging for parts temperature cyclic test using the maximum value computation function.

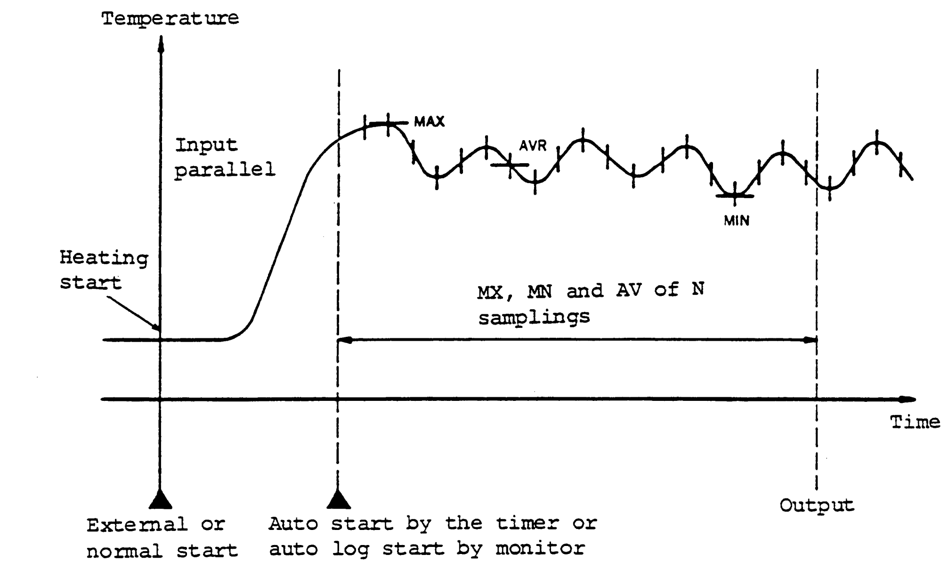


Fig. 3-47 Control response measurement for temperature controller

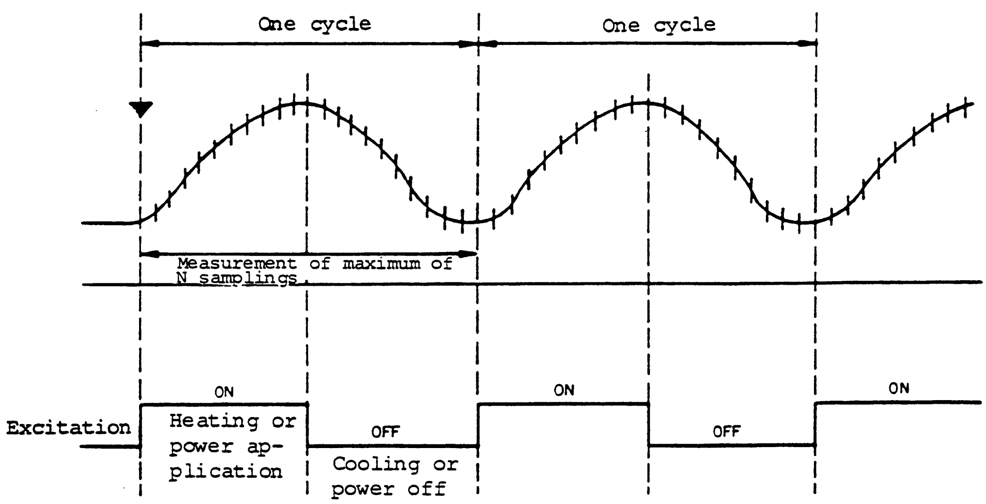


Fig. 3-48 Saturation point measurement for cyclic temperature test

3-10-4. Secondary Arithmetic Operation

Addition of the TR2730-010 Memory/Aux. Function option card to the system makes nine types of secondary arithmetic operations available: i.e., inter-channel difference (SUB), inter-channel multiplication (MUL), inter-channel division (DIV), maximum (Max), minimum (Min), average (Ave), difference between maximum and minimum (p-p), standard deviation (SD), and deviation (Dev). All these operations are performed between two or more channels which belong to the same channel group specified for the primary arithmetic operation. They are effectively used for computation of temperature distribution, average or deviation, and correlation with other channels.

For the Max, Min, Ave, Ripple (p-p), and SD operations, up to three types of operation can be specified for the same group. This makes it possible to obtain, say, the maximum, minimum, and average of log scan data at an arbitrary time.

The subtraction, multiplication and division operations are performed between a specified reference channel and other channels. The reference channel may be inside or outside a specific group to be operated.

The results of the secondary arithmetic operation are output in the group number order after the data subject to the primary arithmetic operation is output. If output of measured data is not necessary, it can be inhibited for each group. The secondary arithmetic operation is valid only to log scan data and upper/lower limit identification is not to be done on the operation results.

Since the secondary arithmetic operation is performed on data already subject to the primary arithmetic operation, it may be used for various applications in many combinations. Figure 3-49 shows an example of temperature dependence measurement achieved by combining the primary arithmetic operation's Δt computation and secondary arithmetic operation's DIV computation. Figure 3-50 shows an example of temperature variation measurement for an electronic oven or thermostatic oven. Figure 3-51 shows a printout example for the secondary arithmetic operation results obtained by the internal printer.

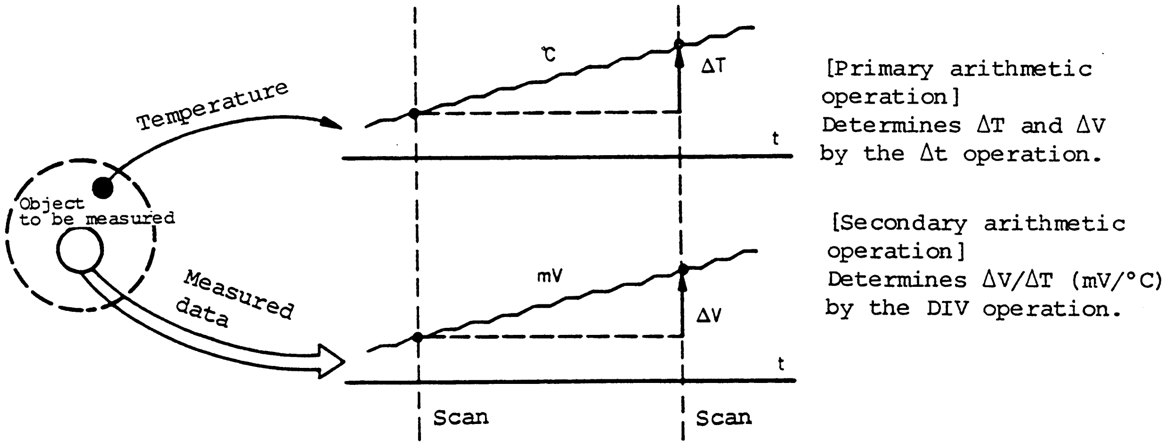


Fig. 3-49 Temperature dependence measurement using the primary and secondary arithmetic operations

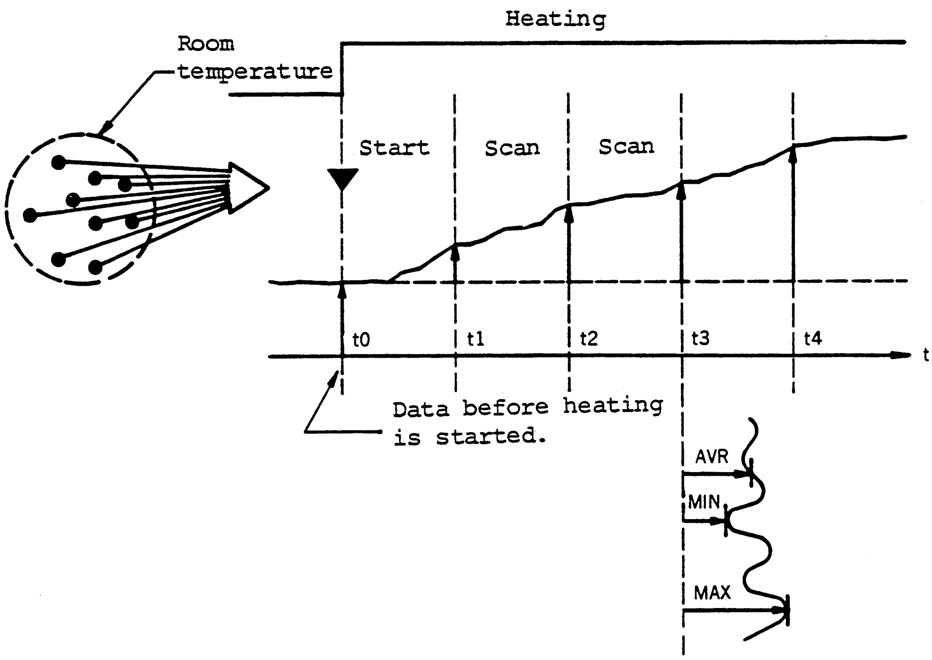


Fig. 3-50 Temperature variation measurement

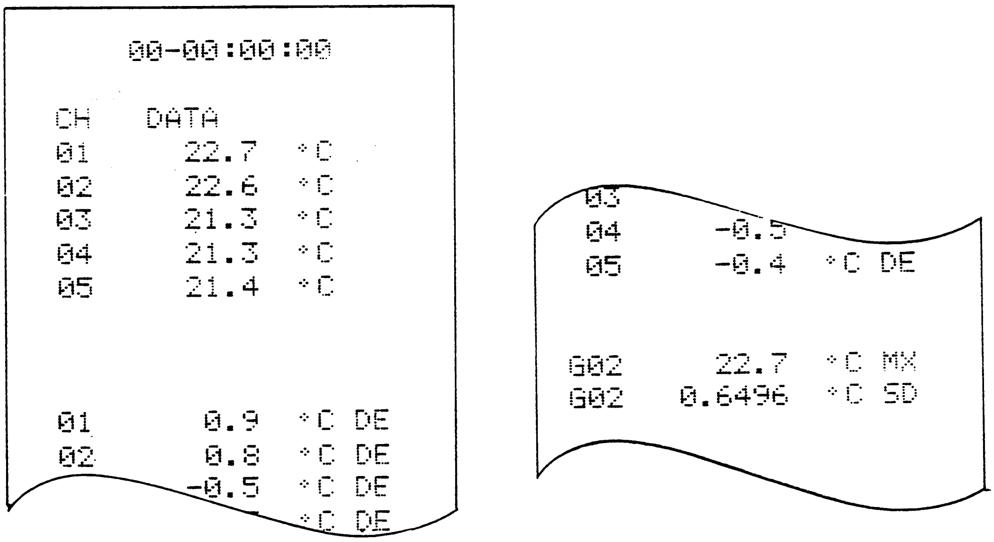


Fig. 3-51 Secondary arithmetic operation results printout example

3-10-5. Upper/Lower Limit Identification and Alarm Comment Output

The basic system configuration permits programming of upper and lower limit values with five digit numeric data with a decimal point, for up to 40 channel groups. When the limit alarm is detected for log scan data, upper/lower limit identification can be made on data subjected to the primary arithmetic operation. Contact status identification is also possible. Upper/lower limit identification is also performed on the sensor fault or over-scale data for thermocouples if limit values are specified.
Relays numbers on the TR2730-540 Relay Output option card are programmable for each of the upper and lower limit values for the same channel group. If more than one Relay Output option card is used, relay numbers from 1 through 80 can be specified consecutively. It limit identification is desired for inconsecutive input channels, available number of groups will be reduced since one group is required for channel skipping.

If an error is detected as a result of limit identification, details of the error can be delivered to print out in the form of a comment. Comments can be defined by up to 12 characters of alphanumeric letters and lowercase letters and can be registered in the memory which is backed up by a battery. Up to four comments can be registered in the memory, and comment numbers can be specified for each of the upper and lower limit values for one group. If a limit error occurs on the channel (group) for which comment is specified, the comment is delivered to the internal printer and the Serial Data Output option card if any. As shown in Figure 3-52, the comment is printed just above the data of the channel (group) on which the error has occurred.

Since lowercase letters and symbols are not available for serial data output, they are printed as follows:

, for o, R for Ω, U for μ, D for Δ , and Q for □.

An alarm comment is output when the alarm print mode is specified, or for log scan data for which upper/lower limit identification is specified.

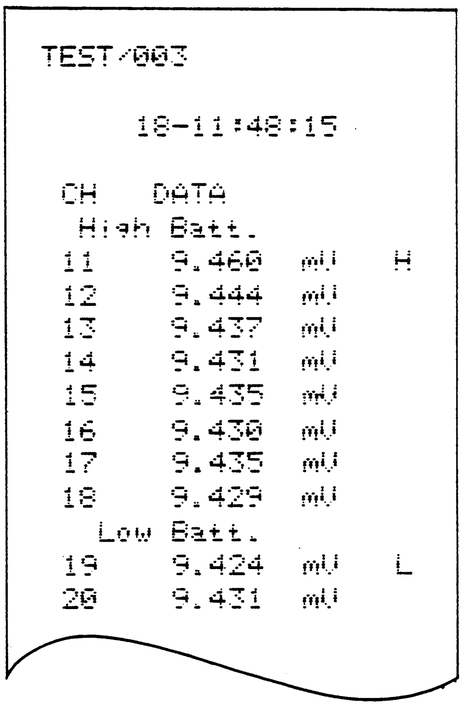


Fig. 3-52 Alarm comment printout example

3-10-6. Contact Input and Digital Input Processing

(1) Contact input

When contact data is read from the TR2741 Sensor Terminal, the corresponding data output on the printer appears as ON or OFF, whereas they are internally treated as 1 for ON and 0 for OFF. For example, if A = 0 and B = 0.1 is assumed for the scaling equation (X-A)/B, the results are 10 and 0, but they appear as On and OFF, respectively, on the printout.

It should be noted, however, that if A = 0.5 and B = 0.1 is assumed for the same equation, the results are 5 and -5, which both appear as ON on the printout.

The output to the TR2730-510 GPIB Interface and TR2730-520 BCD Output/External Control option cards is five digit numbers of 00000 for OFF and 00001 for ON.

(2) Digital input

When six digit data is input from an external unit via the TR2730-530 Digital Input option card, each data (up to 4 input data) is allocated to channels 501 through 504 and can be processed in must the same way as input data from the TR2741 Sensor Terminals. If input data is 8-bits, it is internally processed as binary data, but is output again in 8-bit form.

```
(e.g.) 11111111 = 255
       10110001 = 177
       00000110 =   6
```

For data output to the TR2730-520 BCD Output/External Control option card, the most significant five digits out of six input digits are output to the card, while the least significant five bits out of eight input bits are delivered to the card.

3-11. MAINTENANCE AND CHECK

This paragraph describes the basic operation check procedure, maintenance precautions, and error codes for the TR2731/2741 Computing Data Logger. After the instrument is serviced, be sure to perform the basic operation check before use.

3-11-1. Precautions for Maintenance and Repair

Before opening the outer cover of the instrument to check or repair, internal parts, be sure to set the POWER switch to OFF and unplug the power cable from AC receptacle. Utmost care should be exercised since power will remain in the circuit for a few minutes after the instrument is powered off due to the internal capacitance.
When transporting the instrument, protect it from excessive mechanical shock as it contains mechanically sensitive components such as fluorescent display tubes and a printer.

3-11-2. Self-Diagnosis Function

When the instrument is powered on, a self-diagnosis program is automatically executed. A flowchart for the self-diagnosis sequence is shown in Figure 3-9.
If everything is normal, all dots in the display will turn on a few seconds later. If any error is detected during the diagnosis sequence, the corresponding error message will be shown in the display. Take necessary action according to the following information.

(1) "LOW BAT." message

This message indicates that the internal battery voltage has dropped below the specified limit. This message may be shown if the instrument is used for the first time or it is left unused for more than one month.

If the "LOW BAT." message is displayed, temporarily turn off the POWER switch and then turn it on again. While all dots in the display are lit, press the CLEAR and SET/NEXT keys to erase and initialize the entire programming parameters.

After programming new parameters, leave the instrument powered on for more than eight hours to charge the internal battery.

If the instrument is powered off before the battery is fully charged, part or all of the programming parameters may be erased.

If the "LOW BAT." message is displayed even though the instrument is used every day or it is left powered on for more than eight hours, it is most probable that the internal battery is deteriorated and requires replacement. In this case notify your nearest ADVANTEST representative.

(2) "ERR xxxx xx" message

This message indicates that an error is detected during an internal memory read/write test or that the control and arithmetic program memory is malfunctioning. If this message is displayed, notify your nearest ADVANTEST representative.

When the self-diagnosis sequence is completed, all dots in the display are turned on.

As mentioned above, if the "LOW BAT." message is displayed or if you desire to erase all programming parameters for initialization, press the CLEAR and SET/NEXT keys while all display dots are turned on (approximately 5 seconds).

If the instrument is restored to its initial state with all programming parameters erased, the configuration of the TR2741 Sensor Terminals attached to the TR2731 and that of the optional cards installed in the TR2731 are checked and printed out on the internal printer.

If a printout test for the internal printer or panel key test is desired, press the [0] and [SET/NEXT] keys while all display dots are turned on just after the initial self-diagnosis sequence is completed. The display will show the "KEY TEST" message.

If the numbers indicated on each key in Figure 3-53 are shown in the display, the corresponding key contacts are normal.

Then, consecutive pressing of the [PROGRAM LIST] key three times will show the PRT. TEST message in the display and deliver a test pattern as shown in Figure 3-54 to the internal printer. If any error is observed while pressing the above key or during the printer test, notify your nearest ADVANTEST representative, as key or printer is supposed to be malfunctioning.

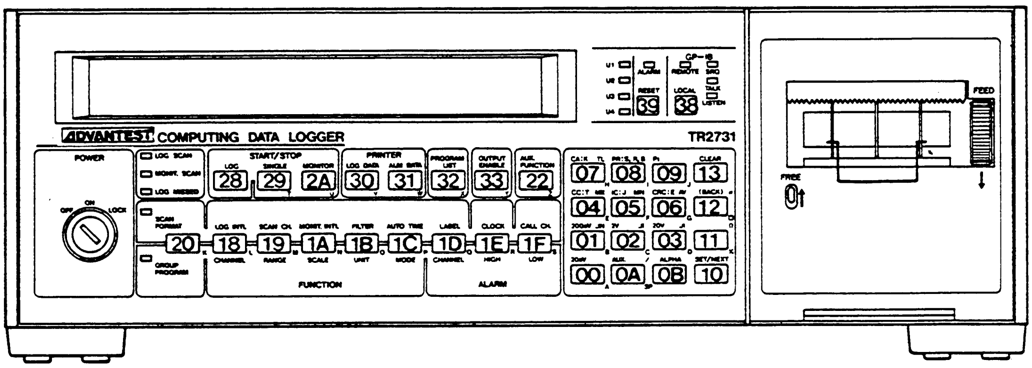


Fig. 3-53 Key check codes

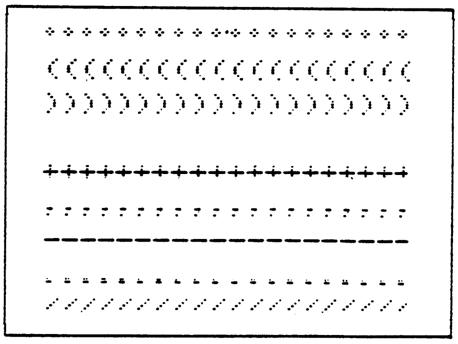


Fig. 3-54 Printer test pattern

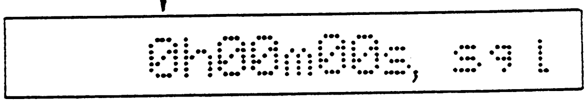
After the printer test is completed, press the SET/NEXT key three times consecutively. This will execute the sensor terminal and optional card configuration check the then place the instrument in the operation ready state. The key and printer test sequence can be repeated any number of times until the SET/NEXT key is pressed three times consecutively.

3-11-3. Routine Operation Check Procedure

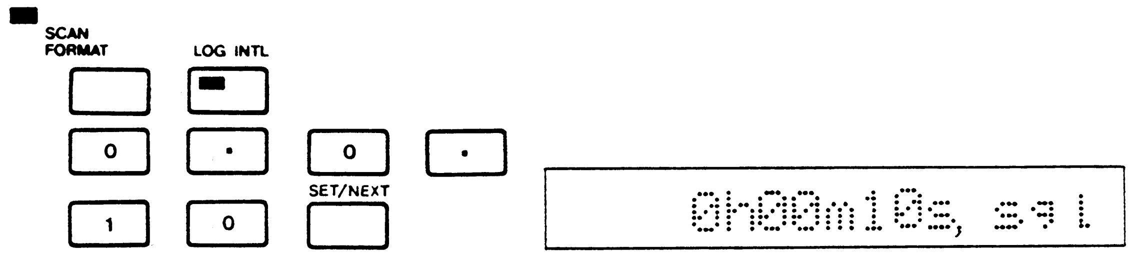
If the instrument is found to be normal after the diagnosis and test sequences described in the preceding item, then perform communication test between the TR2731 mainframe and TR2741 Sensor Terminal(s) in the following procedures:

① Short input channel 1 on TR2741's terminal 1.

Initial value
(or currently programmed value)

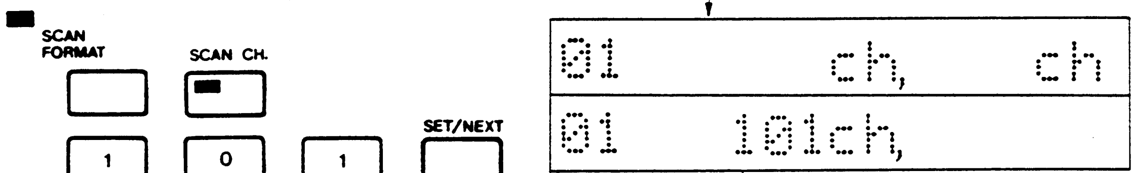


② Specify the log interval to 10 seconds and the log interval mode to Single with:



③ Specify channel 1 of terminal 1 for the scan channel with:

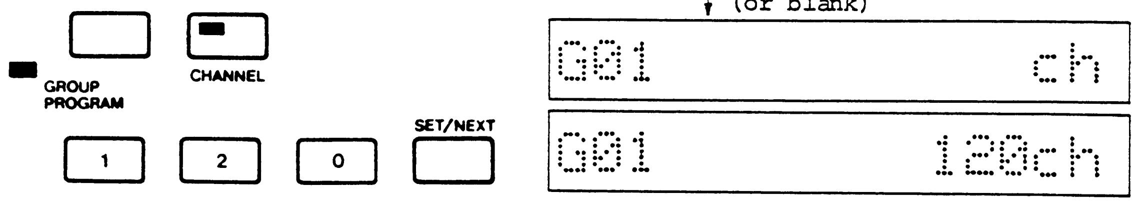
Currently programmed value
(or blank)



When only one terminal, no terminal number will be displayed.

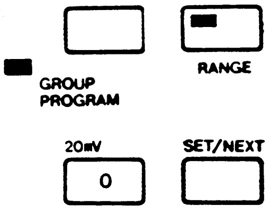
④ Specify channel 20 of terminal 1 for the group boundary channel with:

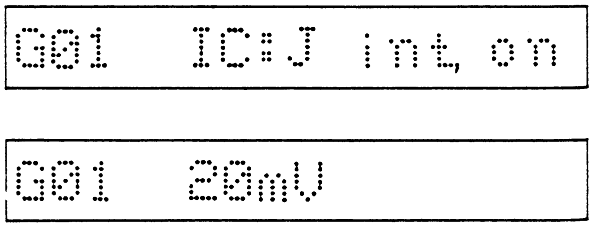
Currently programmed value
(or blank)



⑤ Specify the measurement range to

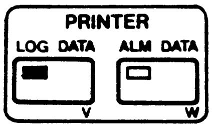
20 mV with:



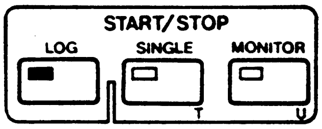


⑥ Output log data to the internal

printer with:



⑦ Command log scan start with:



A printout example is shown in

Figure 3-55.

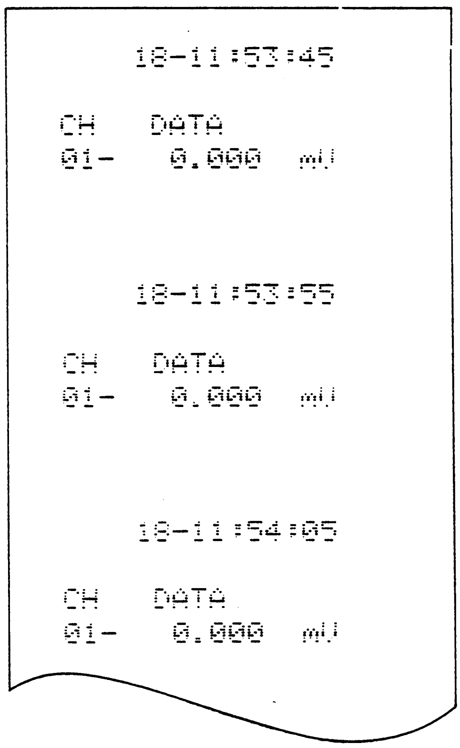
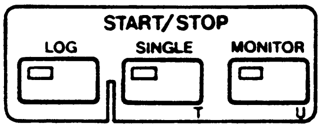
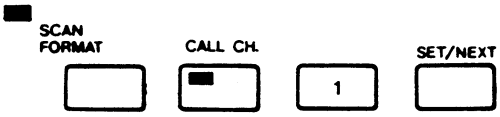


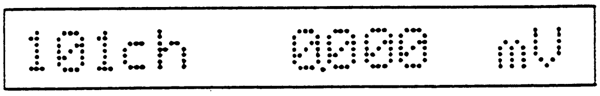
Fig. 3-55 Operation check printout example (1)

⑧ Stop log scan with:



⑨ Specify channel 101 for the call channel with:

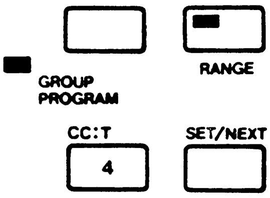


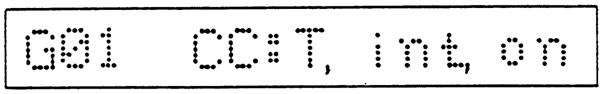


Make sure that the printout and displayed data is within 0.000 mV ±5 counts.

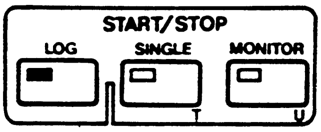
⑩ Next, check operations in a different measurement range.

Select the range T(CC) and activate internal compensation and linearization with:





⑪ Start the log scan with:



A printout example is shown in Figure 3-56.

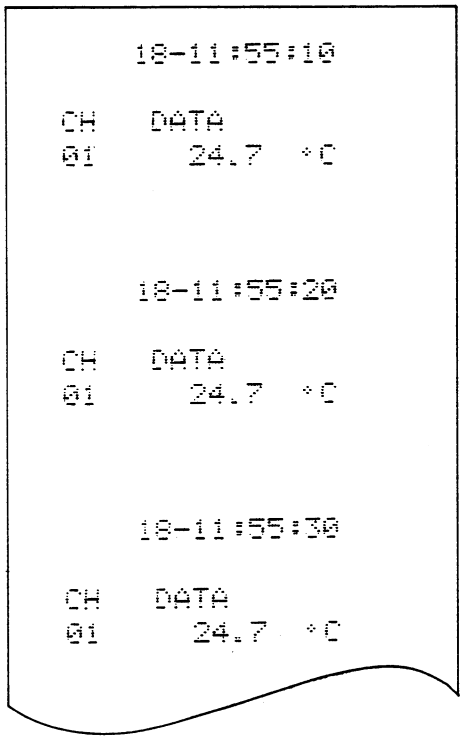
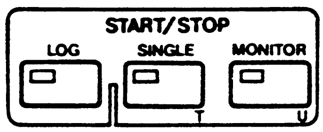


Fig. 3-56 Operation check printout example (2)

⑫ Stop the log scan with:



3-11-4. Problem Determination

If measurement or computation programming for the instrument are not correctly specified, or signal or ground wire connections to the TR2741 Sensor Terminals are not adequate, the correct measurement result may not be obtained. In such a case, determine the problem by referring to the operation manual and the troubleshooting procedure given in Table 3-2. If the problem persists, the instrument may be malfunctioning. Power off the instrument and unplug the power cable from its outlet, then notify your nearest Takeda Riken representative. The addresses and phone numbers are given at the end of this manual.

Table 3-2 Troubleshooting before calling for service

Symptom problem	Contents to be checked	Corrective action	Page for Reference
Power remains off though TR2731's POWER switch is set to ON.	Improper connection of power cable.	o Plug the cable firmly into its outlet.	1-6
	Blown fuse. Be sure to check the fuse with an ohm meter.	o Replace the blown fuse with the supplied spare fuse. If the fuse again blows when the instrument is powered on, notify your nearest ADVANTEST representative.	1-7
	Line voltage in out of the specified range.	o Operate within the correct line voltage.	1-6
POWER indicator lamp on the TR2741 Sensor Terminal remains off.	Improper cable connection to the TR2731 Mainframe.	o Correct the cable connection.	2-22
	POWER switch on the rear panel of the TR2741 is OFF.	o Set the POWER switch to ON.	2-10
	Blown fuse.	o Replace the blown fuse with the supplied spare fuse. If the replaced fuse again blows when the instrument is powered on, notify your nearest ADVANTEST representative.	1-7

Table 3-2 Troubleshooting before calling for service (Cont'd)

Symptom problem	Contents to be checked	Corrective action	Page for Reference
	Improper cable connection.	o Correct the cable connection.	2-22
		o Try to interchange the connections of the two connectors on the rear panel.	2-10
	Switch on the optional card is ON.	o Set the switch on the optional card to ON.	5-7 6-6 11-4
	Improper installation of the optional card.	o After installing the card into its slot, secure it firmly with retention screws.	12-23
Measurement fails to start though the LOG key in the START/STOP section is pressed (lamp in the LOG key remains off.).	No channels (SCAN CH.) to be measured are specified.	o Specify the desired scan channels in advance.	3-40
	The programmed stop time has already been passed when the clock mode is specified.	o Eliminate the programmed stop time or program it again.	3-53

Table 3-2 Troubleshooting before calling for service (Cont'd)

Symptom problem	Contents to be checked	Corrective action	Page for Reference
No output delivered though the LOG DATA key is activated.	Paper has jammed in the internal printer.	o Remove the jammed paper.	3-149
Only label and time data is printed out.	The AUX FUNCTION on the TR2730-010 option card is specified for source data output inhibit (off).	o Change the programming into source data output enable (on).	3-70
Measured data is not normal.	Improper connection of input signal lines to the TR2741 Sensor Terminal.	o Correct the connection.	2-26
	For thermocouple inputs, the selected range does not correspond to the type of thermocouple.	o Select the proper range.	2-34 3-60
	Improper scaling coefficient specified.	o Either specify the proper coefficient value or eliminate the scaling programming.	3-65

Table 3-2 Troubleshooting before calling for service (Cont'd)

Symptom problem	Contents to be checked	Corrective action	Page for Reference
LOG MISSED lamp comes on during log scan.	Log interval is specified for continuous. Interval programming is shorter than the scanning time plus output time.	o No action needed if log interval is continuous (0h: 0m: 0s). o Specify an interval longer than the scan time plus output time. (If the lamp comes on, it is not an instrument malfunction.)	3-22 3-29 3-21 3-85
Computation result is not normal.	Improper scaling coefficient specified. Inter-channel computation is not programmed for proper scan timing (for multi-interval mode, etc.).	o Correct the specification. o Specify the interval so that scanning executes simultaneously.	3-65 3-131
Results of upper/ lower limit identification (H/L) are not printed out.	Improper limit value specification. Log scan mode is not specified for limit identification.	o Correct the limit specification. o Specify the log mode when programming alarm group channels.	3-77 3-78 3-72 7-8

Table 3-2 Troubleshooting before calling for service (Cont'd)

Symptom problem	Contents to be checked	Corrective action	Page for Reference
No contact output obtained though contact output is specified for limit identification for monitor scan data.	Improper limit value specification (no computation other than N is performed).	o The I or t computation are not available for monitor scan data.	3-97 3-99
	Improper contact output channel number specification.	o Correct contact output channel numbers.	7-12
	Improper selection of the output mode switch on the TR2730-540 card.	o Select the correct output mode.	7-5
No data transferred to an attached external unit.	The OUTPUT ENABLE key remains inactive.	o Activate the key.	3-10 5-12 9-10
	When the TR2730-520 is used, its panel switch is OFF.	o Set the switch to ON.	5-7
	When the TR2730-520 is used, transfer rate selection is not correct. Transfer system (RS-232C for standard) is different.	o Output timing will differ depending on transfer rate and format. Check them again.	9-6
	Power to the external unit is off.	o Turn on the power.	

Table 3-2 Troubleshooting before calling for service (Cont'd)

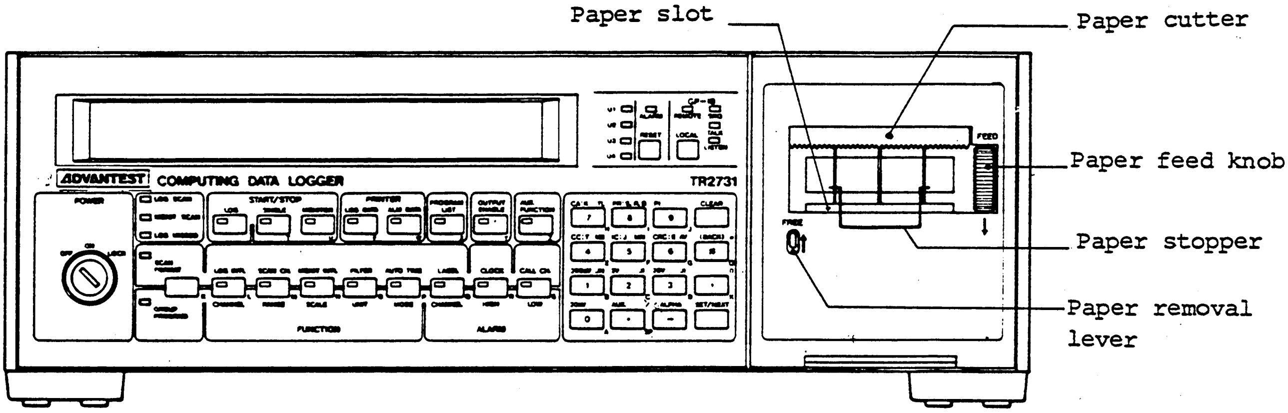
Symptom problem	Contents to be checked	Corrective action	Page for Reference
Measured data is not stable and greatly varies as time elapses.	Input terminal is touched.	o Allow several minutes before starting measurement (until temperature balance on the terminal board is restored.).	
	Terminal board is exposed to airflow or heat radiation.	o Cover the terminal board to protect it from direct exposure to airflow of heat radiation.	
	A sudden change has occurred in the ambient temperature.	o Wait until the temperature stabilizes.	
	Warm-up time is not sufficient.	o Allow more than 30 minutes for warm-up.	
	Improper input signal connection.	o Check input signal connection against the operation manual.	

Table 3-2 Troubleshooting before calling for service (Cont'd)

Symptom problem	Contents to be checked	Corrective action	Page for Reference
Measurement data deviates.	Grounded type sensors are used.	o Check with the item relating input connection procedure and take necessary action (if CMV is large.).	
	Improper line frequency selection.	o Select the correct local line frequency with the line frequency selector switch on the TR2741 rear panel. (The line frequency for the TR2741 may differ from that for the TR2731 Mainframe. To prevent line induction noise, select the TR2741's local line frequency.)	
Results of contact range measurement is always ON.	SENSOR OUT check switch on the TR2741 rear panel is OFF.	o Set the SENSOR OUT switch to ON.	
The printer is not operated.	When the paper was replaced, the paper was drawn so hard between the paper holder and the paper slot?	o Without the slack of the paper, feeding is not smooth. Pull out the paper from the paper holder and loosen the paper.	

3-11-5. Recording Paper Replacement Procedure

Upon receiving the instrument, load the supplied recording paper in the instrument's internal printer as shown in Figure 3-57. If the printer is operated with no recording paper, the printer may be damaged. Red marks are provided on both sides of the recording paper at one meter from the end of the paper. Replace the paper by using these red marks as a guideline.



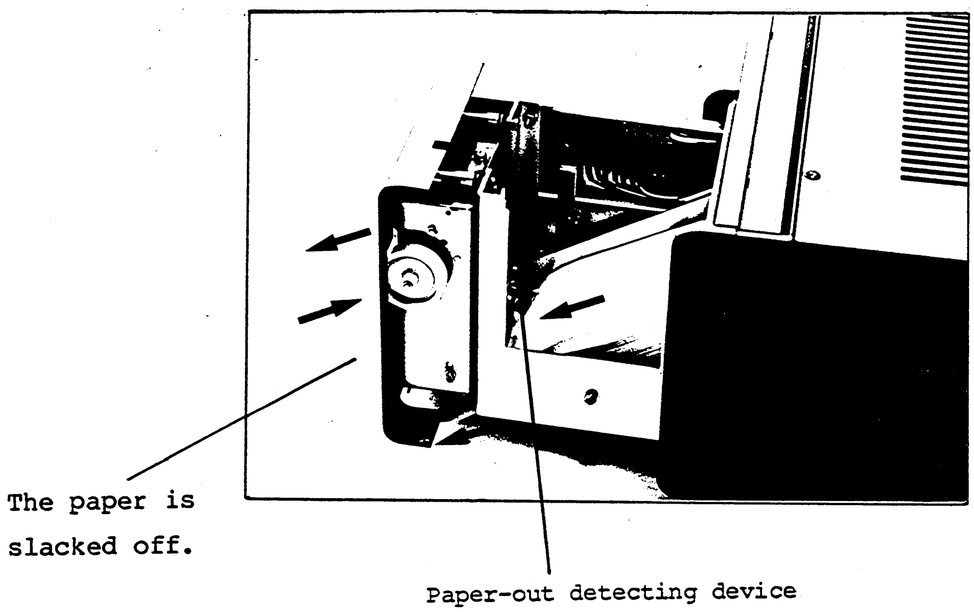


Fig. 3-57 Recording paper replacement procedure

Recording paper replacement procedure

① Pull the printer section forward.

② Remove the remaining papers by turning the FEED knob in the arrow direction.

③ Load the replacement paper in the paper holder with the correct side facing upward. The correct side is indicated by an arrow.

④ Thread the paper through the paper-out detecting device's pins and then insert it into the paper slot while turning the FEED knob in the allow direction.

⑤ Be sure to slack the paper between the paper holder and the paper slot. (See Figure 3-57)

CAUTIONS

1. If paper becomes jammed or is broken during printing, remove the paper while pressing the FREE lever in the arrow direction. Do not touch the FREE lever during printing.
2. Recording paper handling precautions:
   (1) Do not keep in a hot, wet place for a long period of time.
   (2) Do not expose to direct sunlight for a long period of time.
   (3) Keep away from organic solutions (thinners, alcohol, etc.)
   (4) Do not use a solvent bond for sticking.
3. If a PAPER OFF or PAPER JAM message is shown in the display during printing, press the RESET key on the front panel after reloading or correcting the paper.

3-11-6. The Fan Filter Cleaning

The TR2731 uses an inhaling type cooling fan, which exhausts air through the top and bottom ventilator. To assure optimum cooling efficiency, the fan filter requires cleaning once every one or two months.

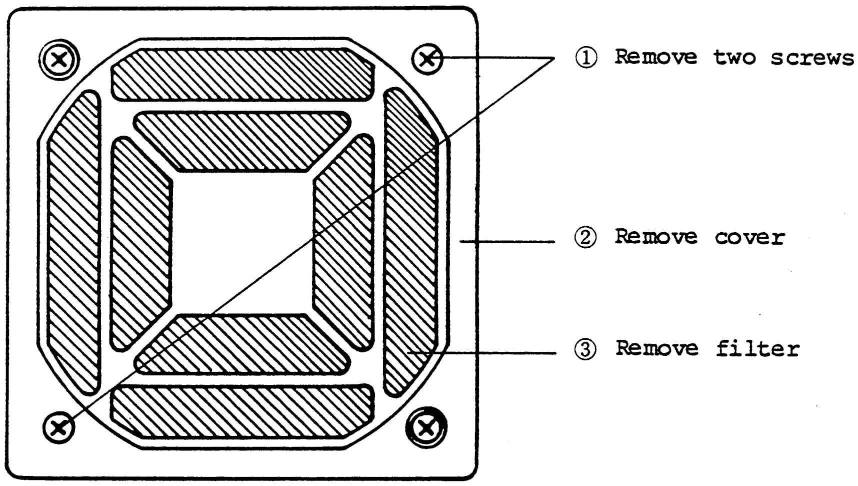
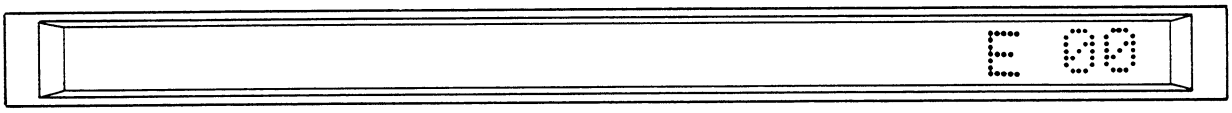


Fig. 3-58 The fan filter cleaning

Dust gathered on the filter can be removed by tapping the filter several times. If dust still remains, wash the filter in water. If the filter is washed, dry it completely before remounting it on the fan.

3-11-7. Error Codes

(1) If the front panel functions of the instrument are programmed wrongly or a wrong operation is made, the following error codes will be displayed according to each type of error:



Error message for programming
for the measurement start

Table 3-3 Error code table I (programming errors)

Display	Information
E 00	Key entry error Entry of an undefined code is attempted. (e.g.) The [ALPHA –] key is pressed while specifying the log internal.
E 01	A group number exceeding the maximum available group number is attempted to be programmed. (e.g.) [(BACK) #] [4] [5] [CHANNEL ▬] (max. 40 groups) (e.g.) [(BACK) #] [9] [LOG INTL ▬] (max. 8 groups in multi-interval mode)
E 02	Format error Error in programming format or procedure. (e.g.) [1] [,] [2] [,] [0] [SET/NEXT] The [·] key must be used for delimiting between hour, minute and second specification, instead of the [,] key.

Table 3-3 Error code table I (programming errors) (Cont'd)

Display	Information
E 03	Over specification error Programming is attempted exceeding the permitted range. (e.g.) [2] [5] [•] [0] [•] [0] [SET/NEXT] This programming exceeds 24 hours 00 minute 00 second. (e.g.) The permissible number of repetitions of sampling in the computation mode is 127. [4 (MX)] [,] [3] [0] [0] [SET/NEXT]
E 04	Double programming error When programming a scan, group or alarm boundary channel, a channel already specified for another group is attempted to specify for a boundary channel.
E 05	Addition or insertion error When programming a scan, group or alarm channels, an attempt is made to add or insert a group though all groups are already specified.
E 06	Channel error An attempt is made to specify channels beyond the current channel configuration. (e.g.) When only one sensor terminal is attached, the following programming is used to specify the scan channel: [2] [0] [1] [SET/NEXT] (e.g.) The following programming is used when the terminal's channel configuration is 40 channels: [5] [0] [SET/NEXT]
E 07	Option error Programming for an optional function is attempted even though no option card is installed. (e.g.) Specification of a relay number is attempted during upper/lower limit programming though the TR2730-540 Relay Output option card is not installed.
E 08	Insertion error When selecting a parameter other than scan, group or alarm channel, the [# (BACK)] [0] and [ ] keys are operated to obtain the insertion mode. (└ Parameter)

Table 3-3 Error code table I (programming errors) (Cont'd)

Display	Information
E 09	Modify error Modification to clock time is attempted during log scan.
E 10	Group error Other parameters from a group for which no group channel or alarm channel is specified, is attempted to read out.
E 11	Add error 1 Multi-interval boundary channels are not specified in ascending order while programming the log interval. A greater channel number in a section having a smaller number is attempted to specify. The interval changeover time for the variable interval is not specified in ascending order. A longer time interval in a section having a smaller number is attempted to specify.
E 12	Add error 2 Multi-interval boundary channels are not specified in ascending order while programming the log interval. A smaller channel number in a section having a larger number is attempted. The interval changeover time for a variable interval is not specified in ascending order. Specification of a shorter time interval in a section having a larger number is attempted.

(2) The following error messages are displayed for each type of error when the log or monitor scan is started or when the call channel is specified:

Table 3-4 Error code table II (error upon measurement start)

Display	Information
E 21	Measurement error 1 Multi-user log scan start is specified though the multi-interval mode is not specified. Simultaneous start/stop is specified for all users while measurement is carried out on one of the users. (e.g.) The following entry is made during scanning for user 1: (BACK) [#] [0] LOG [▬]
E 22	Measurement error 2 The LOG key in the START/STOP section is pressed without specifying boundary channels or times for multi-interval or variable interval mode.
E 23	Measurement error 3 Measurement restart is attempted while the preceding data is currently being output.
E 24	Measurement error 4 Measurement restart is attempted while the contents of the TR2730-570 Data Buffer Memory option card are being printed when its buffer is full or when log scan is stopped.
E 25	Measurement error 5 The LOG, SINGLE, or MONITOR key in the START/STOP section is pressed when no scan channels are specified. No channel range to be scanned is specified. No call channel is specified when the CALL CH. key is pressed.
E 27	Measurement error 7 Inadequate programming exists when the Automatic Start/Stop function is operating.

(Error code E26 is not defined.)

(3) If an error is generated during measurement or test, the following error messages are displayed according to the situation:

Table 3-5 Error code table II (error generated during measurement)

Display or printout	Information
LOW BAT.	Internal battery requires recharging.
ERR XXXX YY	An error is detected during the initial memory test. XXXX indicates the error address and YY indicates the error data.
OOOch SENS OUT	Indicates burnout or malfunction of a thermocouple sensor.
OOOch OVER	Indicates input overload.
OOOch LNR ERR	Indicates that the input data is beyond the capability of linearization.
OOOch RJC ERR	Indicates that the room temperature is beyond the compensatable range.
OOOch ETC ERR	Measurement is attempted in an uncalibrated range.
OOOch TRANS ERR	No data is transferred from the TR2741 (TR2741 is left turned off or the interconnecting cable is disconnected.).
OOOch COMP ERR	An operation error is generated within the TR2731 (for example, division by zero).
PAPER OFF	The recording paper has run out. (See the item relating to the recording paper replacement procedure.).
PAPER JAM	The printer motor is inoperative due to paper jamming, etc. (See the item relating to the recording paper replacement procedure.).
OOO ch PT ERR	For 3-wire RTD measurement, the resistance per wire exceeds 10 ohms.

SECTION 4

TR2730-010 MEMORY/AUX. FUNCTION OPTION CARD

4-1. GENERAL

The TR2730-010 Memory/Aux. Function option card provides additional memory capacity required when more than two TR2741 Sensor Terminals are to be attached to the TR2731 Computing Data Logger Mainframe, or additional computation programs.
This option card permits various statistical operations (maximum, minimum, average, difference between maximum and minimum, standard deviation, and deviation) including inter-channel subtraction, multiplication and division operations for data of a specified group logged at the same time. In addition, it permits the above-mentioned secondary arithmetic operations on data after being subjected to scaling and/or primary arithmetic operations, thereby meeting a broad application requirements.

4-2. SPECIFICATIONS

Input channels: Max. 320 channels (with four TR2741B's)
Secondary arithmetic operation types: Up to 9 types of operations and printout control can be selected for each of up to 40 function groups:

(1) Inter-channel subtraction (SUB) Xn-Y
(2) Inter-channel multiplication (MUL) Xn·Y
(3) Inter-channel division (DIV) Xn/Y
(4) Maximum of a group (Max) $X_{MAX.}$
(5) Minimum of a group (Min) $X_{MIN.}$
(6) Average of a group (Ave) $X_{AVE.}$
(7) Difference between Max and Min (p-p) $X_{MAX.}-X_{MIN.}$
(8) Standard deviation in a group (SD) $\sqrt{\frac{1}{N}\Sigma(Xn-\bar{X})^2}$
(9) Deviation of each channel (Dev) $Xn-\bar{X}$
    Xn: Data of the pertinent channel
    Y : Data of the specified channel
(10) Inhibition of raw data output

Number of digits and position of decimal point for operation result:

For addition and subtraction, operation results have the same number of digits as the input data having a smaller number of decimal places. For multiplication, the number of decimal places of a multiplicand is identical to that of the decimal places of the result. However, if the result exceeds seven digits, the most significant 7 digits are output.

For division, the number of digits of the results depends on the divider as follows:

$1 \leqq$ divider < 10 --- Same as the number of decimal places of the dividend.

$10 \leq$ divider ------- The number of decimal places is increased by the number of integral digits of the divider minus 1.

$1 >$ divider -------- The number of decimal places is decreased by the number of zeros in decimal places of the divider plus 1.

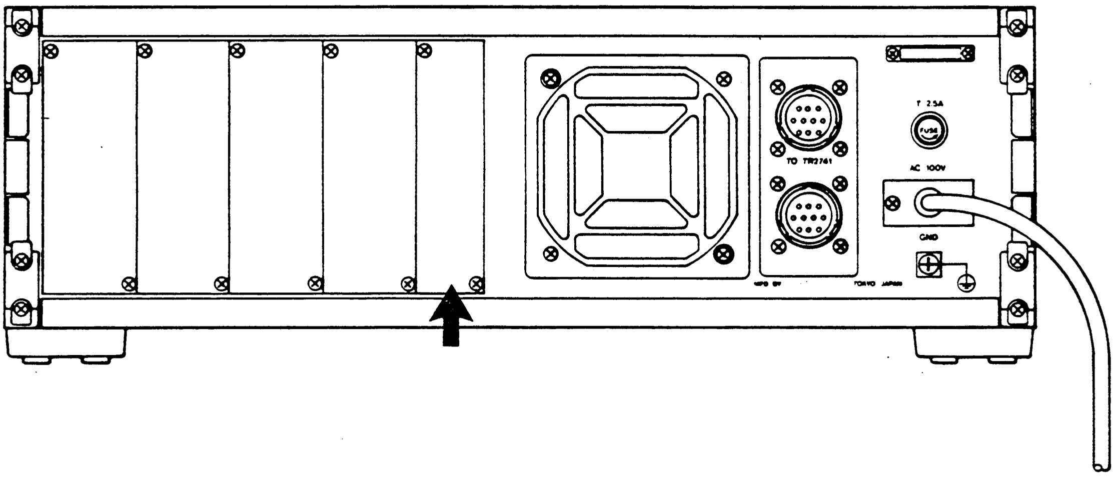
For standard deviation, up to four decimal places are output. However, if the result exceeds seven digits, the most significant 7 digits are output.

Alarm comment : Up to four types of alarm comments defined by up to 12 characters string can be specified for each limit identification group. These alarm comments are printed out during measurement error.

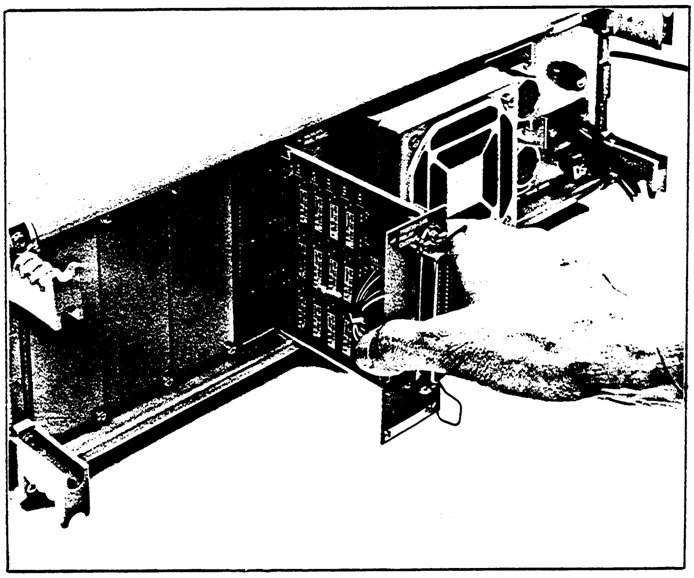
4-3. INSTALLATION PROCEDURE

The TR2730-010 option card is inserted into the card slot on the rear panel of the TR2731 Mainframe and secured with two retention screws. The installation procedure is illustrated in Figure 4-1.

① Remove the blank panel indicated below from the rear panel of the TR2731 Mainframe.



② Place the bottom of the option card on the board guide and insert the card fully into the slot. After plugging the card-edge connector into the slot connector, secure the card with the two retention screws.



This photo indicates another option card.

Fig. 4-1 Option card installation procedure

4-4. OPERATING PROCEDURE

For the detailed operating procedures for the TR2730-010 option card, refer to paragraph 3-6 "Basic Programming Procedure (FUNCTION)", item 3-6-6 "Secondary Arithmetic Operation (AUX. FUNCTION)", paragraph 3-7 "Basic Programming (ALARM)" and item 3-7-4 "Alarm Comment."

SECTION 5

TR2730-520 BCD OUTPUT/EXTERNAL CONTROL OPTION CARD

5-1. GENERAL

The TR2730-520 BCD Output/External Control option card provides BCD parallel output of 3-digit channel numbers and 5-digit data. High speed data transfer to external units is permitted by the parallel output capability. In addition to channel numbers and data, the card also outputs function codes indicating data types and polarity, decimal point position code, and unit codes. This option card also accepts external control signals such as a measurement start signal for individual users in the multi-user log scan mode, that for single user log scan mode and a measurement interval programming signal. In addition, the card can activate scanning valves by utilizing the scan step signal output.

5-2. SPECIFICATIONS

Output signals	: o Terminal number (1 digit), channel number (2 digits), data (5 digits), and clock time (8 digits), plus user number (1 digit) for multi-user log scan mode; 8 digits, 4-wire BCD code o Function code (1 digit); 4-wire BCD code o Unit code (1 digit); 4-wire BCD code o Decimal point position code; 3-wire BCD code, Decimal point polarity; single wire
Connector	: Amphenor 50-pin connector (57-40500) Mating connector (57-30500)
Output level	: TTL compatible, positive logic
Output strobe	: TTL compatible, positive pulse (approx. 500 μs in pulse width)
Data request input:	TTL compatible, positive pulse (more than 100 μs in pulse width)
Time-out interval	: 10 sec.
Pin assignment	: See Figure 5-1.
Output code table	: See Tables 5-1, 5-2, and 5-3.

External control inputs: Non-voltage make contact signal with chattering of less than 30 ms and pulse width of more than 100 ms

- o Start/stop pulse (for single user mode)
- o Multi-user start/stop (4-wire)
- o External interval command

External control outputs: Make contact signal with a common return, 0.2 A/50 Vdc

- o Scan start pulse with pulse width of approx. 100 ms
- o Scan end pulse with pulse width of approx. 100 ms
- o Scan step pulse with pulse width of approx. 20 ms
- o Log status (makes during log busy)

Connector : Amphenor 14-pin connector (57-40140)
Mating connector (57-30140)

Pin assignment : See Figure 5-2.

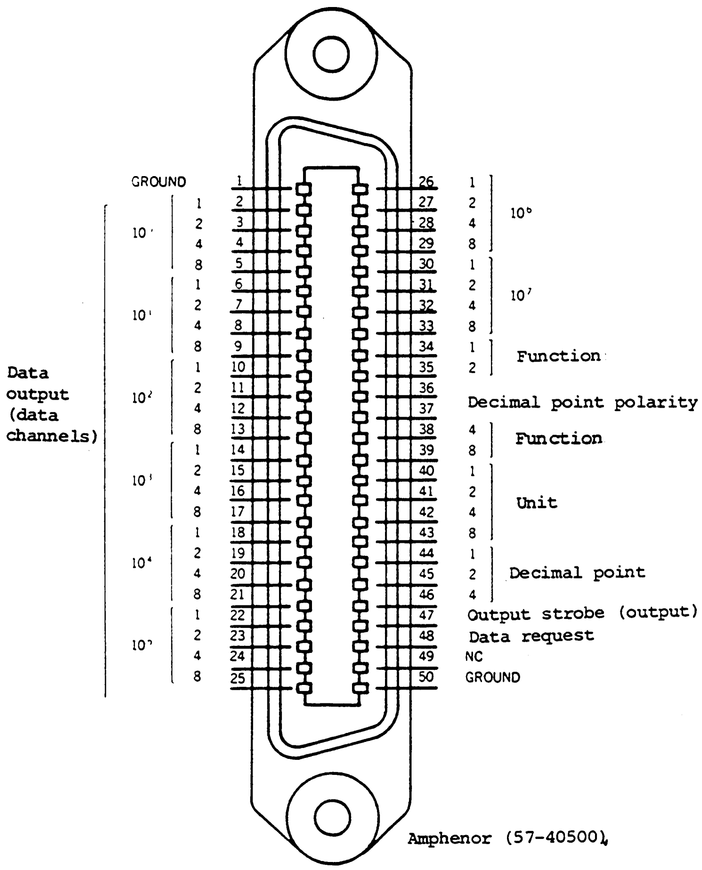
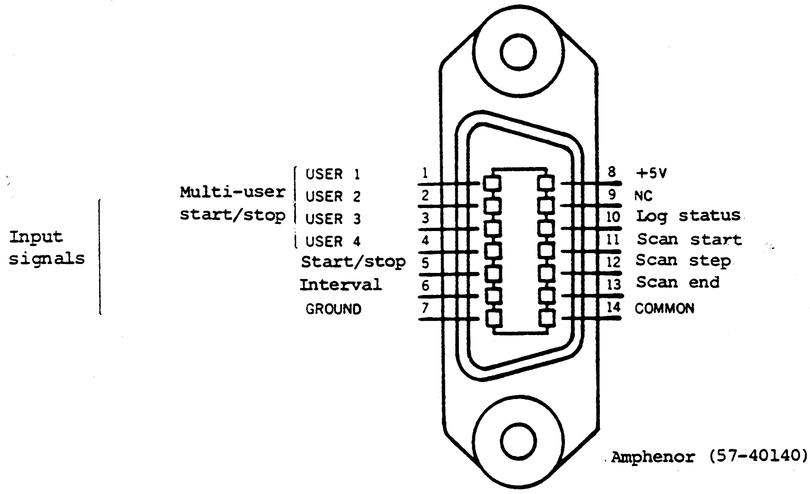


Fig. 5-1 Output connector pin assignment



CAUTION

The +5 V supply applied to pin 8 of this connector is for maintenance purpose only. When wiring external signals to this connector, ensure not to short this pin with other pins.

Fig. 5-2 External control signal connector pin assignment

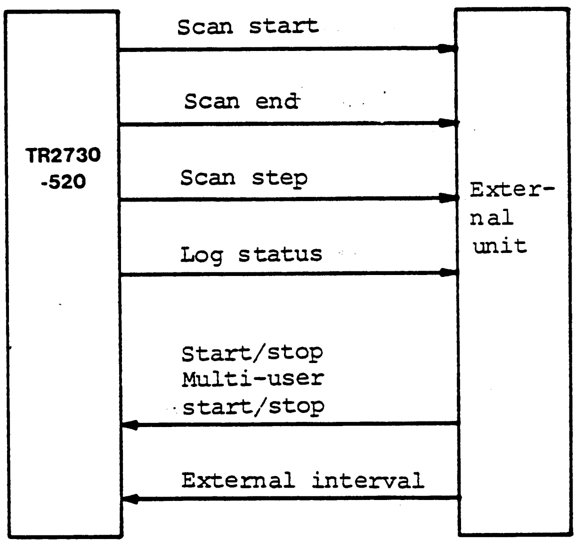


Fig. 5-3 Directions of external control signals

Table 5-1 Function code table (pin numbers 34, 35, 38, 39)

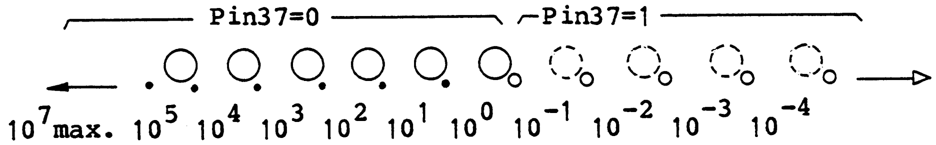
HEX	BCD code				Meaning	Remarks (data output)
	39	38	35	34		
0	0	0	0	0	Data fullscale over	Data information indefinite
1	0	0	0	1	Data polarity positive (+)	For data exceeding 5 digits, the most significant 5 digits are output. For flag input, 00001 when it makes, and 00000 when it breaks.
3	0	0	1	1	Data polarity negative (-)	
8	1	0	0	0	Thermocouple sensor fault	Data information indefinite
9	1	0	0	1	Data transfer error occurring during transfer to a sensor terminal	Data information indefinite
A	1	0	1	0	Signifies check time data.	Eight-digit output of day, hour, minute and second
B	1	0	1	1	Signifies a user number.	Digit 0 of data output is 1 to 4, and all other digits are 0.
E	1	1	1	0	Data end code	All data output digits are hex F.

Table 5-2 Unit code table (pin numbers 40 to 43)

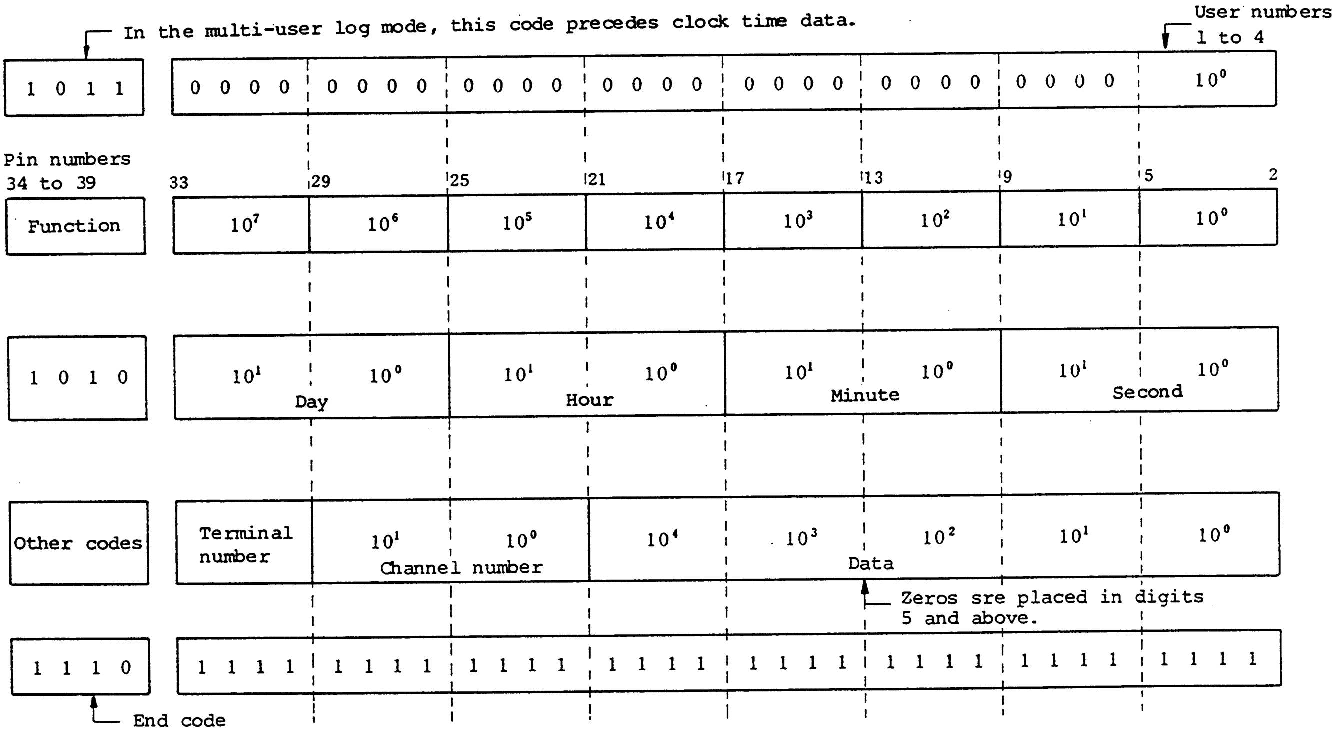
HEX	BCD code				Unit
	43	42	41	40	
0	0	0	0	0	mV
2	0	0	1	0	V
3	0	0	1	1	°C
F	1	1	1	1	Other units

Table 5-3 Decimal point position code table
(pin numbers 44 through 46, 37)

BCD code				Decimal point position
37	46	45	44	
0	0	0	0	10^0
0	0	0	1	10^1
0	0	1	0	10^2
0	0	1	1	10^3
0	1	0	0	10^4
0	1	0	1	10^5



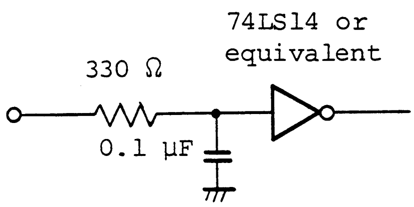
Note: If pin 37 is set to 1, the decimal point shifts right.



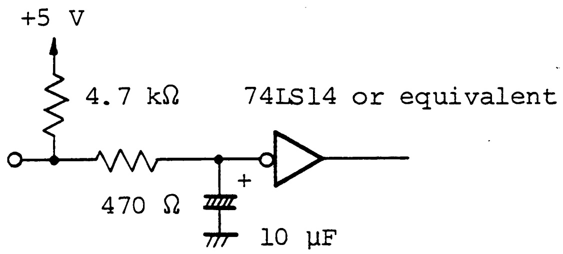
Input/Output Circuits

Input circuits

o Data request input

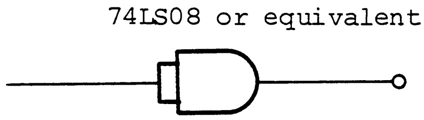


o Start, interval, or other
external control inputs

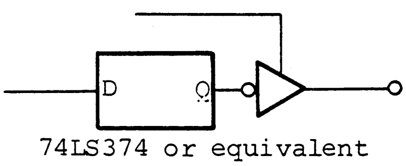


Output circuits

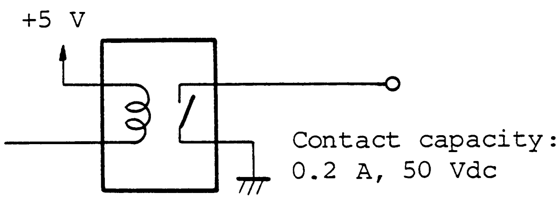
o Data output strobe output



o Data output



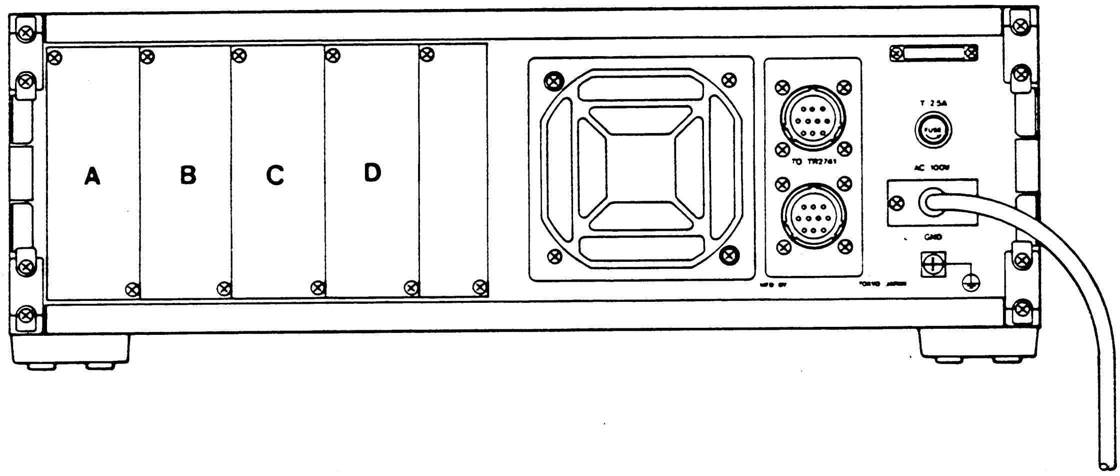
o Status output
Pulse output



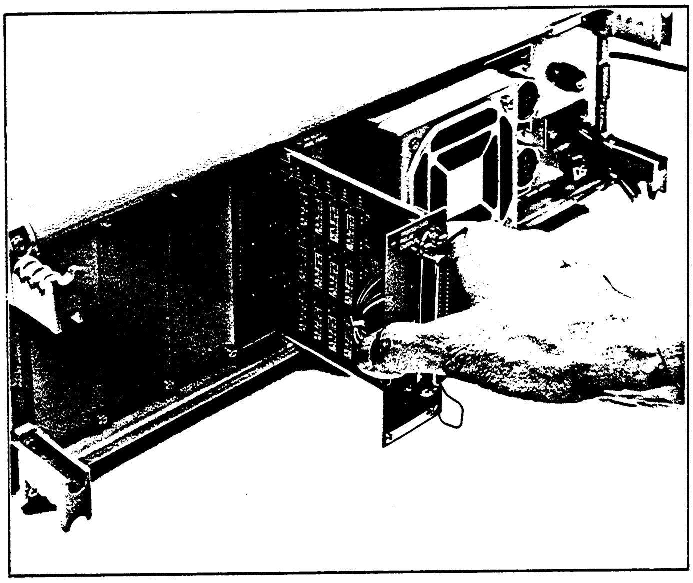
5-3. INSTALLATION PROCEDURE

The TR2730-520 BCD Output/External Control option card is installed in the card slot on the rear panel of the TR2731 Mainframe and is secured with two retention screws. The installation procedure is illustrated in Figure 5-4.

① Remove one of blank panels A, B, C, or D from the rear card slot on the rear panel of the TR2731 Mainframe.



② Place the card on the board guide in the slot and insert the card fully into the slot. After plugging the card into the slot connector, secure it with the two retention screws.



This photo shows another option card.

Fig. 5-4 Option card installation procedure

5-4. DESCRIPTION OF CARD PANEL

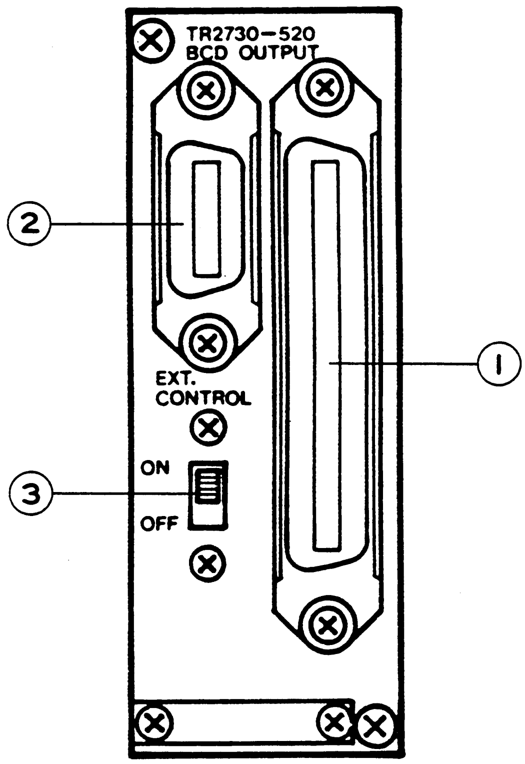


Fig. 5-5 TR2730-520 option card panel

① BCD output connector

This connector provides BCD output of data and some other signals. It uses a 50-pin receptacle (Amphenor 57-40500).

② External control connector

External control input/output signals are available on this connector. It uses a 14-pin receptacle (Amphenor 57-40140).

③ ON/OFF switch

This switch enables (ON) or disables (OFF) BCD output. If no BCD output is required, set this switch to OFF.

This switch has no effect on external control input/output.

5-5. INFORMATION OF DATA OUTPUT SEQUENCE

The TR2730-520 option card can provide BCD parallel output of five digits data and three digits channel-number for single log scan. In addition, the option card also outputs a function code indicating data type and polarity, decimal point position code, and unit code along with data.

When data is logged by log scan, clock time data is first output, which is followed by measurement information, and finally an end code. In the multi-user log scan mode, clock time data is preceded by a user number. No label, non-standard unit, computation mode or program list are output. Data output timing is shown in Figure 5-6.

Data is output together with an output strobe signal. Upon receiving a data output request from an external unit, the card outputs the next data. The next log scan sequence is not started until all measurement information is output. If no data output request is received within the time-out interval specified for the TR2731, the data output sequence is interrupted.

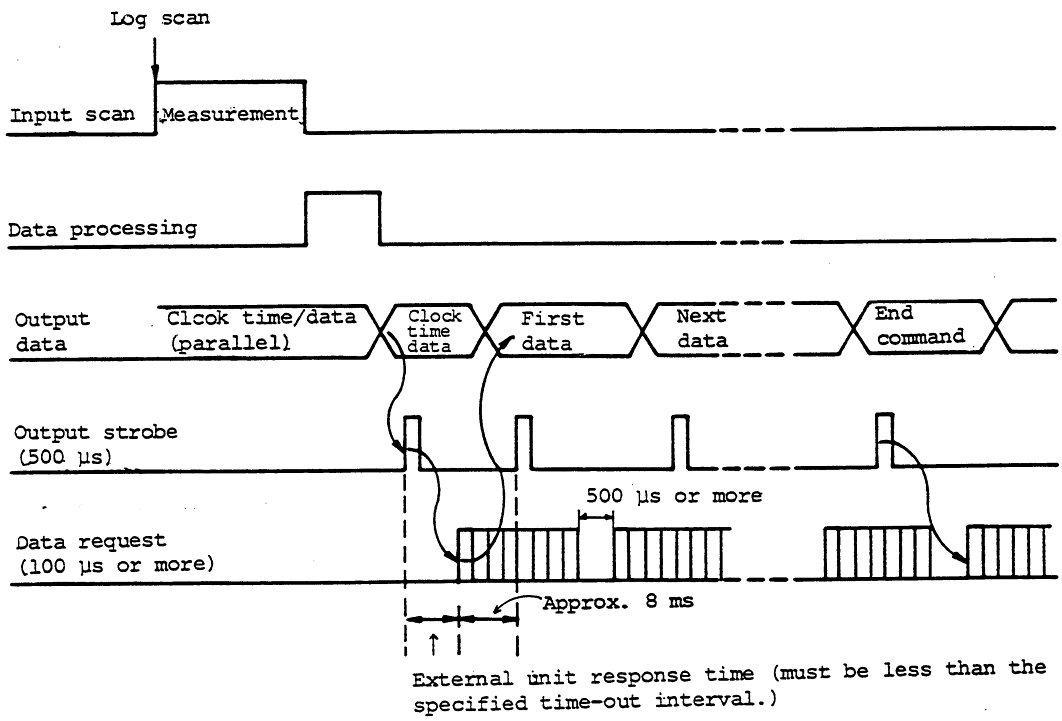


Fig. 5-6 BCD parallel data output timings

CAUTIONS

1. A data request is required for sending an end command as well.
2. The next log scan is not started until all measurement information for the preceding scan is output. If output of the preceding scan data is not completed when the next scan time is reached, the scan is skipped.
3. If a data transfer error occurs while transferring data to/from a sensor terminal, the subsequent scan is interrupted and the instrument sends an end code. However, measurement is continued for all other sensor terminals.
4. If output data exceeds five digits, only the most significant five digits are output. However, if bit input (8 bits) is specified for the TR2730-530 BCD Input option card, the least significant five bits are output in 1/0 format.
5. If the output operation is suspended due to time-out, the instrument regards all data to have been output.

5-6. INFORMATION OF EXTERNAL CONTROL FUNCTIONS

The TR2730-520 option card can provide control input/output signals useful for maintaining synchronization with external units or input responses.

A separate 14-pin connector is provided for external control signal input/output. The available control signals are listed in Table 5-4, and input/output timings for each signal are shown in Figure 5-7.

Signal interface is, in principle, done through relays.

Log scan start/stop signals are available separately for the single and multi-user log scan modes, and are logically OR'ed with panel keys. The interval signal is valid only when log scan is specified for the external interval mode, and determines the scan interval for the second and subsequent scans. The scan step signal is output only when the filter function is activated.

Table 5-4 Control signal types

Signal name		Function	Make time
Input signals	Start/stop	External start/stop for single user log scan	Approx. 100 ms
	Multi-user start/stop	External start/stop for multi-user log scan	Approx. 100 ms
	Interval	Scan command pulse for external interval mode	Approx. 100 ms
Output signals	Scan start	Output at the beginning of a log scan (calibration).	Approx. 100 ms
	Scan end	Output at the end of a log scan.	Approx. 100 ms
	Scan step	Output after the specified number of filter function executions is received.	Approx. 20 ms
	Log status	Output during data logging.	Start to stop

CAUTIONS

1. The external interval signal is valid only when the external interval mode is specified. The first log scan is performed when logging is started.
2. The multi-user start/stop signal is valid only when the multi-interval mode is specified.
3. The start/stop signals have pulse form to provide start and stop commands alternately.

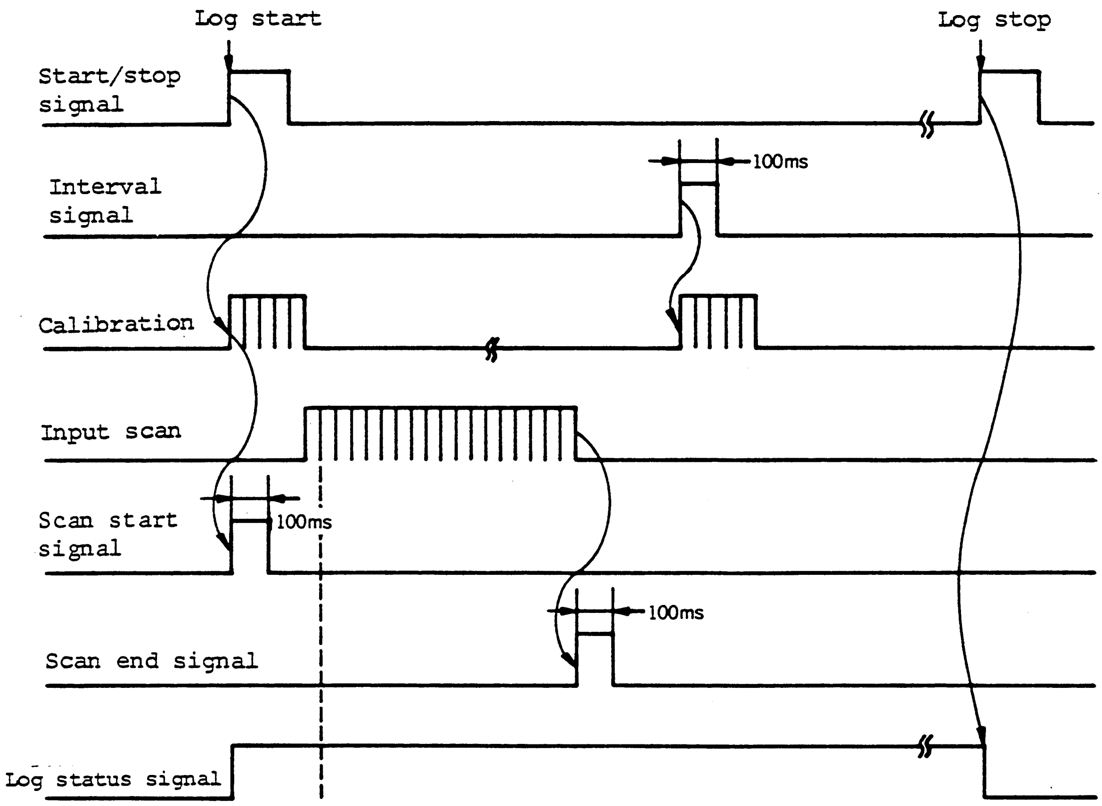


Fig. 5-7 Control signal input/output timings

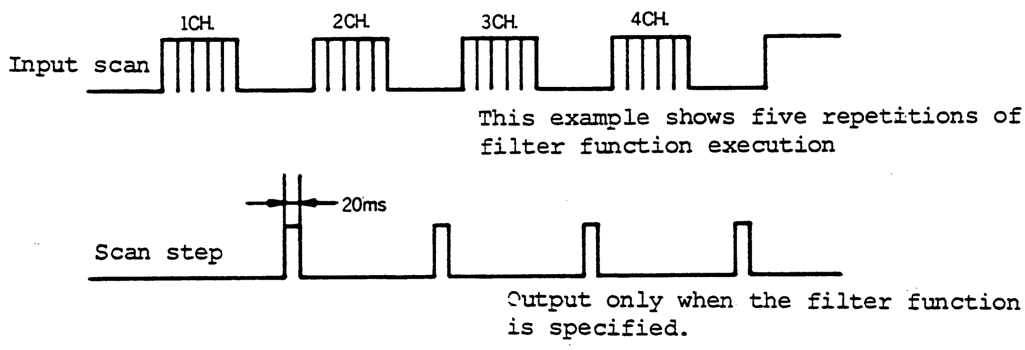


Fig. 5-8 Scan step signal output timing

5-7. OPERATING INSTRUCTIONS

When using the TR2730-520 BCD Output/External Control option card, set its ON/OFF switch to ON to check data transfer to external units.
Press the OUTPUT ENABLE key on the front panel of the TR2731 Mainframe. (The lamp in the key lights.)
If log scan data is to be output to the internal printer as well as an external unit, activate the LOG DATA key in the PRINTER section. (The lamp in the key lights.) However, if high speed data transfer to an external unit is desired, the LOG DATA key must be set to the print disable state (key lamp goes off) to stop data output to the internal printer, because the data transfer speed would be the same as the internal printer's print speed if data output to the internal printer is left enabled.
The instrument is now ready for log scan start/stop.

SECTION 6

TR2730-530 BCD INPUT OPTION CARD

6-1. GENERAL

The TR2730-530 BCD Input Option card accepts BCD parallel inputs of the digital measuring instrument's measurement information, positional information, digital manometer's output data, etc.
This option card outputs a start pulse at the beginning of each log scan, and reads data at the end of analog input scan (waits for the end of log scan if the measurement time of external digital instrumentation equipment is terminated earlier). Digital input is assigned to a specific channel and can be subjected to computation or limit identification. An internal jumper connection permits bit pattern input specification for up to eight bits.
Up to four TR2730-530 option cards (4 channels: Channels 501 through 504) can be installed in the TR2731 Mainframe at one time.

6-2. SPECIFICATIONS

Input digits	: BCD 6 digits (8-bit pattern input specifiable with internal jumper) plus 1 function code digit, 1 unit code digits, and 3 decimal point position code bits
Input format	: Compatible with ADVANTEST'S instrumentation equipment.
Code	: BCD (Binary-coded decimal) code
Input connector	: Amphenor 50-pin connector (57-40500) Mating connector (57-30500)
Input level	: TTL compatible or +8 to +18 V (switchable with a panel key), positive logic
Measurement start pulse output	: Approx. 500 µs in pulse width, positive logic
Data strobe input	: More than 100 µs in pulse width, positive logic
Time-out interval	: Approximately, 2 seconds
Installable cards	: Up to 4 cards (assigned to channels 501 through 504.)
Pin assignment	: See Figure 6-1.
Input code table	: See Tables 6-1 and 6-2.

CAUTION

Concurrent use with the TR2730-580 Pulse Counter option card is not permitted.

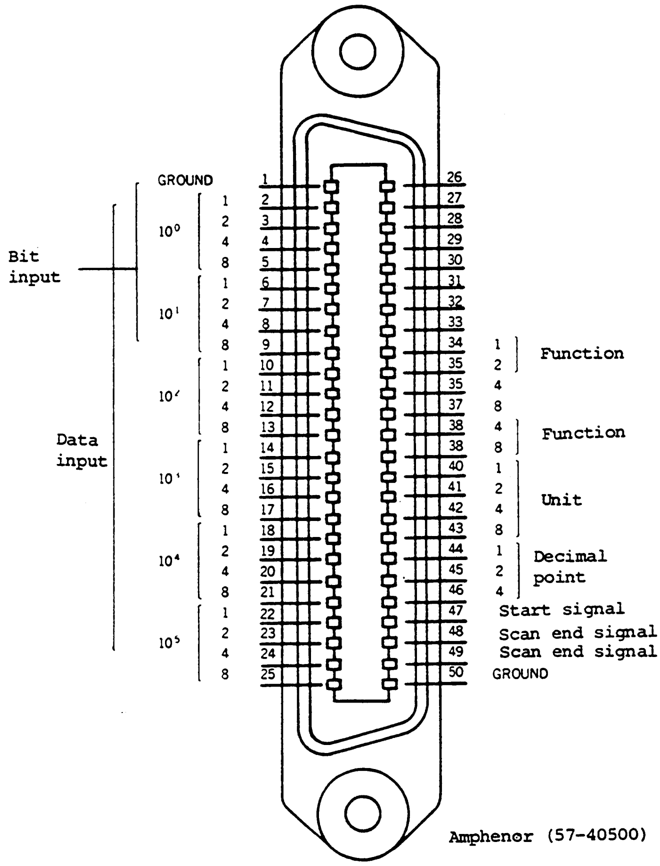


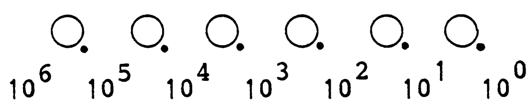
Fig. 6-1 Input connector pin assignment

Table 6-1 Input code table (data, function, unit)

8 4 2 1	Data	Function	Unit
0 0 0 0	0	Over	mV
0 0 0 1	1	-	None
0 0 1 0	2	+	V
0 0 1 1	3	+	°C
0 1 0 0	4	+	None
0 1 0 1	5	+	None
0 1 1 0	6	+	None
0 1 1 1	7	+	None
1 0 0 0	8	+	None
1 0 0 1	9	+	None
1 0 1 0	0	+	None
1 0 1 1	0	+	None
1 1 0 0	0	+	None
1 1 0 1	0	+	None
1 1 1 0	0	+	None
1 1 1 1	0	+	None

Table 6-2 Input code table (decimal point)

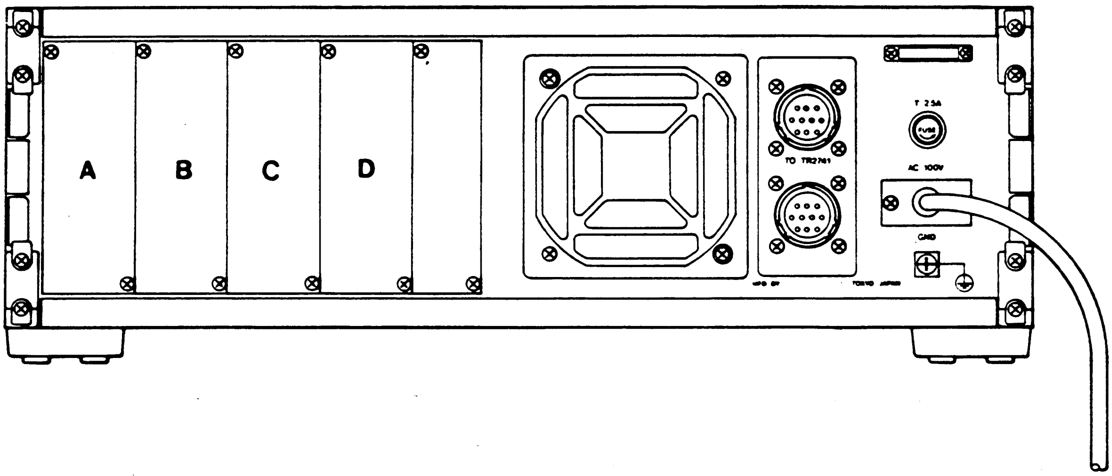
4	2	1	
0	0	0	10^0
0	0	1	10^1
0	1	0	10^2
0	1	1	10^3
1	0	0	10^4
1	0	1	10^5
1	1	0	10^6
1	1	1	10^7



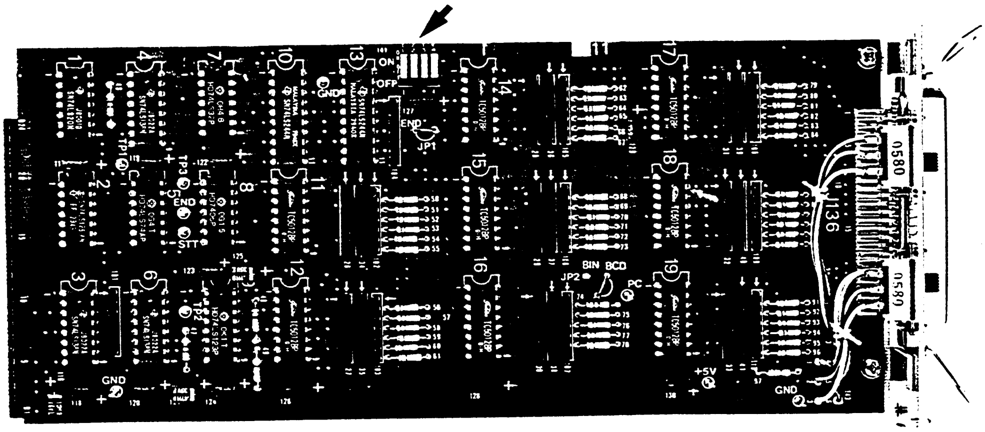
6-3. INSTALLATION PROCEDURE

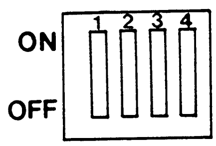
The TR2730-530 BCD Input option card is installed in a card slot on the rear panel of the TR2731 Mainframe and is secured with two retention screws. The installation procedure is as follows:

① Remove one of blank panels A, B, C, or D from the card slot on the rear panel of the TR2731 Mainframe.



② Specify the card number for this option card as follows:





Switch No.				
1	2	3	4	
o	x	x	x	Card 1 (CH. 501)
x	o	x	x	Card 2 (CH. 502)
x	x	o	x	Card 3 (CH. 503)
x	x	x	o	Card 4 (CH. 504)

Mark o: ON

Mark x: OFF

Fig. 6-2 Card number specification

CAUTION

If only one option card is to be used, specify card number 1 for the card. If two option cards are to be used, specify card numbers 1 and 2 for the cards. If there is more than one card having the same card number or card number assignment is not consecutive, an operation error may result. It is recommended to use the supplied card number sticker on the cards to be used.

③ If the option card is to be used in the bit mode, connect the jumper wire shown in Figure 6-2 as shown in Figure 6-3.

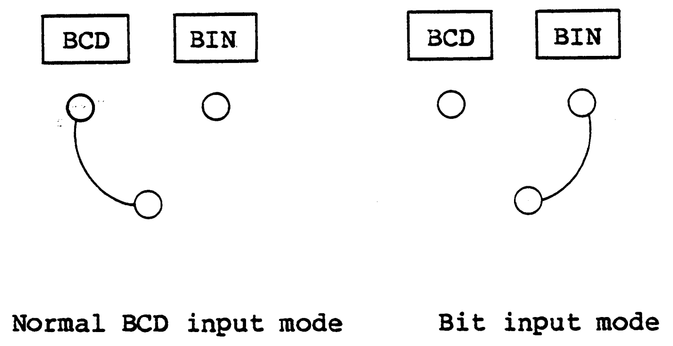


Fig. 6-3 Jumper connection for bit mode

④ Place the card on the board guide in the slot and insert it fully into the slot. After plugging the card into the slot connector, secure it with the two retention screws.

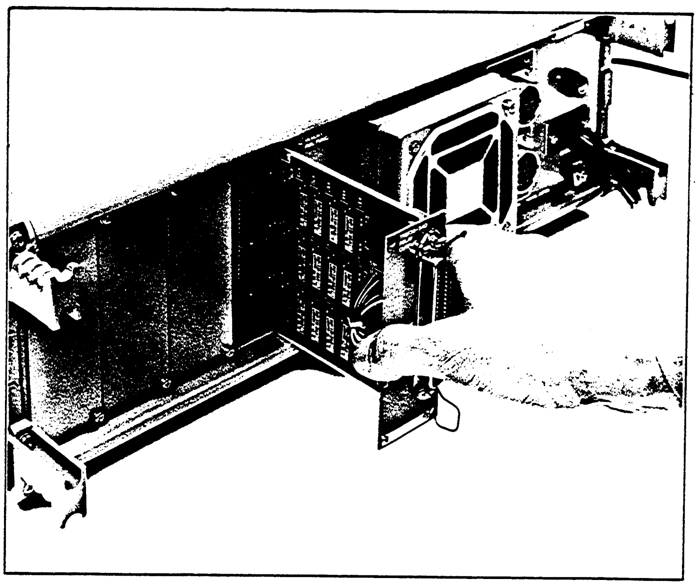


Fig. 6-4 Option card installation procedure

6-4. PANEL DESCRIPTION

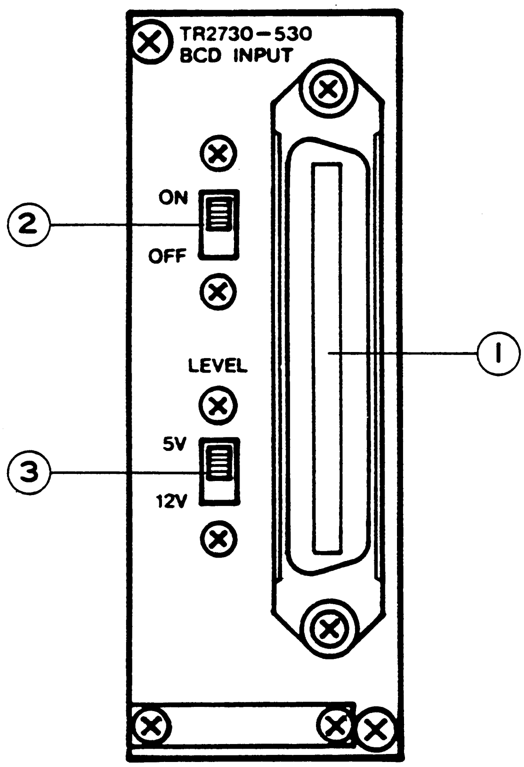


Fig. 6-5 TR2730-530 panel description

① Input connector

This connector accepts digital input signals. It uses a 50-pin connector (Amphenor 57-40500).

② ON/OFF switch

This switch enables (ON) or disables (OFF) digital input. If the digital input function is not to be used, set this switch to OFF.

③ LEVEL switch

This switch selects the input signal's voltage levels.

6-5. PRINCIPLES OF OPERATION

The signal and data transfer directions between the TR2730-530 option card and an external digital instrument are shown in Figure 6-6. The option card transfers a measurement start signal to the external instrument when measuring starts, to trigger the instrument. When a data strobe signal is received from the instrument, the option card reads parallel measurement data from the instrument. Data read timings are shown in Figure 6-7.

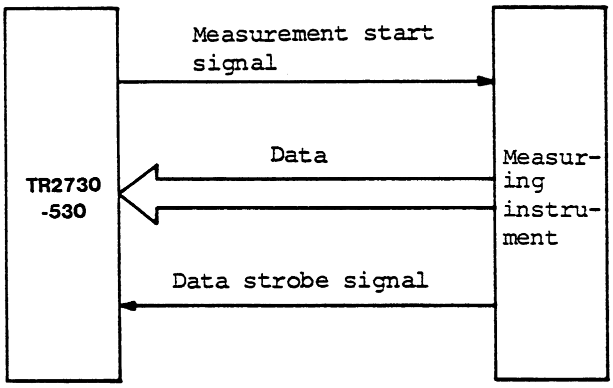


Fig. 6-6 Directions of data and control signal transfer

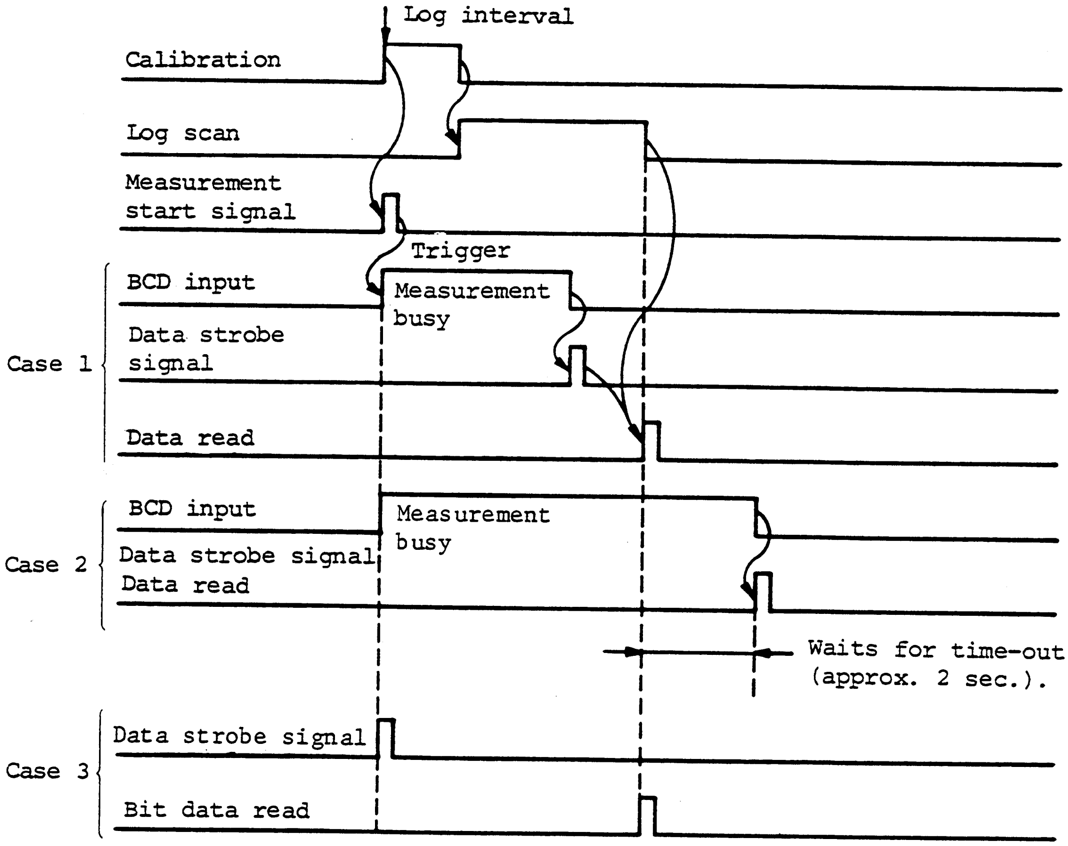


Fig. 6-7 Data read timings

The option card outputs a measurement start signal at the beginning of log scan, and reads data from the external instrument when the analog input scan ends (case 1). If, at this time, no data strobe is received yet, the option card waits for data input until the time-out interval (approx. 2 sec.) expires (case 2). Therefore, if this option card is not used, its ON/OFF switch must be set to OFF or the option card itself must be excluded from scan channels. If not, the system always waits for time-out whenever a log scan sequence for the TR2741 is completed. This will make it impossible to increase the scan rate by reducing the log interval. By selecting an appropriate jumper wire on the TR2730-530 option card, 8-bit status information can be input, instead of BCD parallel code (case 3).

This bit pattern input will be useful when simultaneity is a particular concern for contact inputs using a thermocouple/voltage measurement terminal board or when the bit pattern itself has same meaning. In the bit mode, 8-bit information is read into the card at the end of log scan by shorting the measurement start signal line with the data strobe line. A printout of up to eight bits of ones and zeros (bit pattern) is available in this bit mode, while bit data is internally processed as binary numbers. For call channel as well, a printout of up to eight bits of ones and zeros is available.

6-6. DATA PROCESSING

In the log scan mode, data assigned to channels 501 through 504 are printed on the last line, as shown in Figure 6-8. The maximum data length on printout is six digits and eight bits for binary notation.

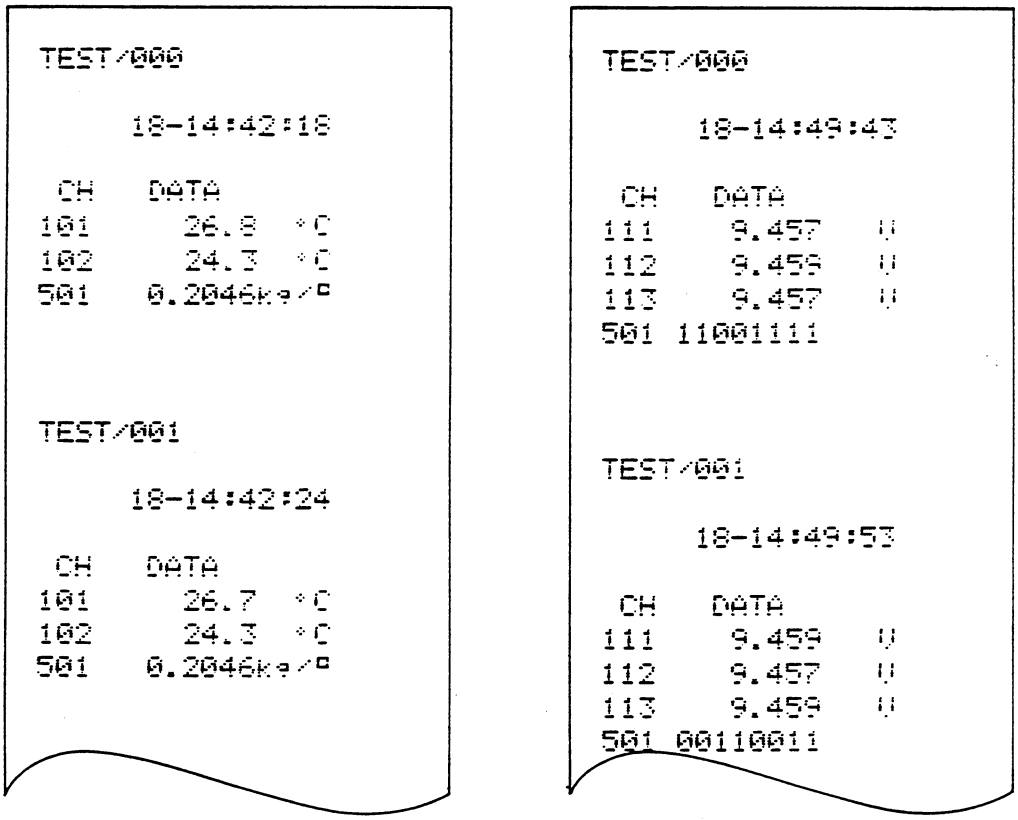


Fig. 6-8 Log scan data printout

Ordinary data on channels 501 through 504 are treated in much the same way as those transferred from the TR2741 Sensor Terminals. (However, output to the TR2730-520 BCD Output/External Control option card is limited to the most significant five digits.)
Since bit pattern input is internally treated as 8-bit binary data, data with all its bits set to 1 is internally treated as 255. If scaling or an arithmetic operation is specified for measurement information, the operation is performed on measurement data after it is converted from binary to decimal, and then the data is again converted into 8-bit 1/0 code before output. When alarm output is to be used, not that a specific bit pattern of ones and zeros cannot be identified. It is identified by an eight-bit binary number (e.g. 01010001 = 81).

6-7. PROGRAMMING SUPPORT

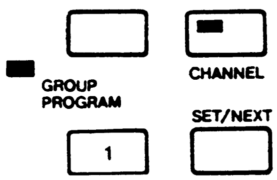
Programming for the TR2730-530 option card uses channels 501 through 504.

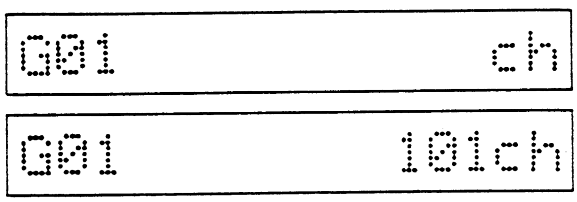
6-7-1. Boundary Channel Specification

(Programming contents)

Group number	Boundary channel
Up to 40 groups are programmable.	501, 502, 503, 504 — If four TR2730-530 option cards are used, channels 501 through 504 are assigned to these cards.

o To specify only channel 1, press:





o To specify channels 2 through 10, enter as follows:

Call the next group with the [SET/NEXT] key.

```
G02                ch
```

Press the [1] [0] and [SET/NEXT] keys.

```
G02             110ch
```

o To specify channels 11 through 20, enter as follows:

Call the next group with the [SET/NEXT] key.

```
G03                ch
```

Press the [2], [0], and [SET/NEXT] keys.

```
G03             120ch
```

o To specify channel 501, enter as follows:

Call the next group with the [SET/NEXT] key.

```
G04                ch
```

Press the [5], [0], [1] and [SET/NEXT] keys.

```
G04             501ch
```

To check the above specification results, enter as follows:

[# (BACK)] [# (BACK)]

```
G03             120ch
```

[# (BACK)] [# (BACK)]

```
G02             110ch
```

[# (BACK)] [# (BACK)]

```
G01             101ch
```

6-7-2. Scaling Specification

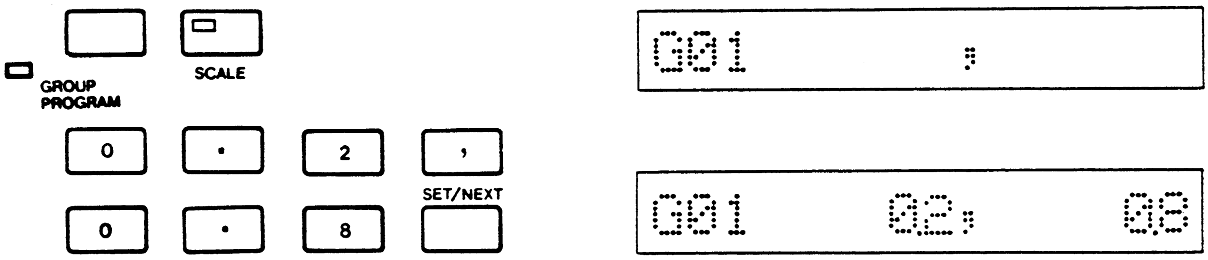
(Programming contents)

Group number	A: offset	B: span

A and B for equation (X − A)/B can be specified with signed 5-digit numbers (±0.0001 to 9999).

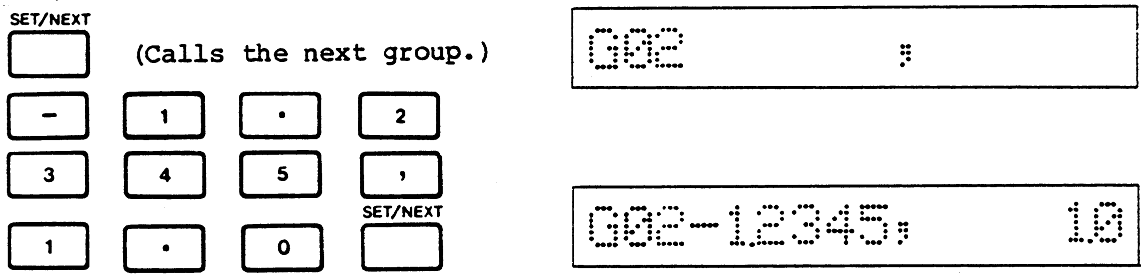
o To specify A=0.2 and B=0.8 for G01,

enter as follows:



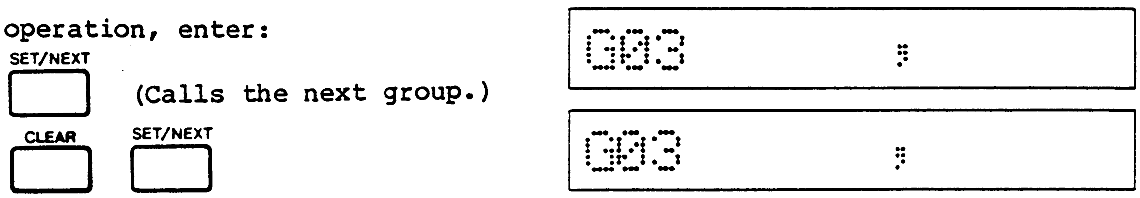
o To specify A=−1.2345 and B=1.0 for

G02, enter as follows:



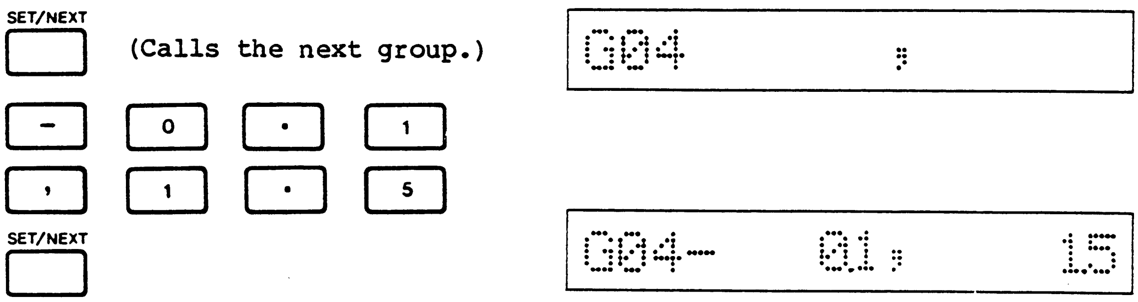
o To cancel G03 and perform no scaling

operation, enter:



o To specify A=−0.1 and B=1.5 for G04,

enter:



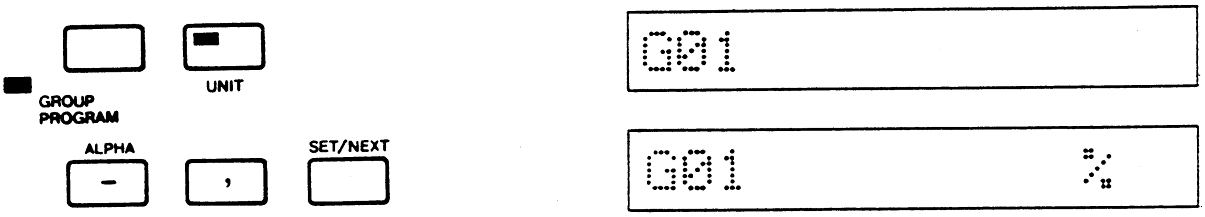
6-7-3. Unit Specification

(Programming contents)

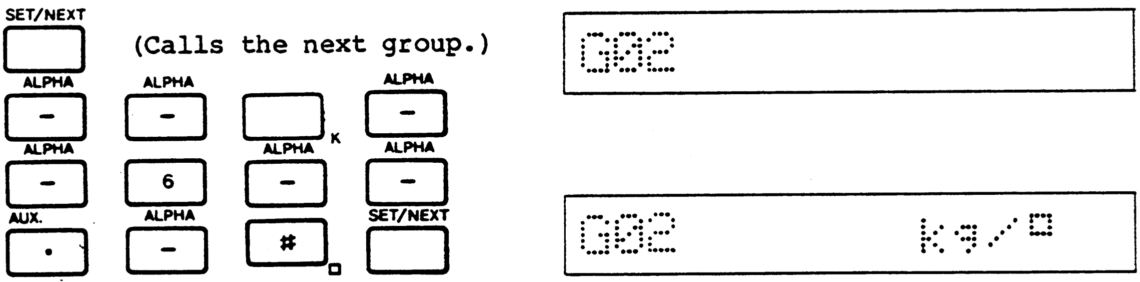
Group number	Unit

Specifiable by combinations of up to 4 alphanumeric characters

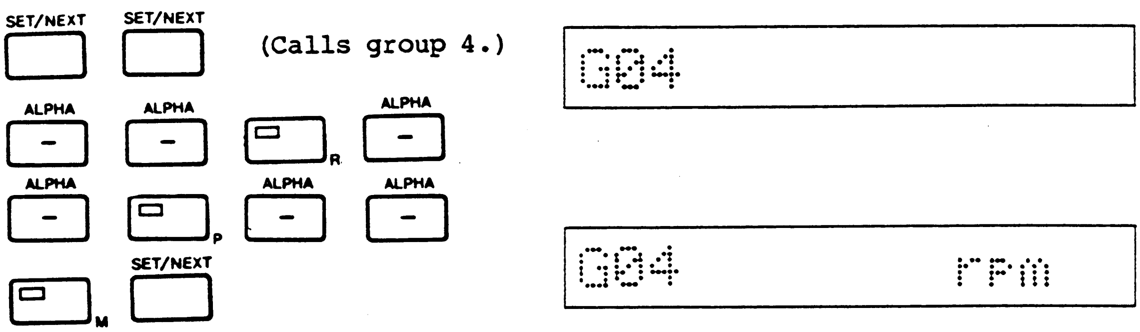
o To specify % for G01, enter as follows:



o To specify kg/m for G02, enter as follows:



o To specify rpm for G04, enter as follows:



CAUTION

When digital inputs are to be used, no input range is necessary to specify. Measurement is not affected whether a voltage range or thermocouple range is selected, and the output units programming through the above key entry override the specification of another unit. If no unit is specified, it appears as a space on the printout.

MEMO

SECTION 7

TR2730-540 RELAY OUTPUT OPTION CARD

7-1. GENERAL

The TR2730-540 Relay Output option card can provide a make contact output if a specified limit value is exceeded during upper/lower limit identification processing by monitor or log scan. Output contacts can be arbitrarily assigned to alarm channels by programming. Each option card contains 21 relays, one of which provides a common output that is activated if over-limit data is generated on any of the channels.
The output modes include pulse output, level output and manual recovery modes, which can be selected with the OUTPUT switch on the rear panel.
Up to four option cards of 84 relays (of which 4 relays are for common output) can be installed in the TR2731 Mainframe.

7-2. SPECIFICATIONS

Output relays	: 20 plus 1 (common relay) (If any of 20 relays on a card is closed, the common relay is also closed.)
Installable cards	: Max. 4 cards (80 relays)
Output format	: Make relay
Contact ratings	: Max. 50 Vdc, 0.2 A
Output connector	: Amphenor 50-pin connector (57-40500) Mating connector (57-30500)
Output mode	: 3 modes selectable with the rear switch
Pulse mode	: Pulse width approx. 150 ms
Level mode 1	: Automatically opens when the data returns within the limit during scanning.
Level mode 2	: Relay is opened by the Alarm Reset key.
Pin assignment	: See Figure 7-1.
Alarm group	: Max. 40 groups programmable.

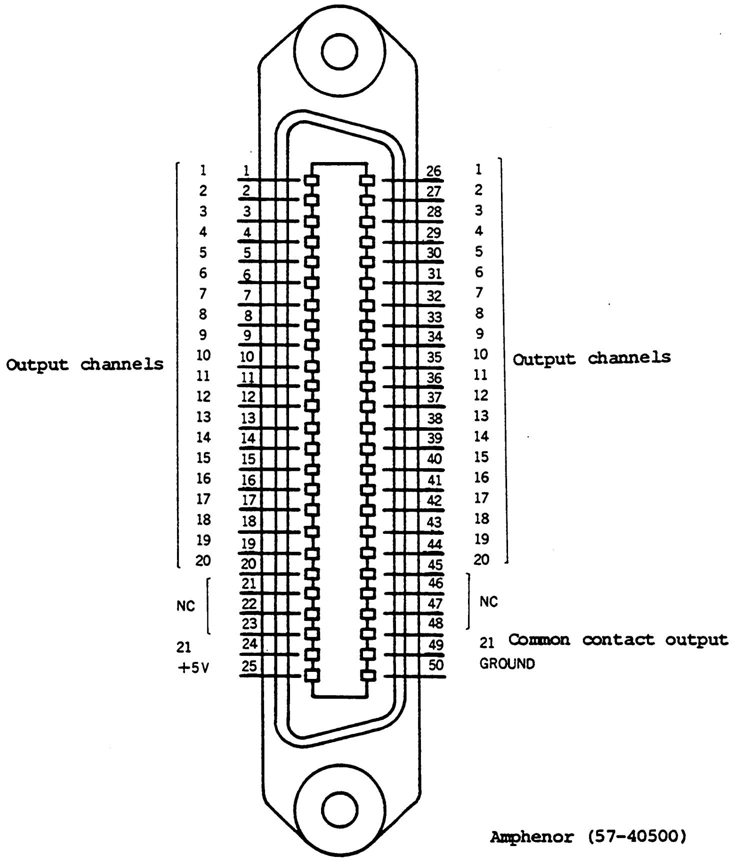


Fig. 7-1 Connector pin assignment

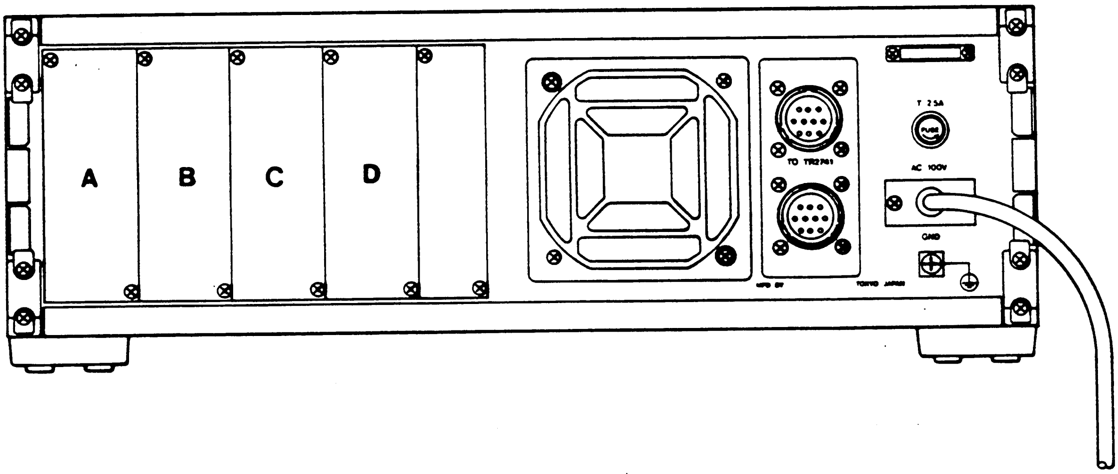
CAUTION

The +5 V supply applied to pin 25 of this connector is for maintenance purpose only. When wiring to this connector, ensure not to short this pin with other pins.

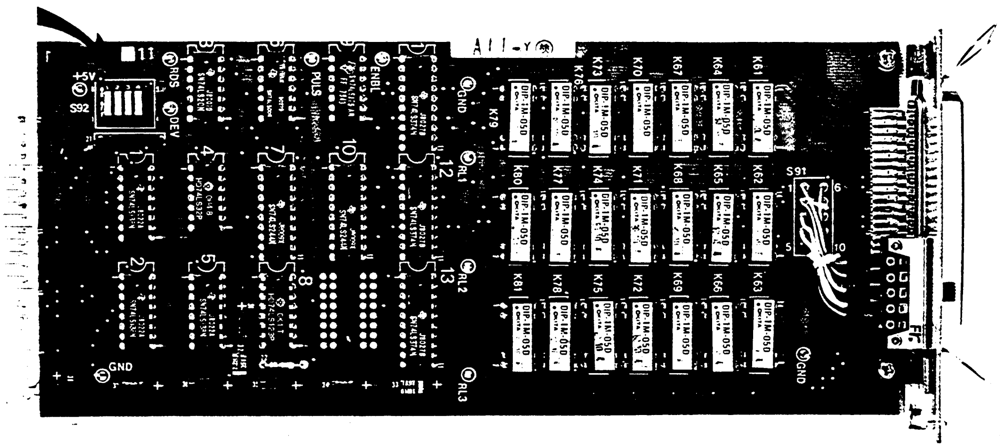
7-3. INSTALLATION PROCEDURE

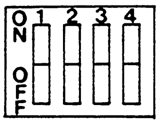
The TR2730-540 option card is inserted into a card slot on the rear panel of the TR2731 Mainframe and secured with two retention screws. The mounting procedure is as follows:

① Remove one of four blank panels A, B, C, or D from the rear card slot.



② Specify the card number for the option card as follows:





Switch No.				
1	2	3	4	
o	x	x	x	Card 1 (CHs. 1 through 20)
x	o	x	x	Card 2 (CHs. 1 through 20)
x	x	o	x	Card 3 (CHs. 1 through 20)
x	x	x	o	Card 4 (CHs. 1 through 20)

Mark o: ON

Mark x: OFF

Fig. 7-2 Card number specification

CAUTION

If only one option card is to be used, set card number 1 for the card. If two option cards are to be used, set card numbers 1 and 2 for the cards. If there is more than one card having the same card number or card number assignment is not consecutive, an operation error may result. It is recommended to use the supplied card number sticker on the cards to be used.

③ Place the card on the board guide in the slot and insert it fully into the slot. After plugging the card into the slot connector, secure it with the two retention screws.

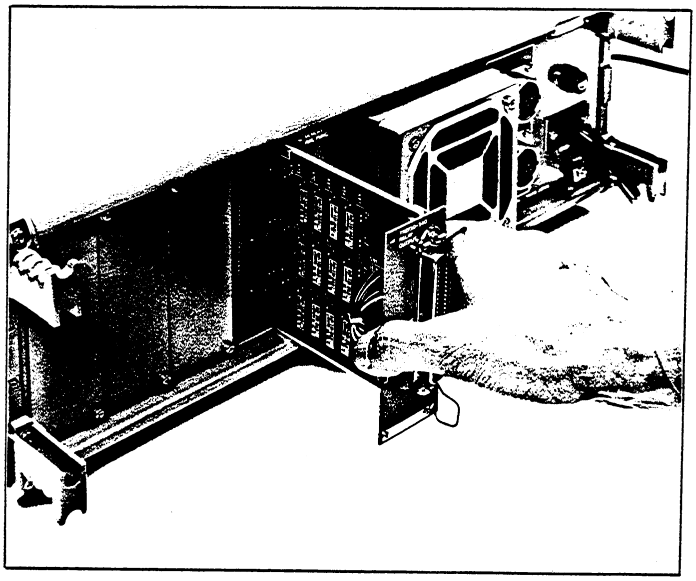


Fig. 7-3 Option card installation procedure

7-4. PANEL DESCRIPTION

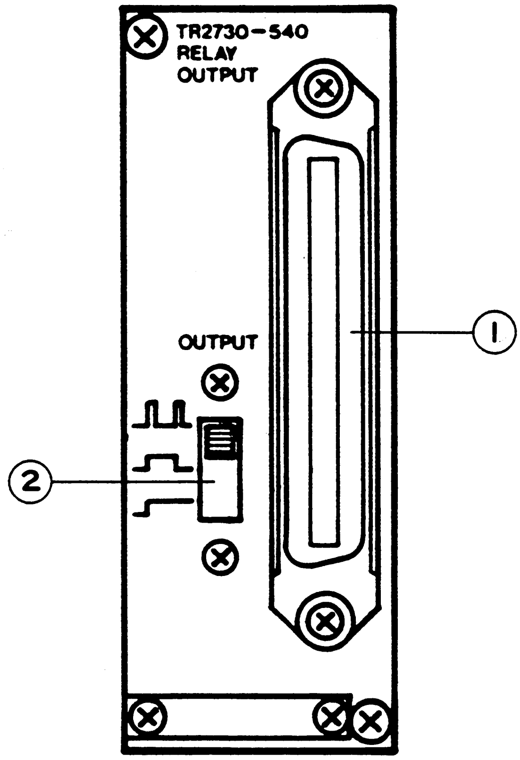


Fig. 7-4 TR2730-540 panel description

① Output connector

This connector provides relay contact outputs. It uses a 50-pin connector (Amphenor 57-40500).

② OUTPUT switch

This switch selects the output modes. Positions , , and of this switch select the pulse output, level 1 output, and level 2 output modes, respectively.

7-5. PRINCIPLES OF OPERATION

In the following descriptions, we use an example in which a make contact signal is output due to over-limit data detected as a result of limit identification during monitor scanning.

As shown in Figure 7-5, if an upper limit value (H) is exceeded, three types of output are available according to the settings of the OUTPUT switch.

If output mode 1 (pulse output) is selected with the OUTPUT switch, detection of data exceeding the upper limit setting during monitor scan closes the specified relay for approximately 150 ms.

If output mode 2 (level 1 output) is selected, the relay is closed the same as in output mode 1, but it is opened if monitor scanning detects data returned within the specified limit value.

If output mode 3 (level 2 output) is selected, the specified relay is closed the same as in output mode 1 or 2, but the front ALARM-RESET key must be operated to open the relay.

In addition to opening the relay, generation of over-limit data is also signaled by the front ALARM indicator lamp and internal electronic buzzer. The ALARM lamp remains on until data on all channels returns within the limit value. The alarm buzzer sounds for approximately two seconds if the limit value is exceeded on any of the channels when a single scan ends.

A similar operation sequence is executed if a lower limit value is exceeded or if over-limit data is detected by limit identification during log scan.

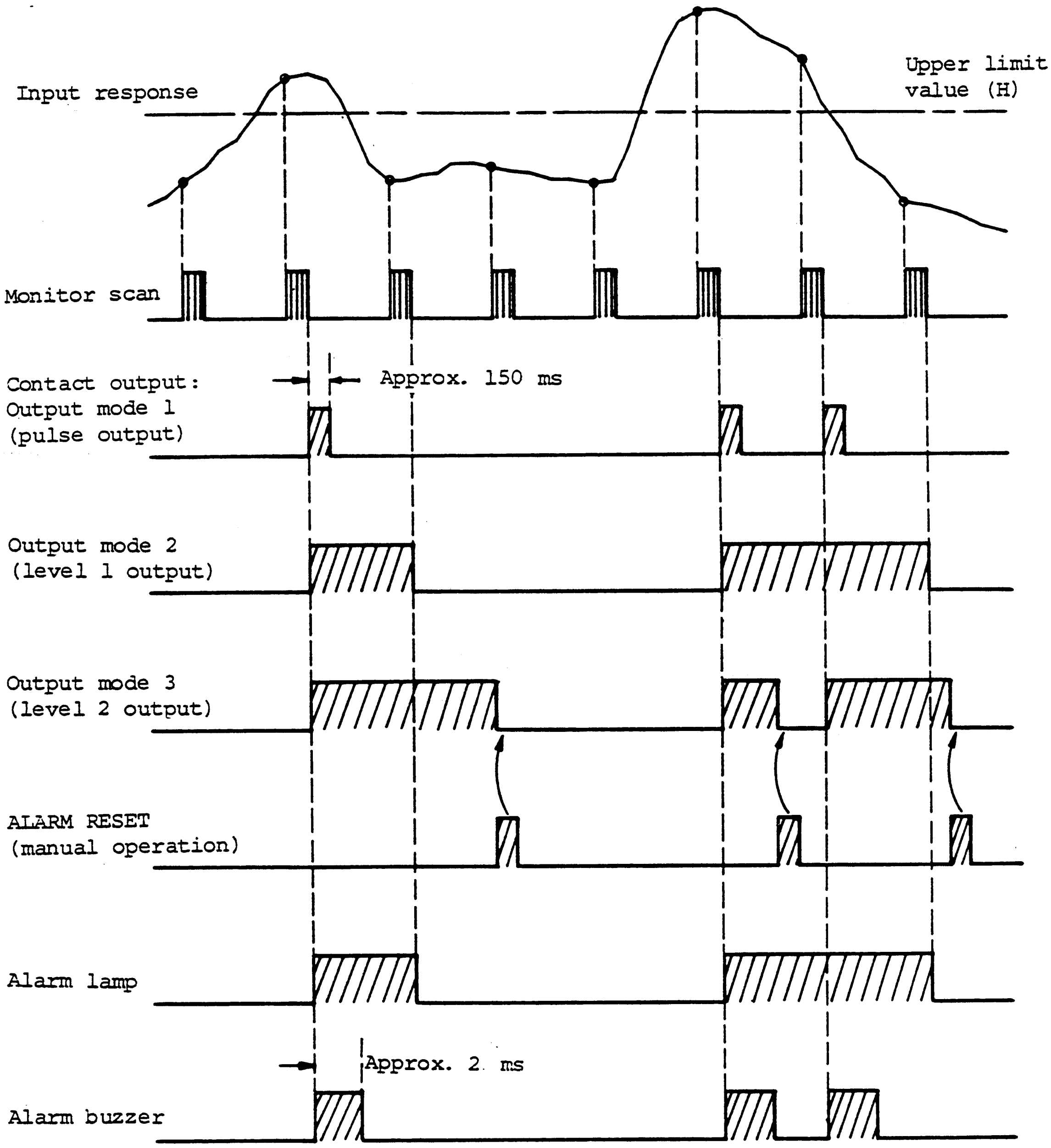


Fig. 7-5 Alarm sequence for monitor scan

7-6. PROGRAMMING SUPPORT

In the following programming example, group boundary channels, upper limit values and corresponding alarm-output relay numbers for each group, and lower limit values and corresponding alarm-output relay numbers are specified for each group as shown in Table 7-1.

Table 7-1 Programming example

Group number	Boundary channel and mode	Upper limit value	Relay No.	Lower limit value	Relay No.
1	105ch, mon	130°C	1	100°C	2
2	115ch, mon				
3	120ch, mon				
4	140ch, log	22°C	15	-5°C	20
37					
38					
39					
40					

7-6-1. Group Boundary Channel Specification

(Programming contents)

[Group boundary channel] [,] [Scan mode]

101 | Maximum channel number

0: Monitor scan
1: Log scan
2: Monitor/log scan
(3-9: Monitor scan)

(Programming procedure)

[GROUP PROGRAM] [CHANNEL]

G01 ch,

o To specify channels 1 through 5 for group 1 and perform limit identification for monitor scan data, enter as follows:

[1] [0] [5] [,]

[0] [SET/NEXT]

└→ Specifies monitor scan.

G01 105chmon

(Simplified entry procedure)

a. [1] [0] [5] → [5]

Entry of terminal number 1 can be omitted. If the channel number is between 1 and 9, entry of the preceding 0 can be omitted.

b. [,] [0] [SET/NEXT] → [SET/NEXT]

If the limit identification mode is monitor, entry of [,] and [0] can be omitted.

o To specify channels 6 through 10 for group 2, enter as follows:

Call the next group with [SET/NEXT] .

`G02          ch`

Press the [1] , [0] and [SET/NEXT] keys.

`G02     1 10ch mon`

* Simplified entry for monitor scan specification.

* If only one terminal is used, no terminal number is shown in the display.

`G02       10ch mon`

o To specify channels 11 through 20 for group 3, enter as follows:

Call the next group with the [SET/NEXT] key.

`G03          ch`

Press the [2] , [0] and [SET/NEXT] keys.

`G03     1 20ch mon`

o For channels 21 through 40, limit identification is performed on logged data after it is subjected to computation.

(Group 4)

Call the next group with the [SET/NEXT] key.

`G04          ch`

[4] [0] [,] [1] [SET/NEXT]

↓ Specifies log scan.

`G04     1 40ch log`

o To divide channels 11 through 20 into subgroups of channels 11-15 and channels 16-20, enter as follows:

(Interrupt)

SET/NEXT [ ]

[1] [5] SET/NEXT [ ]

`G05            ch`

`G03     115chmon`

This interrupt operation searches for a subgroup insertion position (between groups 1 and 4) and, if inserted, automatically shifts the subsequent group numbers. In this example, boundary channel 15 is inserted between channels 11 and 20 (G3). Let us check the change in the group configuration resulting from this insertion.

As the current group number display is G03, enter as follows to return the display to group 1:

(BACK) [#] (BACK) [#] (BACK) [#] (BACK) [#]

Recalls G02. Recalls G01.

`G01     105chmon`

The two consecutive operation of the (BACK) [#] key recalls preceding group.

This recall procedure would take too much time, if group display must be returned from G20 to G01. In such a case, use the following alternative:

(BACK) [#] [1] [▬] CHANNEL

[1] ← Group number to be recalled.

`G01     105chmon`

o Then advance group display in sequential order to check the new group configuration with:

Key	Display
[SET/NEXT]	G02 110chymon
[SET/NEXT]	G03 115chymon
[SET/NEXT]	G04 120chymon
[SET/NEXT]	G05 140chylog

o To delete group 2, enter as follows:

Directly recall group 2 with the [# (BACK)], [2] and [▬ CHANNEL] keys.

G02 110chymon

Press the [CLEAR] and [SET/NEXT] keys.

G02 115chymon

When group 2 is deleted, the subsequent group numbers are shifted in descending direction (i.e. G03 - G02, G04 - G03, and so forth).

7-6-2. Limit Values and Contact Output Channel Specification

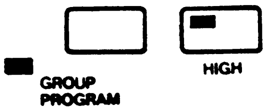
(Programming contents)

Limit values	,	Output channel

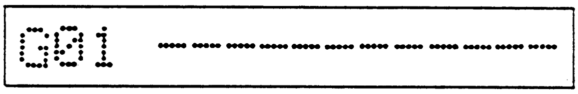
{ Upper limit / Lower limit — Up to 80 output channels can be specified (using the contact outputs of the Relay Output option card).

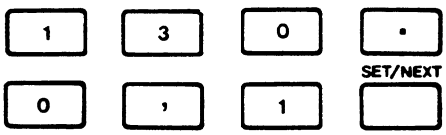
(Programming procedure)

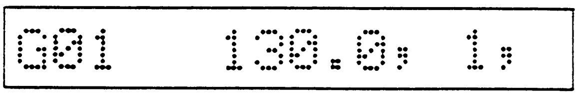
o To specify +130.0°C for the upper limit value for group 1 and output a make signal on contact channel 1 if this upper limit value is exceeded, enter as follows:



Note that if no boundary channel is specified, limit values can not be specified. In such a case, " ---- " will be displayed as shown on the right.







o To specify a lower temperature limit of +100.0°C for group 1 and output a make signal on contact channel 2 if this limit value is exceeded, enter as follows:

Call the lower limit value with [LOW].

```
G01              :    :
```

Press [1] [0] [0] [.] [0] [,] [2] [SET/NEXT]

```
G01     100.0:   2:
```

o Specify an upper limit of +220.0°C and contact channel 15 for group 4, and a lower limit of -5.0°C and contact channel 20 for the same group, and activate the respective relays if the limits are exceeded, as follows:

[HIGH] (Call the upper limit value.)

Currently programmed value (or blank)

```
G01     130.0:   1:
```

[# (BACK)] [4] [HIGH]

```
G04              :    :
```

[2] [2] [.] [0] [,] [1] [5] [SET/NEXT]

```
G04      22.0: 15:
```

[LOW] (Call the lower limit value.)

```
G01     100.0:   2:
```

[# (BACK)] [4] [LOW]

```
G04              :    :
```

[-] [5] [.] [0] [,] [2] [0] [SET/NEXT]

```
G04   -    5.0: 20:
```

(Simplified entry procedure)

When specifying upper and lower limit values for the same group, entry of [# (BACK)] [4] [LOW] for the lower limit value can be omitted since the group is already called when specifying the upper limit value.

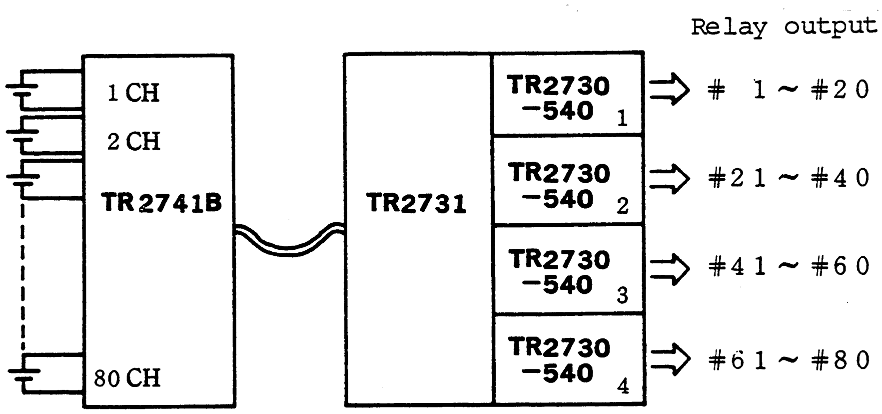
7-7. SPECIAL APPLICATION PROCEDURE

When individual relays are specified for each group, up to 40 different output can be made typically. If relay number is specified as "0", data can be output to the relay having the same number with measuring channel. Up to 40 groups can be specified for upper/lower limit identification. And two or more TR2741 Sensor Terminals are used, terminal number is ignored.

(Example 1)

When channels 1 through 80 are measured by log scan, the same lower limit value is used for identification in all channels, and corresponding relays are activated for each channel,

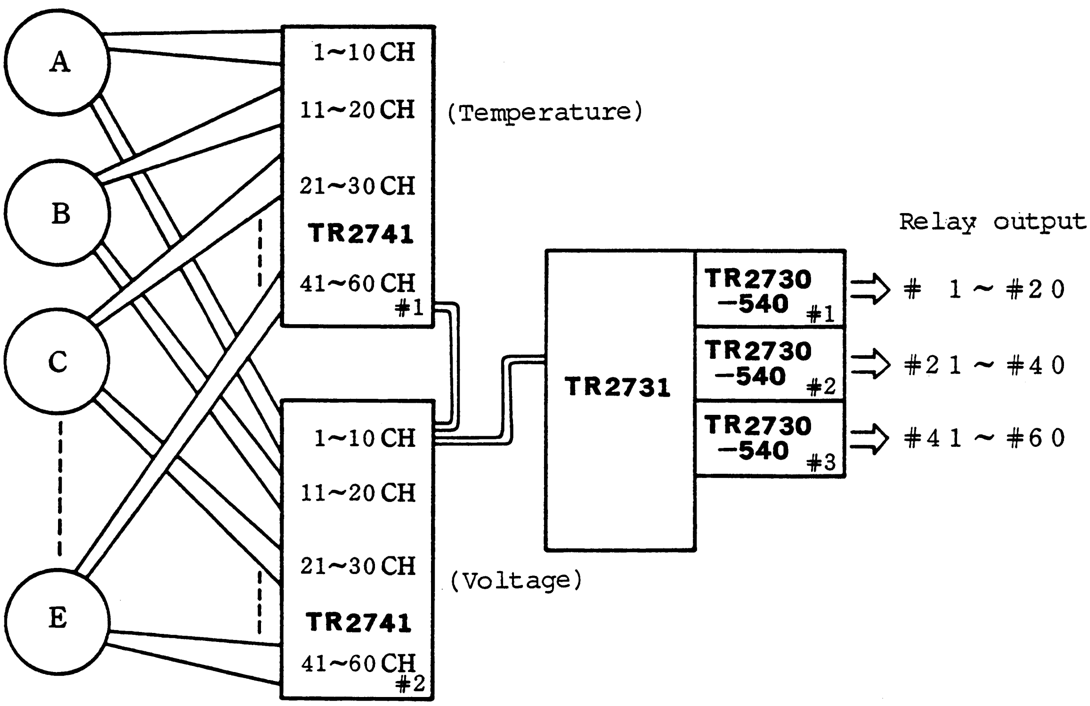
Group number	Group channel and mode	Upper limit value	Relay number	Lower limit value	Relay number
1	180 ch, log	-	-	1.250 V	0



(Example 2)

When 120 channels are to be measured, two types of measurement (temperature and voltage) are performed, ten groups for upper limit identification is specified and the identification result for two types of measurement range being output to the relay having the same number with the measuring channel,

Group number	Group channel and mode	Upper limit value	Relay number	Lower limit value	Relay number
1	110 ch, log	120.0°C	0	-	
2	120 ch, log	100.0°C	0	-	
3	130 ch, log	80.0°C	0	-	
4	140 ch, log	115.0°C	0	-	
5	160 ch, log	180.0°C	0	-	
6	210 ch, log	11.5 mV	0	-	
7	220 ch, log	20.0 mV	0	-	
8	230 ch, log	180.0 mV	0	-	
9	240 ch, log	1.5 V	0	-	
10	260 ch, log	1.8 V	0	-	



Either or both of measurement data on 101 and/or 201 CH. is exceeded upper limit value, relay number 1 is activated. Similarly, either or both of measurement data on 111 and/or 211 CH. is exceeded upper limit value, relay number 11 is activated.

SECTION 8

TR2730-550 ANALOG OUTPUT OPTION CARD

8-1. GENERAL

The TR2730-550 Analog Output option card provides digital-to-analog conversion on logged data and outputs in analog form corresponding to input digital information, and is useful for observing data variations. Analog output is available in two ranges of ±9.99 mV and ±0.999 V, and is electrically isolated from all other circuits on the card. Available analog output functions include measured value output, scaling operation, inter-channel subtraction, output digit selection (arbitrary three digits of data values), entry of 50% offset of full-scale for observing data varying near zero level, and so forth.
The option card provides six output channels per card, and up to two cards can be installed in the TR2731 Mainframe.

8-2. SPECIFICATIONS

Output voltage range: ±9.99 mV (10 mV range) and ±0.999 V (1 V range) are selectable with an on-board slide switch.

Conversion accuracy: ±0.3% of f.s./10 mV range
±0.3% of f.s./1 mV range
Guaranteed for 6 months under an ambient temperature of +23°C ±5°C with relative humidity of 85% or lower.

Conversion speed : Approx. 1 sec. or more in repetitions

Output impedance : Approx. 150 Ω/10 mV range
Approx. 1 kΩ/1 V range

Output update timing: Monitor scan interval

Conversion digits : Either of most, medium or least significant 3 digits

Output channels : 6 channels per card
Up to two option cards can be installed in TR2731.

Output terminals : Screw terminals (4 mm)

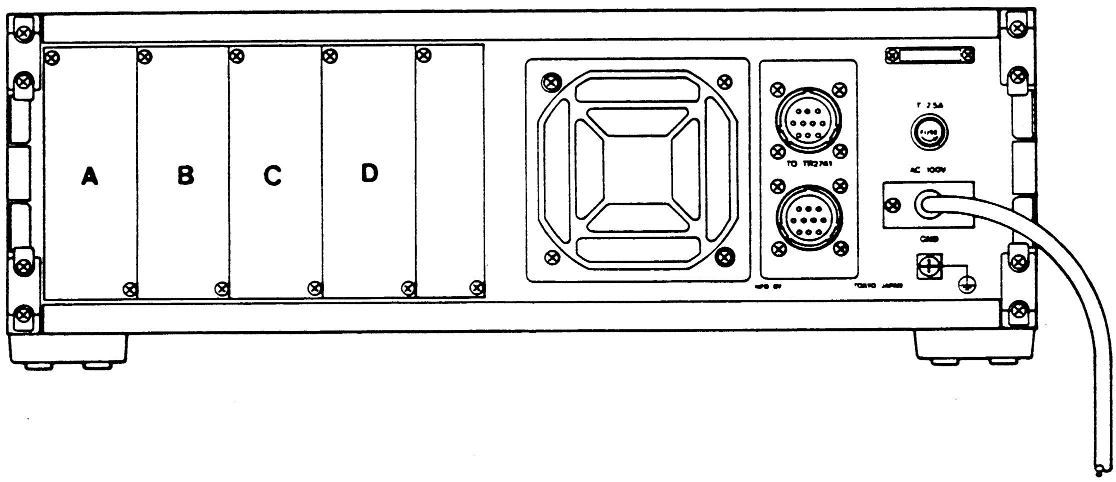
Contact input : If contact input is specified, contact ON and OFF are counted as 1 and 0 respectively. The scaling function is used for positional and amplitude variations of analog output.

Digital offset : Voltage offset of 50% full-scale can be entered or eliminated for each channel. Polarity is automatically identified.

8-3. INSTALLATION PROCEDURE

The TR2730-550 option card is inserted into a card slot on the rear panel of the TR2731 Mainframe and secured with two screws.

① Remove one of four blank panels A, B, C, or D from the card slot in which the option card is to be inserted.



② Specify the output range and card number with three slide switches on the card.

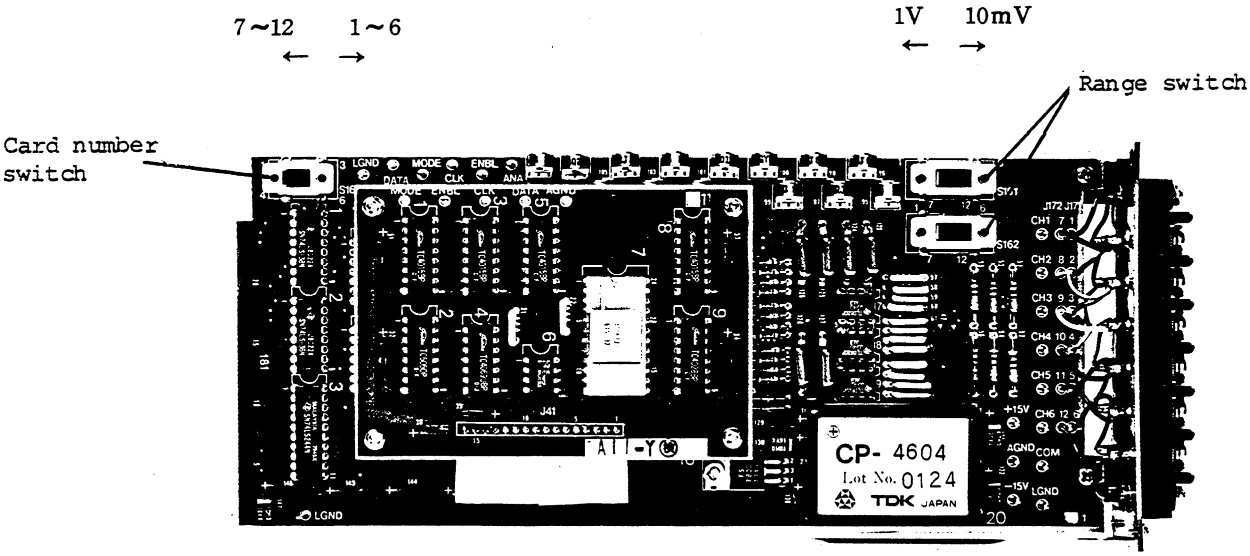


Fig. 8-1 Locations of the range and card number setting switches

a. Range switch

To select the 1 V range, slide the range switch shown in Figure 8-1 to the left (towards printed letter "1"). To select the 10 mV range, slide the switch to the right.

S161 is for channels 1-3 and 7-9, and S162 is for channels 4-6 and 10-12.

b. Card number switch

Up to two TR2730-550 option cards can be installed in the TR2731 Mainframe.

When only one option card is to be used, slide the switch (S163) shown in Figure 8-1 to the right. This will specify analog output channels 1 through 6.

When two option cards are to be installed, slide the switch on the second card to the left. This will specify analog output channels 1 through 6 on card 1 and output channels 7 through 12 on card 2.

If the switch is not set correctly when only one card is to be used, an operation error may occur. Use the supplied card-number sticker on the cards.

③ Place the card on the board guide of the card slot and insert it fully into the slot. After plugging the card into the slot connector, secure it with the two screws.

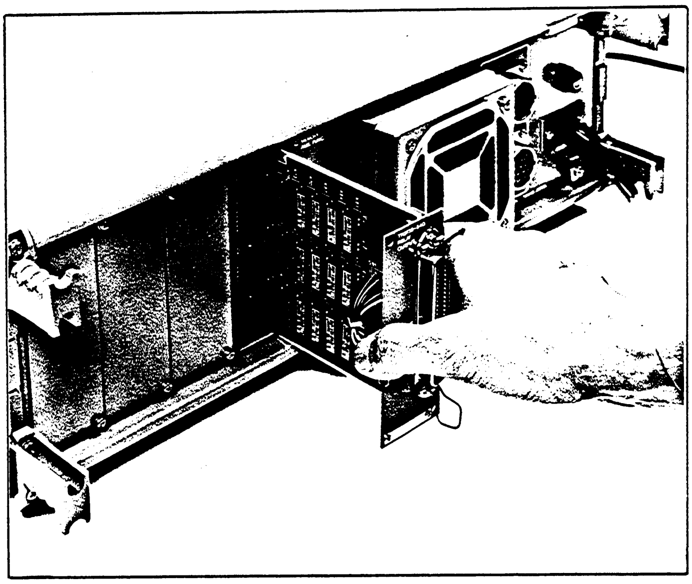
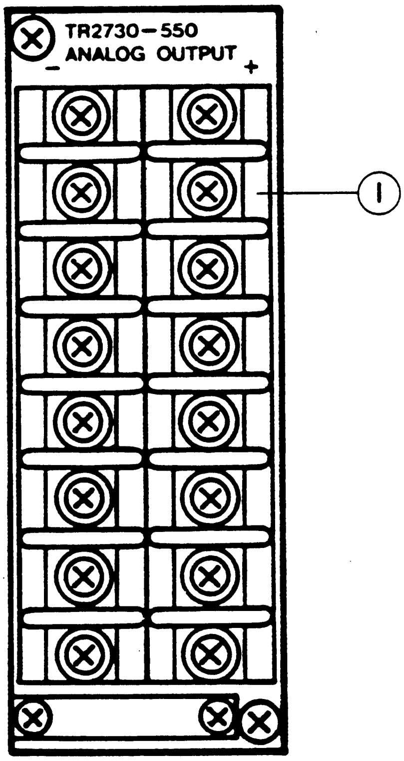


Fig. 8-2 Option card installation procedure

8-4. PANEL DESCRIPTION AND CONNECTION

8-4-1. Panel Description



	Card 1	Card 2
Channel	1	7
Channel	2	8
Channel	3	9
Channel	4	10
Channel	5	11
Channel	6	12

Fig. 8-3 TR2730-550 option card panel description

① Output terminal block

This terminal block provides analog outputs for CH.1, CH.2 ..... CH.6 in pairs from top to bottom of the terminal column. On the second card for which channels 7 through 12 are specified, this terminal block provides outputs for CH.7, CH.8 ..... CH.12 from top to bottom.

The right-hand terminals have positive (+) polarity.

While all outputs are isolated from the internal circuitry, the negative terminals are internally connected together to provide a common level.

8-4-2. Connecting to External Units

This item describes how to connect the analog output terminals to external units such as chart recorders, etc.

The connection methods shown in Figure 8-4 are available. Choose the most appropriate method according to the environmental noise conditions, etc. Also note the following points:

(1) Interconnecting cables should be as short as possible.

(2) Earth both the instruments, preferably at one point.

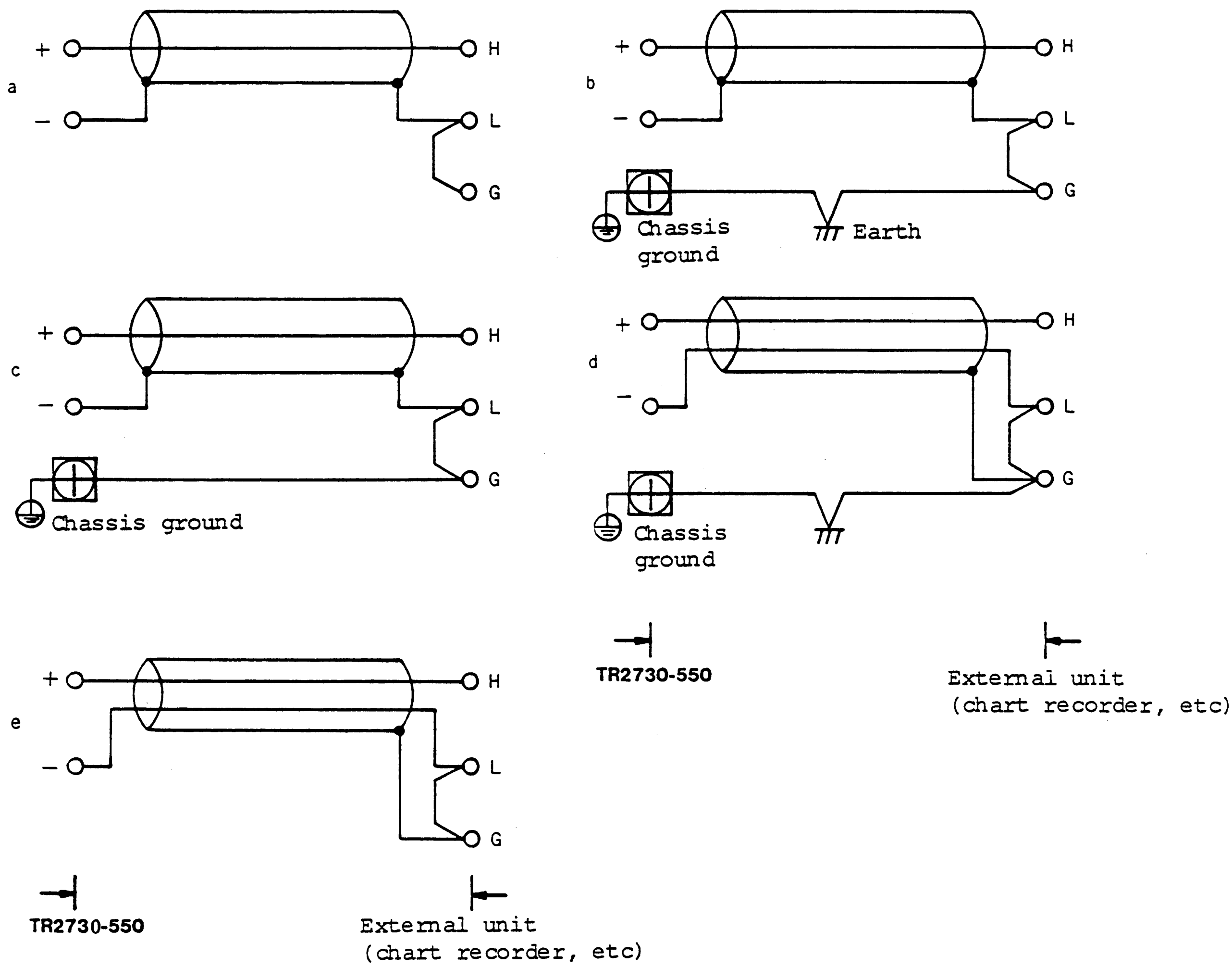


Fig. 8-4 Connecting the TR2730-550 with external units

8-4-3. Output Polarity and Offset

The TR2730-550 option card can automatically provide voltage output of both polarities (+ and -) according to the polarity of input digital information.
If input data varies from 999 to 000, the output voltage will change from full-scale to zero, resulting in discontinued signal response on a recorded chart. To prevent this, activate the 50% offset function, which will add 500 to the input digital data before converting it into an analog voltage. This will facilitate observation of data varying around the zero level.

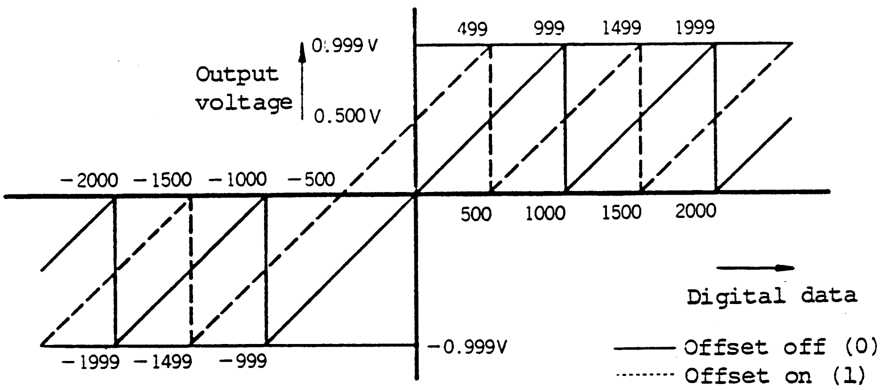


Fig. 8-5 Digital data vs. output voltage in the 1 V range (in the 10 mV range, output voltage is reduced to 1/100 of that in the 1 V range.)

A programming example for the appropriate offset, recorder's span, polarity and zero point is shown in Table 8-1 in reference to the ranges of input digital information. A similar programming procedure can also be used for larger digital data than that listed in this table.

Table 8-1 Programming example for offset and recorder's input range in the 1 V range (in the 10 mV range, the recorder span is reduced to 1/100.)

Input data	Offset	Output voltage	Span	Polarity	Zero point
1500 to 2499	on	0 to 0.999 V	1 V	+	Left end
1000 to 1999	off	0 to 0.999 V	1 V	+	Left end
500 to 1499	on	0 to 0.999 V	1 V	+	Left end
0 to 999	off	0 to 0.999 V	1 V	+	Left end
- 999 to 999	off	-0.999 to 0.999 V	2 V	+	Center
- 500 to 499	on	0 to 0.999 V	1 V	+	Left end
-1499 to 499	on	-0.999 to 0.999 V	2 V	+	Center
- 999 to 0	off	-0.999 to 0 V	1 V	+	Right end
- 999 to 0	off	-0.999 to 0 V	1 V	-	Left end
-1499 to - 500	on	-0.999 to 0 V	1 V	+	Right end
-1499 to - 500	on	-0.999 to 0 V	1 V	-	Left end
-1999 to -1000	off	-0.999 to 0 V	1 V	+	Right end
-1999 to -1000	off	-0.999 to 0 V	1 V	-	Left end
-2499 to -1500	on	-0.999 to 0 V	1 V	+	Right end
-2499 to -1500	on	-0.999 to 0 V	1 V	-	Left end

8-5. PRINCIPLES OF OPERATION

The Analog Output option card can provide scaling and interchannel subtract operations on monitor scan data before converting it into the corresponding analog voltage. As shown in Figure 8-6, the output level changes after each monitor scan. This means that the appropriate monitor scan interval must be selected according to input variations. If the monitor scan overlaps with the log scan, the log scan overrides the monitor scan. While the monitor scan is overridden by the log scan, the preceding monitor scan data is maintained.

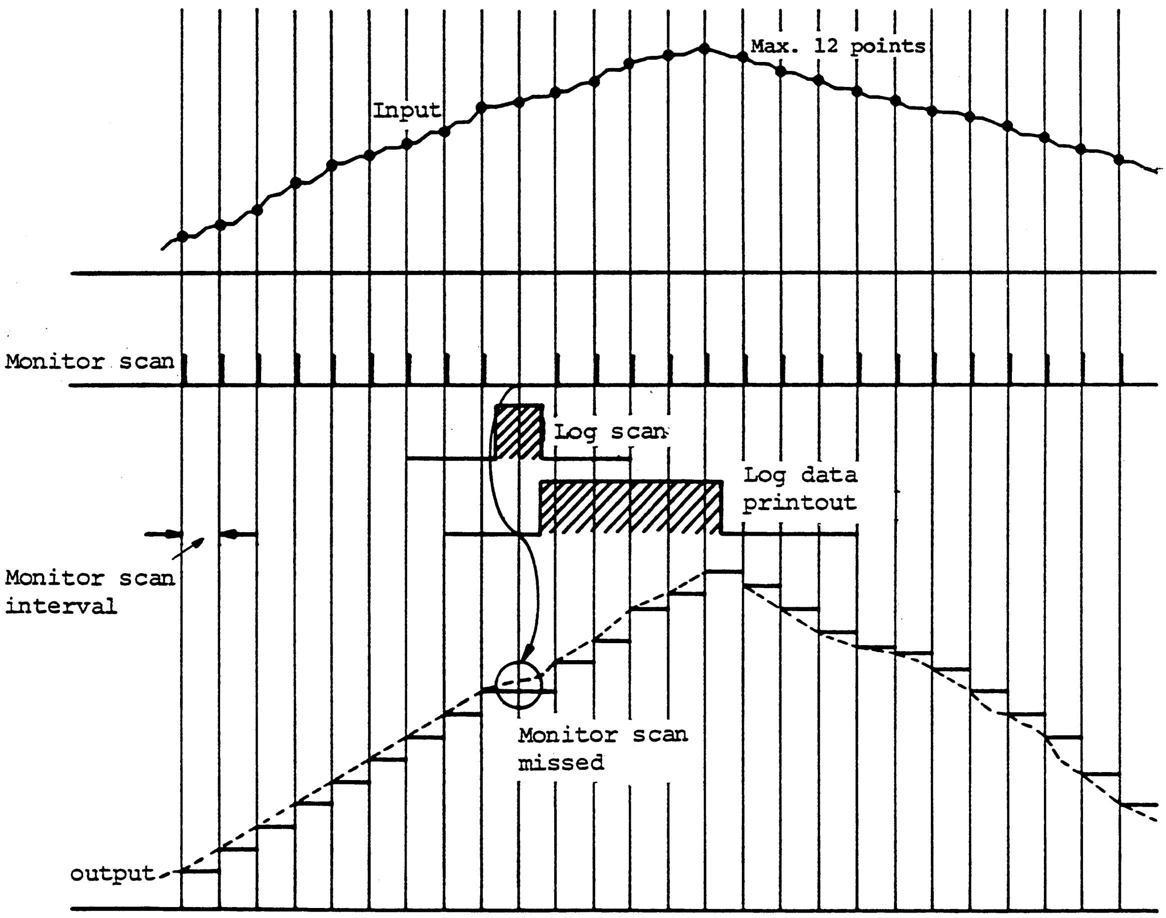
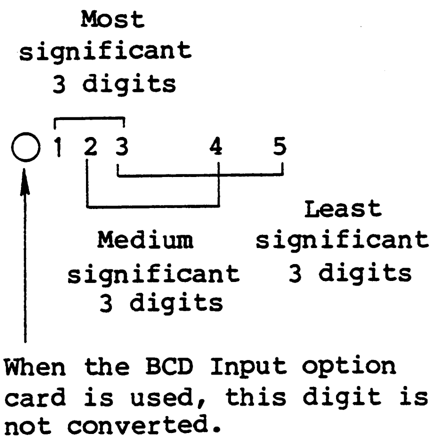


Fig. 8-6 Analog output vs. input data

As shown in Figure 8-7, the most, medium, or least significant digits of input data can be selected for conversion. At this time the decimal point in input data is ignored. If the TR2730-530 BCD Input option card is used with the TR2730-550 Analog Output option card, input data has six digits, but the most significant digit is not to be converted to analog form.



Most significant 3 digits 123	10 mV range		1.23 mV
	1 V range		0.123 V
Medium significant 3 digits 234	10 mV range		2.34 mV
	1 V range		0.234 V
Least significant 3 digits 345	10 mV range		3.45 mV
	1 V range		0.345 V

Fig. 8-7 Digit selection

If the TR2731 is programmed for contact input, output of the option card is available in 0 or 1 count. The full span of 999 counts may be scaled down by the scaling function. If A=0 and B=0.01 is assumed, equation (X-A)/B gives:

When ON → 1 : (1-0)/0.01 = 100

When OFF → 0: (0-0)/0.01 = 0

This is illustrated in Figure 8-8.

If multiple channels are used, the ON level on the recorder can be varied by changing value B, and hence responses between multiple channels are distinguished on the chart.

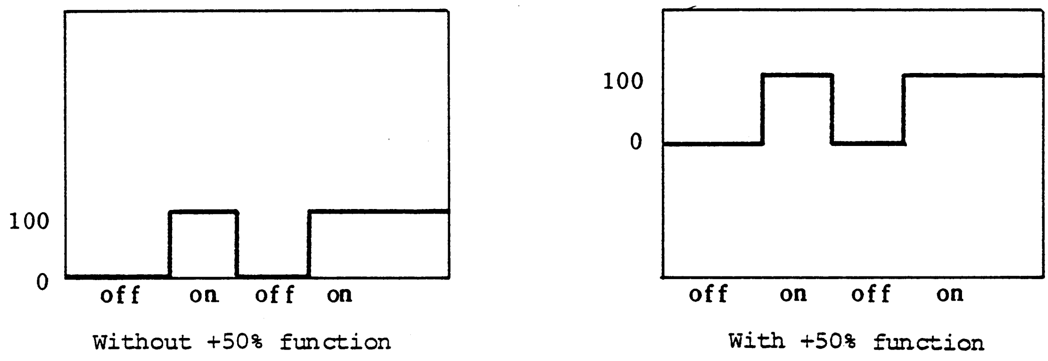


Fig. 8-8 Contact input scaling

8-6. PROGRAMMING SUPPORT

This paragraph describes the TR2731 programming procedures necessary for operating the TR2730-550 Analog Output option card correctly.
When specifying 12 analog-output channels (2 option cards) out of the channels specified for monitor scan, first specify monitor scan, then specify the analog output channels.

8-6-1. Monitor Interval Specification

In the following programming information, all channel scan means scanning of all channels specified as scan channels. Selective channel scan means scanning of the channels specified for the option card's analog output (up to 12 channels).
(Programming contents)

[Interval value] [,] [Interval mode]

(Minute. Second)
00 minute 00 second
|
60 minutes 00 second

0: All channel scan (aLL) [Normal]
1: Selective channel scan (SeL)

8-6-2. Analog Output Channel Specification

If output channels for the Analog Output option card must be specified in the all channel scan mode, or if selective channel scan is to be executed, enter as follows (max. 12 channels):

(Programming contents)

[Channel number] [,] [Digit select code for analog output] [,] [With/without offset for analog output]

101

Maximum channel number

Digit select code for analog output:
- 0: Least significant 3 digits (0C) — Normal
- 1: Medium significant 3 digits (1C)
- 2: Most significant 3 digits (2C)

With/without offset for analog output:
- 0: Without offset (off) — Normal
- 1: With offset (on)

(Programming procedure)

[SCAN FORMAT] [MONIT. INTL] → Display: 0m00s, all

o To perform a monitor scan in the all channel scan mode at 10-second intervals, enter as follows:

[0] [•] [1] [0] [,] [0] [SET/NEXT] → Display: 0m10s, all

(Simplified entry procedure)

a. [0] [•] → [•]

Entry of [•] for 0 minute can be omitted.

b. [,] [0] [SET/NEXT] → [SET/NEXT]

When specifying the all channel scan mode, entry of [,] or [0] can be omitted.

o Set the interval to 10 seconds with:

[.] [1] [0] [SET/NEXT] → `0m10s, all`

o Specify continuous scan with:

[.] [0] [SET/NEXT] → `0m00s, all`

When specifying analog output channels, output the least significant three digits of data on channel 1 of terminal 1 to analog output channel 1.

o To assign the terminal's channel 1 to analog output channel 1, enter as follows:

Call the next item with [SET/NEXT] .

Press [1] [,] [0] [,] `M01 ch, c,`

[1]: Channel 1; [0]: Least significant 3 digits

Currently programmed value (or blank)

M01: Indicates analog output's channel number.

[0] [SET/NEXT] → `M01 101ch, 0c, off`

[0]: With no offset

(Simplified entry procedure)

a. [,] [0] [,] [0] [SET/NEXT] → [SET/NEXT]

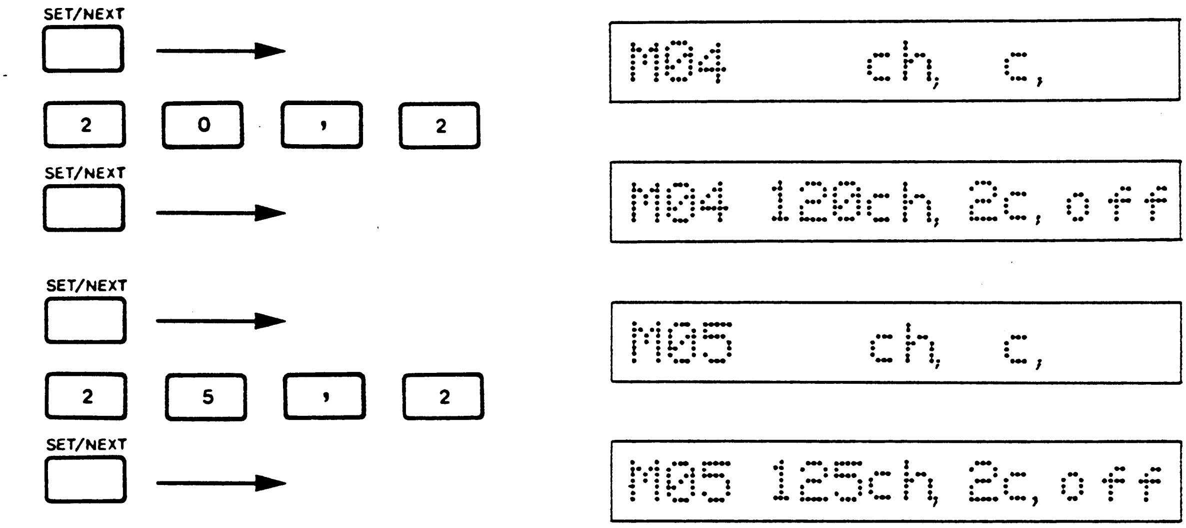
If the output digit positions and offset specification are normal, entry between the first [,] and the last [0] can be omitted.

- Assign the terminal's channel 1 to analog output channel 1 with the [1] and [SET/NEXT] keys.

M01 101ch, 0c, off

o To execute monitor scan on only five channels of Channels 5, 10, 15, 20, and 25 at 15-second intervals, and to output the most significant three digits of scan data with no offset to analog output channels 1 through 5, enter as follows:

Key operation	Display
[MONIT. INTL] →	0m10s, all
[.] [1] [5] [,] [1] [SET/NEXT] → (1 → Selective channel scan mode)	0m15s, sel
[SET/NEXT] →	M01 101ch, 0c, off
[5] [,] [2] [SET/NEXT] → (2 → Most significant 3 digits)	M01 105ch, 2c, off
[SET/NEXT] →	M02 ch, c,
[1] [0] [,] [2] [SET/NEXT] →	M02 110ch, 2c, off
[SET/NEXT] →	M03 ch, c,
[1] [5] [,] [2] [SET/NEXT] →	M03 115ch, 2c, off


SET/NEXT
M04 ch, c,
2 0 , 2
SET/NEXT
M04 120ch, 2c, off
SET/NEXT
M05 ch, c,
2 5 , 2
SET/NEXT
M05 125ch, 2c, off

MEMO

SECTION 9

TR2730-560 SERIAL DATA OUTPUT OPTION CARD

9-1. GENERAL

The TR2730-560 Serial Data Output option card provides serial data output of measurement information or program listings to a CRT display, serial printer, or other external serial output units for real-time data monitoring or batch data recording. The normal data output format is RS-232C. Modification to 20 mA current loop output is permitted only on connector 1. For more details refer to paragraph 9-6.

In the multi-user mode, up to four local output terminals are available for individual users.

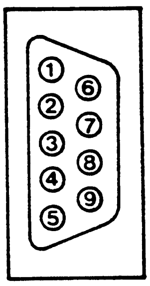
Transfer is available in six rates between 300 bps and 9600 bps.

Remove this option card when no external equipment is connected or operated.

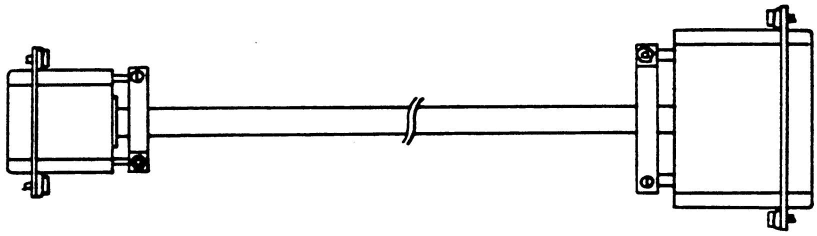
9-2. SPECIFICATIONS

Output connectors : 4 (Japan Aviation Electronics Industry, Ltd. DE-9S)
(Mating plug: DE-9P)
This is one output port, however.

Pin assignment : ① Safeguard GND
② (External unit ready)
③ Output data
④ Request to send
⑤ Send enabled
⑥ Unit ready
⑦ Signal ground
⑧ Carrier sense



Connecting cables : MC-82-01 (5 meters) (optional)
MC-82-01 (15 meters) (optional)



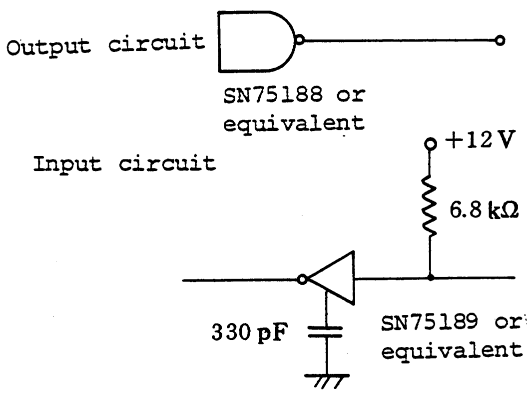
Japan Aviation Electronics Industry Ltd. DE-9P or equivalent	Japan Aviation Electronics Industry Ltd. DB-25P or equivalent

DB-25P connector pin assignment:

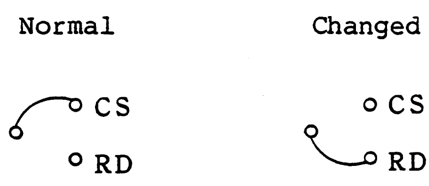
Pin No.	Signal name	Signal direction TR2730-560	External unit
1	Safeguard GND		
3	Data output	→	
4	Request To Send signal	←	H: Send enable L: Send disable
5	Send Enable signal	→	Fixed to HIGH.
6	Unit Ready signal	→	Fixed to HIGH.
7	Signal ground		
8	Carrier Sense signal	→	Fixed to HIGH.
20	External Unit Ready signal	←	H: Send enable L: Send disable

Normally, data send enable/disable is checked with the External Unit Ready signal at pin 20. If it is desired to do this check with the Request To Send signal at pin 4, the jumper wire on the card needs modifying.

Input/output circuits:



Change the jumper wires (1C , 2C , 3C , or 4C , as required) to RD when pin 4 signal is to be used for checkup.



Electrical characteristics:

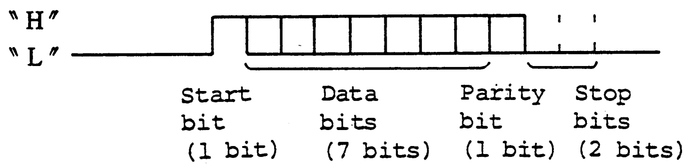
Signal level : Mark and stop bit ---- LOW
Space and start bit ---- HIGH

Output voltage levels: HIGH --- +8 V to +12 V
LOW ---- -8 V to -12 V

Input voltage levels: HIGH --- +3 V to +15 V
LOW ---- -3 V to -15 V

Note: The time-out interval for busy check is 10 seconds. If no response is returned in 10 seconds, output will be halted.

Transfer bit configuration: 11 bits/character



The parity bit is specified for even number.

Code : ASCII code

Lowercase alphabetic characters are converted into uppercase alphabetic characters when output.

Special characters are converted as follows:

(° → ', Ω → R, μ → U, Δ → D, □ → Q)

Attachable output units: Up to 4 units (selectable with switch)

In the single user log mode, data is output only to output channel 1 (switch setting is ignored.). In the multi-user log mode, the number of units is specifiable. If the specified number of units is less than the number of users, data of remaining users are output to the last unit.

Transfer rate : 300, 600, 1200, 2400, 4800, or 9600 bps selectable with the BAUD RATE switch on the rear panel.

Output format : 1, 3, 4, or 5 data per line, selectable with the FORMAT switch on the rear panel.

Page mode ON/OFF specifiable.

A printout example for 3 data/line is shown in Figure 9-1.

```
*CRLF
[USER ID][SP][LABEL][SP][TIME]CRLF
[CH, DATA][SP][CH, DATA][SP][CH, DATA]CRLF
[CH, DATA][SP][CH, DATA][SP][CH, DATA]CRLF
      :            :            :
[CH, DATA][SP][CH, DATA][SP][CH, DATA]CRLF
*CRLF
*CRLF
[CH, Secondary arithmetic operation data][SP][CH, Secondary
arithmetic operation data][SP][CH, Secondary arithmetic operation
data]CRLF
      :            :            :
[CH, Secondary arithmetic operation data][SP][CH, Secondary
arithmetic operation data][SP][CH, Secondary arithmetic operation
data]CRLF
CRLF
[Group No., DATA][SP][Group No., DATA][SP][Group No., DATA]CRLF
      :            :            :
[Group No., DATA][SP][Group No., DATA][SP][Group No., DATA]CRLF
*CRLF
```

1. Source data or primary arithmetic operation data
2. Secondary arithmetic operation data (deviation)
3. Other secondary arithmetic operation data

Fig. 9-1 Output format printout example (3 data/line)

Description for Figure 9-1 Output format printout example

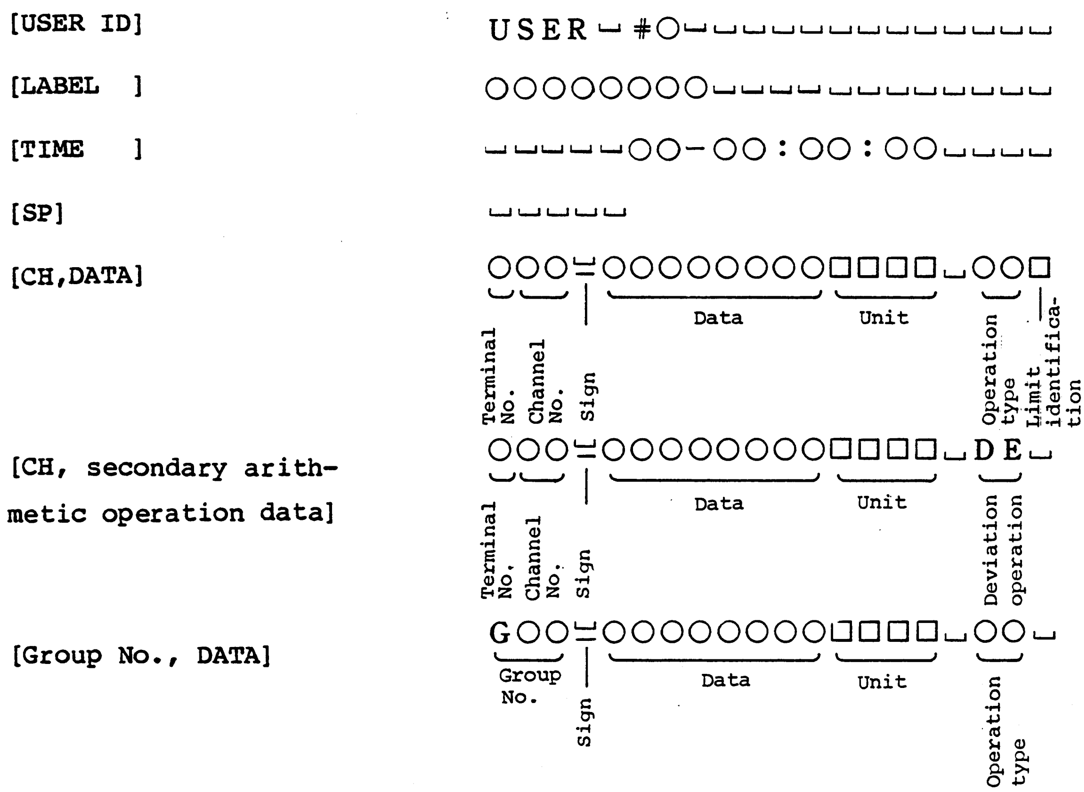
(1) If only primary arithmetic operation is executed, data output is terminated at the *CRLF after the primary arithmetic operation data is output.

(2) If deviation or any other operation of the secondary arithmetic operations is not executed, the section indicated by "{" in the figure is defaulted.

(3) If source data output inhibit is specified, the section indicated by "{" is also defaulted.

(4) Unless otherwise specified, [USER ID] and [LABEL] are defaulted.

(5) The contents of square brackets are as follows (: space):



(6) If the page mode is selected, a from feed code (hex 0C) is output after 60 lines are printed.

(7) If the number of output data (character) digits is less than those specified in each square brackets shown above, the output data (characters) is right justified on each item, and blanked digit positions are filled with space codes.

(8) When only one terminal is used, a space code is output at the most significant digit of a channel number (terminal number).

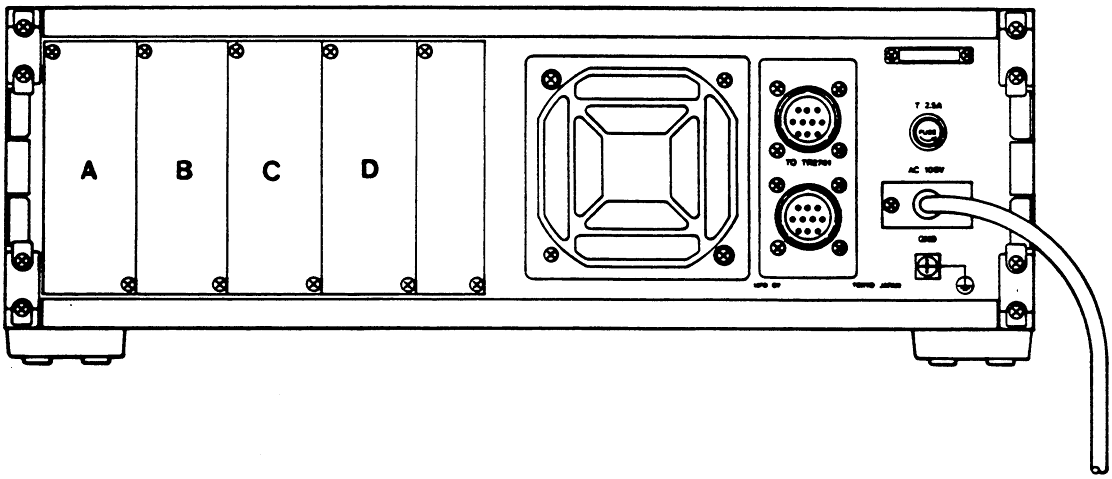
(9) Output for error and contact range

○○○␣␣␣␣␣ **OFF**␣□□□□␣○○□	Contact range OFF
○○○␣␣␣␣␣␣ **ON**␣□□□□␣○○□	Contact range ON
○○○␣␣␣␣ **SENS**␣ **OUT**␣␣○○□	Sensor fault
○○○␣␣␣␣␣ **OVER** ␣␣␣␣␣○○□	Over
○○○␣␣␣ **TRANS** ␣ **ERR**␣␣␣␣␣	Transfer error
○○○␣␣␣␣ **COMP** ␣ **ERR**␣␣○○□	Computation error
○○○␣␣␣␣␣ **LNR**␣ **ERR**␣␣○○□	Linearization error
○○○␣␣␣␣␣ **RJC**␣ **ERR**␣␣○○□	Room temperature compensation error
○○○␣␣␣␣␣ **ETC**␣ **ERR**␣␣○○□	Other error
○○○␣␣␣␣␣␣ **PT**␣ **ERR**␣␣○○□	When a three-wire RTD is used, the resistance per wire exceeds 10 Ω.

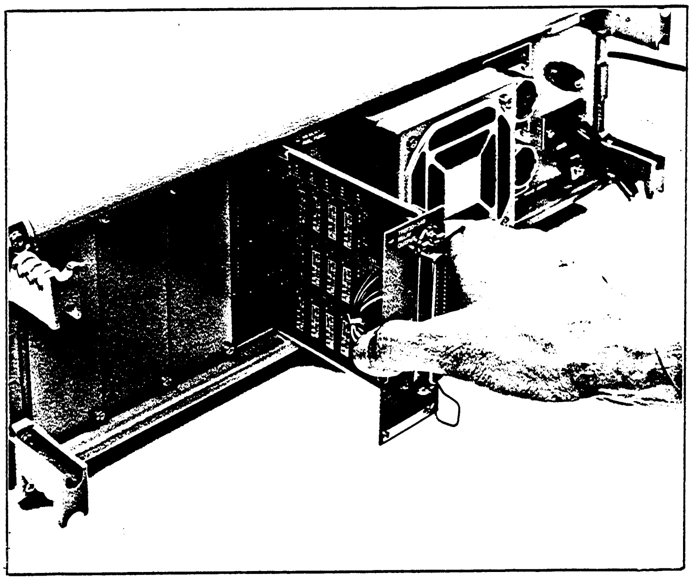
9-3. INSTALLATION PROCEDURE

The TR2730-560 option card can be inserted into a card slot of the TR2731 Mainframe rear panel and secured with two screws. The installation procedure is illustrated in Figure 9-2.

① Remove one of four blank panels A, B, C, or D from the card slot in which the option card is to be inserted.



② Place the option card on the board guide in the slot and insert it fully into the slot. After plugging the card into the card connector, secure it with the two retention screws.



* This photo shows another option card.

Fig. 9-2 Option card installation procedure

9-4. PANEL DESCRIPTION AND SWITCH SETTING

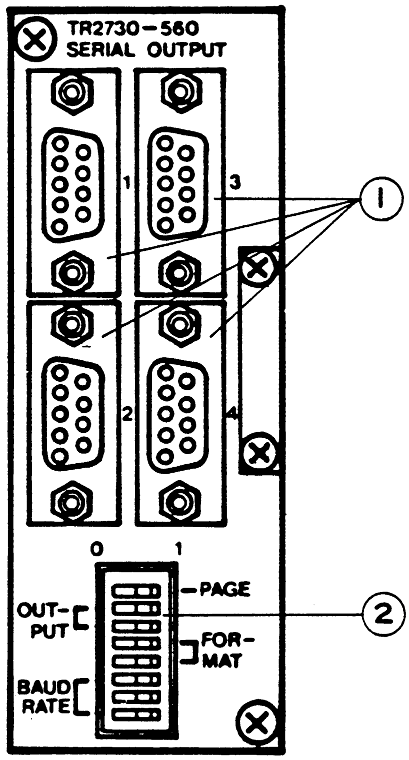


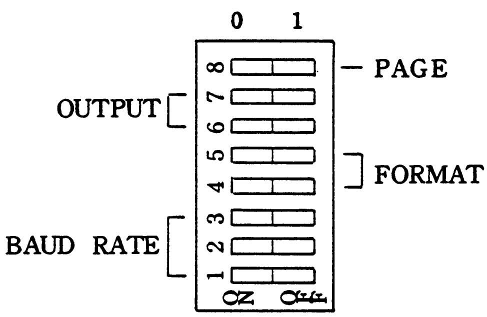
Fig. 9-3 TR2730-560 panel description

① Output connector

This 9-pin connector (Japan Aviation Electronics Industry, Ltd. DE-9S) provides serial data output.

② DIP switch

Bit functions of this DIP switch are shown below.



Note: The switch should be specified according to 1/0 specifications in the following tables (the ON/OFF labels on the switch should be ignored.).

PAGE : This bit turns the Page mode ON or OFF.

Bit 8	Mode
0	OFF
1	ON

If the Page mode is activated, a form feed code (hex 0C) is output after each 60-line printout. The form feed code is also output when log scan stops. After the last data is output, press the LOG STOP key.

OUTPUT : Bits 6 and 7 specify the number of output units to be attached (these bits are ignored when in single user mode.).

Bits		Number of units
7	6	
0	0	1
0	1	2
1	0	3
1	1	4

FORMAT : Bits 4 and 5 specify output format.

Bits		Data/line
5	4	
0	0	1
0	1	3
1	0	4
1	1	5

- **BAUD RATE** : Bits 1, 2 and 3 specify the data transfer rate.

Bits			bits/s
3	2	1	
0	0	0	Unused
0	0	1	
0	1	0	9600
0	1	1	4800
1	0	0	2400
1	0	1	1200
1	1	0	600
1	1	1	300

9-5. OPERATING INSTRUCTIONS

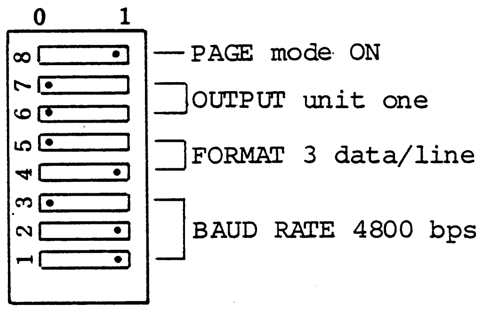
9-5-1. Single User Log Scan Data Output

Specify the number of output units to be attached, data transfer rate and data format with the DIP switch on the option card panel. After setting the switch, connect the external unit to connector 1.

(Programming example)

Connecting to an EPSON RP-80:

① Set the DIP switch on the option card as follows:



② The following interconnecting cables are provided optionally:
MC-82-01 (5 meters)
MC-82-02 (15 meters)

③ Set up the serial interface board on the RP-80 for the following situations:

Table 9-1 RP-80 interface board jumper settings

Jumper	Function				Settings for connection to TR2730-560
J1	ON: Pulls up the DSR and DCD lines to +12 V through 470 Ω.				ON
J2	ON	Input data: RS-232C level	OFF	Input data: Current loop level	ON
J3	OFF		ON		OFF
J4	ON: Pulls up the TTY-TXD line to +12 V through 470 Ω.				OFF
J5	ON: Grounds the TTY-TXD return line to the communication GND.				OFF
J6	ON: Pulls up the TTY-RXD line to +12 V through 470 Ω.				OFF
J7	ON: Grounds the TTY-RXD return line to the communication GND.				OFF

Note: ON means jumper connected, OFF means jumper disconnected.

Table 9-2 Baud rate seting

Bit per second	SW1-1	SW1-2	SW1-3	SW1-4	Settings for connection to TR2730-560
75	OFF	OFF	ON	ON	
110	ON	ON	OFF	ON	
1345	OFF	ON	OFF	ON	
150	ON	OFF	OFF	ON	
200	OFF	OFF	OFF	ON	
300	ON	ON	ON	OFF	
600	OFF	ON	ON	OFF	
1200	ON	OFF	ON	OFF	
1800	OFF	OFF	ON	OFF	
2400	ON	ON	OFF	OFF	
4800	OFF	ON	OFF	OFF	o
9600	ON	OFF	OFF	OFF	
Self test	ON	ON	ON	ON	

Note: ● 8-bit DIP switch: SW1-1 to SW1-8
4-bit DIP switch: SW2-1 to SW2-4
● Reset the power switch when switch setup is changed.

Table 9-3 Flag reset timming

Residual bytes in data buffer	SW1-5	SW1-6	Settings for connection to TR2730-560
152	ON	ON	o
288	OFF	ON	
560	ON	OFF	
1936	OFF	OFF	

Table 9-4 RP-80 interface board DIP switch settings

DIP switch pin No.	Function	Settings for connection to TR2730-560
SW1-7	ON: Parity check disabled OFF: Parity check enabled	OFF
SW1-8	ON: Even parity OFF: Odd parity	ON
SW2-1	ON: 7-bit word length OFF: 8-bit word length	ON

Table 9-5 SW2 setup

<table>
<tr><th>DIP switch pin No.</th><th colspan="4">Function</th><th>Settings for connection to TR2730-560</th></tr>
<tr><td>SW2-2</td><td>ON</td><td rowspan="2">In the serial data input inhibit state, reverse channel = mark (RS-232C), TTY-TXD = mark (current loop)</td><td>OFF</td><td rowspan="2">In the serial data input inhibit state, reverse channel = space (RS-232C), TTY-TXD = space (current loop)</td><td>ON</td></tr>
<tr><td>SW2-3</td><td>OFF</td><td>ON</td><td>OFF</td></tr>
<tr><td>SW2-4</td><td colspan="4">ON: Reverse channel available
OFF: Reverse channel is fixed</td><td>ON</td></tr>
</table>

Note: Do not set both SW2-2 and SW2-3 to ON; it will cause malfunction.

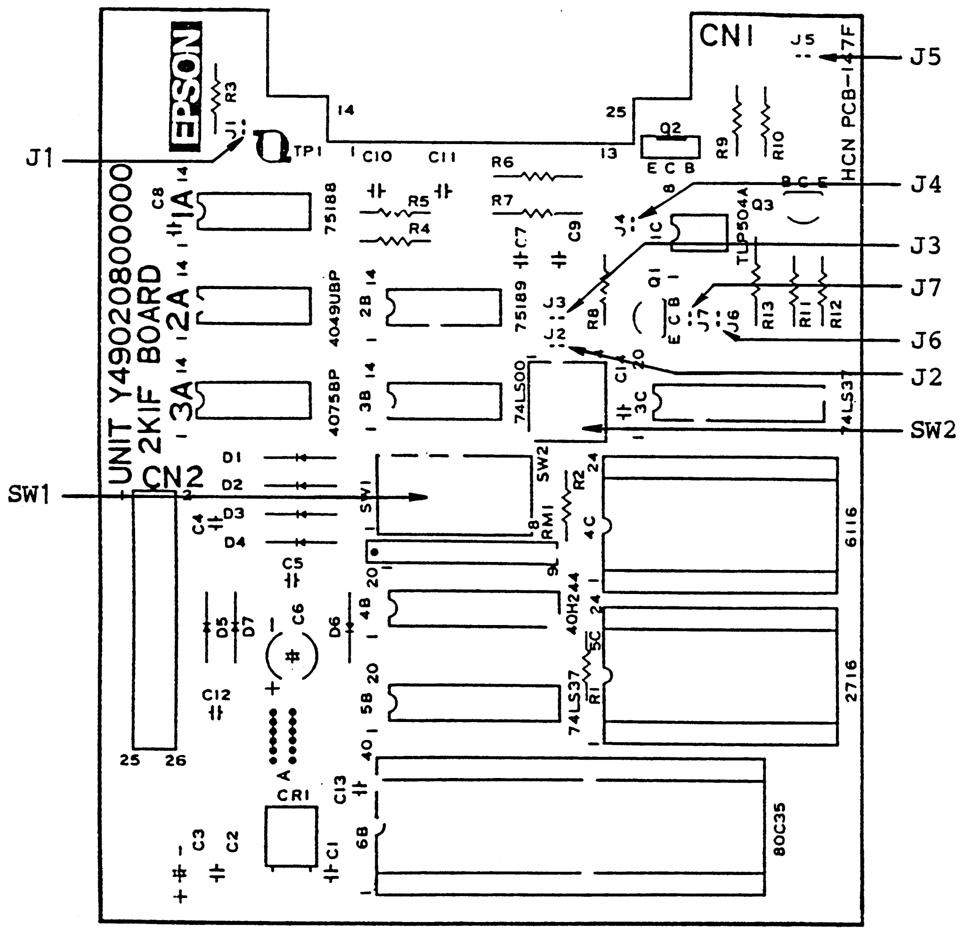


Fig. 9-4 RP-80 interface board parts layout

④ After completing the above settings and connections, press the OUTPUT ENABLE key on the TR2731 Mainframe front panel; the lamp in the key lights.

Now data printout for each log scan is ready:

CAUTIONS

1. When external output units are connected, set the recording paper to the home position before starting log. If the Page mode is specified, a new page operation is performed at the end of each 60-line printout.
2. External output is not available for alarm printout.

```
*
TEST/000                                18-12:14:30
 01      24.9   'C          02      23.0   'C          03      23.8   'C
 04      23.1   'C          05      23.7   'C          11     9.413   MV    L
 12     9.422   MV    L     13     9.422   MV    L     14     9.415   MV    L
 15     9.418   MV    L     16     9.420   MV    L     17     9.420   MV    L
 18     9.421   MV    L     19     9.414   MV    L     20     9.422   MV    L
*
*
TEST/001                                18-12:15:30
 01      24.9   'C          02      23.0   'C          03      23.8   'C
 04      23.1   'C          05      23.9   'C          11     9.428   MV
 12     9.433   MV          13     9.430   MV          14     9.419   MV    L
 15     9.427   MV          16     9.424   MV    L     17     9.428   MV
 18     9.427   MV          19     9.424   MV    L     20     9.422   MV    L
*
*
TEST/002                                18-12:16:30
 01      24.9   'C          02      23.0   'C          03      23.9   'C
 04      23.1   'C          05      24.0   'C          11     9.426   MV
 12     9.426   MV          13     9.426   MV          14     9.422   MV    L
 15     9.424   MV    L     16     9.420   MV    L     17     9.433   MV
 18     9.425   MV          19     9.423   MV    L     20     9.420   MV    L
*
*
TEST/003                                18-12:17:30
 01      24.9   'C          02      22.9   'C          03      23.8   'C
 04      23.1   'C          05      23.8   'C          11     9.424   MV    L
 12     9.427   MV          13     9.425   MV          14     9.423   MV    L
 15     9.419   MV    L     16     9.426   MV          17     9.427   MV
 18     9.427   MV          19     9.415   MV    L     20     9.429   MV
*
*
TEST/004                                18-12:18:30
         25.0   'C          02     [illegible]         [illegible]   23.8   'C
                                                                         L
```

Fig. 9-5 Serial data printout example I

9-5-2. Multi-User Log Scan Data Output

In the multi-user log scan mode, data for individual users can be output to user-independent units respectively.

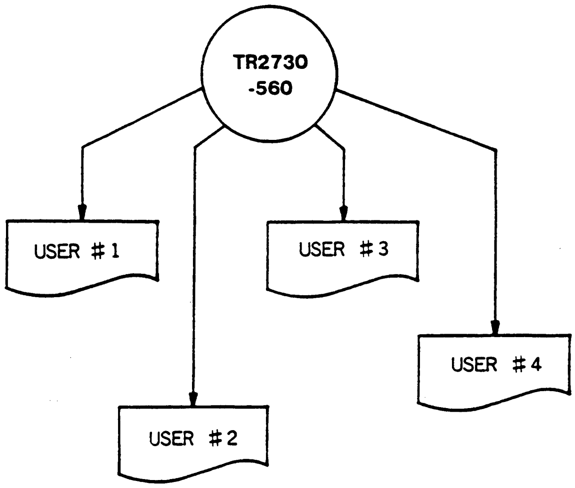
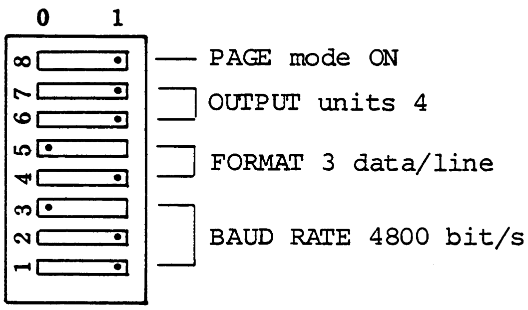


Fig. 9-6 Outline of multi-user log scan data output

If there are fewer attached units than the number of users, the data of remaining user(s) is output to the last unit.

(Programming example)

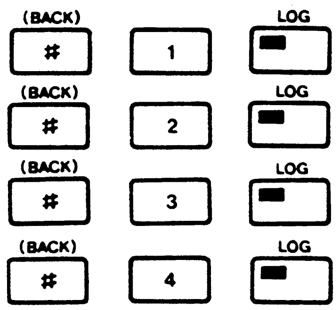
① Set the DIP switch on the option card as follows:



② The following interconnecting cables are optionally available:
MC-82-01 (5 meters)
MC-82-02 (15 meters)

③ After completing the above settings and connection, press the OUTPUT ENABLE key on the TR2731 front panel; the lamp in the key lights.

④ Make log start for each user. Log scan data for individual users will be printed on the four output units respectively.



CAUTIONS

1. Before starting log for each user, set the recording paper to the home position (if the page mode is selected, a new page operation is performed for each user.).
2. When more than one output unit is attached, the data transfer rate must be identical for all units.
3. The output format must also be identical for all attached units.
4. External output is not available for alarm printout.

```
*
USER #3                          00-00:44:46
   16      21.6  'C          17      21.6  'C          18      21.6  'C
   19      21.6  'C          20      21.6  'C          21      21.6  'C
   22      21.6  'C          23      21.6  'C          24      21.6  'C
   25      21.6  'C
*
*
USER #3                          00-00:44:56
   16      21.6  'C          17      21.6  'C          18      21.6  'C
   19      21.6  'C          20      21.6  'C          21      21.6  'C
   22      21.6  'C          23      21.6  'C          24      21.6  'C
   25      21.6  'C
*
*
USER #3                          00-00:45:06
   16      21.6  'C          17      21.6  'C          18      21.6  'C
   19      21.6  'C          20      21.6  'C          21      21.6  'C
   22      21.6  'C          23      21.6  'C          24      21.6  'C
   25      21.6  'C
*
*
USER #3                          00-00:45:16
   16      21.6  'C          17      21.6  'C          18      21.6  'C
   19      21.6  'C          20      21.6  'C          21      21.6  'C
   22      21.6  'C          23      21.6  'C          24      21.6  'C
   25      21.6  'C
*
*
USER #3                          00-00:45:26
   16      21.6  'C          17      21.6  'C          18      21.6  'C
                             20      21.6  'C          21      21.6  'C
                                     21.6  'C          24      21.6  'C
```

Fig. 9-7 Serial data printout example II

9-5-3. Program Listing

When setup and connection are made according to the procedure given in paragraph 9-5-1 or 9-5-2, a program list can be output to the attached external unit by first activating the OUTPUT ENABLE key (the lamp in the key lights) and then pressing the PROGRAM LIST key (the lamp in the key lights), both on the front panel of the TR2731 Mainframe.

If the PROGRAM LIST key is pressed with the OUTPUT ENABLE key left inactive, the listing is delivered only to the internal printer.

If more than one unit is attached, the listing is delivered to the unit connected to output connector No. 1, whether the multi-user mode is in use or not.

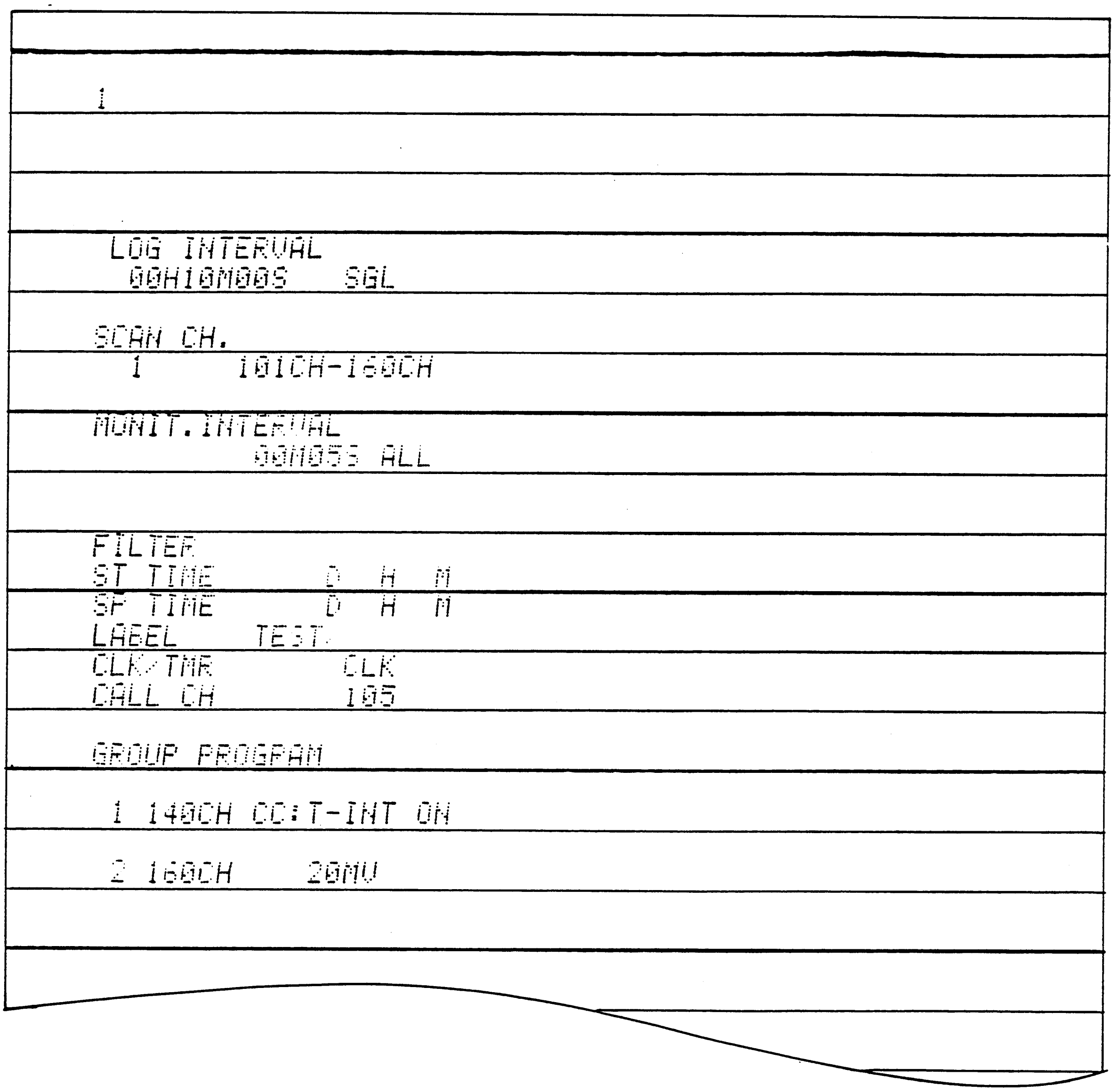
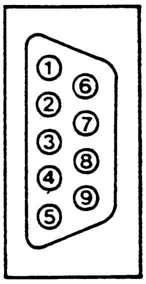


Fig. 9-8 Program listing printout example

9-6. MODIFYING TO 20 mA CURRENT LOOP INTERFACE

While all the four outputs on the TR2730-560 option card typically have the RS-232C compatible output format, the output on connector 1 can be modified to the 20 mA current loop interface. Note that this modification is not available for connectors 2, 3, and 4.

Pin assignment :



Current loop

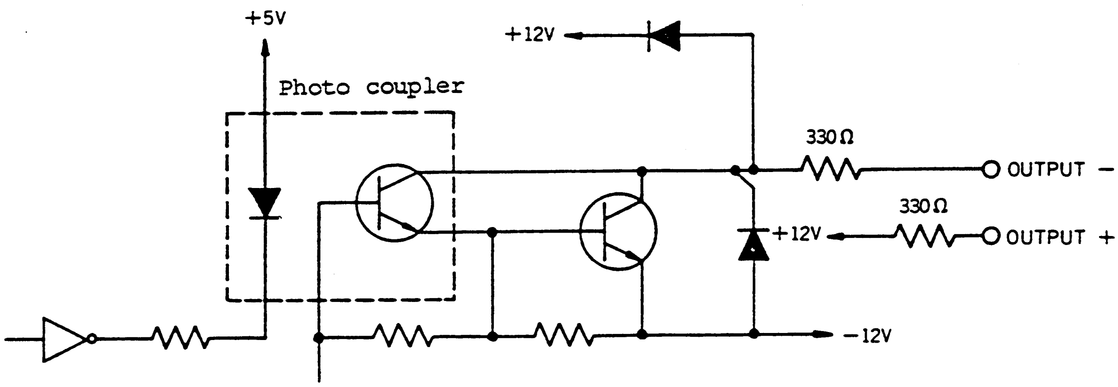
⑥ Output -

⑦ Output +

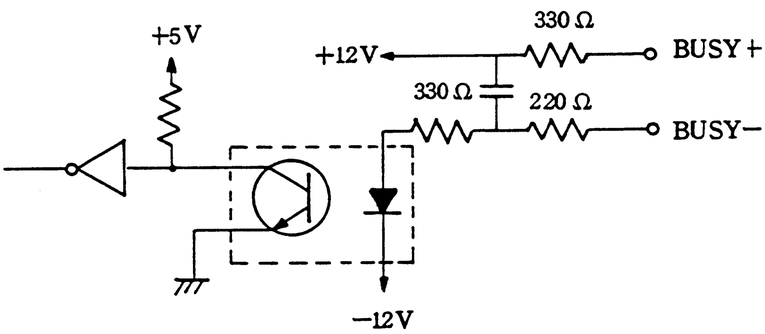
③ Busy +

④ Busy -

Output format : 20 mA current loop output



Input format : 20 mA current loop input



Current ON: Data send disabled

Current OFF: Data send enabled

Modification method: Cut jumper wires across 1-9 of JP5.

Connect jumper wires across 1-6 of JP1.

MEMO

SECTION 10

TR2730-570 DATA BUFFER MEMORY OPTION CARD

10-1. GENERAL

The TR2730-570 Data Buffer Memory option card provides data buffering for up to 3200 data. If rapidly changing input events are logged while logged data is delivered to external output units or internal printer in real-time processing, the output operation may not catch up with data sampling speed. In such a case, logged data can be temporarily buffered in memory to deliver to output units at an optional transfer rate by using the TR2730-570 option card.

When data is logged in the multi-interval mode or data of several users are delivered to only one printer, this option card can also be effectively used to rearrange the data configuration on printout for each interval or user.

MEMO

10-2. SPECIFICATIONS

Storage capacity and contents:

Log scan mode	Interval	Memory contents (bytes)	Storage capacity (number of data)
Single user	Single interval (0h 0m 0s)	Data block start mark (2) Secondary operation discriminating code (2) Data (5) + (2) Data block end mark (2)	*-1 3200
	Single interval (1s or more)	Data block start mark (2) Time of every scan (7) Secondary operation discriminating code (2) Data (5) + (2) Data block end mark (2)	*-2 3120
	Multi-interval	Data block start mark (2) Time of every scan (7) Secondary operation discriminating code (2) Multi-mark (1) Channel number (2) Data (5) + (2) Data block end mark (2)	*-3 2000
Multi-user	Multi-interval	Data block start mark (2) Time of every scan (7) Secondary operation discriminating code (2) Multi-mark (1) Channel number (2) Data (5) + (2) Data block end mark (2)	*-4 2000

Notes: 1) "Data (5) + (2)" shown is the memory contents' column of this table indicates that there are seven data bytes when the Digital Input option card is used. Typically, data sent from the TR2741 Sensor Terminals is 5-bytes long.

2) The number of bytes to be used in a single scanning is obtained from the following calculation:

A parenthesized number marked with in the "storage contents" column x The number of measuring channels + a parenthesized number not marked with • .

3) The storage capacity (the number of data items) is calculated for an 80-channel scan (without the digital input option).

Storage capacity calculation method

(1) The option card has a total storage capacity of 16384 bytes.

(2) {N x (Number of bytes of data (marked with •) + Number of bytes of other data (not marked with •)} x M ≦ 16384

Where : N = Number of scan channels

M = Number of scans

Calculate the number of scan (M) by the formula above, and then obtain the number of data items by multiplying M and N.

(3) *-1

{80 (number of channels) x 5 (number of bytes of data) + 6 (number of bytes of other data) } x M (number of scans) = 16384

$$M = \frac{16384}{80 \times 5 + 6} \fallingdotseq 40$$

∴ Number of data items = 39 x 80 = 3200

*-2

{80 (number of channels) x 5 (number of bytes of data) +13 (time and number of bytes of other data) } x M (number of scans) = 16384

$$M = \frac{16384}{80 \times 5 + 13} \fallingdotseq 39$$

Number of data items = 39 x 80 = 3120

*-3

{80 (number of channels) x [1 (multi-mark) + 2 (channel number) + 5 (number of bytes of data)] + 13 (time and number of bytes of other data)} x M (number of scans) = 16834

$$M = \frac{16384}{80 \times 8 + 13} \fallingdotseq 25$$

Number of data items = 25 x 80 = 2000

*-4 is the same as *-3.

The caluculations above assume that the number of scan channels is 80. If the number of scan channels is 1, the storage capacity in *-2 is calculated as follows:

$$M = \frac{16384}{1 \times 5 + 13} \fallingdotseq 910$$

∴ Number of data items = 910 x 1 = 910

Storage mode : One of the following three storage modes is selectable with the rear FORMAT switch:

OFF : Stores no data.

NORM. : Outputs data in the scanning order (from old data) while storing.

MULT. INT.: In the multi-interval mode, outputs data of each interval channel group after storing.

Data output mode: One of the following three output modes can be selected with the rear OUTPUT switch:

MANUAL : Permits manual delivery of data to the internal printer or an external unit with TR2731's front key operation.

EXT. AUTO.: Automatically outputs data to external units when logging stops or when the buffer is full.

PRT AUTO. : Automatically outputs data to the internal printer when logging stops or when the buffer is full.

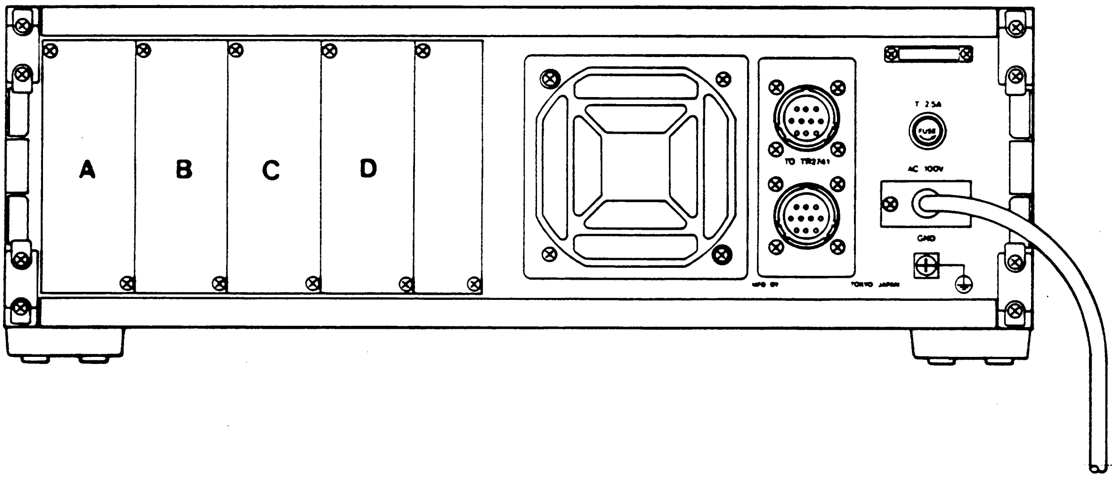
CAUTIONS

1. The PRT AUTO and EXT. AUTO modes can be cleared after automatic data output is initiated, by operating the LOG DATA and OUTPUT ENABLE keys on the TR2731 front panel, respectively. (Once the mode is cleared, data is discarded.)
2. If the MULT. INT. storage, single user log scan and single interval modes are selected at the same time, no data will be output until the buffer is full or logging stops.

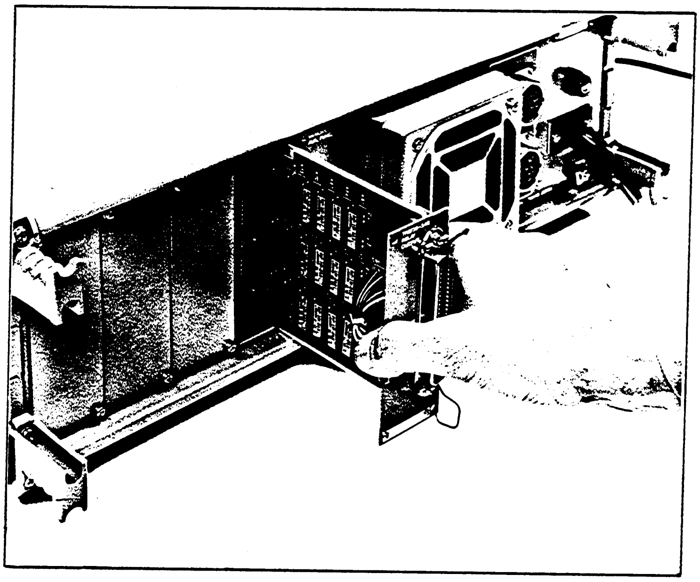
10-3. INSTALLATION PROCEDURE

The TR2730-570 option card can be inserted into a card slot of the TR2731 Mainframe rear panel and secured with two screws. The installation procedure is illustrated in Figure 10-1.

① Remove one of four blank panels A, B, C, or D from the card slot in which the card is to be inserted.



② Place the card on the board guide in the slot and insert it fully into the slot. After plugging the card into the slot connector, secure it with the two screws.



* This photo shows another option card.

Fig. 10-1 Option card installation procedure

10-4. PANEL DESCRIPTION

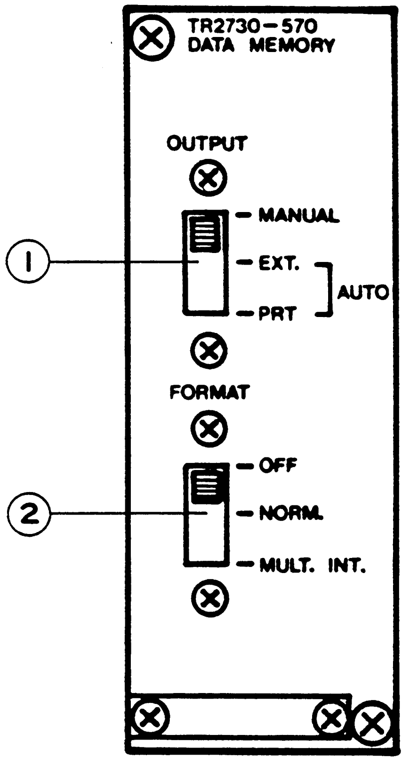


Fig. 10-2 TR2730-570 panel description

① OUTPUT switch

This switch selects the data output mode. It is activated only if the FORMAT switch is set at the MULT. INT. position.
The MANUAL position of the OUTPUT switch permits manual data output to the internal printer or external unit with TR2731's front key operation. The PRT-AUTO position of the switch permits automatic data output to the internal printer when logging stops or the buffer is full. The EXT.-AUTO position of the switch permits automatic data output to external units when logging stops or the buffer is full.

② FORMAT switch

The FORMAT switch selects storage mode. If no data is to be stored, set this switch to OFF. To output data in the scanning order (from old data) while storing, set it to NORM. To output data for each interval channel group after storing (in the multi-interval mode), set it to MULT. INT.

10-5. PRINCIPLES OF OPERATION

10-5-1. Data Buffering

The buffering function of the option card, with which logged data is delivered to output units in the scanning order (FIFO) while storing, is illustrated in Figure 10-3.

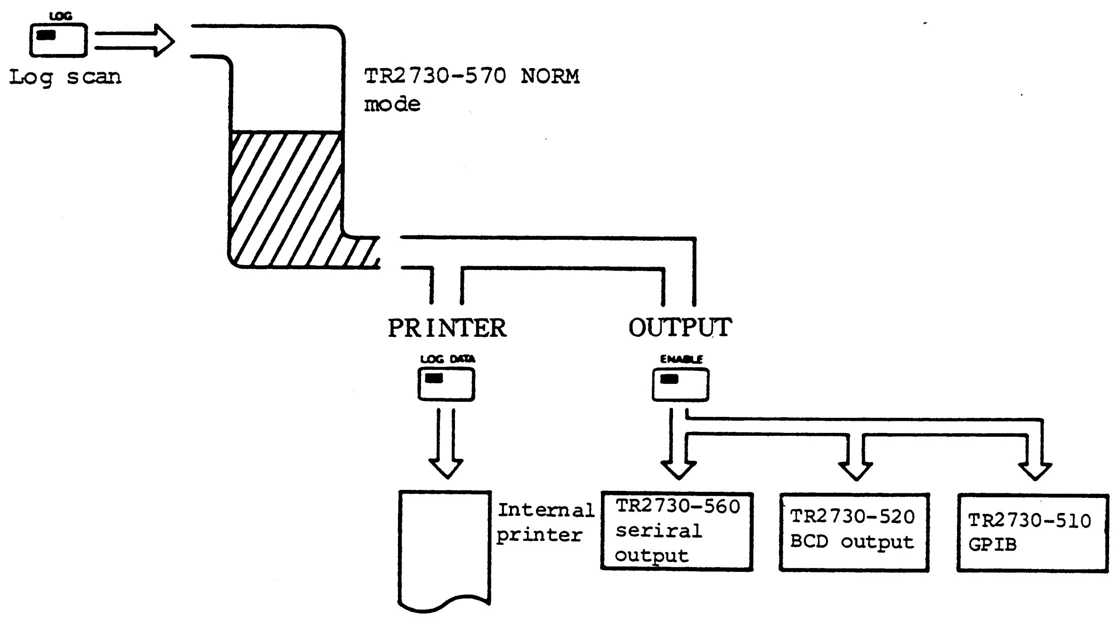
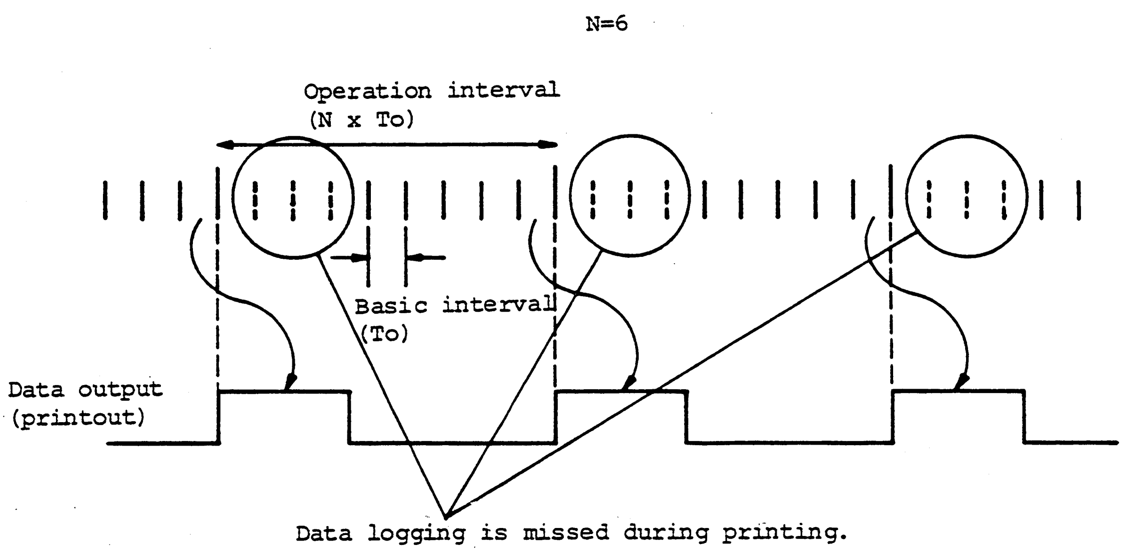


Fig. 10-3 TR2730-570 buffering function

This buffering function provides data logging, which is not affected by the speed of the attached output units (internal printer or external output units), until the buffer becomes full.

As shown in Figure 10-4, if the print time required for statistic operations on the time axis is longer than the basic interval, one or more log scans will be missed during printout, which results in an measurement error. In such a case, correct operation results will be obtained by using the buffering function as it allows data logging irrelevant to printing sequence.

a. When using no data buffer memory



b. When using the data buffer memory

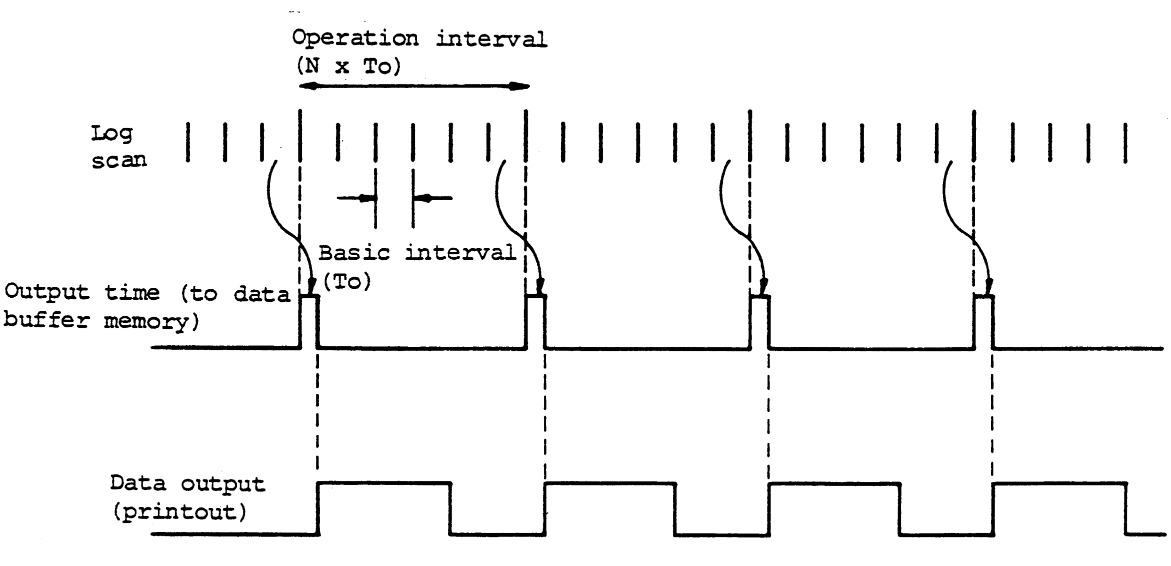
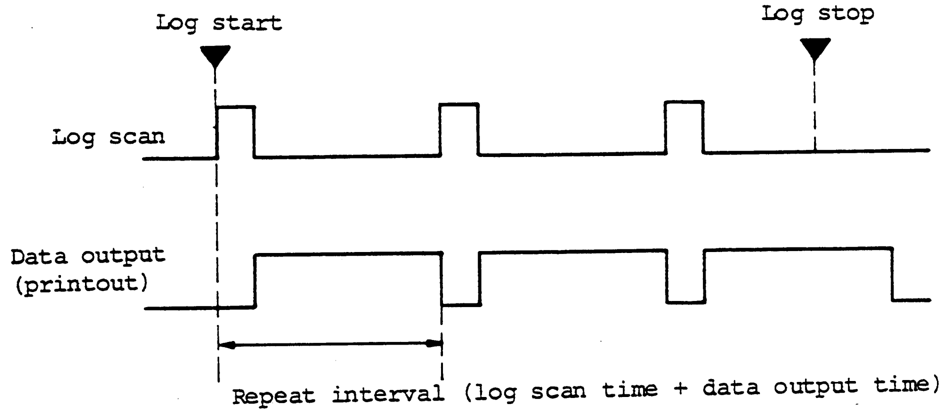


Fig. 10-4 Application example of buffering function I

The data buffering function may also be used for high-speed data logging. If the total amount of logged data is less than the storage capacity of the buffer memory, data can be logged in continuous mode with no regard to the speed of the output unit being used.

a. When using no data buffer memory



b. When using the data buffer memory

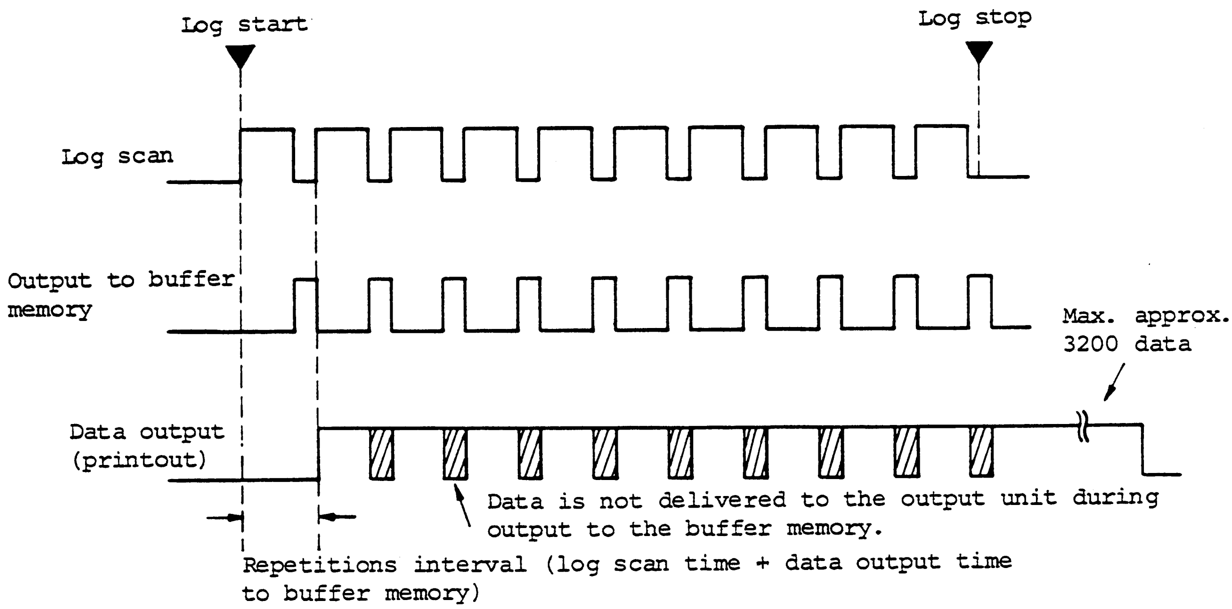


Fig. 10-5 Application example of buffering function II

If a data output option card (TR2730-520 BCD Output/External Control or TR2730-560 Serial Data Output option card) is used with the buffer memory function, continuous logging of data exceeding the capacity of the data buffer memory is enabled as shown by the timings in Figure 10-6.

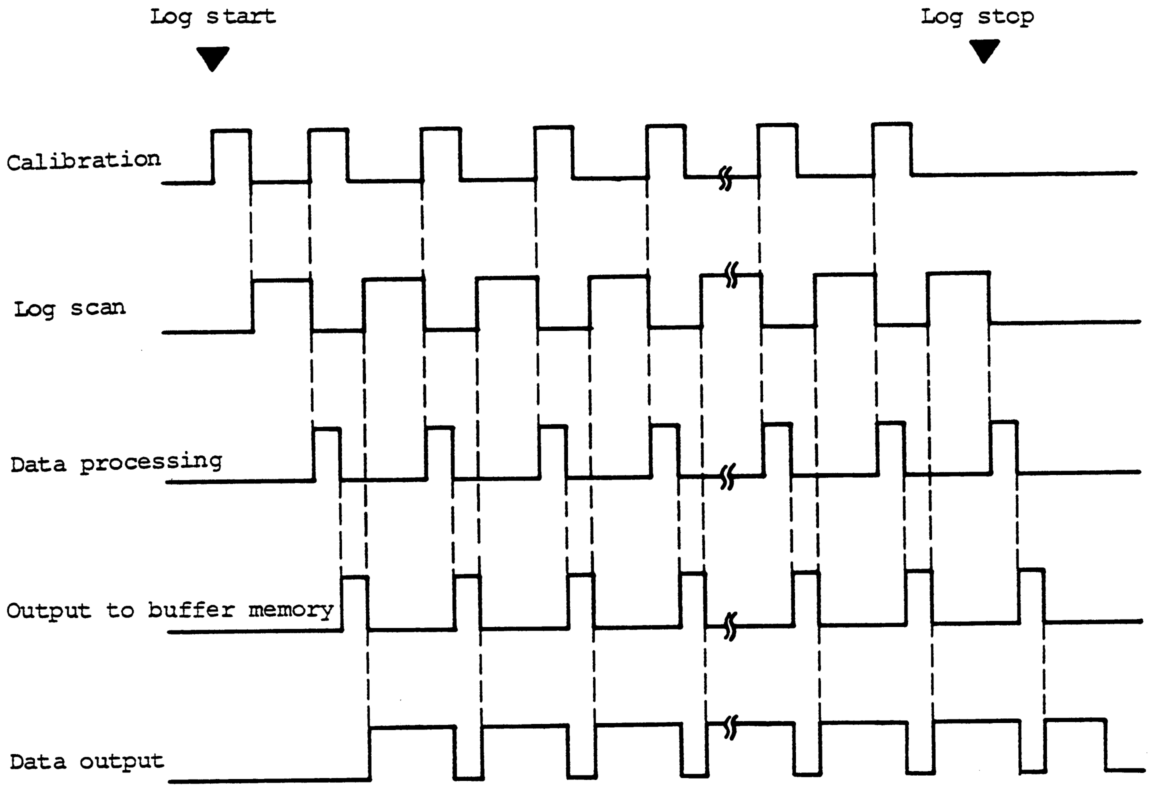


Fig. 10-6 Application example of data buffering function III

In this case, log scan and data output are executed in parallel. If the data output time is equal to or less than log scan time, the data buffer memory never becomes full. The output time to the buffer memory is approximately 5 ms/data. The BCD data output time is approximately 10 ms + external unit's response time per data, which is short enough to output data within the scanning time.

CAUTIONS

1. In the buffering mode, no channel number is stored in the data buffer memory. Therefore, wrong data will be output if the scan channel is changed during measurement.
2. Data is output in the scanning order in the multi-user log scan mode as well. If more than one output unit is attached via the TR2730-560 Serial Data Output option card, data of individual users are delivered to the units assigned to each user.
3. If continuous log scan is specified, the data buffer memory outputs measurement start time data at the beginning, and subsequently outputs only measurement data for each scan. If continuous log scan is not specified, the buffer memory outputs time, label and data for each scan.
4. If output to external unit is specified (OUTPUT ENABLE switch ON) and the response from the external unit doesn't occur for 10 seconds or more (e.g. the case external unit is not connected or inactivated), time-out is determined and so the data stored in the buffer is erased one by one.
5. If LOG DATA key in the PRINTER section and OUTPUT ENABLE key is set to OFF during data output to internal printer or external unit, data output is suspended until set to ON again. (The data remains alive.)
6. If scanning is stopped once and then restarted, the data in the buffer is erased and the instrument is initialized.
   And if the buffer memory is stored fully, scanning can not be restarted until data output is completed. Therefore switch the POWER off and then on again, if required.
7. Single-log scan data is not stored in the buffer memory.

10-5-2. Data Rearrangement

The data rearrangement function is available for the multi-interval or multi-user log scan modes.
In the multi-interval mode, data is printed in the scanning order, and hence data of a certain input group is inconsecutive on printout. In the multi-user log scan mode, if data of all users are output to only one unit, data of a specific user will also be inconsecutive on printout, mixed with data of other users.
In such cases, the data rearrangement function may be effectively used to provide consecutive data for each input group or user for buffer data readability, by temporarily storing logged data until measurement is stopped and rearranging data configuration. In the multi-user log scan mode, the data memory is equally divided into four sections, which are assigned to individual users.
Figure 10-7 shows data output sequences in different output modes selected with the OUTPUT switch on the option card rear panel. As shown in this figure, if MANUAL mode is selected, data output to the internal printer or external units is initiated by key operation on the TR2731 Mainframe. If the AUTO mode is selected, data is automatically delivered to the selected unit (internal printer or external unit) when logging stops or the buffer is full, regardless of the panel switch setting.

CAUTIONS

1. When the data rearrangement function is used, data is not output until the buffer is full or logging stops. While data is being output, execution of the next scan must be suspended.
2. In the multi-user log scan mode, if data output (print) for a specific user is started when logging ends or the buffer is full, scan sequences for other users is stopped after the first scan is completed, and is restarted at the intervals specified for individual users when the output operation of the said user is completed.

CAUTIONS (Cont'd)

3. Data output in the scanning order is available by activating data output during data logging with the OUTPUT ENABLE key and LOG DATA or ALM DATA key in the PRINTER section of the TR2731 Mainframe front panel.
4. If, in the multi-user log scan mode, data of users 1 through 4 are stored in the buffer memory in random order, they are output to one printer after being rearranged into user-independent data arrays.
5. If only two output units are available for four users, data of three users are output to the second output unit.
6. When data is being output because the buffer is full or logging has ended, monitor scan can be executed only if the ALM DATA key in the PRINTER section is deactivated (the lamp in the key goes off.).
7. If data output is stopped by operating the panel key, the remaining data in the buffer is discarded and will not be output when output restart is specified by another panel key operation.
8. If a large portion of data remains in the buffer memory when data output is stopped by panel key operation, it will take up to two minutes to internally process (discard) the remaining data.
9. When data remains in the buffer memory (during data output or when output is disabled after the buffer is full or logging ends), logging cannot be restarted.

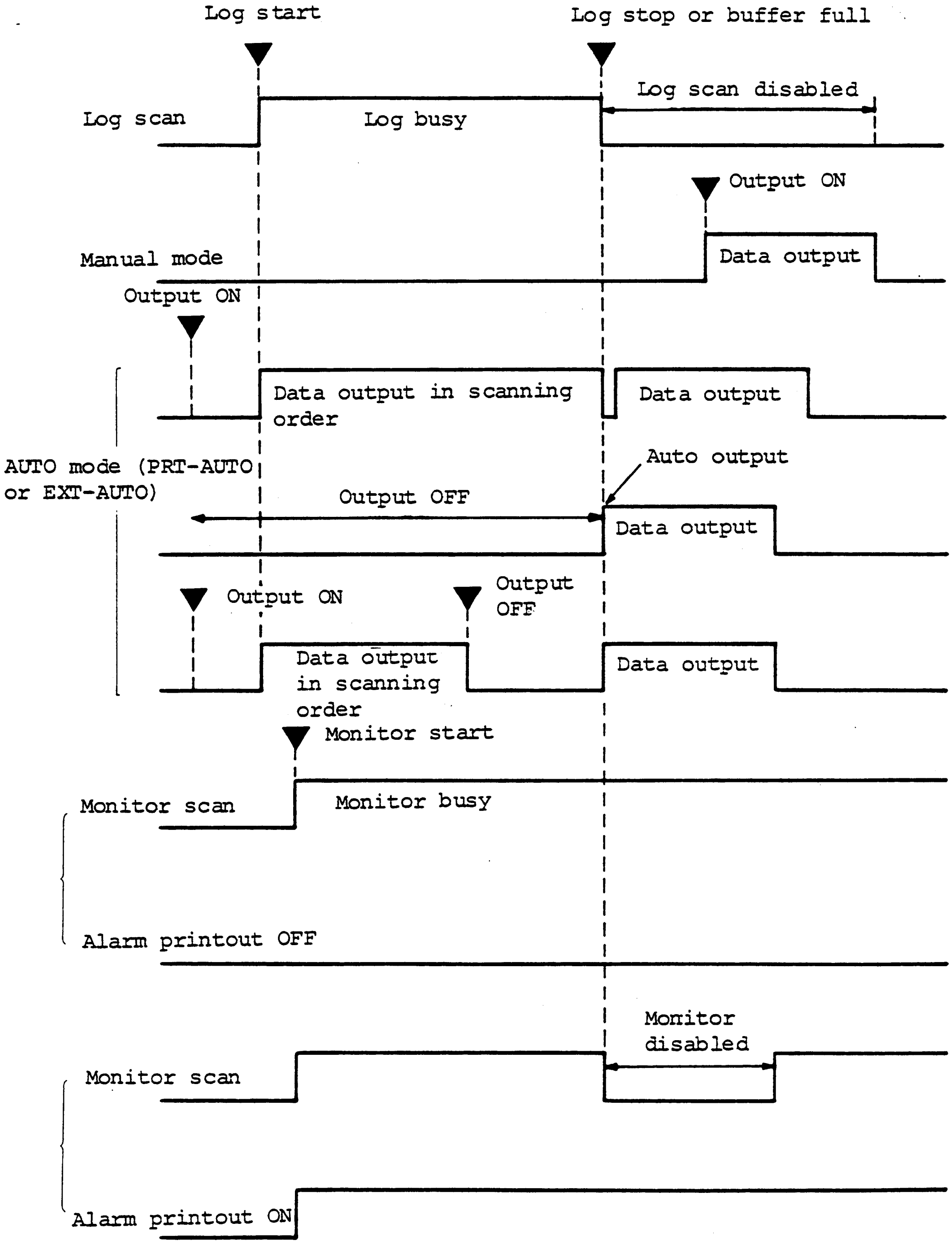


Fig. 10-7 Data rearrangement operation sequences using TR2730-570 option card

SECTION 11

TR2730-580 PULSE COUNTER OPTION CARD

11-1. GENERAL

TR2730-580 Pulse Counter option card provides the capability for measuring the outputs of various transducers which convert input events (turning speed, fluid flow, electric power, etc.) into pulse train. It can accept up to four input channels per card. Measurement can be synchronized with log scan in two methods. In the Counter mode, counting is executed at each log interval for a gate time of 0.1 or 1 second. In the Integration mode, input is counted over the entire interval time.

11-2. SPECIFICATIONS

Input channels : 4 channels/card (only one card installable.)

Input types : 2 (switchable)

  Contact input : 10 Hz max. (with chattering of less than 30 ms and pulse width of more than 50 ms)

  Non-contact input: 10 kHz max. (TTL compatible or AC signal with an amplitude of 1 Vp-p or more or 10 Vp-p or less, switchable)

Measurement modes : 2 (switchable)

  Counter mode : Gate time 0.1/1 sec. switchable

  Integration mode: Integrates pulses during log interval.

Counting digits : 4 digits max. (9999)

Connector : Isolated BNC receptacle (DDK 31-10)

CAUTIONS

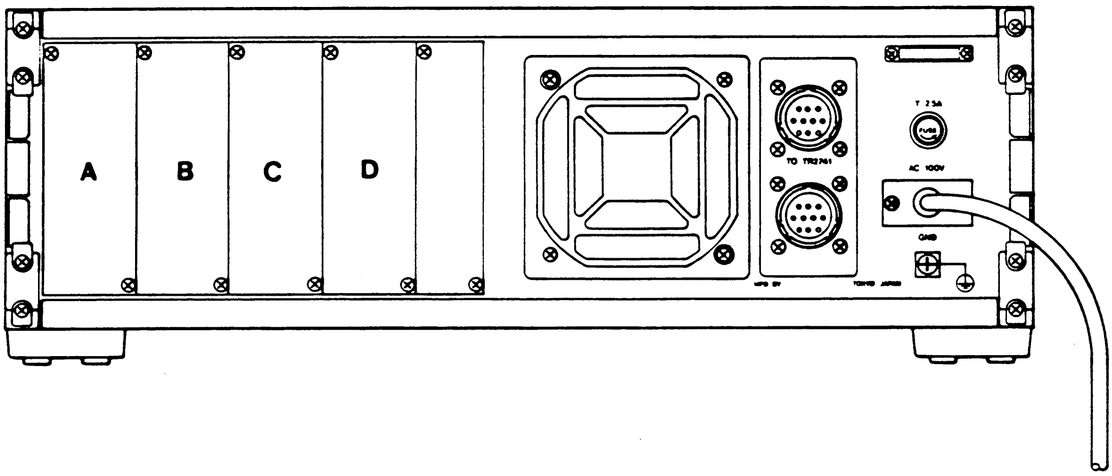
1. Concurrent use with the TR2730-530 BCD Input option card is not permitted.
2. The required programming is the same as that for the TR2730-530. The TR2730-580 option card is allocated to channels 501 through 504 for channel programming.
3. If monitor scan is used during the integration mode, data is not guaranteed.

   Channels 501 to 504 cannot be used as a call channel.

11-3. INSTALLATION PROCEDURE

The TR2730-580 option card can be inserted into a card slot of the rear panel on the TR2731 Mainframe and secured with two screws. The installation procedure is described below.

① Remove one of four blank panels A, B, C, or D from the card slot in which the option card is to be inserted.



② Specify input type as follows:

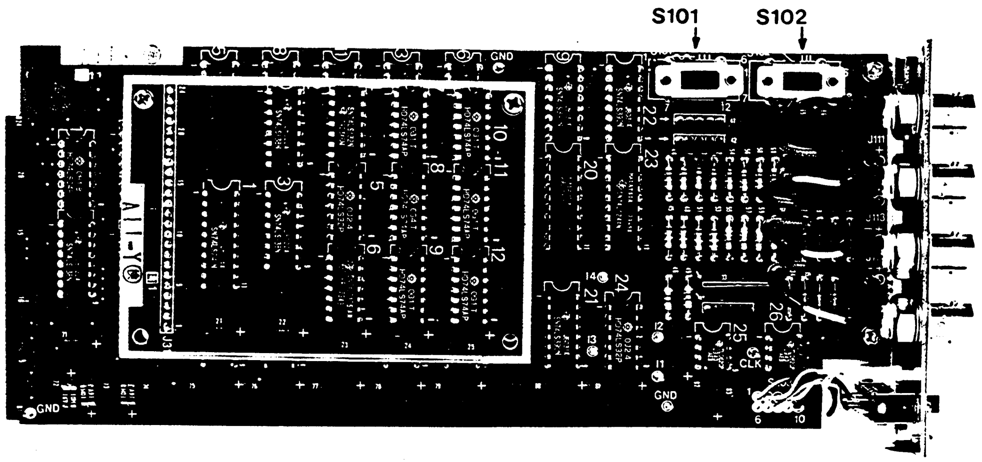
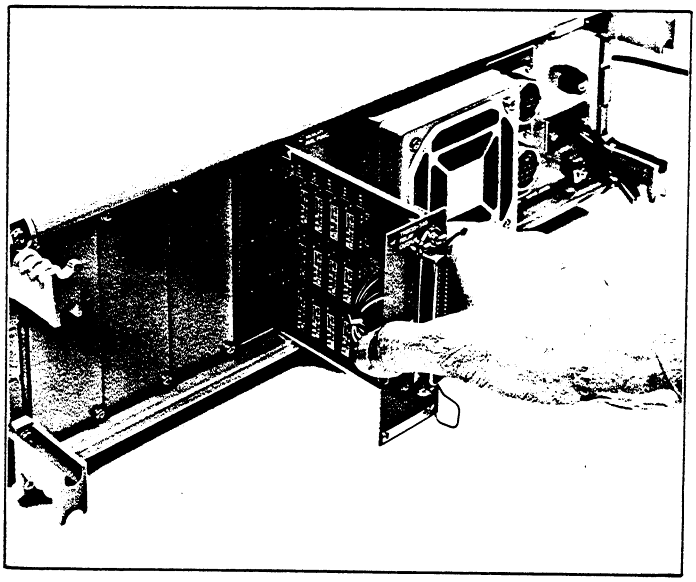


Fig. 11-1 Input type specification

a. Contact input --- Set switch S102 to the ___╲___ position, and switch S101 to the ⊥⊥⊥ position.

b. Non-contact input --- Set switch S102 to the ⊓⊓⊓ position.
   If the input signal is TTL compatible, set switch S101 to the ⊓⊓⊓ position; if it is an AC signal, set the switch to the ∿ position.

③ Place the card on the board guide in the slot and insert it fully into the slot. After plugging the card into the slot connector, secure it with the two screws.



* This photo shows another option card.

Fig. 11-2 Option card installation procedure

11-4. PANEL DESCRIPTION

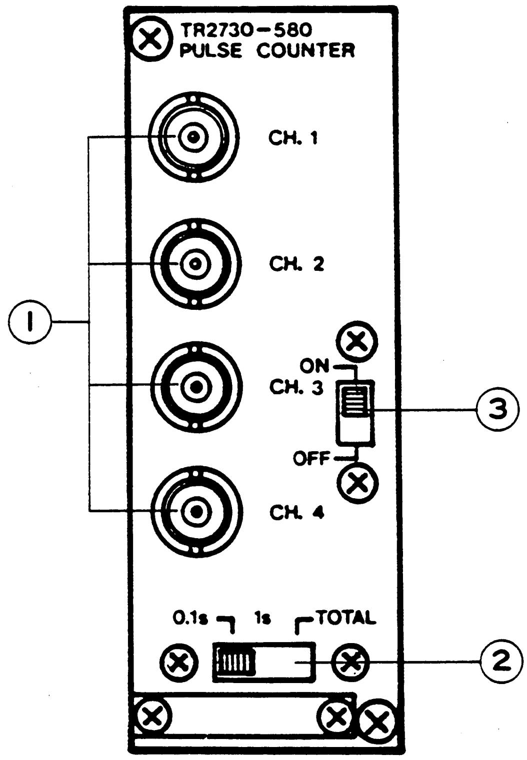


Fig. 11-3 TR2730-580 panel description

① Input connectors

These isolated BNC receptacles (DDK 31-10) accept output signals from various transducers.

② Mode select switch

This switch selects measurement modes. The 0.1s and 1s positions of this switch select the Counter mode, and the TOTAL position selects the Integration mode.

③ ON/OFF switch

If this card is not to be used, be sure to set this switch to OFF.

11-5. PRINCIPLES OF OPERATION

11-5-1. Counter Mode Operation

The Counter mode allows for two different gate times: 0.1 and 1 second. A Counter mode operation timing is shown in Figure 11-4. The count input is the pulse train applied to the input connectors (CH.1 through CH.4). The counter gate is opened in synchronization with log scan (shaded parts). A gate open time interval between 0.1 and 1 second can be selected with the MODE switch. Input pulses are counted during this gate open interval. The output of the counter is read by the TR2731 Mainframe as input data and is subjected to internal computation in much the same way as analog input data.

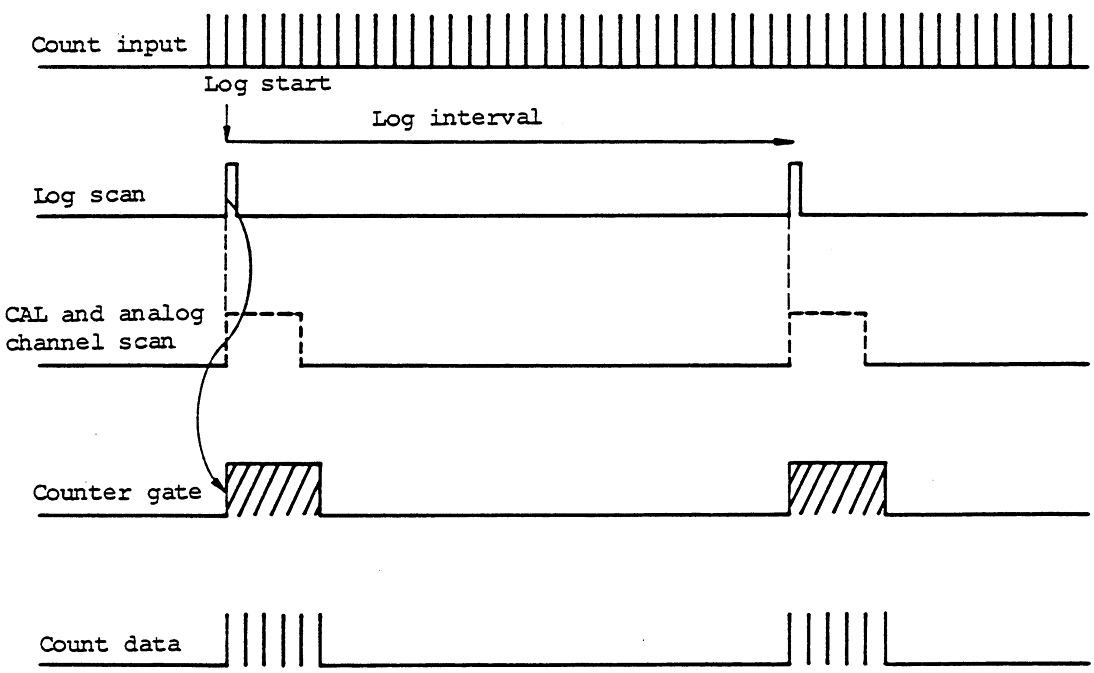


Fig. 11-4 Counter more timing

11-5-2. Total Mode Operation

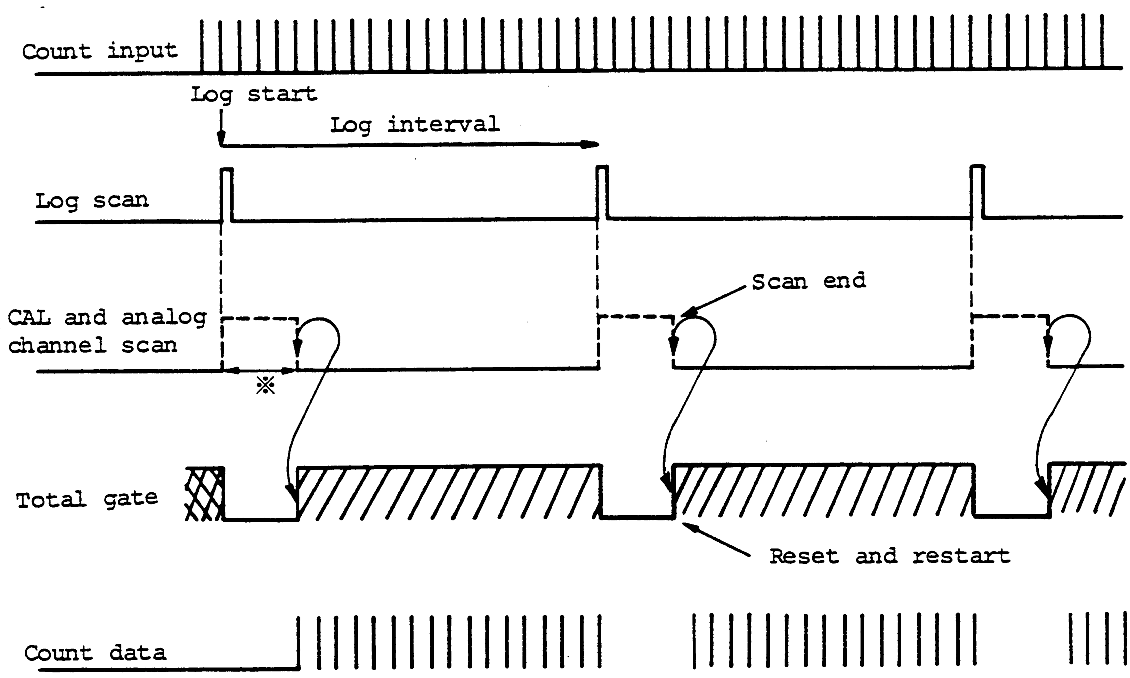
In the Total mode, input pulses are counted over the log interval up to 9999.

A Total mode timing is shown in Figure 11-5. After input channels are scanned, the total data is read into the TR2731 Mainframe, and the counter is immediately reset and restarted. The total mode may be used for relatively slow input events such as contact pulse inputs. It should be noted, however, the first data obtained in the total mode is not guaranteed, and a TRANS ERR message or indefinite data will be output. If a TRANS ERR message is delivered, the pulse data on the pertinent channel and all subsequent channels will not be output.

If counting continues beyond 9999, the least significant four digits are output. For example, if count data is 10011, only 0011 is output as data.

Data read in the instrument is subjected to computations in much the same way as analog inputs.

In the Total mode, no pulse integration performs during log scan.



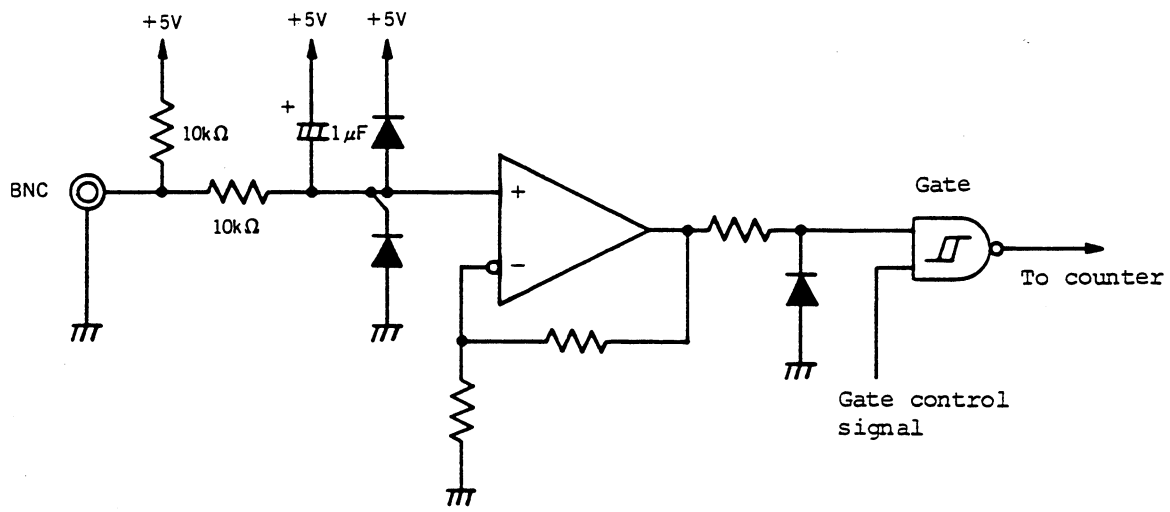
* In the event of TRANS ERR, CAL and analog channel scan takes an additional 2 seconds.

Fig. 11-5 Total mode timing

11-6. INPUT CIRCUIT

Input types are selectable with on-board slide switch S102.
The input circuit for contact input is shown in Figure 11-6(a), and that for non-contact input is shown in Figure 11-6(b).

(a) Input circuit for contact signal



(b) Input circuit for non-contact signal

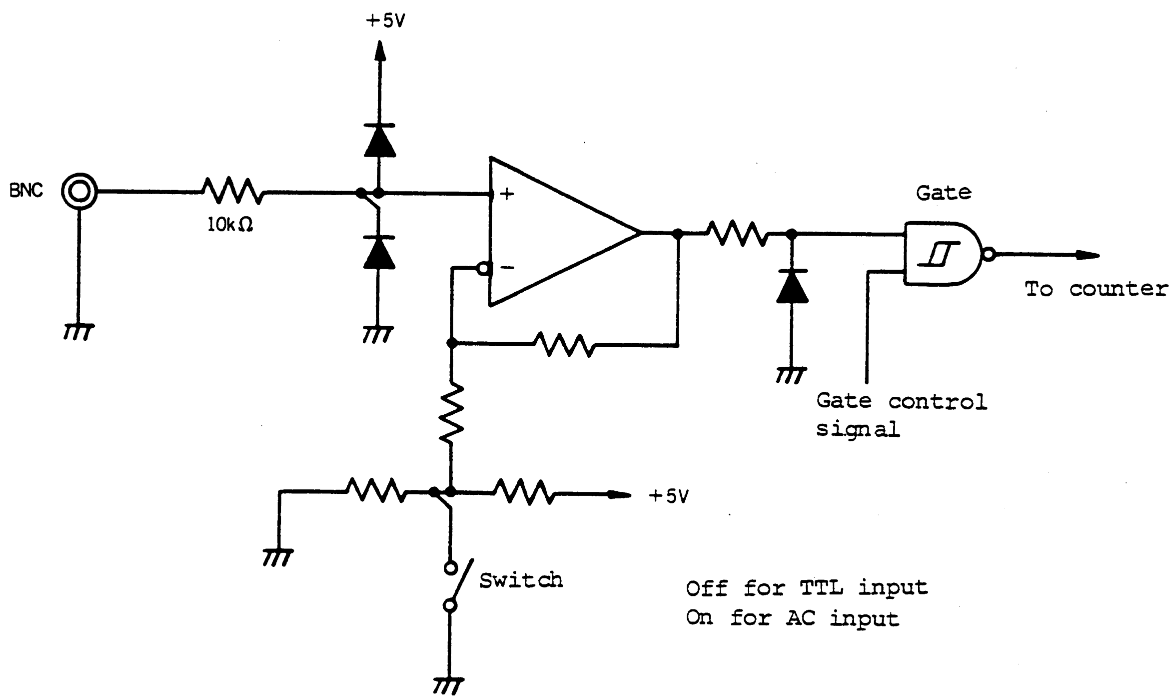


Fig. 11-6 Input circuits for contact/non-contact input signals

11-7. PROGRAMMING SUPPORT

Channels 501 through 504 are available for programming of the TR2730-580 option card.

11-7-1. Boundary Channel Specification

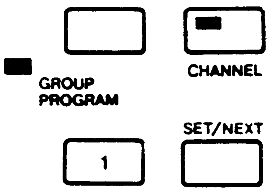
(Programming contents)

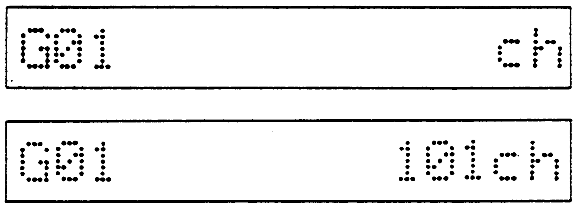
Group number	Boundary channel
└ Up to 40 groups	└ 501, 502, 503, 504

(Programming procedure)

o To specify only channel 1 for group 1,

enter as follows:



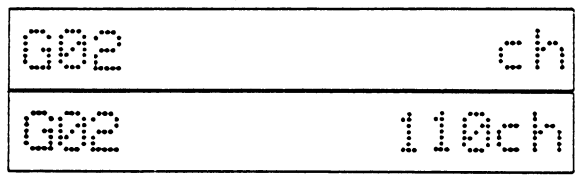


o To specify channels 2 through 10 for

group 2, enter:

Call the next group with the [SET/NEXT] key.

Press [1] [0] [SET/NEXT] .

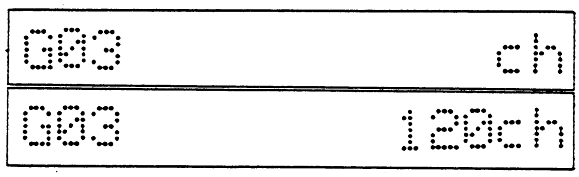


o To specify channels 11 through 20 for

group 3, enter:

Call the next group with the [SET/NEXT] key.

Press [2] [0] [SET/NEXT] .



o To specify channels 501 for group 4,

enter:

Call the next group with the [SET/NEXT] key.

Display: `G04 ch`

Press [5] [0] [1] [SET/NEXT]

Display: `G04 501ch`

o To check the above programming results, enter as follows:

[# (BACK)] [# (BACK)]

Display: `G03 120ch`

[# (BACK)] [# (BACK)]

Display: `G02 110ch`

[# (BACK)] [# (BACK)]

Display: `G01 101ch`

11-7-2. Scaling Specification

(Programming contents)

Group number	A: Offset	B: Span

Constants A and B for equation (X-A)/B can be specified between ±0.0001 and 99999.

(Programming procedure)

o To specify A=0.2 and B=0.8 for G01,

enter as follows:

[GROUP PROGRAM] [SCALE]

Display: `G01 :`

[0] [.] [2] [,]

[0] [.] [8] [SET/NEXT]

Display: `G01 02: 08`

o To specify A=-1.2345 and B=1.0 for

G02, enter as follows:

[SET/NEXT] (Call the next group) — Display: `G02 ;`

[-] [1] [.] [2]

[3] [4] [5] [,]

[1] [.] [0] [SET/NEXT] — Display: `G02-1.2345; 1.0`

o To cancel the programming contents for

G03 (perform no scaling operation),

enter as follows:

[SET/NEXT] (Call the next group) — Display: `G03 ;`

[CLEAR] [SET/NEXT] — Display: `G03 ;`

o To specify A=-0.1 and B=1.5 for G04,

enter as follows:

[SET/NEXT] (Call the next group) — Display: `G04 ;`

[-] [0] [.] [1]

[,] [1] [.] [5]

[SET/NEXT] — Display: `G04- 0.1; 1.5`

11-7-3. Unit Specification

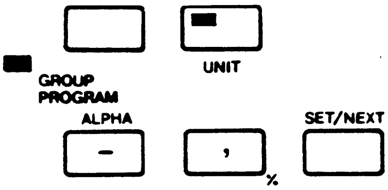
(Programming contents)

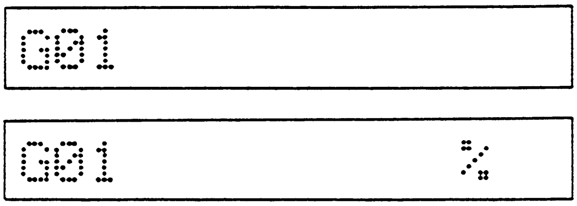
Group number	Unit

Unit: Up to 4 alphanumeric characters

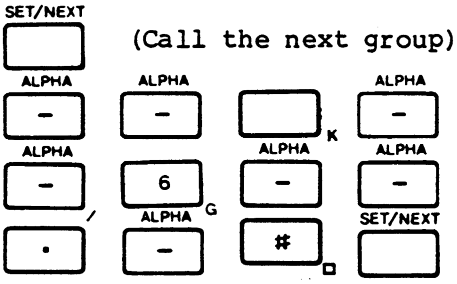
(Programming procedure)

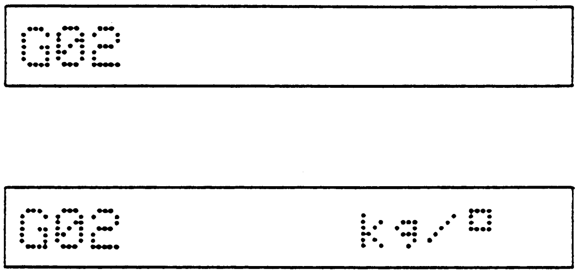
- o To specify unit % for G01, enter as follows:



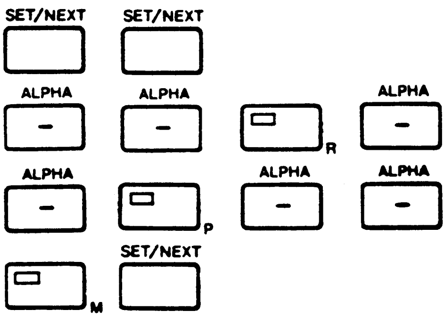


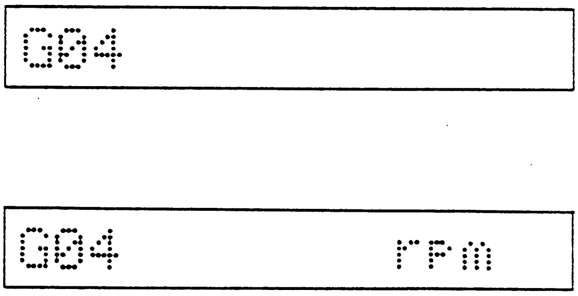
- o To specify unit kg/m for G02, enter as follows:





- o To specify unit rpm for G04, enter as follows:





CAUTION

When using pulse counter inputs, no input range specification is necessary. Measurement is not affected whether a voltage range or thermocouple range is selected. The above unit specification overrides all other unit specifications. If no unit is specified, it appears as space on the printout.

SECTION 12

TR2730-510 GPIB INTERFACE OPTION CARD

12-1. GENERAL

The TR2730-510 GPIB Interface option card interfaces the TR2731 Computing Data Logger with an instrumentation bus that complies with the IEEE488 Standard. It permits easy construction of a GPIB instrumentation system configured around a personal computer or other central processing facilities and thus meets more sophisticated requirements involving mass data processing.
The TR2730-510 option card also makes the versatile functions of the TR2731 Mainframe available to the system operator with a simpler programming scheme, rather than where an individual scanner, digital instrumentation equipment and printer are used to configure a system.
In addition, remote programming via the GPIB interface facility can be performed under the same programming categories as those provided by the TR2731 Mainframe's front panel key functions.
* GPIB: General Purpose Interface Bus

12-2. OUTLINE OF GPIB

The General Purpose Interface Bus transfers data and commands between measuring instruments, controller and other peripheral units of an instrumentation system on 16 signal lines.
Compared with other interface systems, the GPIB offers better expandability, operability, and compatibility with other industry's products in electrical, mechanical and functional aspects. It thus permits construction of simple to highly complex automatic instrumentation system via a single passive bus cable.

In a GPIB system, addresses must be specified for each component on the bus line. Units connected to the bus line may be talkers, listeners, or controllers. Several listeners can be active simultaneously but only one talker can be active at a time. The controller dictates the roll of each of the other components by sending talk or listen addresses on the data lines, to transfer data from a talker to listeners or program measurement parameters from the controller itself to listeners.

The eight Data I/O lines are reserved for the transfer of data and other messages in a byte-serial, bit-parallel format. Data and message transfer is asynchronous and bidirectional. The asynchronous nature of the system permits both high-speed and low-speed components to be combined in the same system.

Data and messages transferred between components include measurement information, measurement parameters (program) and commands, all using the ASCII code.

In addition to the eight Data I/O lines, the GPIB also includes three handshake lines to control asynchronous data transfer between components and the other five bus management lines to control data flow on the bus line.

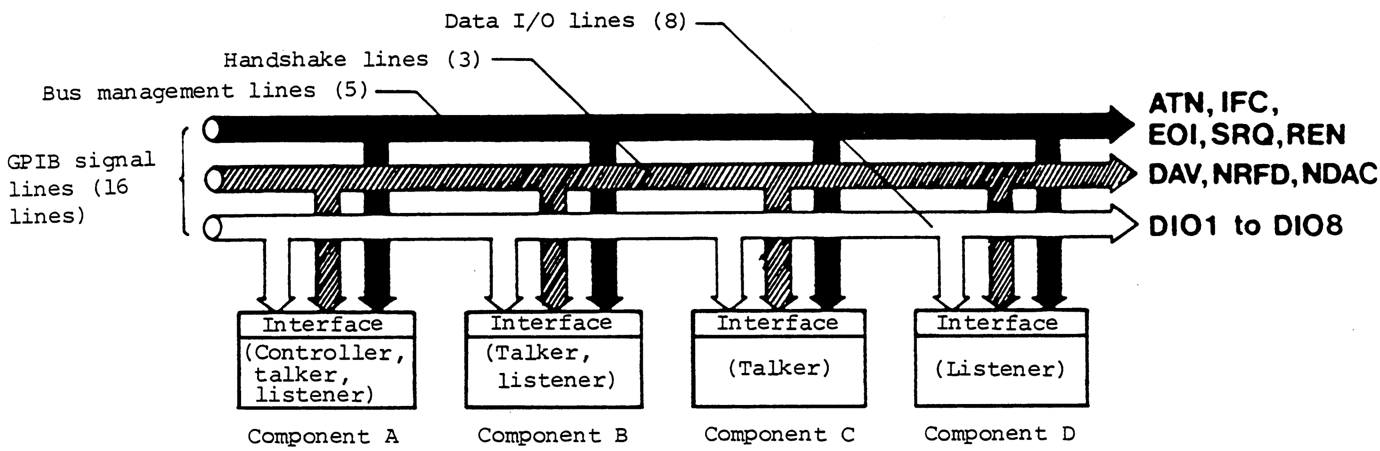


Fig. 12-1 GPIB signal lines

The three handshake lines include the following:

Data Valid (DAV) : Indicates validity of data.

Not Ready For Data (NRFD): Indicates data receive not ready state.

Not Data Accepted (NDAC): Indicates data receive complete state.

The five bus management lines include the following:

Attention (ATN) : Indicates whether addresses-or-commands are on the data lines, or other information is on the data lines.

Interface Clear (IFC): Clears the interface.

End or Identify (EOI): Used by a component to indicate the end of a multiple-byte transfer sequence.

Service Request (SRQ): Used to indicate to the controller that some component on the bus line wants attention.

Remote Enable (REN): Used to place remotely programmable components in remote mode.

12-3. SPECIFICATIONS

12-3-1. GPIB Specifications

Standard : IEEE Standard 488-1978

Code : ASCII code

Logical levels : Logic 0: HIGH --- +2.4 V or more

Logic 1: LOW ---- +0.4 V or less

Signal line termination: The 16 bus lines are terminated as follows:

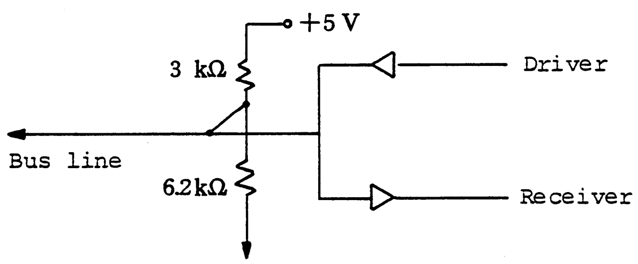


Fig. 12-2 Signal line termination

Driver : Open collector

LOW state output: +0.4 V or less, 48 mA

HIGH state output: +2.4 V or more, -5.2 mA

Receiver : Low at +0.6 V or less

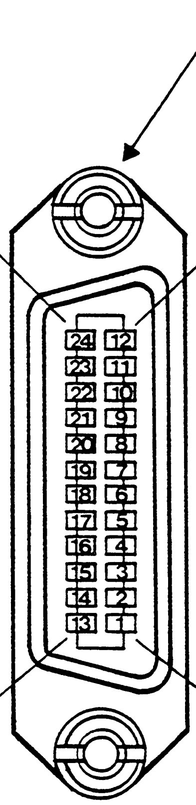
High at +2.0 V or more

Bus cable length: The total length of bus cables must be equal to or less than (the number of on-bus components) x 2 meters, and must not exceed 20 meters.

Address settings: Up to 31 talk/listen addresses can be selected with the rear ADDRESS switch.

Connector : 24-pin GPIB connector
Amphenor 57-20240-D35A or equivalent

Signal name	Pin No.
GND. LOGIC	24
GND. (ATN)	23
GND. (SRQ)	22
GND. (IFC)	21
GND. (NDAC)	20
GND. (NRFD)	19
GND. (DAV)	18
REN	17
DIO 8	16
DIO 7	15
DIO 6	14
DIO 5	13



Pin No.	Signal name
12	SHIELD
11	ATN
10	SRQ
9	IFC
8	NDAC
7	NRFD
6	DAV
5	EOI
4	DIO 4
3	DIO 3
2	DIO 2
1	DIO 1

Fig. 12-3 GPIB connector pin assignment

12-3-2. Interface Functions

Table 12-1 Interface functions

Code	Function and Remarks
SH1	Source handshake
AH1	Acceptor handshake
T5	Basic talker, serial poll, talk-only mode, unaddressed to talk when addressed to listen
L4	Basic listener, unaddressed to listen when addressed to talk
SR1	Service request
RL1	Remote/local switching
PP0	No parallel function available
DC1	Device clear (SDC and DCL commands available.)
DT1	Device trigger (GET command available.)
C0	No controller function available.
E1	Open collector bus driver

12-3-3. Talker Format (Data Output Format)

(1) Basic format

```
User No., Label, Time, Channel, Data,            Measurement data
   ①       ②      ③      ④       ⑤               (Primary arithmetic
                  Unit, Mode, Alarm              operation data)
                   ⑥     ⑦     ⑧
Channel, Data, Unit, Mode, Alarm,
Channel, Data, Unit, Mode, Alarm CRLF
Channel, Data, Unit, Mode
   ⑨      ⑩     ⑪     ⑫
Channel, Data, Unit, Mode                      Secondary arithmetic operation
Group, Data, Unit, Mode, __                    (Defaulted if no computation
  ⑬     ⑭     ⑮     ⑯    ⑰                     is specified.)
Group, Data, Unit, Mode CRLF
                         ⑱ (EOI)
```

① User No. UNd (in multi-user mode)

Header

② Label LBxxxxxxxx (Defaulted if not specified.)
Header 8 characters (ASCII code)

③ Time T␣ddhhmmss
Header

dd: Day
hh: Hour
mm: Minute
ss: Second
} 2 digits each

④ ⑨ Channel N␣tnn
Header

t: Terminal number
nn: Channel number
("1" is output for the terminal number if only one TR2741 terminal is used.)

⑤ ⑩ ⑭ Data XX␣dddddd·dE ±d
Header

- Exponent (E + polarity + 1 digit)
- Mantissa (decimal point + 7 digits)
- Polarity (- sign or space)

Header	Contents	Unit
DV	Measurement range is DC voltage, or is thermocouple with no linearization.	V
TC	Measurement range is thermocouple and platinum RTD, with linearization.	°C
R	Measurement range is platinum RTD with no linearization.	Ω
BT	Thermocouple sensor fault	
OL	Over range	
ER	Error (transfer error or computation error)	
D␣	Digital Input (TR2730-530) data with input unit other than mV, V, or °C.	
FL	Measurement range is contact input.	

␣ : Space code

Number of data digits and decimal point position

- o If output data is seven digits or less, its decimal point position is the same as that of printout data.

  (e.g.) If 12.345 mV in 20 mV range,

  DV␣0012.345E-3

  If -23.5°C in the T(CC) range,

  TC-000023.5E+0

- o If the integral part of a computation result is eight digits or more, eight-digit data with no decimal point is output.

  (e.g.) If temperature is 1234.5°C, scaling coefficients A=0, B=0.0001, and 1234.5/0.0001=12345000 in the R(PR) range,

  TC␣12345000E+0

- o When TR2730-530 BCD Input option card is used, 8-bit binary data is also output as an 8-digit data with no decimal point.

  (e.g.) 8-bit data of 01010011

  D␣␣01010011E+0

- o For contact range input, 1/0 data corresponding to contact ON/OFF is output as follows:

  (e.g.) FL␣0000001.E+0 (ON)

  FL␣0000000.E+0 (OFF)

- o If an error occurs (sensor fault, over range, etc.), data of all zeros is output.

  (e.g.) BT␣0000000.E+0

⑥ ⑪ ⑮ Unit UTxxxx

Header (UT) → 4 characters (ASCII code) (xxxx)

If no unit is specified, 4 space codes are output.

Lowercase characters are replaced with uppercase characters and symbols are replaced as µ→U, Ω→R, □→Q when output.

⑦ ⑫ ⑯ Mode MDd

Header (MD) → 1 digit (d)

d	Primary arithmetic operation	Secondary arithmetic operation
0	No computation	———
1	ΔN (inter-channel difference)	SUB (inter-channel subtraction)
2	ΔI (difference from initial value)	MUL (inter-channel multiplication)
3	Δt (difference from the preceding value)	DIV (inter-channel division)
4	Max (maximum)	Max (maximum of channels)
5	Min (minimum)	Min (minimum of channels)
6	Ave (average)	Ave (average of channels)
7	Ttl (total)	P-P (between maximum and minimum)
8		SD (standard deviation)
9		Dev (deviation)

⑧ Alarm A␣d

Header → 1 digit

d	Alarm contents
0	Normal
1	Sensor fault
2	Over range
3	Transfer error
4	Computation error
5	Upper limit over (H)
6	Lower limit over (L)

⑬ Group G␣nn

Header └→Group number

⑰ "," string delimiter

Indicates the end of a string (channel, data, etc.).

⑱ CR LF Block delimiter

(EOI)

Normally, CRLF and EOI (output simultaneously with LF) are output as block delimiters. Output of only LF can be specified from the controller.

(2) Default format

User No., Time, CH, Data, CH, Data, ... CRLF	Measurement data (Primary arithmetic operation data)
CH, Data, CH, Data, ... Group, data, Group, Data CRLF (EOI)	Secondary arithmetic operation data (Defaulted if no computation is specified.)

A label, units for each channel data, mode, and alarm are omitted from the basic format. The time, channel and data format is identical to the basic format.

CAUTIONS

1. If the HEADER bit of the rear function switch is set to 0, the two header characters are omitted from each item in both the basic and default formats.
2. User numbers are output only in the multi-user log scan mode.
3. In the single scan mode, a single scan data is output after time data is output.

12-3-4. Listener Format (Program Code)

(1) Measurement start/stop function, etc.

Code	Contents	Initial state
T1	Log scan start	
T2	Monitor scan start	
T3	Single log scan start	
C0	Places the instrument in the power on state.	
C1	Log scan stop	o
C2	Monitor scan stop	o
C3	Alarm reset	o

(2) Output function

Code	Contents	Initial state
W0 W1	Log print OFF Log print ON	o
W2 W3	Alarm print OFF Alarm print ON	o
W4 W5	List output OFF List output ON	o
W6 W7	External output OFF External output ON	o

(3) SRQ sendout mode specification

Code	Contents	Initial state
S0	Specifies SRQ sendout mode. If addressed to talk when log scan ends the unit sends data out without requesting SRQ. If unaddressed to talk, the unit sends out an SRQ.	
S1	Specifies no SRQ sendout mode.	o

(4) Data output format specification

Code	Contents	Initial state
S2	Outputs all information which is delivered to the TR2731's internal printer (basic format).	o
S3	Outputs only time, channel information and data (default format).	

(5) Block delimiter specification upon data output

Code	Contents	Initial state
D0	Outputs a block delimiter of CR LF and EOI (EOI is output simultaneously with LF.).	o
D1	Outputs only LF as a block delimiter.	

(6) Parameter specification (see the paragraph for panel programming)

a. Scan format

Header	Contents	Format
LI	Log interval	LI hour , minute , second , 0 (single interval log) For single interval log, 0 is omittable. LI hour , minute , second , 1 (multi-interval log) CH. , N ; CH. , N ; ...... LI hour , minute , second , 2 (Variable interval log) day , hour , minute , N ; ...... LI 0 , 0 , 0 , 3 (external interval log) [e.g.] "LI0, 2, 0, 1 ; 110, 1 ; 120, 5 ; 130, 10" Multi-mode for two-minutes basic interval 2 minutes (basic X1) interval up to 110CH. 10 minutes (basic X5) interval up to 120CH. 20 minutes (basic X10) interval up to 130CH.
SC	Scan channel	SC CH. , CH. ; CH. , CH. ...... For a single channel, CH. is defaultable. [e.g.] "SC101, 108 ; 111, 120 ; 125, 130" between 101CH. and 108CH. between 111CH. and 120CH. between 125CH. and 130CH.

Header	Contents	Format
MI	Monitor interval	MI minute , second , ␣ ; ↑ Mode { 0: All channel scan mode / 1: Selective channel scan mode CH , digit , ␣ ; ↑ Offset Digit: 0: Least significant 3 digits; 1: Medium significant 3 digits; 2: Most significant 3 digits Offset: 0: With no offset; 1: With offset o If the specification for digit and offset is 0, only channel specification is required (,0,0 is omittable.). [e.g.] "MIO, 10, 1; 101, 1, 0; 102, 1, 0; 103, 1, 0; 104, 1, 1; 105, 0, 1; 106, 0, 1" 101CH. Medium specificant 3 digits D/A with no offset 102CH. Medium specificant 3 digits D/A with no offset 103CH. Medium specificant 3 digits D/A with no offset 104CH. Medium specificant 3 digits D/A with offset 105CH. Least significant 3 digits D/A with offset 106CH. Least significant 3 digits D/A with offset
FL	Filter	FL N , ␣ ↑ Number of repetitions (N 2) ↑ Mode { 0: Average mode / 1: Delay mode o If average mode is specified, only N (number of repetitions) is required (, 0 is omittable).
AT	Auto time	AT day , hour , minute ; day , hour , minute (day , hour , minute: Log start time; day , hour , minute: Log stop time)
LB	Label	LB xooooooooox 8 characters x: Character or symbol, other than the 8 specified characters and header characters, to enclose those 8 characters (Semicolon (;) is not permissible) LB xooooox,1 5 characters o If ",1" is inserted, the Index mode will be selected.

Header	Contents	Format
CK	Clock	CK day , hour , minute , ␣ ↑ Mode Mode { 0: Clock, 1: Timer } o ", 0" for the Clock mode is omittable.
CC	Call channel	CC CH.
N	Number specification (multi-user)	N ␣ ↑User number (e.g.) N1T1 (User 1, log start) N0T1 (User 1-4 log start)
G	Number specification (function group number)	G␣ ↑Group number (e.g.) G01FC (specifies a function group channel for group 1.)

b. Function group

Header	Contents	Format
FC	(Function) Group channel	FC CH. (e.g.) "FC105;110;115;120;125;130" Function channel Group 1 up to 105CH. Group 2 up to 110CH. Group 3 up to 115CH. Group 4 up to 120CH. Group 5 up to 125CH. Group 6 up to 130CH.
FR	(Function) Range	FR␣ └ Range { 0: 20 mV, 1: 200 mV, 2: 2 V, 3: 20 V } FR ␣ , ␣ , ␣ Range { 4: T(CC), 5: J(IC), 6: E(CRC), 7: K(CA) } Reference junction compensation { 0: Internal, 1: External } Linearization { 0: On, 1: Off }

Header	Contents	Format
FR		FR␣,␣,␣,␣ Range 8: PR 0: PR10(S) 1: PR13(R) 2: PR30(B) 3: PR12.8 Reference junction compensation: 0: Internal, 1: External Linearization: 0: On, 1: Off o If reference junction compensation is internal (0) and linearization is on (0), specification of ",0,0" is omittable. FR␣,␣,␣ Range 9: Pt 0: 3-wire RTD 1: 4-wire RTD 2: 4-wire RTD high resolution Linearization: 0: On, 1: Off FR␣,␣ Range ●: AUX 0: AUX (contact) 1: Option (e.g.) "FR0;1;4;8,1;4,1,1;4,1,1;o,0" Function range Group 1 0 20 mV Group 2 4(,0,0) T(CC), internal compensation, linearization ON Group 3 8,1(,0,0) R(PR13%), internal compensation, linearization ON Group 4 4,1,1 T(CC), external compensation, linearization OFF Group 5 o,0 Contact range
FS	(Function) scaling coefficient	FS ±oooooo, ±oooooo, A B Up to 4 digits including a decimal point
FU	(Function) Unit	FU xoooox x: Character or symbol, other than the 4 specified characters and header characters, to enclose 4 characters (e.g.) "FU#RPM#;;;#XX#" Group 1 RPM Group 2, Group 3 } Unit by measuring range Group 4 xx

Header	Contents	Format
FM	(Function) Computation mode	FM␣ , ooo ── Mode 1: ΔN ── Channel number FM ␣ ── Mode { 2: I 3: t } FM␣ , ooo ── Mode { 4: MX (maximum) 5: MN (minimum) 6: AV (average) 7: TL (total) } ── Number of totalizations 1-127 (e.g.) "FM1,101;;;2;6;10" Function mode Group 1 ΔN, difference from 101CE. Group 2 } Group 3 } No arithmetic operation Group 4 ΔI (difference from initial value) Group 5 Average value for ten times repetition of scanning

c. Alarm group

Header	Contents	Format
AC	(Alarm) Group channel	AC ooo, ␣ CH. ── Mode { 0: Monitor scan 1: Log scan 2: Log on monitor scan }
AH	(Alarm) Upper limit value	AH -ooooo, oo, ␣␣ Up to 5 digits with a decimal point ── Alarm output relay No. ── Alarm comment No. (e.g.) "AH12.3,1,1;15.34,2;-0.123,.2" Alarm (upper limit value) / Relay number / Comment number Group 1 12.3 / 1 / 1 Group 2 15.34 / 2 / None Group 3 -0.123 / None / 2
AL	(Alarm) Lower limit value	AL -ooooo, oo, o Up to 5 digits with a decimal point Same as those for AH

d. AUX. function

Header	Contents	Format
XF	AUX. function	XF ␣, ␣, ␣ Mode: 1: SUB (subtraction) 2: MUL (multiplication) 3: DIV (division) Channel number 0: Source data output inhibit To enable source data output omit ", ␣". XF ␣, ␣, ␣, ␣ Mode: 4: Max (maximum) 5: Min (minimum) 6: Ave (average) 7: p-p (Max - Min) 8: SD (standard deviation) 9: Dev (deviation) 0: Source data output inhibit To enable source data output omit ", ␣". o For computations 4 through 9, up to three types of computation can be specified at one time. When specifying two or less computation types, ", ␣" is omittable. (e.g.) When determining average only, specify: XF6 To determine maximum and minimum data and inhibit source data output, specify: XF4, 5, 0
XM	Alarm comment	XM xooooooooooooox x: Character or symbol, other than the 12 characters to be specified and header characters, to enclose those 12 characters

(7) Deletion and erasure of parameters

Code	Contents
C4	Deletes only one parameter category out of those specified in advance. (e.g.) To delete the scaling value specified in function group 3, enter as follows: G03FSC4 C4 — Clear FS — Function scale
Z0	Erases all internal programming parameters and initializes the instrument. (Initial value) Log interval: `0h00m00s, all` Scan channel: `01 101ch, 120ch` Monitor interval: `0m00s, all` Clock: `00-00:00:00` Call channel: `101ch` Function group channel: `G01 120ch` Function group range: `G01 20mV` All other categories are left unspecified. The SCAN FORMAT lamp and CLOCK key lamp light on the front panel, and the display shows time beginning from 0. Note: The function of this code Z0 includes that of code C0 as well, and initializes all operation modes of the instrument.

(8) Notes on parameter programming

a. When setting channel numbers, terminal number 1 is omittable.

(e.g.) SC101,110;120,125 (CH.101 to 110 CH.120 to 125)

SC1,10;20,25

Spaces preceding programming values are ignored.

b. When setting scaling coefficients or upper/lower limit values, only the necessary number of digits may be specified with the floating point system.

(e.g.) Scaling coefficients A=10.210, B=1.1

FS10.21,1.1

c. When specifying function items (group channels, ranges, scaling coefficients, units, modes) or alarm items (group channels, upper/lower limit values) consecutively while incrementing the group number, the following programming format can be used:

   (e.g.) To specify group 1 and function group channels 105,110,140,210, and 220:
   G01FC105;110;140;210;220

d. When a function group channel is deleted, the range, scaling coefficients, unit and mode selection in the pertinent group is also deleted (same as the case of panel operation). The group numbers subsequent to the deleted group number are shifted in descending order. When an alarm group channel is deleted, the upper/lower limit setting for the group is deleted, and the subsequent group numbers are shifted in descending order.

   (e.g.) To delete group 2: G02FCC4

e. Start/stop for multi-user log scan can be specified as follows:

   (e.g.) To start log scan for user 1: N1T1
   (e.g.) To start log scan for user 2: N2T1
   (e.g.) To stop log scan for user 1: N1C1

f. If a header is specified with no Gxx when setting parameters, the group number is 1. If a semicolon (;) is used as a delimiter after a header is specified, the group number is incremented by one. Gxx must be specified when specifying groups other than group 1.

g. If an undefined code is specified, D2 of the status byte is set to 1, although no change in programming occurs. If, at this time, the SO mode is selected, an SRQ is sent to indicate a syntax error.

h. If other parameters are to be consecutively specified when specifying labels, alarm comments or units, they must be delimited with semicolons (;).

   (e.g.) G02FU#%#;G02FM1,123

i. When addressing the instrument as a talker to send data, set the External Output switch to ON (by using command W7) in advance.

j. When programming parameters, send out delimiter (CR LF) or following header consecutively after sendout of header or numerical data. If space code or "," is inserted to follow numerical data, preceding numerical character or code is ignored.

False "LI0, 10, 0␣SC101, 130"

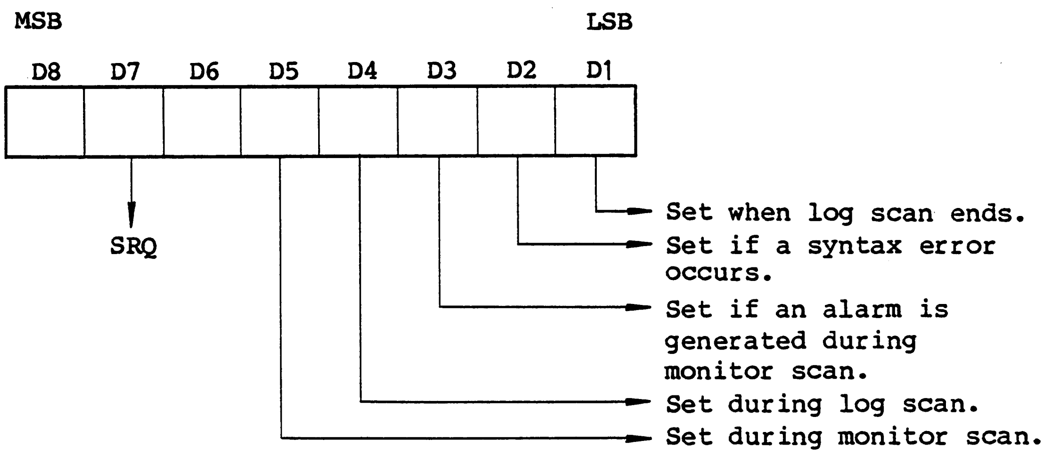
"LI0, 10, 0,SC101, 130"

Correct "LI0, 10, 0SC101, 130"

12-3-5. Service Request

When the instrument is placed in the S0 mode, receipt of a measurement end of undefined code causes the instrument to send a service request to the controller. Once the instrument sends a service request, it returns a status byte in response to the SPE command sent from the controller as a result of execution of a serial polling sequence.

(1) Status byte



(2) Description of causes

o Log scan end

The instrument sends an SRQ if it is not addressed as a talker when log scan ends.

While the SRQ bit of the status byte is reset upon execution of the SPE command, bit D1 remains set until all data is transferred.

o Syntax error

An SRQ is sent if an undefined code is specified or programming parameters exceed a specified range during remote programming.

While the SRQ bit of the status byte is reset upon execution of the SPE command, bit D2 remains set until the instrument is again addressed to listen for remote programming.

o Alarm generation during monitor scan

An SRQ is sent only once if a limit error is generated on a channel during monitor scan.

While the SRQ bit of the status byte is reset upon execution of the SPE command, bit D3 remains set until the next monitor scan is started.

o During log scan or monitor scan

Bits D4 and D5 of the status byte are set to 1 during log scan and monitor scan respectively. However, no change occurs in the SRQ bit status and no service request is sent out.

(3) Status byte read-out procedure

Status byte can be known to the controller by executing serial polling.

a. When using HP model 9825A

```
0: rds (701)→S
1: if bit (0,s) = 0;gto 10
2: ........
```

0: Read status byte into valiables S.

1: If the least significant bit (bit 0) is 0, it returns to line 10 from interrupt.

2: If not 0 (the end of log scan), it goes to data readout routine.

b. When using HP model 9845B

```
10: STATUS 701;S
20: IF BIT (S,O) = 0 THEN 100
30: ......
```

10: Read status byte into valiables S.

20: If the least significant bit (bit 0) of variables S (1 byte = 8 bits) is 0, it returns to line 100 from interrupt.

30: If not 0 (the end of log scan), it goes to data readout routine.

CAUTION

In the S1 mode (in which no SRQ is sent), the SRQ bit (D7) of the status byte remains at 0 if bit D1, D2 or D3 is set to 1.

12-3-6. Device Trigger Function

Log scan start can be externally triggered with the GET command. In this case, the function of the GET command is identical to that of program code T1.

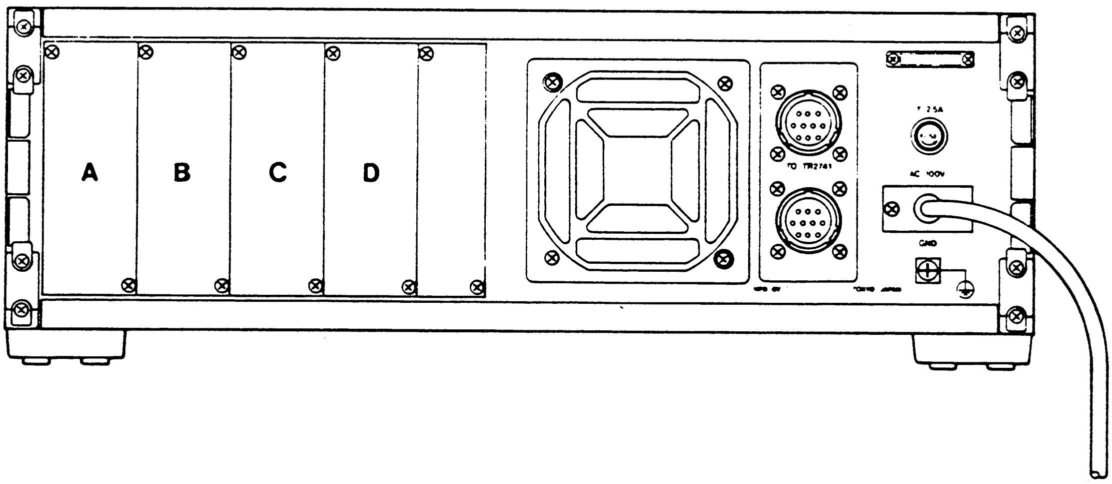
12-3-7. Device Clear Function

Execution of the SDC and DCL commands places the instrument in the initial power-on state. In this case, the function of these commands is identical to program code C0.

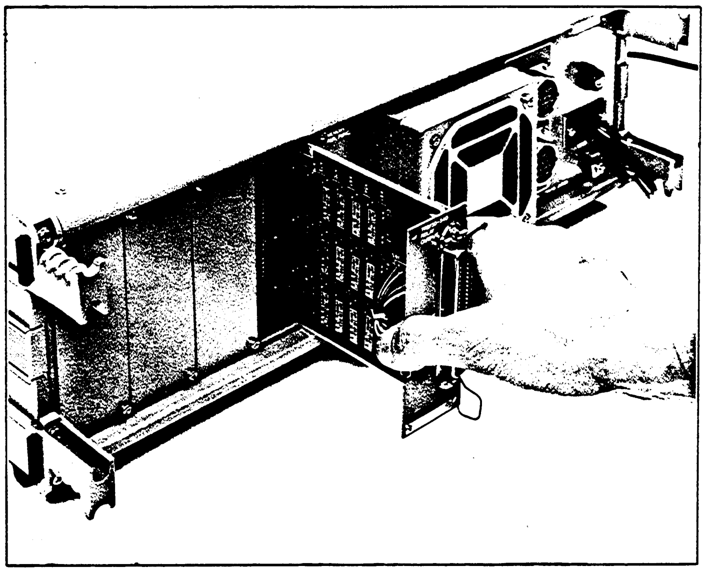
12-4. INSTALLATION PROCEDURE

The TR2730-510 option card can be inserted into a card slot on the rear panel of the TR2731 Mainframe and secured with two screws. Before installation, be sure that the TR2731 Mainframe is powered off.

① Remove one of four blank panels A, B, C, or D from the rear card slot in which the option card is to be inserted.



② Place the option card on the board guide in the slot and insert it fully into the slot. After plugging the card into the slot connector, secure it with the two screws.



* This photo shows another option card.

Fig. 12-4 Option card installation procedure

12-5. GPIB HANDLING PROCEDURE

12-5-1. System Configuration

The GPIB system consists of multiple components. Note the following precautions for system configuration:

(1) Before connecting components, check the initial status and operation of the TR2731 Mainframe, controller and peripheral units by referring to their own instruction manuals.

(2) Signal cables to instrumentation equipment and the bus cable to the controller or other units should be as short as possible. The length of the bus cable must be within the specification. It must be not more than the number of on-bus components x 2 meters and must not exceed 20 meters in total length.
The following standard bus cables are available from ADVANTEST:

Table 12-2 Standard bus cables (option)

Length	Name
0.5 m	408JE-1P5
1 m	408JE-101
2 m	408JE-102
4 m	408JE-104

(3) Do not stack more than three connectors for bus cable connection. After each cable connector plug is plugged in its mating receptacle, firmly secure them with the plug retention screws.
The bus cable connectors are piggyback type and comprise both male and female connectors, and permit stacked use.

(4) Carefully check the source power, grounding, and programmings (if necessary) of each component before powering them on.
Be sure to turn on all the components connected to the bus. If any one of the on-bus components is left off, total system operation will not be guaranteed.

12-5-2. Panel Description

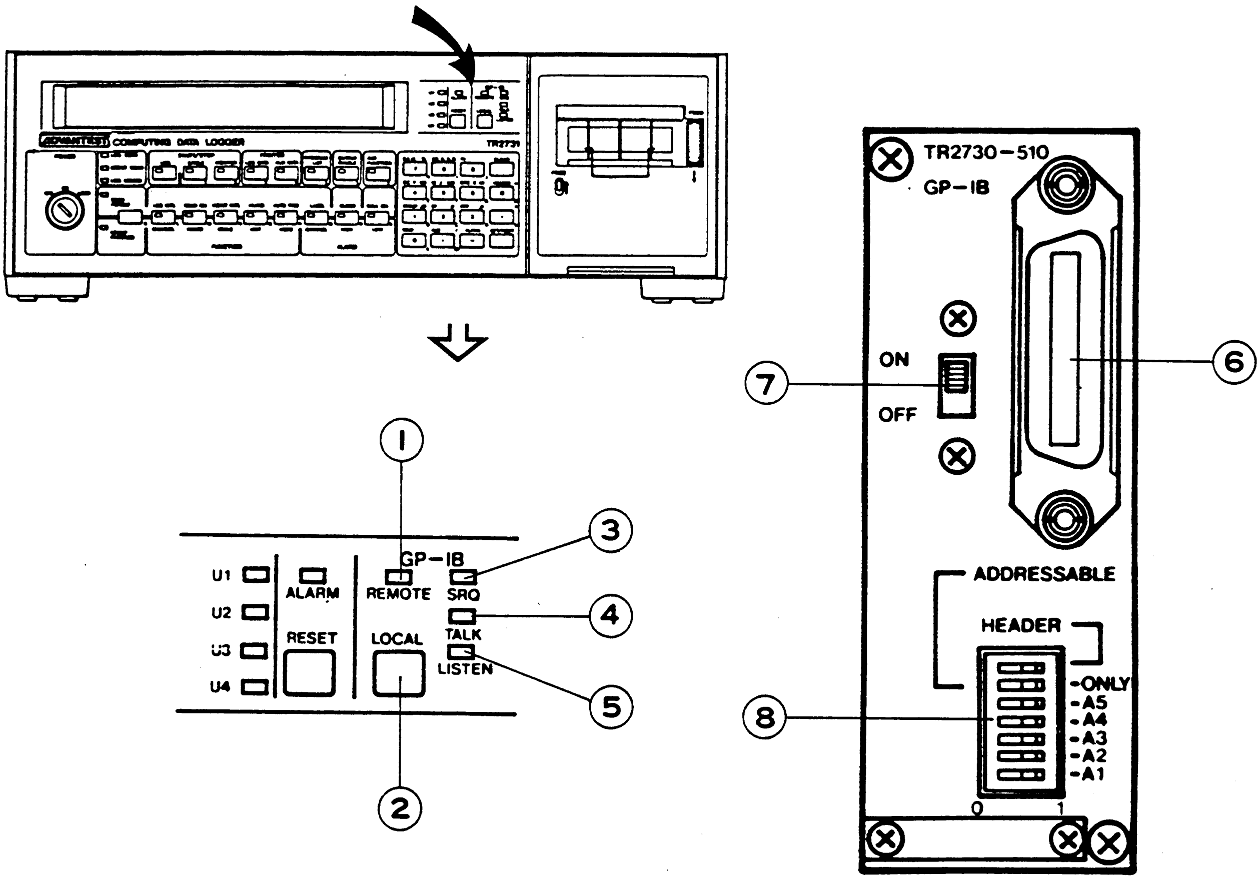


Fig. 12-5 GPIB option card panel description

① REMOTE lamp

This lamp comes on if the instrument's functions are programmed from an external controller, not with its front panel keys. When this lamp is on, the front panel key functions are disabled.

② LOCAL key

If this key is operated when the instrument is placed in the REMOTE mode (REMOTE lamp on), the instrument is returned to the LOCAL mode and its front panel key functions are enabled. The instrument is initially placed in the LOCAL mode when it is powered on.

③ SRQ lamp

This lamp indicates that the instrument is in request for service to the controller.

④ LISTEN lamp

This lamp indicates that the instrument is addressed to listen.

⑤ TALK lamp

This lamp indicates that the instrument is addressed to talk.

⑥ GPIB connector

A 24-pin connector for IEEE 488 bus. Being piggyback type, this connector permits stacked use of standard bus cables. However, do not stack more than three connectors.

⑦ ON/OFF switch

If this option card is not to be used, set this switch to OFF.

⑧ Address switch

This switch sets the address of the instrument and controls the header.

It is a 7-bit DIP switch, and up to 31 different addresses are selectable with its five address bits A1 through A5. If Figure 12-6, for example, the address bits are set at 00100, which denotes "4" in decimal notation. In the ASCII code format, talker address D and listener address $ are assigned to the instrument as indicated in Table 12-3, when the address bits are set to 00100.

If bit 6 of this switch is set to ADDRESSABLE, the instrument can respond to the controller only if an address from the controller agrees with the address bit setting (A1-A5) on the instrument. If bit 6 is set to TALK ONLY, the instrument is unconditionally placed in the TALK ONLY mode regardless of the address setting on the instrument.

If bit 7 of the switch is set to 1, the instrument sends a two-character header when data is sent out. If bit 7 is set to 0, the two characters of the header are discarded. An address code table is shown in Table 12-3.

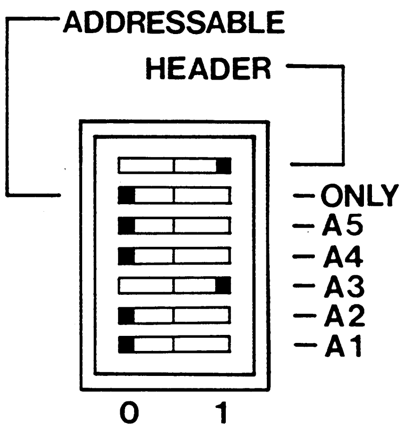


Fig. 12-6 Address switch setting example
Note) Letters printed around the address switch have no meanings. Ignore them.

Table 12-3 Address code table

ASCII code character		ADDRESS switch					5-bit decimal code
LISTEN	TALK	A5	A4	A3	A2	A1	
SP	@	0	0	0	0	0	0
!	A	0	0	0	0	1	1
"	B	0	0	0	1	0	2
#	C	0	0	0	1	1	3
$	D	0	0	1	0	0	4
%	E	0	0	1	0	1	5
&	F	0	0	1	1	0	6
'	G	0	0	1	1	1	7
(	H	0	1	0	0	0	8
)	I	0	1	0	0	1	9
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
-	M	0	1	1	0	1	13
.	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
0	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	26
;	[	1	1	0	1	1	27
<	\	1	1	1	0	0	28
=	]	1	1	1	0	1	29
>	^	1	1	1	1	0	30

12-6. GENERAL PRECAUTIONS FOR GPIB OPERATIONS

(1) Notes on Only Mode operations

When the instrument is to be operated in the Only mode, be sure to set bit 6 of the rear Address switch to ONLY and place the partner component on the bus line also in the Only mode. In the Only mode, however, the controller function must be disabled.

If the controller is used in the Only mode, normal system operation will not be guaranteed as all commands from the controller are ignored by other components.

(2) Power intermission

If a power intermission (including power fluctuation) occurs during operation of the GPIB system including the TR2731, the system is usually initialized to the power-on state when the power is recovered. Care should be exercised for power intermission processing for other system components.

(3) Controller interrupt to data transfer between components

The GPIB system permits data transfer between system components other than the controller. If the controller is to interrupt data transfer between system components (handshake) to switch into the serial poll mode or to add a new listener, data transfer is overriden by the controller interrupt. After the interrupt sequence is completed, the system resume data transfer.

When data transfer is to be performed between system components with no intervention of the controller, programming should be made so that the controller can recognize the data transfer status.

(4) Notes on Address switch setting modification during operation

If the Address switch setting on the instrument is modified during operation, the new address is recognized by the controller immediately after the switch setting is modified.

This principle is also applied to the ONLY-ADDRESSABLE and HEADER bits of the Address switch as well as the address bits.

(5) If log scan is started when the instrument is attached to an external controller with the ON/OFF switch on the TR2730-510 option card left at the ON position, GPIB data output is performed for every scan, and then the instrument proceeds with the next operation after the time-out interval of 10 seconds expires.

(6) When the instrument is powered on or receives each command, it is placed in the following status:

Command	Talker (with lamp)	Listener (with lamp)	SRQ (with lamp)	Status	Send data	Panel setup	Display
POWER ON	Clear	Clear	Clear	Clear	Clear	Initial-ization	Time
IFC	Clear	Clear	/	/	/	/	/
DCL, SDC or C0	/	/	Clear	Clear	Clear	Initial-ization	Time
GET or T1	/	/	/	Clears the "Send Data Present" bit.	Clear	LOG START lamp turned on.	/
Addressed to talk to the instrument	Set	Clear	/	/	/	/	/
Not addressed to talk	Clear	/	/	/	/	/	/
Addressed to listen to the instrument	Clear	Set	/	Clears the Syntax error bit.	/	/	/
Not addressed to listen	/	Clear	/	/	/	/	/
Serial polling	/	/	Clear	Clears the SRQ bit.	/	/	/

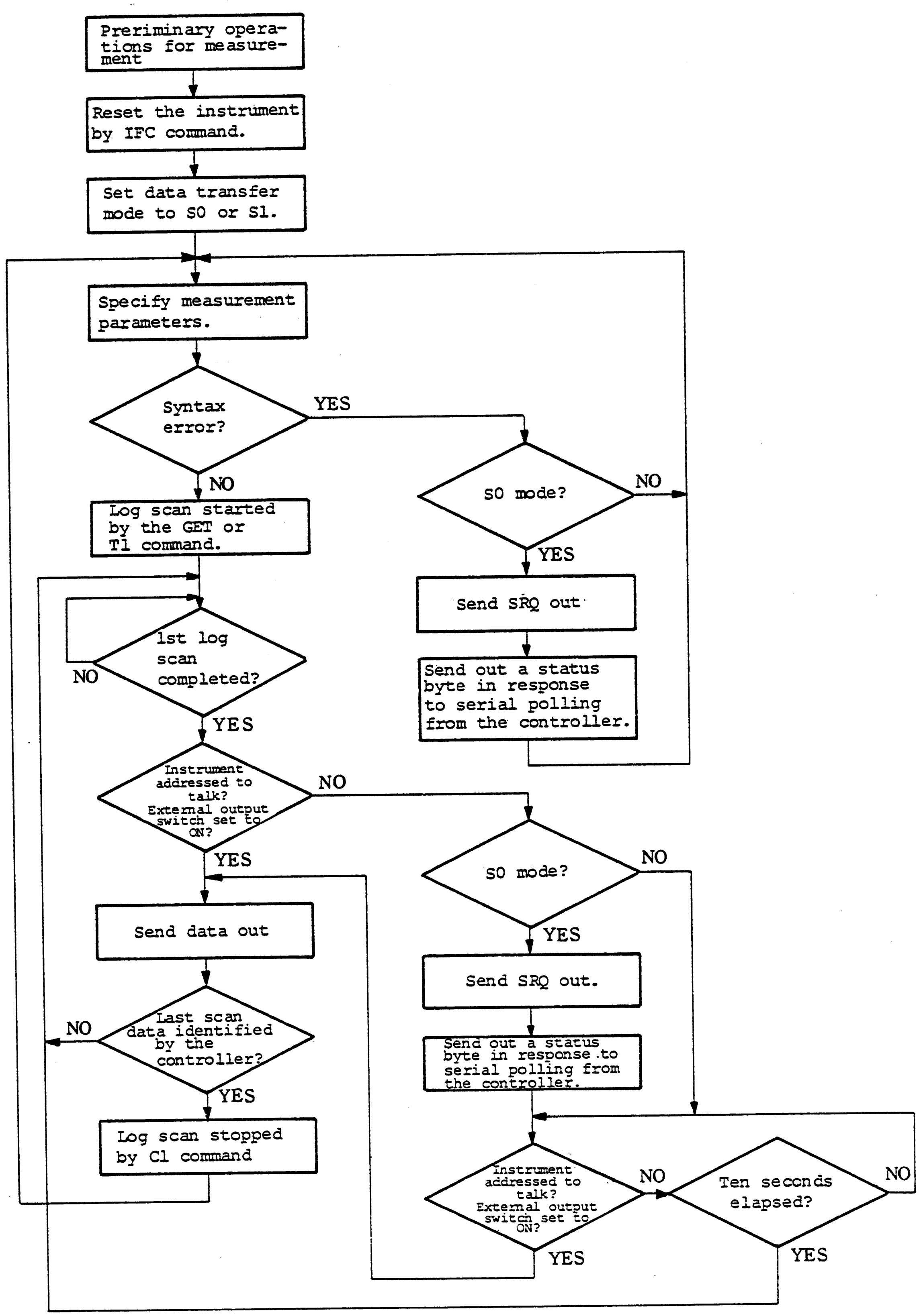
Note: Slash (/) indicates no status change.

DCL: Device Clear

SDC: Selected Device Clear

GET: Group Execute Trigger

12-7. OUTLINE OPERATION FLOW



12-8. PROGRAMMING SUPPORT AND PRECAUTIONS

(1) Programming example (using the HP-9825A for controller)

a. `w r t 7 01,  "LI0'10'0 SC1,10 FC10 FR4"`

- w r t 7 — Output to GPIB
- 01 — TR2730-510's device address
- "LI0'10'0 — Log interval: 10 minutes 0 second in single interval
- SC1,10 — Scan channel: CHs.1-10
- FC10 — Group channel: CH.10
- FR4" — Range (T: CC, int, on)

Each of the above items is sequentially programmed from the controller. The programming operation for each item actually occurs when another header or delimiter (;) is encountered. If a parameter with two or more groups is delimited by a semicolon (;), the programming sequence proceeds with the next item (group).

b. `w r t 7 01, "SC1,10;15,20 MI75,0 FC20"`

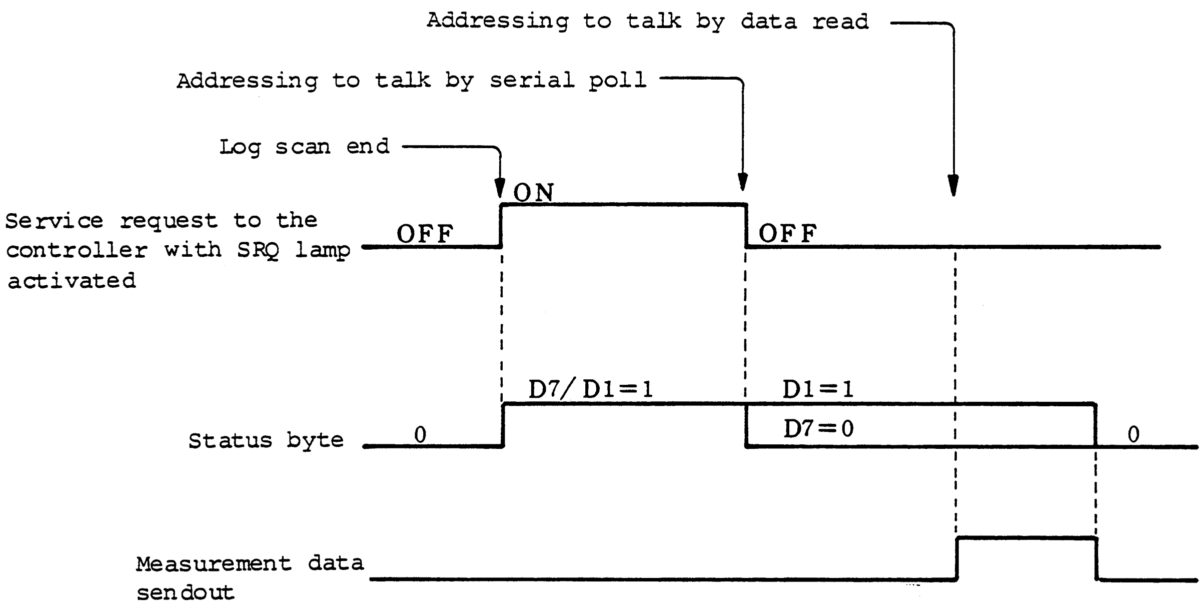
- w r t 7 — Output to GPIB
- 01 — TR2730-510's device address
- "SC1,10;15,20 — Scan channels: CHs.1-10 and 15-20
- MI75,0 — Monitor interval: 75 minutes 00 second Syntax error due to over-range setting
- FC20" — Function group channel: CH.20

If the S0 mode is selected, the instrument sends out a service request when MI75, 0 is programmed. In this case, the scan channels and function group channel are normally programmed, but the monitor interval (MI) programming is ignored.

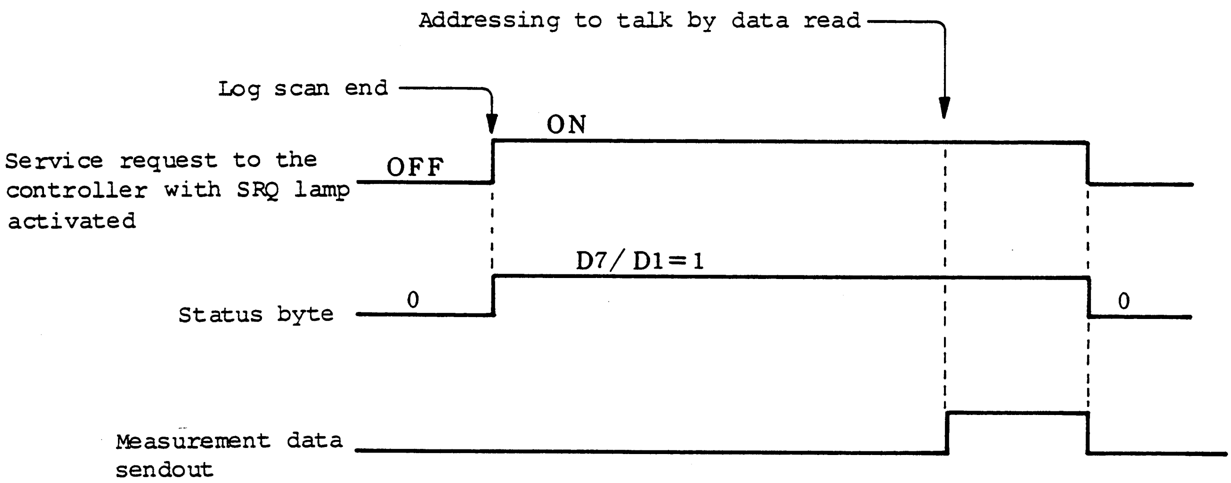
(2) Service request sequence

a. The following service request sequence is initiated when log scan (S0 mode) ends:

o When serial polling is to be made



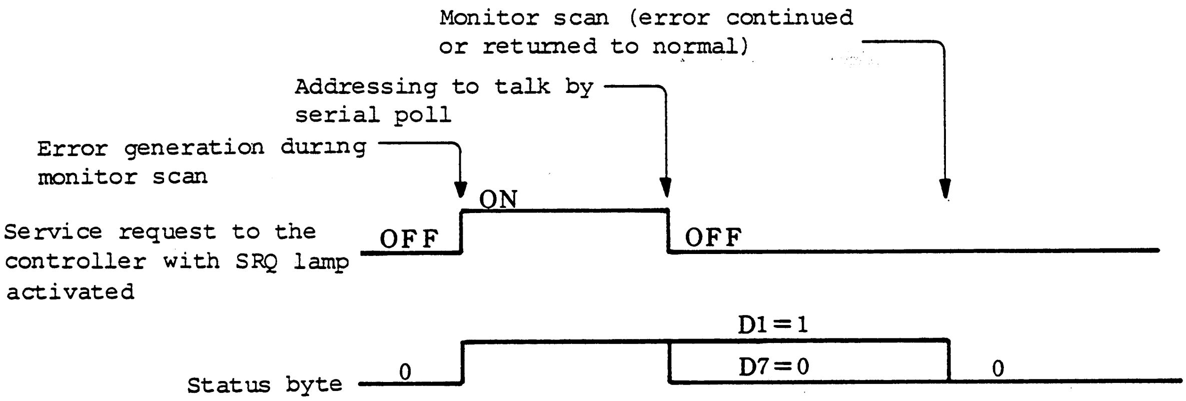
o When no serial polling is to be made



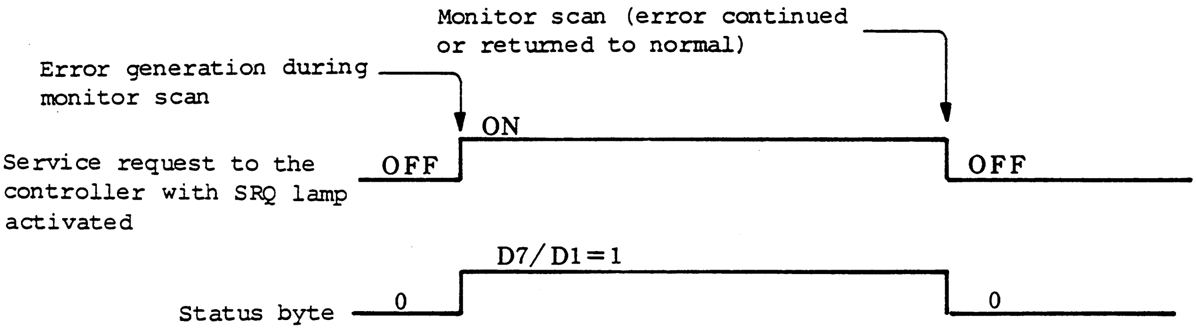
Note: Each status byte includes log scan busy (D4=1) and monitor scan busy (D5=1) information.

b. **The following service request sequence is initiated when an alarm is generated during monitor scan:**

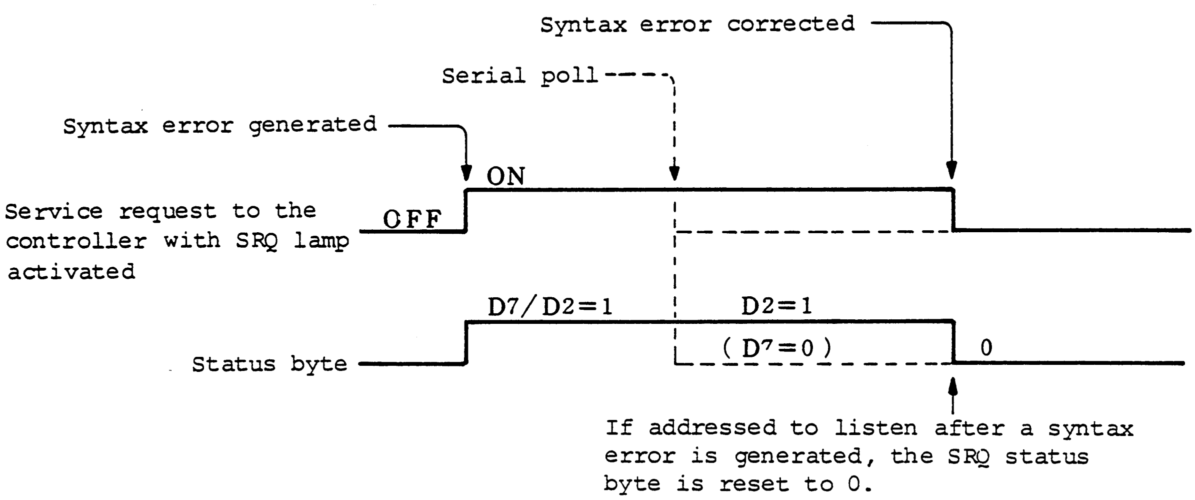
o When serial polling is to be made



o When no serial polling is to be made



c. **The following service request sequence is initiated when a syntax error is generated:**



12-9. PROGRAMMING EXAMPLES

(1) In the following programming example, channels 1 through 40 are measured with the thermocouple T(CC) range, channels 41 through 50 with the DC voltage range (20 V), and channels 51 through 60 with the DC voltage range (20 mV) all at 10-minute intervals, and measurement data is transferred to the controller. Also channels 41 through 50 are subjected to scaling operation to convert input voltages of 1 to 5 V into output percentage of 0 to 100%. (The values are directly defined in this programming example.)

Initial reset by the IFC command	
Erase parameter files by initializing with program code Z0.	Z0
Set the SRQ send to S0.	S0
Set the log interval to 10 minutes and specify single interval mode.	L10'10'0 Hour Minute Second
Set channels 1 through 60 as scan channels.	SC1'60
Set the monitor interval to 10 seconds and specify the selective channel scan mode.	M10'10'1 Hour Minute Selective channel mode
Specify analog output channels.	;1;11;21;31;41;51

Note: The delimiter (;) advances a set group to the next.

Continued on the next page.

Specify function group channels.

FC40;50;60

- Group 1 CH.40
- Group 2 CH.50
- Group 3 CH.60

Specify functions and ranges.

G01FR4;3;0

- Group 1 T(CC), int, on
- Group 2
- Group 3

Specify scaling coefficients for channels 41 through 50 (group 2).

G02FS1,0 04

Specifies group 2.

- Coefficient A=1
- Coefficient B=0.04

$$1V \quad \frac{(1.0000-1)}{0.04} = 0.00$$

to

$$5V \quad \frac{(5.0000-1)}{0.04} = 100.00$$

Specify a unit for group 2.

G02FU#%#

Specifies group 2.

Enclose the specified character with characters or symbols other than the specified characters and header characters. In this example, symbol "%" is enclosed with symbol "%".

All parameters are now programmed.

Specify the simplified format for output data, and start measurement.

W7 S3 T1 T2

- T2 — Monitor scan start
- T1 — Log scan start
- S3 — Data output in the simplified format
- W7 — Set the external output switch to ON.

Data read

Data may be read while it is monitored with status bytes or while an interrupt by SRQ is serviced each time.

Stop measurement. Log scan, monitor scan

C1 C2

- C2 — Monitor scan stop
- C1 — Log scan stop

The basic parameter programming is shown below.

Programming example using the HP Model 9825A as a controller

```
0: wrt 701,"Z0
 S0"
1: wrt 701,"LI0,
 10,0SC1,60"
2: wrt 701,"MI0,
 10,1;1;11;21;
 31;41;51"
3: wrt 701,"FC40
 ;50;60"
4: wrt 701,"G01F
 R4;3;0"
5: wrt 701,"G02F
 S1,0.04"
6: wrt 701,"G02F
 U#%#"
7: wrt 701,"W7S3
 T1T2"
*21606
```

Program description

0: Initial reset and parameter file total erase.
Specify S0 for SRQ sendout mode.

1: Set the log interval to 10 minutes.
Specify channels 101 through 160 as scan channels.

2: Set the monitor interval to 10 minutes and specify the selective scan mode for channels 1, 11, 21, 31, 41, and 51 (digit and offset specifications are typical.).

3: Specify function group channels: CH.40 for group 1, CH.50 for group 2, CH.60 for group 3

4: Specify ranges:
T(CC) for group 1, 20 V for group 2, 20 mV for group 3

5: Specify scaling coefficients for group 2:
A=1, B=0.04

6: Specify unit % for group 2.

7: Specify the simplified data output format and start log scan and monitor scan.

(2) In the following example, the range programming for group 2 (Channels 41 through 50) is modified into 2 V, the scaling operation is omitted, and the unit is changed into KG:

Step	Command
Call group 2 for function range setting and specify the 2 V range for the group.	G02 FR 2 (G02: Group 2; 2: 2V)
Delete the scaling coefficients from group 2.	G02 FS C4 (G02: Group 2; C4: Delete the specified item.)
Specify the KG unit for group 2.	G02 FU #KG# (G02: Group 2; #KG#: Specify the KG unit)

Programming hereafter is the same as example (1).

Note: Specify group numbers for function and alarm parameters when specifying a header. Use a semicolon (;) as a delimiter to sequentially advance the group number in the same parameter item. Specifying two consecutive semicolons (;;) will advance two group numbers.

Programming example using
the HP Model 9825A as a
controller

```
0: wrt 701,"G02F
 R2"
1: wrt 701,"G02F
 SC0"
2: wrt 701,"G02F
 U#KG#"
*6885
```

(3) Data readout procedure

The following two procedures are available to read data.

a. Data read is executed by the SRQ signal from he TR2731 at the end of measurement.

b. Data sent out after measurement is read when the TR2731 is addressed to talk all the time and so controller is ready to receive inputs.

Cause of interrupt is analyzed and processed by the procedures described in item 12-3-5 (c), for a.

Sendout data is read by addressing the TR2731 to talk, for both a. and b. Note the data sendout format especially for the delimiter's validity.

As described in item 12-3-3. Talker Format, the delimiter for the serial data such as time, channel and data is executed by "," (string delimiter) or "CR LF" (block delimiter), and is output at the end of a single scan.

Note that some controller requires definition of input data delimiter is advance, or specification of input command.

Example using the HP model 9825A

red701, A In this format, "," and "CR LF" are valid.

Example using the HP model 9845B

ENTER 701 ; A In this format, "LF" is identified as delimiter.

ENTER 701 USING "#,F";A In this format, "," is identified as delimiter.

For details, refer to each controller's instruction manual.

(4) In the following example, measurement interval is specified 10 minutes, channels 1 through 40 are measured with the thermocouple range T(CC), and data is read into the controller.

a. When using no SRQ

i) Example using the HP Model 9825A

```
0: dim B[40,2]
1: fmt 1,"Time",
 f8.0,f6.0,"ch",
 f8.1,"°C"
2: wrt 701,"Z0"
3: fxd 0
4: wrt 701,"S1S3
 LI0,10,0SC1,40"
5: wrt 701,"FC40
 FR4CKW7"
6: wrt 701,"T1"
7: red 701,A
8: for N=1 to 40
9: red 701,B[N,
 1]
10: fxd 1
11: red 701,B[N,
 2]
12: wrt .1,A,
 B[N,1],B[N,2]
13: next N
14: cmd 7,"_"
15: gto 7
*25020
```

Program description

0: Defines data area.

1: Defines the output format.

2: Erase TR2731's parameters.

3: Specify numerical format (with no decimal places).

4: S1 (no SRQ sent)
 S3 (data format, default mode)
 LI0, 10, 0 (log interval 10 minutes)
 SC1, 40, (scan channels 1 through 40)

5: FC40 (group channel CH.40)
 FR4 (range T(CC))
 CK (clock mode)
 W7 (external output ON)

6: Log start

7: Time data readout

8: Data read loop for channels 1 through 40

9: Channel number readout

10: Specify numerical format (with one decimal place).

11: Data readout

12: Output data to 9825A in output format 1.

13: Proceed with next data readout.

14: Specify UNTALK command.

15: Wait for the next scan data.

ii) Example using the HP Model 9845B as a controller

```
10 DIM B(40,2)
20 CLEAR 7
30 OUTPUT 701;"Z0"                          !PARAMETER ALL CLEAR
40 OUTPUT 701;"S1S3LI0,10,0SC1,40"          !SRQ,SHORT FORMAT
50 !                                         10MIN. INTERVAL,1CH-40CH
60 OUTPUT 701;"FC40FR4CKW7"                 !GROUPE1 40CH,CC(T),CLOCK
70 OUTPUT 701;"T1"                          !LOG START
80  ENTER 701 USING "#,F";A                 !READ TIME DATA
90  PRINT A
100 FOR N=1 TO 39                           !FIRST CH TO LAST CH-1
110 ENTER 701 USING "#,F,F";B(N,1),B(N,2)!READ CH NO. & DATA
120 PRINT B(N,1),B(N,2)
130 NEXT N
140 ENTER 701;B(40,1),B(40,2)               !READ LAST CH & CR LF
150 PRINT B(40,1),B(40,2)
160 SENDBUS 7;95                            !"UNTALK CODE"
170 GOTO 80                                 !READ NEXT SCAN DATA
```

Program description

10: Defines the data area.

20: Clear the GPIB bus line interface.

30: Erase TR2731's parameters.

40: S1 (no SRQ sentout)

S3 (simplified output format)

LI (log interval 10 minutes)

SC (scan channels 1 through 40)

60: FC40 (group channel 40)

FR4 (Range T(CC))

CK (clock mode)

W7 (external output ON)

70: T1 (log start)

80: Read out time data and specify a character or symbol other than numeric characters as a delimiter.

90: Print time data.

100: Channel number and measurement data readout loop (to the channel just preceding the last channel)

Note: The last channel is excluded from the loop because of the difference in delimiter format.

110: Read channels and data, and specify a character or symbol other than numeric characters as a delimiter (#, F, F).

Note: The default assumption for the ENTER statement uses an LF code as a delimiter. Therefore, use the USING statement to specify a comma (,) as a delimiter.

120: Print channel and its data.

130: Next data

140: Read out the last channel number and its data.

Note: LF must be read, as CR and LF is output as delimiter.

150: Print the last channel number and its data.

160: UNTALK command

170: Wait for the next scan data readout.

b. When using SRQ

i) Example using the HP Model 9825A

```
0: dim B[40,2]
1: fmt 1,"Time",
 f8.0,f6.0,"ch",
 f8.1,"'C"
2: cli 7
3: wrt 701,"Z0"
4: oni 7,"SRQ"
5: fxd 0
6: wrt 701,"S0S3
 LI0,10,0SC1,40"
7: wrt 701,"FC40
 FR4CKW7"
8: wrt 701,"T1"
9: eir 7
10: jmp 0
11: "SRQ":rds(70
 1)→S;gto 14
12: eir 7
13: iret
14: red 701,A
15: for N=1 to
 40
16: red 701,B[N,
 1]
17: fxd 1
18: red 701,B[N,
 2]
19: wrt .1,A,
 B[N,1],B[N,2]
20: next N
21: cmd 7,"_"
22: gto 12
*21731
```

Program description

0: Defines the data area.

1: Defines the output format.

2: Clear the GPIB bus line interface.

3: Erase TR2731's parameters and initialize it.

4: Define the top address of the interrupt service routine.

5: Define the numerical format (with no decimal places)

6: S0 (SRQ sendout mode)
   S3 (Simplified data output format)
   LI0, 10, 0 (log interval 10 minutes)
   SC1, 40 (scan channels 1 through 40)

7: FC40 (function group channels up to CH.40)
   FR4 (range T(CC)), internal compensation and linearization ON)
   CK (clock mode)
   W7 (external output ON)

8: Log start

9: Enable SRQ interrupt.

10: Wait for interrupt.

11: Start interrupt service routine. Read out status byte and go to line 14.

12: Enable SRQ interrupt.

13: Return from the interrupt service routine.

14: Read out one data (time data).

15: Readout loop for channels 1 through 40

16: Read out one data (channel number).

17: Defines the numerical character format (with one digit below decimal point)

18: Read out one data (measurement data)

19: Output data to 9825A in output format 1

20: Read the next data

21: Specify UNTALK

22: End of interrupt service routine, go to line 12

ii) Example using the HP Model 9845B

```
10 DIM B(40,2)
20 CLEAR 7
30 OUTPUT 701;"Z0"                           !PARAMETER ALL CLEAR
40 ON INT #7 GOSUB Srq                       !SRQ-->"Srq"ROUTINE
50 OUTPUT 701;"S0S3LI0,10,0SC1,40"           !SRQ,SHORT FORMAT
60 !                                          10MIN. INTERVAL,1CH-40CH
70 OUTPUT 701;"FC40FR4CKW7"                  !GROUPE1 40CH,CC(T),CLOCK
80 OUTPUT 701;"T1"                           !LOG START
90 CONTROL MASK 7;128                        !SRQ MASK
100 CARD ENABLE 7                            !SRQ ENABLE
110 GOTO 110
120 Srq:STATUS 701;S                         !READ STATUS BYTE
130 ENTER 701 USING "#,F";A                  !READ TIME DATA
140 PRINT A
150 FOR N=1 TO 39                            !FIRST CH TO LAST CH-1
160 ENTER 701 USING "#,F,F";B(N,1),B(N,2)!READ CH NO. & DATA
170 PRINT B(N,1),B(N,2)
180 NEXT N
190 ENTER 701;B(40,1),B(40,2)                !READ LAST CH & CR LF
200 PRINT B(40,1),B(40,2)
210 SENDBUS 7;95                             !"UNTALK CODE"
220 CARD ENABLE 7
230 RETURN
```

Program description

10: Defines the data area.

20: Clear the GPIB bus line interface.

30: Erase TR2731's parameters.

40: Interrupt service routine address "Srq"

50: S0 (SRQ sendout mode)

S3 (simplified data output format)

LI0, 10, 0 (log interval 10 minutes)

SC1, 40 (scan channels 1 through 40)

70: FC40 (group channels up to CH.40)

FR4 (range T(CC))

CK (clock mode)

W7 (external output ON)

80: T1 (log start)

90: Specify an SRQ mask bit.

100: Enable interrupt.

110: Wait for interrupt.

120: Interrupt service routine.

130: Read out time data.

140: Print time data.

150: Readout loop for channel numbers and their data.

160: Read out channel numbers and data.

170: Print channels numbers and data.

180: Next data

190: Read out the last data.

200: Print the last data.

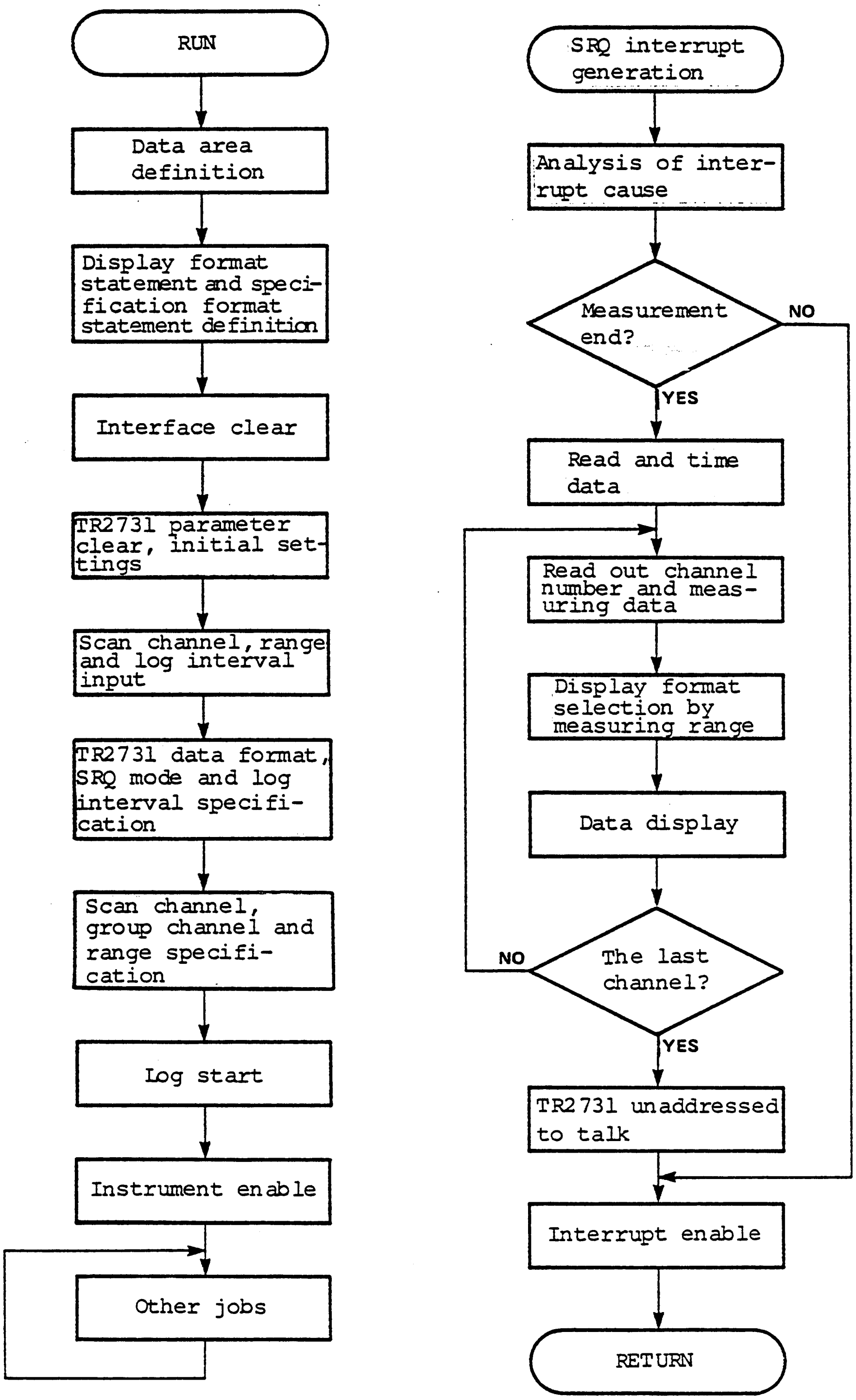
210: UNTALK command

220: Enable interrupt.

230: End of interrupt service routine.

(5) By key command from controller, log scan interval, scan channel and measuring range for the TR2731 are input to specify via GPIB. After completion of programming, log scan is started by using SRQ interrupt to read measurement to the controller. (Procedures using variables for parameter programming to TR2731.)

i) Outlined flow-chart



ii) Example using the HP model 9825A

```
0: "**********":
1: "* TR2731 *":
2: "* GPIB   *":
3: "*EXSAMPLE*":
4: "* PROGRAM*":
5: "**********":
6: dim B[80,2]
7: "**********":
8: "* FORMAT *":
9: "**********":
10: fmt 5,"Time"
 ,f8.0,f6.0,"ch"
 ,f8.3,"mV"
11: fmt 6,"Time"
 ,f8.0,f6.0,"ch"
 ,f8.2,"mV"
12: fmt 7,"Time"
 ,f8.0,f6.0,"ch"
 ,f8.4,"V"
13: fmt 8,"Time"
 ,f8.0,f6.0,"ch"
 ,f8.3,"V"
14: fmt 1,"Time"
 ,f8.0,f6.0,"ch"
 ,f8.1,"°C"
15: fmt 2,"S0S3L
 I",f2.0,",",
 f2.0,",",f2.0
16: fmt 3,"SC",
 f3.0,",",f3.0
17: fmt 4,"FC",
 f3.0,"FR",f1.0,
 "CKW7T1"
18: "*********":
19: "* INIT. *":
20: "*********":
21: cli 7
22: wrt 701,"Z0"
23: oni 7,"SRQ"
24: "*********":
25: "* INPUT *":
26: "* PARA. *":
27: "*********":
28: ent "LOG
 INTL...(H)",H
29: ent "...(M)"
 ,M
30: ent "...(S)"
 ,S
31: ent "FIRST
 CH.?",F
32: ent "LAST
 CH.?",L
33: ent "RANGE(0
 -3:DCV,4-8:TC,
 9:Pt)",R
34: fxd 0
35: dsp "LOG
 INTL",H,"H",M,
 "M",S,"S"
36: "*********":
37: "* SET   *":
38: "* PARA. *":
39: "*********":
40: wrt 701.2,H,
 M,S
41: wrt 701.3,F,
 L
42: wrt 701.4,L,
 R
43: eir 7
44: "*********":
45: jmp 0
46: "*********":
47: "SRQ":rds(70
 1)→S;if bit(0,
 S)=0;gto 70
48: "*********":
49: "* INPUT *":
50: "*  DATA *":
51: "*********":
52: red 701,A
53: for N=1 to
 L-(F-1)
54: fxd 4
55: red 701,B[N,
 1]
56: red 701,B[N,
 2]
57: if R=0;gto
 62
58: if R=1;gto
 63
59: if R=2;gto
 64
60: if R=3;gto
 65
61: if
```

```
                R>=4;gto
 66
62: wrt .5,A,
 B[N,1],B[N,2]*
 1000;gto 67
63: wrt .6,A,
 B[N,1],B[N,2]*
 1000;gto 67
64: wrt .7,A,
 B[N,1],B[N,2];
 gto 67
65: wrt .8,A,
 B[N,1],B[N,2];
 gto 67
66: wrt .1,A,
 B[N,1],B[N,2]
67: next N
68: "*********":
69: cmd 7,"_"
70: eir 7
71: iret
*26905
```

Program description (9825A)

6:	Data area definition		
10:	Format 5	Data display for 20 mV range	oo.ooomV
11:	Format 6	Data display for 200 mV range	ooo.oomV
12:	Format 7	Data display for 2 V range	o.ooooV
13:	Format 8	Data display for 20 V range	oo.oooV
14:	Format 1	Data display for temperature range	oooo.o'C
15:	Format 2	Format for parameter programming	
		S0 (SRQ sendout mode), S3 (simplified format)	
		LI (log interval)	
16:	Format 3	Format for parameter programming	
		SC (scan channel)	
17:	Format 4	Format for parameter programming	
		FC (function channel)	
		FR (function range)	
		CK (clock mode)	
		W7 (external output enable)	
		T1 (log start)	

21: Interface clear

22: TR2731 parameter all-clear, initial settings

23: Specification of program to be executed at the generation of SRQ interrupt

28-30: Log interval input

31, 32: Scan channel input

33: Measuring range input

34: Number of digits specification for the log interval display

35: Log interval display

40: Log interval specification

41: Scan channel specification

42: Function channel and range specification

43: SRQ interrupt enable

45: Other processing program (wait for interrupt)

47: Status byte readout
Determines if log scan end interrupt or not

52: Time data readout

53: Loop for channel number and data readout

54: Specifies number of decimals in the data

55: Channel number readout

56: Data readout

57-61: Display format specification by measuring range

62-66: Specified format display for each measuring range

67: Readout loop for the next data

69: UNTALK command (unaddressed to talk)

70: Interrupt enable

71: Returns from interrupt routine

iii) **Example using the HP model 9845B**

```
10    ! ***********************************
20    ! *  TR2731 GPIB EXSAMPLE PROGRAM    *
30    ! *   FILE NAME "2731.6"             *
40    ! *    FOR HP-9845B                  *
50    ! ***********************************
60    !
70    ! **** DEFINE DATA AREA ****
80    !
90    DIM B(80,2)                        !DATA AREA
100   !
110   ! **** FORMAT OF DATA DISPLAY ****
120   !
130   IMAGE "TIME",2XZZZZZZZZ            !TIME DATA
140   IMAGE DDD,"ch.",5XMDD.DDD,"mV"     !20mV RANGE
150   IMAGE DDD,"ch.",5XMDDD.DD,"mV"     !200mV RANGE
160   IMAGE DDD,"ch.",5XMD.DDDD," V"     !2V RANGE
170   IMAGE DDD,"ch.",5XMDD.DDD," V"     !20V RANGE
180   IMAGE DDD,"ch.",5XMDDDD.D,"'C"     !Temp.RANGE
190   !
200   ! **** FORMAT OF SETTING PARAMETER ****
210   !
220   IMAGE "S0S3LI",DD,",",DD,",",DD    !SRQ ON,SHORT FORMAT,LOG INTL
230   IMAGE "SC",DDD,",",DDD             !SCAN CH.
240   IMAGE "FC",DDD,"FR",D,"CKW7T1      !CH,RANGE,CLOCK,OUTPUT ENB.,LOG START
250   !
260   ! **** INITIALIZE GPIB & TR2731 ****
270   !
280   ABORTIO 7                          !"IFC"
290   CLEAR 7                            !"DCL"
300   OUTPUT 701;"Z0"                    !PARAMETER ALL CLEAR
310   !
320   ON INT #7 GOSUB Srq                !SRQ-->"Srq"ROUTINE
330   !
340   !
350   ! **** INPUT SCAN CH.& LOG INTERVAL & RANGE ****
360   !
370   INPUT "LOG INTERVAL? (H),(M),(S)",H,M,S
380   INPUT "FIRST CH?(F),LAST CH?(L)",F,L
390   INPUT "RANGE? (0-3:DCV),(4-8:TC),(9:PT)",R
400   !
410   !
420   ! **** SET PARAMETER TO TR2731 ****
430   !
440   OUTPUT 701 USING 220;H,M,S
450   OUTPUT 701 USING 230;F,L
460   OUTPUT 701 USING 240;L,R
470   !
480   ! **** ENABLE INTERRUPT ****
490   !
500   CONTROL MASK 7;128                 !SRQ MASK
510   CARD ENABLE 7                      !SRQ ENABLE
520   !
530   !
540   ! **** OTHER JOB ****
550   !
560   GOTO 560
      !
```

```
                                          !WAIT INTERRUPT(TR2731)
570
580    !
590    ! **** ROUTINE FOR INTERRUPT ****
600    !
610 Srq:  STATUS 701;S                    !READ STATUS BYTE
620    IF BIT(S,0)=0 THEN Ret             !NOT TR2731'S INTERRUPT
630    !
640    ! **** READ DATA FROM TR2731 ****
650    !
660    ENTER 701 USING "#,F";A            !READ TIME DATA
670    PRINT USING 130;A                  !PRINT TIME
680    !
690    FOR N=1 TO L-F                     !FIRST CH TO LAST CH-1
700    ENTER 701 USING "#,F,F";B(N,1),B(N,2) !READ CH NO. & DATA
710    X=B(N,1)
720    Y=B(N,2)
730    IF R=0 THEN R20m
740    IF R=1 THEN R200m
750    IF R=2 THEN R2
760    IF R=3 THEN R20
770    IF R>=4 THEN Temp
780 R20m:     PRINT USING 140;X,Y*1000
790    GOTO 870
800 R200m:    PRINT USING 150;X,Y*1000
810    GOTO 870
820 R2:       PRINT USING 160;X,Y
830    GOTO 870
840 R20:      PRINT USING 170;X,Y
850    GOTO 870
860 Temp:     PRINT USING 180;X,Y
870    IF N=L-(F-1) THEN 940
880    NEXT N
890    N=L-(F-1)                          !SET LAST CH.NO
900    ENTER 701;B(N,1),B(N,2)            !READ LAST CH & CR LF
910    GOTO 710
920    !
930    !
940    SENDBUS 7;"_"                      !UNTALK
950 Ret:      CARD ENABLE 7               !ENABLE INTERRUPT
960    RETURN
```

Program description (9845B)

90: Data area description

130: Time display format specification

140: Data display format for 20 mV range oo.ooomV

150: Data display format for 200 mV range ooo.oomV

160: Data display format for 2 V range o.ooooV

170: Data display format for 20 V range oo.oooV

180: Data display format for temperature range oooo.o'C

220: Format for parameter programming

S0 (SRQ sendout format), S3 (simplified format)

L1 (log interval)

230: Format for parameter programming

SC (scan channel)

240: Format for parameter programming

FC (function channel)

FR (function range)

CK (clock mode)

W7 (external output enable)

T1 (log start)

280: Interface clear

290: Device clear

300: TR2731 parameter all clear, initial settings

320: Specification of program to be executed at the generation of SRQ interrupt

370: Log interval input

380: Scan channel input

390: Measuring range input

440: Log interval specification

450: Scan channel specification

460: Function channel and range specification

500: SRQ interrupt mask reset

510: SRQ interrupt enable

560: Other processing program (wait for interrupt)

610: Status byte readout

620: Determines if log scan end interrupt or not

660: Time data readout

670: Time data display

690: Loop for channel number and data readout

700: Reads channel number and data in free format and identifies "," as delimiter

710, 720: Variables replacement

730-770: Display format specification by measuring range

780-860: Specified format display for each measuring range

870: Determines if last channel or not

880: Readout loop for the next data

890: Specifies N as the last channel data number

900: Identifies "CR LF" as delimiter to read channel number and data in the last channel

910: Go to line 710

940: UNTALK command (unaddressed to talk)

950: Interrupt enable

960: Returns from interrupt routine

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SECTION 13

TROUBLESHOOTING

13-1. GENERAL

This section summarizes troubleshooting procedures for TR2731 and TR2741 in flow-chart form. After completing any repairs, always calibrate and check the performance of the unit before using it again. Note that part numbers and symbols used in this section are the same as those imprinted or marked in the circuit diagrams and boards.

13-2. PRELIMINARY PREPARATIONS

The measuring instruments and apparatus required for troubleshooting purposes are listed below. Use the instruments listed in Table 13-1, or those of equivalent or better performance capacity.

Table 13-1 Measuring instruments required for troubleshooting

Measuring instrument	Performance rating	Recommended equipment	Remarks
Oscillo-scope	Frequency: DC to 30 MHz Sensitivity: 10 mV/div. or better		
Digital multimeter	DC voltage: 0 to ±300.0 V Resistance: 0 to 1 MΩ	TR6824 (ADVANTEST)	
DC voltage standard	DC voltage: 0 to ±50.00 V	TR6141 (ADVANTEST)	
Frequency generator	Frequency: 1 to 100 kHz Waveform: Sine wave or square wave		To be used for TR2730-580

Table 13-2 Other apparatus required for troubleshooting

Article	Stock No.	Remarks
BNC-BNC cable	MI-02	To be used for TR2730-580
Clip type cord		
Adjustment board	BLC-010540	

13-3. GENERAL PRECAUTIONS

(1) This troubleshooting section has been intended for use by electronic engineers and personnel with experience in repairing measuring instruments. An adequate knowledge of electric circuits is necessary.

(2) The AC power supply used must be within the specified voltage range and the specified frequency range.

(3) The power cord plug is a three-prong plug, the round prong in the center is for grounding. When this plug is connected to the AC mains receptacle via a two-prong adapter, always ensure that either the adaptor ground lead or the GND terminal on the rear panel of the unit is connected to an external earth ground. (See Figure 1-3).

(4) Conduct the troubleshooting in a place free of dust, vibration, and noise.

(5) Whenever the interior of the unit is to be examined, always make sure that the POWER switch is set to OFF. (The TR2741 POWER switch is located on the rear panel). The POWER switch must also be set to OFF whenever extracting or inserting circuit boards.

(6) When measuring with an oscilloscope or digital voltmeter, be particularly careful to prevent shorting with lead wires of the parts or neighboring terminals, etc.

(7) When using a soldering iron to replace defective parts on a circuit board, perform the soldering as quickly as possible, and use an iron rated at 20 W to 30 W. If a hot soldering iron is applied to a circuit component (particularly semiconductors) for long, the heat may cause damage to that part and/or the printed pattern. The soldering iron should also be a low-leakage type with the iron tip connected to ground via a resistance from 100 kΩ to 1 MΩ.

(8) When replacing parts, use parts of equal performance ratings as indicated in the parts list at the end of this manual. Parts marked by an asterisk (*) are dedicated. Contact your nearest ADVANTEST representative for further details.

(9) Parts marked by a # must be protected from damage by static electricity in the following ways.

- o Handle these parts as infrequently as possible.
- o Store the parts by wrapping in material of good conductivity to prevent accumulation of static electricity, or enclose in a sponge material also of good conductivity.
- o Make sure that the personnel handling such parts do not wear clothing made of synthetic fiber, and that any residual static electricity is discharged before starting operations.
- o When handling ICs, do not touch the pins directly by hand.
- o Never slide ICs along any surface, no matter what kind of material it is.

(10) Reread section 3-11 "Maintenance and Check" to make sure that the trouble is not due to an operational error. After confirming the defect, proceed to correct the problem as directed by flowchart.

(11) When checking internal circuits, be very careful not to short the printed pattern or other circuit components apart from those specified. When connecting circuits by clip or other similar means, check that the tip of the clip does not overlap onto another circuit. Accidental shorting can result in desctruction of circuit components.

(12) Unless otherwise specified, use the circuit ground as the reference voltage when measuring voltages, connecting the voltmeter "-" or "LOW" side to ground.

(13) Although the troubleshooting flowcharts mainly stipulate ICs, transistors, and other semiconductor elements as the defective parts, also check resistors and other components connected in the vicinity of the specified part.

(14) Also check the input/output logic of semiconductors before replacing such components. Defects in other circuit components can sometimes appear to be due to the semiconductor.

13-4. FAILURE DIAGNOSIS

When the unit fails to operate as described in the operation manual, it can be assumed that a failure has occurred.

Major defects include:

- o Scanning failure,
- o Data discrepancy (in respect to expected value),
- o Printing failure, and
- o Parameter setting failure.

First check that there has been no operational error by referring back to section 3-11-4 "Problem Determination".

Then determine whether the failure has occurred in the TR2731 or the TR2741, and follow the respective troubleshooting procedures accordingly.

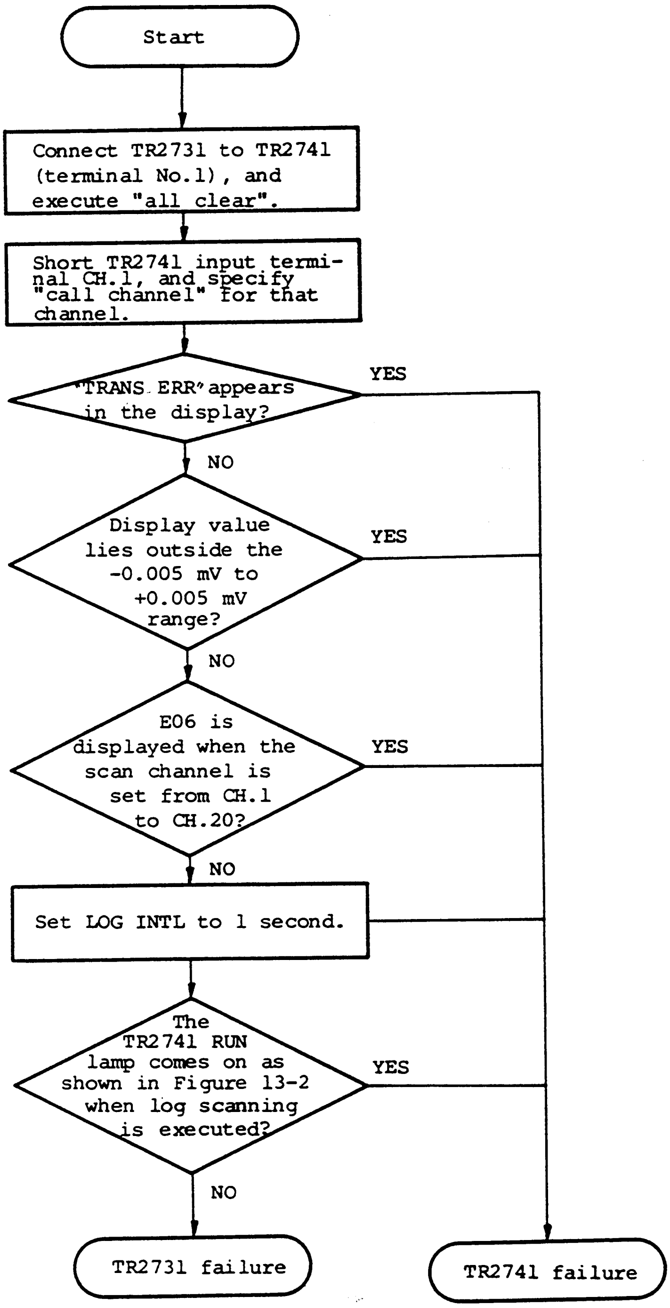


Fig. 13-1 Failure diagnosis flowchart

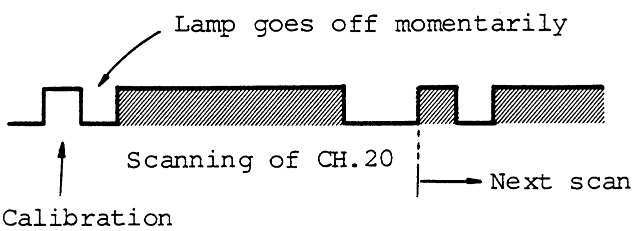


Fig. 13-2 RUN lamp

13-5. PRINCIPLES OF THE TR2741 SENSOR TERMINAL OPERATION

13-5-1. Operation of Component Parts

See Figure 13-3 for an outline of the TR2741 block diagram.

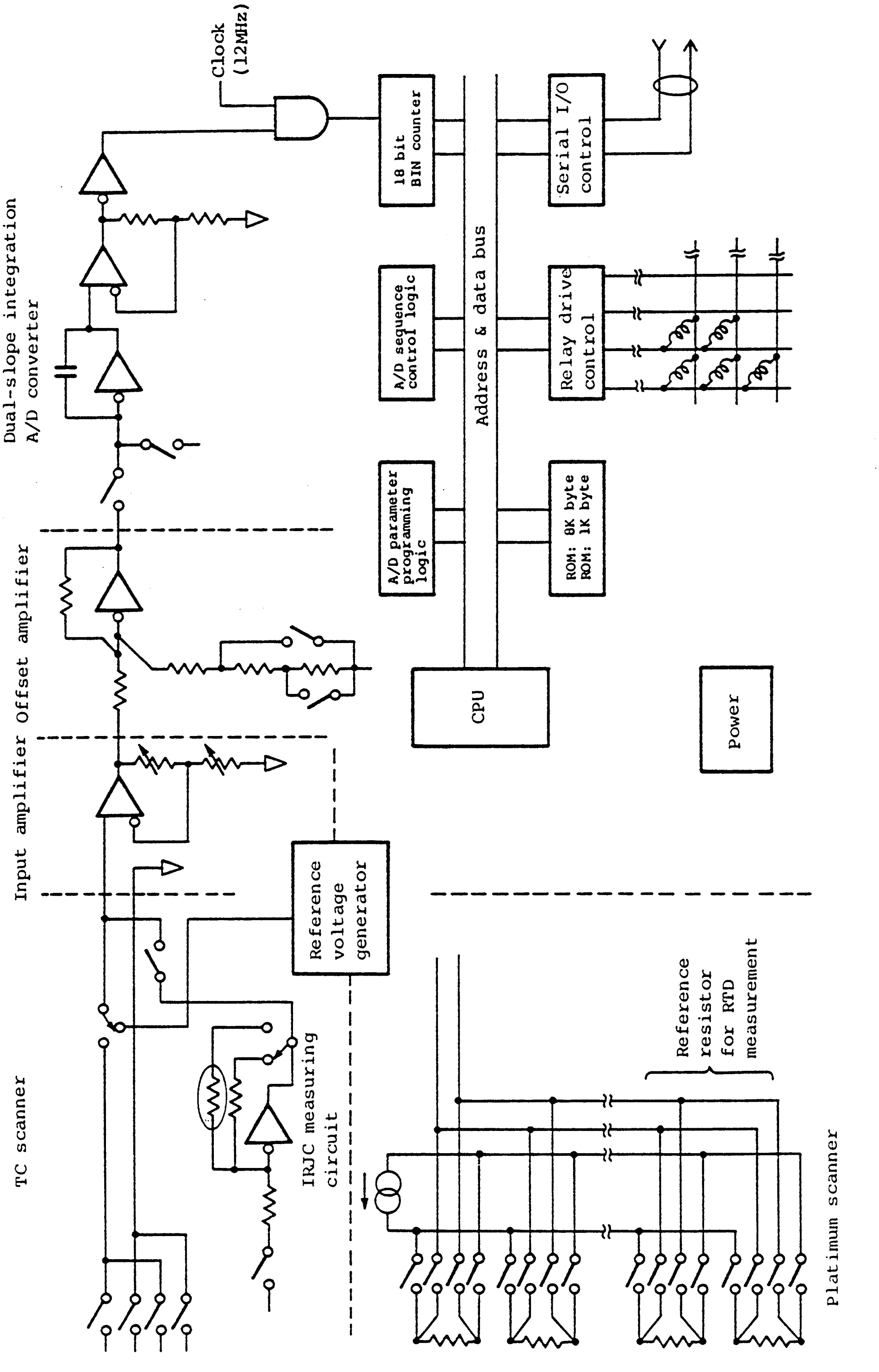


Fig. 13-3 TR2741 block diagram

(1) TC scanner

The TC scanner consists of a set of input switching relays, and a terminal board temperature measuring circuit for internal reference junction compensation purposes.

With 40 channels divided into two groups, the input scanner executes switching operations by 20 relays. The relays are connected in a matrix form.

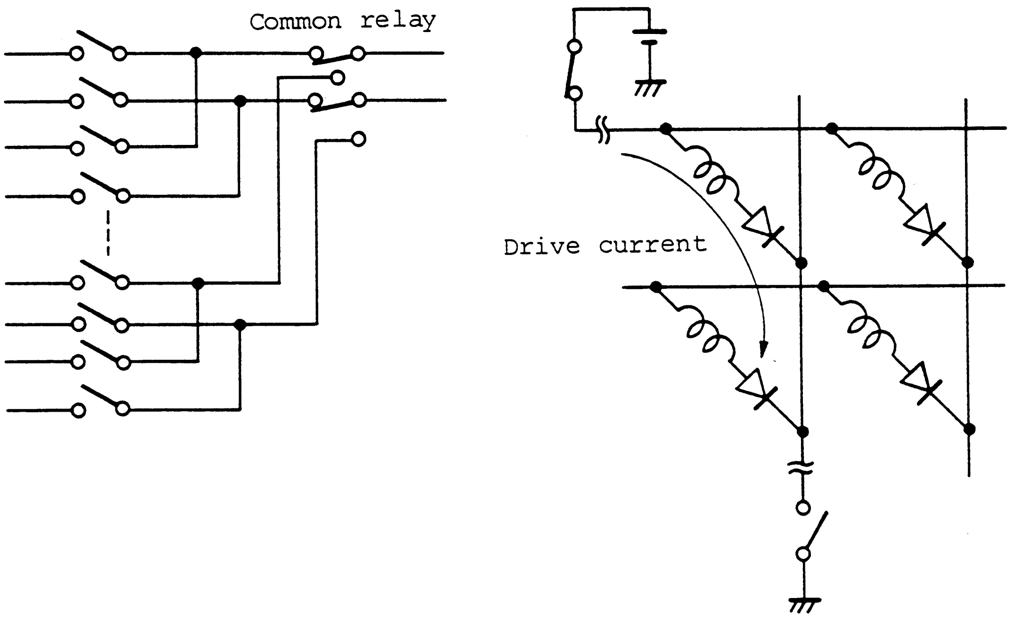


Fig. 13-4 Relay connection diagram

In the internal reference junction compensation circuit (see Figure 13-5), changes in resistance due to the temperature of the platinum sensor (platinum resistive temperature detector) are converted to changes in voltages. The output voltage is measured three times under the following conditions, the results linearized, and the terminal board temperature determined.

① Kl: OFF, K2: 1 Amplifier offset measurement ...... Voff

② Kl: ON, K2: 1 Output voltage for fixed resistance (100 Ω) .... VR

③ Kl: ON, K2: 2 Output voltage for platinum sensor .... VPt

$\frac{VPt - Voff}{VR - Voff}$ is calculated, and the results linearized.

The above measurement is to be conducted for each calibration and each terminal board.

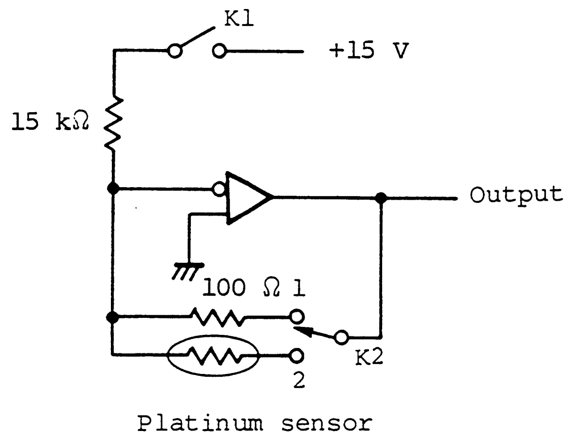
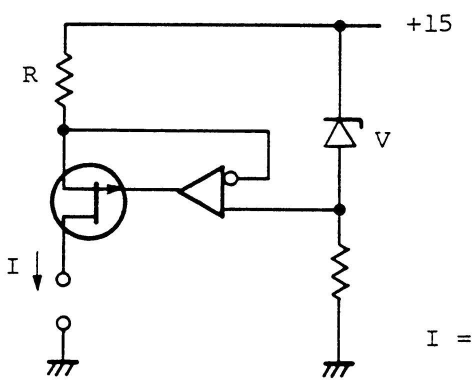


Fig. 13-5 Internal reference junction compensation circuit

(2) Platinum scanner

The platinum scanner consists of an input switching relay group and a constant current circuit for resistance measurements by platinum sensor. The input scanner consists of one channel per single package relay with four make contacts. This scanner handles up to 20 channels, and is driven in the same way as the TC scanner.

Since the constant current circuit (see Figure 13-6) is given different values when used, long term stability is not required. These values are given each time the scanner is calibrated.



$$I = \frac{V}{R} = 2 \text{ mA}$$

Fig. 13-6 Constant current circuit for platinum sensor measurements

The scanner is calibrated at two points - 0 Ω and 260 Ω (180 Ω + 80 Ω) - in the 3-wire RTD and 4-wire RTD ranges, and at two points - 80 Ω and 180 Ω - in the 4-wire RTD high resolution range. For this reason, the scanner includes two high-accuracy reference resistances, 80 Ω and 180 Ω.

(3) Input amplifier

The input amplifier is a high-impedance non-inverting amplifier where the gain is varied according to the measuring range. The circuit is outlined in Figure 13-7.

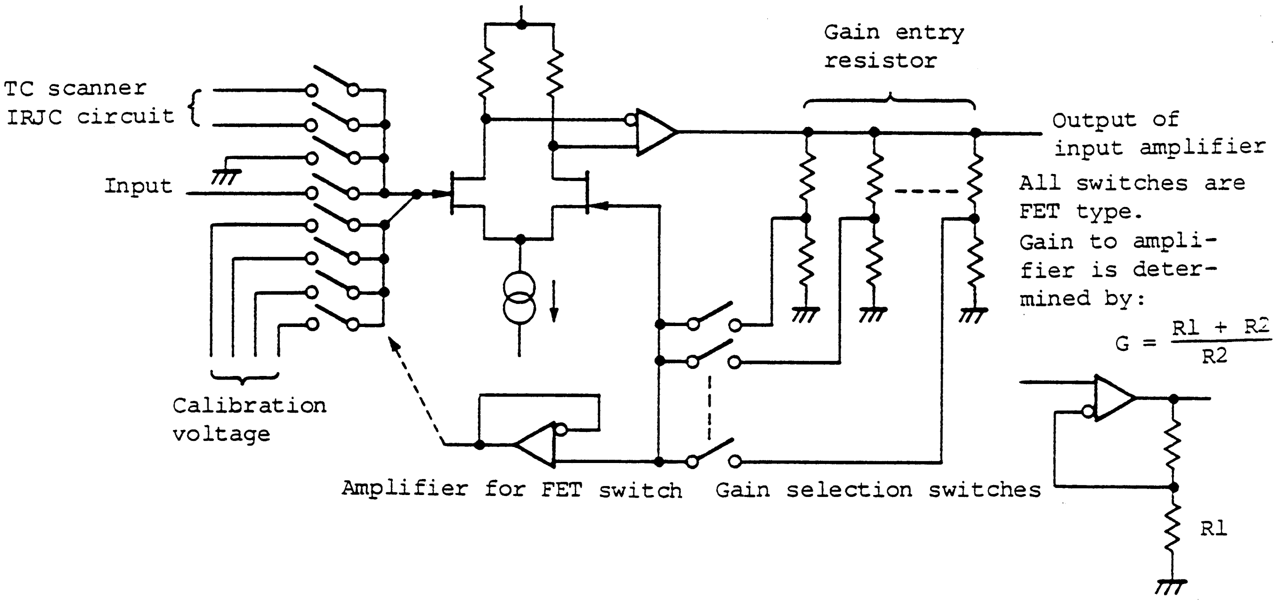


Fig. 13-7 Input amplifier block diagram

The gain for each measuring range is listed in the following table. Gain error is of the order of 2% to 3%.

Measuring range		Gain
Voltage range	20 V, 2 V 200 mV 20 mV	x 1 x 10 x 100
Thermocouple range	T, J, E, K S, R, B, 12.8	x 48 x 200
Platinum range	3-wire, 4-wire 4-wire high resolution	x 10 x 40 + offset

(4) Dual slope integration A/D converter

This uni-polar A/D converter has an input range from -10 V to 0 V. The count is about 240,000 at 50 Hz for an input of -10 V, and about 200,000 at 60 Hz. Reference voltage is +10 V. The initial integration time is 20 ms (50 Hz) and 16.66 ms (60 Hz), and the clock frequency is 12 MHz.

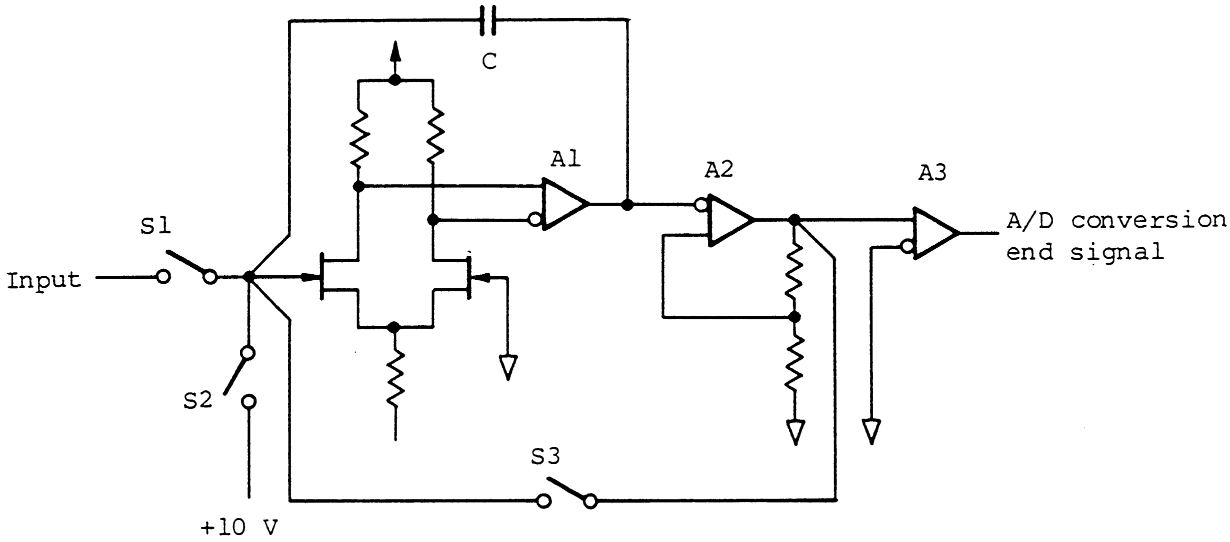


Fig. 13-8 A/D converter block diagram

After switch S1 is switched on for the primary integration time (20 ms at 50 Hz, and 16.66 ms at 60 Hz), switch S2 is switched on, followed by switch S1 being switched off again. Comparator A3 is activated when the A2 output drops below a level of about 0 V, resulting in the output of an A/D conversion end signal. S3 is an auto-zero switch which determines the amount of charge on the integrating capacitor at the start of integration. The switch remains on when no integration is executed.

(5) Offset amplifier

Since the A/D converter is a uni-polar type, an offset signal is applied to achieve overall bipolarity. In other words, when the input is 0 V in the voltage range, the offset amplifier output is set to about 1/2 full scale of the A/D converter (about 5 V), and the gain is doubled.

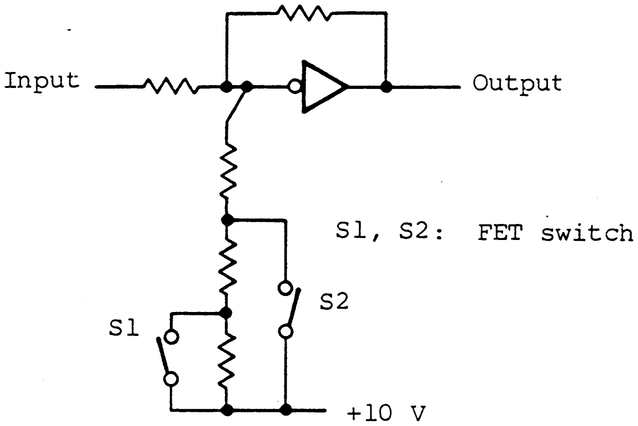
With an input of 0 V, the amplifier output is as follows:

o Voltage range .... Approx. -5 V

o Thermocouple T,J,E,K .... Approx. -1.8 V

o Thermocouple S,R,B,Pt ranges .... Approx. -0.86 V

See Figure 13-9 for the circuit block diagram.



S1	S2	Output offset voltage
OFF	OFF	-0.86 V
ON	OFF	-1.8 V
OFF	ON	-5 V

Fig. 13-9 Offset amplifier block diagram

(6) Reference voltage generator

Reference voltage are generated for voltage range and temperature range calibrations. The voltages generated include - full scale, or 0, and + full scale, and values are given to the analog system (from input amplifier to A/D converter). ±2 V, ±200 mV, ±20 mV, and +80 mV voltages are generated by dividing the +10 V voltage. The relevant block diagram is outlined in Figure 13-10.

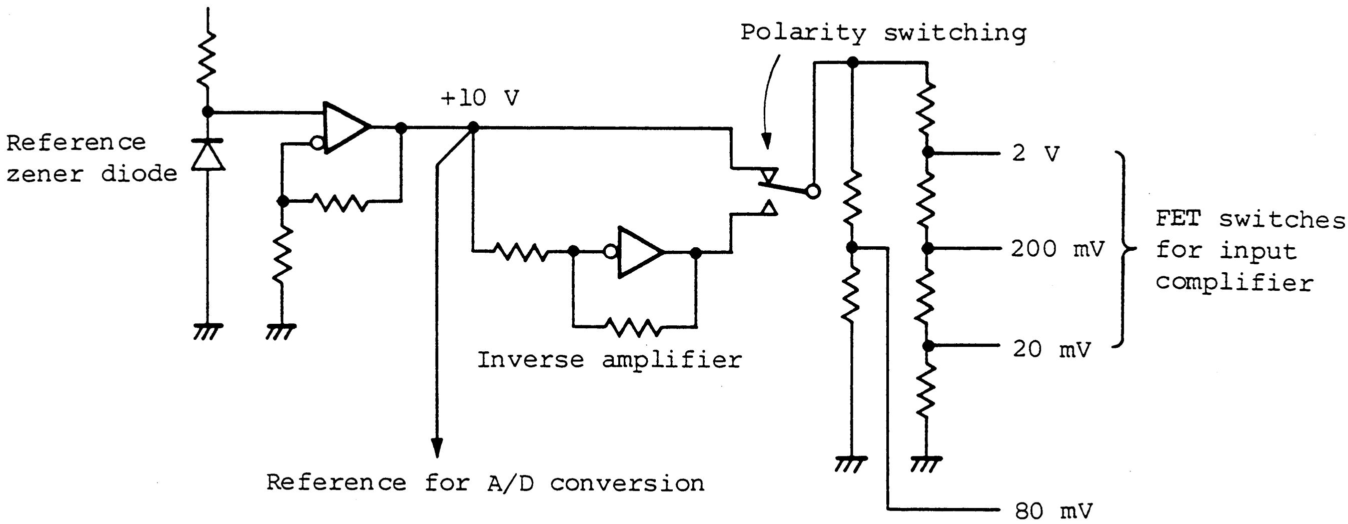


Fig. 13-10 Reference voltage generator block diagram

(7) CPU

This microprocessor controller regulates all relays, the analog system, and serial I/O. See Figure 13-11 for the relevant block diagram.

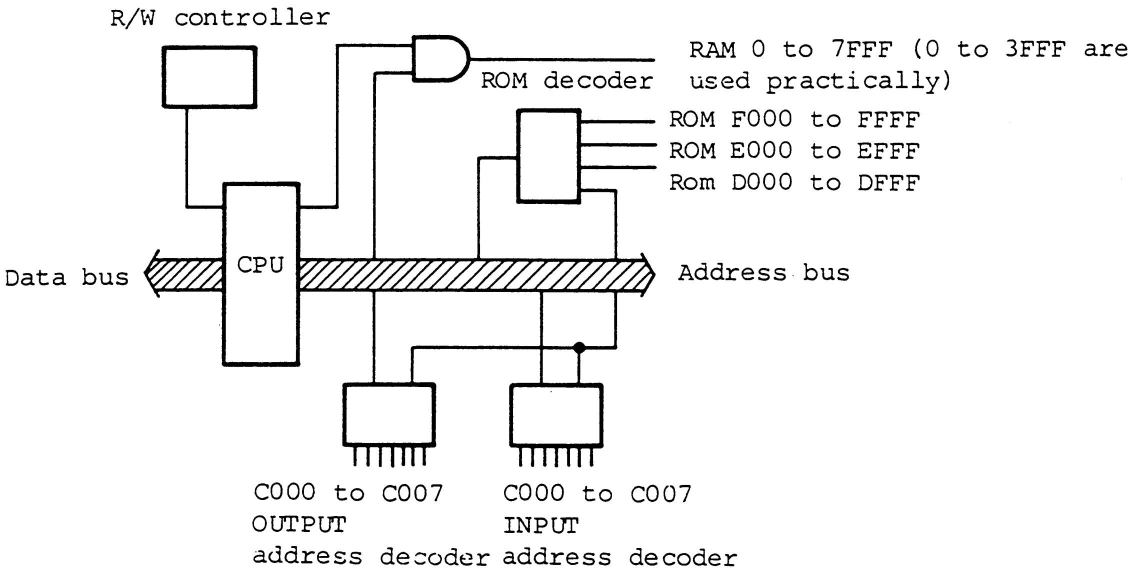


Fig. 13-11 CPU block diagram

(8) ROM & RAM

ROM address (Hexadecimal): E000 to FFFF (8K bytes), RAM address (Hexadecimal): 0 to 3FF (1K byte).

(9) A/D conversion control logic

When a start signal is delivered from the CPU, the primary integration (16.66 ms or 20 ms) and secondary integration are executed, this being followed by end of operation. The block diagram and a simplified timing chart are outlined in Figures 13-12 and 13-13.

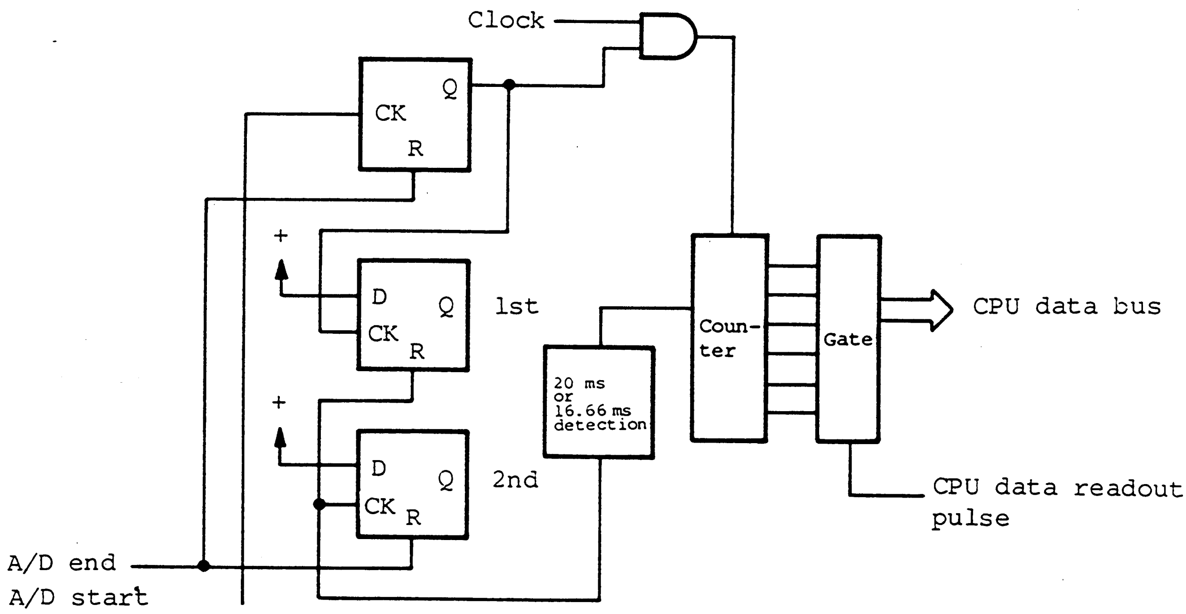


Fig. 13-12 A/D conversion control logic block diagram

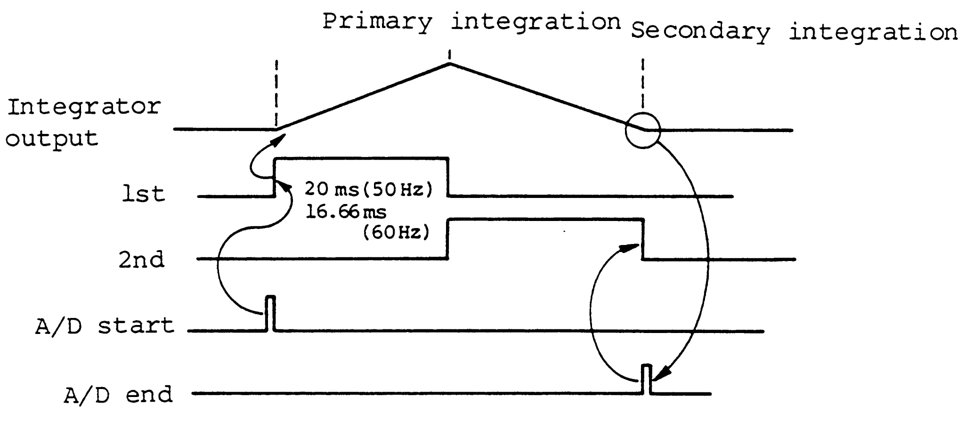


Fig. 13-13 A/D conversion control logic timing chart

(10) A/D conversion parameter setting logic

Data related to input amplifier and offset amplifier gain is received from the CPU, latched, and then used to activate switches. See Figure 13-14 for the block diagram.

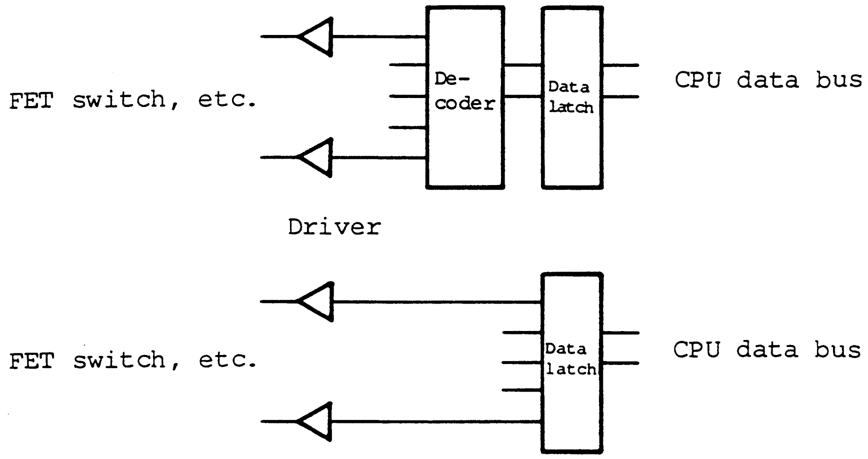


Fig. 13-14 A/D conversion parameter setting logic

(11) Relay drive control

Data for switching certain relays on is received from the CPU, latched, and relevant currents then passed to the relay matrix.

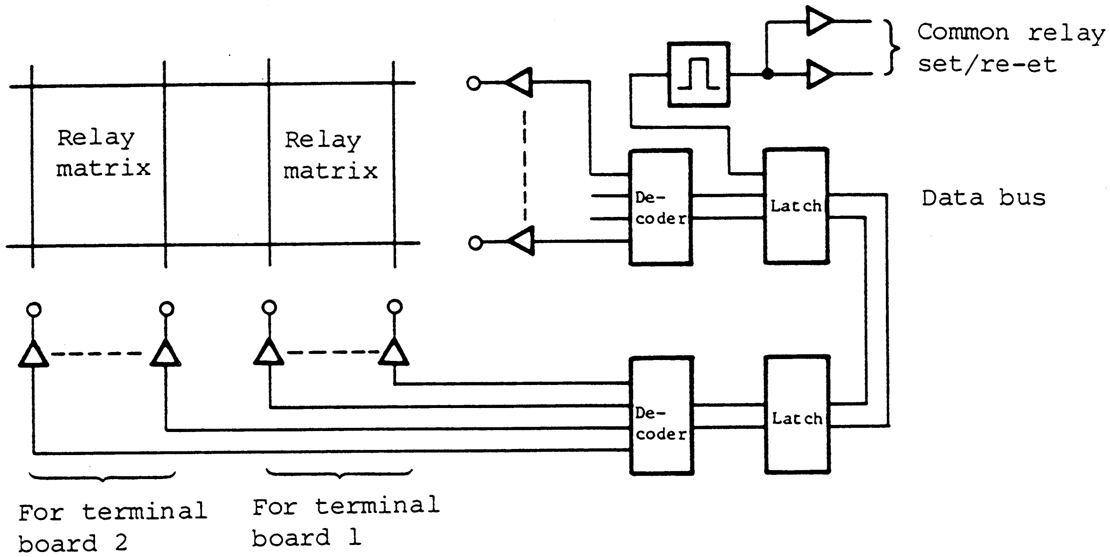


Fig. 13-15 Relay drive control block diagram

(12) Serial I/O control

Only the data required by the terminal is selected from the serial data sent from the TR2731, this being delivered to the CPU after reception.

The serial I/O is completely isolated from the TR2731 side by photocoupler.

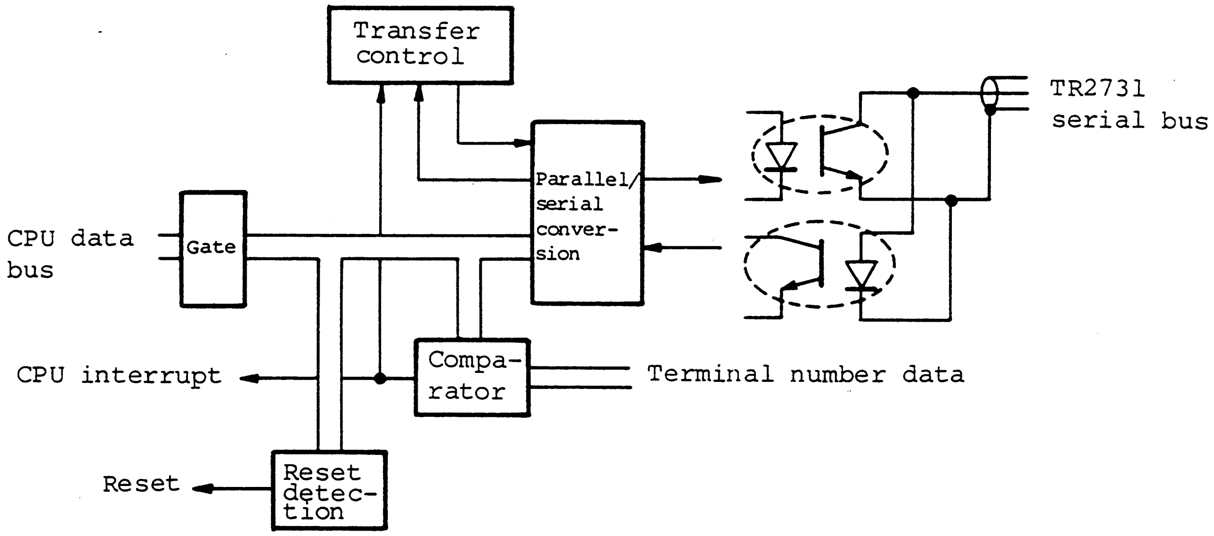


Fig. 13-16 Serial I/O control block diagram

(13) **Power supply**

The +15 V, -15 V, +5 V, and +20 V power supplies required by the TR2741 are generated from the 32 V power supply from the TR2731. The required isolation between the TR2731 and TR2741 is achieved by using a DC/DC converter.

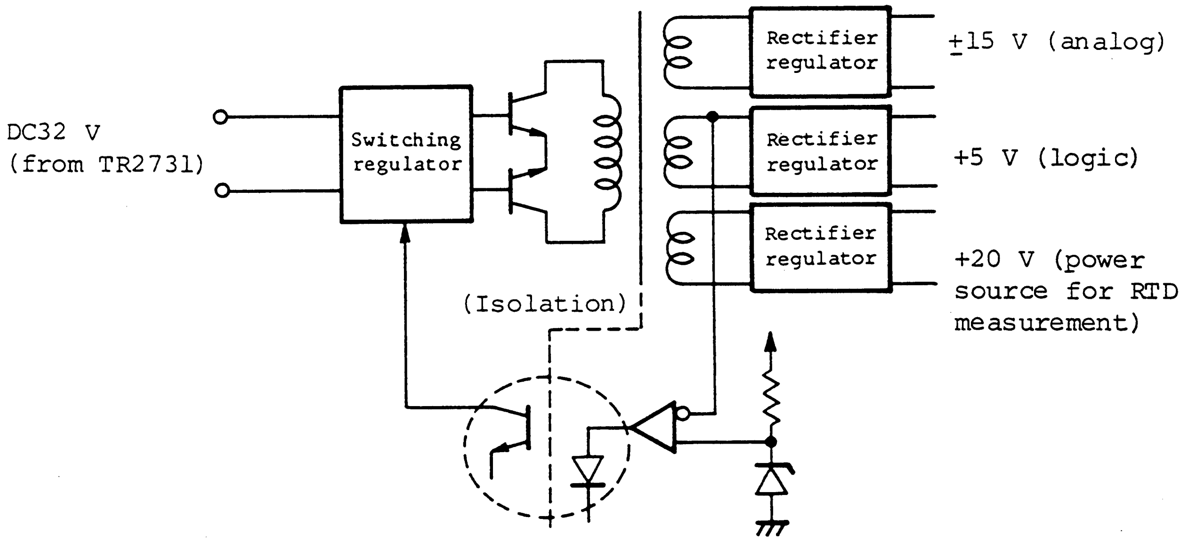
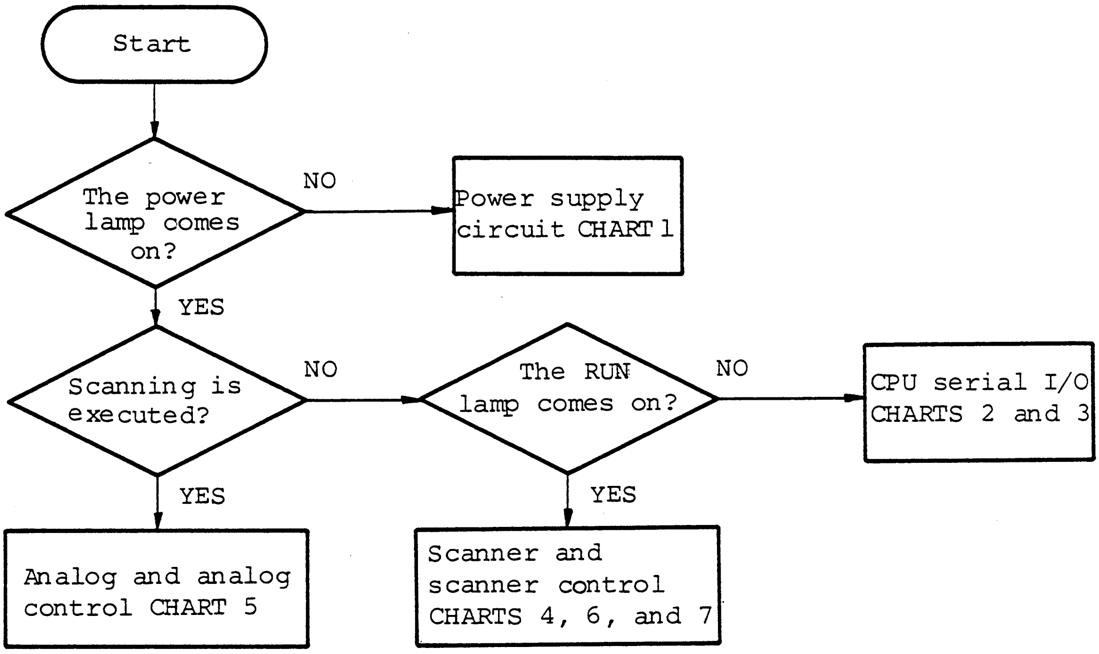


Fig. 13-17 Power supply block diagram

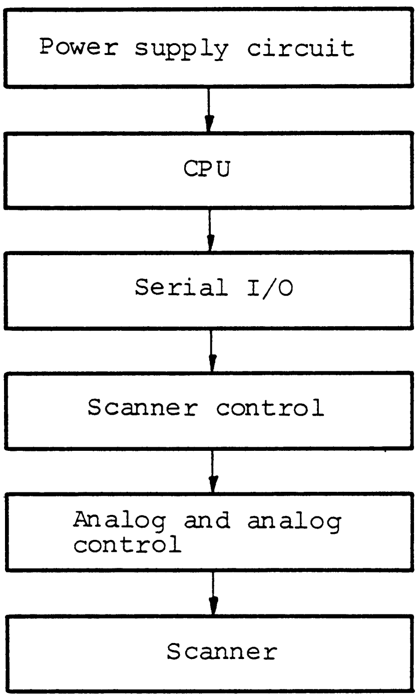
13-6. TR2741 TROUBLESHOOTING

13-6-1. Flowchart Summary

The general troubleshooting procedures are summarized in the following flowchart.



Proceed according to the following check priority.



After completing the check, also check the jumper and switch settings indicated in Figure 14-7.

13-6-2. Detailed Flowchart

The detailed troubleshooting flowcharts are provided below.

MEMO

CHART 1 Power Supply Circuit

Note 1: The board to be checked is BLM-010166 (A/D board) for CHART 1 thru CHART 5.

Start (Note 1)

- The fuse has been blown?
  - YES → Terminal 2 of T556 is shorted to TP GND?
    - YES → Check IC84, Q124, Q125, C475, R407, and printed patterns.
    - NO → Replace the fuse, and switch the power back on. (Note 2)
      - The fuse blew out?
        - YES → Cut the +5 V, −15 V, and +15 V jumper wires, and replace the fuse.
          - The fuse blew out again?
            - NO → Check for shorting to GND on the load side of each power supply line.
            - YES → Disconnect wires 1, 2, and 3 to T556.
              - The fuse blows again when the power is switched on following fuse replacement?
                - NO → Check T556 and the rectifier diode, smoothing capacitor, IC80 thru IC82, and the printed pattern on the secondary coil side of T556.
                - YES → Check Q124, Q125, and IC84.
        - NO → (go to Measure the voltage between each test point and GND)
  - NO → Measure the voltage between each test point and GND.
    - +5 V . . . . . +5 V ±0.25 V
    - −15 V . . . . . −15 V ±0.75 V
    - +15 V . . . . +15 V ±0.75 V

    (Note 3)
    - The measured voltages lie within the above ranges?
      - YES → **Normal**
      - NO → The voltage between the test point TP GND and the fuse holder bracket lies between +27 V and +33 V?
        - NO → Check the cable/connector used to connect the TR2731 to the TR2741.
        - YES → Cut the +5 V, −15 V, and +15 V jumper wires.
          - Measure the above voltages again.
          - → (A)

Note 2: Fuse blow-outs can be caused by
- shorting in the 32 V dc line
- currents passed through Q124, Q125, and IC84
- shorting in the rectifier diode and smoothing capacitor
- shorting in the transformer coils.

If these defects are not properly repaired, the fuse may blow out repeatedly.

Note 3: Test point locations
- +5 V (right hand side of IC57)
- −15 V (right hand side of IC57)
- +15 V (right hand side of IC63)
- GND (right hand side of IC63)

Also note the three different types of ground
- TP GND . . . . Transformer primary coil ground
- GND . . . . Logic circuit ground
- TP.G . . . . Analog ground

(A)

- The measured result is within the specified ranges?
  - YES → Possible power supply shorting in pattern or IC. Check visually, or test by passing a current if there is a current limiter in the external power supply.
  - NO → The D168 cathode voltage lies between +7.3 V and +9 V?
    - YES → Measure the voltage at the following points.
      - D166 cathode. . . . . +17.5 V to +20 V
      - D170 anode. . . . . −17.5 V to −20 V
      - D172 cathode (+) and T556 11 (−) after removing J8 and J9 . . . . 22 V to 26 V

      (Note 4)
      - The measured voltages lie within the specified ranges?
        - YES → Check IC80 thru IC82.
        - NO → • T556 • Rectifier diode. • Smoothing chemical capacitor • Smoothing ceramic capacitor • IC80 thru IC82. Check the above components.
    - NO → The pin-2 of IC83 voltage is between +7.6 V and +9.6 V?
      - NO → The voltage at test point +15 V lies between +14.25 V and +15.75 V?
        - YES → Check D164, D165, and R411.
        - NO → The D166 cathode voltage lies between +17.5 V and +20 V?
          - YES → Check IC80, etc.
          - NO → (return to Check the Q124 and Q125 base waveforms)
      - YES → Check the Q124 and Q125 base waveforms. (See Figure 1-a. (Note 5))
        - NG → Check IC84, etc.
        - OK → Check the Q124 and Q125 collector waveforms. (See Figure 1-a.)
          - NG → Check Q124 and Q125. (Note 6)
          - OK → Check IC83, IC84, CP133, and other related elements.

Note 4: J8 and J9 are for the platinum RTD and voltage scanner current supply.

Note 5: Always connect the oscilloscope probe ground to TP GND.

Note 6:
IC84 includes a built-in generator, the outputs present at pins 11 and 14, thereby drives the bases of Q124 and Q125. The Q124 and Q125 waveforms are displaced by 1/2 cycle.

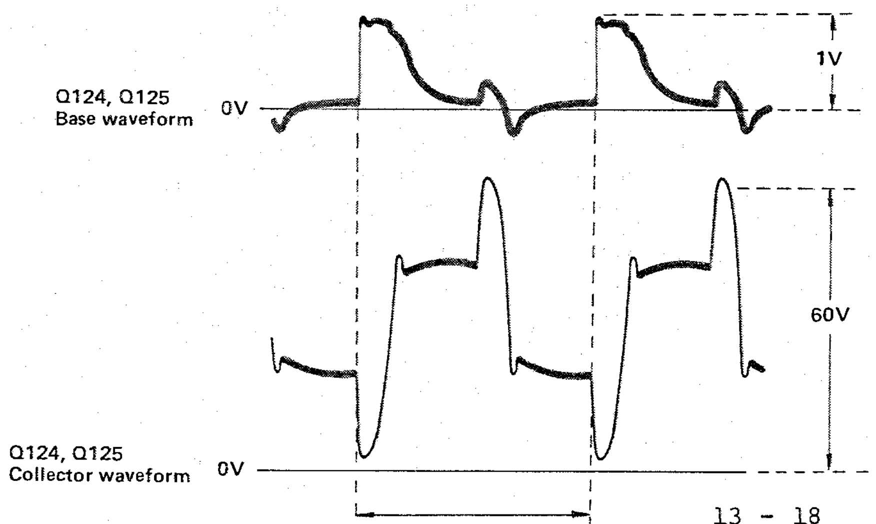
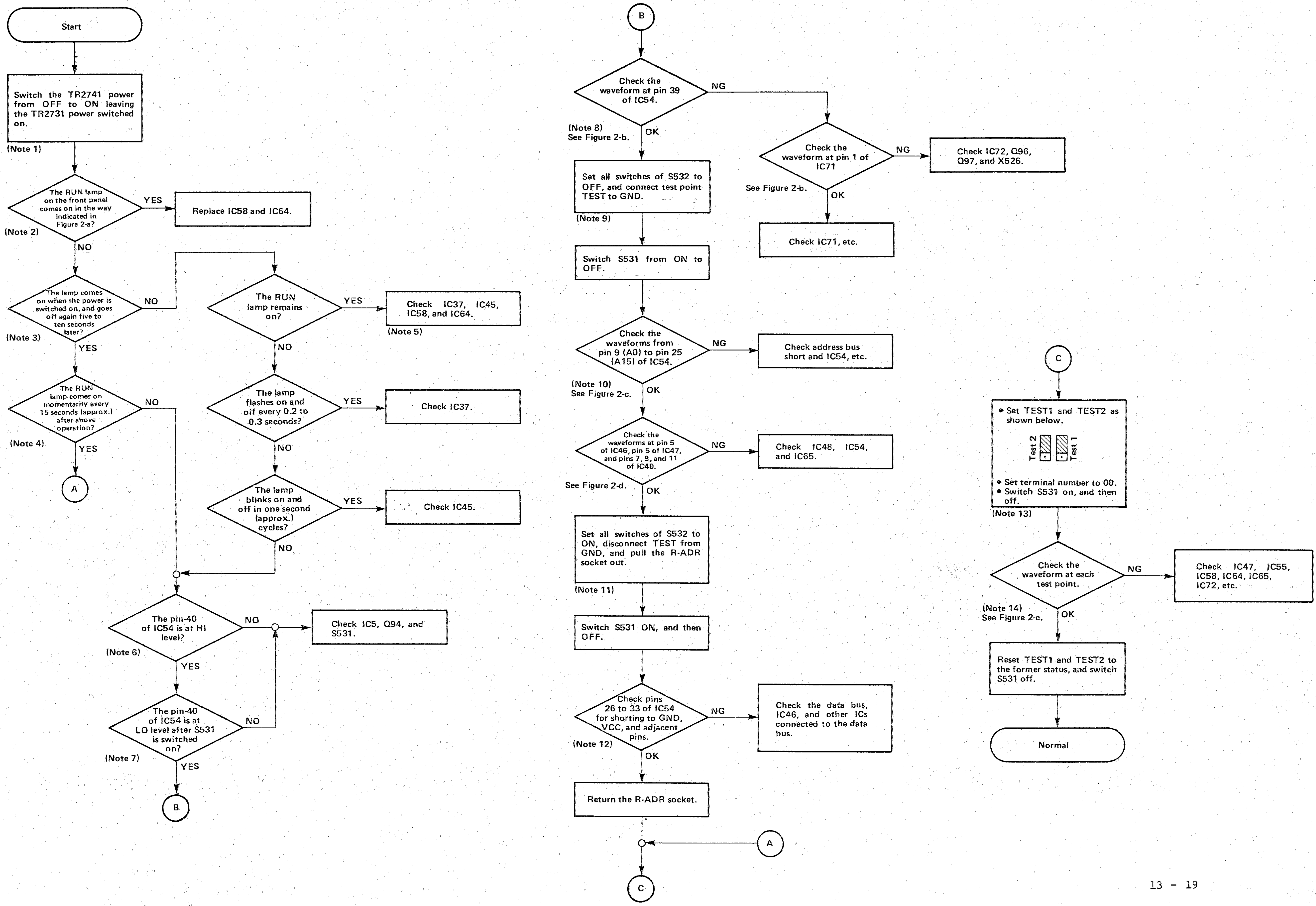


Fig. 1-a

CHART 2 CPU


Start
Switch the TR2741 power from OFF to ON leaving the TR2731 power switched on.
(Note 1)
The RUN lamp on the front panel comes on in the way indicated in Figure 2-a?
(Note 2)
YES
Replace IC58 and IC64.
NO
The lamp comes on when the power is switched on, and goes off again five to ten seconds later?
(Note 3)
NO
The RUN lamp remains on?
YES
Check IC37, IC45, IC58, and IC64.
(Note 5)
NO
The lamp flashes on and off every 0.2 to 0.3 seconds?
YES
Check IC37.
NO
The lamp blinks on and off in one second (approx.) cycles?
YES
Check IC45.
NO
YES
The RUN lamp comes on momentarily every 15 seconds (approx.) after above operation?
(Note 4)
NO
YES
A
The pin-40 of IC54 is at HI level?
(Note 6)
NO
Check IC5, Q94, and S531.
YES
The pin-40 of IC54 is at LO level after S531 is switched on?
(Note 7)
NO
YES
B
B
Check the waveform at pin 39 of IC54.
(Note 8)
See Figure 2-b.
NG
Check the waveform at pin 1 of IC71
See Figure 2-b.
NG
Check IC72, Q96, Q97, and X526.
OK
Check IC71, etc.
OK
Set all switches of S532 to OFF, and connect test point TEST to GND.
(Note 9)
Switch S531 from ON to OFF.
Check the waveforms from pin 9 (A0) to pin 25 (A15) of IC54.
(Note 10)
See Figure 2-c.
NG
Check address bus short and IC54, etc.
OK
Check the waveforms at pin 5 of IC46, pin 5 of IC47, and pins 7, 9, and 11 of IC48.
See Figure 2-d.
NG
Check IC48, IC54, and IC65.
OK
Set all switches of S532 to ON, disconnect TEST from GND, and pull the R-ADR socket out.
(Note 11)
Switch S531 ON, and then OFF.
Check pins 26 to 33 of IC54 for shorting to GND, VCC, and adjacent pins.
(Note 12)
NG
Check the data bus, IC46, and other ICs connected to the data bus.
OK
Return the R-ADR socket.
A
C
C
• Set TEST1 and TEST2 as shown below.
Test 2
Test 1
• Set terminal number to 00.
• Switch S531 on, and then off.
(Note 13)
Check the waveform at each test point.
(Note 14)
See Figure 2-e.
NG
Check IC47, IC55, IC58, IC64, IC65, IC72, etc.
OK
Reset TEST1 and TEST2 to the former status, and switch S531 off.
Normal

Note 1: Since IC54, IC58, and IC64 use sockets, replace them with spares (if available) before starting the test.

Note 2: The program to check the integrated ROM/RAM is activated when the power is switched on. This test is for checking the ROM.

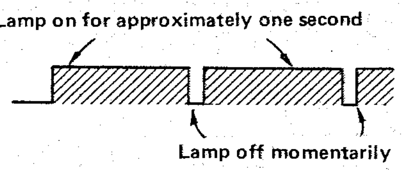


Fig. 2-a

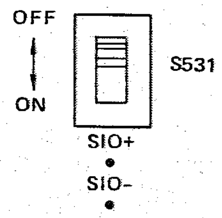
Note 3: This test is for checking the RAM.

Note 4: The lamp does not come on when the serial I/O is not activated. It is used to indicate that auto-calibration is being executed.

Note 5: Defects in the CPU (IC54) or ROM (IC58 and IC64) can result in completely unexpected operations. The block tests referred to in notes 2 and 3 are used only to check for partial defects in the CPU and ROM.

Note 6: Pin 40 of IC54 is the master reset line.

Note 7: S531 is the manual-reset switch. The on/off status is indicated below.



Note 8: The CPU clock is 4 MHz with a 2:1 duty cycle.

Note 9: The test point TEST is located on the lower left side of IC65.

Note 10: Since the data bus reads the NOP command under all circumstances, the CPU simply increments the address.

Note 11: The R-ADR is located on the left hand side of IC54, and can be disconnected by pulling the blue socket up.

Note 12: Check the IC pins by oscilloscope.

Note 13: Start the program for output of 0 to FF data for all devices.

Note 14: 0_5 may be used as the trigger.

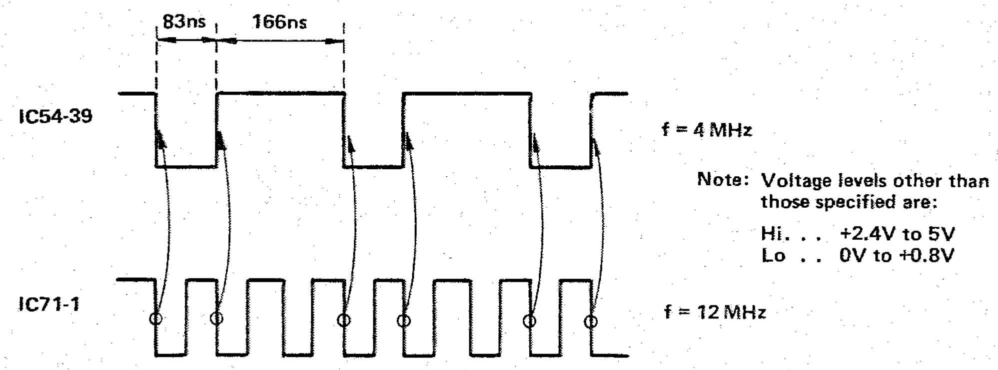


Figure 2-b

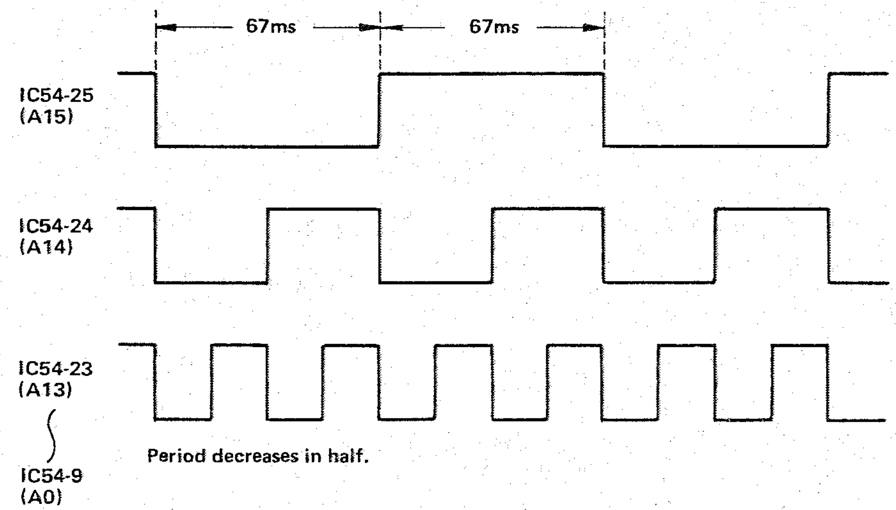


Figure 2-c

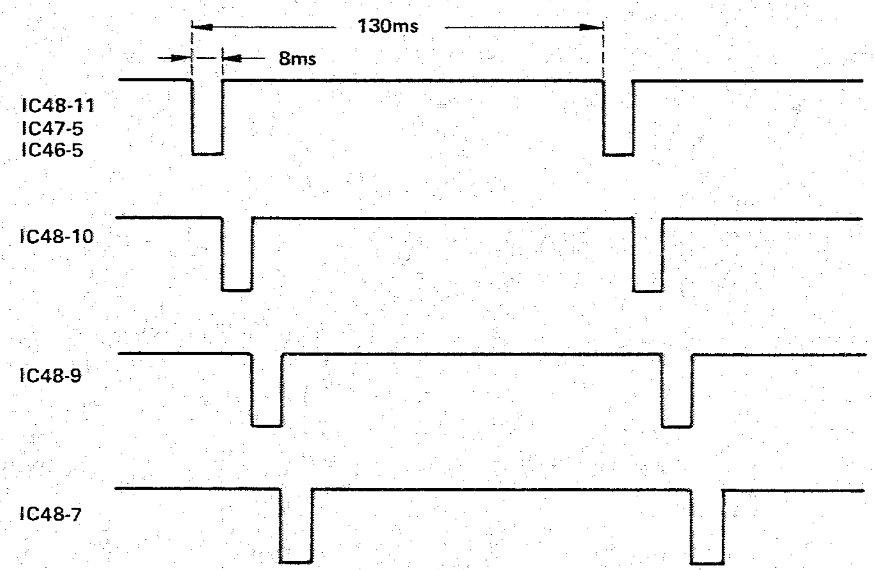


Figure 2-d

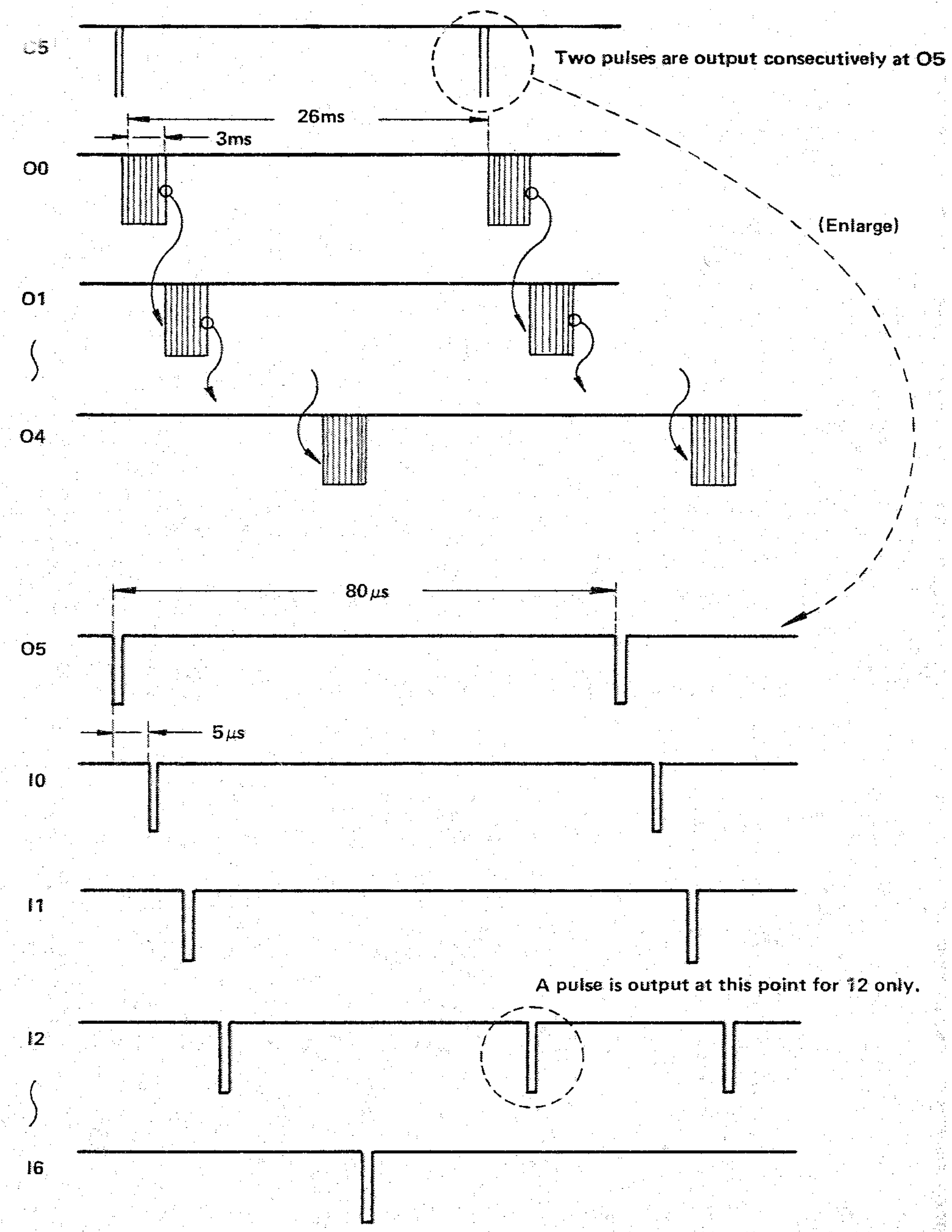
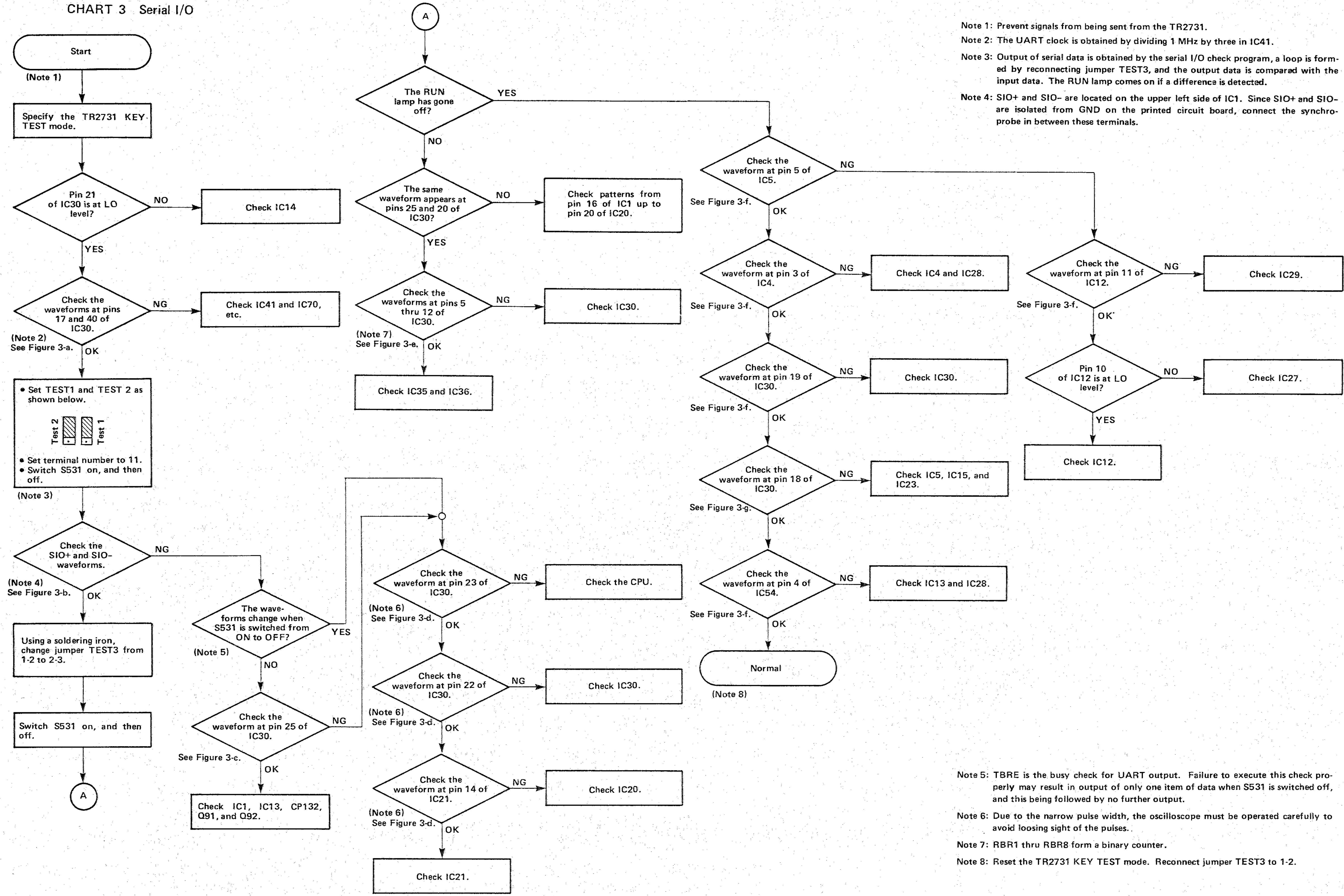


Figure 2-e

CHART 3 Serial I/O



Note 1: Prevent signals from being sent from the TR2731.

Note 2: The UART clock is obtained by dividing 1 MHz by three in IC41.

Note 3: Output of serial data is obtained by the serial I/O check program, a loop is formed by reconnecting jumper TEST3, and the output data is compared with the input data. The RUN lamp comes on if a difference is detected.

Note 4: SIO+ and SIO– are located on the upper left side of IC1. Since SIO+ and SIO– are isolated from GND on the printed circuit board, connect the synchro-probe in between these terminals.

Note 5: TBRE is the busy check for UART output. Failure to execute this check properly may result in output of only one item of data when S531 is switched off, and this being followed by no further output.

Note 6: Due to the narrow pulse width, the oscilloscope must be operated carefully to avoid loosing sight of the pulses.

Note 7: RBR1 thru RBR8 form a binary counter.

Note 8: Reset the TR2731 KEY TEST mode. Reconnect jumper TEST3 to 1-2.

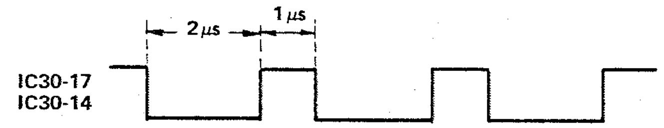


Figure 3-a

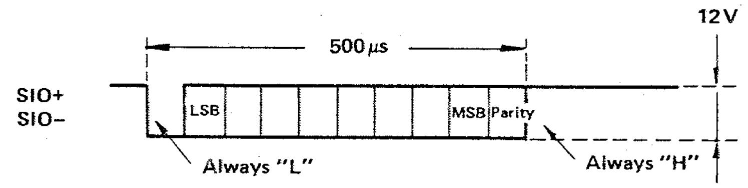


Figure 3-b

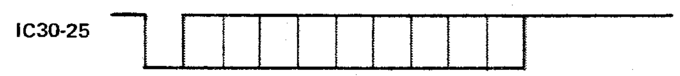


Figure 3-c

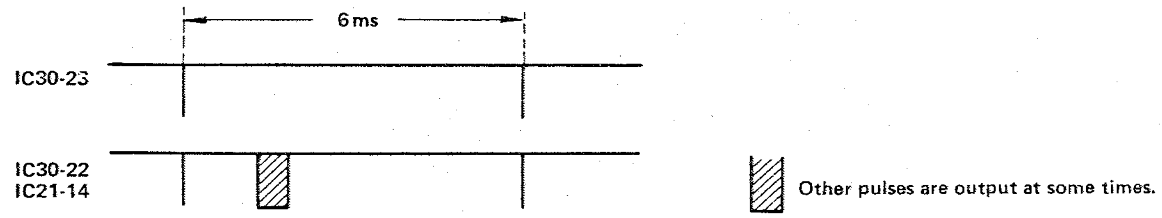


Figure 3-d

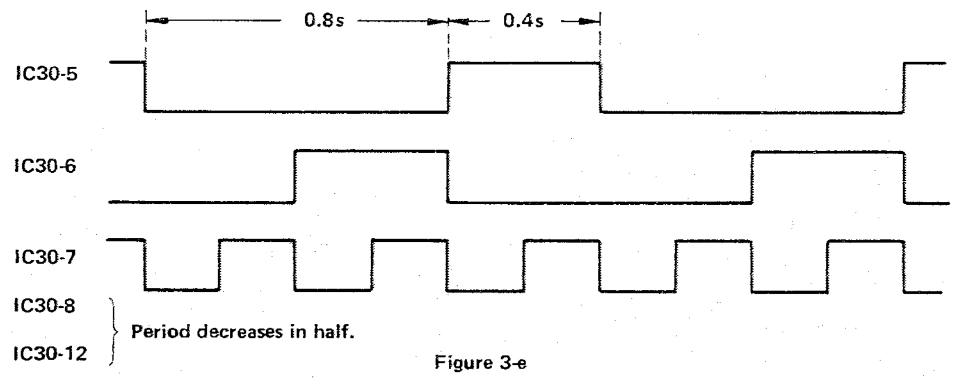


Figure 3-e

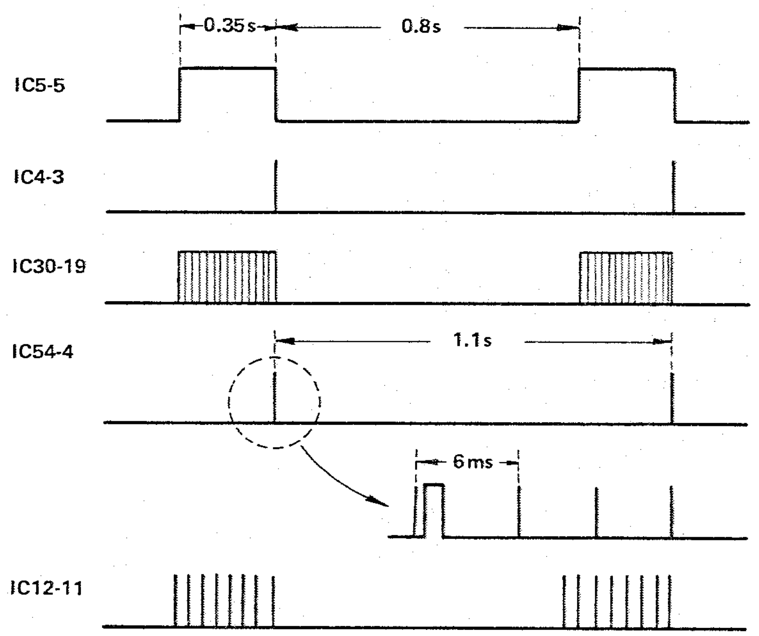


Figure 3-f

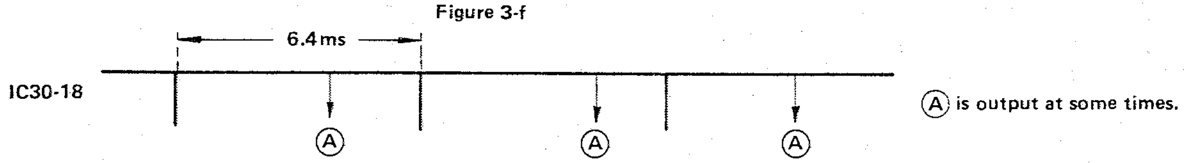
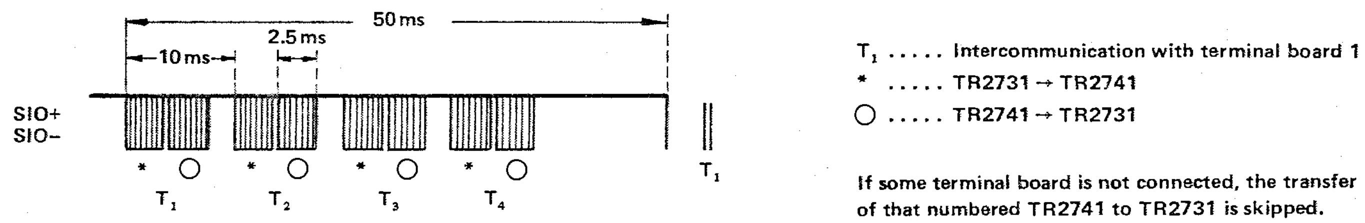
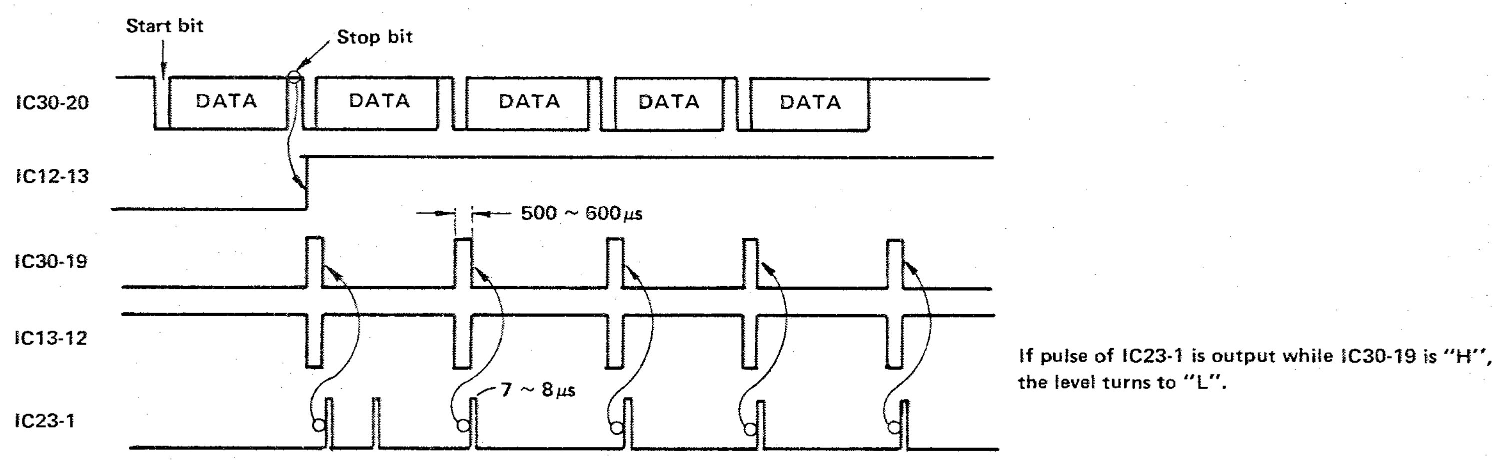


Figure 3-g

Serial I/O timing chart





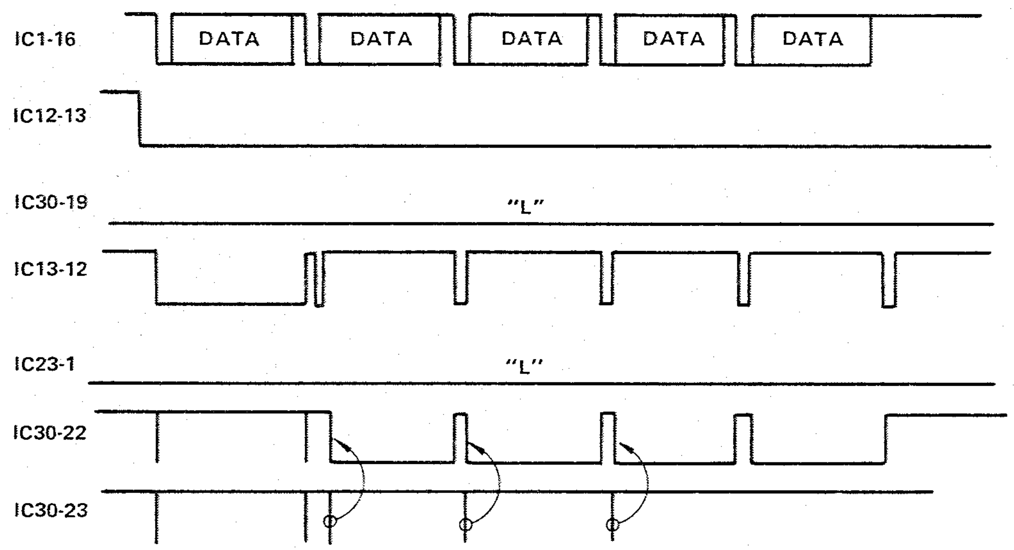
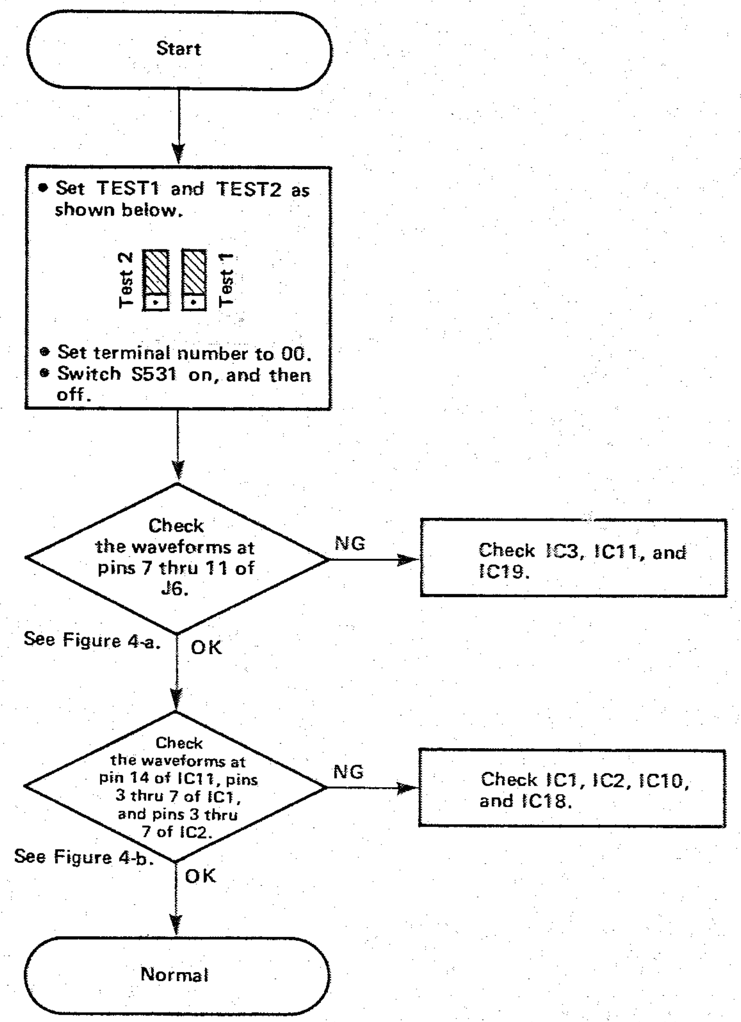


CHART 4 Scanner Control



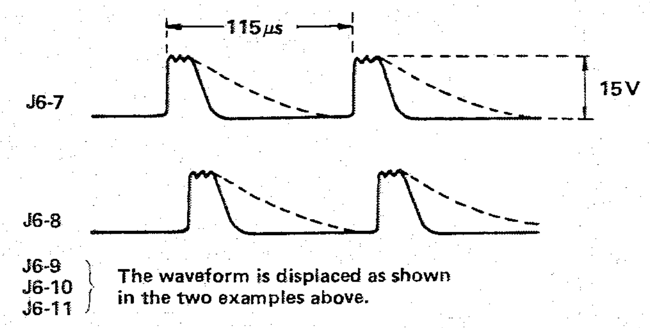


Figure 4-a

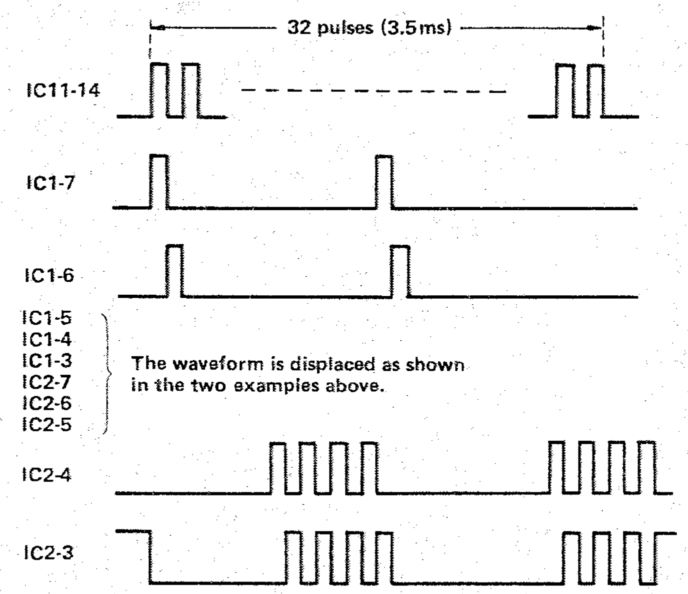


Figure 4-b

CHART 5-1 Analog and Analog Control

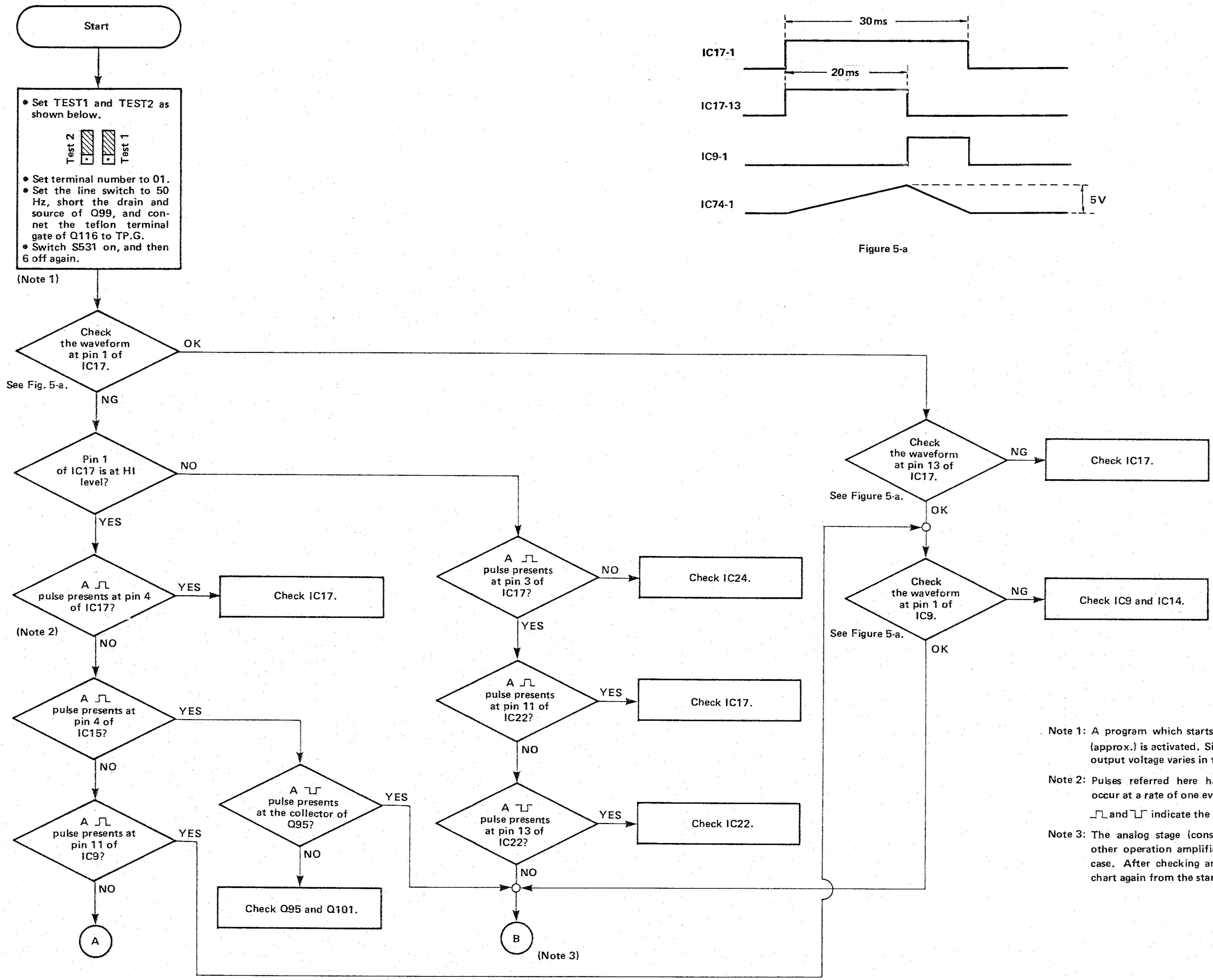
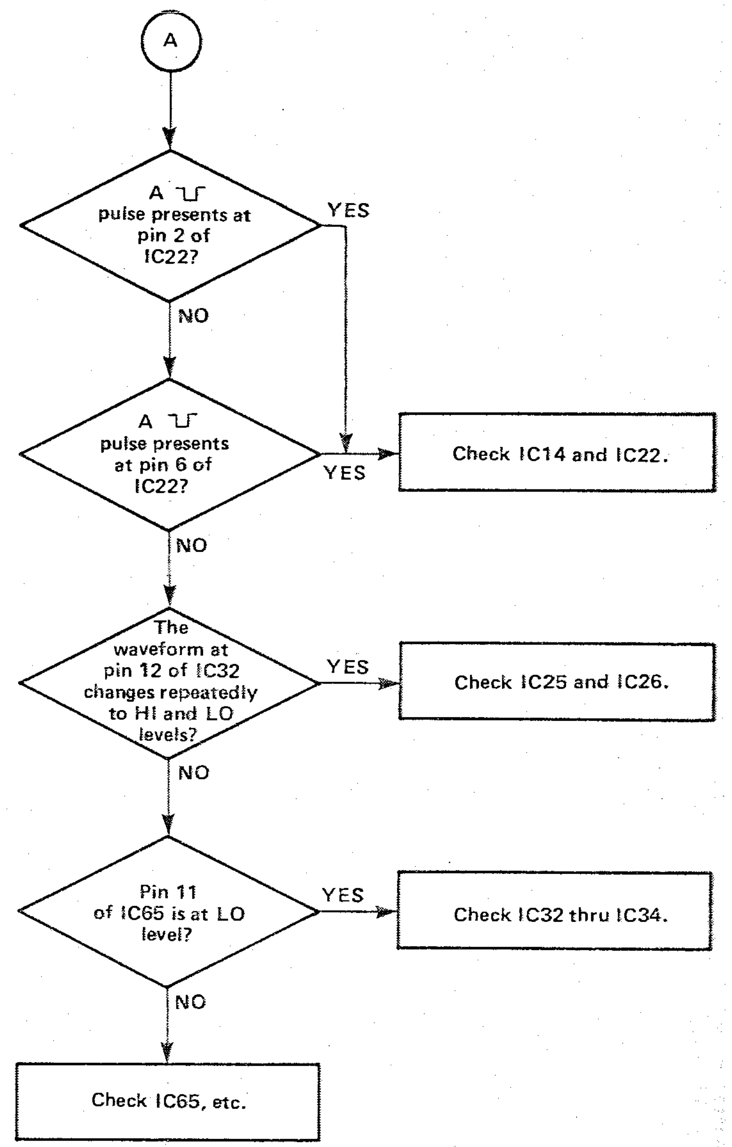


Figure 5-a



Note 1: A program which starts the A/D converter every two seconds (approx.) is activated. Since the input is shorted, the integrator output voltage varies in the 0 V to 5 V range.

Note 2: Pulses referred here have a pulse width of several μs, and occur at a rate of one every two seconds (approx.).
⎍ and ⊔ indicate the polarity.

Note 3: The analog stage (consisting of Q116, IC73 thru IC75, and other operation amplifiers) is thought to be defective in this case. After checking analog circuitry from Ⓐ on, check this chart again from the start.

CHART 5-2 Analog and Analog Control

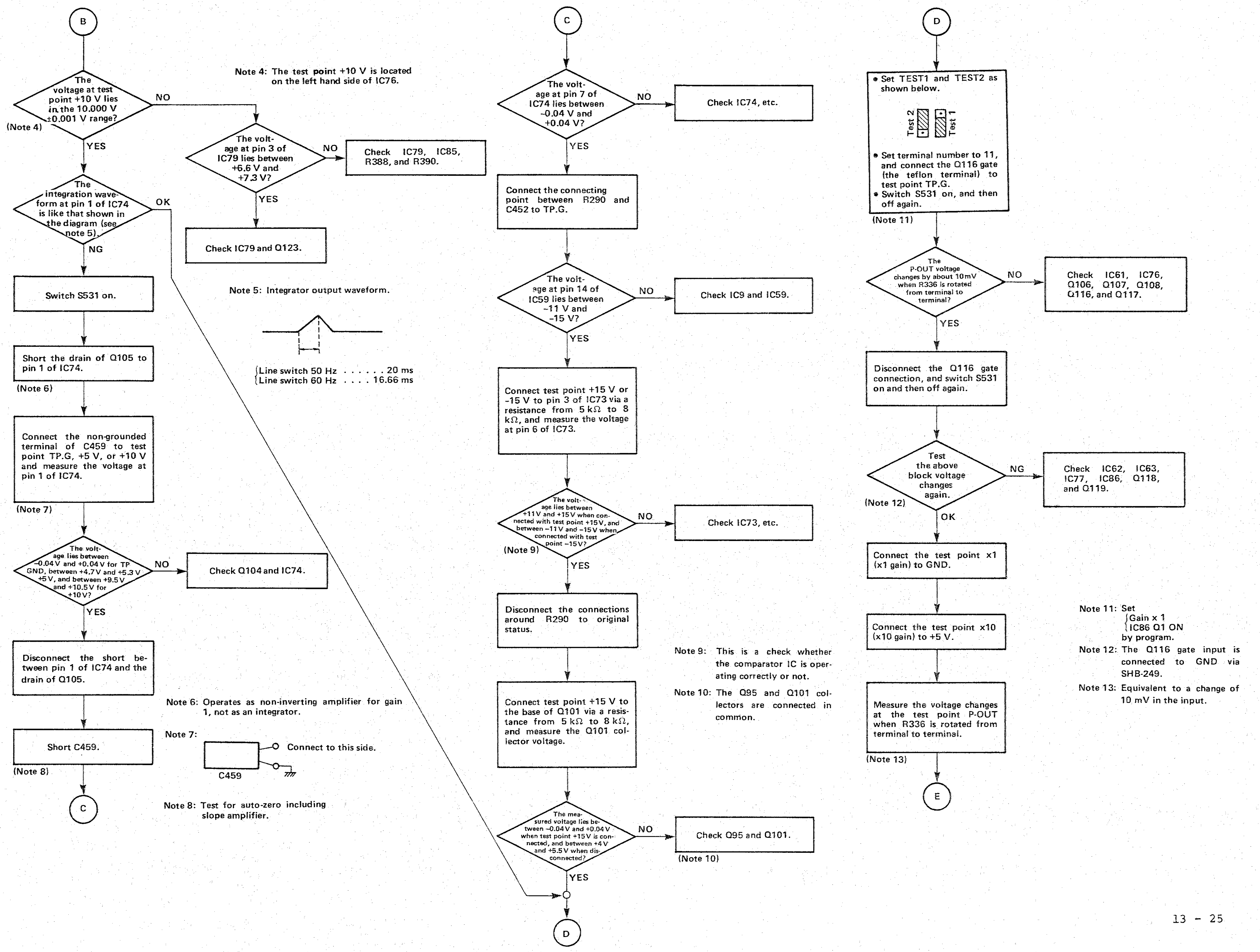
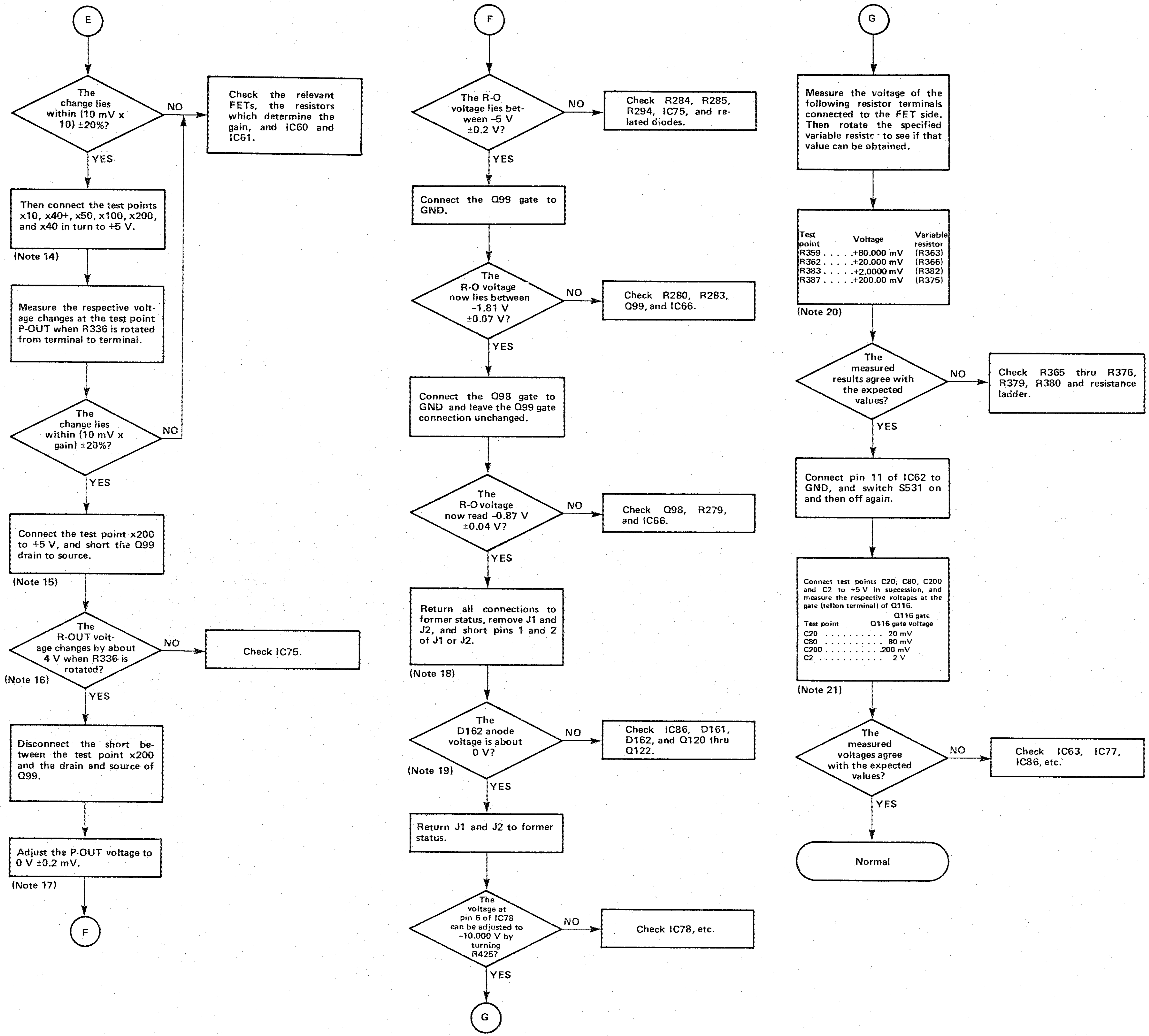


CHART 5-3 Analog and Analog Control



Note 14: These test points are located in the following positions.
- x1 (above IC55)
- x10 (right hand side of IC55)
- x40+ (below IC50)
- x50 (below IC50)
- x100 (below IC50)
- x200 (upper right of IC62)
- x40 (lower left of IC44)

Note 15: The input amplifier output voltage = 10 mV x 200 = 2 V.
The R-OUT voltage (offset amplifier output) = 2 V x 2 = 4 V

Note 16: R-OUT is located on the left hand side of IC75.

Note 17: P-OUT is located on the upper right side of IC76.

Note 18: This involves disconnecting the following connections.
- Test point x1 to GND.
- Q98 gate to GND.
- Q99 gate to GND.

Note 19: This is a check to see that the input protection circuit is operating normally.

Note 20: This is a check to see that the reference voltages are correctly generated.

Note 21: Test point locations.
- C20 (upper right of IC52)
- C80 (above IC56)
- C200 (upper right of IC57)
- C2 (upper right of IC52)

A/D timing chart and program operation

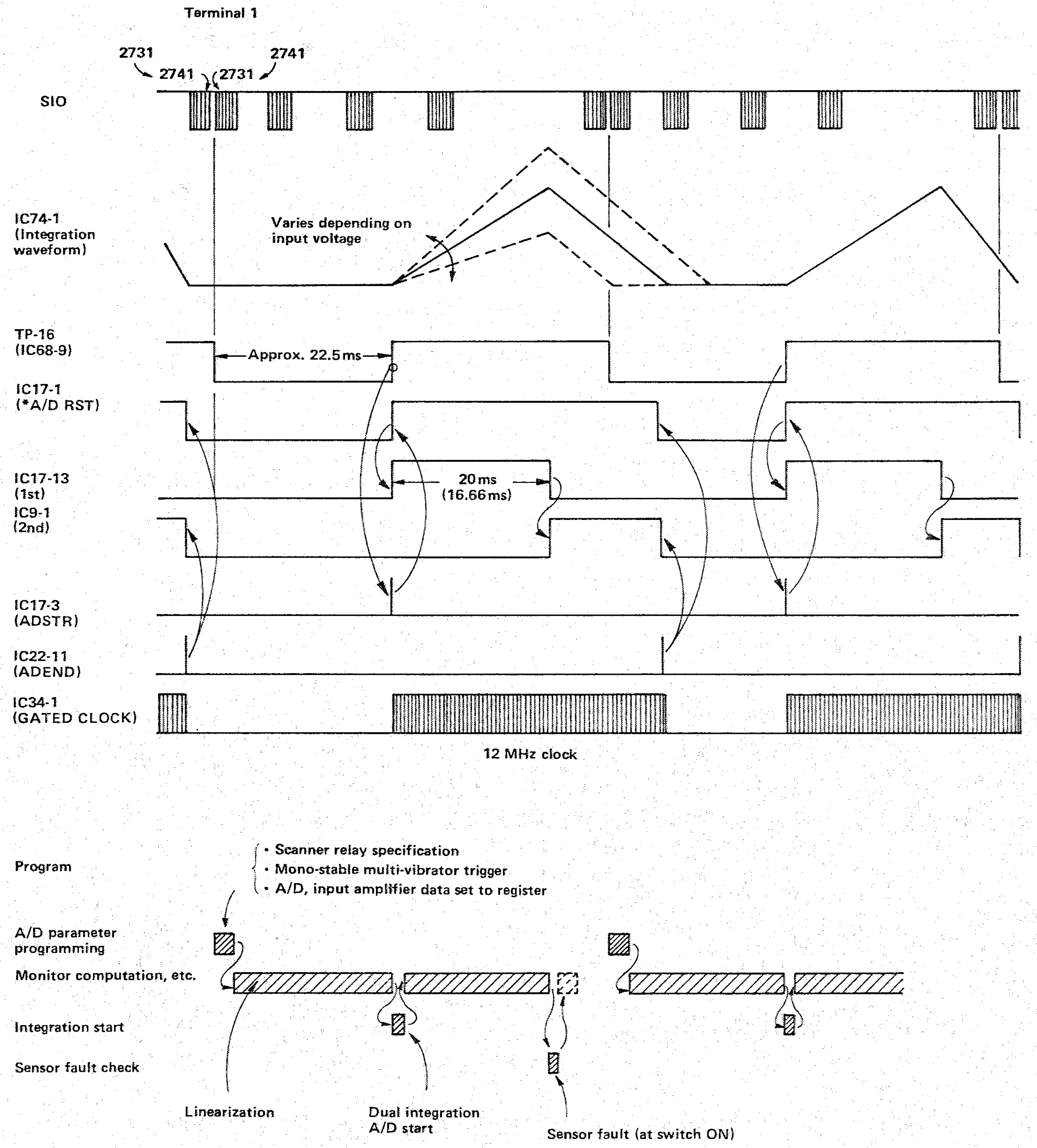
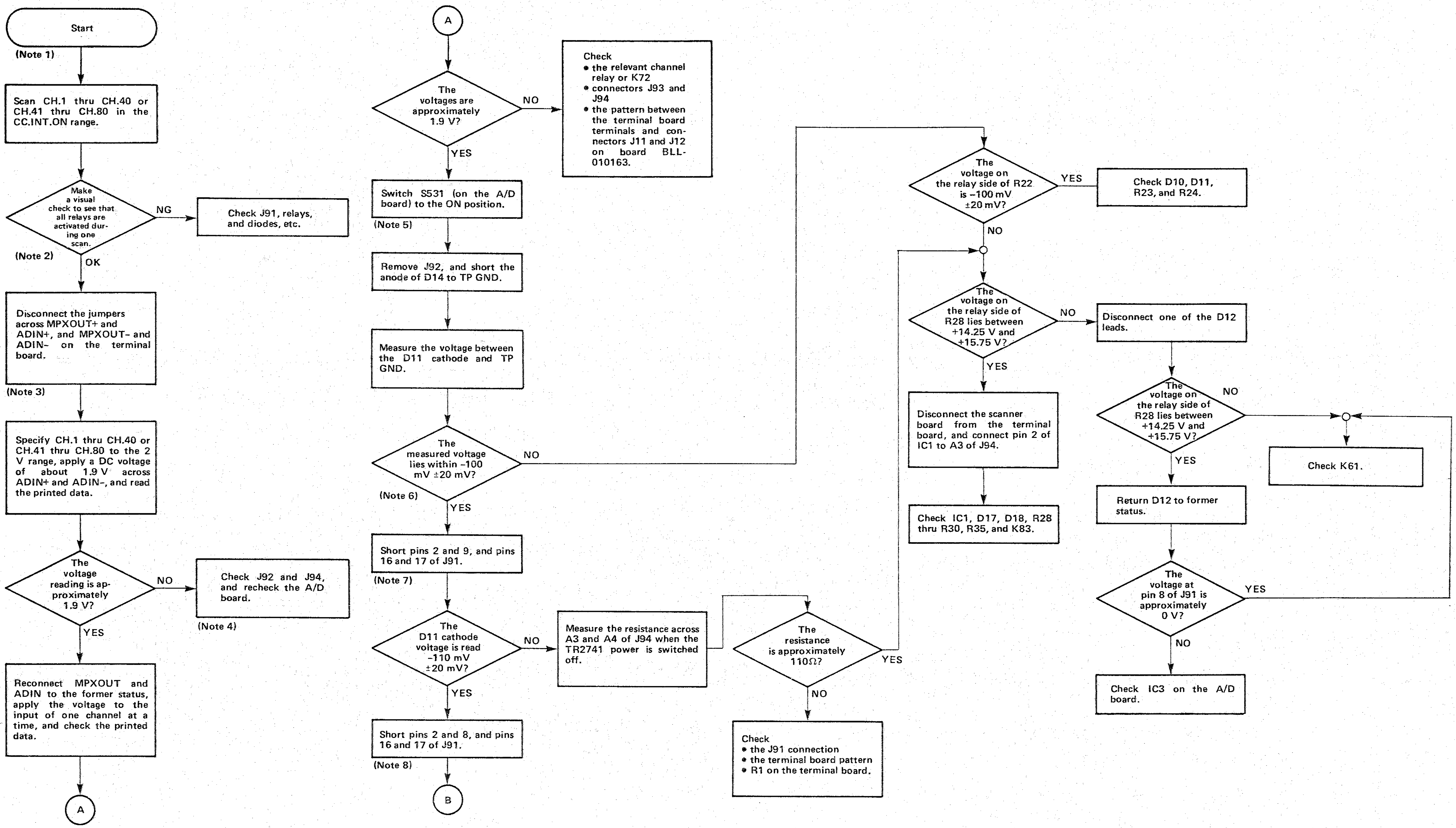
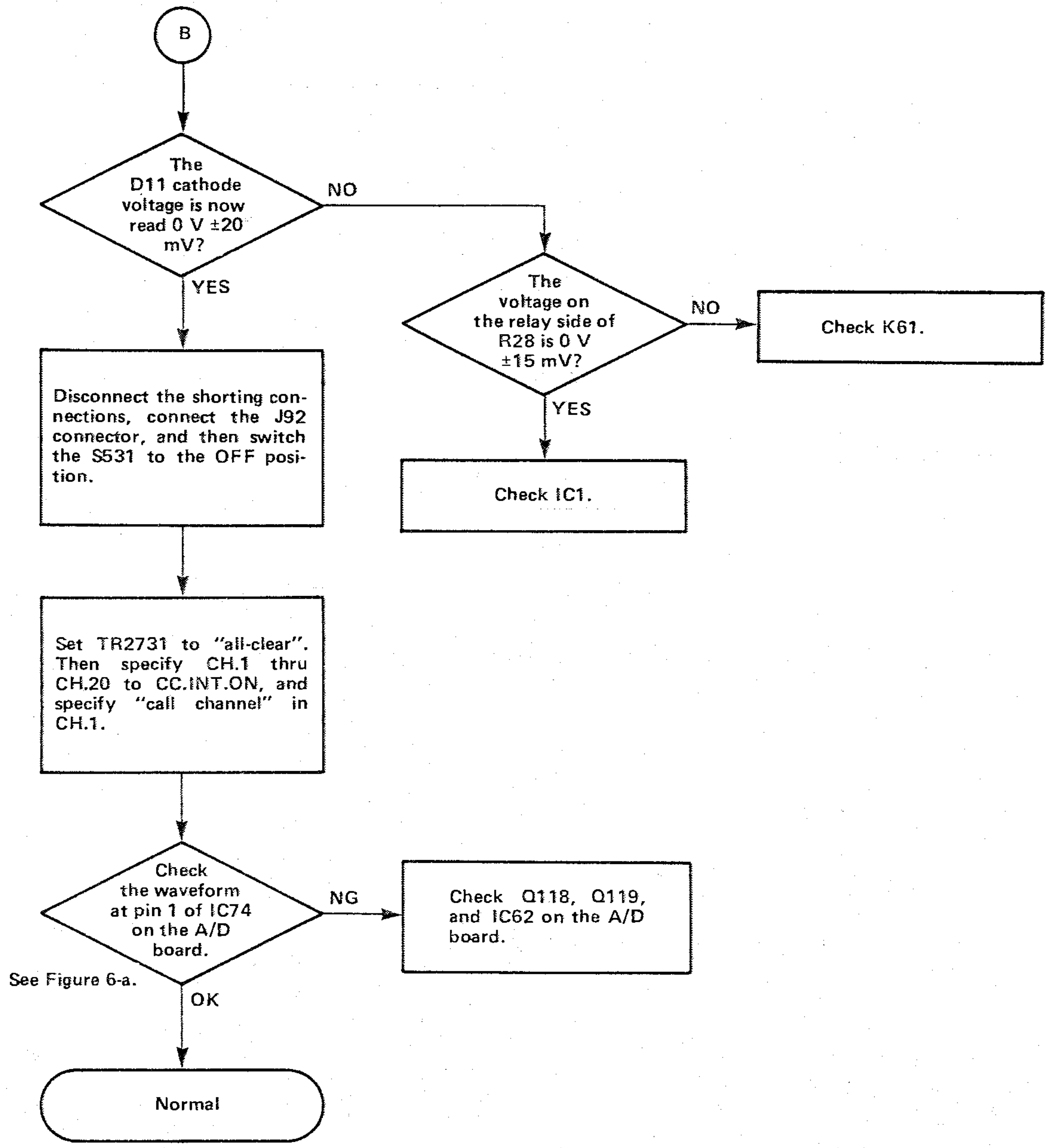


CHART 6-1 Thermocouple Voltage Scanner (TR2741A/B/E)





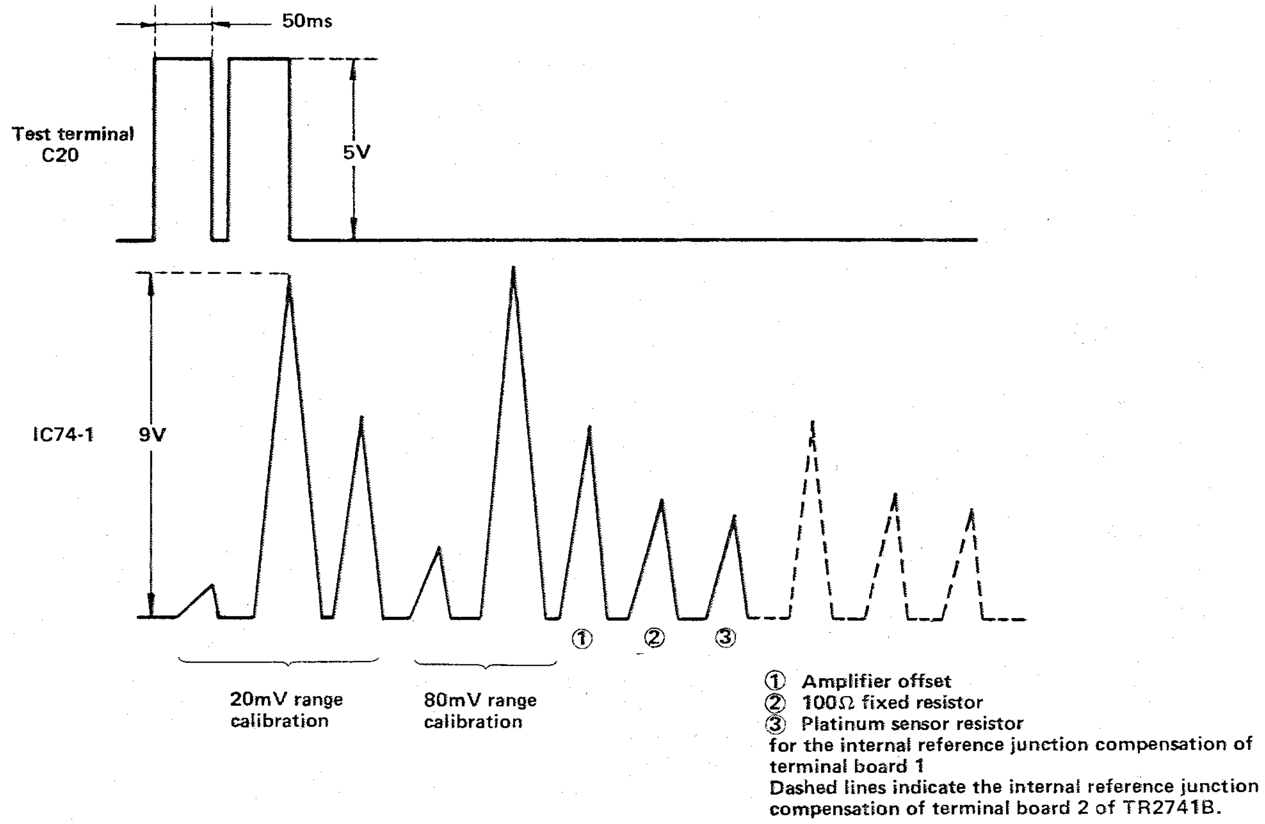


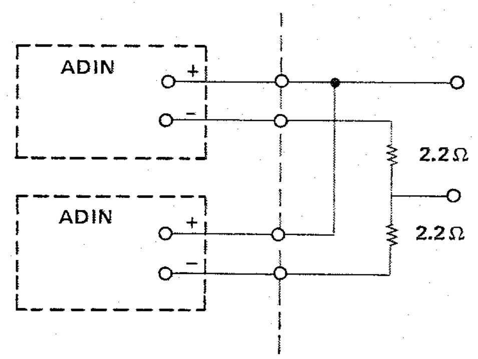
Figure 6-a

Note 1: The board to be checked is BLG-010165 (TC SCANNER board).

Note 2: K83 is activated during calibration of scanning start.
Subsequent operation occurs at every second relay from K62 up to CH. 20. K72 is then activated from CH. 21, followed by scanning operation at every second relay from K62 up to CH.80.

Note 3: Voltage is applied directly to the A/D converter without being passed via a relay.

Note 4: When two terminal boards are used (TR2741B/E).



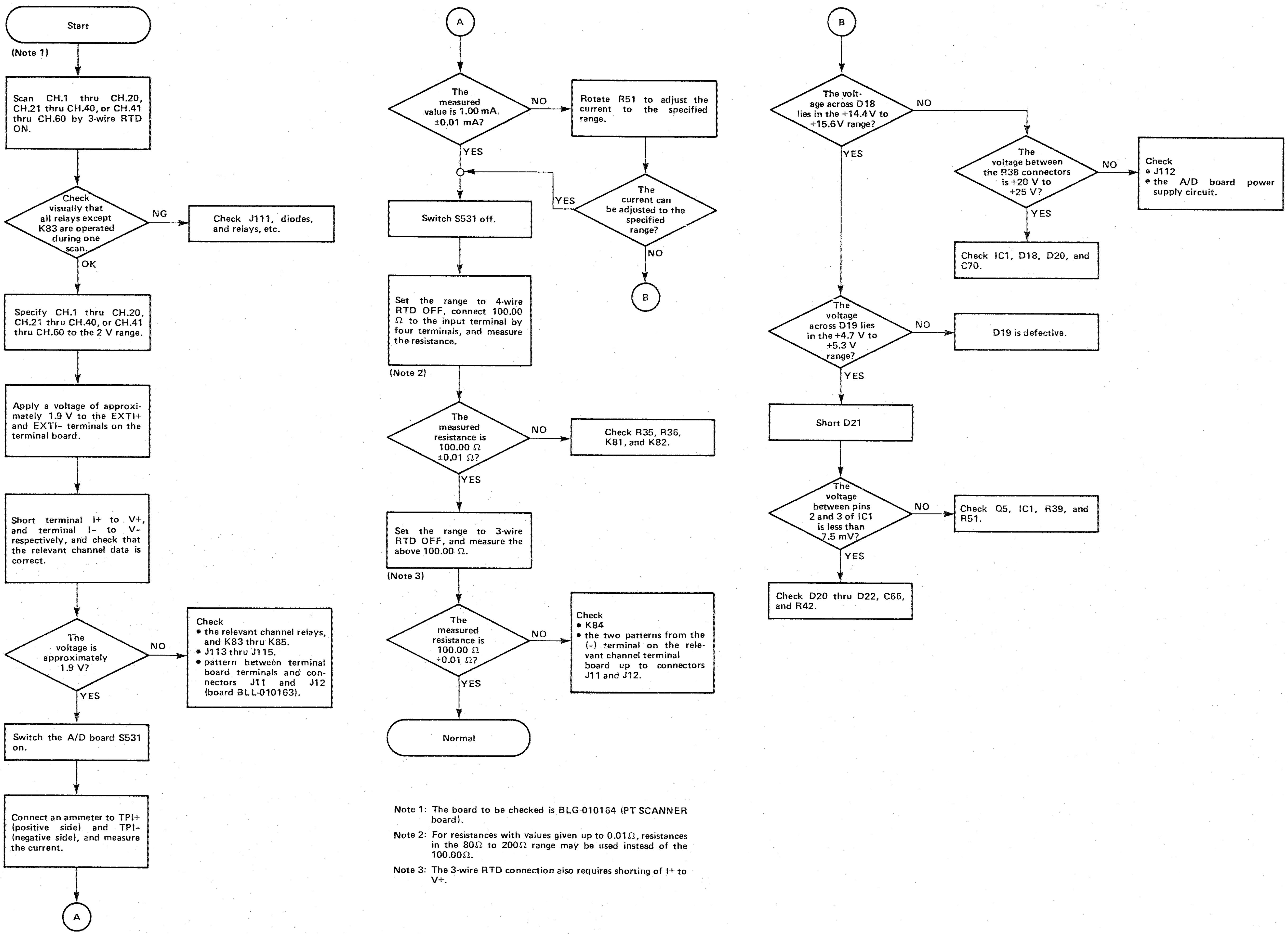
Note that ADIN is connected inside the A/D board. Also note that J1 of the A/D board must be inserted in J92 of either terminal board. If not properly inserted, the program may fail to operate correctly.

Note 5: S531 is the CPU reset switch which makes all control disabled when switched on. Resetting at this stage is used to prevent automatic calibration every 15 seconds.

Note 6: 100Ω x 1 mA ± OFFSET ≒ 100 mV ±20mV.

Note 7: K83 is forced on.

Note 8: K61 is also forced on.



Note 1: The board to be checked is BLG-010164 (PT SCANNER board).

Note 2: For resistances with values given up to 0.01Ω, resistances in the 80Ω to 200Ω range may be used instead of the 100.00Ω.

Note 3: The 3-wire RTD connection also requires shorting of I+ to V+.

13-7. PRINCIPLES OF THE TR2731 COMPUTING DATA LOGGER OPERATION

13-7-1. Description of Each Section Operation

The block diagram for the TR2731 is outlined in Figure 13-18. The operation of each section is described below.

(1) CPU

The μCPU used is equivalent to a 6800 type 8-bit microcomputer LSI.

(2) Clock pulse generator (CPG)

Based on a 4 MHz quartz resonator, the CPG generates two-phase clock pulses (ø1 and ø2) for CPU drive purposes, and also synchronizes the control signals during DMA (Direct Memory Access) transfer.

(3) Clock divider circuit

Generation of timing pulses (10 ms) for the base of TR2731 operation, buzzer clocks (4 kHz), and also heater power supply pulses for fluorescent display tube drive purposes.

(4) Address decoder

Input and output signals used in the TR2731 are decoded from the address bus and obtained as single line signals.

(5) DMA control circuit for data transfer

Input and output to and from the memory are executed by using DMA during data transfer with the TR2741. Operation can be made independently of program control.

(6) Data transfer circuit

Fixed area data in the memory is converted to serial data by control signal from the DMA control circuit, and then transferred. And serial data from the TR2741 is converted to 8-bit parallel data and stored in the fixed area of the memory.

(7) Power failure protection and time counting circuit

In addition to protecting the CMOS RAM storage contents during a power failure, this circuit also measures the duration of the power failure. The circuit is driven by a built-in battery which also involves the use of a 32.768 kHz quartz resonator.

(8) Memory

The TR2731 integrates an 8K byte RAM (of which 4K byte are protected by the back-up battery), and a 48K byte ROM as standard performance.

Address	0000 to 0FFF	RAM
	2000 to 2FFF	RAM (CMOS)
	4000 to FFFF	ROM

(9) Display circuit and DMA control circuit for display

Using a 5 x 7 dot 16-digit fluorescent display tube, displays are obtained by memory fixed area correspondence to the display dot pattern with DMA execution according to CPU timing which does not involve the address bus or data bus.

(10) Key switches and LEDs

The key input section is connected to the CPU bus by encoder LSI. This LSI register is also used for dynamic drive of corresponding key switch LEDs and status display LEDs.

(11) Printer

This thermal printer drive circuit includes a built-in memory for storing dot patterns for one line of printing. The circuit also covers printing speed and synchronization.

(12) Option card slots

In addition to TR2730-010, the 510, 520, 530, 540, 550, 560, 570, and 580 option card connecting slots plus data bus and address bus control lines are also available.

(13) Power supply

The voltages (and consumption currents) used by the TR2731 are listed below.

a.	+5 V	3 A	Logic IC, Vcc
b.	+24 V	1 A	Thermal printer
c.	+35 V	1 A	TR2741 sensor terminal
d.	12 V	150 mA	Data transfer line between TR2731 and TR2741
e.	+12 V	300 mA	Option card
f.	−12 V	100 mA	Option card
g.	+37 V	60 mA	Display
h.	8 V	60 mA	Display

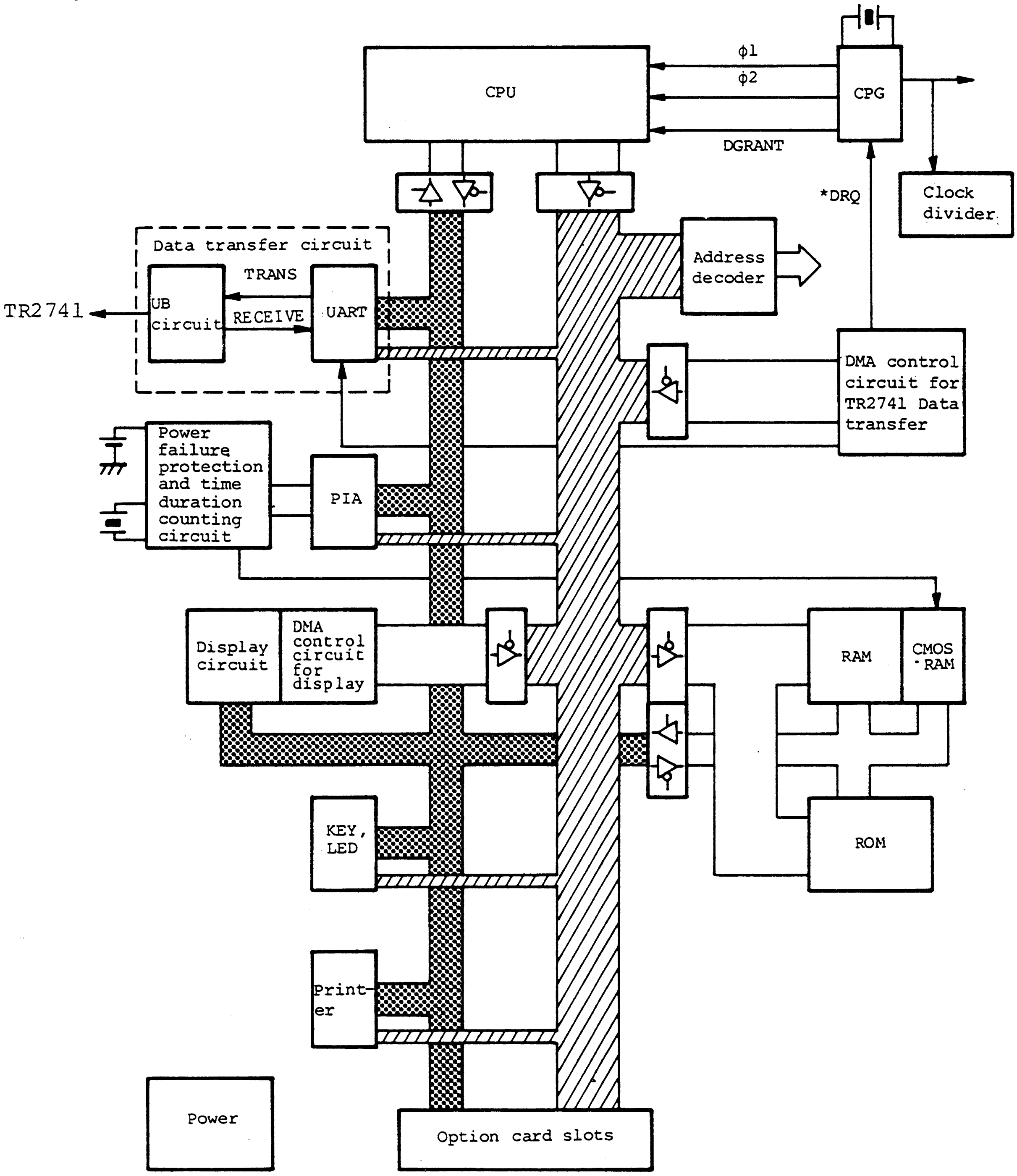
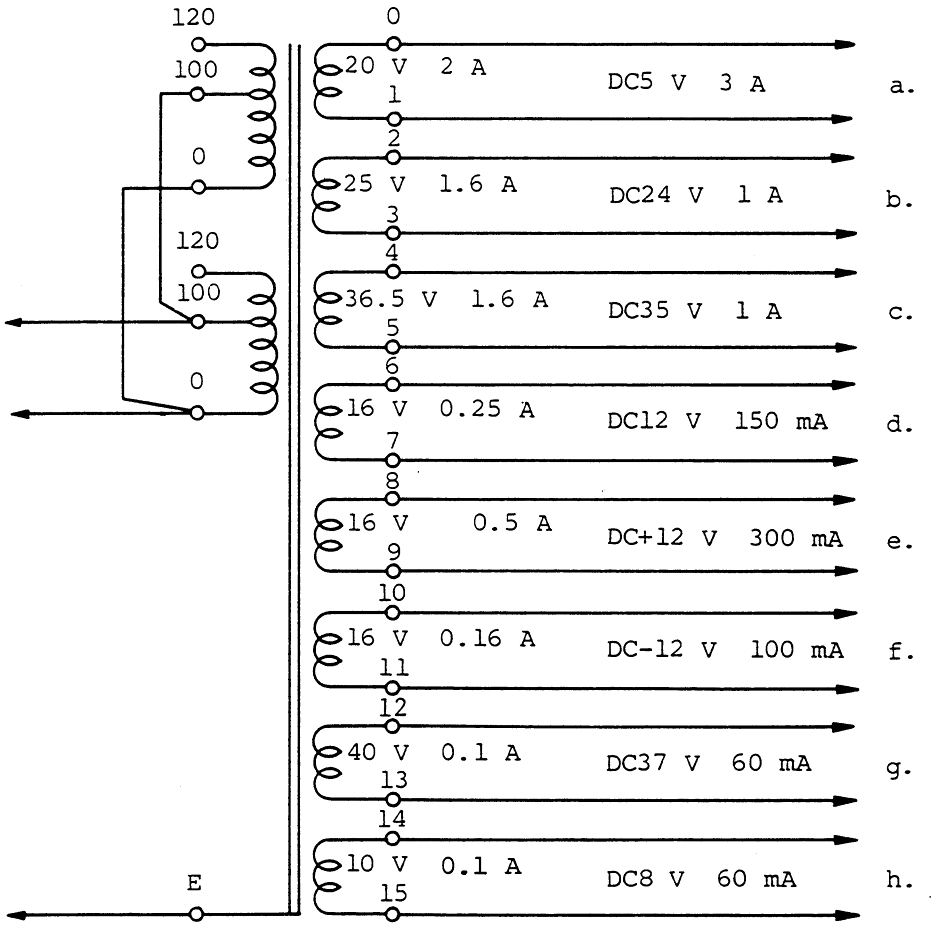


Fig. 3-18 TR2731 block diagram



13-7-2. Outline of Operation

Up to four TR2741 units can be connected to one TR2731 unit. The TR2741 measuring channel number and range are specified by the TR2731. The result of the measurement is received from the TR2741 and calculated in the TR2731.

The data transfer timing with the TR2741 is outlined in Figure 13-19.

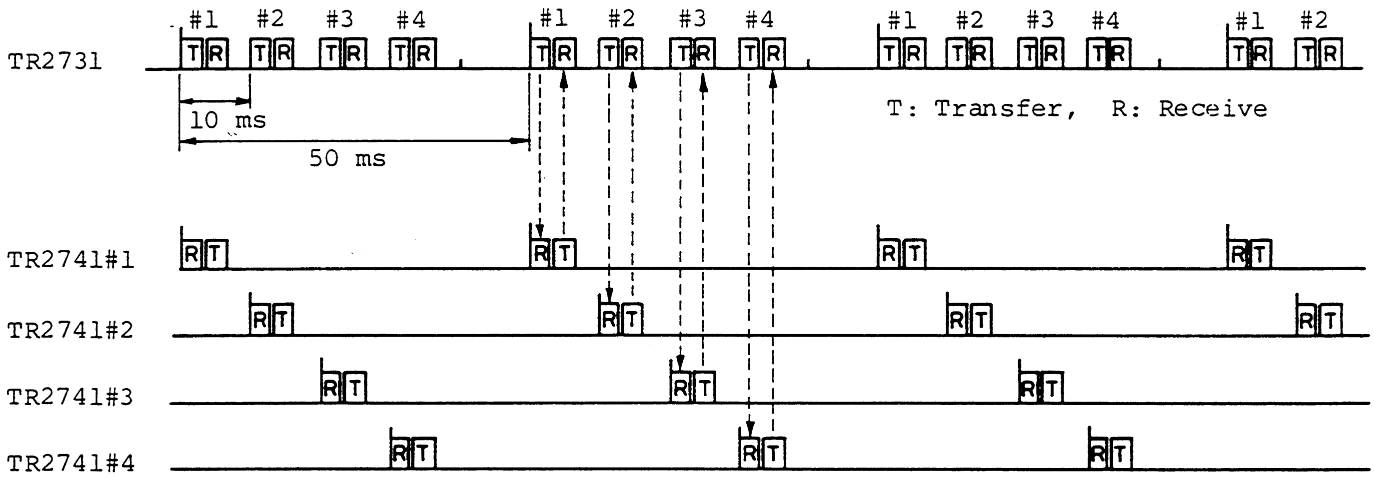


Fig. 13-19 Data transfer timing

Although the TR2741 #1 and #2, #2 and #3, and #3 and #4 are displaced by 10 ms from each other, operation within each TR2741 unit is identical.

All operations in the TR2731 are controlled by software program. The configuration concept of software is outlined below.

OS (Operating System)

MAIN (time relations control program)

PROG (condition setting program)

SCAN (measuring commands passed to the TR2741, and data reception program)

PROC (data processing and calculating program)

PRINT (data printing and output program)

Each program operates independently (as is shown in Figure 13-20), the overall operation being regulated by the OS.

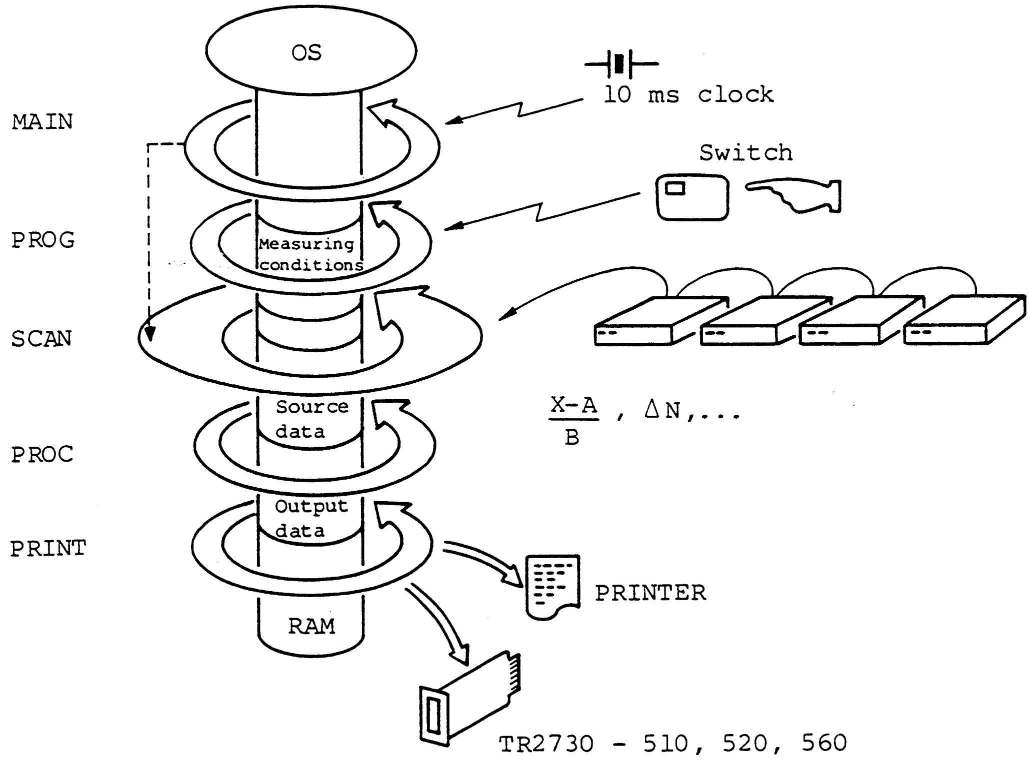


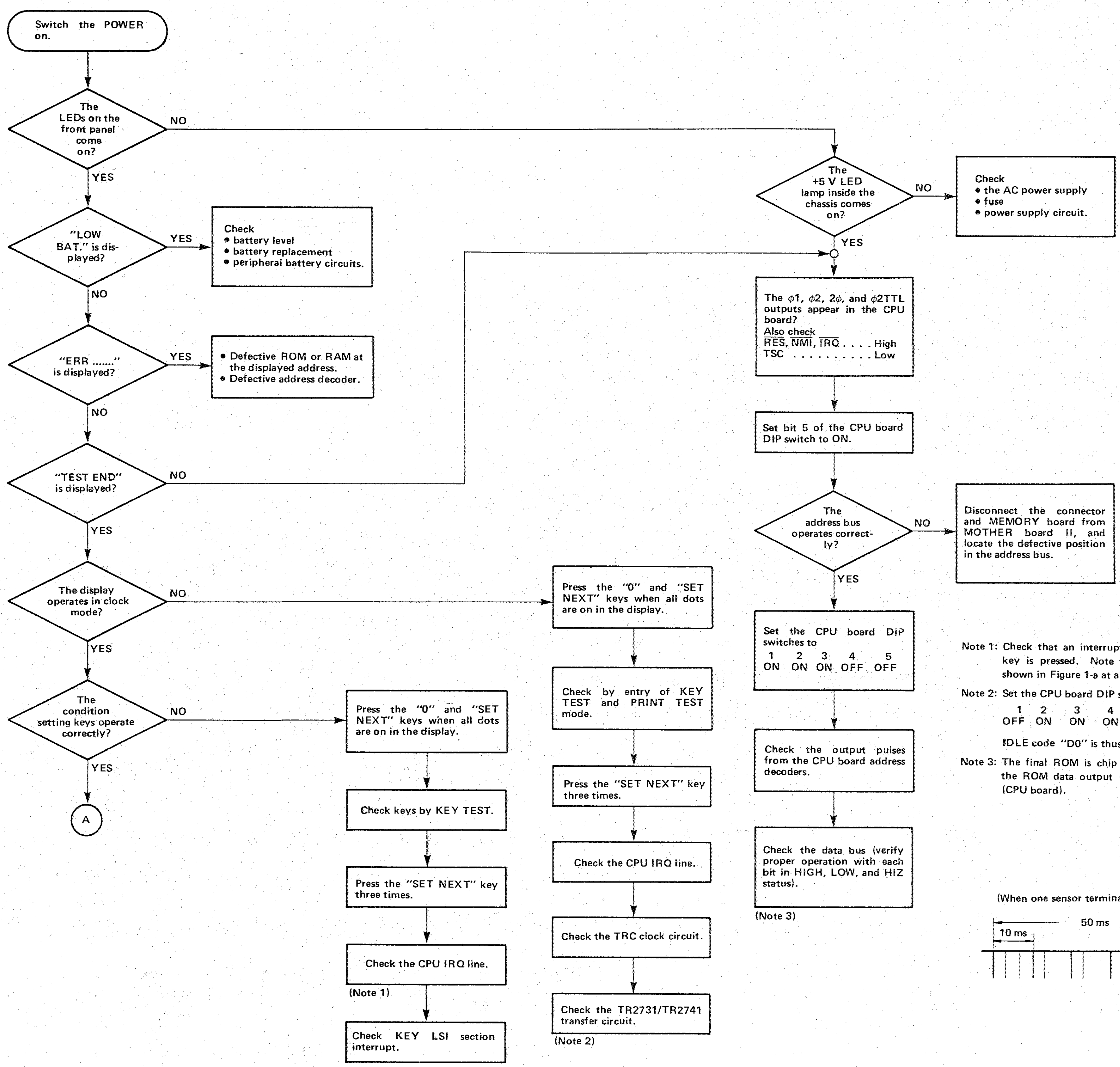
Fig. 13-20 Operation outline between programs

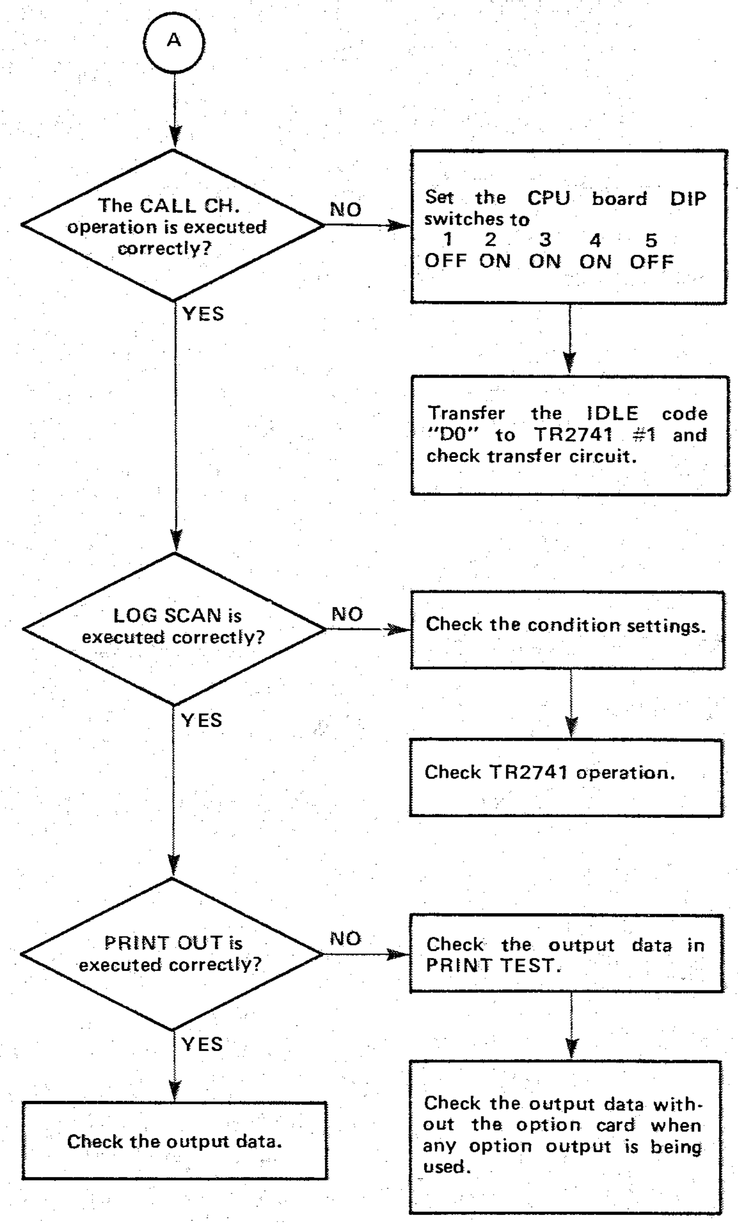
Commands are passed to and measured results are received from the TR2741 (in accordance with preset conditions) by clock pulse generated every 10 ms. Immediately upon reception of the data, that data is subject to calculations by the processing program, and immediately upon completion of arithmetic processing of the data, that data is passed out by the output program.

13-8. TR2731 TROUBLESHOOTING

Troubleshooting procedures are performed according to the following flowcharts.

CHART 1 Summarized TR2731 Troubleshooting Flowchart





Note 1: Check that an interrupt is generated in the IRQ line each time a key is pressed. Note that interrupts are generated normally as shown in Figure 1-a at all times.

Note 2: Set the CPU board DIP switches to

1	2	3	4	5
OFF	ON	ON	ON	OFF

IDLE code "D0" is thus transferred to TR2741 #1.

Note 3: The final ROM is chip selected. Check the data bus route from the ROM data output (MEMORY board) to the CPU data input (CPU board).

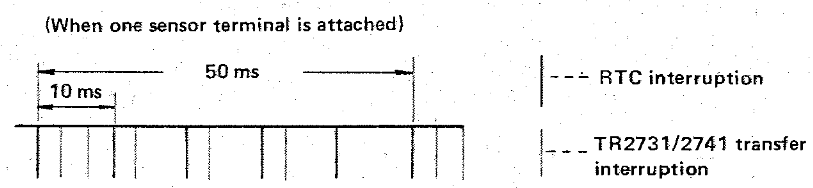


Figure 1-a

CHART 2-1 Detailed TR2731 Troubleshooting Flowchart

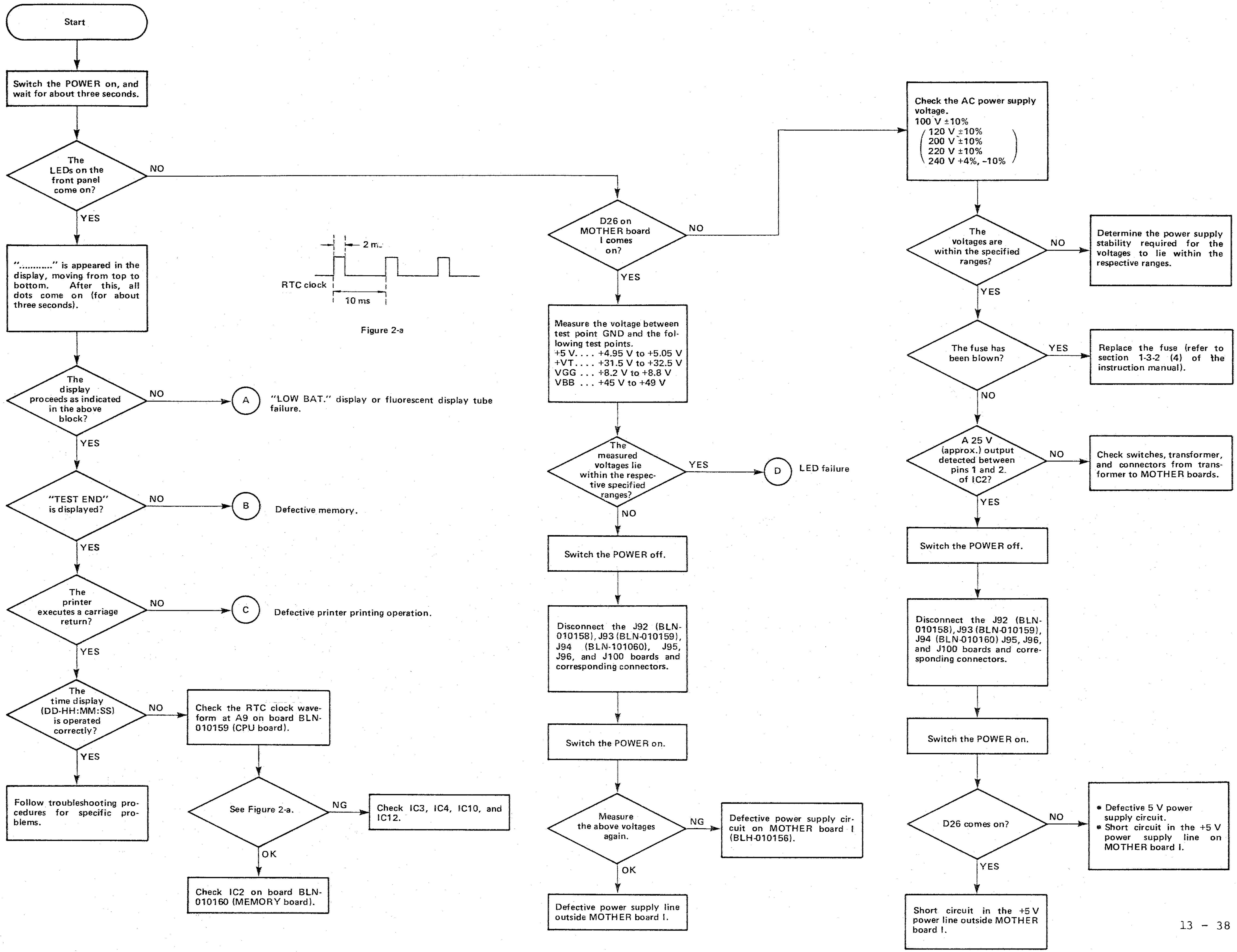
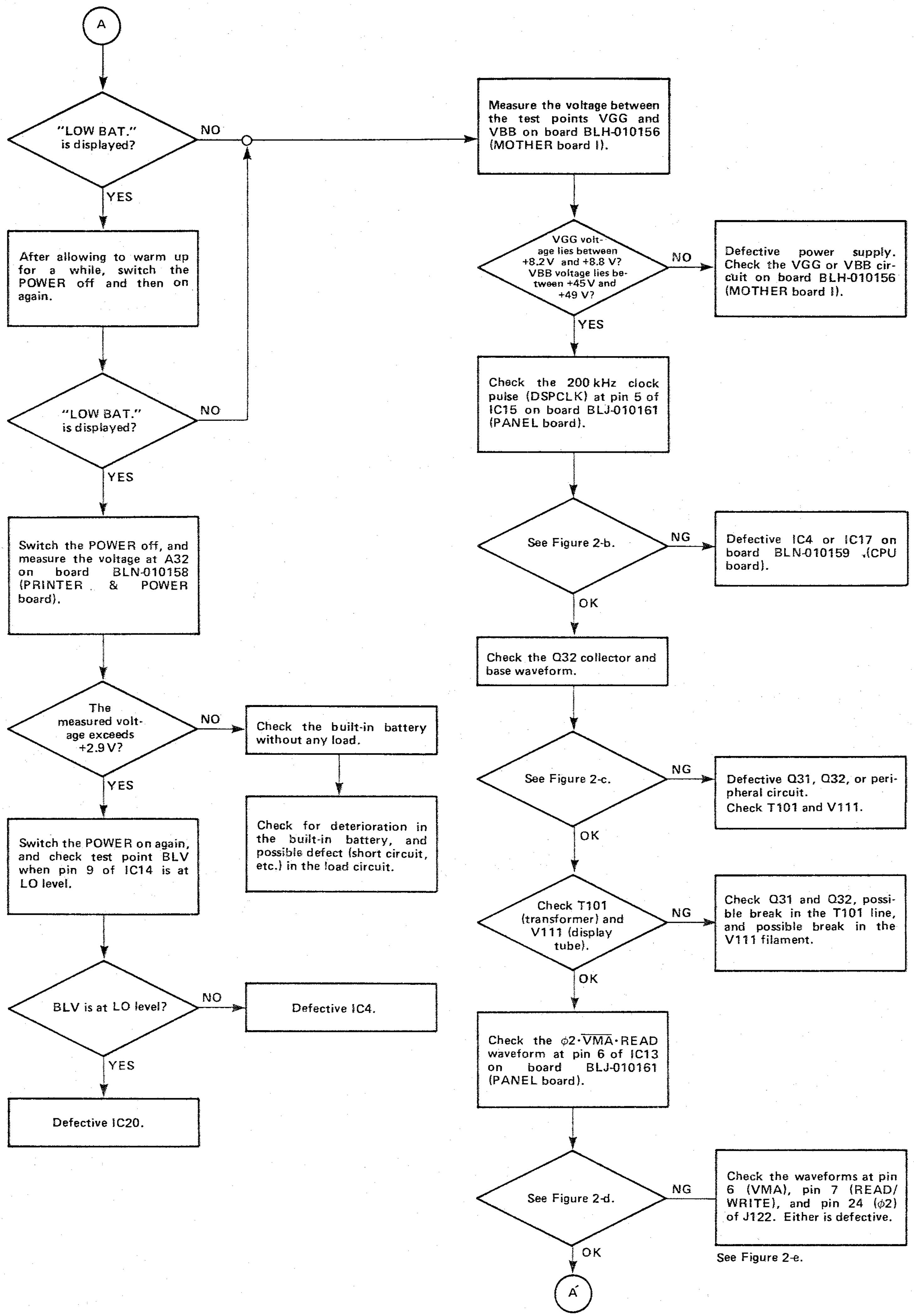


CHART 2-2 Detailed TR2731 Troubleshooting Flowchart



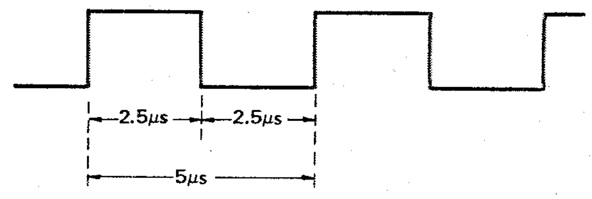


Figure 2-b

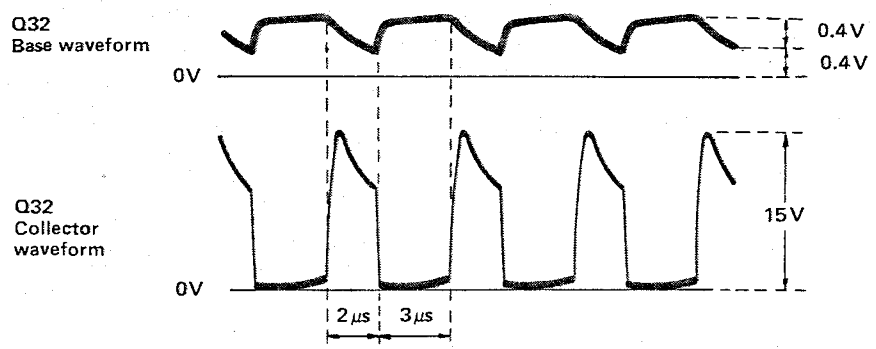


Figure 2-c

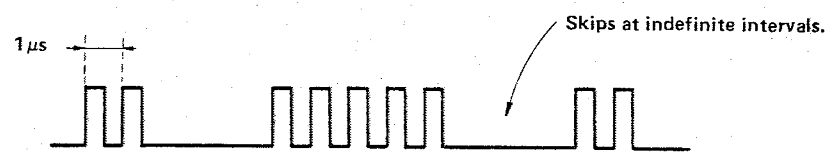


Figure 2-d

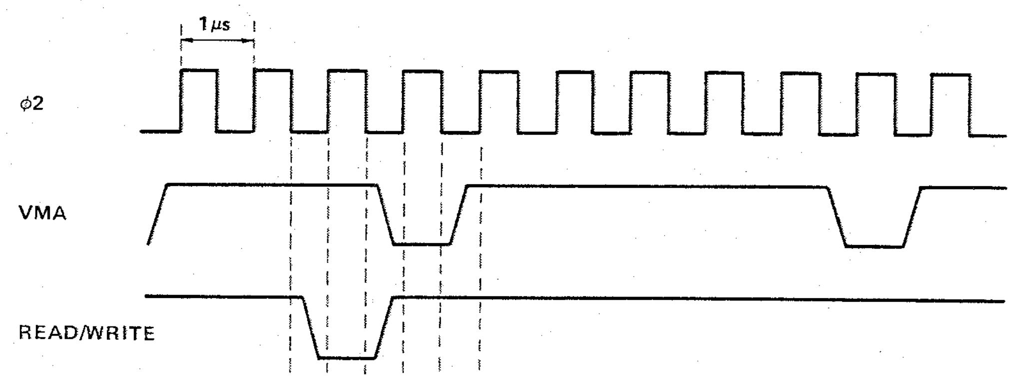


Figure 2-e

CHART 2-3 Detailed TR2731 Troubleshooting Flowchart

(A′)

1. Check the waveform at test point ENB.
2. See Figure 2-f. — NG → Check IC16 and IC19. — OK ↓
3. Check the waveforms at test points DT1 thru DT5.
4. See Figure 2-f. — NG → Check IC13, IC17, and IC18. — OK ↓
5. Check the IC9 and IC26 waveforms.
6. See Figure 2-g. — NG → Check IC9, IC14, IC17, IC19, and IC26. — OK ↓
7. When specific digits fail to come on, check IC9, IC10, IC25, and IC26. And if a specific row of dots fails to come on, check IC2 thru IC6 and IC20 thru IC24.

(Note)

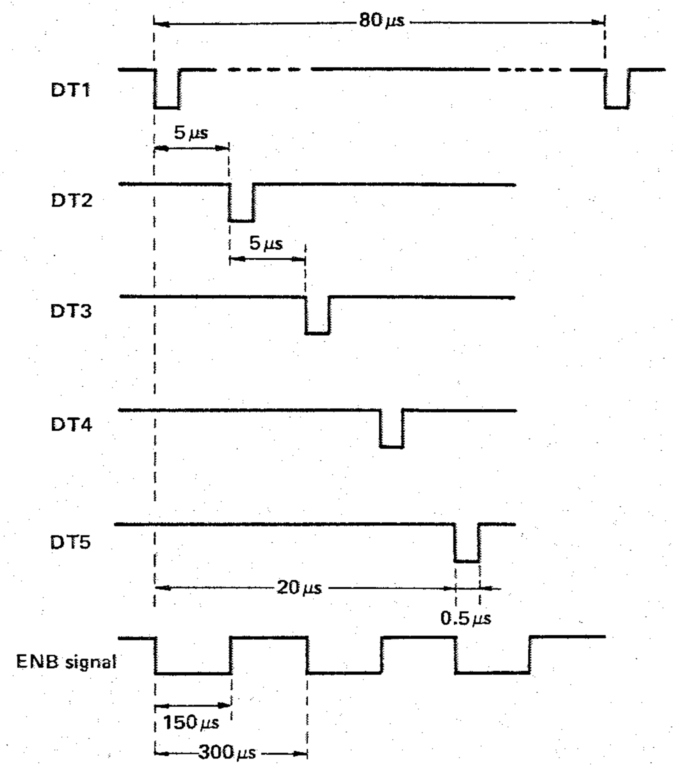
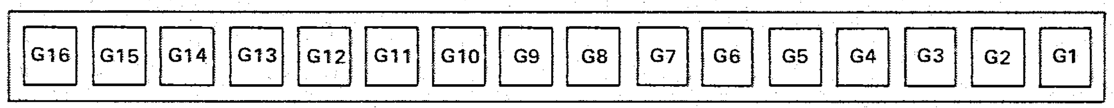
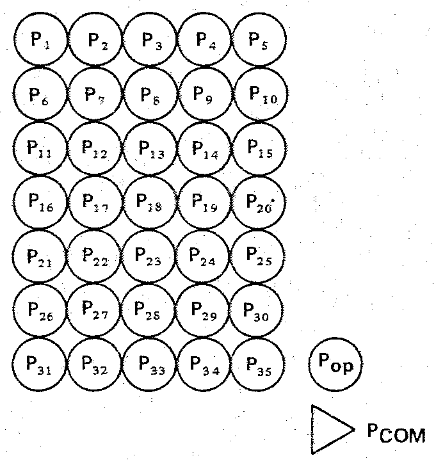


Figure 2-f

Note: Display digit and digit selection signals



Display dots and dot signals



(B)

1. "ERR XXXX YY" is displayed? — NO → Defective check program ROM. Check IC40 on board BLN-010160 (MEMORY board). — YES ↓
2. XXXX ⩾ 4000? — YES → Defective ROM on board BLN-010160 (MEMORY board)

4000	IC35
6000	IC36
8000	IC37
A000	IC38
C000	IC39
E000	IC40

3. XXXX ⩾ 4000? — NO → XXXX < 1000?
   - YES → Defective RAM on board BLN-010160 (MEMORY board)

XXXX	YO	OY
0000 ~ 03FF	IC28	IC29
0400 ~ 07FF	IC20	IC21
0800 ~ 0BFF	IC12	IC13
0CFF~ 0FFF	IC5	IC6

   - NO → Defective RAM on board BGJ-010169 (MEMORY/AUX. FUNC) of TR2730-010

XXXX	YO	OY
1000 ~ 13FF	IC13	IC14
1400 ~ 17FF	IC15	IC16
1800 ~ 1BFF	IC17	IC18
1C00 ~ 1FFF	IC10	IC11

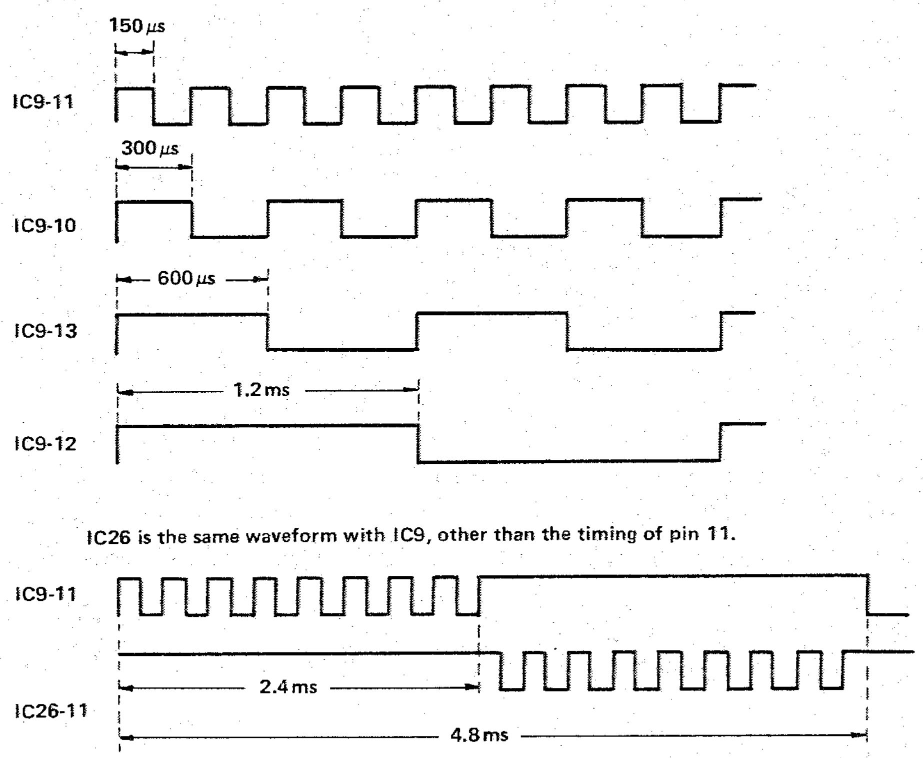
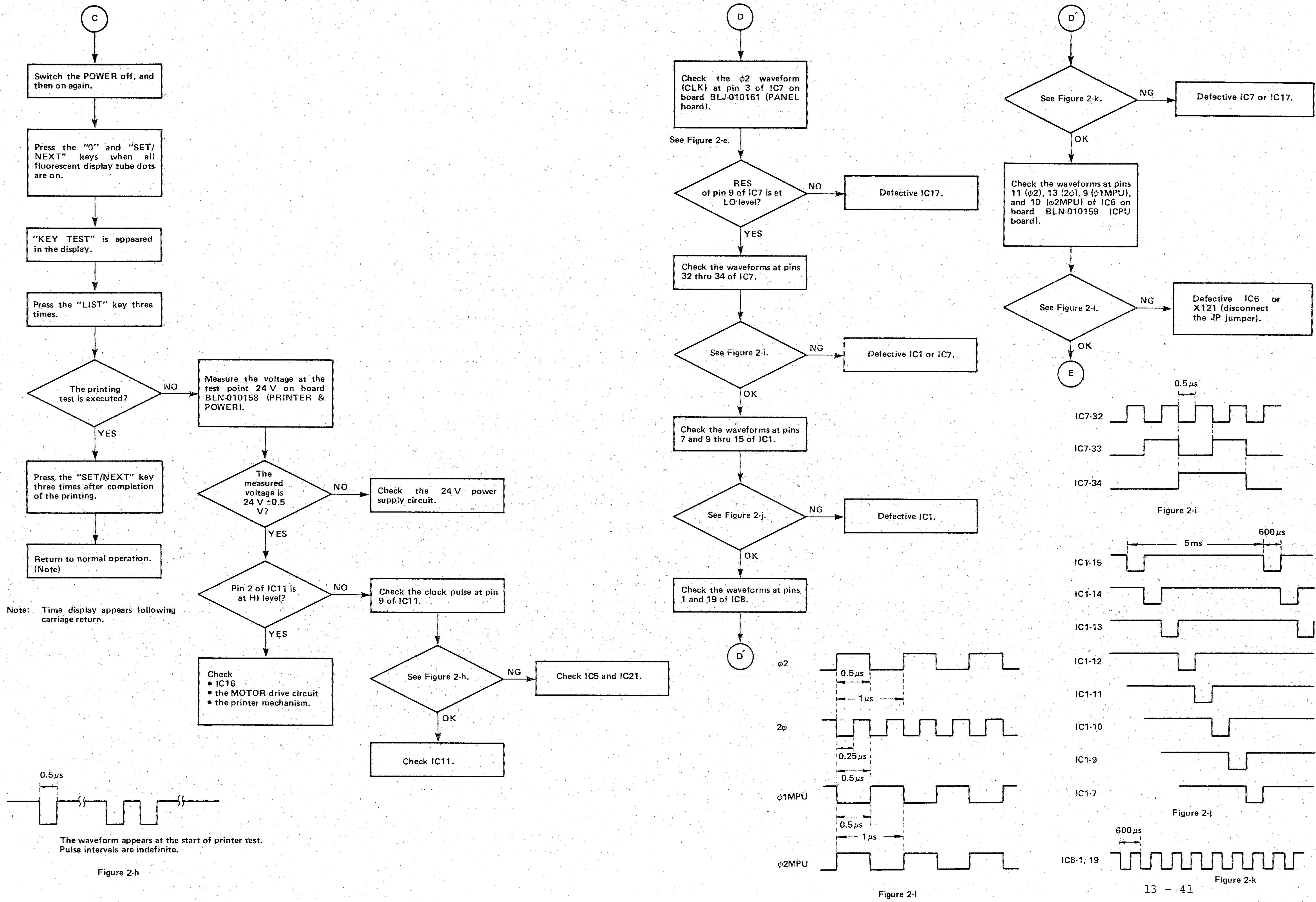


Figure 2-g

CHART 2-4 Detailed TR2731 Troubleshooting Flowchart

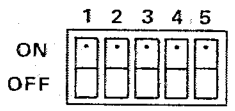


(E)

1. Check the waveforms at pins 36 (DBE), 39 (TSC), and 40 ($\overline{RES}$) of IC27.
2. See Figure 2-m.
   - NG → Check each signal line.
   - OK → continue.
3. Set bit 5 of S132 to ON. (Note)
4. Check the waveforms at A0 thru A15 of IC27 to confirm that operation is the same as the binary counter output.
5. See Figure 2-n.
   - NG → Check the NOP code for IC27 bus lines D0 thru D7. → D1 thru D7 are at LO level, and D0 at HI level?
     - NO → Defective IC26 or IC34.
     - YES → Defective IC27.
   - OK → continue.
6. Check the waveforms in the A0 thru A15 address lines for the CPU board connector pins A10 thru A17 and B10 thru B17, confirming that the operation is the same as the binary counter.
7. See Figure 2-n.
   - NG → Remove board BLN-010160 (MEMORY board) and check the patterns for address lines A0 thru A15. Also check IC35, IC36, IC42, and IC43 on board BLN-010159 (CPU board).
   - OK → **(F)**

Note: Only one digit in the fluorescent display tube comes on, or else none at all.

S132 settings status.



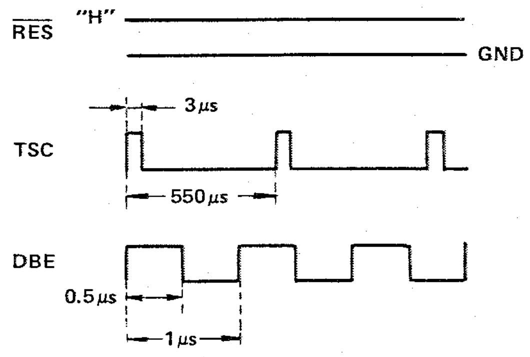


Figure 2-m

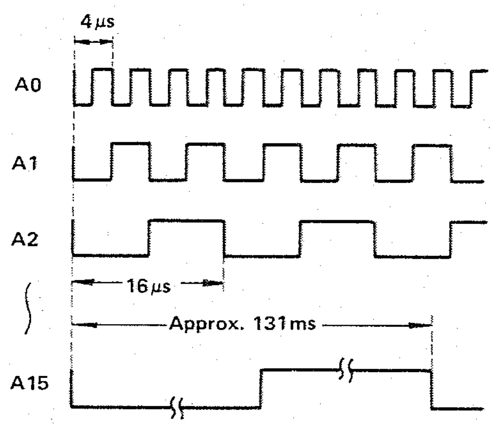
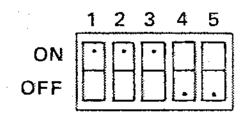


Figure 2-n

(F)

1. Check the waveforms at pins 7 and 9 thru 13 of IC30 on board BLN-010160 (MEMORY board).
2. A pulse-state output is detected?
   - NO → • Defective address line. • Defective IC30.
   - YES → continue.
3. Use an oscilloscope to observe the waveforms in bus lines D0 thru D7 for MEMORY board connector pins A18 thru A21 and B18 thru B21.
4. Check that no lines have remained at either HI or LO level.
   - NG → Defective D0 thru D7 line patterns or connected IC.
   - OK → continue.
5. Switch the POWER off.
6. Set S132 as shown below.



7. Switch the POWER back on.
8. Check the waveforms at test point TEST and the other test points. (Note)
9. See Figure 2-o.
   - NG → **(G)**
   - OK → **(H)**

Note: Disconnect the jumper RST4 on board BLN-010159 (CPU board) for this check.

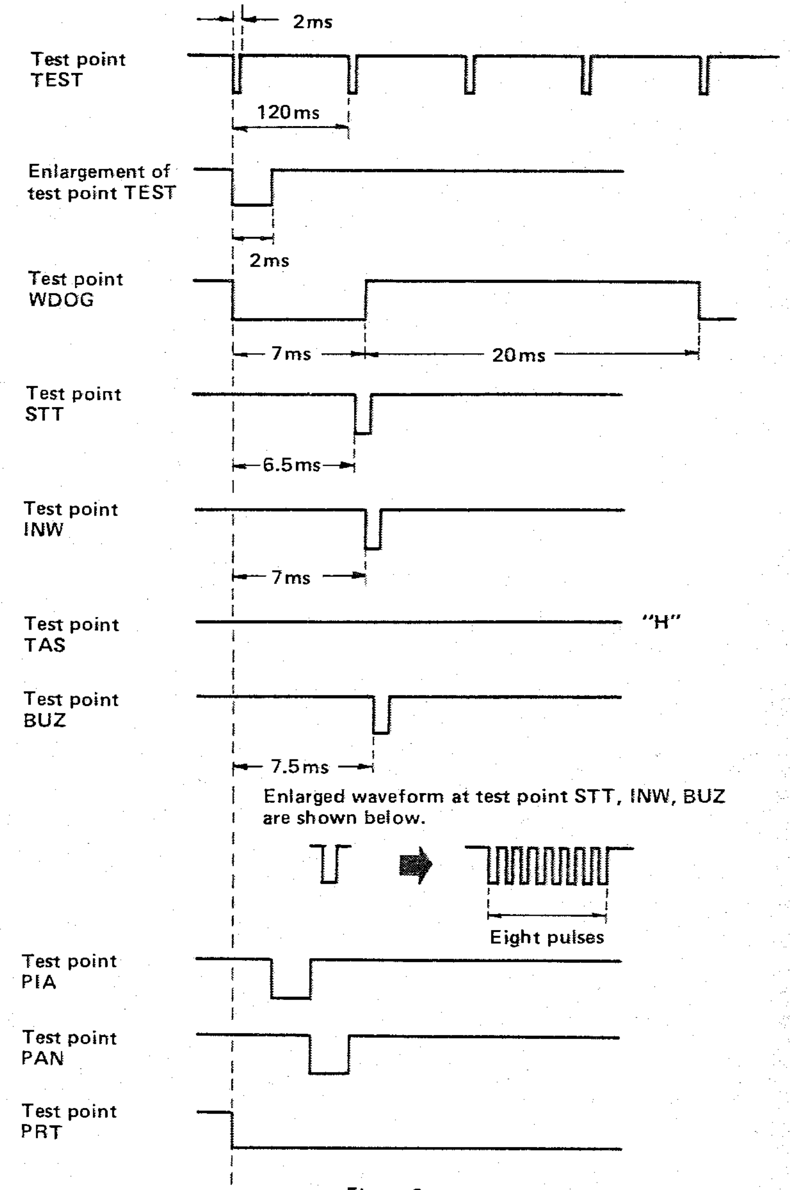
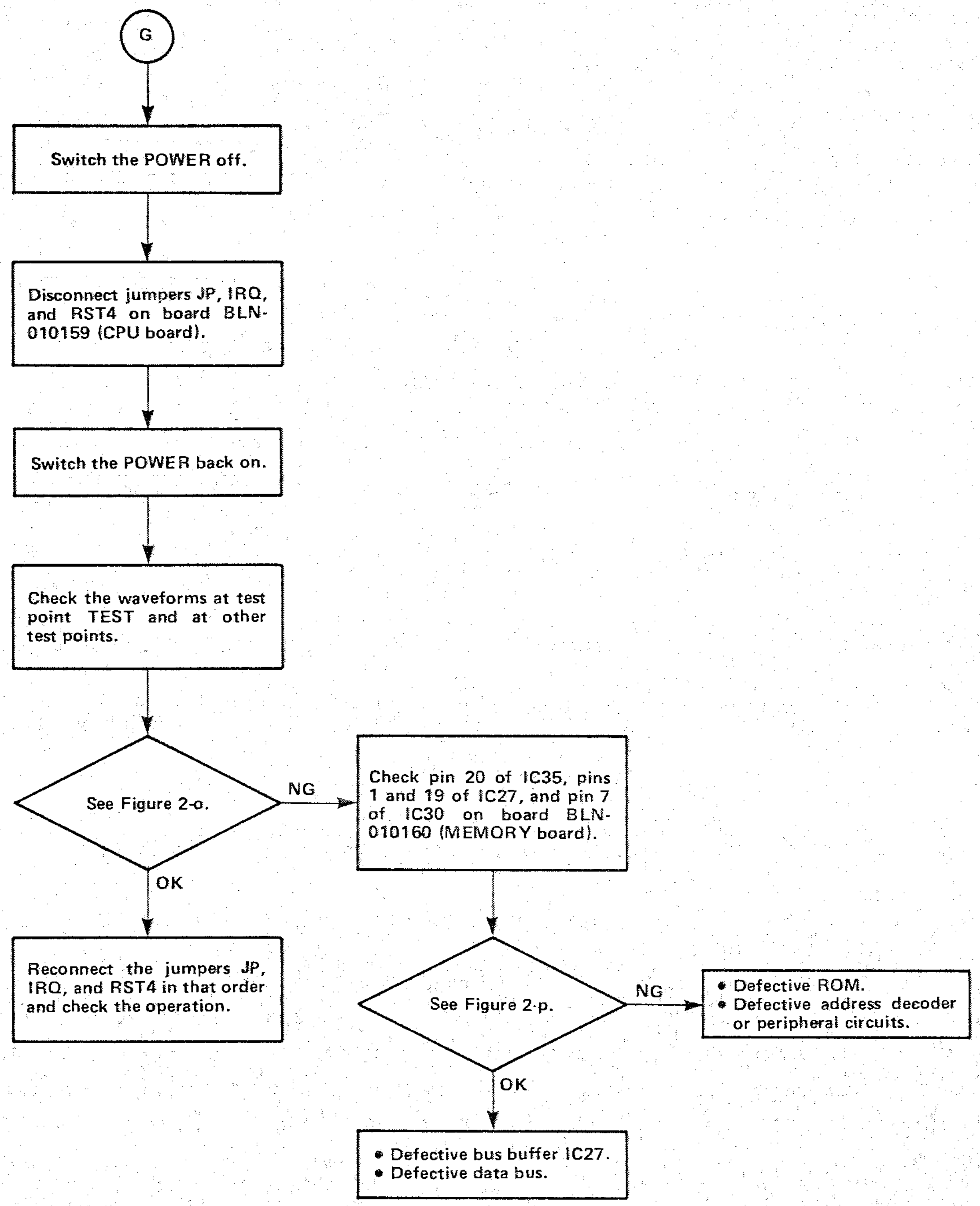
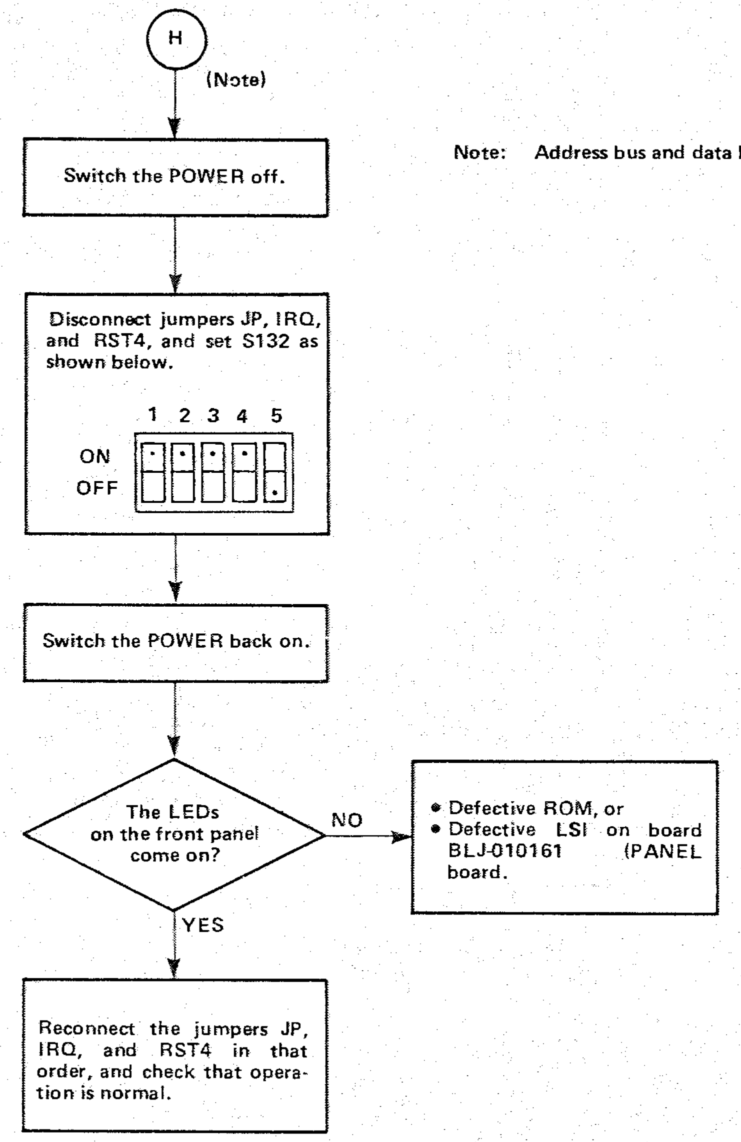


Figure 2-o





Note: Address bus and data bus are normal at this time.

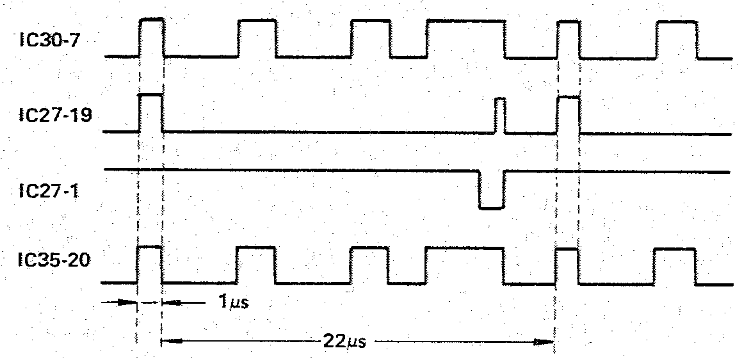
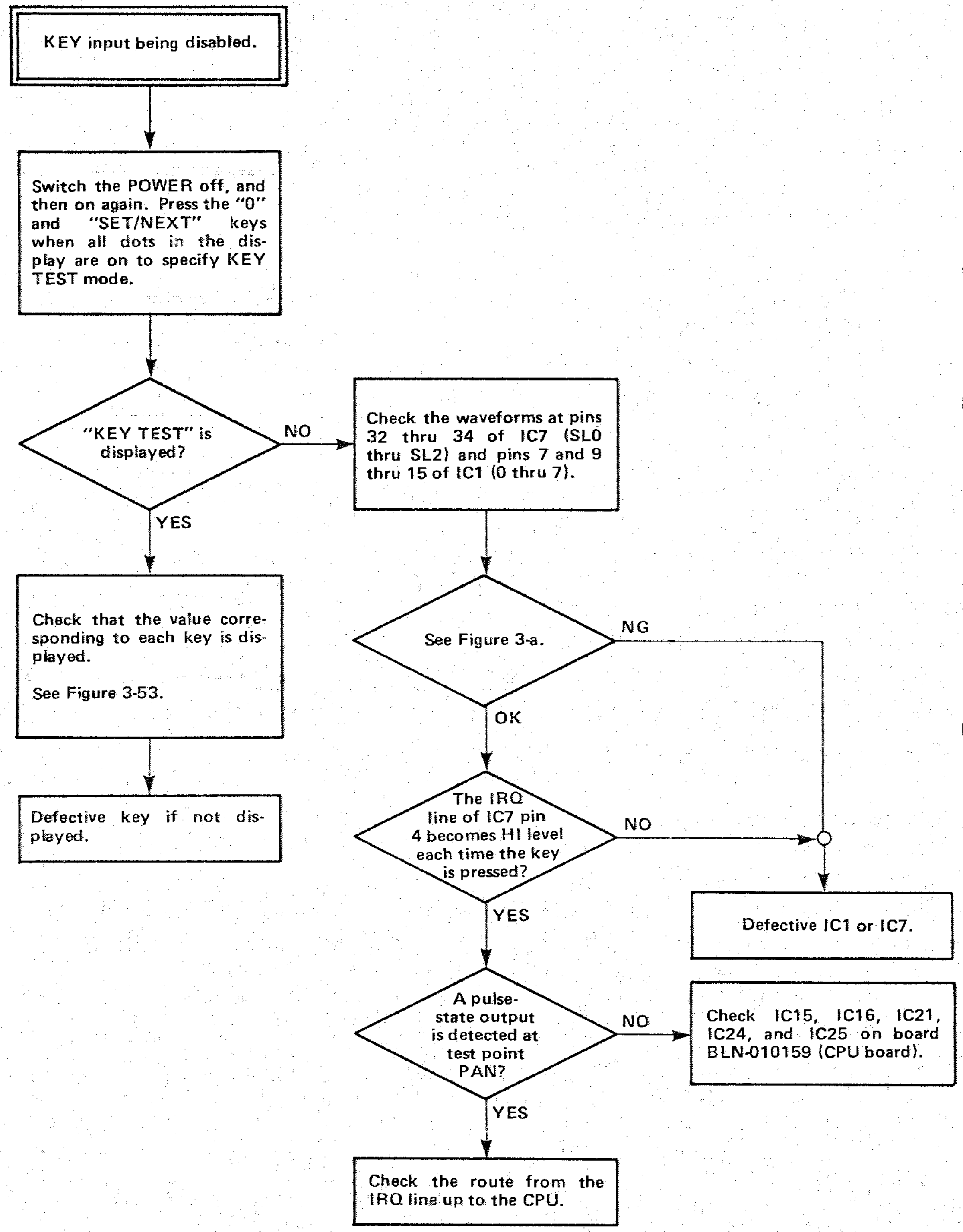


Figure 2-p

CHART 3-1 TR2731 Troubleshooting Flowcharts for Specific Problems



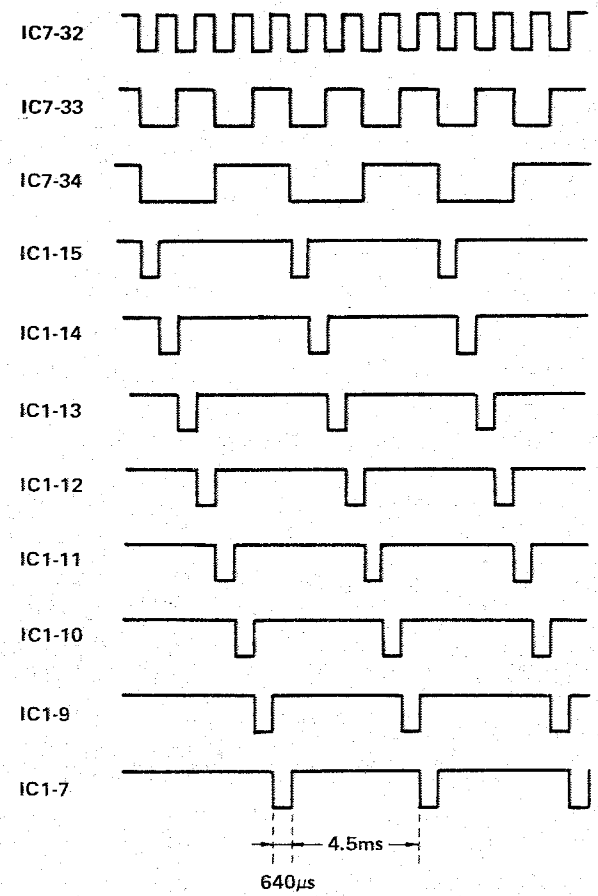
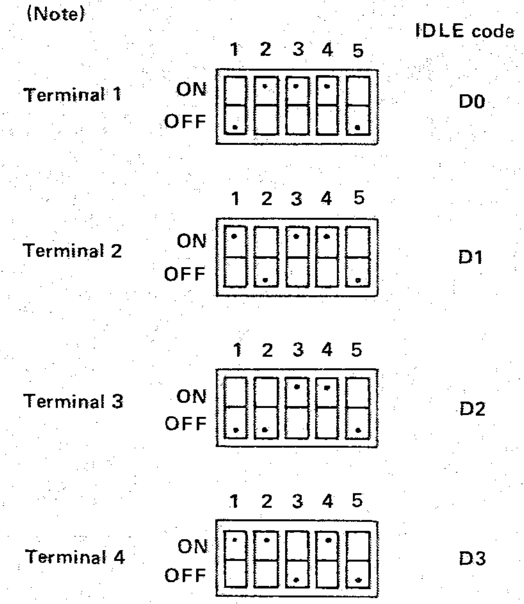
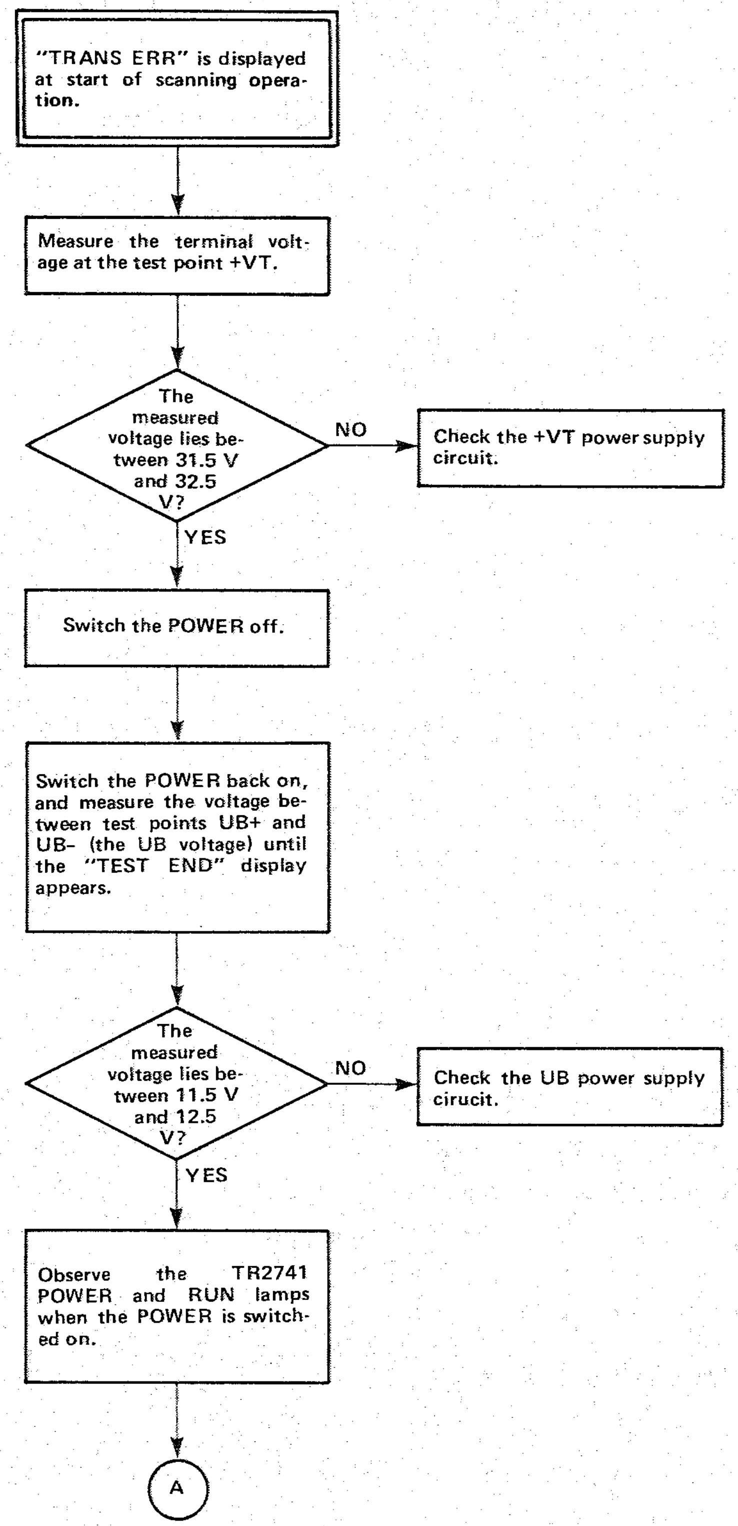
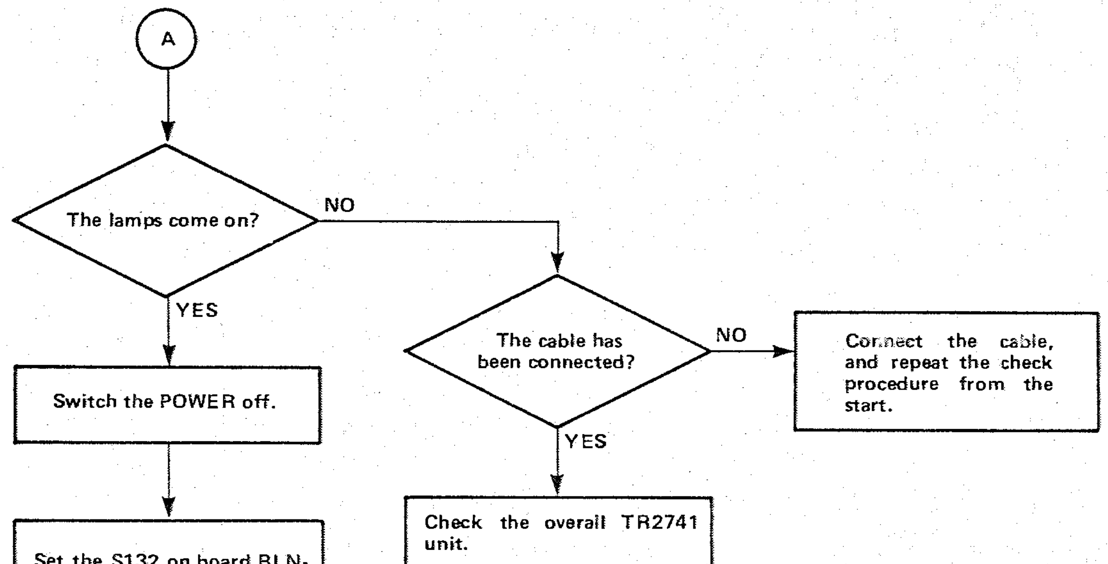
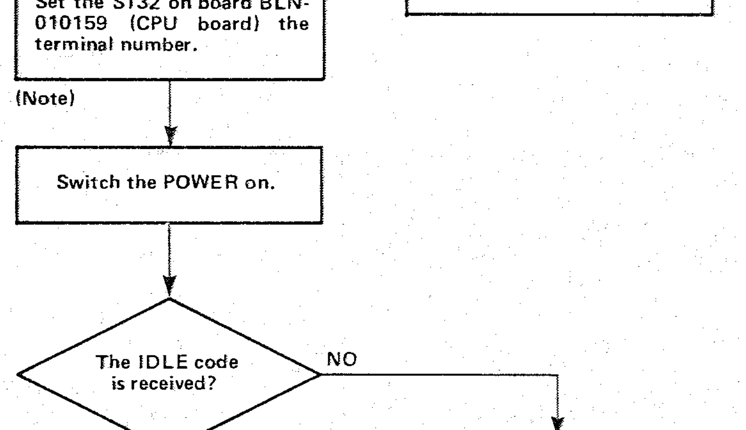
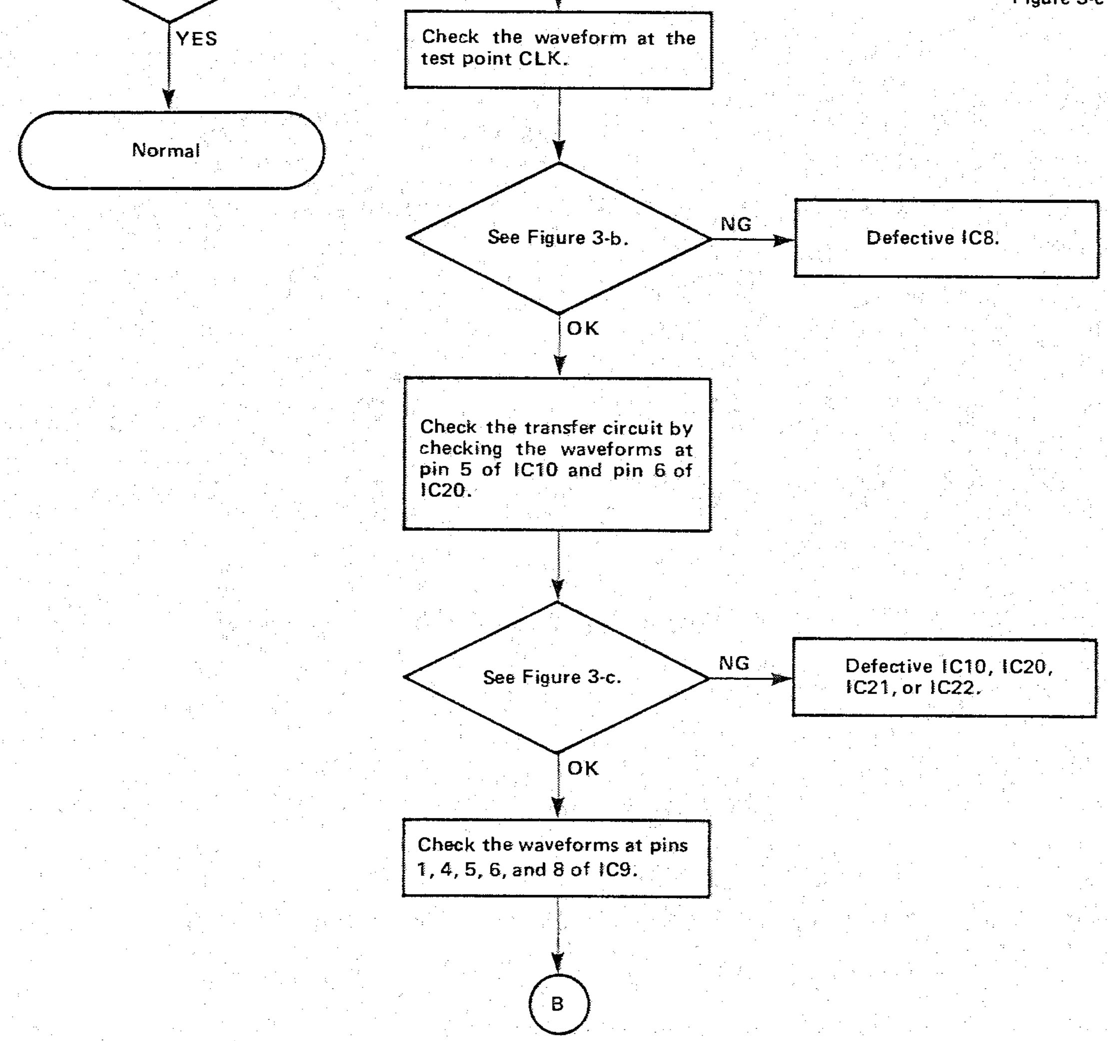


Figure 3-a

(Note)





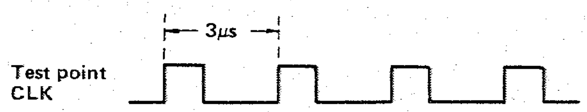


Figure 3-b

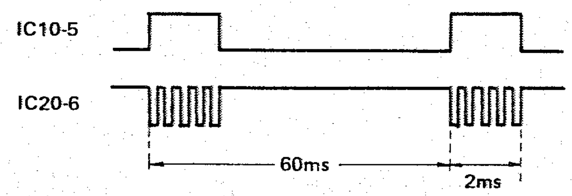
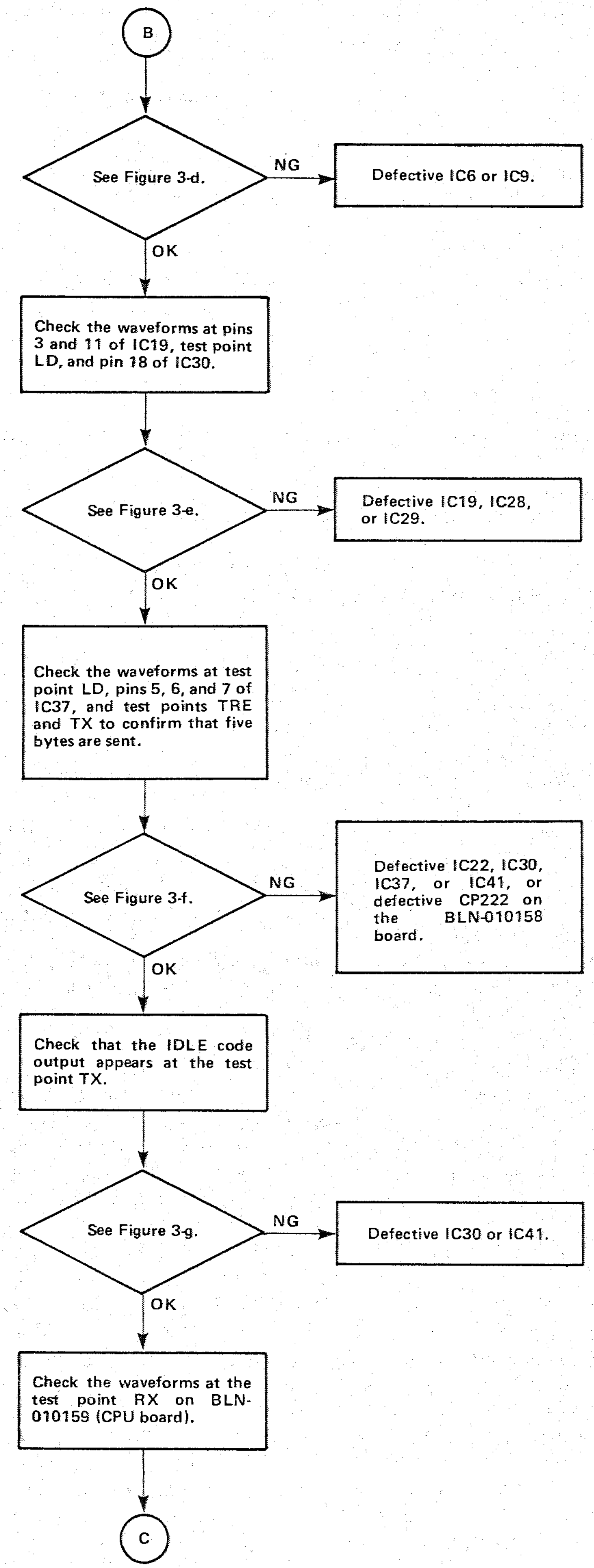


Figure 3-c



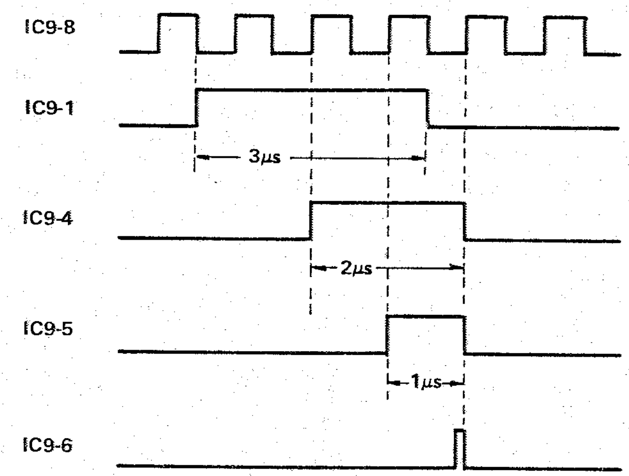


Figure 3-d

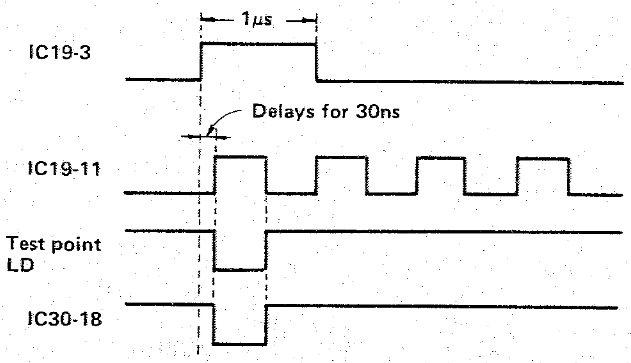


Figure 3-e

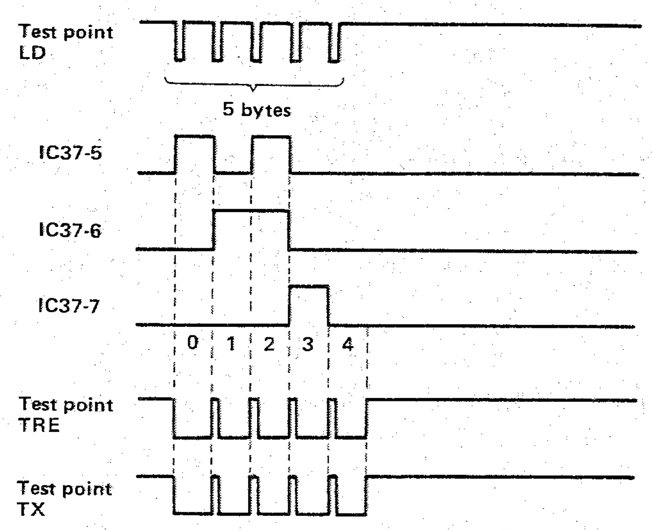
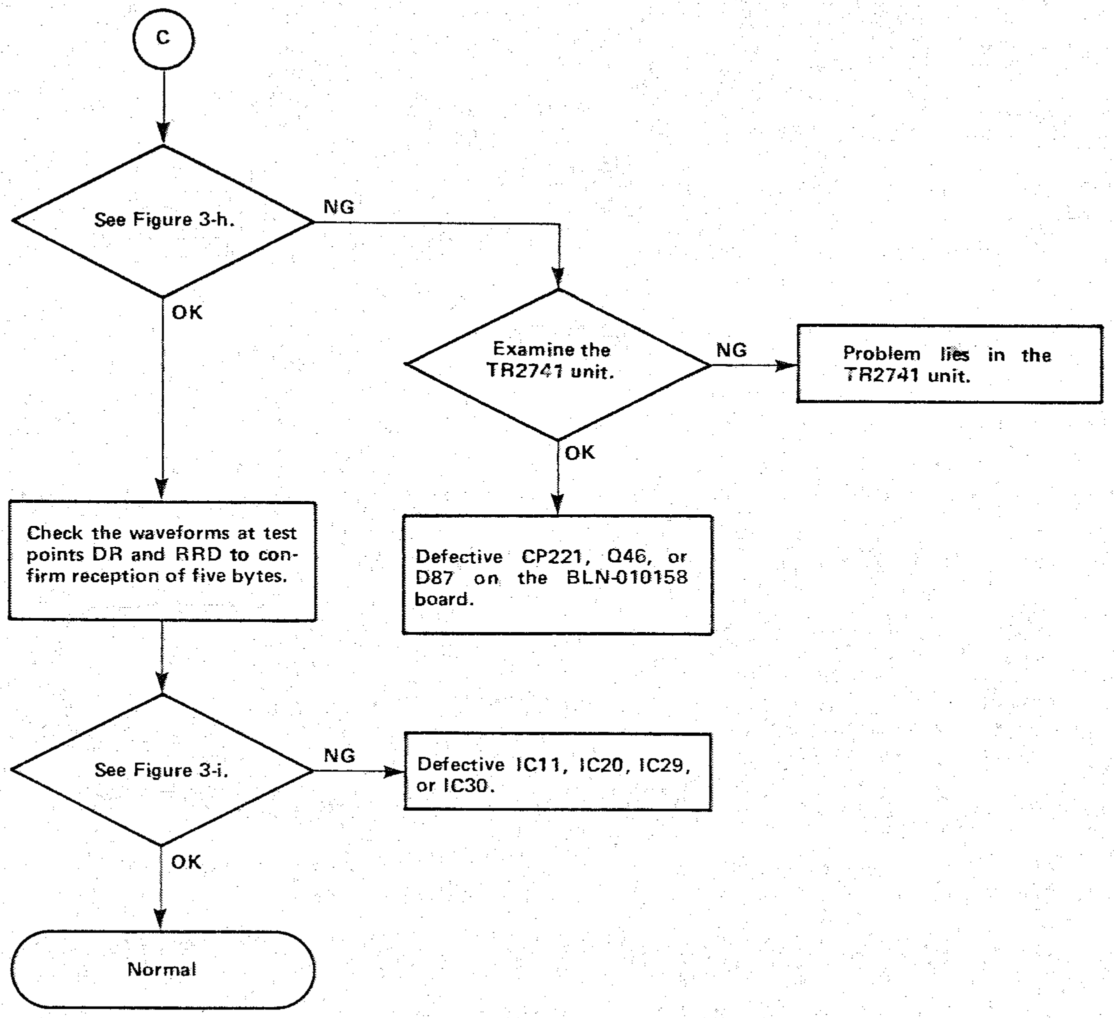


Figure 3-f



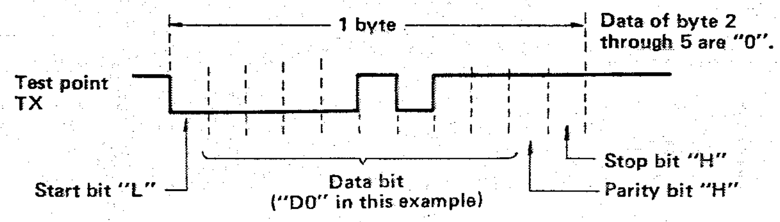
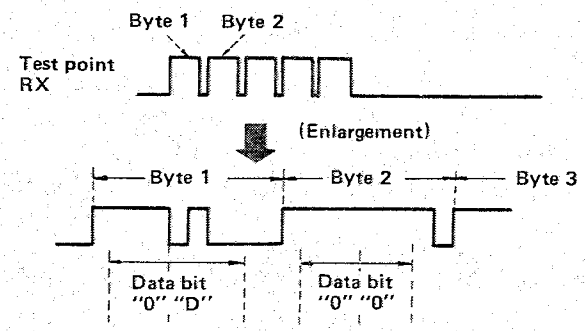


Figure 3-g



· IDLE code is received at byte 1, and "0" is received at byte 2 through 5.

Figure 3-h

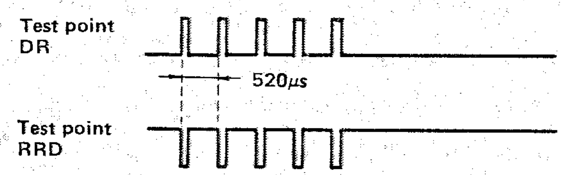
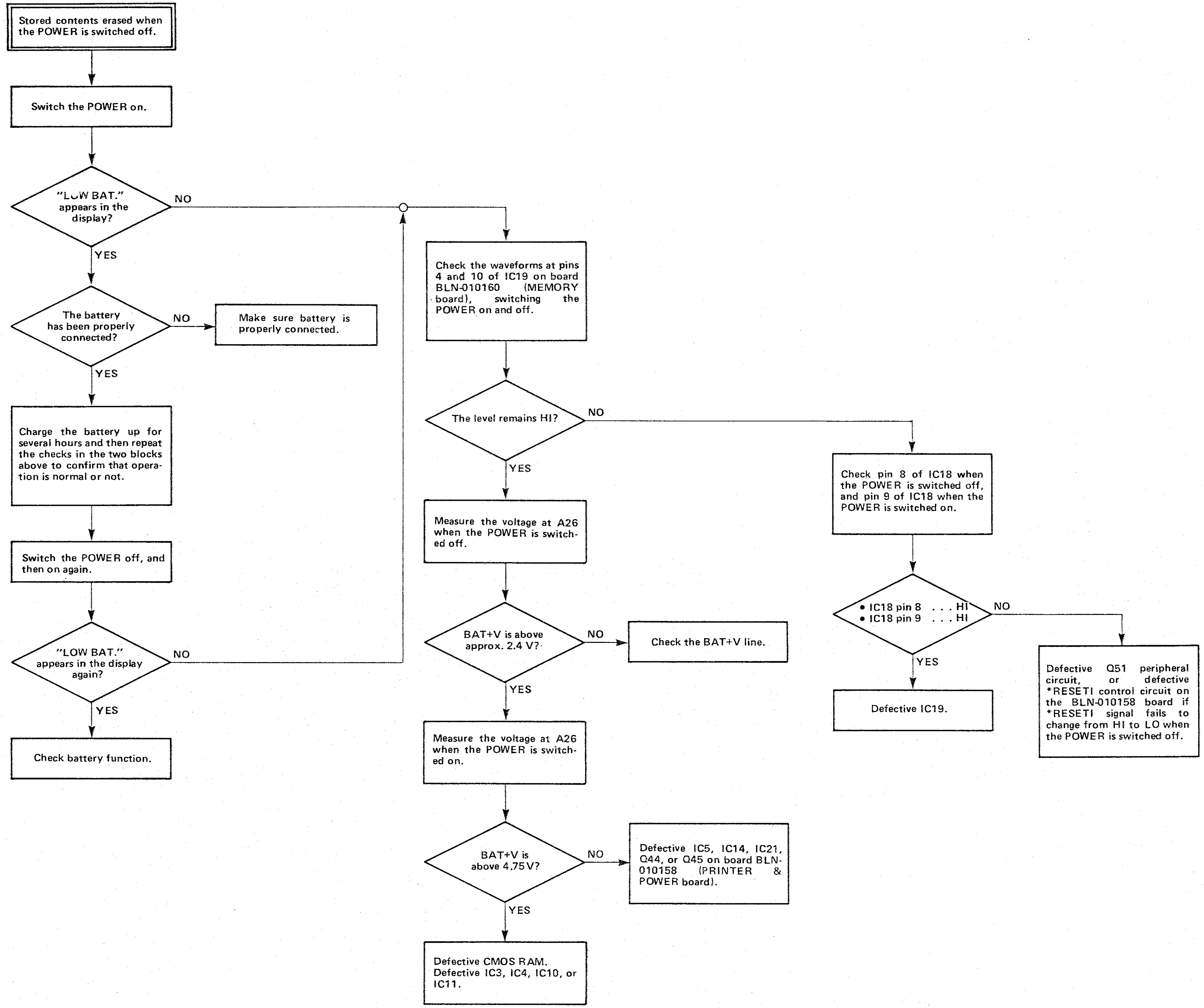
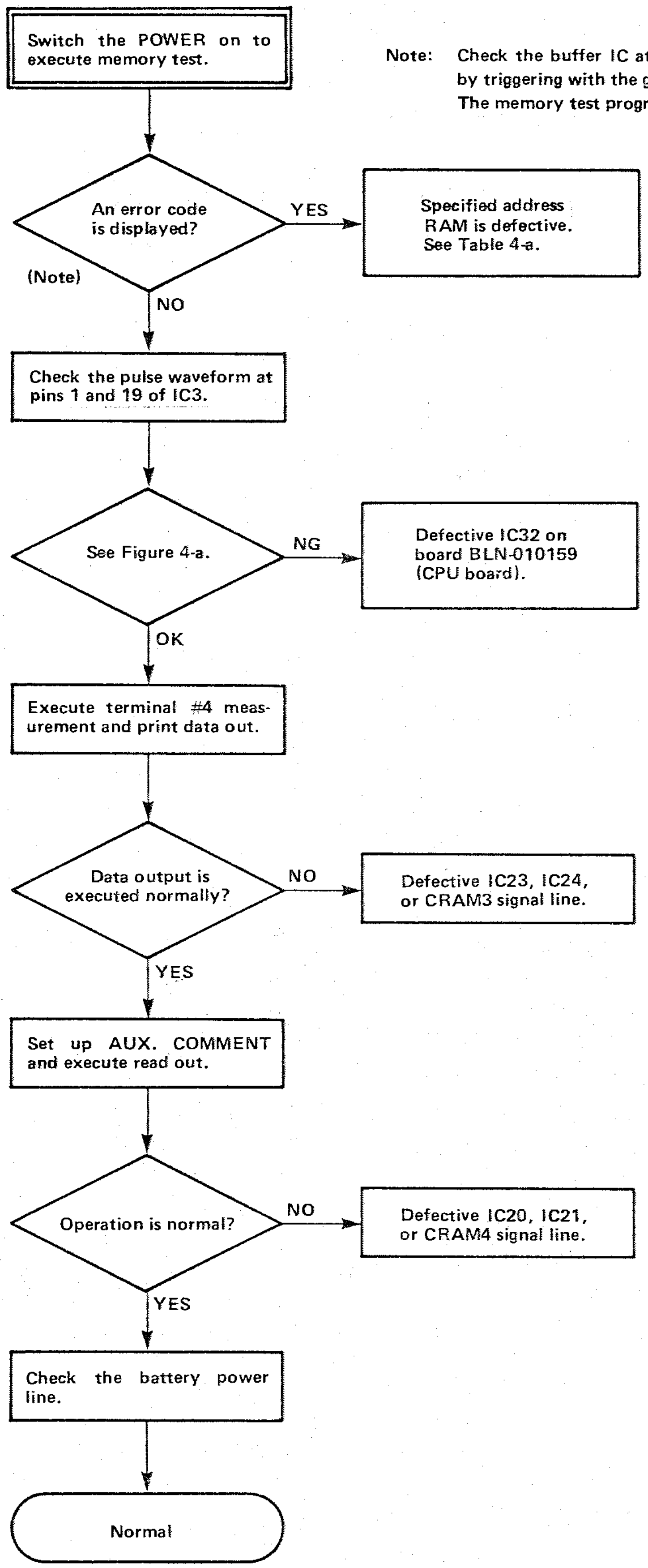


Figure 3-i


Stored contents erased when the POWER is switched off.
Switch the POWER on.
"LOW BAT." appears in the display?
NO
YES
The battery has been properly connected?
NO
Make sure battery is properly connected.
YES
Charge the battery up for several hours and then repeat the checks in the two blocks above to confirm that operation is normal or not.
Switch the POWER off, and then on again.
"LOW BAT." appears in the display again?
NO
YES
Check battery function.
Check the waveforms at pins 4 and 10 of IC19 on board BLN-010160 (MEMORY board), switching the POWER on and off.
The level remains HI?
NO
YES
Measure the voltage at A26 when the POWER is switched off.
BAT+V is above approx. 2.4 V?
NO
Check the BAT+V line.
YES
Measure the voltage at A26 when the POWER is switched on.
BAT+V is above 4.75 V?
NO
Defective IC5, IC14, IC21, Q44, or Q45 on board BLN-010158 (PRINTER & POWER board).
YES
Defective CMOS RAM. Defective IC3, IC4, IC10, or IC11.
Check pin 8 of IC18 when the POWER is switched off, and pin 9 of IC18 when the POWER is switched on.
• IC18 pin 8 . . . HI
• IC18 pin 9 . . . HI
NO
YES
Defective IC19.
Defective Q51 peripheral circuit, or defective *RESETI control circuit on the BLN-010158 board if *RESETI signal fails to change from HI to LO when the POWER is switched off.

Note: Check the buffer IC at this time by comparing the input and output data by triggering with the gate signal of pin 19 of IC6.
The memory test program is executed when the POWER is switched on.



Error address	Higher order 4 bits	Lower order 4 bits
1000 ~ 13FF	IC13	IC14
1400 ~ 17FF	IC15	IC16
1800 ~ 1BFF	IC17	IC18
1C00 ~ 1FFF	IC10	IC11

Table 4-a

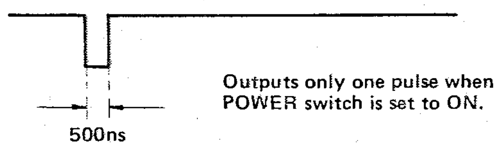
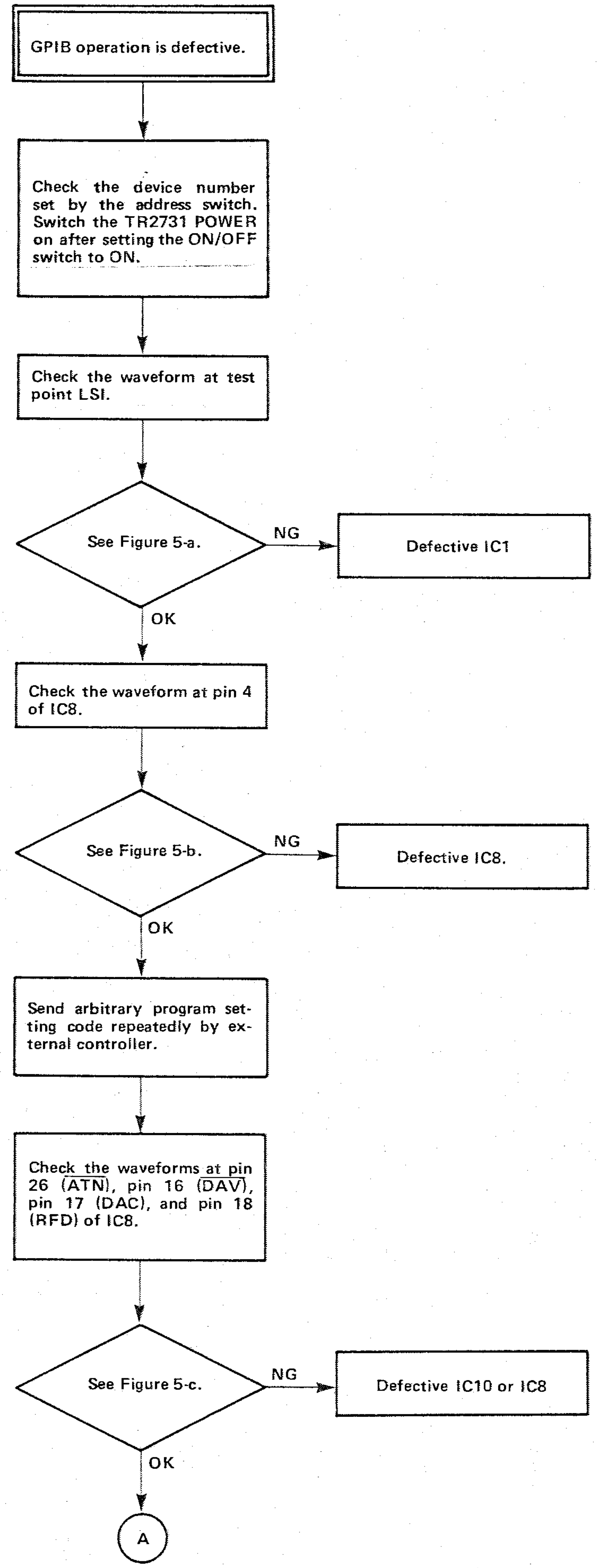


Fig. 4-a



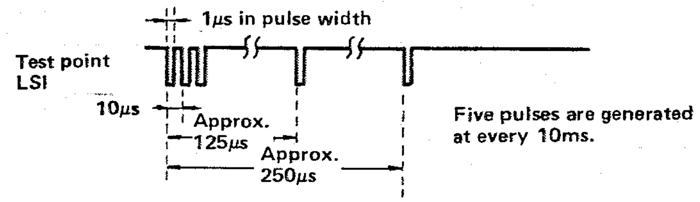


Figure 5-a

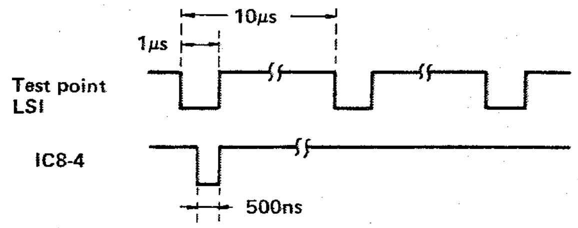


Figure 5-b

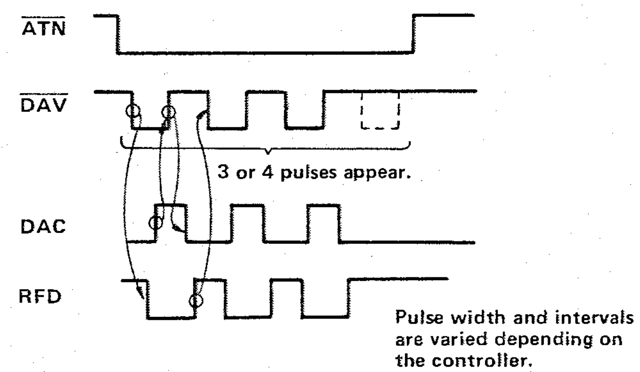
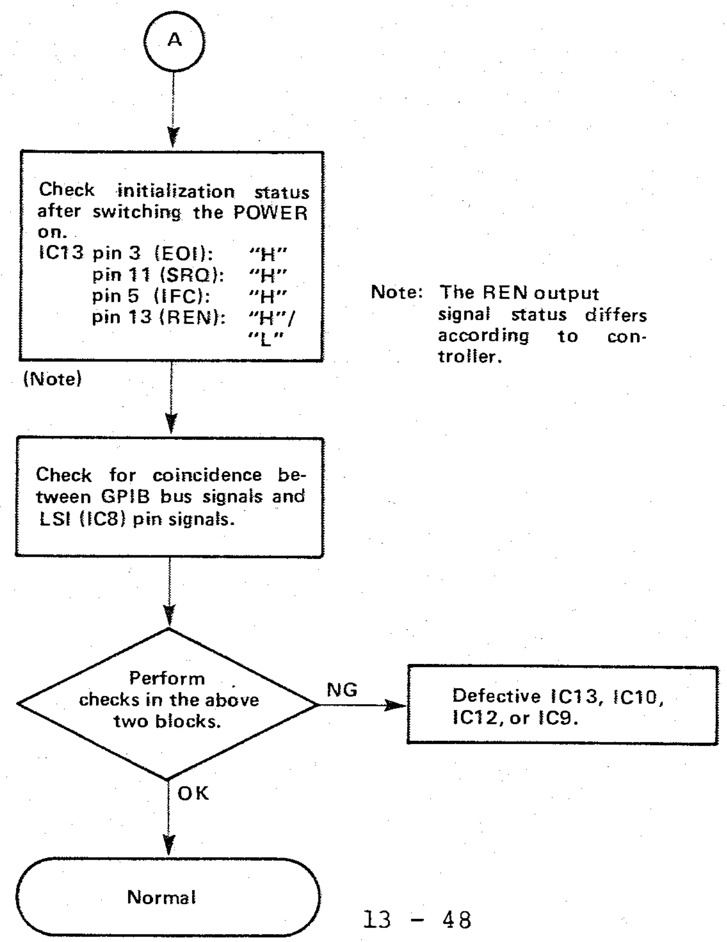


Figure 5-c



Note: The REN output signal status differs according to controller.

CHART 6-1 TR2730-520 BCD Output/External Control Option Card Troubleshooting (BGJ-010171)

No BCD output.

↓

Short TR2741 CH.1.

↓

Short test points P.C and P.E.

↓

Set TR2731 as follows.
LOG INTERVAL 0S
SCAN CH CH.1
RANGE . . . . .20 V

↓

Set the TR2731 LOG and OUTPUT ENABLE switches to ON.

↓

Check waveforms at pins 7 and 9 thru 15 of IC16.

↓

See Figure 6-a. — NG → Check IC1, IC2, IC3, and IC16.

↓ OK

Check waveforms at test point P.C, and pins 16, 19, 5, and 2 of IC18, and confirm correct output of the time, data, and end code.

↓

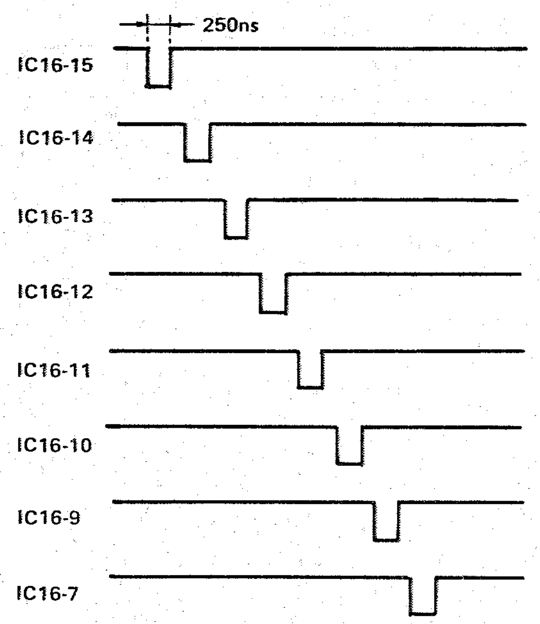
See Figure 6-b. — NG → Check IC15 and IC18.

↓ OK

Confirm data output is executed.

↓

(A)



(Each pulse intervals are indefinite.)

Figure 6-a

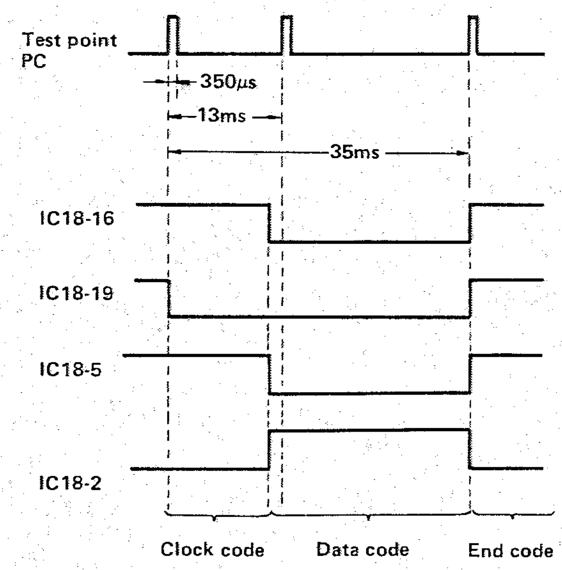


Figure 6-b

Note: Data is changed by resetting scaling coefficients.
Each IC is OK if outputs are as shown in the following table when data codes are output.

(A)

↓

See Table 6-a. — NG → Check ICs with different outputs.

↓ OK

Confirm output of terminal No. and channel No.

↓

See Table 6-b. — NG → Check ICs of different output.

↓ OK

Confirm output of unit, decimal point position, and polarity sign data.

↓

See Table 6-c. — NG → Check ICs of different output.

↓ OK

Disconnect the short between test points P.C and P.E.

↓

Set up TR2731 as follows.
LOG INTERVAL. . . .0S
SCAN CH. CH.1

↓

Check the waveform at test point P.E to confirm input of data request signal.

↓

See Figure 6-c. — NG → Check connected devices.

↓ OK

Normal

IC No. / Pin No. / Scaling coefficient	IC22								IC19								IC23			
	2	5	6	9	19	16	15	12	2	5	6	9	19	16	15	12	2	5	6	9
Not set	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A = -1.111, B = 1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
A = -2.222, B = 1	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0
A = -4.444, B = 1	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0
A = -8.888, B = 1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0

Table 6-a

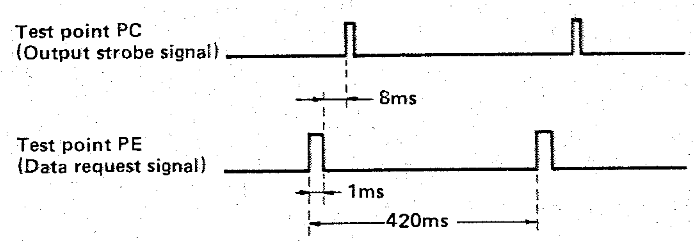
IC No. / Pin No. / TR2731 settings	IC23				IC20							
	19	16	15	12	2	5	6	9	19	16	15	12
SCAN CH......17 CH.	1	1	1	0	1	0	0	0	1	0	0	0
SCAN CH......18 CH.	0	0	0	1	1	0	0	0	1	0	0	0
SCAN CH......77 CH.	1	1	1	0	1	1	1	0	1	0	0	0
SCAN CH......80 CH.	0	0	0	0	0	0	0	1	1	0	0	0

Table 6-b

When TR2741 B type is used, check the following table as well.

IC No. / Pin No. / TR2731 settings	IC18						IC21						
	2	5	6	9	19	16	2	5	6	9	19	16	15
Set scaling to A = 1 and B = 1	1	1	0	0	0	0	0	1	0	0	0	0	1
Set scaling to A = -1 and B=1	1	0	0	0	0	0	0	1	0	0	0	0	1
Set scaling to A=1000 and B=1	1	1	0	0	0	0	0	1	0	0	1	0	0
Set scaling to A=10 and B=1	1	1	0	0	0	0	0	1	0	0	1	1	0
Set RANGE to 2 V	1	1	0	0	0	0	0	1	0	0	1	1	0
Set RANGE to 20 mV	1	1	0	0	0	0	0	0	0	0	1	1	0
Set RANGE to CCT INT ON	1	1	0	0	0	0	1	1	0	0	1	0	0
Set UNIT to Ω	1	1	0	0	0	0	1	1	1	1	1	0	0

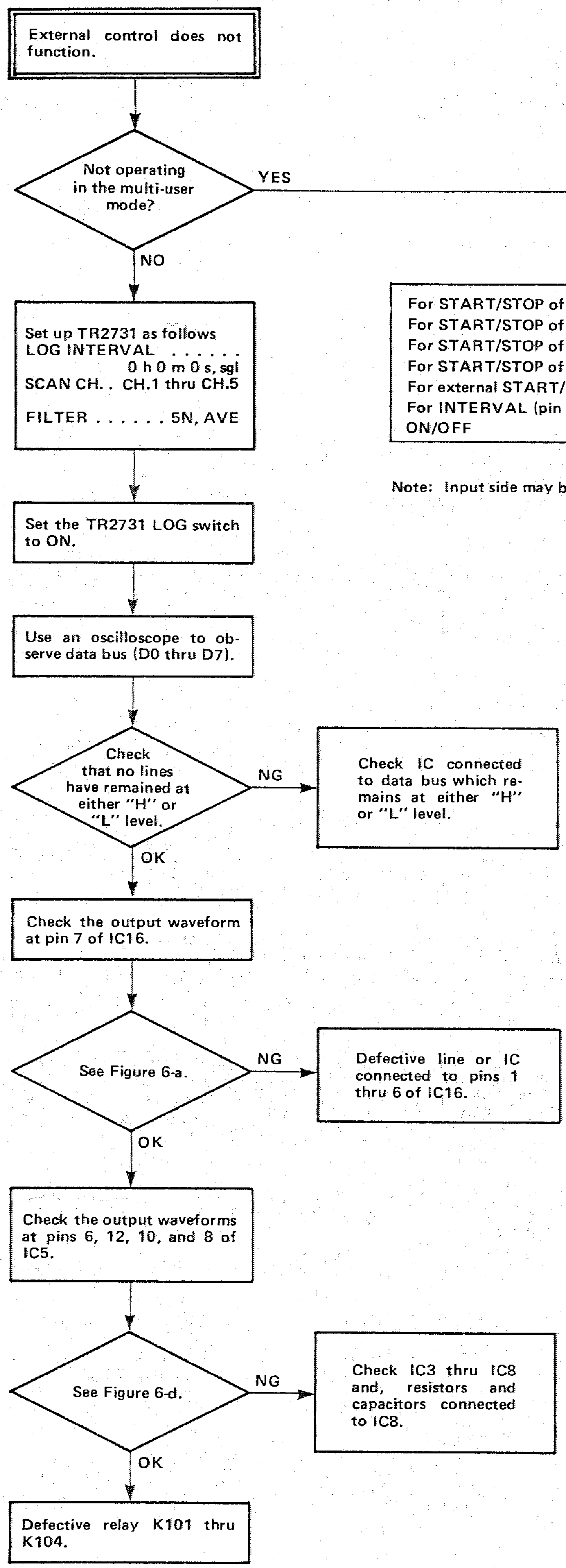
Table 6-c



(When connected with TR6198 Digital Recorder)

Figure 6-c

CHART 6-2 TR2730-520 BCD Output/External Control Option Card Troubleshooting (BGJ-010171)



For START/STOP of user 1	D0 (pin 15) on input side of IC13: "H"
For START/STOP of user 2	D1 (pin 8) on input side of IC13: "H"
For START/STOP of user 3	D2 (pin 13) on input side of IC13: "H"
For START/STOP of user 4	D3 (pin 11) on input side of IC13: "H"
For external START/STOP	D4 (pin 2) on input side of IC13: "H"
For INTERVAL (pin 6 connector) ON/OFF	D5 (pin 4) on input side of IC13: "H"

Note: Input side may be either "H" or "L" level. There is no intermediate level.

Table 6-d

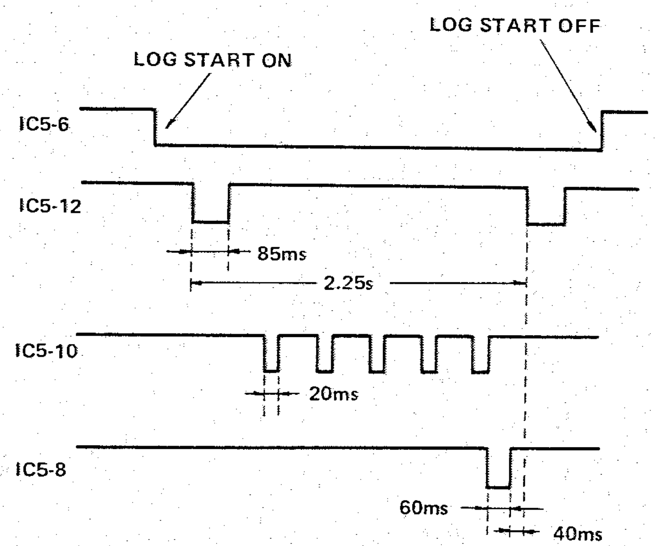
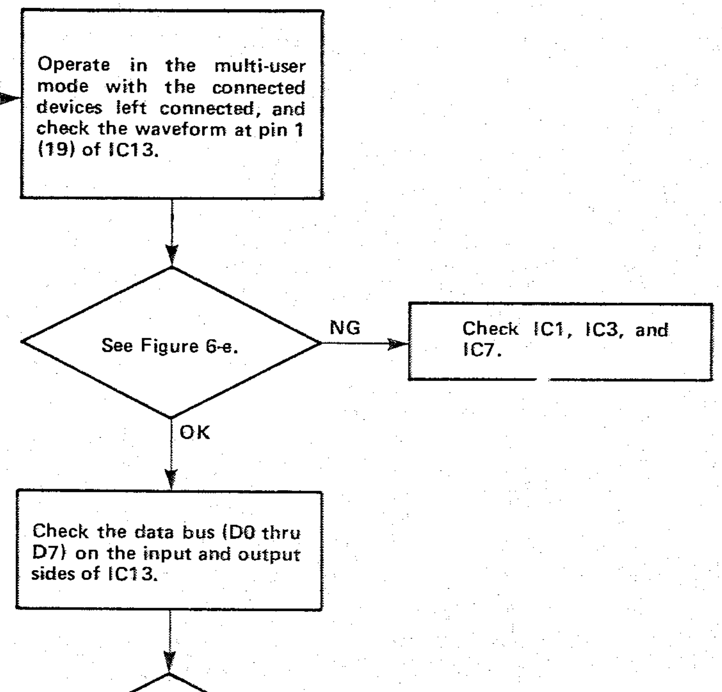
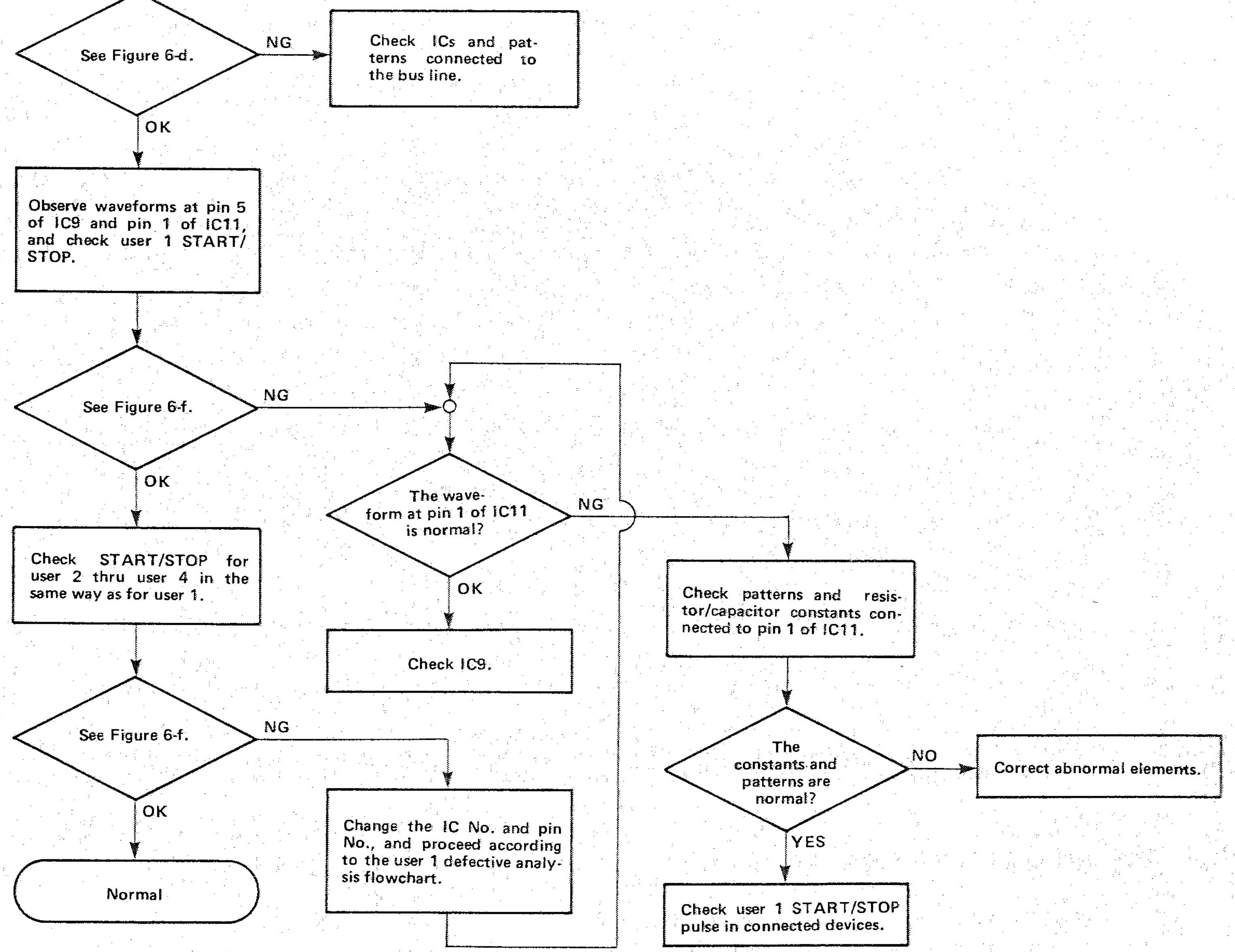


Figure 6-d





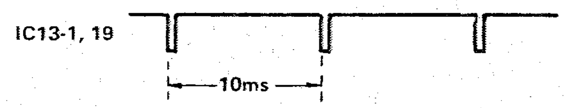


Figure 6-e

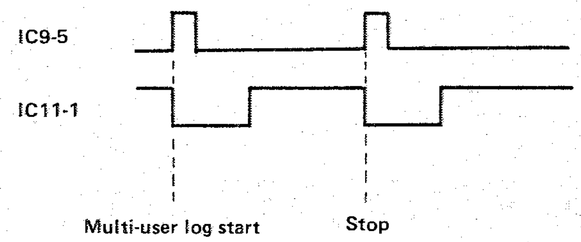
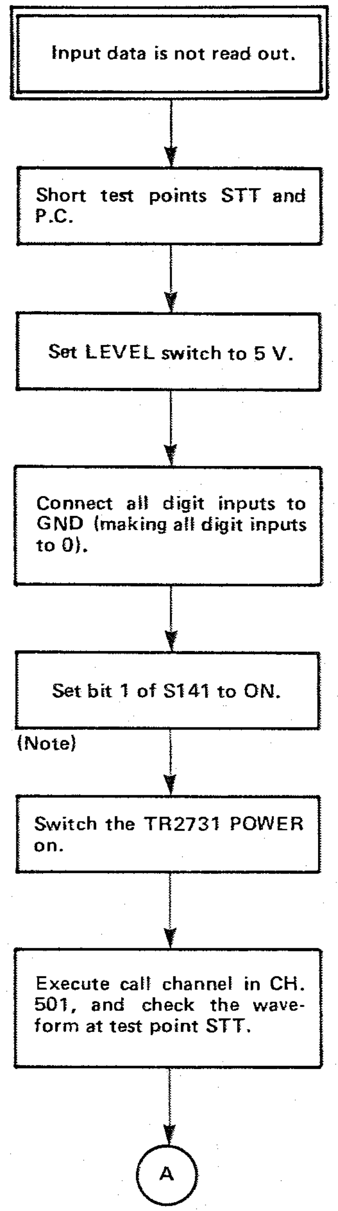


Figure 6-f

CHART 7 TR2730-530 Digital Input Option Card Troubleshooting (BGJ-010172)



Note: Setting of S141.

	Address being used	Channel No.
ON only for bit 1	3F18 ~ 3F1F	501
ON only for bit 2	3F10 ~ 3F17	502
ON only for bit 3	3F08 ~ 3F0F	503
ON only for bit 4	3F00 ~ 3F07	504

If S141 is reset, switch the POWER off, and then on again.

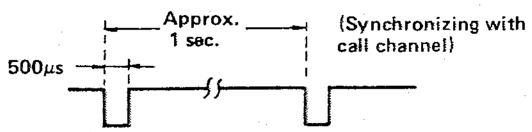
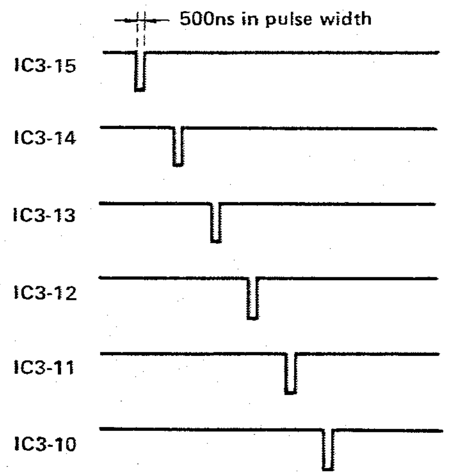


Figure 7-a



(Each pulse intervals are indefinite.)

Figure 7-b

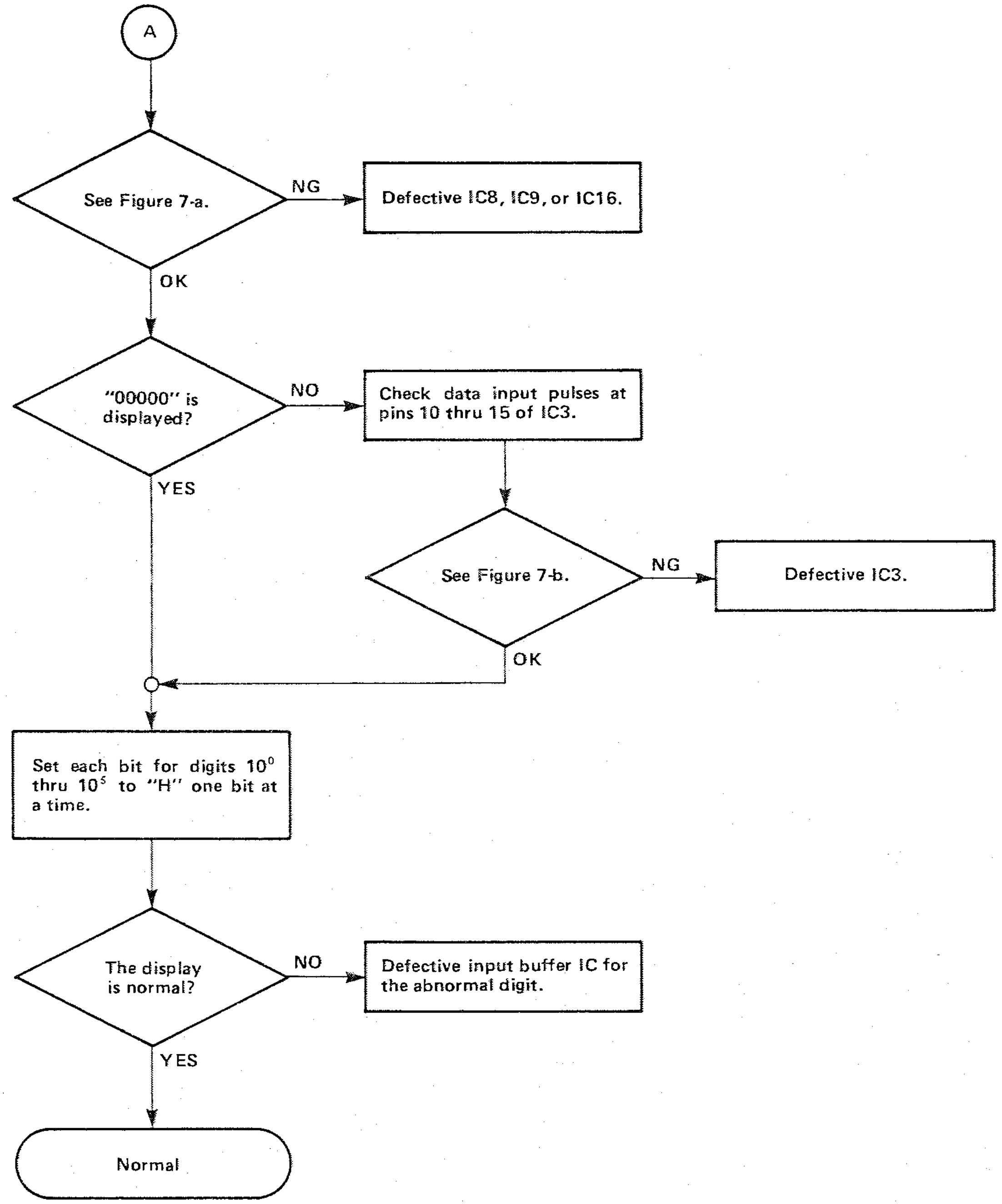
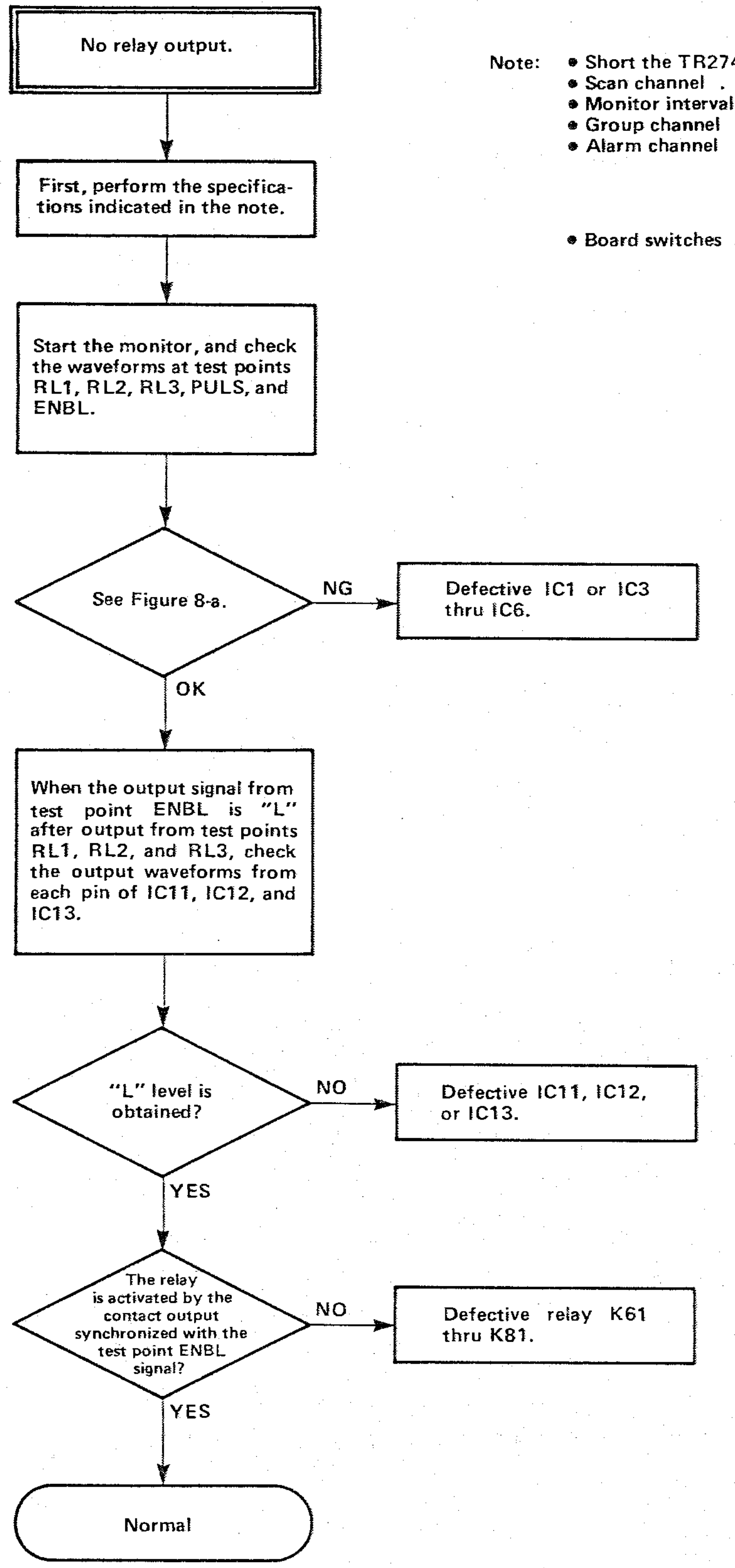


CHART 8 TR2730-540 Contact Output Option Card Troubleshooting (BGJ-010173)



Note:
- Short the TR2741 inputs
- Scan channel . . . . .CH.1 thru CH.20
- Monitor interval . . . . .2 sec. for all channels.
- Group channel . . . . .G01, CH.20, 20 mV
- Alarm channel . . . . .G01, CH.20, High -10.0,0

  Relay No. 0 output to relay of same number as measured channel.

- Board switches . . . . .S92: switch 1 ON. and 2 thru 4 OFF.
  S91: set to pulse output + mode "⎍⎍".

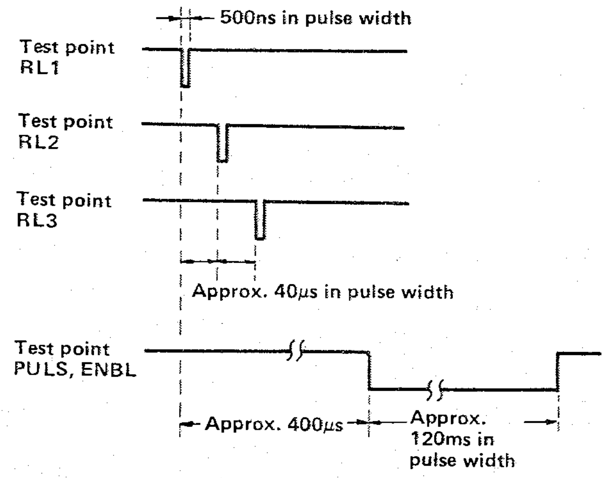
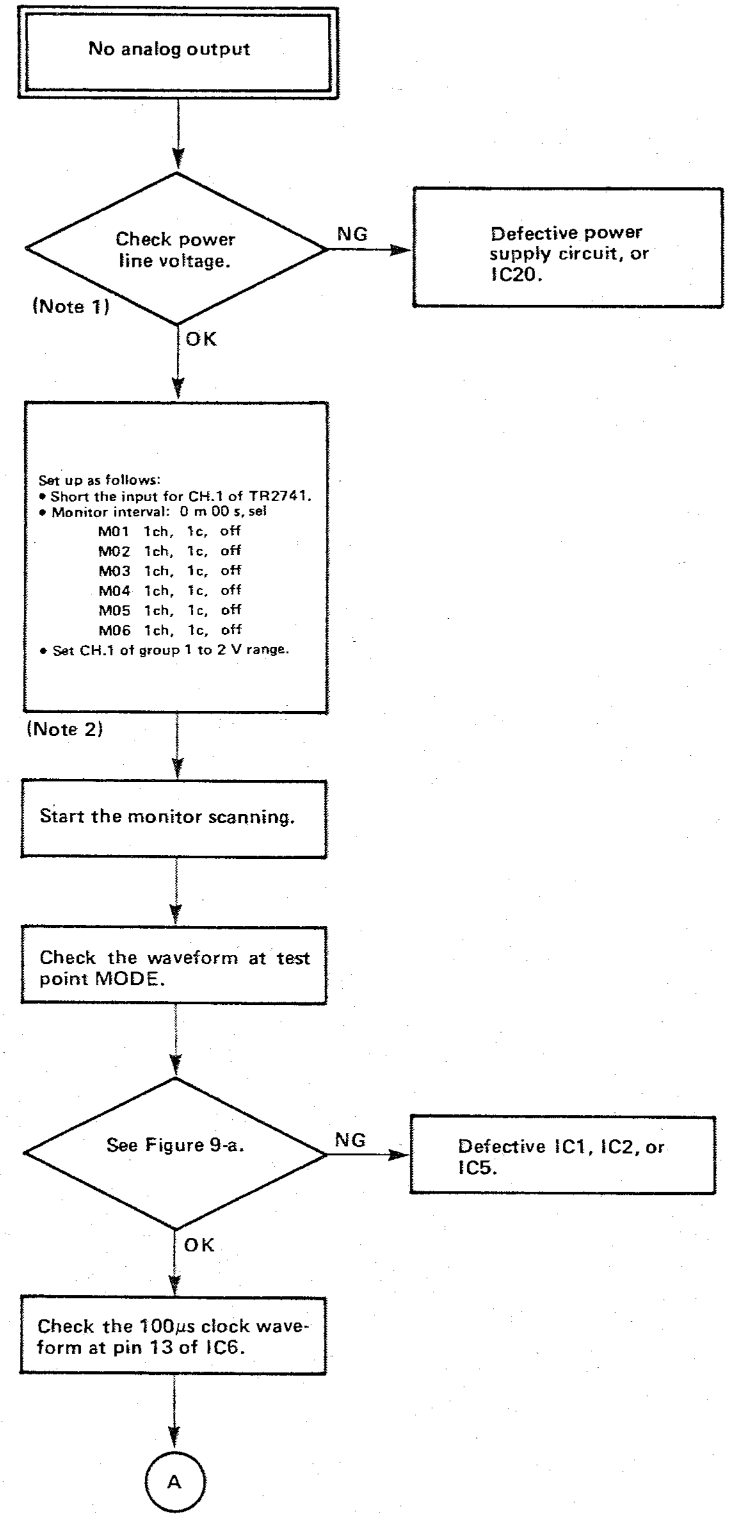


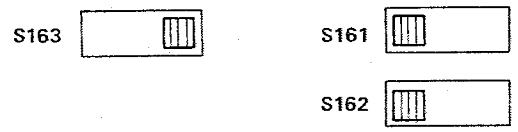
Figure 8-a

CHART 9-1 TR2730-550 Analog Output Option Card Troubleshooting (BGJ-010174, BLB-010175)



Note 1: Logic +5 V . . . . .Test point L.GND and card connector pins A and B2.
Analog +15 V . . . .Test point A.GND and test point +15
Analog -15 V . . . .Test point A.GND and test point -15
Analog +5 V . . . .Test point A.GND and IC16 pin 2.

Note 2: Set the board switches as shown below.



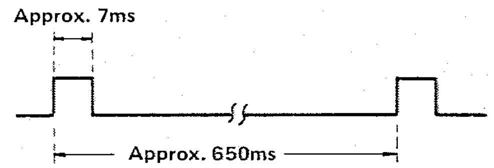


Figure 9-a

(A)

- See Figure 9-b. — NG → Defective IC6.
- OK ↓
- Check waveforms at test points CLK and ENBL.
- See Figure 9-c. — NG → Defective IC7 thru IC10.
- OK ↓
- Check waveforms at test point DATA, and at test point DATA on the board BLB-010175.
- Confirm that waveforms are equal. (Note 3) — NG → Defective CP31.
- OK ↓
- Check waveforms at test points CLK, MODE, and ENBL on board BLB-010175. (Note 4)
- Confirm that waveforms are identical to those shown in Figure 9-c. (Note 5) — NG → Defective CP32, CP33, CP34, or IC4.
- OK ↓
- Check the channel select signal at pins 3, 14, 2, 15, 1, and 6 of IC9 on the board BLB-010175.

(B)

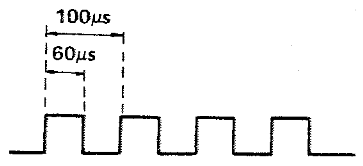


Figure 9-b

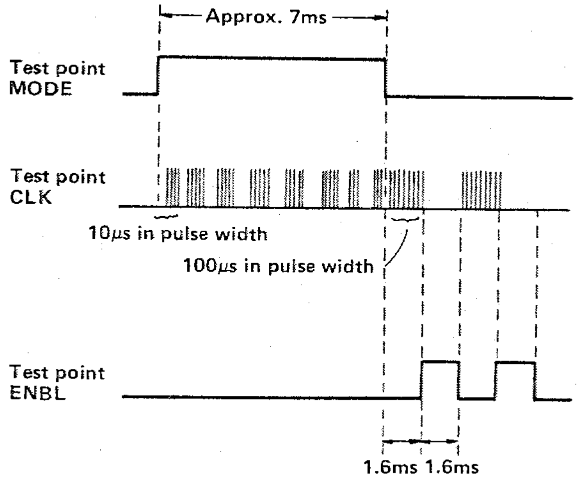


Figure 9-c

Note 3: Delay in passage through photocoupler.
Note 4: Use A.GND for GND.
Note 5: Photocoupler passage delay in respect to waveform in Figure 9-c.

(B)

- See Figure 9-d. — NG → Defective IC1, IC2, IC3, IC5, IC8, or IC9 on the board BLB-010175.
- OK ↓
- Check waveforms at test points ANA and COM.
- See Figure 9-e. — NG → Defective IC1, IC2, IC3, or IC5 thru IC8 on the board BLB-010175.
- OK ↓
- Measure the voltage at pin 2 of IC13, and at pins 2, 3, 9, and 10 of IC13.
- The voltage is +2.5 V? — NG → Defective IC13, IC15, IC17, IC18, IC19, or C123 thru C128.
- OK ↓
- Measure the voltage at pins 1 and 7 of IC17, pins 1 and 7 of IC18, and at pins 1 and 7 of IC19.
- The voltage is +2.5 V? — NG → Defective IC17, IC18, or IC19, or adjustment required for R95, R97, R99, R102, R104, or R106
- OK ↓
- Check the switches in the output stages for each channel.

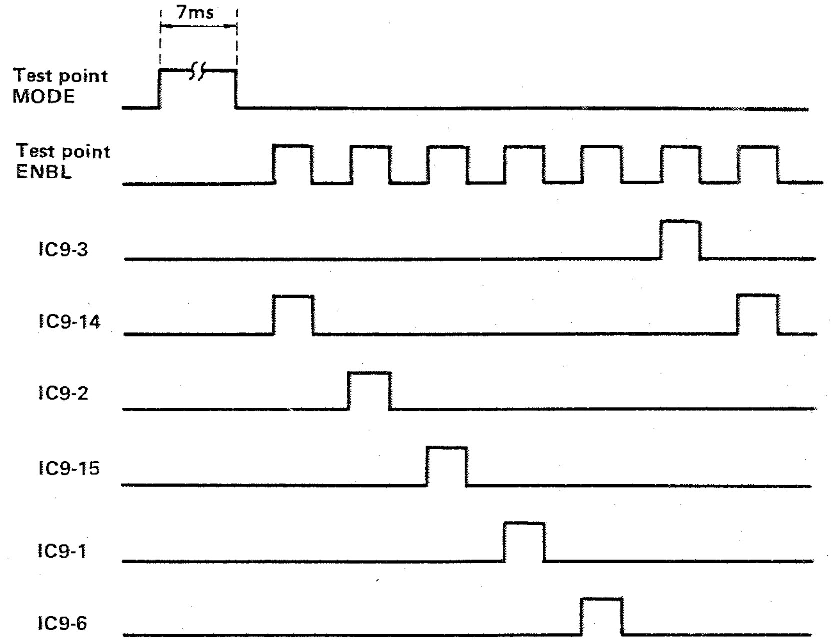


Figure 9-d

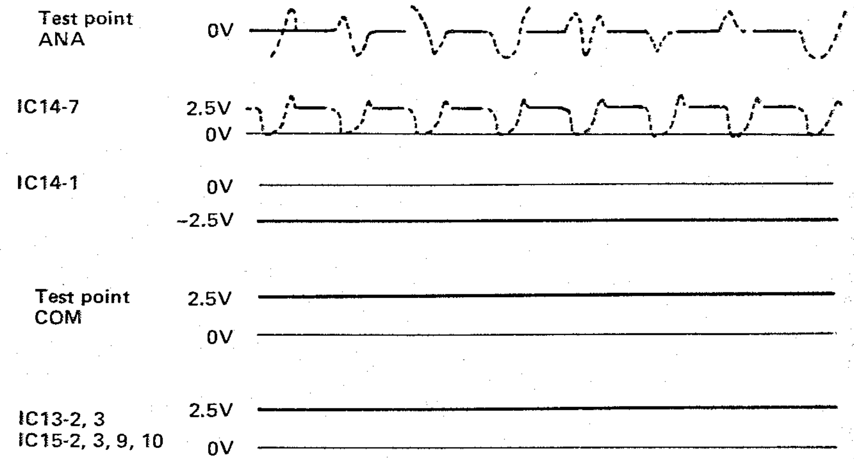
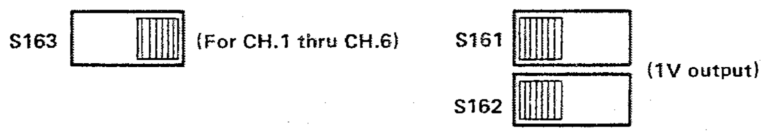


Figure 9-e

1) Perform the following specifications.

Monitor interval:	0m 01 s, sel (1 sec. selection mode)	
Monitor output channels	M01 2ch, 1c, off	Output of 3 intermediate digits in CH.2 measured data without offset to CH.1 thru CH.6 of the D/A output terminals.
	M02 2ch, 1c, off	
	M03 2ch, 1c, off	
	M04 2ch, 1c, off	
	M05 2ch, 1c, off	
	M06 2ch, 1c, off	
Channel program	G01 CH.1 2V range without scaling.	
	G02 CH.2 2V range without scaling.	

2) Set the TR2730-550 board switches as shown below.



3) Set R95, R97, R99, R102, R104, and R106 to center level positions.

4) Start the TR2731 monitor scanning.

5) Execute call channel in CH.1, connect the input cable to TR2741 CH.1, and short CH.2.

6) Apply the voltage between TR2730-550 test point COM (–) and test point CH.1 (+), and measure to adjust R107 to obtain reading of 0.0000V ±5 counts.

7) Connect the test point COM for (–) side and the test points of each channel for (+) side and measure the voltage for each connection. Then adjust the resistor for each corresponding channel to obtain readings of 0.0000V ±2 counts.

Channel	CH.1	CH.2	CH.3	CH.4	CH.5	CH.6
Adjustment resistor	R95	R97	R99	R102	R104	R106

8) Set the TR2731 channel program as follows.

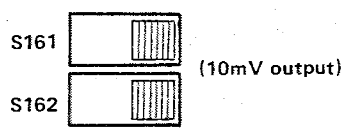
G02 CH.2 2V range scaling coefficient: A = –0.999, B = 1

9) Measure the voltage between test point COM and test point CH.1, and adjust R108 to obtain a reading of 0.9990V ±2 counts.

10) Set the TR2731 channel program as follows.

G01 CH.1 20mV range no scaling.

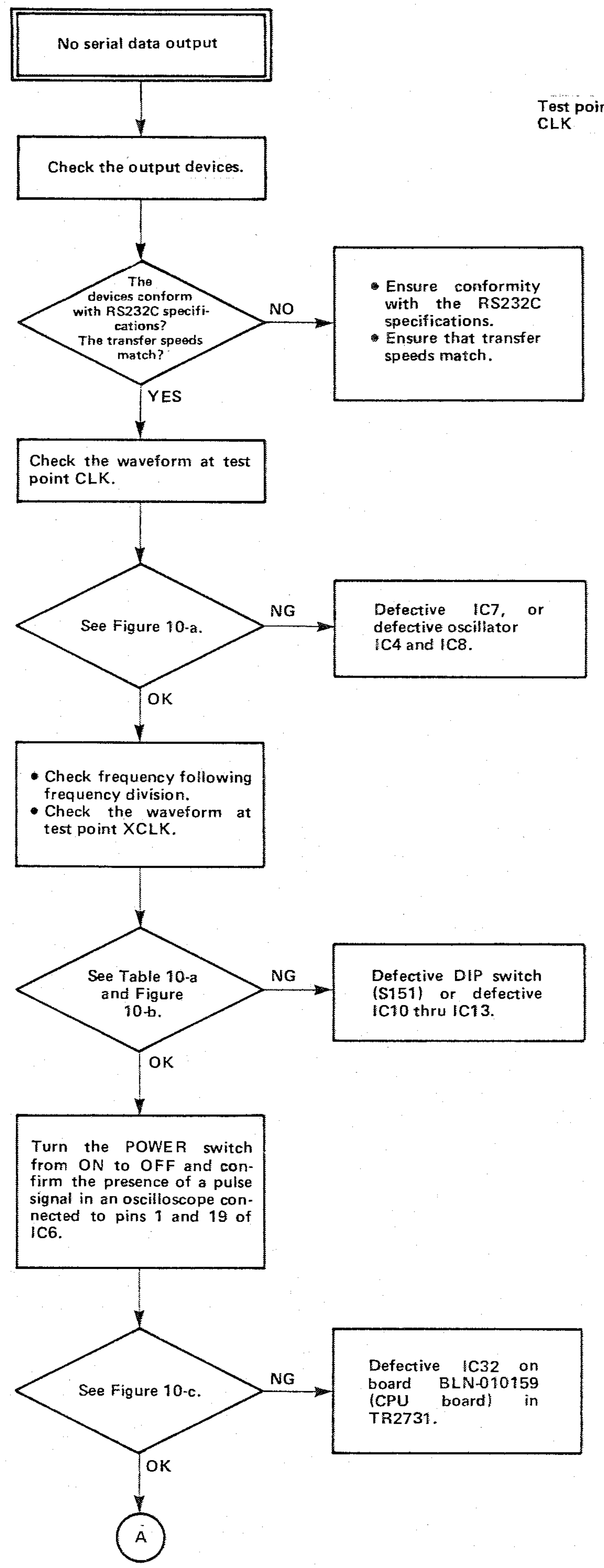
11) Set the TR2730-550 board switches as shown below.



12) Measure the voltages in the same way as in step 7, and adjust the corresponding resistors to obtain readings of 9.990V ±2 counts.

Channel	CH.1	CH.2	CH.3	CH.4	CH.5	CH.6
Adjustment resistor	R96	R98	R100	R101	R103	R105

CHART 10-1 TR2730-560 Serial Data Output Option Card Troubleshooting (BGJ-010176)



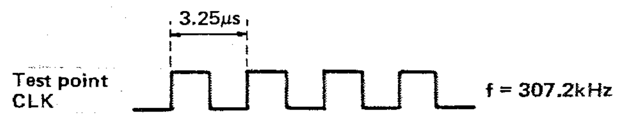


Figure 10-a

Table 10-a

Transfer rate (bit/s)	Frequency at test point XCLK (kHz)
300	4.8
600	9.6
1200	19.2
2400	38.4
4800	76.8
9600	153.6

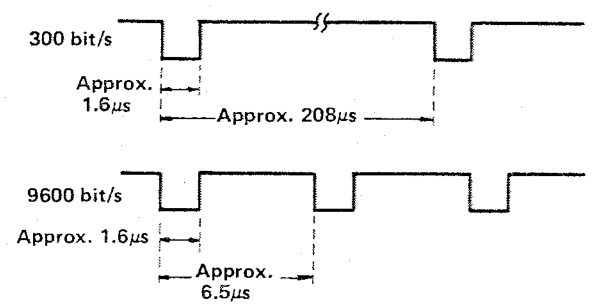
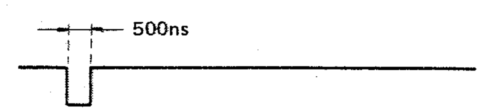


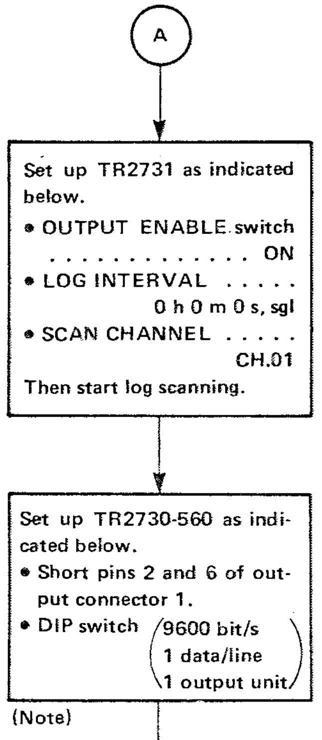
Figure 10-b

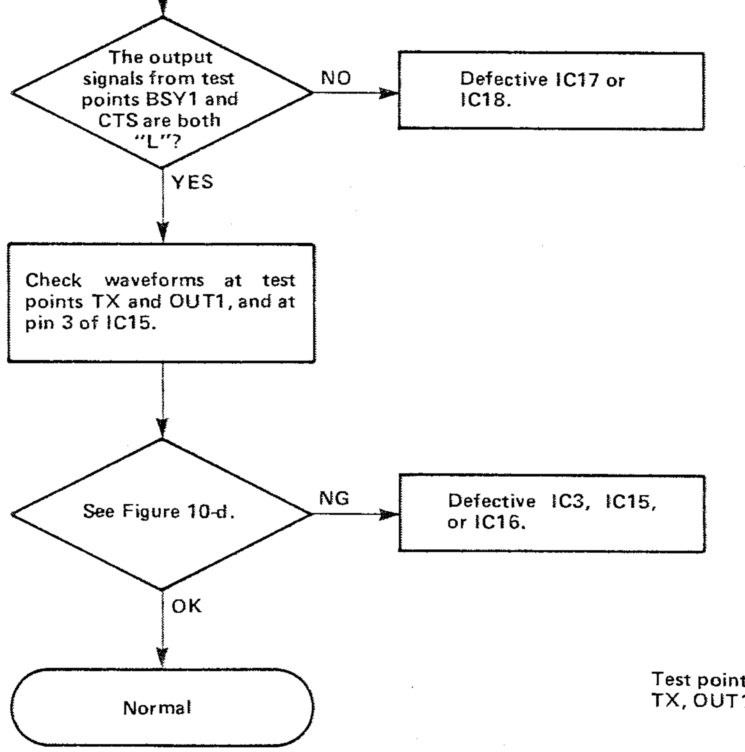


Outputs only one pulse when POWER switch is set to ON.

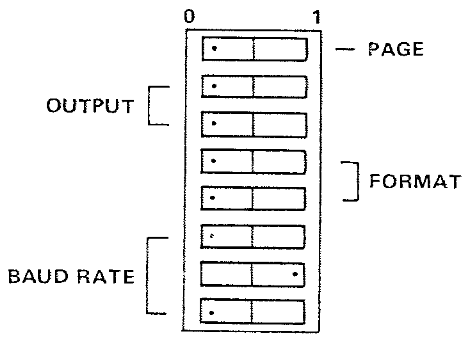
Figure 10-c

CHART 10-2 TR2730-560 Serial Data Output Option Card Troubleshooting (BGJ-010176)





Note: DIP switch settings are as follows.



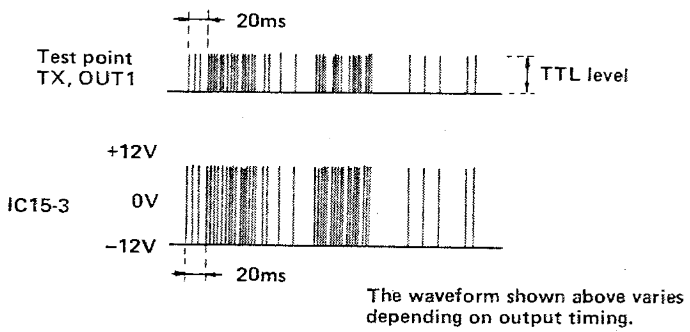
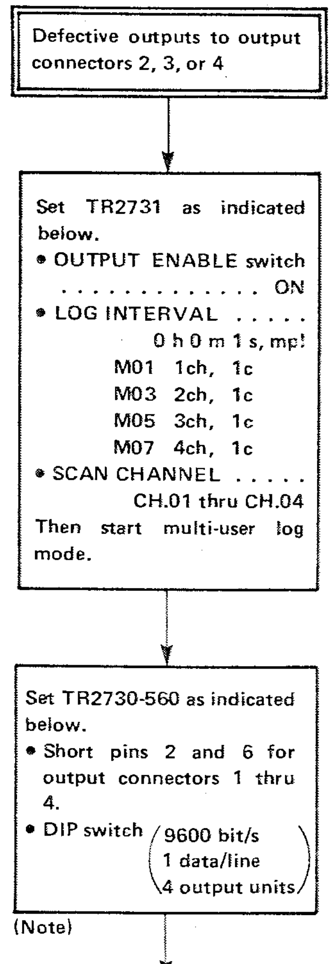
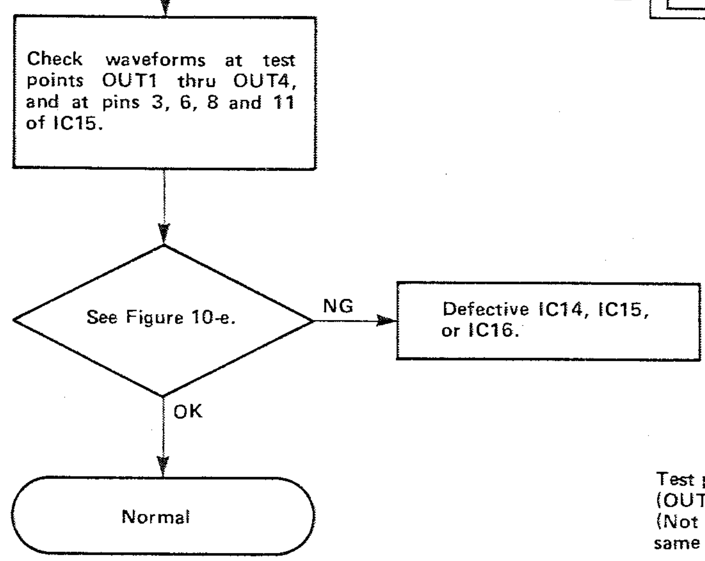
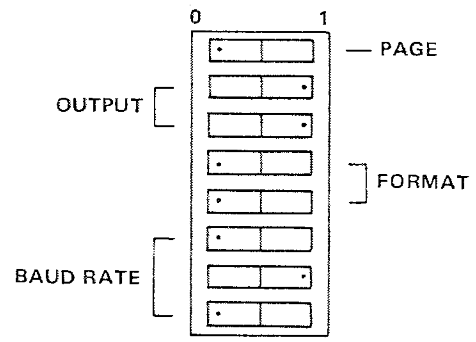


Figure 10-d





Note: DIP switch settings are as follows.



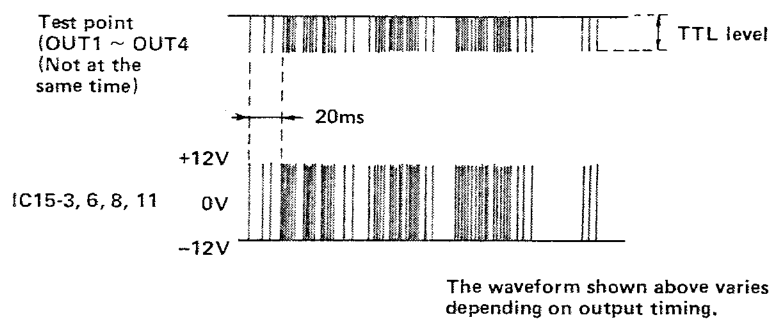


Figure 10-e

CHART 11 TR2730-570 Data Buffer Memory Option Card Troubleshooting (BGJ-010178)

Note: Check at the following points:
+5 V . . . . .Between card connector pins AB1 (GND) and AB2.
+12 V . . . .Between card connector pins AB1 (GND) and A3
-5 V . . . . .Between card connector pin AB1 (GND) and pin 2 of IC4.

- Defective data buffer card operation
- Check power line voltage. (Note)
  - NG → Defective TR2731 power supply circuit, or defective IC4 (if -5 V line is abnormal).
  - OK ↓
- Check waveforms at connector B5 (φ2), and at test points RAS, ROW, REF, COL, and CAS.
- See Figure 11-a.
  - NG → Defective circuit corresponding to defective waveform.
  - OK ↓
- Select NORM. mode, specify arbitrary scan channel, and start log scanning.
- Check the waveform at test point WE.
- See Figure 11-b.
  - NG → Defective IC1, IC3, IC7, IC11, or IC12.
  - OK ↓
- The counters IC23, IC27, IC24, and IC33 count up in response to pulse outputs from test point WE?
  - NG → Defective IC23, IC27, IC24, or IC33.
  - OK ↓
- The counter IC30 count up in response to pulse outputs from test point REF?
  - NG → Defective IC30.
  - OK ↓
- The RAM address lines (A0 thru A6) switch to IC26, IC29, and IC32 outputs in response to pulse outputs from test points ROW, COL, and REF?
  - NG → Defective IC26, IC29, or IC32.
  - OK ↓
- Normal

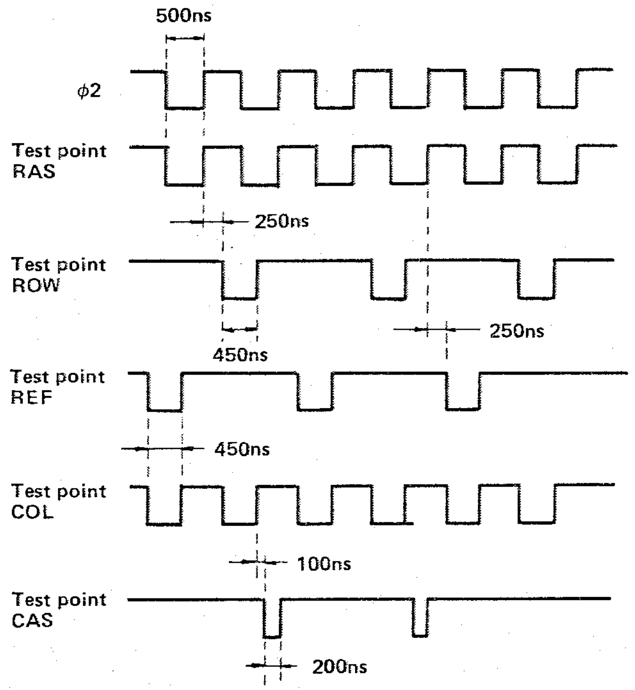


Figure 11-a

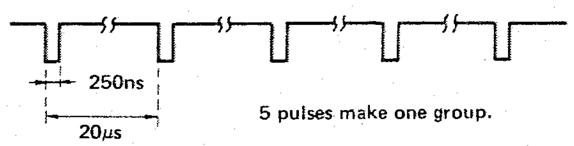


Figure 11-b

CHART 12-1 TR2730-580 Pulse Counter Option Card Troubleshooting (BGJ-010179 and BLB-010244)

- No inputs are counted.
- • For contact input
  Set S102 to ⌐_ mark side, and S101 to ⊥⊥⊥ mark side.
  • For pulse input or sine wave.
  Set S102 to ⊥⊥⊥ mark side, and S101 to ⊥⊥⊥ mark side if signal level is TTL level, or to ∿ mark side if signal level is a waveform with + and - amplitudes centered at 0 V.
  (board BGJ-010179)
- Check the switch settings.
  - NG → Set correctly.
  - OK ↓
- The input waveform level lies between 1 V_{p-p} and 10 Vp-p?
  - NO → Correct the input level.
  - YES ↓
- Connect a frequency generator to input connector CH.1, and apply a 5 kHz, ±5 V output.
- Check the output waveform at the J111 + terminal and pin 7 of IC27. (Note 1)
- See Figure 12-a.
  - NG → Defective IC27.
  - OK ↓
- Specify call channel in channel which is not counted, and execute call channel display.
- (A)

Note 1: Also check CH.2 thru CH.4 of the input connectors in the same way. In this case, check the output waveform between the J112 + terminal and pin 1 of IC27 for CH.2, between the J113 + terminal and pin 7 of IC26 for CH.3, and between the J114 + terminal and pin 1 of IC26 for CH.4.

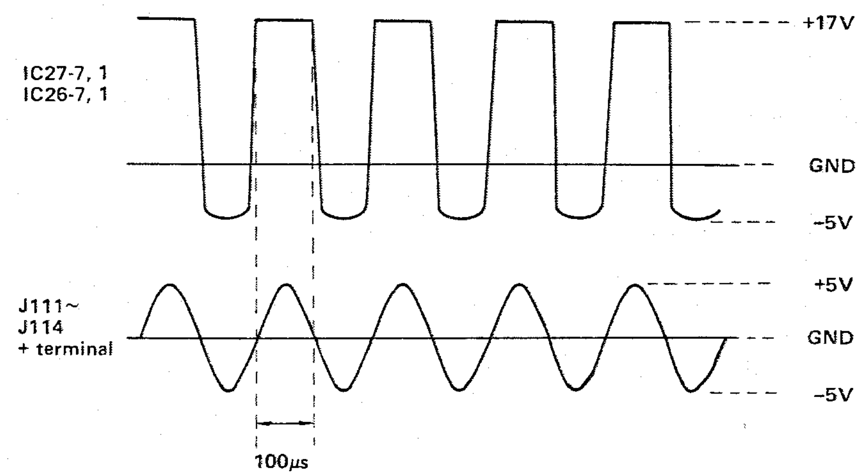


Figure 12-a

(A)

When the measuring mode is set to the 1-second gate, check the gate waveform of channel for which call channel was specified at pin 1 (CH.1), pin 10 (CH.2), pin 13 (CH.3), and pin 4 (CH. 4) of IC25.

See Figure 12-b.

- NG → **A 1-second clock output is obtained at test point CLK?**
  - NO → Defective S103 or IC22.
  - YES → Defective IC7, IC4, or IC10 on board BLB-010244 if waveforms at pins 1 and 10 of IC25 are defective, or defective IC8, IC5, or IC11 if waveforms at pins 13 and 4 of IC25 are defective.
- OK → Check test points I1, I2, I3, and I4.

A 5 kHz pulse is detected only while the 1-second gate is open?

- NO → Defective IC25.
- YES → Check the following counter IC outputs IC20 and IC23 (CH.1), IC13 and IC17 (CH. 2), IC11 and IC14 (CH.3), and IC5 and IC8 (CH.4).

The output is counted up when the gate is opened?

- NO → **The CLEAR1 thru CLEAR4 signals are normally "H" at all times?** (Note 3)
  - → Either of the counter ICs is defective.
  - → Defective IC1 on board BLB-010244.
- YES → Check the enable signal for data read buffer. (Note 2) → **(B)**

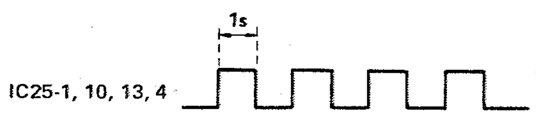


Figure 12-b

(B)

See Figure 12-c

- → Defective IC7.
- → Either of buffer ICs is defective.
  IC21 and IC24 for CH.1, IC16 and IC18 for CH.2, IC12 and IC15 for CH.3, and IC6 and IC9 for CH.4.

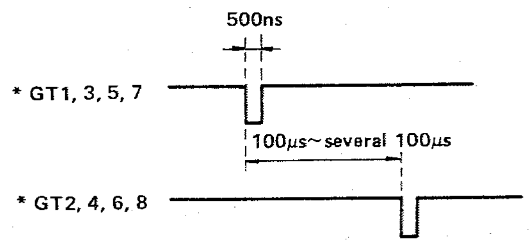


Figure 12-c

Note 2: Check the following positions for the corresponding channels.
CH.1 . . . . .IC7 pin 9 (*GT1) and pin 7 (*GT2)
CH.2 . . . . .IC7 pin 11 (*GT3) and pin 10 (*GT4)
CH.3 . . . . .IC7 pin 13 (*GT5) and pin 12 (*GT6)
CH.4 . . . . .IC7 pin 15 (*GT7) and pin 14 (*GT8)

Note 3: Check the following positions for the corresponding channels.
CH.1 . . . . .IC10 pin 8 (CLEAR1)
CH.2 . . . . .IC10 pin 10 (CLEAR2)
CH.3 . . . . .IC10 pin 4 (CLEAR3)
CH.4 . . . . .IC10 pin 2 (CLEAR4)

SECTION 14

CALIBRATION

14-1. GENERAL

The TR2731/2741 are calibrated on a regular basis (every six months) to ensure that the prescribed measuring accuracy (as indicated in sections 2-2 and 3-2) is maintained, and also after any repairs are carried out. The calibration procedures are described in this section. Note that parts numbers and symbols used in this section are the same as those marked in the circuit diagrams and inscribed on the circuit boards.

14-2. GENERAL PRECAUTIONS

(1) Calibrations require a power supply of 100 V ±10% and 50 Hz/60 Hz AC line. Always be sure to warm up the instrument for the prescribed period of time or more (30 minutes for the TR2741) before starting any calibration operations.

(2) Calibrations should be conducted within an ambient temperature range of $23^{\circ}C \pm 3^{\circ}C$ and at relative humidity no greater than 85%.

(3) Always allow the calibration equipments to warm up for the prescribed period of time.

(4) After completing the calibration, it is recommended to mark in the date, and the time limit for the next calibration on a card or label on the instrument.

14-3. PRELIMINARY PREPARATIONS

The equipments required for calibration purposes are listed in the following table. If equipment listed in this table is not available, use of other equipment of equivalent or better performance ratings is permitted.

Table 14-1 Equipment required for calibration purposes

Type of equipment	Performance rating	Recommended model
DC voltage standard	Output voltage: ±0 mV to ±20.000 V Calibration accuracy: ±0.001% of setting + ±0.0001% of range	TR6120 (by ADVANTEST)
DC voltage divider	Calibration accuracy: ±0.001% or better	TR1323 (by ADVANTEST)
Thermocouple [T(CC) type]	Unit with error of less than ±0.05°C near 0°C	
Reference cold junction unit	Unit with error of less than ±0.05°C near 0°C	TR7021 (by ADVANTEST)
DC voltmeter	Maximum resolution: at least 0.01 mV Accuracy: at least ±0.02% of rdg. ±2 counts	TR6875 (by ADVANTEST)
DC ammeter	Maximum resolution: at least 0.01 mA Accuracy: at least ±0.5% of rdg. ±5 counts	TR6840 (by ADVANTEST)

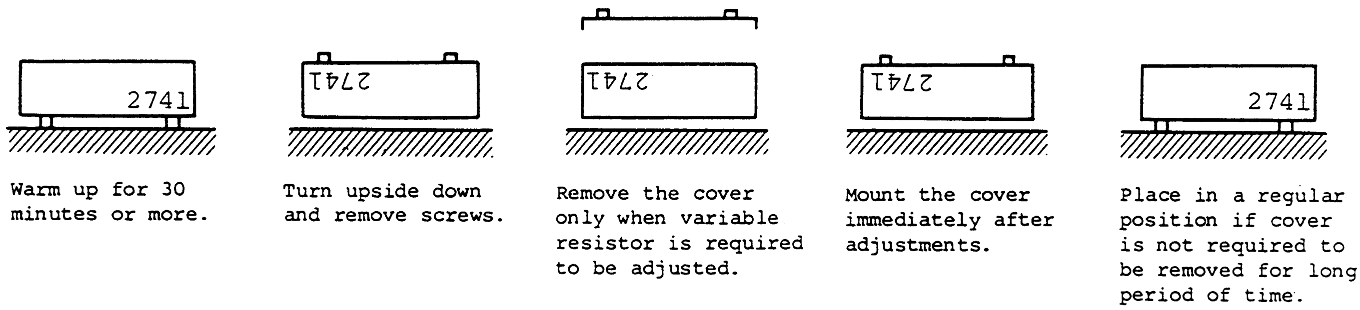
14-4. TR2741 CALIBRATION PRECAUTIONS

(1) The top and bottom covers must be removed for calibration purposes. See Figure 14-1 for the cover removal procedure.

(2) Calibration operations are performed without removing the shield box.

(3) Calibration procedures must always be performed in the prescribed sequence.

(4) The warm-up period ensures that the temperature inside the chassis reaches a fixed even level. Removal of the covers for calibration purposes should be performed in as short a period of time as possible.



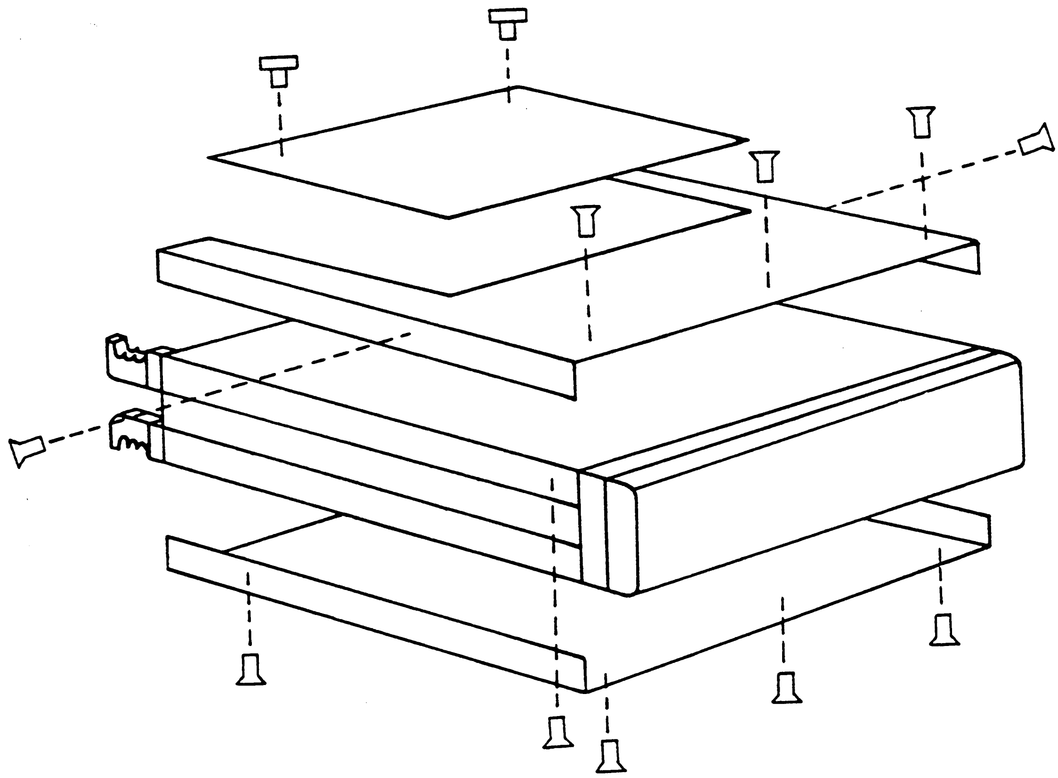


Fig. 14-1 Cover removal

14-5. CALIBRATION LOCATIONS

The calibration and test point locations are indicated in Figure 14-2 below.

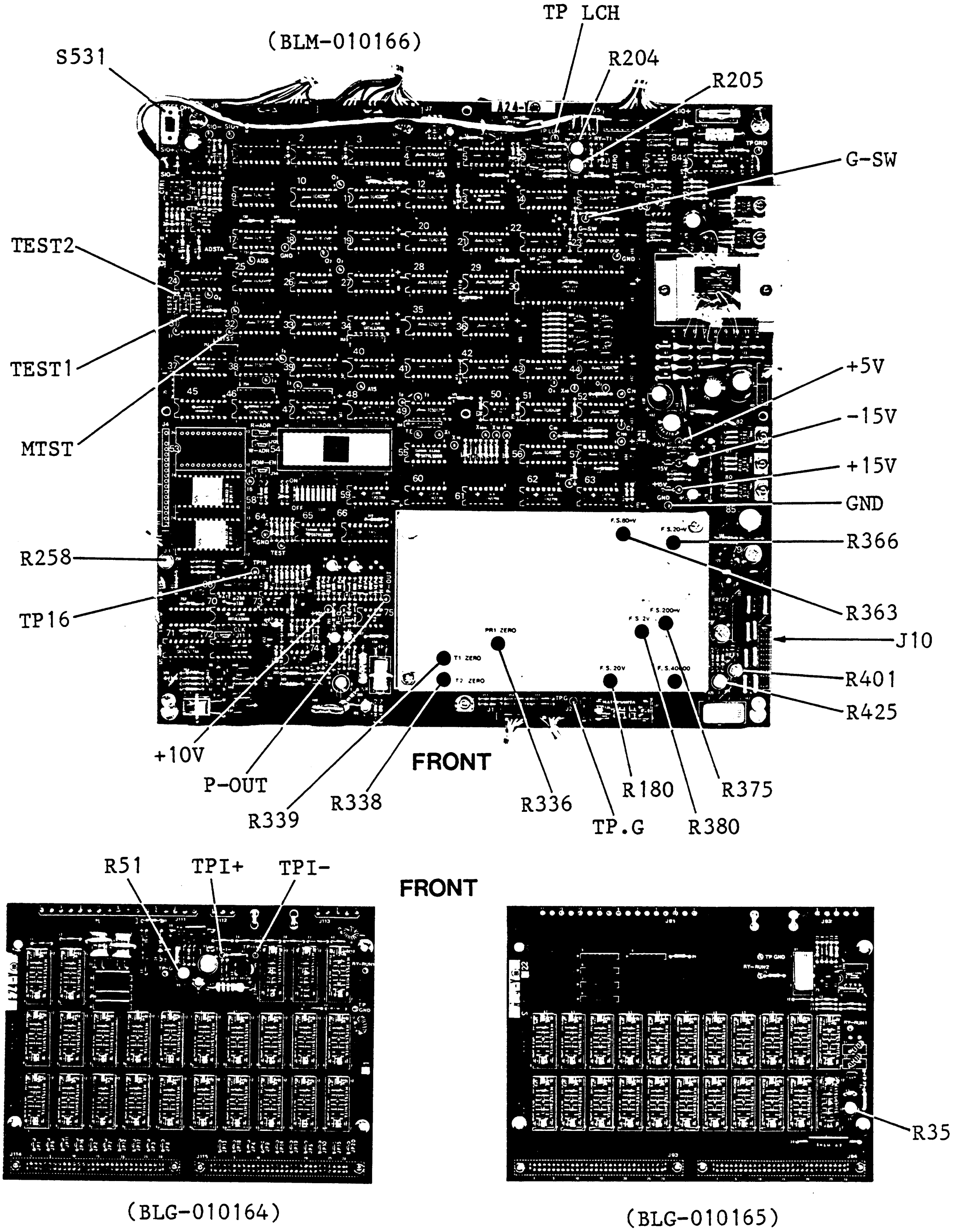


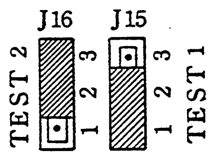
Fig. 14-2 Calibration and test point locations

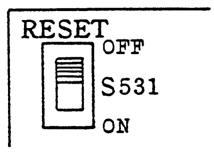
14-6. CALIBRATION PROCEDURES

14-6-1. Offset Adjustment

① Set TERMINAL NO. switch on the rear panel to "1-1".

② Remove the bottom cover, and set TEST1 (J15) and TEST2 (J16) with a shorting socket as shown below.





③ Switch S531 on, and then off again.

④ Connect a DC ammeter to test points TP.G and P-OUT.

⑤ Adjust R336 to obtain a reading as close as possible to 0 V within the 0 V ±0.2 mV range

⑥ Since the timer adjustment follows, leave the TEST1 and TEST2 settings unchanged.

14-6-2. Timer Adjustment

① Set the TERMINAL NO. switch to the same settings used for the offset adjustment.

② Connect test point MTST to the test points listed in Table 14-2 with a clip or similar means.

③ After setting the Terminal No. to the settings listed in Table 14-2, switch S531 on and off, and adjust the corresponding variable resistor control so that the RUN lamp on the front panel commes on.

Table 14-2 Timer adjustment

Terminal No.	Test point	VR control
0-0	TP16	R258
0-1	TP LCH	R204
0-1	G-SW	R205

④ After completing this adjustment, return the shorting socket, etc. to the former status.

14-6-3. Reference Voltage Adjustment

① Connect the voltmeter to the test point TP.G and +10 V.

② Adjust R401 to obtain a reading of +10.000 V ±1 mV.

③ If this reading cannot be obtained within the R401 range, change the J10 setting with a shorting socket and adjust R401 again.

④ After completing this adjustment, close the bottom cover (but without tightening the screws).

14-6-4. Zero Point and Full Scale Adjustments

① Connect the voltage divider (ATT.) and DC voltage standard to the input as shown in Figure 14-3.

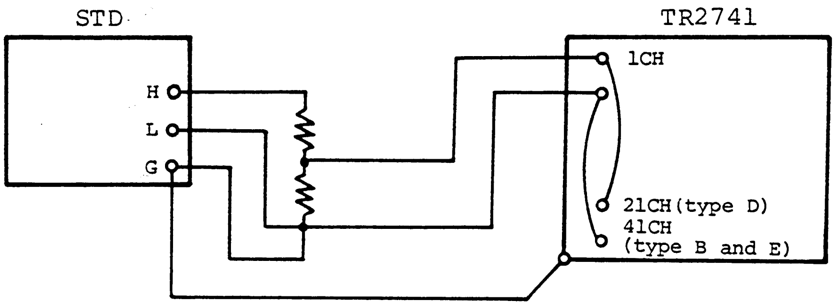


Fig. 14-3 Input connection

② Allow to warm up for about 20 minutes.

③ Adjust the level of the T1ZERO (R339) and T2ZERO (R338) variable resistor controls to the center of the variable range.

④ 200 mV range adjustment

Specify the 200 mV range to CH.1, and execute the call channel. Adjust to obtain the reading shown in Table 14-3. Repeat this step two or three times until the correct adjustment is made.

Table 14-3 200 mV range adjustment

STD. output voltage	Reading	Variable resistor control
+19.000 V	190.00 mV	F.S. 200 mV (R375)
0 V	0.00 mV	Check errors of ±1 count or better
-19.000 V	-190.00 mV	R425

⑤ 20 mV range adjustment

Specify the 20 mV range to CH.1, and execute the call channel. Adjust to obtain the reading shown in Table 14-4. Since the 0 V adjustment also results in displacement of the + full scale value, repeat this step two or three times to ensure that the adjustment is correctly made. (Adjust the variable resistor control F.S. 20 mV and T1ZERO alternately).

Since the reading does not change immediately when the variable resistor control is turned in this range, always wait for the reading to stabilize (approximately two seconds) each time the control is turned. If the correct reading is not obtained, the control must be turned again.

Table 14-4 20 mV range adjustment

STD. output voltage	Reading	Variable resistor control
+19.000 V	190.00 mV	F.S. 200 mV (R366)
0 V	0.00 mV	T1ZERO (R339)
-19.000 V	-190.00 mV	Check errors of ±2 counts or better

For the TR2741B, D, and E types, adjust with the following channels only for the 0 V adjustment.

TR2741B .... CH.41 }
TR2741D .... CH.21 } Adjust T2ZERO (R338)
TR2741E .... CH.41 }

⑥ Temperature range adjustment

Specify the "CC:T, ext, off" range to CH.1, and execute the call channel. Adjust to obtain the reading shown in Table 14-5. If there is a small amount of fluctuation in the reading, take the center of the fluctuation.

Table 14-5 Temperature range adjustment

STD. output voltage	Reading	Variable resistor control
+7.9000 V	79.000 mV	F.S. 80 mV (R363)
0 V	0.000 mV	Check errors of ±2 counts or better.

⑦ 2 V (20 V) range adjustment
Disconnect the voltage divider, and apply the voltage from STD. directry to the TR2741 input terminal. Set the 2 V range (20 V range) to CH.1, and execute the call channel. Adjust to obtain the reading shown in Table 14-6.

Table 14-6 2 V and 20 V range adjustments

	STD. output voltage	Reading	Variable resistor control
2 V range	+1.9000 V	1.9000 V	F.S.2 V (R382)
	0 V -1.9000 V	0.0000 V -1.9000 V	Check errors of ±1 count or better.
20 V range	+19.000 V	19.000 V	F.S.20 V (R180)
	0 V -19.000 V	0.0000 V -19.000 V	Check errors of ±1 count or better.

14-6-5. Power Suppy Current Adjustment (TR2741C/D/E types)

① Reset the call channel if being executed.

② Open the top cover, and connect an ammeter to test points TPI+ and PTI-. Adjust R65 to obtain a reading of 1.00 mA ±0.01 mA.

14-6-6. Internal Reference Junction Compensation Circuit Adjustment (TR2741A/B/E types)

① Connect a T type (copper-constantan) standard sensor to CH.23, and place the sensor in an automatic reference cold junction unit (which has been allowed to warm up for the prescribed period of time).

② Leave the system in this condition for at least 15 minutes.

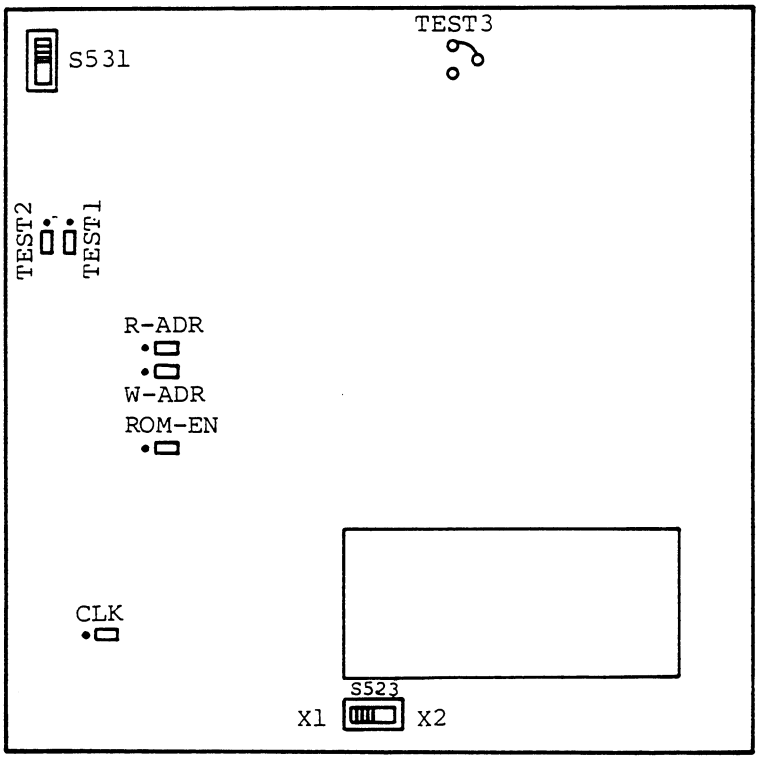
③ Specify the "CC:T, into, on" range to CH.23, and execute the call channel.

④ Remove the top cover, and adjust R35 to obtain a reading equivalent to the automatic reference cold junction calibration minus the sensor calibration.

⑤ For the TR2741B type, also calibrate in the same way for CH.63.

14-6-7. Shorting Socket and Switch Settings

The correct positions for the TR2741 shorting sockets and switches are shown in Figure 14-4. Correct operation is ensured when connected to the TR2731 in this condition.



Note: Some type of board contains no S523.

Fig. 14-4 Correct shorting socket and switch positions

MEMO

SECTION 15
PARTS LIST

15-1. OUTLINE

This section lists the electrical and mechanical parts used in the TR2731/2741 Computing Data Logger. When replacing parts due to failure, check the ratings and use parts having equivalent ratings. Order electrical and mechanical parts from ADVANTEST or your nearest representative by part and stock numbers.

NOTE

> These specifications may be changed without prior notice by user requirements or improvement of Takeda Riken's quality control.

15-2. SYMBOLS AND ABBREVIATIONS

Table 15-1 lists the symbols and abbreviations used in this manual, including the circuit diagrams, and Tables 15-2 and 15-3 list the signal names.
(See Appendix "Abbreviations" for the abbreviations inscribed on the front panel, displayed in the display section and printed in output paper.)

REFERENCE DESIGNATIONS

- C : Capacitor
- CO: Coil
- Ca: Cable
- F : Fuse
- FH: Fuse Holder
- IC: Integrated Circuit
- J : Electrical Connector, Jack
- L : Coil, Inductor
- Q : Transistor
- R : Resistor
- S : Switch (Slide, Lever, Push Button)
- SW: Rotary Switch
- T : Transformer
- TP: Test Point (Check Point)
- X : Crystal

MULTIPLIERS

Abbrebiation	Prefix	Multiple
G	giga	10^9
M	mega	10^6
k	kilo	10^3
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}

ABBREVIATIONS

A	ampere
AC	alternating current
ADJ.	adjustment
A/D	analog-to-digital
AMP.	amplifier
ATT.	attenuator
ASTIG.	astigmatism
ANT.	antenna
AUTO	automatic,-operation
BCD	binary coded decimal
B.P.F.	bandpass filter
B.W.	bandwidth
CAR	carbon
CAL.	calibrate
CER	ceramic
cm	centimeter
COM.	common
CRT	cathode-ray tube
D/A	digital-to-analog
dB	decibel
dBm	decibel referred to 1mW
dBμ	decibel(0dBμ=1μVrms.)
DC	direct current
DET.	detector
DIV.(div.)	division
DISP.	dispersion
ELECT	electrolytic
EXT.	external
F	farad
FET.	field-effect transistor
FM	frequency modulation
FREQ.	frequency
FXD	fixed
FLM	film
g	gram
GHz	gigahertz
GND	ground
H	henry
h	hour

Table 15-1 Abbreviations

HI	high	OPT.	option
H.P.F.	high-pass filter	OSC.	oscillator
Hz	Hertz	Ω	ohm
H.POSI.	Horizontal Position	OUT.	output
H.GAIN	Horizontal Gain		
		p	peak
IC	integrated circuit	pF	picofarad
IF	intermediate frequency	PL	phase lock
INT	internal	PLO	phase lock oscillator
		PM	phase modulation
kg	kilogram	p-p	peak-to-peak
kHz	kilohertz	PPM	pulse-position-modulation
kΩ	kilohm	PRF	pulse-repetition frequency
kV	kilovolt	ps	picosecond
		POSI.	position
LED	light-emitting diode	PNP	positive-negative-positive
LIN.	linear		
LO	low, local oscillator	Q.P.	Quasi Peak Value
LOG.	logarithm		
L.P.F.	low-pass filter	REF.	reference
LEV.	level	RF	radio frequency
		rms.	root-mean-square
m	meter		
mA	milliampere	SI	silicon
MAX.	maximum	s	second(time)
MΩ	megohm	S.G.	signal generator
mg	milligram	SSB	single sideband
MHz	megahertz	S.W.R	standing-wave ratio
MIN.	minimum		
min.	minute(time)	T	timed(slow-blow fuse)
mm	millimeter	TTL	transistor-transistor logic
MOD.	modulator	TV	television
ms	millisecond	TP	test point
mV	millivolt		
mVrms.	millivolt rms	VAR	variable
mW	milliwatt	V	volt
μA	microampere	VA	voltampere
μF	microfarad	VCO	voltage-controlled oscillator
μH	microhenry	VFO	variable-frequency oscillator
μs	microsecond	Vp-p	volts peak-to-peak
μV	microvolt	Vrms.	volts rms
μVrms.	microvolt rms	V.S.W.R.	voltage standing wave ratio
μW	microwatt	V.POSI.	vertical position
MANU.	manual	V.GAIN	vertical gain
MIX.	mixer	W	watt
		YIG.	yttrium-iron-garnet
NPN	negative-positive-negative		
nA	nanoampere	1st	the first
NC	no connection	2nd	the second
NORM.	normal	3rd	the third
ns	nanosecond		
nW	nanowatt		

Table 15-1 Abbreviations

Table 15-2 TR2741 signals

Signal name	Function
ADEND	Second integration end pulse
ADSTR	A/D conversion start pulse
DR	Strobe signal indicating that the data of RBR1 through RBR8 is established
I0 - I6	CPU data fetch pulse
O0 - O5	Latch pulse of the data output port from CPU
RBR1 - RBR8	This signal makes TR2731 to output one byte data.
SIO+, SIO-	Intercommunication serial signal with the TR2731
TBRE	The signal indicating that one byte data output to the TR2731 is completed.
1st	This signal determines the first integration time of the A/D converter.
2nd	The signal indicating the second integration of the A/D converter

Table 15-3 TR2731 signals

Signal name	Function
BAT+V	Internal battery voltage signal
CLEAR1 - 4	Counter IC clear signal for CH.1 through CH.4
DSPCLK	DC/DC converter input clock for the fluorescent-tube display heater power supply
ENB signal	This signal indicates the displayable timing in a dynamic illumination display.
GT1 - GT8	Data readout gate signal of the counter IC for CH.1 through CH.4
$\overline{IRQ}$	Interruption request signal for μCPU
$\overline{NMI}$	Non maskable interruption request signal
$\overline{RES}$	Reset signal for μCPU initialization
*RESET I	Reset signal I for overall internal circuit
RTC clock	Realtime clock (pulses for every 10 seconds)
TSC	Control signal used to maintain μCPU data bus and address bus in a high impedance state

Note: The symbol $\overline{\quad\quad}$, which is indicating a negative logic, is replaced with * in the circuit diagram.

TR2731
MECHANICAL PARTS LIST
FRAME & CABINET

Fig. & INDEX No.	Stock No.	Description	Qty
15-1 1	MMX-10270A-1	HANDLE, carrying	1
2	MPX-15065A-1	COVER B, side	1
3	MHT-17737A	FRAME B, side	1
4	MKN-10442A-1	SPACER, handle	2
5	MPX-15064A-1	COVER A, side	1
6	MBS-17721B	PANEL, front	1
7	MPX-10295A-1	BELT COVER, bottom	1
8	MHT-17723B	SUBFRAME, bottom	1
9	MHT-17724B	SUBFRAME, top	1
10	MMX-11091A-1	BELT COVER, top	1
11	MPX-17739A	COVER, top	1
12	MEX-11053A-1	FOOT B, stack	2
13	MPX-10293A-1	PROTECTOR, side	8
14	MCT-10162A-1	CORNER, side	2
15	MPX-15069A-1	BELT COVER, side	2
16	MMX-10267A-1	FOOT, rear	4
17	MPX-10295A-1	COVER, side	1
18	MBX-10202A-1	PLATE, side	4
19	MHT-17736A	FRAME A, side	1
20	MPX-17740B	COVER, bottom	1
21	MMX-11092A-1	FOOT A, stack	2

TR2731
MECHANICAL PARTS LIST
FRONT PANEL & CIRCUIT BOARD ASSEMBLY

Fig. & INDEX No.	Stock No.	Description	Qty
15-2 1	MBS-17721B	PANEL, front	1
2	MEE-18692A	ESCUTCHEON	1
3	MBZ-17690A	HOLDER, display	1
4	MBZ-17722B	HOLDER, transformer	1
5	MPX-17981B	FILTER, display	1
6	MMX-10278A-1	CAP, acrylicresin	14
7	MBT-17717B	CORNER, center	1
8	MHT-17737A	FRAME B, side	1
9	MEX-17693A	CUSHION, display	1
10	MBZ-17708A	HOLDER, pcb	4
11	MPX-15081A	SPACER, LED	14
12	MBJ-17726D	PLATE, shield	1
13	KSE-000401-1	SWITCH, POWER	1
14	MBZ-17709B	HOLDER, switch	1
15	MBZ-18304B	COVER, battery	1
16	MBZ-17729D	CASE, battery	1
17	MBZ-17718B	PLATE, magnet	1
18	MPX-17734C	RAIL A, printer	1
19	JTT-AA003EX01-1	LUG, tight	1
20	MBJ-17691G	HEAT SINK A	1
21	MBJ-17692C	HEAT SINK B	1
22	MHJ-17731B	SUPPORTER A	1
23	YEE-000151	GUIDE, pcb	6
24	MBJ-17712D	HOLDER A, guide	1
25	MHJ-17741C	SUPPORTER B	1
26	JCB-AD048JX03-1	CONNECTOR	6
27	MBJ-17727F	SUPPORTER, board	1
28	MPX-17733D	RAIL B, printer	1
29	MHJ-17742A	HOLDER, board	1
30	MBJ-17728E	HOLDER B, guide	1

TR2731

MECHANICAL PARTS LIST

FRONT PANEL & CIRCUIT BOARD ASSEMBLY

Fig. & INDEX No.	Stock No.	Description	Qty
15-2 31	MSB-17735C	PANEL, rear	1
32	MHJ-17713A	SUPPORTER C	2
33	MHJ-17714B	SUPPORTER D	1
34	MHJ-17730B	SUPPORTER E	1
35	YEE-000491-1	GUIDE, option board	5
36	MBJ-17738C	CHASSIS, guide	1
37	MHT-17736A	FRAME A, side	1
38	YEE-000291-1	CLAMP, nylon	1

TR2731
MECHANICAL PARTS LIST
REAR PANEL ASSEMBLY

Fig. & INDEX No.	Stock No.	Description	Qty
15-3 1	MBT-14704A-1	GUARD, fan	1
2	MEX-10496A	FILTER, fan	1
3	DMF-000107-1	FAN MOTOR	1
4	MBT-17725A	SPACER, fan motor	1
5	MBT-17711A	PLATE A, blank	4
6	MBT-17707A	PLATE B, blank	1
7	MKN-12026A	SPACER, fan	4
8	FH-003	HOLDER, fuse	1
9	DNF-000207-1	CABLE ASSEMBLY, AC power	1
10	MBS-17735C	PANEL, rear	1
11	TOP-23A	LUG, GND	1
12	JCS-AX010JX01-1	CONNECTOR	2

TR2731
MECHANICAL PARTS LIST
PRINTER ASSEMBLY

Fig. & INDEX No.		Stock No.	Description	Qty
15-4	1	MBS-17716D	PANEL, printer	1
	2	MBJ-18299E	COVER, connector	1
	3	AAA-EUY10T331R	ASSEMBLY, printer	1
	4	MKZ-15312A-1	SPACER, connector	2
	5	MKX-17982B	SPACER, printer	4
	6	MEX-17983D	GUIDE, paper	1
	7	JCB-AB015JX01-1	CONNECTOR	1
	8	MBZ-18300A	HOLDER, connector	1
	9	MBN-18303C	GUIDE, paper	1
	10	MKN-17720B	STOPPER	1
	11	MBN-17732D	CASE, paper	1
	12	MKN-17719C	SLIDING SHAFT	4
	13	MBJ-17743E	HOLDER, paper case	1
	14	MBJ-18302B	HOLDER, magnet	1
	15	YEE-000512	MAGNET	1
	16	MBZ-18301A	NUT	1

TR2741
MECHANICAL PARTS LIST
FRAME & CABINET

Fig. & INDEX No.	Stock No.	Description	Qty
15-5 1	MMX-10270A-1	HANDLE, carrying	1
2	MPX-15064A-1	COVER B, side	1
3	MHT-17776B	FRAME B side	1
4	MKN-10442A-1	SPACER, handle	2
5	MPX-10295A-1	COVER A, side	1
6	MPX-15081A	SPACER, LED	2
7	MMX-10278A-1	CAP, acrylicresin	2
8	MBS-17773B	PANEL, front	1
9	MHT-17770A	SUBFRAME, upper	1
10	MHT-17770A	SUBFRAME, lower	1
11	MMX-11091A-1	BELT COVER, lower	1
12	MPX-15074A-1	BELT COVER, upper	1
13	MBX-17777C	COVER, top	1
14	MBX-18912A	HOLDER, cover	1
15	MBJ-18913A	SUPPORTER, cover	1
16	MBX-17778D	COVER, terminal board	1
17	YFA-D00579	FASTENER, terminal board	2
18	MMX-10267A-1	FOOT, rear	4
19	MPX-10293A-1	PROTECTOR, side	8
20	MPX-15065A-1	COVER, side	1
21	MHT-17776A	FRAME A, side	1
22	MMX-11092A-1	FOOT A, stack	2
23	MBX-17247A	COVER, bottom	1
24	MPX-17779A	BELT COVER, side	2
25	MCT-10163A-1	CORNER, side	2
26	MEX-11053A-1	FOOT B, stack	2

TR2741
MECHANICAL PARTS LIST
CIRCUIT BOARD ASSEMBLY

Fig. & INDEX No.		Stock No.	Description	Qty
15-6	1	MBJ-17678A	HEAT SINK	1
	2	MBJ-17676B	HOLDER, transformer	1
	3	MEX-17677B	CUSHION, transformer	1
	4	MBS-17985B	CASE, shield	1
	5	MKN-10438A-1	SPACER, case	2
	6	YEE-000087	CLIP, plastic	3
	7	MKN-17763B	SHAFT, board	4
	8	MKN-12965A-1	SPACER, pcb	8/4
	9	MKN-10433A-1	SPACER BOLT	5
	10	MPX-18319A	BLANK PANEL B	(1)
	11	MBA-17986B	BLANK PANEL A	(1)
	12	MKE-17679B	HEAT SINK	1/2
	13	MMX-17675B	TERMINAL C (black)	-
		MMX-18044A	TERMINAL D (red)	-
	14	MBJ-17775D	CHASSIS, guard	1
	15	MMX-10487A	SPACER	6
	16	MMX-10486A	GROMMET	6
	17	MHT-17776A	FRAME A, side	1
	18	YEE-000199-1	RIVET, plastic	2

Note: 1. BLANK PANEL A and B are mounted only for type A and C.
2. Quantity of (8) SPACER and (12) HEAT SINK are dependent on the type of the sensor terminal as listed in the table below.

Model	SPACER	HEAT SINK
A, C	4	1
B, D, E	8	2

TR2741
MECHANICAL PARTS LIST
REAR PANEL ASSEMBLY

Fig. & INDEX No.		Stock No.	Description	Qty
15-7	1	MBS-17774D	PANEL, rear	1
	2	JCP-AX002JX01-1	CONNECTOR, J9, EXT. START/STOP	1
	3	KSL-000034-1	SWITCH, slide, POWER	1
	4	JCS-AX010JX01-1	CONNECTOR, J7, J8	2
	5	JTE-AG001EX01-1	LUG, GND	1

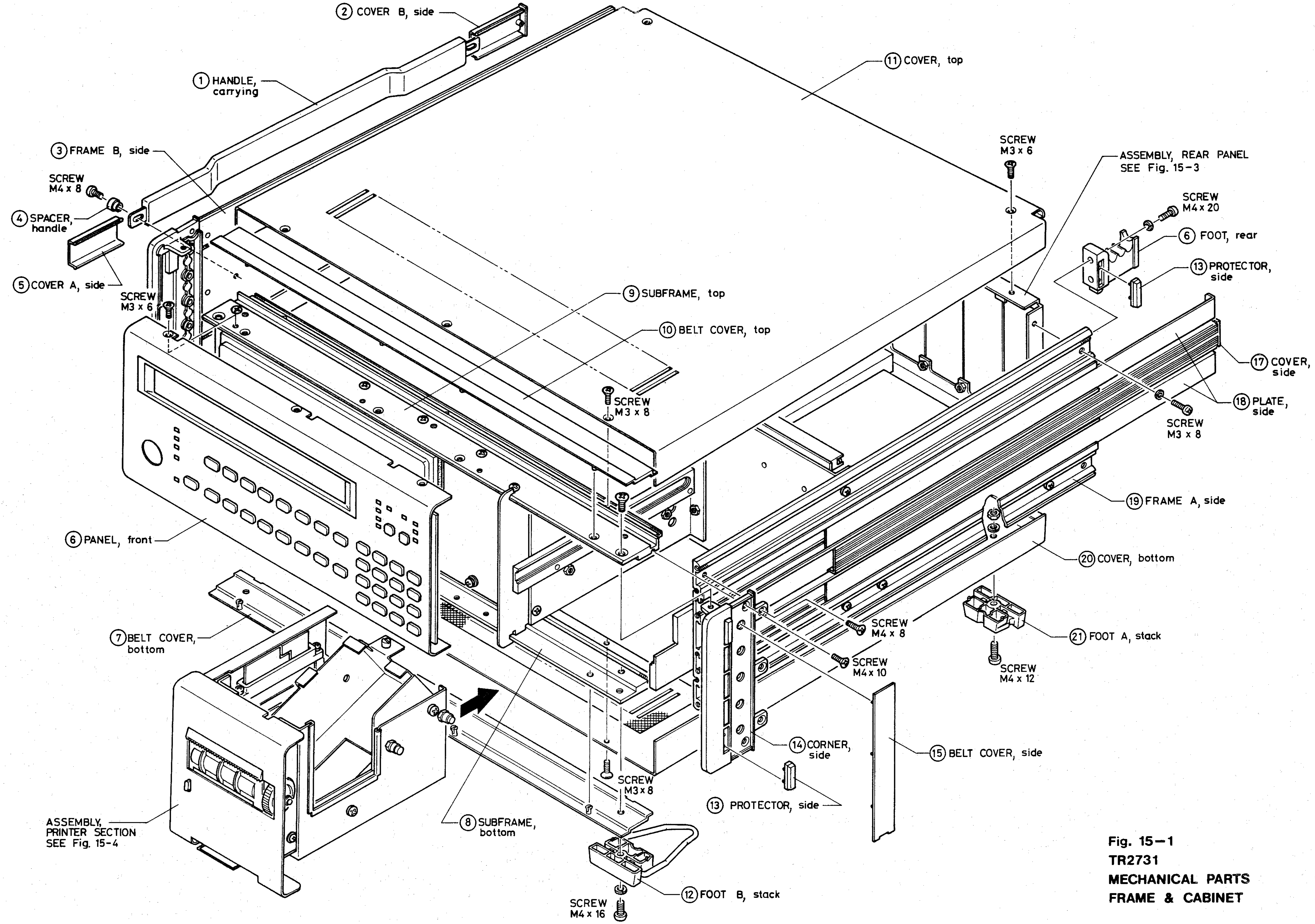


Fig. 15—1
TR2731
MECHANICAL PARTS
FRAME & CABINET

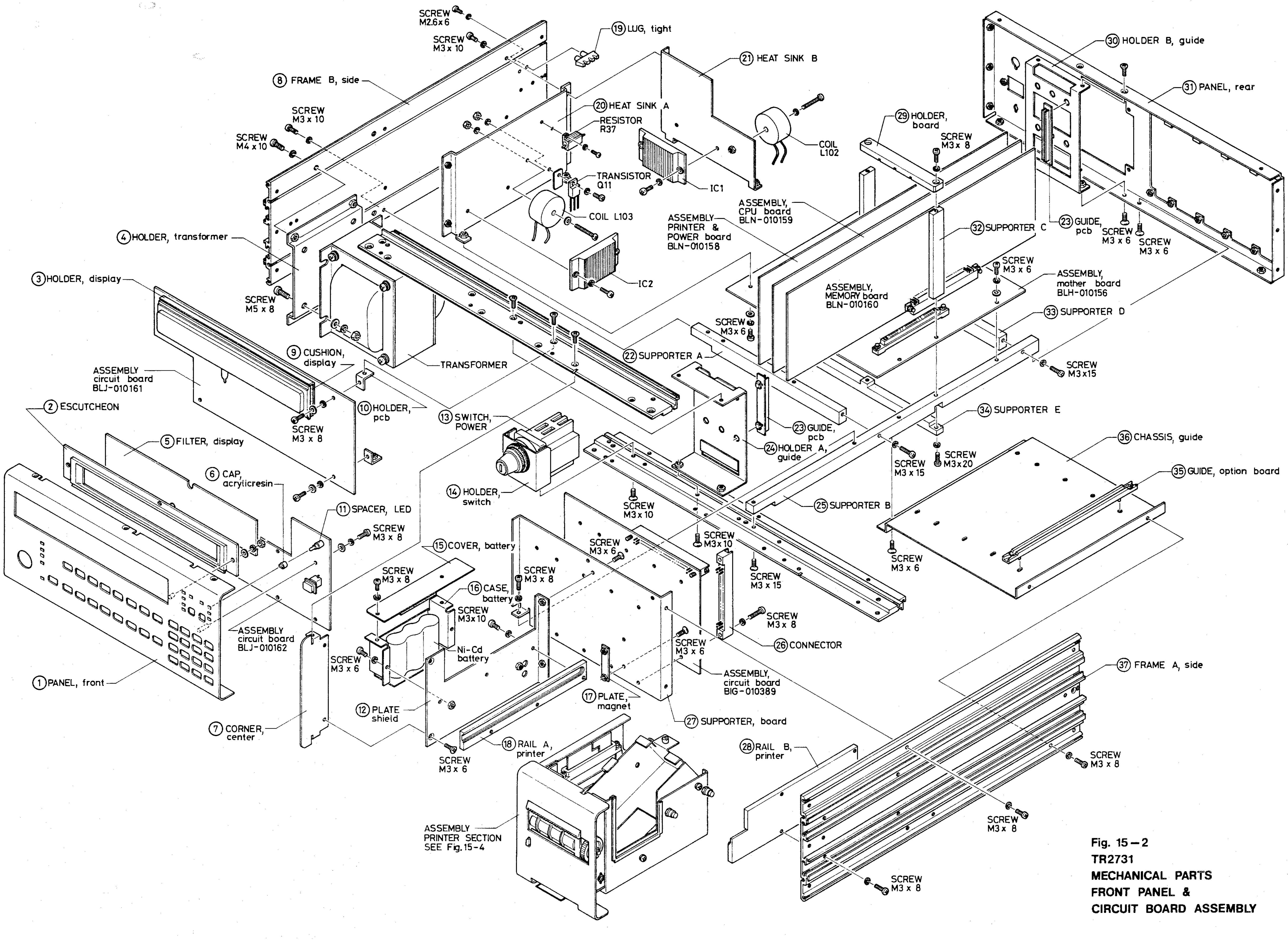


Fig. 15 – 2
TR2731
MECHANICAL PARTS
FRONT PANEL &
CIRCUIT BOARD ASSEMBLY

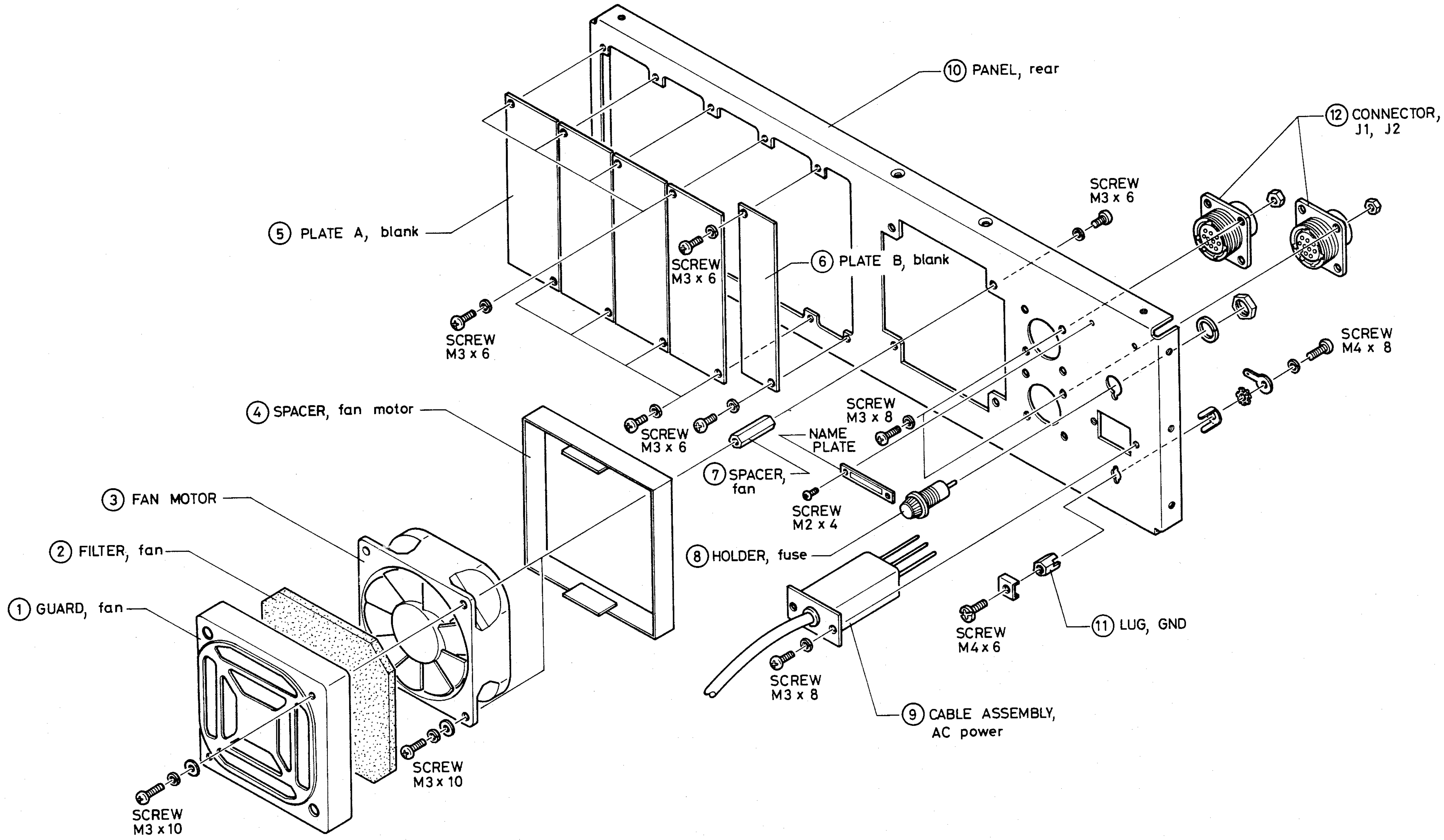


Fig. 15—3
TR2731
MECHANICAL PARTS
REAR PANEL ASSEMBLY

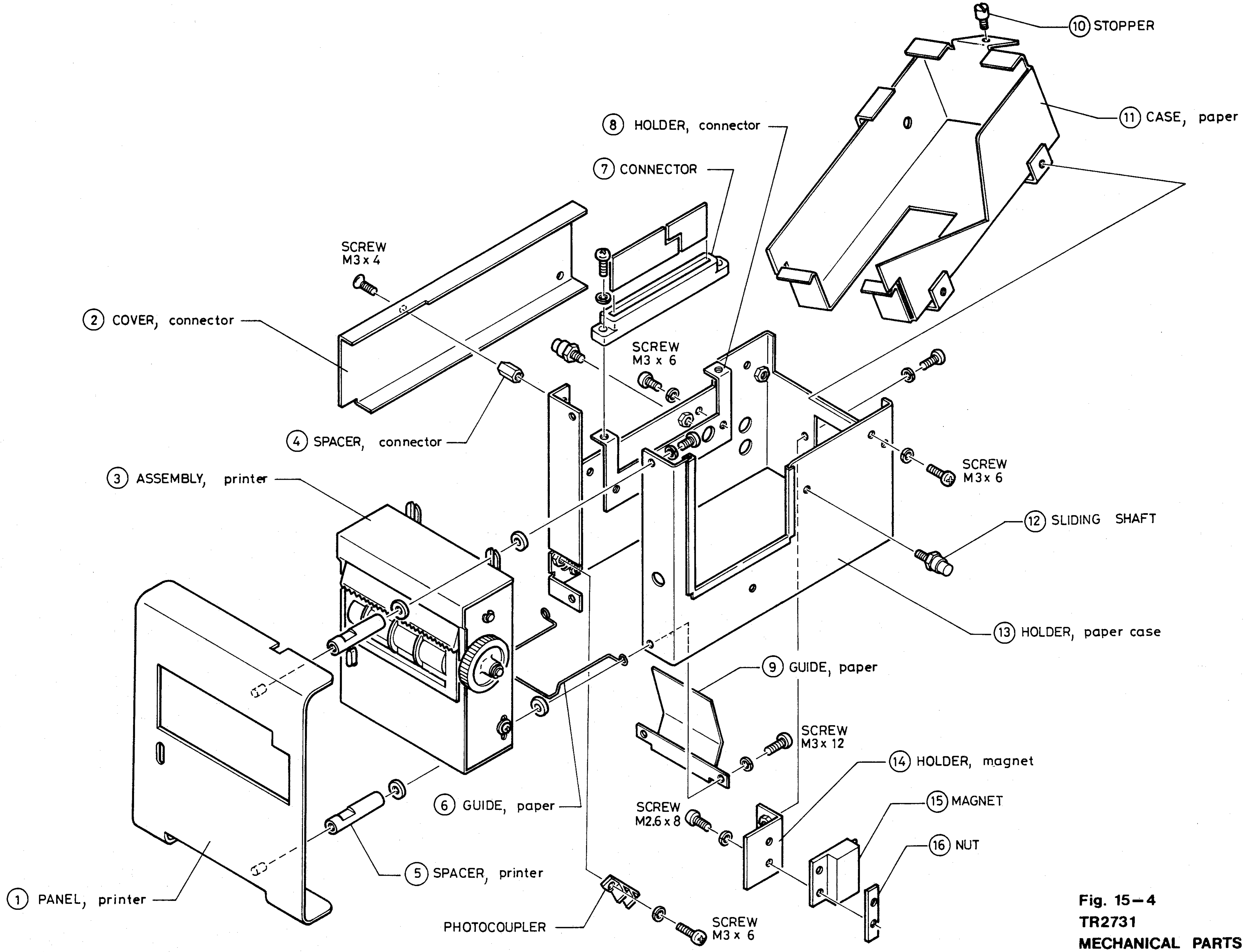


Fig. 15-4
TR2731
MECHANICAL PARTS
PRINTER ASSEMBLY

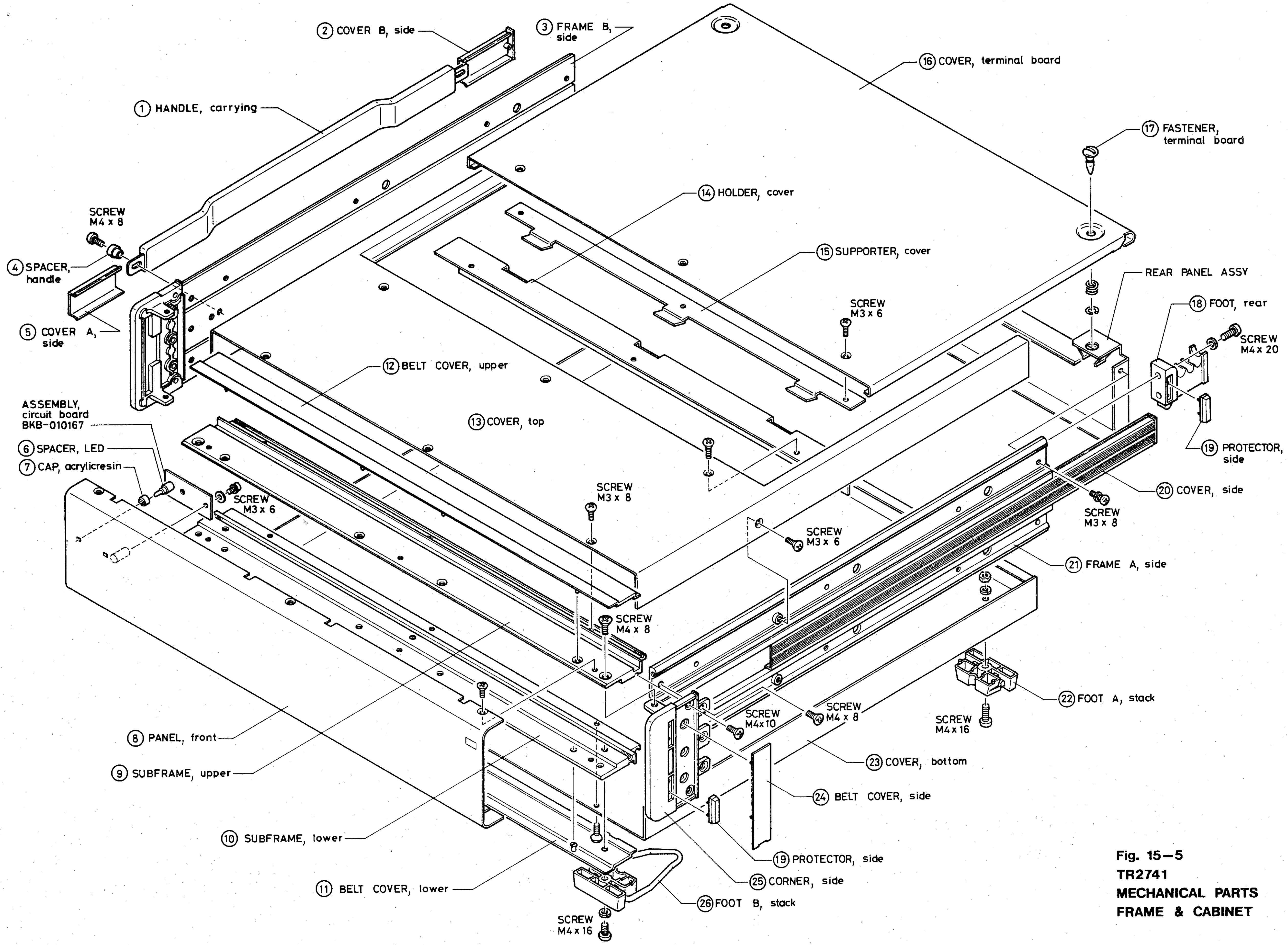


Fig. 15-5
TR2741
MECHANICAL PARTS
FRAME & CABINET

BLANK PANELs are mounted only for type A and C.

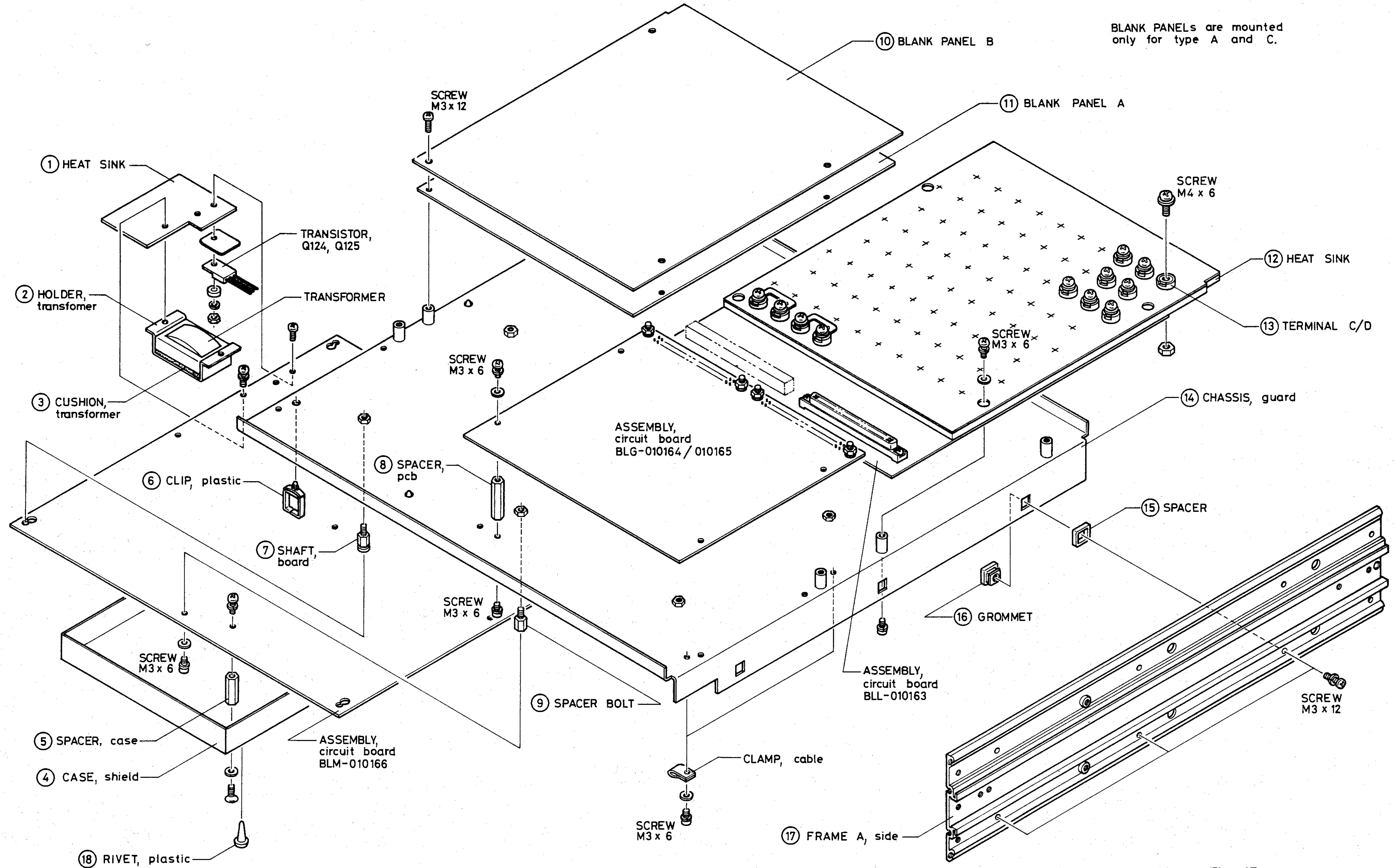


Fig. 15–6
TR2741
MECHANICAL PARTS
CIRCUIT BOARD ASSEMBLY

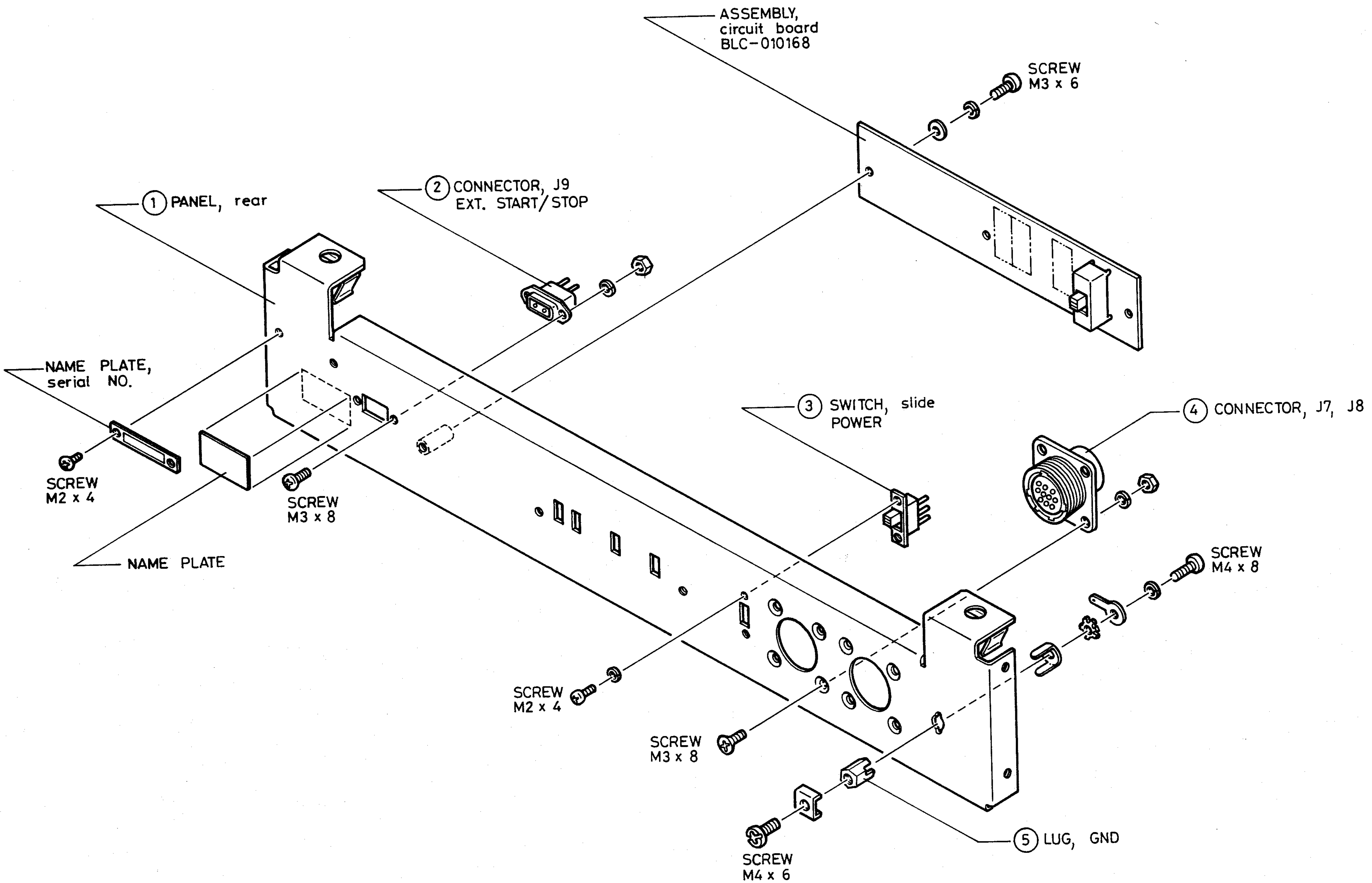


Fig. 15–7
TR2741
MECHANICAL PARTS
REAR PANEL ASSEMBLY

SECTION 16 LOCATIONS & DIAGRAMS

TR2741	BLL-010163	INPUT TERMINAL
	BLG-010165	TC SCANNER
	BLG-010164	PT SCANNER
	BLM-010166	A/D CONVERTER
	BLC-010168	REAR SWITCH
	BKB-010167	LED ASSEMBLY
TR2731	BLH-010156	MOTHER BOARD I
	BLG-010389	MOTHER BOARD II
	BLN-010158	PRINTER & POWER SECTION
	BLN-010159	CPU BOARD
	BLN-010160	MEMORY SECTION
	BLJ-010161	PANEL SECTION
	BLJ-010162	KEY BOARD
TR2730-010	BGJ-010169	MEMORY/AUX. FUNC.
-510	BGJ-010170	GPIB
-520	BGJ-010171	BCD OUTPUT
-530	BGJ-010172	BCD INPUT
-540	BGJ-010173	RELAY OUTPUT
-550	BGJ-010174	ANALOG OUTPUT I
	BLB-010175	ANALOG OUTPUT II
-560	BGJ-010176	SERIAL OUTPUT SWITCH BOARD
-570	BGJ-010178	DATA MEMORY
-580	BGJ-010179	PULSE COUNTER I
	BLB-010244	PULSE COUNTER II

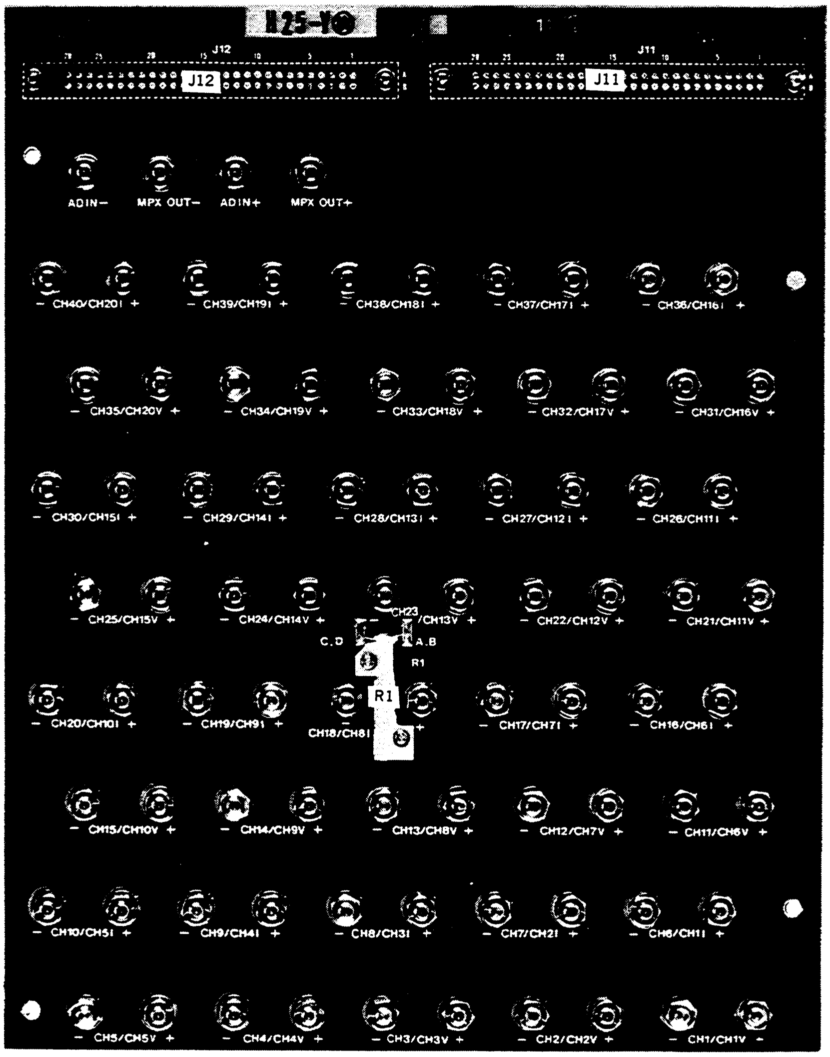


Fig. 16-1 BLL-010163 locations

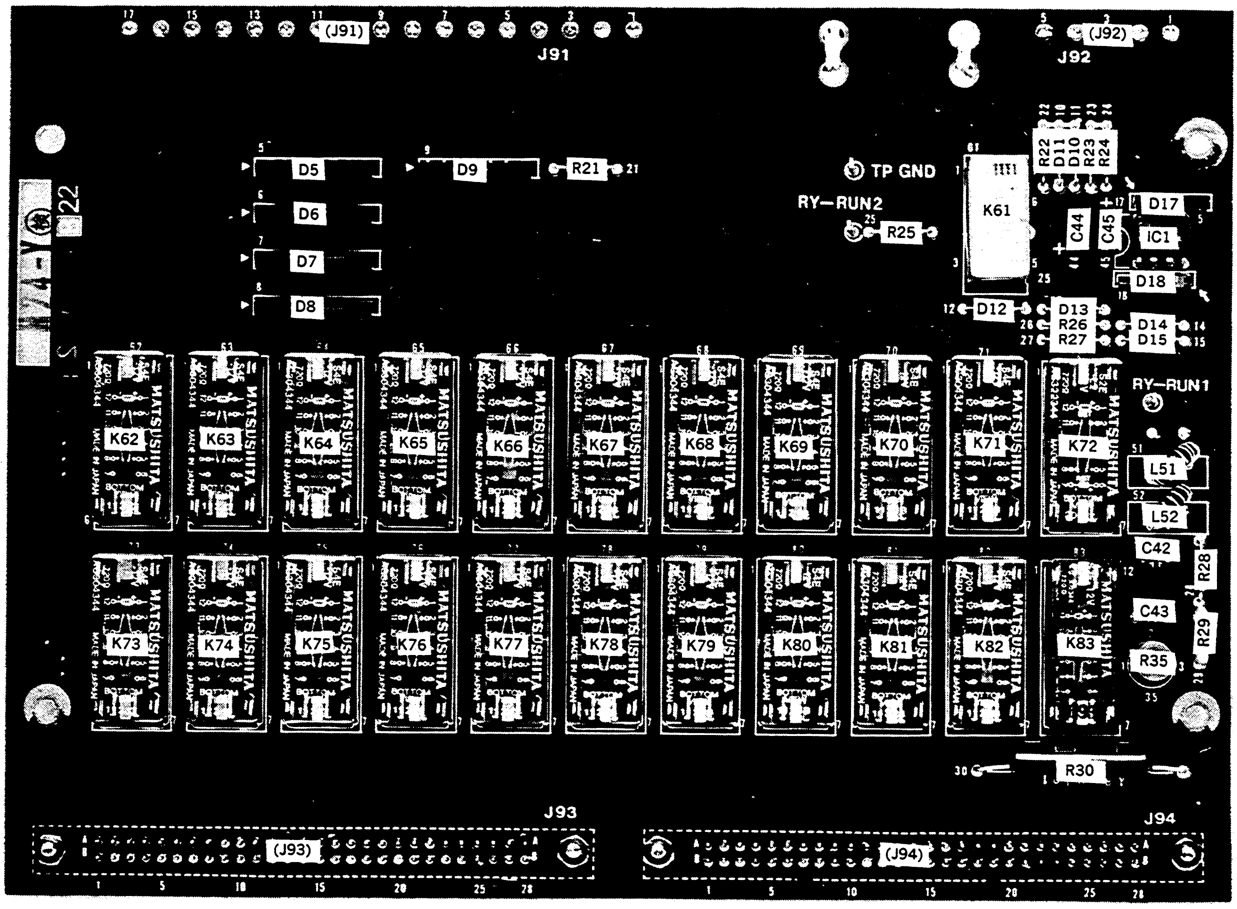


Fig. 16-2 BLG-010165 locations

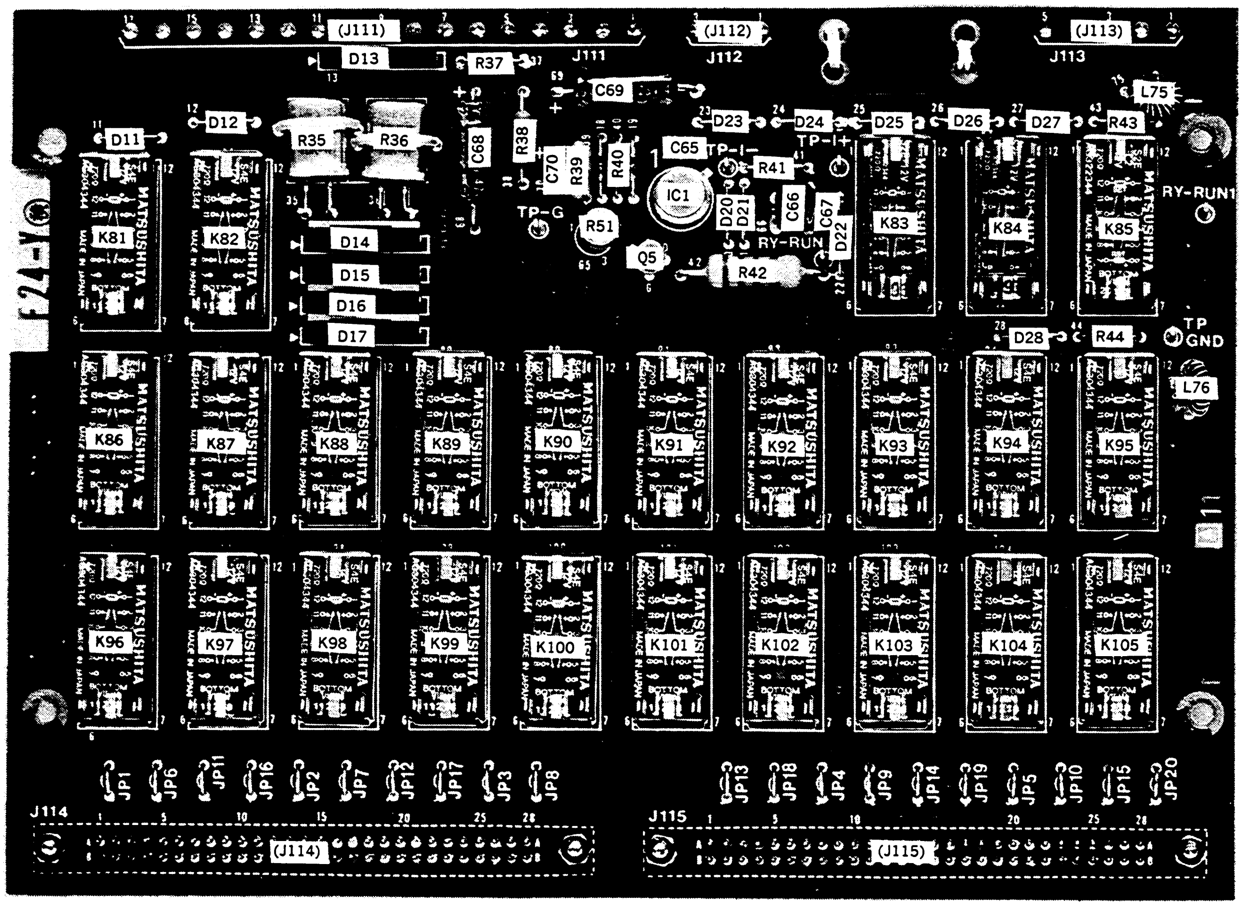


Fig. 16-3 BLG-010164 locations

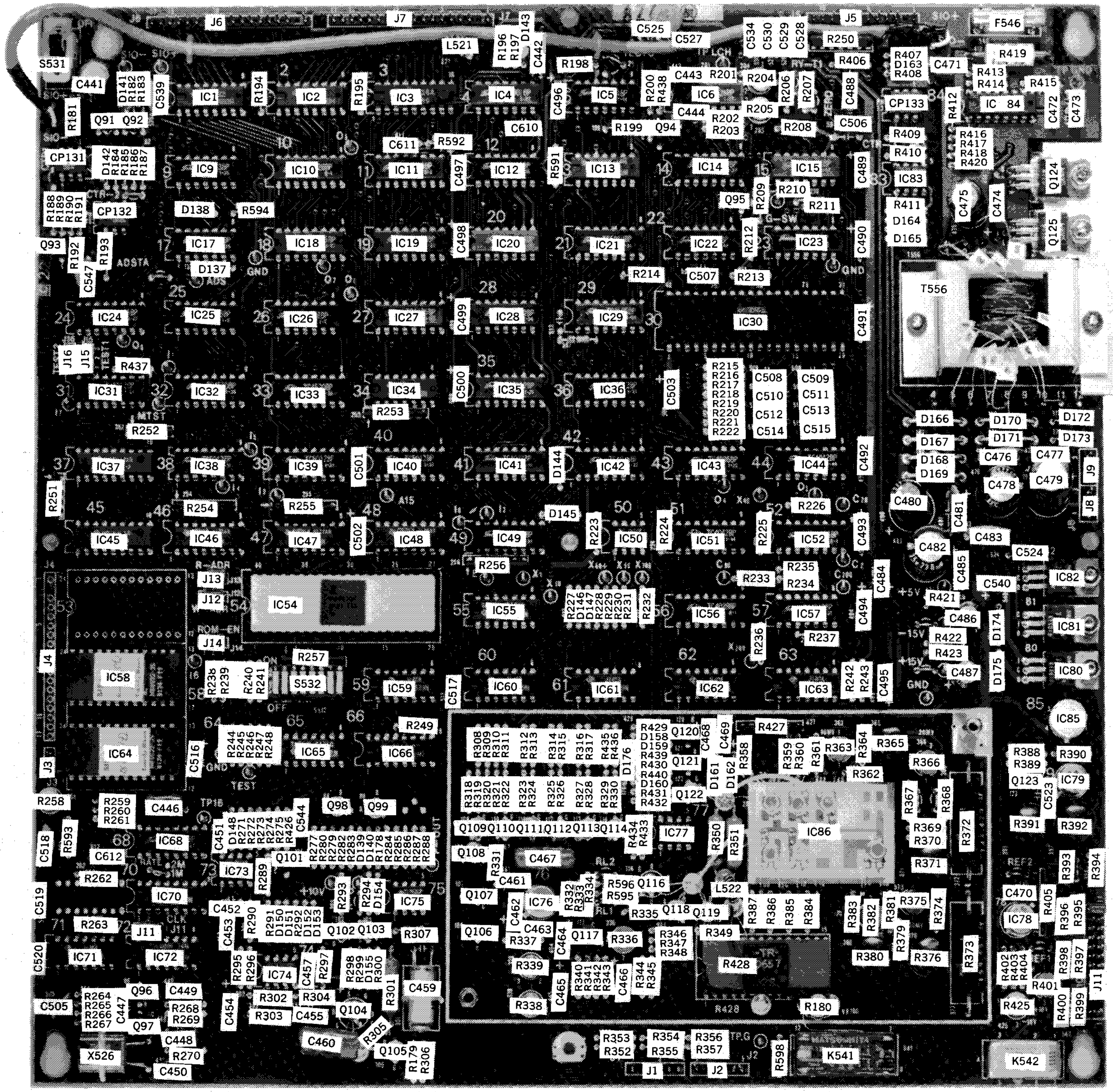


Fig. 16-4 BLM-010166 locations

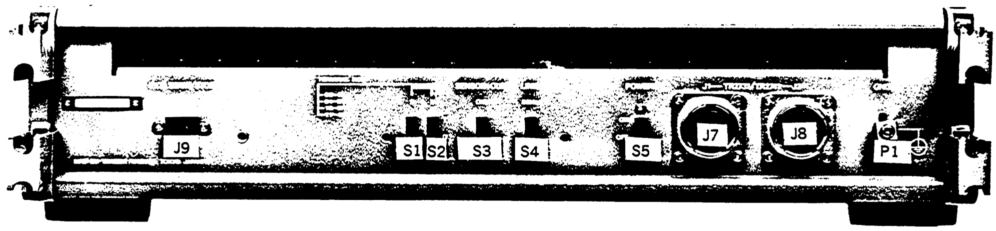


Fig. 16-5 BLC-010168 locations

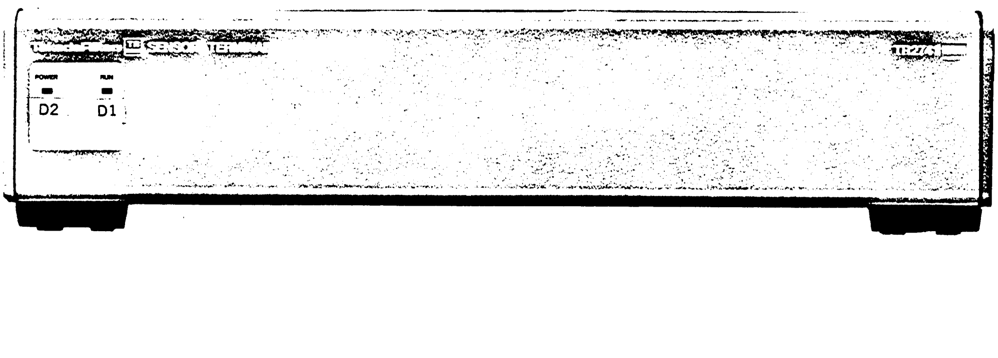


Fig. 16-6 BKB-010167 locations

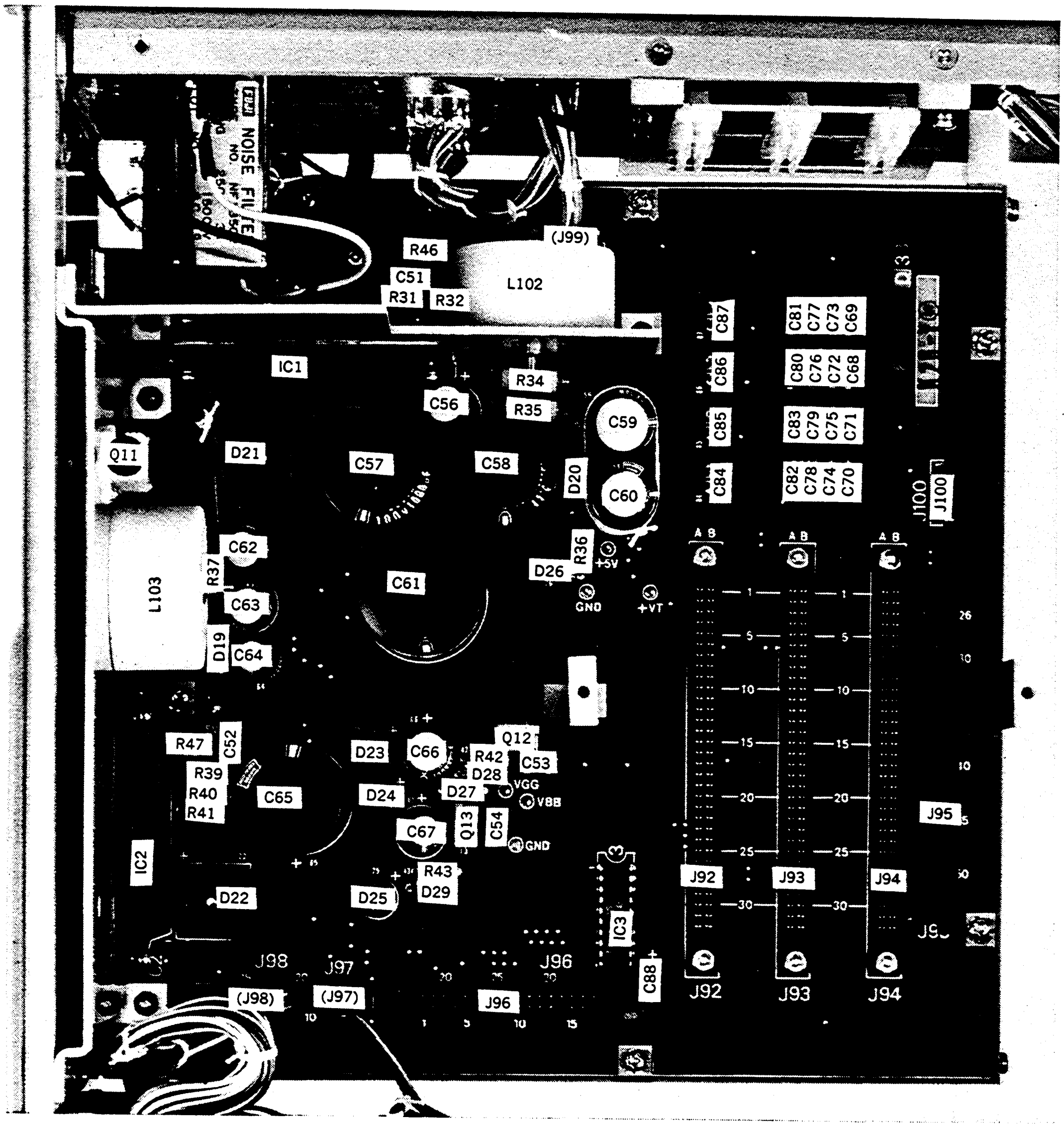


Fig. 16-7 BLH-010156 locations

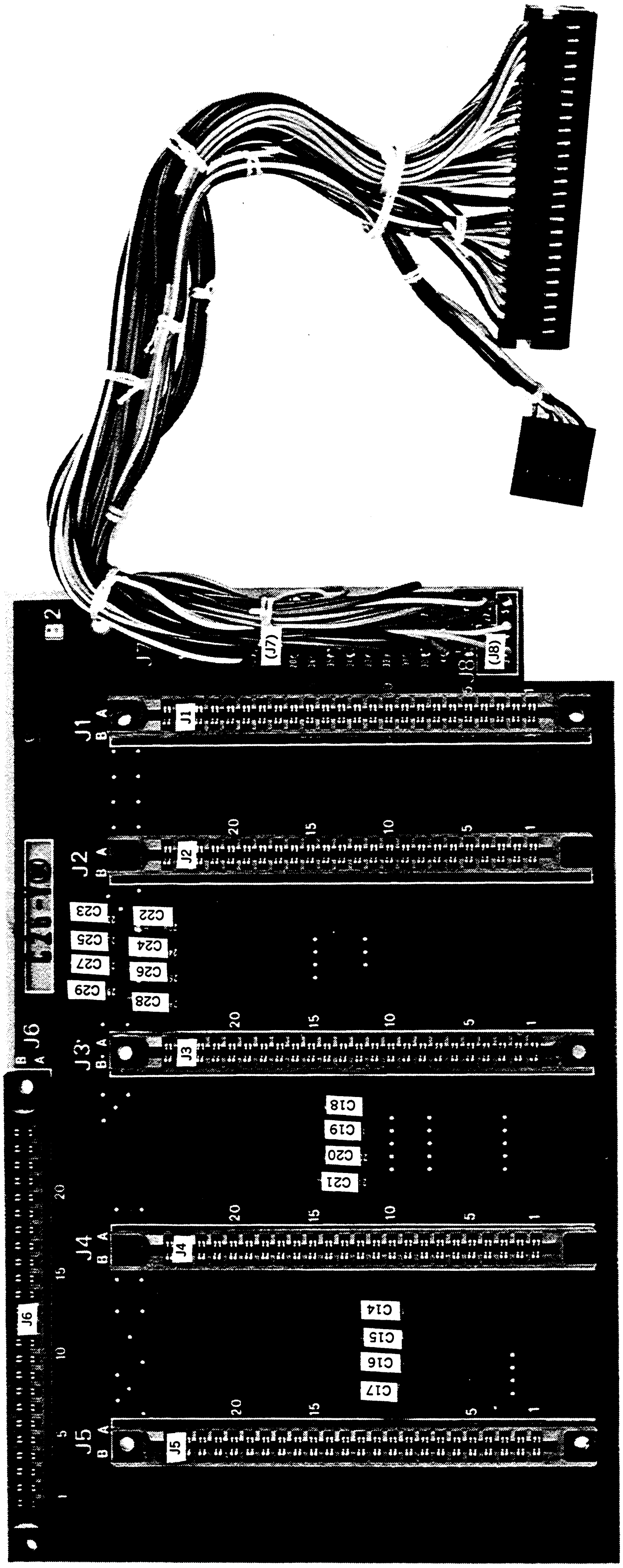


Fig. 16-8 BLG-010389 locations

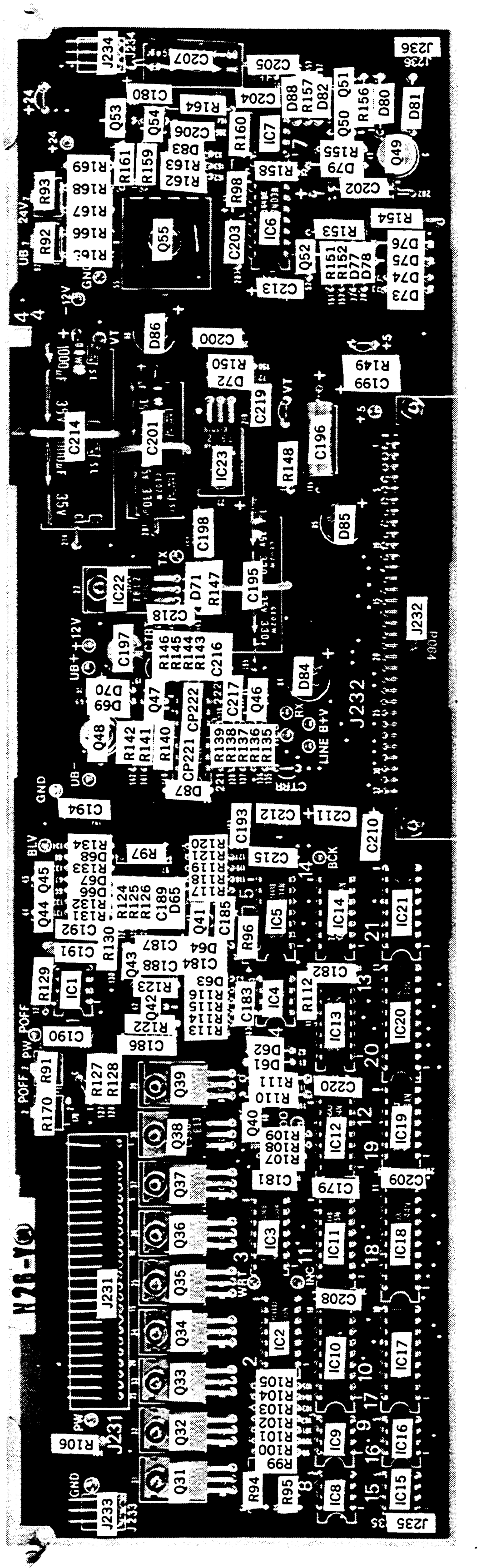


Fig. 16-9 BLN-010158 locations

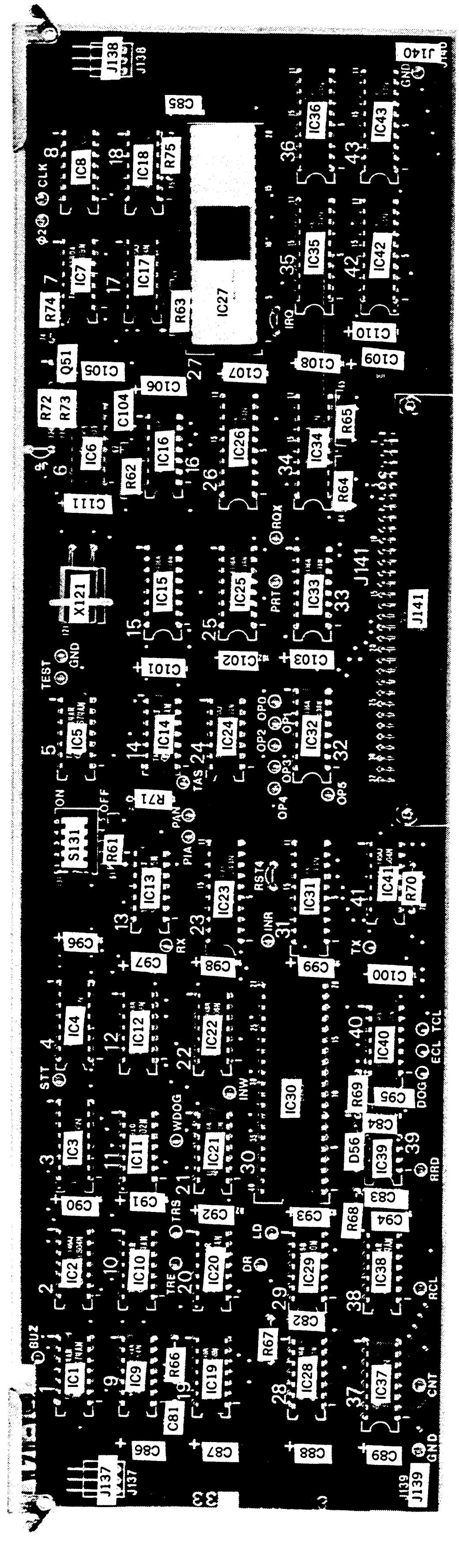


Fig. 16-10 BLN-010159 locations

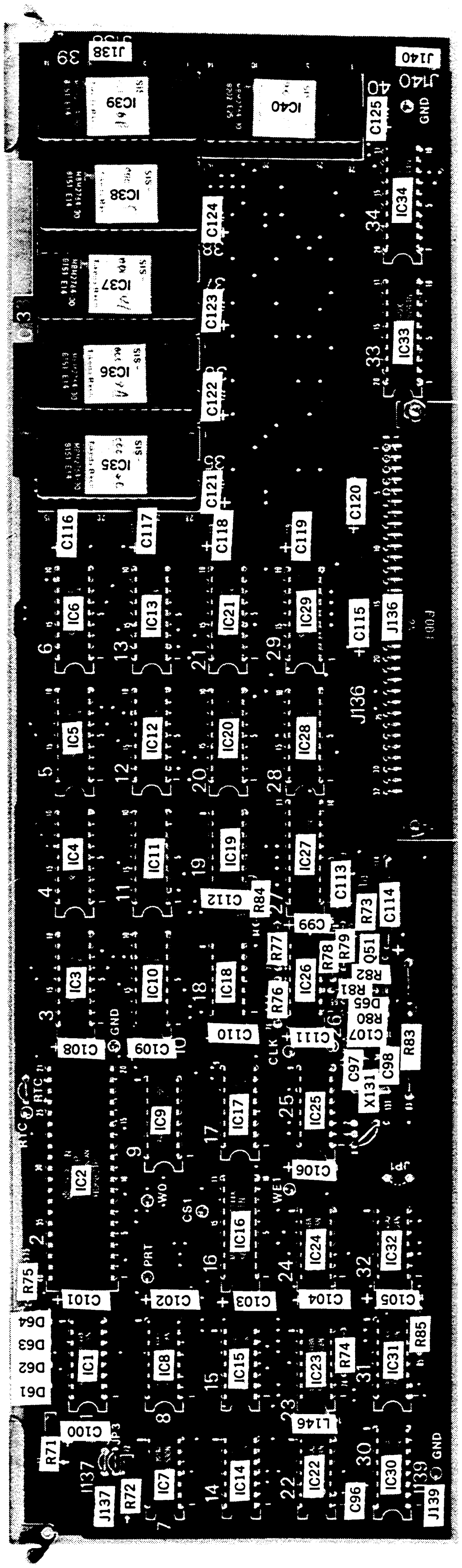


Fig. 16-11 BLN-010160 locations

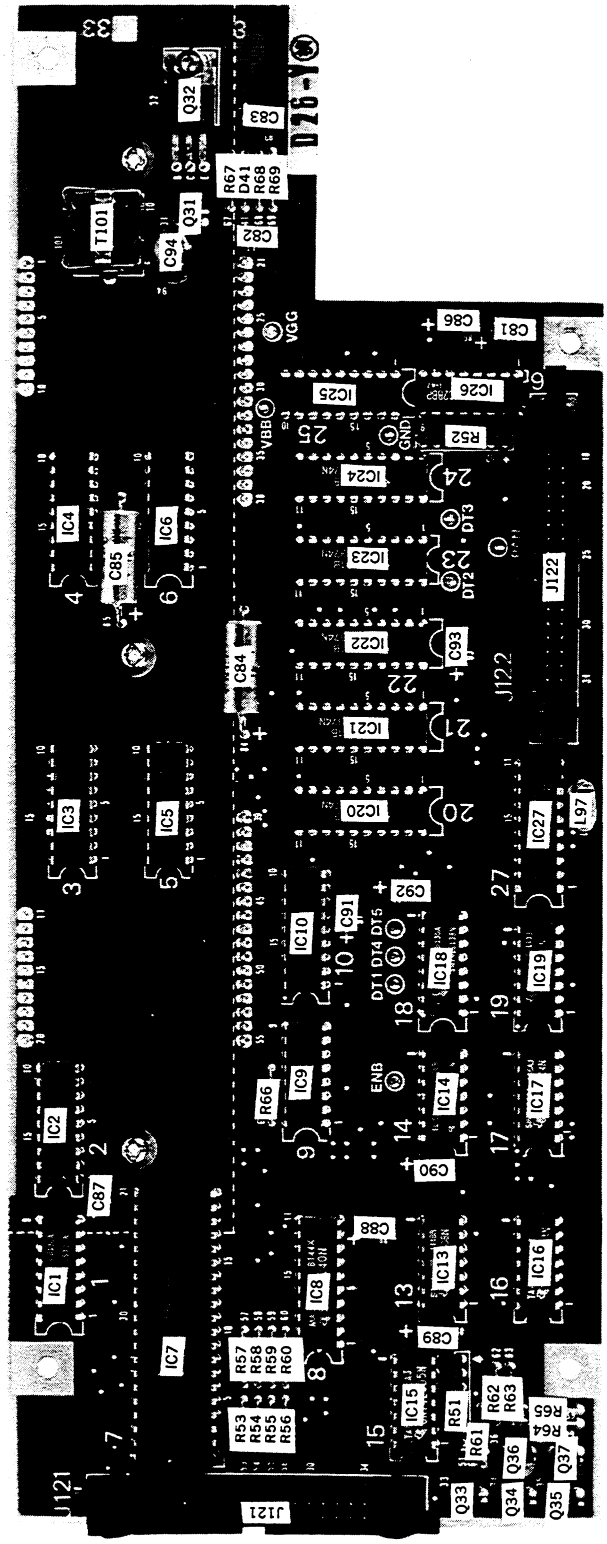


Fig. 16-12 BLJ-010161 locations

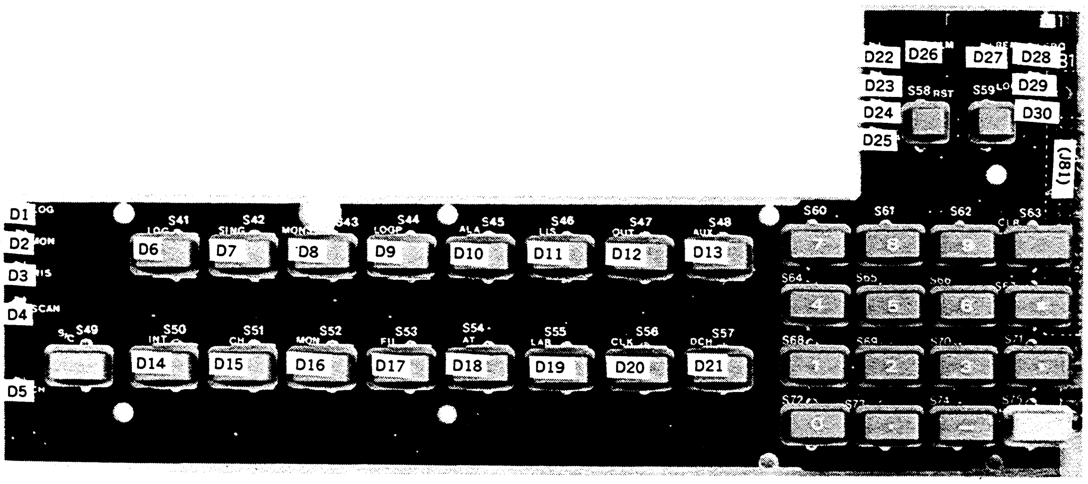


Fig. 16-13 BLJ-010162 locations

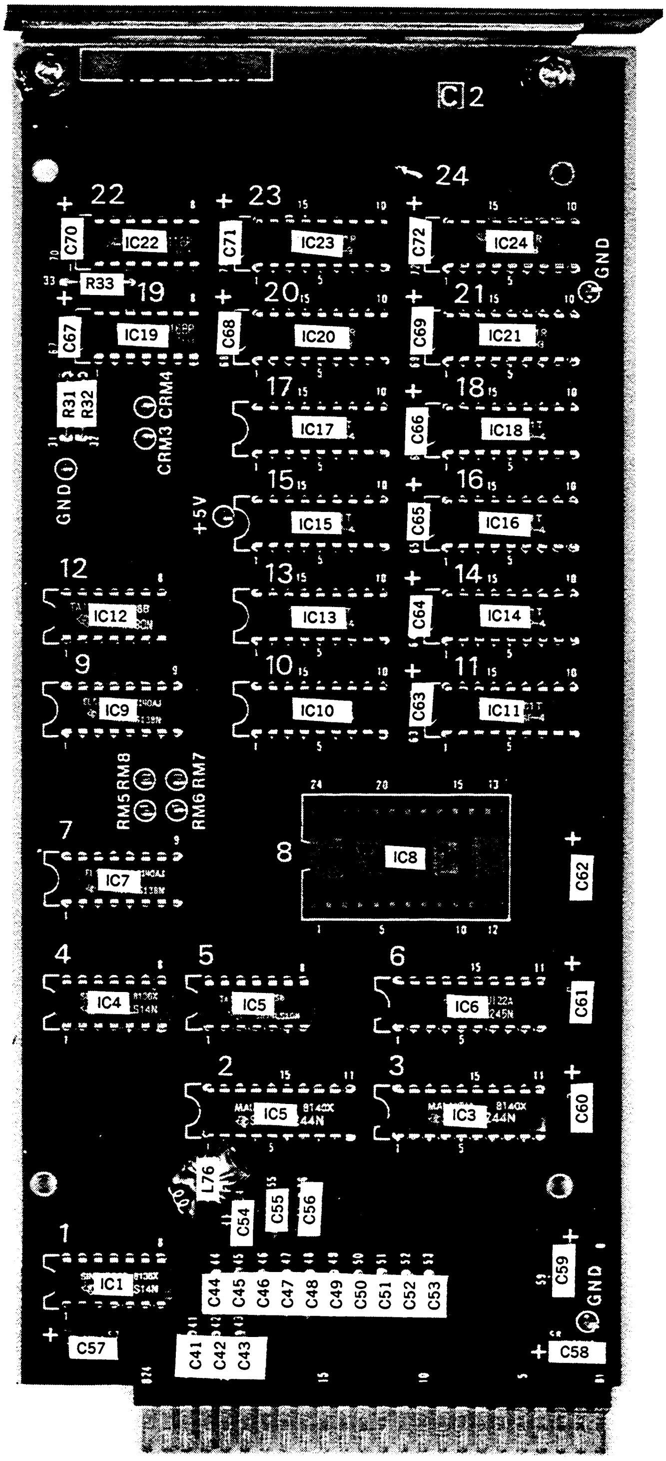


Fig. 16-14 BGJ-010169 locations

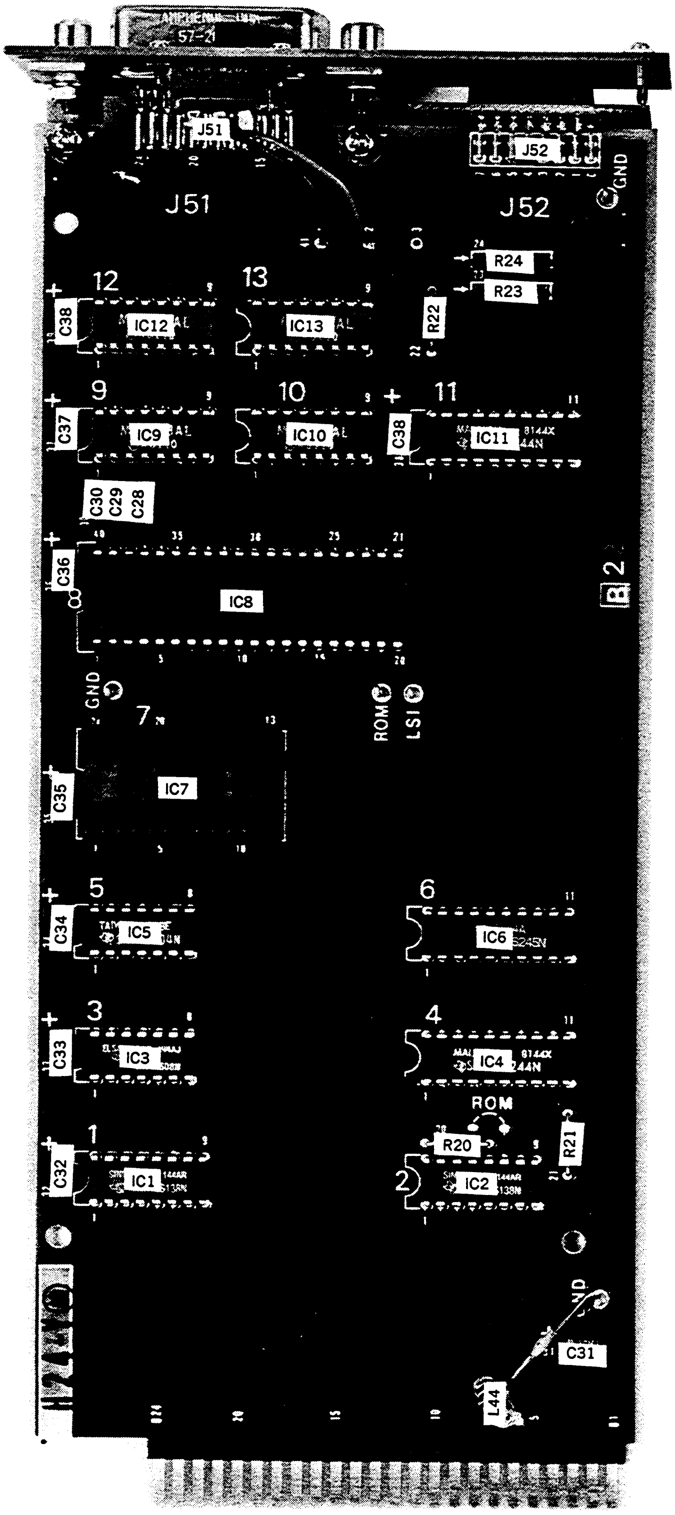


Fig. 16-15 BGJ-010170 locations

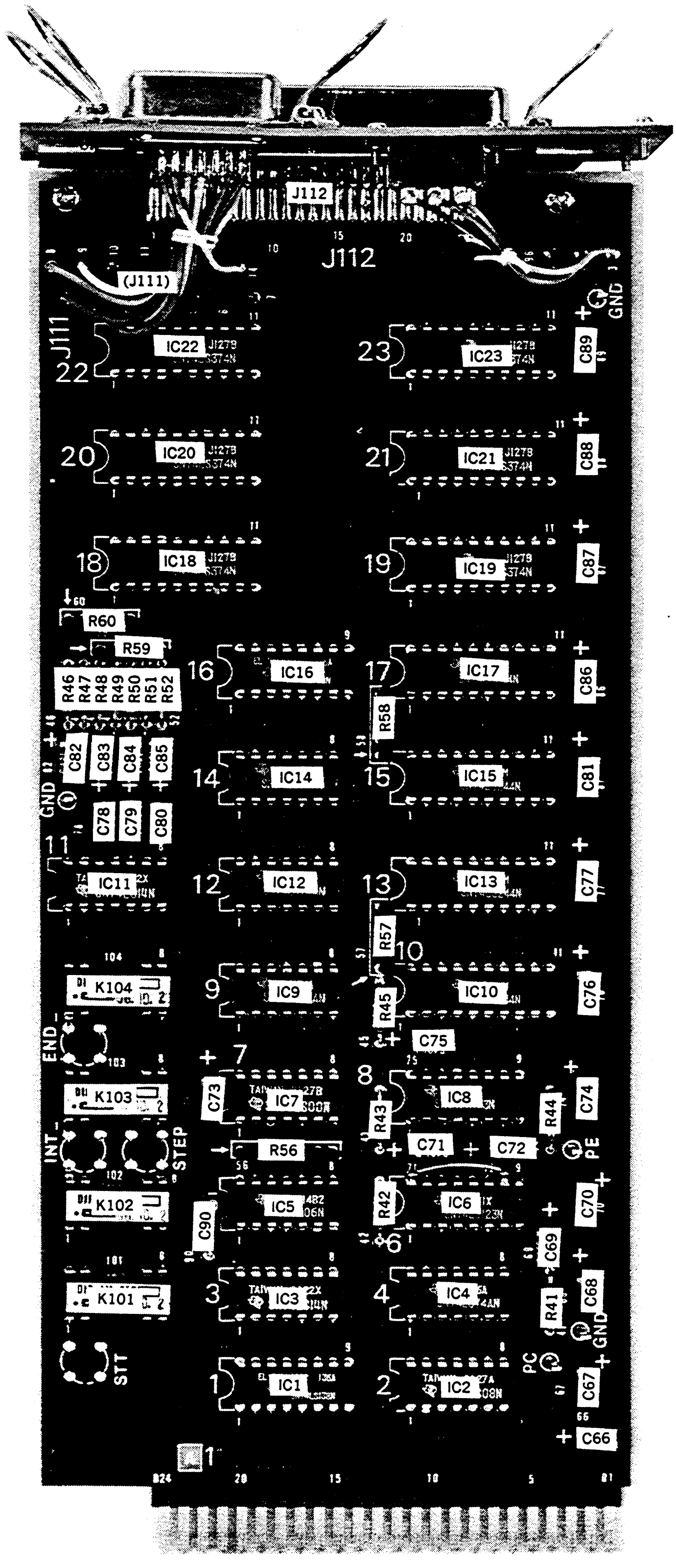


Fig. 16-16 BGJ-010171 locations

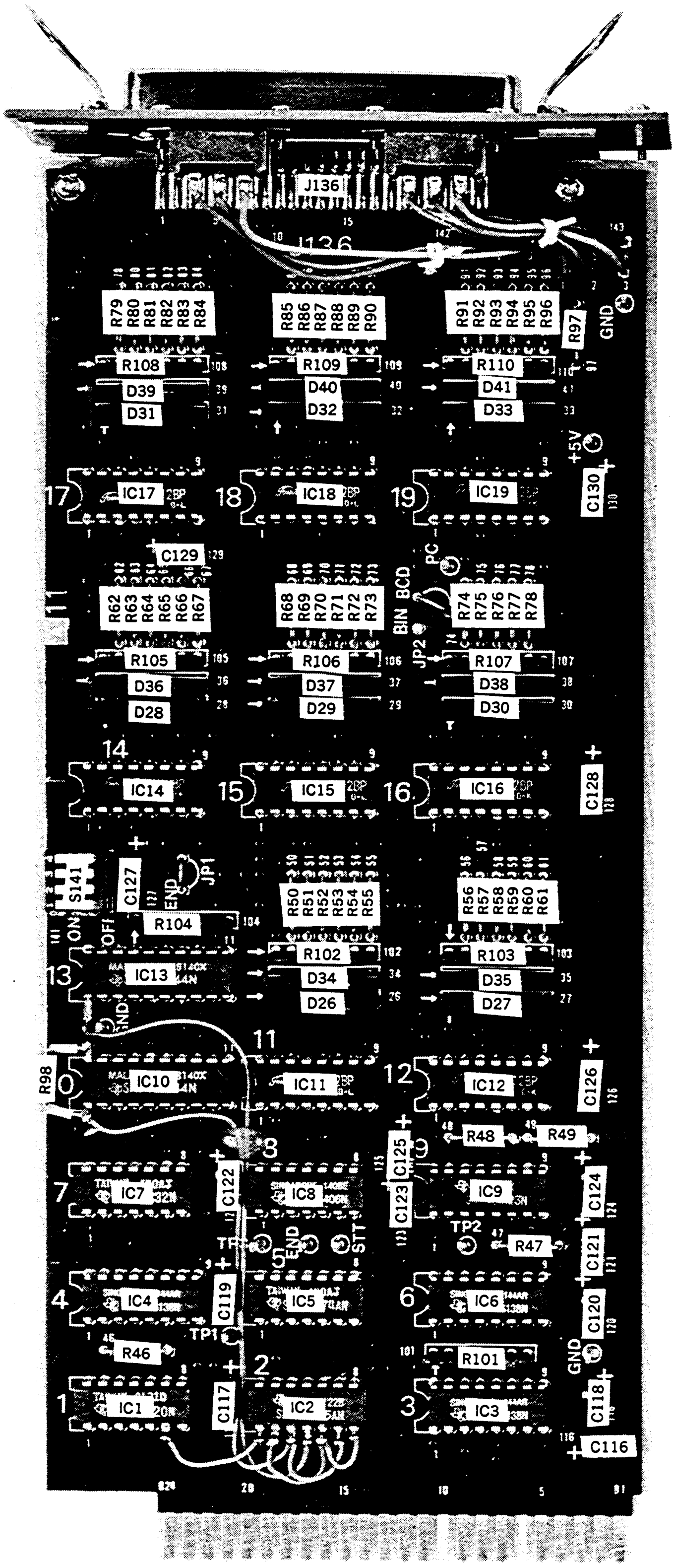


Fig. 16-17 BGJ-010172 locations

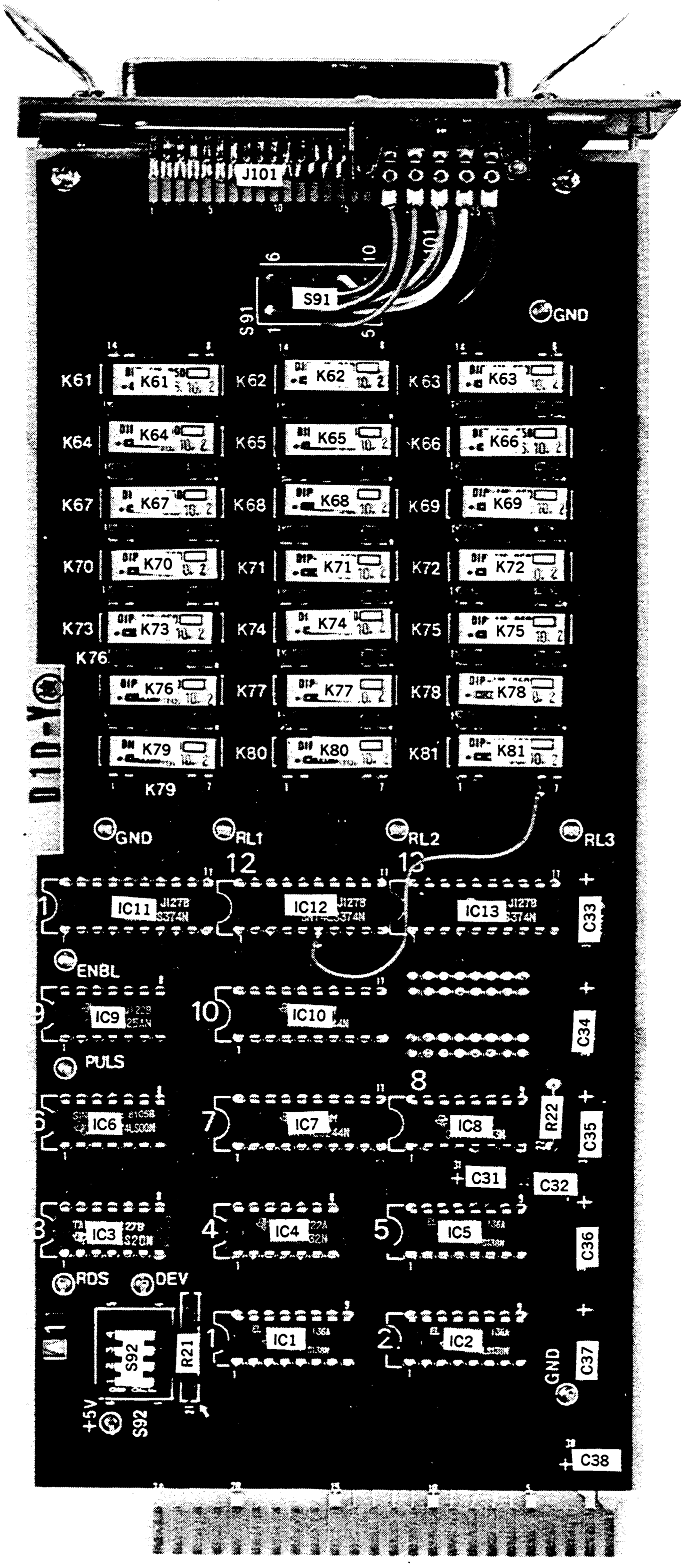


Fig. 16-18 BGJ-010173 locations

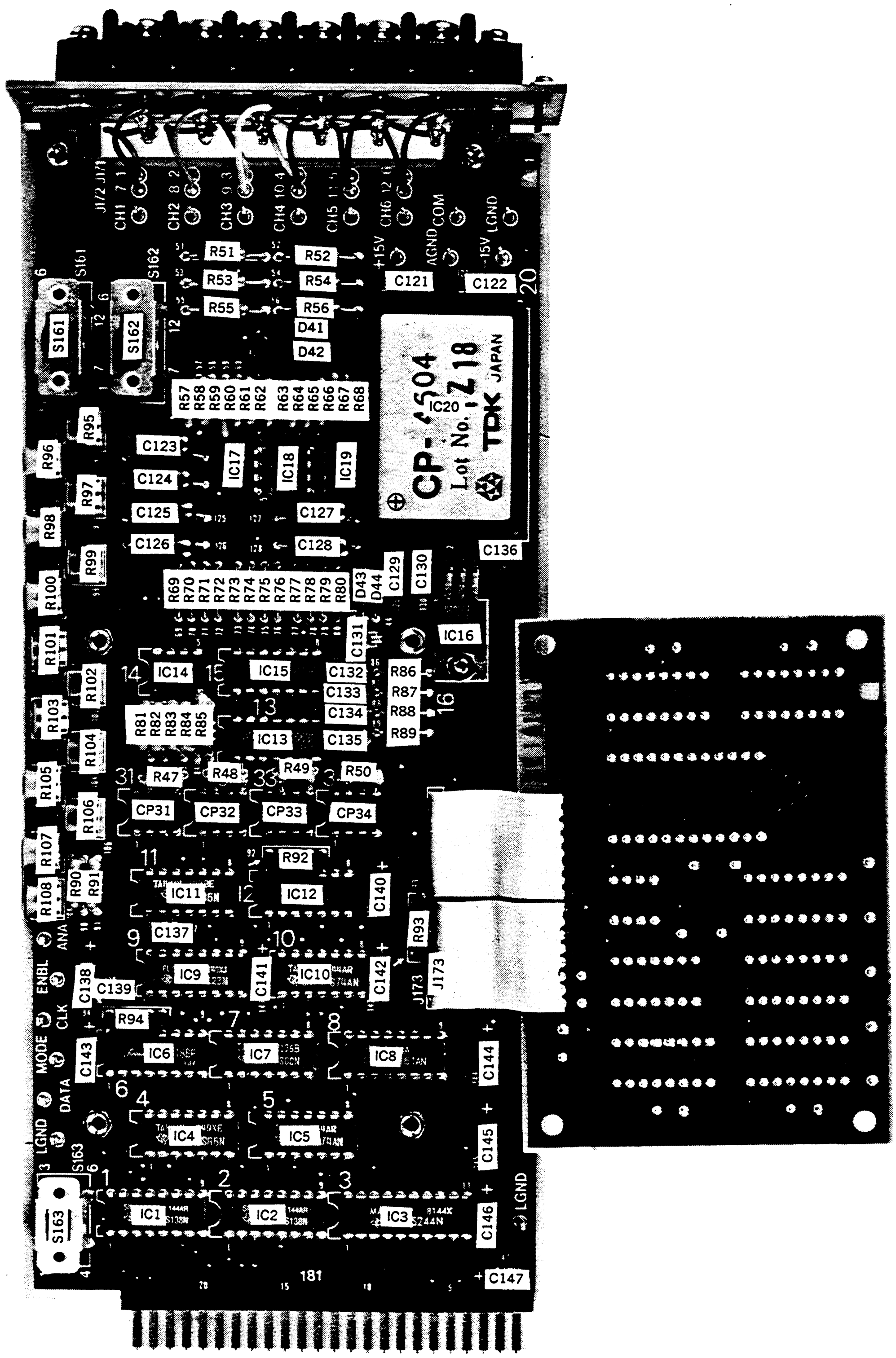


Fig. 16-19 BGJ-010174 locations

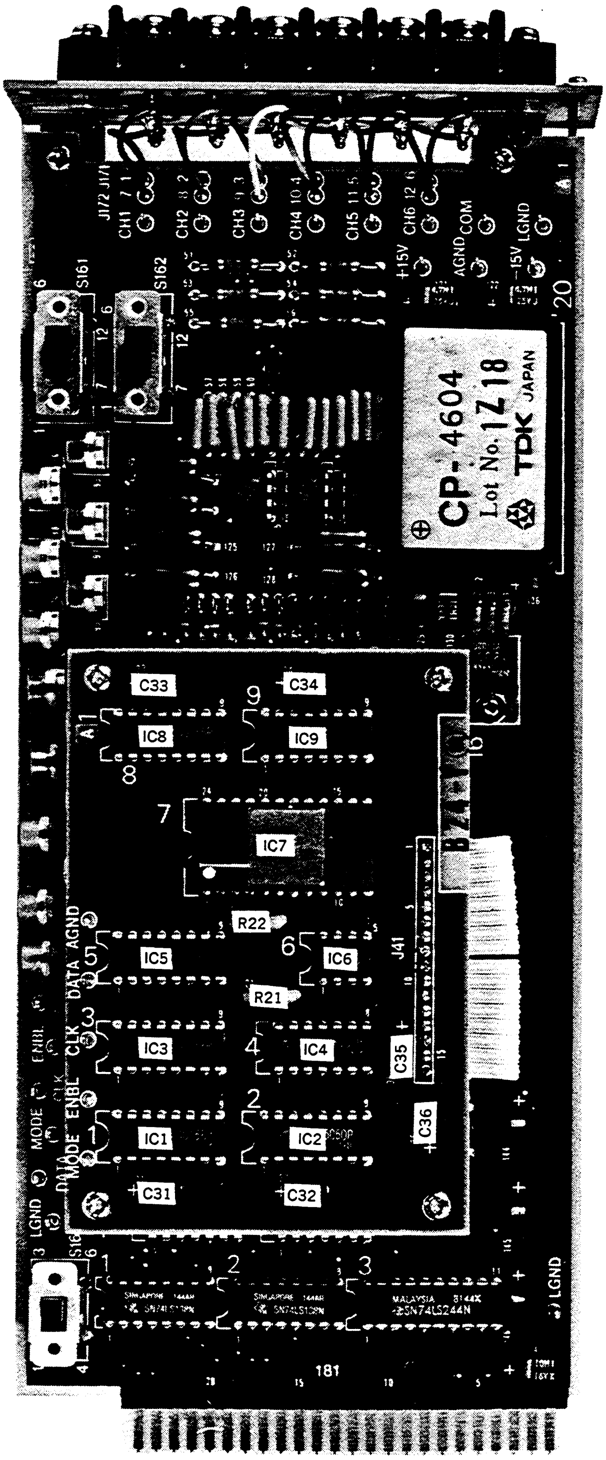


Fig. 16-20 BLB-010175 locations

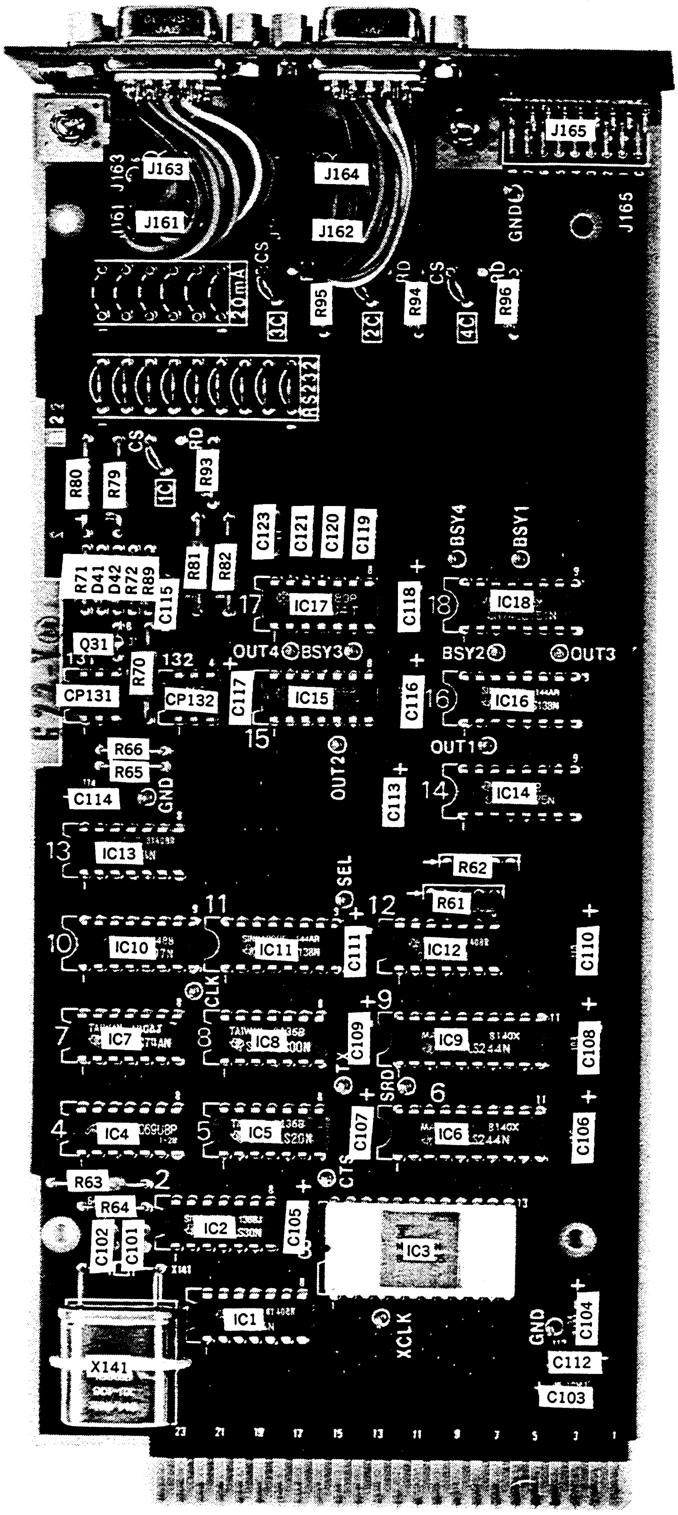


Fig. 16-21 BGJ-010176 locations

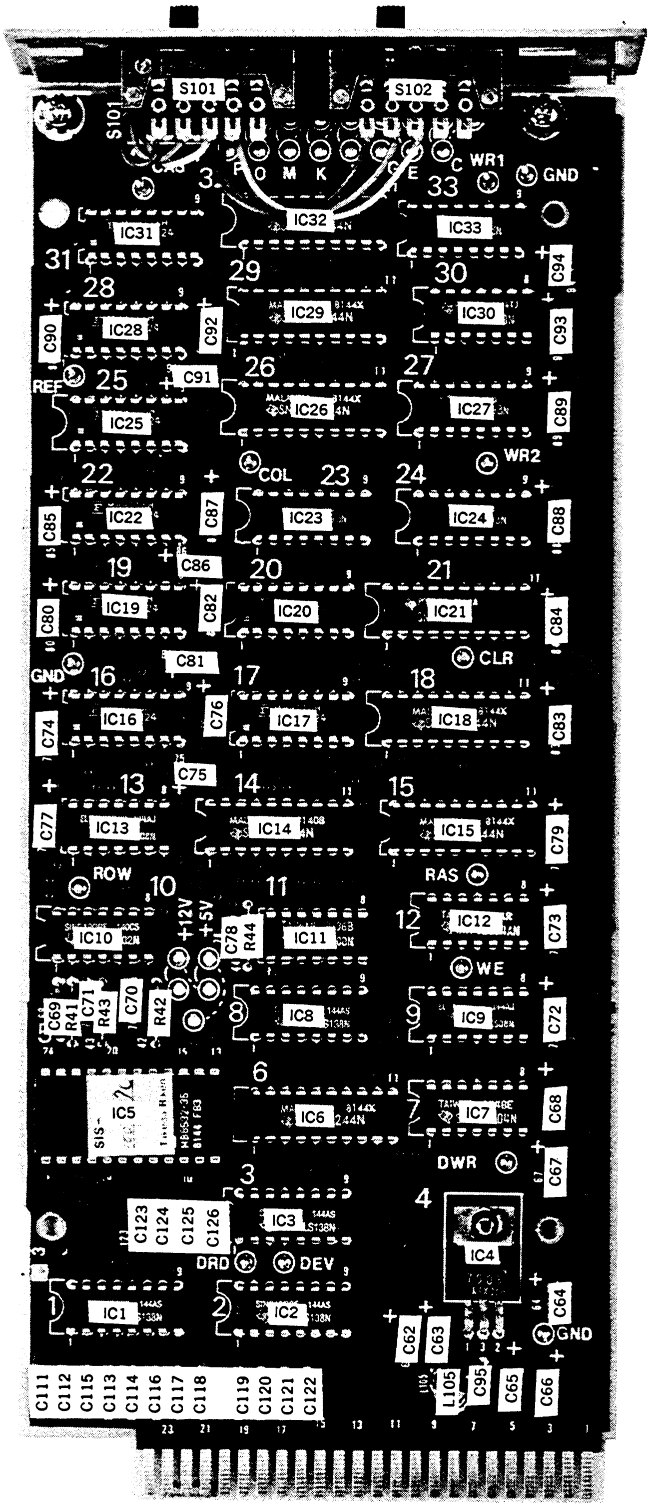


Fig. 16-22 BGJ-010178 locations

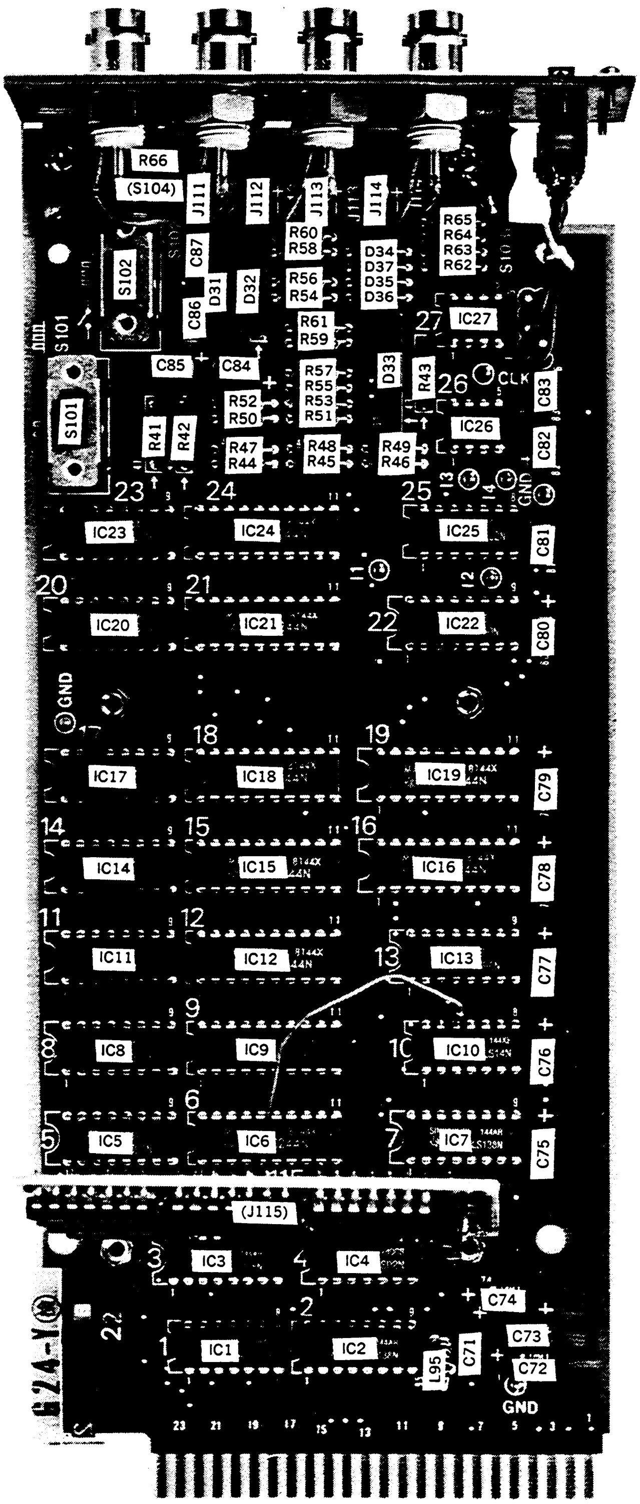


Fig. 16-23 BGJ-010179 locations

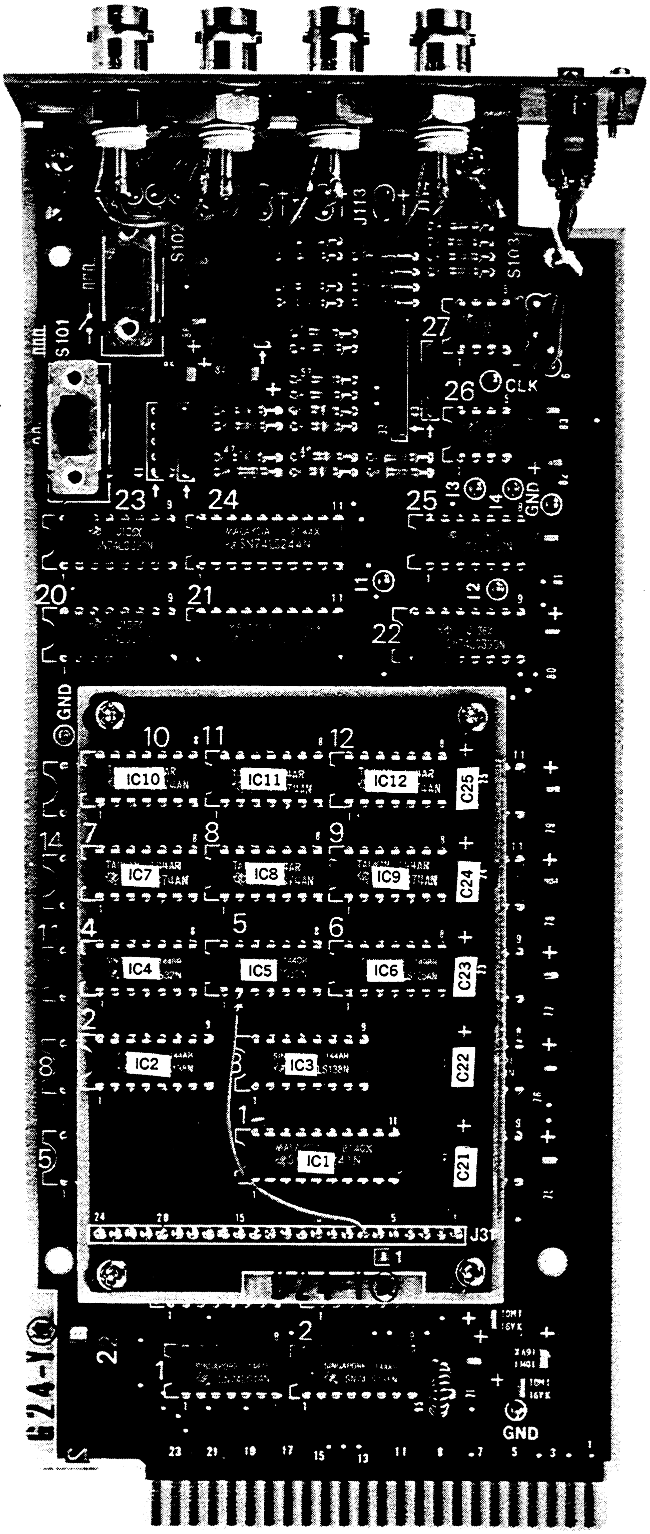


Fig. 16-24 BLB-010244 locations

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
P1	JTE-AG001EX01-1	*	Terminal

TR2741
INPUT TERMINAL
BLL-010163

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
R1	DST-000349-1	GB100-2-0.3	R: Pt-RTD 100 Ω
J11	JSC-AA056JX04-2	FCN-364J056-AN	Connector
J12	JSC-AA056JX04-2	FCN-364J056-AN	Connector
	MKE-17679B-1	*	Heat Sink
	MMX-17675B-1	*	Terminal
	MMX-18044A-1	*	Terminal

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIA-TL062-1	TL062CP	IC: Dual Operational Amplifier
D5 thru D8	SDS-A54-1	UPA54H	Diode SI
D9	SDS-A64-1	UPA64H	Diode SI
D10 thru D15	SDS-1S953-1	1S953	Diode SI
D16			Not assigned
D17	SDS-AN401-1	DAN401	Diode SI
D18	SDS-AP401-1	DAN401	Diode SI
R21	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820 Ω ±5% 1/4W
R22	RCB-AH2R2K-1	RD25S 2.2KΩJ	R: FXD CAR 2.2 kΩ ±5% 1/4W
R23	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R24	RCB-AH220-1	RD25S 220ΩJ	R: FXD CAR 220 Ω ±5% 1/4W
R25	RCB-AH15K-1	RD25S 15KΩJ	R: FXD CAR 15 kΩ ±5% 1/4W
R26	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820 Ω ±5% 1/4W
R27	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820 Ω ±5% 1/4W
R28	RMF-AR15KFK-1	SN14K2E15KΩF	R: FXD Metal FLM 15 kΩ ±1% 1/4W
R29	RMF-AB6R8KFG-1	RF 1/4N 6.8KΩRF	R: FXD Metal FLM 6.8 kΩ ±1% 1/4W
R30	RWT-AA101QB-1	*	R: FXD WW 101 Ω
R31 thru R34			Not assigned
R35	RVR-BE10K-1	X6T10KΩ	R: VAR WW 10 kΩ
C41			Not assigned
C42	CMC-AB100PR3K-4	DM10D101J3	C: FXD DIPPED MICA 100pF ±5% 300V
C43	CSM-AC2200P50V-1	0.0022UF 50WV	C: FXD CER 0.0022μF +80, -20% 50V
C44	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C45	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
L51	LCL-T00084-1	LT-3	L: FXD Coil
L52	LCL-T00084-1	LT-3	L: FXD Coil
K61	KRL-000419-1	NR-SD-12V-5	Relay
K62 thru J71	KRL-000403-1	S4E-12V	Relay
K72	KRL-000407-1	S2E-L2-12V	Relay
K73 thru K82	KRL-000403-1	S4E-12V	Relay
K83	KRL-000402-1	S2E-12V	Relay
J91	DCB-QS0664-1	TOC-1A18200N	Connector
J92	DCB-QS0488-1	TOC-1A06030N	Connector
J93	JCS-AA056PX04-1	FCN-364P056-AG	Connector
J94	JCS-AA056PX04-1	FCN-364P056-AG	Connector
	MBM-1-372A-1	401-9630A	Terminal

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC5	SIA-308-1	LM308H	IC: Operational Amplifier
Q5	SFP-2N2609-1	2N2609	FET Junction N-Channel
D11	SDS-1S953-1	1S953	Diode SI
D12	SDS-1S953-1	1S953	Diode SI
D13	SDS-A64-1	UPA64H	Diode SI
D14 thru D17	SDS-A54-1	UPA54H	Diode SI
D18	SDZ-W150-1	WZ-150	Zener Diode
D19	SDZ-W150-1	WZ-150	Zener Diode
D20	SDS-1S953-1	1S953	Diode SI
D21	SDS-1S953-1	1S953	Diode SI
D22	SDP-SM1-1	SM-1-02	Diode SI
D23 thru D28	SDS-1S953-1	1S953	Diode SI
R35	RFL-AB80QQ-1	RDX2F80ΩT	R: FXD Metal FLM 80 Ω
R36	RFL-AB180QQ-1	RDX2F180ΩT	R: FXD Metal FLM 180 Ω
R37	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820 Ω ±5% 1/4W
R38	RCB-AH470-1	RD50S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/2W
R39	RMF-AB4R7KFJ-1	RF 1/4N 4.7KΩSF	R: FXD Metal FLM 4.7 kΩ ±1% 1/4W
R40	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R41	RCB-AH15K-1	RD25S 15KΩJ	R: FXD CAR 15 kΩ ±5% 1/4W
R42	RMF-AJ1KJM-1	RSF2B1KΩJ	R: FXD Metal FLM 1 kΩ ±5% 2W
R43	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820 Ω ±5% 1/4W
R44	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820 Ω ±5% 1/4W
R45 thru R50			Not assigned
R51	RVR-AK1K-1	3321H-1-102	R: VAR CERMET 1 kΩ
C65	CSM-AC33P50V-1	33PF 50WV	C: FXD CER 33pF ±10% 50V
C66	CFM-ABR047U50V-1	501N5002-473K	C: FXD Mylar 0.047µF +80, -20% 50V
C67	CSM-AC1000PR5K-1	1000PF 500WV	C: FXD CER 1000pF +80, -20% 50V
C68	CCK-AA47I25V-1	47UF 25V	C: FXD ELECT 47µF 25V
C69	CCK-AA47I25V-1	47UF 25V	C: FXD ELECT 47µF 25V
C70	CTA-AC1U50V-2	1UF 50WV	C: FXD ELECT TANTAL 1µF ±20% 50V
L75	LCL-T00084-1	LT-3	L: FXD Coil
L76	LCL-T00084-1	LT-3	L: FXD Coil
K81	KRL-000403-1	S4E-12V	Relay
K82	KRL-000403-1	S4E-12V	Relay
K83	KRL-000402-1	S4E-12V	Relay
K84	KRL-000402-1	S4E-12V	Relay
K85	KRL-000407-1	S2E-L2-12V	Relay
K86 thru K105	KRL-000403-1	S4E-12V	Relay

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
J111	DCB-QS0664-1	TOC-1A18200N	Connector
J112	DCB-QS0483-1	TOC-1A03060N	Connector
J113	DCB-QS0488-1	TOC-1A06030N	Connector
J114	JCS-AA056PX04-1	FCN-364P056-AG	Connector
J115	JCS-AA056PX04-1	FCN-364P056-AG	Connector
	MBM-10372A-1	401-9630A	Terminal

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TR2741
A/D BOARD
BLM-010166

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIT-75468-1	SN75468N	IC: Darlington Transistor Array
IC2	SIT-75468-1	SN75468N	IC: Darlington Transistor Array
IC3	SIT-6118-1	UDN-6118A	IC: Voltage Driver
IC4	SIM-4001-1	TC4001BP	IC: Quad 2-Input NOR Gate
IC5	SIM-4011-1	TC4011BP	IC: Quad 2-Input NOR Gate
IC6	SIM-4528-1	TC4528BP	IC: Dual Monostable Multivibrator
IC7			Not assigned
IC8			Not assigned
IC9	SIM-4013-1	TC4013BP	IC: Dual D-Type Flip Flop
IC10	SIM-4828-1	TC4028BP	IC: BCD to Decimal Decoder
IC11	SIM-4828-1	TC4028BP	IC: BCD to Decimal Decoder
IC12	SIM-4013-1	TC4013BP	IC: Dual D-Type Flip Flop
IC13	SIT-74LS04-9	SN74LS04N	IC: Hex Inverter
IC14	SIM-4049-1	TC4049BP	IC: Hex Buffer/Converter Inverting Type
IC15	SIM-4081-1	TC4081BP	IC: Quad 2-Input Positive AND Gate
IC16			Not assigned
IC17	SIM-4013-1	TC4013BP	IC: Dual D-Type Flip Flop
IC18	SIM-4035-1	TC4035BP	IC: 4-Bit Parallel IN/Parallel OUT Shift Register
IC19	SIM-4035-1	TC4035BP	IC: 4-Bit Parallel IN/Parallel OUT Shift Register
IC20	SIM-4013-1	TC4013BP	IC: Dual D-Type Flip Flop
IC21	SIM-5012-1	TC5012BP	IC: 3-Stage Buffer
IC22	SIM-4011-1	TC4011BP	IC: Quad 2-Input NAND Gate
IC23	SIM-4025-1	TC4025BP	IC: Triple 3-Input NOR gate
IC24	SIM-4035-1	TC4035BP	IC: 4-Bit Parallel IN/Parallel OUT Shift Register
IC25	SIM-4068-1	TC4068BP	IC: 8-Input NAND Gate
IC26	SIM-4068-1	TC4068BP	IC: 8-Input NAND Gate
IC27	SIM-4035-1	TC4035BP	IC: 4-Bit Parallel IN/Parallel OUT Shift Register
IC28	SIM-4012-1	TC4012BP	IC: Dual 4-Input Positive NAND Gate
IC29	SIM-4585-1	TC4585BP	IC: 4-bit Magnitude Comparator
IC30	SIM-6402-1	TC6402BP	IC: Universal Asynchronous Receiver/Transmitter
IC31	SIM-5012-1	TC5012BP	IC: 3-Stage Buffer
IC32	SIM-4520-1	TC4520BP	IC: Dual Binary UP Counter
IC33	SIM-4520-1	TC4520BP	IC: Dual Binary UP Counter
IC34	SIT-74LS393-9	SN74LS393N	IC: Dual 4-bit Binary Counter
IC35	SIM-5012-1	TC5012BP	IC: 3-Stage Buffer
IC36	SIM-5012-1	TC5012BP	IC: 3-Stage Buffer
IC37	SIM-4334-1	TC4334BP	IC: 4K-bit CMOS RAM
I38 thru IC40	SIM-5012-1	TC5012BP	IC: 3-Stage Buffer
IC41	SIM-4027-1	TC4027BP	IC: Dual J-K Master-Slave Flip Flop
IC42	SIM-4035-1	TC4035BP	IC: 4-bit Parallel IN/Parallel OUT Shift Register
IC43	SIM-4035-1	TC4035BP	IC: 4-bit Parallel IN/Parallel OUT Shift Register
IC44	SIM-4042-1	TC4042BP	IC: Quad Clocked "D"-Latch
IC45	SMM-4334-1	TC4334BP	IC: 4K-bit CMOS RAM

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC46 thru IC48	SIT-74LS138-9	SN74LS138N	IC: Decoder/Demultiplexer
IC49	SIM-5012-1	TC5012BP	IC: 3-Stage Buffer
IC50	SIA-TL062-1	TL062CP	IC: Dual Operational Amplifier
IC51	SIM-4042-1	TC4042BP	IC: Qual Clocked "D"-Latch
IC52	SIM-4028-1	TC4028BP	IC: BCD to Decimal Decoder
IC53			Not assigned
IC54	SIM-6802-3	MB8870N	IC: 8-bit Microprocessor
IC55	SIT-74LS00-9	SN74LS00N	IC: Quadruple 2-Input NAND Gate
IC56	SIM-4028-1	TC4028BP	IC: BCD to Decimal Decoder
IC57	SIM-4013-1	TC4013BP	IC: Dual D-type Flip Flop
IC58	SIS-000370C-1	*	IC: 32K-bit UV EPROM
IC59 thru IC63	SIT-339-1	*	IC: Quad Comparator
IC64	SIS-000371C-1	*	IC: 32K-bit UV EPROM
IC65	SIT-74LS02-9	SN74LS02N	IC: Quadruple 2-Input NOR Gate
IC66	SIT-75468-1	SN75468N	IC: Darlington Transistor Array
IC67			Not assigned
IC68	SIM-4528-1	TC4528BP	IC: Dual Monostable Multivibrator
IC69			Not assigned
IC70	SIT-74LS390-9	SN74LS390N	IC: Dual Decoder Counter
IC71	SIT-74LS73-9	SN74LS73N	IC: Dual J-K Master-Slave Flip Flop
IC72	SIT-74LS04-9	SN74LS04N	IC: Hex Inverter
IC73	SIA-TL080-1	TL080CP	IC: Operational Amplifier
IC74	SIA-TL062-1	TL062CP	IC: Dual Operational Amplifier
IC75	SIA-TL062-1	TL062CP	IC: Dual Operational Amplifier
IC76	SIA-308-1	LM308H	IC: Operational Amplifier
IC77	SIA-TL062-1	TL062CP	IC: Dual Operational Amplifier
IC78	SIA-301A-12	LM301A	IC: Operational Amplifier
IC79	SIA-301A-12	LM301A	IC: Operational Amplifier
IC80	SIA-7815U-5	UPC-7815H	IC: Series Voltage Regulator
IC81	SIA-7815U-5	UPC-7815H	IC: Negative-voltage Regulator
IC82	SIA-7805U-5	UPC-7805H	IC: Voltage Regulator
IC83	SIA-TL080-1	TL080CP	IC: Operational Amplifier
IC84	SIA-SG3524-1	SG3524N	IC: Regulating Pulse Width Modulators
IC85	SDZ-6-1	LM399H	IC: Zener Diode
IC86	SHB-000249B-1	*	IC: FET Assembly
Q91	STN-2SC1959-1	2SC1959	Transistor SI NPN
Q92 thru Q97	STN-2SC1815-15	2SC1815GR	Transistor SI NPN
Q98	SFN-2SK141-18	*	FET Junction N-Channel
Q99	SFN-2SK141-18	*	FET Junction N-Channel
Q100			Not assigned
Q101	STN-2SC1815-15	2SC1815GR	Transistor SI NPN
Q102	SFN-2N4393-18	*	FET Junction N-Channel
Q103	SFN-2N4393-18	*	FET Junction N-Channel
Q104	SFT-A71-18	*	FET Junction N-Channel

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
Q105	SFN-2SK141-18	*	FET Junction N-Channel
Q106	STN-2SC1815-15	2SC1815GR	Transistor SI NPN
Q107	STP-2SA1015-1	2SA1015	Transistor SI PNP
Q108 thru Q114	SFN-2SK141-18	*	FET Junction N-Channel
Q115			Not assigned
Q116	SFT-840-28	*	FET Junction N-Channel
Q117	STN-2SC1815-15	2SC1815GR	Transistor SI NPN
Q118	SFN-2SK141-18	*	FET Junction N-Channel
Q119	SFN-2SK141-18	*	FET Junction N-Channel
Q120	STP-2SA1015-1	2SA1015	Transistor SI PNP
Q121	STN-2SC1815-15	2SC1815GR	Transistor SI NPN
Q122	SFN-2SK141-18	*	FET Junction N-Channel
Q123	STN-2SC1815-15	2SC1815GR	Transistor SI NPN
Q124	STN-2SC2335-1	2SC2335	Transistor SI NPN
Q125	STN-2SC2335-1	2SC2335	Transistor SI NPN
CP131 thru CP133	SEC-PS2001-1	PS2001B	Photocoupler
D137 thru D148	SDS-1S953-1	1S953	Diode SI
D149			Not assigned
D150	SDZ-W110-1	WZ-110	Zener Diode
D151	SDZ-W110-1	WZ-110	Zener Diode
D152	SDS-1S953-1	1S953	Diode SI
D153	SDS-1S953-1	1S953	Diode SI
D154	SDZ-W110-1	WZ-110	Zener Diode
D155	SDS-1S953-1	1S953	Diode SI
D156			Not assigned
D157			Not assigned
D158	SDZ-W061-1	WZ-061	Zener Diode
D159	SDZ-W061-1	WZ-061	Zener Diode
D160	SDS-1S953-1	1S953	Diode SI
D161	SDS-LD1-19	*	Diode SI
D162	SDS-LD1-19	*	Diode SI
D163	SDZ-W150-1	WZ-150	Zener Diode
D164	SDS-1S953-1	1S953	Diode SI
D165	SDZ-W081-1	WZ-081	Zener Diode
D166 thru D171	SDP-1S2764-2	GU-3SZ	Diode SI
D172 thru D176	SDS-1S953-1	1S953	Diode SI
R177	RCB-AH220-1	RD50S 220ΩJ	R: FXD CAR 220 Ω ±5% 1/2W
R178	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R179	RCB-AH22K-1	RD25S 22KΩJ	R: FXD CAR 22 kΩ ±5% 1/4W
R180	RVR-AK1K-1	3321H-1-102	R: VAR CERMET 1 kΩ

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Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
R181	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/4W
R182	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R183	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R184	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R185	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R186 thru R189	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/4W
R190	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R191	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R192	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/4W
R193	RCB-AH120-1	RD25S 120ΩJ	R: FXD CAR 120 Ω ±5% 1/4W
R194	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820 Ω ±5% 1/4W
R195	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820 Ω ±5% 1/4W
R196	RCB-AH33-1	RD25S 33ΩJ	R: FXD CAR 33 Ω ±5% 1/4W
R197	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R198	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R199	RCB-AH470K-1	RD25S 470KΩJ	R: FXD CAR 470 kΩ ±5% 1/4W
R200	RCB-AH47K-1	RD25S 47KΩJ	R: FXD CAR 47 kΩ ±5% 1/4W
R201	RCB-AH220K-1	RD25S 220KΩJ	R: FXD CAR 220 kΩ ±5% 1/4W
R202	RCB-AH220K-1	RD25S 220KΩJ	R: FXD CAR 220 kΩ ±5% 1/4W
R203	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R204	RVR-AK500K-1	3321H-1-504	R: VAR CERMET 500 kΩ
R205	RVR-AK500K-1	3321H-1-504	R: VAR CERMET 500 kΩ
R206	RCB-AH470K-1	RD25S 470KΩJ	R: FXD CAR 470 kΩ ±5% 1/4W
R207	RCB-AH470K-1	RD25S 470KΩJ	R: FXD CAR 470 kΩ ±5% 1/4W
R208	RCB-AH2R7K-1	RD25S 2.7KΩJ	R: FXD CAR 2.7 kΩ ±5% 1/4W
R209	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R210	RCB-AH47K-1	RD25S 47KΩJ	R: FXD CAR 47 kΩ ±5% 1/4W
R211	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R212	RCB-AH4R7K-1	RD25S 4.7KΩI	R: FXD CAR 4.7 kΩ ±5% 1/4W
R213	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R214	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R215 thru R222	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R223	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R224	RCB-AH47K-1	RD25S 47KΩJ	R: FXD CAR 47 kΩ ±5% 1/4W
R225	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R226	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R227	RCB-AH330K-1	RD25S 330KΩJ	R: FXD CAR 330 kΩ ±5% 1/4W
R228 thru R336	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R237	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R238	RCB-AH68K-1	RD25S 68KΩJ	R: FXD CAR 68 kΩ ±5% 1/4W
R239	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R240	RCB-AH47K-1	RD25S 47KΩJ	R: FXD CAR 47 kΩ ±5% 1/4W
R241	RCB-AH47K-1	RD25S 47KΩJ	R: FXD CAR 47 kΩ ±5% 1/4W
R242	RCB-AH27K-1	RD25S 27KΩJ	R: FXD CAR 27 kΩ ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
R243	RCB-AH27K-1	RD25S 27KΩJ	R: FXD CAR 27 kΩ ±5% 1/4W
R244	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/4W
R245	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/4W
R246	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R247	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560 Ω ±5% 1/4W
R248	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R249	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820 Ω ±5% 1/4W
R250	RAY-AA100K6-1	TMR6-104	R: FXD COM 100 kΩ
R251	RAY-AA100K4-1	TMR4-104	R: FXD COM 100 kΩ
R252	RAY-AA100K4-1	TMR6-103	R: FXD COM 100 kΩ
R253 thru R255	RAY-AA10K6-1	TMR6-103	R: FXD COM 10 kΩ
R256	RAY-AA100K6-1	TMR6-104	R: FXD COM 100 kΩ
R257	RAY-AA47K6-1	TMR6-473	R: FXD COM 47 kΩ
R258	RVR-AK500K-1	3321H-1-504	R: VAR CERMET 500 kΩ
R259	RCB-AH120K-1	RD25S 120KΩJ	R: FXD CAR 120 kΩ ±5% 1/4W
R260	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R261	RCB-AH470K-1	RD25S 470KΩJ	R: FXD CAR 470 kΩ ±5% 1/4W
R262	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R263	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R264	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/4W
R265	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R266	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560 Ω ±5% 1/4W
R267	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R268	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R269	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560 Ω ±5% 1/4W
R270	RCB-AH22K-1	RD25S 22KΩJ	R: FXD CAR 22 kΩ ±5% 1/4W
R271	RCB-AH330K-1	RD25S 330KΩJ	R: FXD CAR 330 kΩ ±5% 1/4W
R272 thru R274	RCB-AH15K-1	RD25S 15KΩJ	R: FXD CAR 15 kΩ ±5% 1/4W
R275	RCB-AH3R3K-1	RD25S 3.3KΩJ	R: FXD CAR 3.3 kΩ ±5% 1/4W
R276			Not assigned
R277	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R278			Not assigned
R279	RMF-AR180KFK-1	SN14K2E180KΩF	R: FXD Metal FLM 180 kΩ ±1% 1/4W
R280	RMF-AR5R6KFK-1	SN14K2E5.6KΩF	R: FXD Metal FLM 5.6 kΩ ±1% 1/4W
R281			Not assigned
R282	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R283	RMF-AR100KFK-1	SN14K2E100KΩF	R: FXD Metal FLM 100 kΩ ±1% 1/4W
R284	RMF-AR30KFK-1	SN14K2E30KΩF	R: FXD Metal FLM 30 kΩ ±1% 1/4W
R285	RMF-AR30KFK-1	SN14K2E30KΩF	R: FXD Metal FLM 30 kΩ ±1% 1/4W
R286	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R287	RMF-AR15KFK-1	SN14K2E15KΩF	R: FXD Metal FLM 15 kΩ ±1 1/4W
R288	RMF-AR15KFK-1	SN14K2E15KΩF	R: FXD Metal FLM 15 kΩ ±1 1/4W
R289	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/4W
R290	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R291	RCB-AH82K-1	RD25S 82KΩJ	R: FXD CAR 82 kΩ ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
R292	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R293	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R294	RMF-AR30KFK-1	SN14K2E30KΩJ	R: FXD Metal FLM 30 kΩ ±1% 1/4W
R295	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/4W
R296	RCB-AH5R6K-1	RD25S 5.6KΩJ	R: FXD CAR 5.6 kΩ ±5% 1/4W
R297	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/4W
R298	RCB-AH39K-1	RD25S 39KΩJ	R: FXD CAR 39 kΩ ±5% 1/4W
R299	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R300	RCB-AH820K-1	RD25S 820KΩJ	R: FXD CAR 820 kΩ ±5% 1/4W
R301	RCB-AH470K-1	RD25S 470KΩJ	R: FXD CAR 470 KΩ ±5% 1/4W
R302	RCB-AH39K-1	RD25S 39KΩJ	R: FXD CAR 39 kΩ ±5% 1/4W
R303	RCB-AH39K-1	RD25S 39KΩJ	R: FXD CAR 39 kΩ ±5% 1/4W
R304	RCB-AH1R2K-1	RD25S 1.2KΩJ	R: FXD CAR 1.2 kΩ ±5% 1/4W
R305	RMF-AR200KFK-1	SN14K2E200KΩF	R: FXD Metal FLM 200 kΩ ±1% 1/4W
R306	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R307	RCB-AH180-1	RD25S 180ΩJ	R: FXD CAR 180 Ω ±5% 1/4W
R308	RMF-AR18KFK-1	SN14K2E18KΩF	R: FXD Metal FLM 18 kΩ ±1% 1/4W
R309	RMF-AR220KFK-1	SN14K2E220KΩF	R: FXD Metal FLM 220 kΩ ±1% 1/4W
R310	RMF-AR68KFK-1	SN14K2E68KΩF	R: FXD Metal FLM 68 kΩ ±1% 1/4W
R311	RMF-AR10KFK-1	SN14K2E10KΩF	R: FXD Metal FLM 10 kΩ ±1% 1/4W
R312	RMF-AR47KFK-1	SN14K2E47KΩF	R: FXD Metal FLM 47 kΩ ±1% 1/4W
R313	RMF-AR47KFK-1	SN14K2E47KΩF	R: FXD Metal FLM 47 kΩ ±1% 1/4W
R314	RMF-AR180KFK-1	SN14K2E180KΩF	R: FXD Metal FLM 180 kΩ ±1% 1/4W
R315	RMF-AR18KFK-1	SN14K2E18KΩF	R: FXD Metal FLM 18 kΩ ±1% 1/4W
R316	RMF-AR330KFK-1	SN14K2E330KΩF	R: FXD Metal FLM 330 kΩ ±1% 1/4W
R317	RMF-AR68KFK-1	SN14K2E68KΩF	R: FXD Metal FLM 68 kΩ ±1% 1/4W
R318	RMF-AR2KFK-1	SN14K2E2KΩF	R: FXD Metal FLM 2 kΩ ±1% 1/4W
R319	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R320	RMF-AR22KFK-1	SN14K2E22KΩF	R: FXD Metal FLM 22 kΩ ±1% 1/4W
R321	RMF-AR2KFK-1	SN14K2E2KΩF	R: FXD Metal FLM 2 kΩ ±1% 1/4W
R322	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R323	RMF-AR2KFK-1	SN14K2E2KΩF	R: FXD Metal FLM 2 kΩ ±1% 1/4W
R324	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R325	RMF-AR2KFK-1	SN14K2E2KΩF	R: FXD Metal FLM 2 kΩ ±1% 1/4W
R326	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R327	RMF-AR2KFK-1	SN14K2E2KΩF	R: FXD Metal FLM 2 kΩ ±1% 1/4W
R328	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R329	RMF-AR2KFK-1	SN14K2E2KΩF	R: FXD Metal FLM 2 kΩ ±1% 1/4W
R330	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R331	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R332	RMF-AB39KFK-1	SN14K2E39KΩF	R: FXD Metal FLM 39 kΩ ±1% 1/4W
R333	RMF-AB39KFK-1	SN14K2E39KΩF	R: FXD Metal FLM 39 kΩ ±1% 1/4W
R334	RCB-AH1R8K-1	RD25S 1.8KΩJ	R: FXD CAR 1.8 kΩ ±5% 1/4W
R335	RCB-AH51-1	RD25S 51ΩJ	R: FXD CAR 51 Ω ±5% 1/4W
R336	RVR-BE50-1	X6T50Ω	R: VAR WW 50 Ω
R337	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/4W
R338	RVR-AK100K-1	3321H-1-104	R: VAR CERMET 100 kΩ
R339	RVR-AK100K-1	3321H-1-104	R: VAR CERMET 100 kΩ

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
R340	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/4W
R341	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R342	RCB-AH5R6K-1	RD25S 5.6KΩJ	R: FXD CAR 5.6 kΩ ±5% 1/4W
R343	RCB-AH12K-1	RD25S 12KΩJ	R: FXD CAR 12 kΩ ±5% 1/4W
R344	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R345	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R346	RCB-AH820K-1	RD25S 820KΩJ	R: FXD CAR 820 kΩ ±5% 1/4W
R347	RCB-AH270K-1	RD25S 270KΩJ	R: FXD CAR 270 kΩ ±5% 1/4W
R348	RCB-AH270K-1	RD25S 270KΩJ	R: FXD CAR 270 kΩ ±5% 1/4W
R349	RCB-AH820K-1	RD25S 820KΩJ	R: FXD CAR 820 kΩ ±5% 1/4W
R350	RCB-AF56K-1	RD1S 56KΩJ	R: FXD CAR 56 kΩ ±5% 1W
R351	RCB-AF56K-1	RD1S 56KΩJ	R: FXD CAR 56 kΩ ±5% 1W
R352	RCB-AH820K-1	RD25S 820KΩJ	R: FXD CAR 820 kΩ ±5% 1/4W
R353	RCB-AH820K-1	RD25S 820KΩJ	R: FXD CAR 820 kΩ ±5% 1/4W
R354	RCB-AH6R8K-1	RD25S 6.8KΩJ	R: FXD CAR 6.8 kΩ ±5% 1/4W
R355	RCB-AH6R8K-1	RD25S 6.8KΩJ	R: FXD CAR 6.8 kΩ ±5% 1/4W
R356	RCB-AH2R2-1	RD25S 2.2ΩJ	R: FXD CAR 2.2 Ω ±5% 1/4W
R357	RCB-AH2R2-1	RD25S 2.2ΩJ	R: FXD CAR 2.2 Ω ±5% 1/4W
R358	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R359	RCB-AH27K-1	RD25S 27KΩJ	R: FXD CAR 27 kΩ ±5% 1/4W
R360	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R361	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R362	RCB-AH27K-1	RD25S 27KΩJ	R: FXD CAR 27 kΩ ±5% 1/4W
R363	RVX-BE1K-1	X6T1KΩ	R: VAR WW 1 kΩ
R364	RCB-AH2R2-1	RD25S 2.2ΩJ	R: FXD CAR 2.2 Ω ±5% 1/4W
R365	RWT-AS92R7KA-1	*	R: FXD WW 92.7 kΩ
R366	RVR-BE200-1	X6T200Ω	R: VAR WW 200 Ω
R367	RMF-AR180QFK-1	SN14K2E180ΩF	R: FXD Metal FLM 180 Ω ±1% 1/4W
R368	RMF-AR180QFK-1	SN14K2E180ΩF	R: FXD Metal FLM 180 Ω ±1% 1/4W
R369	RCB-AH2R2-1	RD25S 2.2ΩJ	R: FXD CAR 2.2 Ω ±5% 1/4W
R370	RCB-AH2R2-1	RD25S 2.2ΩJ	R: FXD CAR 2.2 Ω ±5% 1/4W
R371	RWT-AS1R7971KA-1	*	R: FXD WW 1.7971 kΩ
R372	RWT-AA746R42QA-1	*	R: FXD WW 746.42 kΩ
R373	RWT-AA199R45QA-1	*	R: FXD WW 199.45 kΩ
R374	RCB-AH4R7-1	RD25S 4.7ΩJ	R: FXD CAR 4.7 Ω ±5% 1/4W
R375	RVR-BE500-1	X6T500Ω	R: VAR WW 500 Ω
R376	RWT-AS17R975KA-1	*	R: FXD WW 17.975 kΩ
R377			Not assigned
R378			Not assigned
R379	RMF-AR47QFK-1	SN14K2E47ΩF	R: FXD Metal FLM 47 Ω ±1% 1/4W
R380	RWT-AS79R976KA-1	*	R: FXD WW 79.976 kΩ
R381	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R382	RVR-BE5K-1	X6T 5KΩ	R: VAR WW 5 kΩ
R383	RCB-AH27K-1	RD25S 27KΩJ	R: FXD CAR 27 kΩ ±5% 1/4W
R384	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R385	RCB-AH27K-1	RD27S 27KΩJ	R: FXD CAR 27 kΩ ±5% 1/4W
R386	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R387	RCB-AH27K-1	RD25S 27KΩJ	R: FXD CAR 27 kΩ ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
R388	RMF-AR6R8KFK-1	SN14K2E6.8KΩF	R: FXD Metal FLM 6.8 kΩ ±1% 1/4W
R389	RCB-AH150-1	RD25S 150ΩJ	R: FXD CAR 150 Ω ±5% 1/4W
R390	RCB-AH2R7K-1	RD25S 2.7KΩJ	R: FXD CAR 2.7 kΩ ±5% 1/4W
R391	RWT-AS10KD-1	*	R: FXD WW 10 kΩ
R392	RWT-AS3R722KD-1	*	R: FXD WW 3.722 kΩ
R393	RMF-AB91QFG-1	RF 1/4N 91ΩRF	R: FXD Metal FLM 91 Ω ±1% 1/4W
R394	RMF-AB680QFG-1	RF 1/4N 680ΩRF	R: FXD Metal FLM 680 Ω ±1% 1/4W
R395 thru R400	RMF-AB91QFG-1	RF 1/4N91ΩRF	R: FXD Metal FLM 91 Ω ±1% 1/4W
R401	RVR-BE100-1	X6T 100Ω	R: VAR WW 100 Ω
R402	RCB-AH220-1	RD25S 220ΩJ	R: FXD CAR 220 Ω ±5% 1/4W
R403	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R404	RCB-AH470K-1	RD25S 470KΩJ	R: FXD CAR 470 kΩ ±5% 1/4W
R405	RAY-BAX0002-1	RA942	R: FXD COM 20 kΩ
R406	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R407	RCB-AH2R7K-1	RD25S 2.7KΩJ	R: FXD CAR 2.7 kΩ ±5% 1/4W
R408 thru R410	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R411	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R412	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R413	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820 Ω ±5% 1/4W
R414	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820 Ω ±5% 1/4W
R415	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R416	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R417	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/4W
R418	RCB-AH5R6K-1	RD25S 5.6KΩJ	R: FXD CAR 5.6 kΩ ±5% 1/4W
R419	RWR-AER43QE-1	*	R: FXD WW 43 Ω
R420	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/4W
R421	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R422	RCB-AH3R3K-1	RD25S 3.3KΩJ	R: FXD CAR 3.3 kΩ ±5% 1/4W
R423	RCB-AH3R3K-1	RD25S 3.3KΩJ	R: FXD CAR 3.3 kΩ ±5% 1/4W
R424			Not assigned
R425	RVR-AK50K-1	3321H-1-503	R: VAR CERMET 50 kΩ
R426	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R427	RAY-AA68K6-1	TMR6-683	R: FXD COM 68 kΩ
R428	RHB-000003-1	*	R: Hybrid
R429	RCB-AH6R8K-1	RD25S 6.8KΩJ	R: FXD CAR 6.8 kΩ ±5% 1/4W
R430	RCB-AH6R8K-1	RD25S 6.8KΩJ	R: FXD CAR 6.8 kΩ ±5% 1/4W
R431	RCB-AH150K-1	RD25S 150KΩJ	R: FXD CAR 150 kΩ ±5% 1/4W
R432	RCB-AH330K-1	RD25S 330KΩJ	R: FXD CAR 330 kΩ ±5% 1/4W
R433	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R434	RCB-AH270K-1	RD25S 270KΩJ	R: FXD CAR 270 kΩ ±5% 1/4W
R435	RMF-AR68KFK-1	SN14K2E68KΩF	R: FXD Metal FLM 68 kΩ ±1% 1/4W
R436	RMF-AR10KFK-1	SN14K2E10KΩF	R: FXD Metal FLM 10 kΩ ±1% 1/4W
R437	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R438	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R439	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
R440	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R441	CCK-AB100U25V-1	25VB100	C: FXD ELECT 100μF 25V
C442	CCK-AB3R3U50V-1	50VB3R3	C: FXD ELECT 3.3μF 50V
C443	CFM-ABR047U50V-1	501N5002-473K	C: FXD Mylar 0.047μF +80, -20% 50V
C444	CFM-ABR047U50V-1	501N5002-473K	C: FXD Mylar 0.047μF +80, -20% 50V
C445			Not assigned
C446	CFM-AHR22U100V-1	ECQ-E1224KN	C: FXD Polyester FLM 0.22μF +80, -20% 100V
C447	CSM-AC1000P50V-1	0.001UF 50WV	C: FXD CER 0.001μF 50V
C448	CMC-AC560PR3K-2	DM15D561J3	C: FXD DIPPED MICA 560pF ±5% 300V
C449	CMC-AB100PR3K-4	DM10D101J3	C: FXD DIPPED MICA 100pF ±5% 300V
C450	CMC-AB47PR3K-4	DM10D470J3	C: FXD DIPPED MICA 47pF ±5% 300V
C451	CSM-AC22P50V-1	22PF 50WV	C: FXD CER 22pF ±10% 50V
C452	CSM-AC100P50V-1	100PF 50WV	C: FXD CER 100pF ±10% 50V
C453	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C454	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C455	CMC-AB330PR3K-4	DM10D331J3	C: FXD DIPPED MICA 330pF ±5% 300V
C456			Not assigned
C457	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C458	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C459	CFM-AMR1U100V-1	ECQ-P1104FZ	C: FXD Polyester FLM 0.1μF +80, -20% 100V
C460	CFM-AMR1U100V-1	ECQ-P1104FZ	C: FXD Polyester FLM 0.1μF +80, -20% 100V
C461	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C462	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C463	CSM-AC33P50V-1	33PF 50WV	C: FXD CER 33pF ±10% 50V
C464 thru C466	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C467	CFM-AMR1U100V-1	ECQ-P1104FZ	C: FXD Polyester FLM 0.1μF +80, -20% 100V
C468	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C469	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C470	CSM-AC33P50V-1	33PF 50WV	C: FXD CER 33pF ±10% 50V
C471	CTA-AC3R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7μF ±20% 25V
C472	CFM-AB2200P50V-1	501N5002-222K	C: FXD FXD Mylar 2200pF ±10% 50V
C473	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C474	CFM-AAR01UR1K-1	441N1003-103K	C: FXD Myler 0.01μF ±10% 1KV
C475	CCK-AB33U50V-1	50VB33	C: FXD ELECT 33μF 50V
C476	CSM-ACR1U25V-1	0.1UF 25WV	C: FXD CER 0.1μF +80, -20% 50V
C477	CSM-ACR047U50V-1	0.047UF 50WV	C: FXD CER 0.047μF +80, -20% 50V
C478	CCK-AB220U25V-1	25VB220	C: FXD ELECT 220μF 25V
C479	CCK-AB100U50V-1	50VB100	C: FXD ELECT 100μF 50V
C480	CCK-AB330U10V-1	10VB330	C: FXD ELECT 330μF 10V
C481	CSM-ACR1U25V-1	0.1UF 25WV	C: FXD CER 0.1μF +80, -20% 25V
C482	CCK-AB220U25V-1	25VB220	C: FXD ELECT 220μF 25V
C483	CSM-ACR1U25V-1	0.1UF 25WV	C: FXD CER 0.1μF +80, -20% 25V
C484	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TRANTAL 4.7μF ±20% 25V
C485	CSM-AC4700P50V-1	0.0047UF 50WV	C: FXD CER 0.0047μF +80, -20% 50V
C486	CCK-AB33U25V-1	25VB33	C: FXD ELECT 33μF 25V
C487	CCK-AB33U25V-1	25VB33	C: FXD ELECT 33μF 25V

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
C488 thru C503	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C504			Not assigned
C505	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C506	CMC-AC470PR3K-2	DM15D471J3	C: FXD DIPPED MICA 470pF ±5% 300V
C507	CMC-AB330PR3K-4	DM10D331J3	C: FXD DIPPED MICA 330pF ±5% 300V
C508 thru C515	CMC-AB150PR3K-4	DM10D151J3	C: FXD DIPPED MICA 150pF ±5% 300V
C516	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C517	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C518 thru C520	CSM-ACR022U50V-1	0.022UF 50WV	C: FXD CER 0.022μF +80, -20% 50V
L521	LCL-T00084-1	LT-3	L: FXD Coil
L522	LCL-T00084-1	LT-3	L: FXD Coil
C523	CSM-AC47P50V-1	47PF 50WV	C: FXD CER 47pF ±10% 50V
C524	CSM-ACR022U50V-1	0.022UF 50WV	C: FXD CER 0.022μF +80, -20% 50V
C525	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
X526	DXD-000447-1	XU-103	Crystal
C527 thru C530	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
S531	KSL-000140-1	SJ0235	Switch
S532	KSA-000270-1	435166-5	Switch
S533			Not assigned
C534	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C535 thru C538			Not assigned
C539	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C540	CTA-AB10U25V-1	221M2502-106M	C: FXD ELECT TANTAL 10μF
K541	KRL-000402-1	S2E-12V	Relay
K542	KRL-000419-1	NR-SD-12V-5	Relay
C544	CSM-AC2200P50V-1	0.0022UF 50WV	C: FXD CER 0.0022μF +80, -20% 50V
C545	CTA-AB4R7U35V-1	221M3502-475M	C: FXD ELECT TANTAL 4.7μF ±20% 35V
F546	DFT-AAR4A-1	EAWK0.4A	Fuse
C547	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C548 thru C550			Not assigned
	MBJ-17678A-1	*	Heat Sink
T556	LTP-000338A-1	*	Transformer
	MBN-10371A-1	401-9619B	Fuse Holder
	JCI-AD040JX01-1	ICN-406-S5	IC Socket
	JCI-AD024JX01-2	DL2-24A	IC Socket

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
J1	JCP-AA006PX01-1	A-1106	Connector
J2	JCP-AA006PX01-1	A-1106	Connector
J3	JCP-AA003PX05-1	A-1103	Connector
J4			Not assigned
J5	JCP-AA012PX01-1	A-1112	Connector
J6	JCP-AA018PX01-1	A-1118	Connector
J7	JCP-AA018PX01-1	A-1118	Connector
J8	JCP-AA003PX05-1	A-1103	Connector
J9	JCP-AA003PX05-1	A-1103	Connector
J10	JCP-AA024PX05-1	DL2-24A	Connector
J11 thru J16	JCP-AA003PX05-1	A-1103	Connector
	MEM-10372A-1	401-9630A	Terminal
	JTF-AA001EX02-1	FT-E-15	Teflon Terminal
	JTT-AB001EX04-1	A-105	Hermetic Seal
R591	RCB-AH270K-1	RD25S 270KΩJ	R: FXD CAR 270 kΩ ±5% 1/4W
R592	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R593	RCB-AH330K-1	RD25S 330KΩJ	R: FXD CAR 330 kΩ ±5% 1/4W
R594	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R595	RCB-AH390-1	RD25S 390ΩJ	R: FXD CAR 390 Ω ±5% 1/4W
R596	RCB-AH390-1	RD25S 390ΩJ	R: FXD CAR 390 Ω ±5% 1/4W
R597			Not assigned
R598	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
C610	CSM-AC1000P50V-1	0.001UF 50WV	C: FXD CER 0.001μF +80, -20% 50V
C611	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
C612	CFM-ABR022U50V-1	501N5002-223K	C: FXD Mylar 0.022μF +80, -20% 50V
C613			Not assigned

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TR2741
LED ASSY
BKB-010167

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
D1	NLD-000003-1	BR3402S	Light Emitting Diode
D2	NLD-000003-1	BR3402S	Light Emitting Diode
J3	DCB-QS0483-1	TOC-1A03060N	Connector
	MPX-15081A-1	MXP-0296-0112-3	Spacer

TR2741
REAR SWITCH
BLC-010168

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
S1 thru S4	KSL-000140-1	SJ0235	Switch
S5	KSL-000034-1	MFS-201N6	Switch
J6	DCB-QS0495-1	TOC-1A12030N	Connector
J7	JCS-AX010JX01-1	JRC21RG-10S	Connector
J8	JCS-AX010JX01-1	JRC21RG-10S	Connector
J9	JCP-AC002PX01-1	SI-7501	Connector

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
FL1	DNF-000207-1	NF13502	Noise Filter
FH1	DFN-000192-1	NF-003	Fuse Holder
F1	DFT-AA2R5A-1	EAWK2.5A	Fuse
M1	DMF-000107-1	8500H4	Blower
S1	KSE-000739-1	ASS3K04N	Switch
T1	LTP-000334-1	*	Power Transformer
PR1	AAA-EUY10T311RC-1	*	Termal Dots Printer
D1	SEC-TLP517-2	TLP-517	Photo Interruptor
B1	DBP-000459-2	K-3N1650C-SB	Ni-Cd Battery
J1	JCS-AX010JX01-1	JRC21RG-10S	Connector
J2	JCS-AX010JX01-1	JRC21RG-10S	Connector
J3	JCB-AB015JX02-1	CR6-15S-3.96E	Connector
J4	DCB-QS0539-1	TOC-2A24060N	Connector with Cable
J5	DCB-QS0493-1	TOC-1A12030N	Connector with Cable
J6	DCB-QS0507-1	TOC-1A24060N	Connector with Cable
J7			Not assigned
J8	DCB-PR0676X01-1	FCA-0017-01	Connector with Cable
J9	DCB-RR0754X01-1	*	Connector with Cable
P1	JTT-AA003EX01-2	RGKS-3B	Terminal
P2	JTE-AG001EX01-1	TOP-23A	Terminal
J10 thru J15	DCB-QS0481-1	TOC-1A03030N	Connector with Cable

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIA-SC32405-1	EHD-SC32405	IC: Voltage Regulator
IC2	SIA-SC30505-1	EHD-SC30505	IC: Voltage Regulator
IC3	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
Q11 thru Q13	STN-2SC1826-1	2SC1826	Transistor SI NPN
D19	SDP-SM1-1	SM-1-02	Diode SI
D20	SDP-SM1-1	SM-1-02	Diode SI
D21	SDS-RB402-2	S4VB10	Diode SI
D22	SDS-RB402-2	S4VB10	Diode SI
D23 thru D25	SDP-W02-1	W02	Diode SI
D26	NLD-000020-1	SLP-24B	Light Emitting Diode
D27	SDZ-W150-1	WZ-150	Zener Diode
D28	SDZ-W240-1	WZ-240	Zener Diode
D29	SDZ-W090-1	WZ-090	Zener Diode
R31	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R32	RCB-AH100-1	RD25S 100ΩJ	R: FXD CAR 100 Ω ±5% 1/4W
R33			Not assigned
R34	RWR-AER22Q-1	*	R: VAR WW 22Ω
R35	RWR-AER22Q-1	*	R: VAR WW 22Ω
R36	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/4W
R37	RPW-ACR-1-2	RH10-0.1ΩK	R: FXD WW 0.1 Ω
R38			Not assigned
R39	RCB-AH22K-1	RD25S 22KΩJ	R: FXD CAR 22 kΩ ±5% 1/4W
R40	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R41	RCB-AH100-1	RD25S 100ΩJ	R: FXD CAR 100 Ω ±5% 1/4W
R42	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R43	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R44			Not assigned
R45			Not assigned
R46	RVR-AK2K-1	3321H-1-202	R: VAR CERMET 2 kΩ
R47	RVR-AK500-1	3321H-1-501	R: VAR CERMET 500 Ω
C51	CSM-ACR1U50V-1	0.1UF 50WV	C: FXD CER 0.1µF +80, -20% 50V
C52	CSM-ACR022U50V-1	0.022UF 50WV	C: FXD CER 0.022µF +80, -20% 50V
C53	CSM-ACR047U50V-1	0.047UF 50WV	C: FXD CER 0.047µF +80, -20% 50V
C54	CSM-ACR047U50V-1	0.047UF 50WV	C: FXD CER 0.047µF +80, -20% 50V
C55			Not assigned
C56	CCK-AB100U50V-1	50VB100	C: FXD ELECT 100µF 50V
C57	CCK-AC1000UR1K-1	100VP1000	C: FXD ELECT 1000µF 100V
C58	CCK-AC1000UR1K-1	100VP1000	C: FXD ELECT 1000µF 100V
C59	CCK-AB470U50V-1	50VB470	C: FXD ELECT 470µF 50V
C60	CCK-AB470U50V-1	50VB470	C: FXD ELECT 470µF 50V
C61	CCK-AC4700U50V-1	50VB4700	C: FXD ELECT 4700µF 50V
C62	CCK-AB470U16V-1	16VB470	C: FXD ELECT 470µF 16V
C63	CCK-AB470U16V-1	16VB470	C: FXD ELECT 470µF 16V

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
C64	CCK-AB220U10V-1	10VB220	C: FXD ELECT 220µF 10V
C65	CCK-AC2200U50V-1	50VP2200	C: FXD ELECT 2200µF 50V
C66	CCK-AB47U100V-1	100VB47	C: FXD ELECT 47µF 100V
C67	CCK-AB100U25V-1	25VB100	C: FXD ELECT 100µF 25V
C68 thru C83	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
C84 thru C87	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01µF +80, -20 50V
C88	CTA-AC1U50V-4	TA-050TN1R0-R	C: FXD ELECT TANTAL 1µF
J92 thru J94	JCS-AA064JX04-1	FCN-364J064-AG	Connector
J95	JCR-AB050PX03-1	HIF3-50P-2.54DSA	Connector
J96	JCR-AB034PX03-1	HIF3-34P-2.54DSA	Connector
J97	JCP-AA003PX01-1	A-1103	Pin Connector
J98	JCP-AA024PX05-1	A-2124	Pin Connector
J99	JCP-AA012PX01-1	A-1112	Pin Connector
J100	JCP-AA006PX01-1	A-1106	Pin Connector
L102	LCL-T00326-1	SF5-401K05A-02	L: FXD Coil
L103	LCL-T00326-1	SF5-401K05A-02	L: FXD Coil
BZ106	DEE-000382-1	PKM11-4A0	Buzzer
	MBM-000382-1	401-9630A	Terminal

TR2731
MOTHER BOARD II
BLG-010389

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
J1 thru J6	JCB-AD048JX03-1	PBRS-48-T10	Connector
J7	DCB-QS0797X01-1	*	Connector with Cable
J8	DCB-QS0488-1	TOC-1A06030N	Connector with Cable
C14 thru C29	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIA-555-7	HA17555PS	IC: Timer
IC2	SIT-74LS393-9	SN74LS393N	IC: Dual 4-Bit Binary Counter Low Power
IC3	SIT-74LS00-9	SN74LS00N	IC: Quadruple 2-Input NAND Gate Low Power
IC4	SIA-393-1	LM393	IC: Dual Voltage Comparator
IC5	SIA-74LS14-9	SN74LS14N	IC: Hex Schmitt-Trigger Inverter Low Power
IC6	SIT-7403-1	SN7403N	IC: Quadruple 2-Input NAND Gate with Open Collector Output
IC7	SIA-555-7	HA17555PS	IC: Timer
IC8	SIT-75472-1	SN75472P	IC: 3-State Output
IC9	SIT-75472-1	SN75472P	IC: 3-State Output
IC10	SMM-2114-8	HM472114P-4	IC: 4K bit Static RAM
IC11	SIT-74LS175-9	SN74LS175N	IC: Complementary Output Common Direct Clear Low Power
IC12	SIT-74LS04-9	SN74LS04N	IC: Hex Inverter Low Power
IC13	SIT-74LS08-9	SN74LS08N	IC: Quadruple 2-Input Positive-AND Gate Low Power
IC14	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC15	SIT-75472-1	SN75472P	IC: 3-State Output
IC16	SIT-75472-1	SN75472P	IC: 3-State Output
IC17	SMM-2114-8	HM472114P-4	IC: 4K bit Static RAM
IC18	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC19	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC20	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC21	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC22	SIA-7812U-5	UPC7812H	IC: Series Voltage Regulator
IC23	SIA7812U-5	UPC7912H	IC: Series Voltage Regulator
Q31 thru Q37	STP-2SA473-1	2SA473	Transistor SI PNP
Q38	STN-2SD330-1	2SD330	Transistor SI NPN
Q39	STP-2SA473-1	2SA473	Transistor SI PNP
Q40	STP-2SA1015-1	2SA1015	Transistor SI PNP
Q41 thru Q44	STN-2SC1815-15	2SC1815GR	Transistor SI NPN
Q45	STP-2SA1015-1	2SA1015	Transistor SI PNP
Q46	STN-2SC1815-15	2SC1815GR	Transistor SI NPN
Q47	STN-2SC1815-15	2SC1815GR	Transistor SI NPN
Q48	STN-2SC594-1	2SC594	Transistor SI NPN
Q49	STP-2SA510-1	2SA510	Transistor SI PNP
Q50	STN-2SC982-1	2SC982	Transistor SI NPN
Q51 thru Q54	STN-2SC1815-15	2SC1815GR	Transistor SI NPN
Q55	STN-2SC510-1	2SC510	Transistor SI NPN
D61 thru D74	SDS-1S953-1	1S953	Diodo SI

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
D75	SDP-SM1-1	SM-1-02	Diode SI
D76	SDP-SM1-1	SM-1-02	Diode SI
D77	SDZ-W162-1	WZ-162	Zener Diode
D78	SDZ-W177-1	WZ-177	Zener Diode
D79 thru D81	SDP-SM1-1	SM-1-02	Diode SI
D82	SDZ-W177-1	WZ-177	Zener Diode
D83	SDZ-W061-1	WZ-061	Zener Diode
D84 thru D86	SDP-W02-1	W02	Diode SI
D87	SDZ-W056-1	WZ-056	Zener Diode
D88	SDS-1S953-1	IS953	Diode SI
R91	RVR-CD10K-2	3321N-1-103	R: VAR CERMET 10 kΩ
R92	RVR-CD5K-2	3321N-1-502	R: VAR CERMET 5 kΩ
R93	RVR-CD5K-2	3321N-1-502	R: VAR CERMET 5 kΩ
R94 thru R96	RAY-AA3R3K4-1	TMR4-332	R: FXD COM 3.3 kΩ
R97	RAY-AA10K4-1	TMR4-103	R: FXD COM 10 kΩ
R98	RAY-AA10K4-1	TMR4-103	R: FXD COM 10 kΩ
R99 thru R105	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R106	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/4W
R107	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/4W
R108	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R109	RCB-AH3R3K-1	RD25S 3.3KΩJ	R: FXD CAR 3.3 kΩ ±5% 1/4W
R110	RCB-AH2R2K-1	RD50S 2.2KΩJ	R: FXD CAR 2.2 kΩ ±5% 1/2W
R111	RCB-AH150-1	RD50S 150ΩJ	R: FXD CAR 150 Ω ±5% 1/2W
R112	RCB-AH220-1	RD25S 220ΩJ	R: FXD CAR 220 Ω ±5% 1/4W
R113	RCB-AH220K-1	RD25S 220KΩJ	R: FXD CAR 220 Ω ±5% 1/4W
R114	RCB-AH180K-1	RD25S 180KΩJ	R: FXD CAR 180 kΩ ±5% 1/4W
R115	RCB-AH18K-1	RD25S 18KΩJ	R: FXD CAR 18 kΩ ±5% 1/4W
R116	RCB-AH10-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R117	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R118	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R119	RCB-AH47K-1	RD25S 47KΩJ	R: FXD CAR 47 kΩ ±5% 1/4W
R120	RCB-AH220K-1	RD25S 220KΩJ	R: FXD CAR 220 kΩ ±5% 1/4W
R121	RCB-AH12K-1	RD25S 12KΩJ	R: FXD CAR 12 kΩ ±5% 1/4W
R122	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/4W
R123	RCB-AH220-1	RD25S 220ΩJ	R: FXD CAR 220 Ω ±5% 1/4W
R124	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R125	RCB-AH220-1	RD25S 220ΩJ	R: FXD CAR 220 Ω ±5% 1/4W
R126	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R127	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R128	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R129	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R130	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
R131	RCB-AH18K-1	RD25S 18KΩJ	R: FXD CAR 18 kΩ ±5% 1/4W
R132	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R133	RCB-AH33-1	RD25S 33ΩJ	R: FXD CAR 33 Ω ±5% 1/4W
R134	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R135 thru R137	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/4W
R138	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R139	RCB-AH180-1	RD25S 180ΩJ	R: FXD CAR 180 Ω ±5% 1/4W
R140	RCB-AH180-1	RD25S 180ΩJ	R: FXD CAR 180 Ω ±5% 1/4W
R141	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R142	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R143	RCB-AH1R2K-1	RD25S 1.2KΩJ	R: FXD CAR 1.2 kΩ ±5% 1/4W
R144	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
R145	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/4W
R146	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/4W
R147	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R148	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R149	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R150	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R151	RCB-AH4.7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R152	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R153	RCB-AH3R3K-1	RD25S 3.3KΩJ	R: FXD CAR 3.3 kΩ ±5% 1/4W
R154	RCB-AH2R7K-1	RD25S 2.7KΩJ	R: FXD CAR 2.7 kΩ ±5% 1/4W
R155	RCB-AH3R3K-1	RD25S 3.3KΩJ	R: FXD CAR 3.3 kΩ ±5% 1/4W
R156	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820 Ω ±5% 1/4W
R157	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R158	RCB-AH100-1	RD25S 100ΩJ	R: FXD CAR 100 Ω ±5% 1/4W
R159	RCB-AH2R2K-1	RD25S 2.2KΩJ	R: FXD CAR 2.2 kΩ ±5% 1/4W
R160	RCB-AH330K-1	RD25S 330KΩJ	R: FXD CAR 330 kΩ ±5% 1/4W
R161	RCB-AH1R2K-1	RD25S 1.2KΩJ	R: FXD CAR 1.2 kΩ ±5% 1/4W
R162	RCB-AH180-1	RD25S 180ΩJ	R: FXD CAR 180 Ω ±5% 1/4W
R163	RCB-AH2R2K-1	RD25S 2.2KΩJ	R: FXD CAR 2.2 kΩ ±5% 1/4W
R164	RCB-AH10-1	RD50S 10ΩJ	R: FXD CAR 10 Ω ±5% 1/2W
R165	RCB-AH2R2K-1	RD25S 2.2KΩJ	R: FXD CAR 2.2 kΩ ±5% 1/4W
R166	RCB-AH5R6K-1	RD25S 5.6KΩJ	R: FXD CAR 5.6 kΩ ±5% 1/4W
R167	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R168	RCB-AH18K-1	RD25S 18KΩJ	R: FXD CAR 18 kΩ ±5% 1/4W
R169	RCB-AH18K-1	RD25S 18KΩJ	R: FXD CAR 18 kΩ ±5% 1/4W
R170	RVR-CD10K-2	3321N-1-103	R: VAR CERMET 10 kΩ
C179	CSM-AC100P50V-1	100PF 50WV	C: FXD CER 100pF ±10% 50V
C180	CSM-AC33P50V-1	33PF 50WV	C: FXD CER 33pF ±10% 50V
C181	CMC-AC220PR3K-2	DM15D221J3	C: FXD DIPPED MICA 200pF ±5% 300 V
C182	CSM-AC470P50V-1	470PF 50WV	C: FXD CER 470pF ±10% 50V
C183	CSM-AC100P50V-1	100PF 50WV	C: FXD CER 100pF ±10% 50V
C184	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C185	CTA-AB4R7U10V-1	221M1002-475M	C: FXD ELECT TANTAL 4.7μF ±20% 10V
C186	CSM-ACR047U50V-1	0.047UF 50WV	C: FXD CER 0.047μF +80, -20% 50V

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
C187	CSM-ACR047U50V-1	0.047UF 50WV	C: FXD CER 0.047μF +80, -20% 50V
C188	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C189	CSM-ACR022U50V-1	0.022UF 50WV	C: FXD CER 0.022μF +80, -20% 50V
C190	CFM-ABR1U50V-1	501N5002-103K	C: FXD Mylar 1μF ±10% 50V
C191	CSM-ACR1U25V-1	0.1UF 25WV	C: FXD CER 1μF +80, -20% 25V
C192	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C193	CSM-ACR047U50V-1	0.047UF 50WV	C: FXD CER 0.047μF +80, -20% 50V
C194	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10ΩF ±20% 16V
C195	CCK-AA330U35V-1	35T330	C: FXD ELECT 330μF 35V
C196	CTA-AA10U50V-1	111M5002-106M	C: FXD ELECT TANTAL 10μF ±20% 50V
C197	CCK-AB47U25V-1	25VB47	C: FXD ELECT 47μF 25V
C198 thru C200	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C201	CCK-AA330U35V-1	35T330	C: FXD ELECT 330μF 35V
C202	CCK-AA3R3U100V-1	100T3R3	C: FXD ELECT 3.3μF 100V
C203	CMC-AC470PR3K-2	DM15D471J3	C: FXD DIPPED MICA 470μF ±5% 300V
C204	CFM-ABR047U50V-1	501N5002-473K	C: FXD Mylar 0.047μF ±10% 50V
C205	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C206	CSM-ACR047U50V-1	0.047UF 50WV	C: FXD CER 0.047μF +80, -20% 50V
C207	CCK-AA47U50V-1	50T47	C: FXD ELECT 47μF 50V
C208 thru C213	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C214	CCK-AA1000U35V-1	35T1000	C: FXD ELECT 1000μF 35V
C215	CSM-ACR047U50V-1	0.047UF 50WV	C: FXD CER 0.047μF +80, -20% 50V
C216	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C217	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20%, 50V
C218	CSM-ACR022U50V-1	0.022UF 50WV	C: FXD CER 0.022μF +80, -20% 50V
C219	CSM-ACR022U50V-1	0.022UF 50WV	C: FXD CER 0.022μF +80, -20% 50V
C220	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
CP221	SEC-PS2001-1	PS2001B	Photocoupler
CP222	SEC-PS2001-1	PS2001B	Photocoupler
J231	JCP-AA024PX07-1	A-1324	Connector
J232	JCS-AA064PX05-1	FCN-365P064-AG	Connector
J233	JCP-AA003PX06-1	A-1303	Pin Connector
J234	JCP-AA003PX06-1	A-1303	Pin Connector
J235	JCP-AA003PX05-1	A-1103	Pin Connector
J236	JCP-AA003PX05-1	A-1103	Pin Connector
	MBM-10372A-1	401-9630A	Terminal

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Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC2	SIT-74LS04-9	SN74LS04N	IC: Hex Inverter Low Power
IC3	SIT-74LS390-9	SN74LS390N	IC: Dual Decade Counter Low Power
IC4	SIT-74LS390-9	SN74LS390N	IC: Dual Decade Counter Low Power
IC5	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC6	SIM-26501-1	HD26501	IC: Clock Pulse Generator/Controller
IC7	SIT-7408-1	SN7408N	IC: Quadruple 2-Input Positive AND Gate
IC8	SIT-74LS73-9	SN74LS73N	IC: Dual J-K Flip Flop with Clear Low Power
IC9	SIT-74LS164-9	SN74LS164N	IC: 8-bit Parallel Output Serial Shift Register Low Power
IC10	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC11	SIT-74LS02-9	SN74LS02N	IC: Quadruple 2-Input Positive NOR Gate Low Power
IC12	SIT-74LS08-9	SN74LS08N	IC: Quadruple 2-Input Positive AND Gate with Open-Collector Output Low Power
IC13	SIT-74LS05-9	SN74LS05N	IC: Hex Inverter with Open-Collector Output
IC14	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC15	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC16	SIT-74LS20-9	SN74LS20N	IC: Dual 4-Input Positive-NAND Gate Low Power
IC17	SIT-74LS04-9	SN74LS04N	IC: Hex Inverter Low Power
IC18	SIT-74LS00-9	SN74LS00N	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC19	SIT-74LS08-9	SN74LS08N	IC: Quadruple 2-Input Positive AND Gate with Open Collector Output Low Power
IC20	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC21	SIT-74LS00-9	SN74LS00N	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC22	SIT-74LS08-9	SN74LS08N	IC: Quadruple 2-Input Positive AND Gate with Open Collector Output Low Power
IC23	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC24	SIT-74LS32-9	SN74LS32N	IC: Quadruple 2-Input Positive OR Gate Low Power
IC25	SIT-74LS183-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC26	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC27	SIM-6800-3	MB8861	IC: 8-bit Mciroprocessor
IC28	SIT-74LS00-9	SN74LS00N	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC29	SIT-74LS10-9	SN74LS10N	IC: Triple 3-Input Positive-NAND Gate Low Power
IC30	SIM-6402-1	IM6402IPL	IC: Universal Asynchronous Receiver/Transmitter
IC31	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC32	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC33	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC34	SIT-74LS245-9	SN74LS245N	IC: Octal Bus Transceiver Low Power
IC35	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC36	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC37	SIT-74LS390-9	SN74LS390N	IC: Dual Decade Counter Low Power
IC38	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC39	SIA-555-7	HA17555PS	IC: Timer
IC40	SIT-74LS00-9	SN74LS00N	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC41	SIT-74LS04-9	SN74LS04N	IC: Hex Inverter Low Power
IC42	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC43	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
Q51	STN-2SC1815-15	2SC1815GR	Transistor SI NPN
D56	SDS-1S953-1	1S953	Diode SI
R61 thru R63	RAY-AA10K4-1	TMR4-103	R: FXD COM 10 kΩ
R64	RAY-AA22K4-1	TMR4-223	R: FXD COM 22 kΩ
R65	RAY-AA22K4-1	TMR4-223	R: FXD COM 22 kΩ
R66	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R67	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/4W
R68	RCB-AH560K-1	RD25S 560KΩJ	R: FXD CAR 560 kΩ ±5% 1/4W
R69	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R70	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R71	RCB-AH6R8K-1	RD25S 6.8KΩJ	R: FXD CAR 6.8 kΩ ±5% 1/4W
R72	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R73	RCB-AH100-1	RD25S 100ΩJ	R: FXD CAR 100 Ω ±5% 1/4W
R74	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R75	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/4W
C81	CSM-AC220P50V-1	220PF 50WV	C: FXD CER 220pF ±10% 50V
C82	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
C83	CFM-ABR022U50V-1	501N5002-223K	C: FXD Mylar 0.022μF ±10% 50V
C84	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C85	CSM-AC220P50V-1	220PF 50WV	C: FXD CER 220pF ±10% 50V
C86 thru C94	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C95	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C96 thru C103	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C104	CTA-AB4R7U10V-1	221M1002-475M	C: FXD ELECT TANTAL 4.7μF ±20% 10V
C105 thru C108	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C109	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C110	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C111	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
X121	DXD-000449-1	XU-105	Crystal
S132	KSA-000269-1	435166-3	Switch

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
J137	JCP-AA003PX06-1	A-1303	Pin Connector
J138	JCP-AA003PX06-1	A-1303	Pin Connector
J139	JCP-AA003PX05-1	A-1303	Pin Connector
J140	JCP-AA003PX05-1	A-1303	Pin Connector
J141	JCS-AA064PX05-1	FCN-365P064-AG	Connector
	JCI-AD040JX01-2	DL2-40A	IC Socket
	MBM-10372A-1	401-9630A	Terminal
C112	CTM-BJ20P-1	ECV-1ZW20X40	C: VAR CER 20 P
C113	CMC-AB20PR5K-6	DM10C200K5	C: FXD DIPPED MICA 20pF ±5% 500V
C114	CMC-AB3PR5K-2	DM10C030D5	C: FXD DIPPED MICA 3pF ±5% 500V
C115	CMC-AB6PR5K-6	DM10C060K5	C: FXD DIPPED MICA 6pF ±5% 500V

TR2731
MEMORY
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Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIT-74LS175-9	SN74LS175N	IC: Quad D-Type Flip Flop Low Power
IC2	SIM-6821-2	HD46821P	IC: Peripheral Interface Adaptor
IC3	SMM-5514A-1	TC5514AP-2	IC: 4K bit CMOS RAM
IC4	SMM-5514A-1	TC5514AP-2	IC: 4K bit CMOS RAM
IC5	SMM-2114-8	HM472114P-4	IC: 4K bit Static RAM
IC6	SMM-2114-8	HM472114P-4	IC: 4K bit Static RAM
IC7	SIT-74LS30-9	SN74LS30N	IC: 8-Input NAND Gate Low Power
IC8	SIT-74LS138-9	SN74LS138N	IC: Decoder/Demultiplexer Low Power
IC9	SIM-4020-1	TC4020BP	IC: 14-Stage Binary Counter
IC10	SMM-5514A-1	TC5514AP-2	IC: 4K bit CMOS RAM
IC11	SMM-5514A-1	TC5514AP-2	IC: 4K bit CMOS RAM
IC12	SMM-2114-8	HM472114P-4	IC: 4K bit Static RAM
IC13	SMM-2114-8	HM472114P-4	IC: 4K bit Static RAM
IC14	SIT-74LS00-9	SN74LS00N	IC: Quadruple 2-Input NAND Gate Low Power
IC15	SIT-74LS00-9	SN74LS00N	IC: Quadruple 2-Input NAND Gate Low Power
IC16	SIT-74LS241-9	SN74LS241N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC17	SIM4020-1	TC4020BP	IC: 14-Stage Binary Counter
IC18	SIM-4001-1	TC4001BP	IC: Quad 2-Input Positive NOR Gate
IC19	SIM-4011-1	TC4011BP	IC: Quad 2-Input Positive NAND Gate
IC20	SMM-2114-8	HM472114P-4	IC: 4K bit Static RAM
IC21	SMM-2114-8	HM472114P-4	IC: 4K bit Static RAM
IC22	SIT-74LS04-9	SN74LS04N	IC: Hex Inverter Low Power
IC23	SIT-74LS04-9	SN74LS08N	IC: Hex Inverter Low Power
IC24	SIT-74LS04-9	SN74LS08N	IC: Hex Inverter Low Power
IC25	SIM4020-1	TC4020BP	IC: 14-Stage Binary Counter
IC26	SIM4069-1	TC4069UBP	IC: Hex Inverter
IC27	SIT-74LS245-9	SN74LS245N	IC: Octal bus Transceiver Low Power
IC28	SMM-2114-8	HM472114P-4	IC: 4K bit Static RAM
IC29	SMM-2114-8	HM472114P-4	IC: 4K bit Static RAM
IC30	SIT74LS138-9	SN74LS138N	IC: Decoder/Demultiplexer Low Power
IC31	SIT74LS138-9	SN74LS138N	IC: Decoder/Demultiplexer Low Power
IC32	SIT-74LS04-9	SN74LS04N	IC: Hex Inverter Low Power
IC33	SIT74LS244-9	SN74LS244M	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC34	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC35	SIS-000442A		IC: 64K bit UV EPROM
IC36	SIS-000443		IC: 64K bit UV EPROM
IC37	SIS-000444		IC: 64K bit UV EPROM
IC38	SIS-000445		IC: 64K bit UV EPROM
IC39	SIS-000446		IC: 64K bit UV EPROM
IC40	SIS-000447A		IC: 64K bit UV EPROM
IC41 thru IC44			Not assigned
Q51	STN-2SC1815-15	2SC1815GR	Transistor SI NPN
D61 thru D64	NLD-000020-1	SLP-24B	Light Emitting Diode

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
D65	SDS-1S953-1	1S953	Diode SI
R71	RAY-AA470Q4-1	TMR4-471	R: FXD COM 470 Ω
R72	RAY-AA10K4-1	TMR4-103	R: FXD COM 10 kΩ
R73	RAY-AA10K4-1	TMR4-103	R: FXD COM 10 kΩ
R74	RCB-AN220-1	RD25S-220ΩJ	R: FXD CAR 220 Ω ±5% 1/4W
R75	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R76	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R77	RCB-AH15K-1	RD25S 15KΩJ	R: FXD CAR 15 kΩ ±5% 1/4W
R78	RCB-AH220K-1	RD25S 220KΩJ	R: FXD CAR 220 kΩ ±5% 1/4W
R79	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R80	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R81	RCB-AH150K-1	RD25S 150KΩJ	R: FXD CAR 150 kΩ ±5% 1/4W
R82	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R83	RCB-AB22M-1	HM 1/2 22MΩJ	R: FXD CAR 22 MΩ ±5% 1/2W
R84	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 2.7 kΩ ±5% 1/4W
R85	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
C96	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
C97	CSM-AC33P50V-1	33PF 50WV	C: FXD CER 33pF ±10% 50V
C98	CSM-AC33P50V-1	33PF 50WV	C: FXD CER 33pF ±10% 50V
C99	CTA-AC1U50V-4	TA-050TN1R0-P	C: FXD ELECT TANTAL 1μF +100, -0% 50V
C100 thru C106	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C107	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C108 thru C112	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF +80, -20% 50V
C113	CTA-AC2R2U35V-1	242M3502-225M	C: FXD ELECT TANTAL 2.2μF ±20% 35V
C114	CCK-AA47U10V-1	10T47	C: FXD ELECT 47μF 10V
C115	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C116 thru C119	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C120	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C121 thru C125	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
X131	DXD-000448-1	XU-104	Crystal
J136	JCS-AA064PX05-1	FCN-365P064-AG	Connector
J137 thru J140	JCS-AA003PX05-1	A-1103	Pin Connector
L146	LCL-T00084-1	LT-3	L: FXD Coil
	MBM-10372A-1	401-9630A	Terminal

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Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIT-74LS138-9	SN74LS138N	IC: Decoder/Demultiplexer Low Power
IC2 thru IC6	SIT-6118-1	UDN-6118A	IC: Voltage Driver
IC7	SIM-8279-5	UPD8279C-5	IC: Programmable Keyboard/Display Controller
IC8	SIT-74LS240-9	SN74LS240N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC9	SIM-4028-1-1	TC4028BP	IC: BCD to Decimal Decoder
IC10	SIT-6118-1-1	UDN-6118A	IC: Voltage Driver
IC11			Not Assigned
IC12			Not Assigned
IC13	SIT-74LS08-9	SN74LS08N	IC: Quadruple 2-Input Positive AND Gate Low Power
IC14	SIT-74LS00-9	SN74LS00N	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC15	SIT-74LS05-9	SN74LS05N	IC: Hex Inverter with Open-Collector Output Low Power
IC16	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear
IC17	SIT-74LS04-9	SN74LS04N	IC: Hex Inverter Low Power
IC18	SIT74LS138-9	SN74LS138N	IC: Decoder/Demultiplexer Low Power
IC19	SIT-74LS393-9	SN74LS393N	IC: Dual 4-bit Binary Counter Low Power
IC20 thru IC24	SIT-74LS374-9	SN74LS374N	IC: Octal D-Type Flip Flop Low Power
IC25	SIT-6118-1	UDN-6118A	IC: Voltage Driver
IC26	SIM-4828-1	TC4028BP	IC: BCD to Decimal Decoder
IC27	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
Q31	STN-2SC1815-15	2SC1815GR	Transistor SI NPN
Q32	STN-2SC1173-1	2SC1173	Transistor SI NPN
Q33 thru Q37	STP-2SA695-1	2SA695	Transistor SI PNP
D41	SDS-1S953-1	1S953	Diode SI
R51	RAY-AA2R2K6-1	TMR6-222	R: FXD COM 2.2 kΩ
R52	RAY-AA10K6-1	TMR6-103	R: FXD COM 10 kΩ
R53 thru R60	RCB-AH120-1	RD25S 120ΩJ	R: FXD CAR 120 Ω ±5% 1/4W
R61 thru R65	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820 Ω ±5% 1/4W
R66	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R67	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 kΩ ±5% 1/4W
R68	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R69	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
C81	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C82	CSM-AC1000P50V-1	0.001UF 50WV	C: FXD CER 1000pF +80, -20% 50V
C83	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C84	CTA-AA10U50V-1	111M5002-106M	C: FXD ELECT TANTAL 10μF ±20% 50V
C85	CTA-AA10U50V-1	111M5002-106M	C: FXD ELECT TANTAL 10μF ±20% 50V

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
C86 thru C93	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C94	CCK-AB10U50V-1	50VB10	C: FXD ELECT 10μF 50V
L97	LCL-T00084-1	LT-3	L: FXD Coil
T101	LTP-000339	*	Transformer
V111	NDG-000095-1	DC1612B2	Fluorescent Display Tube
J121	JCR-AB034PX03-1	HIF3-34P-2.54DSA	Connector
J122	JCR-AB034PX03-1	HIF3-34P-2.54DSA	Connector
	MBM-10372A-1	401-9630A	Terminal

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
D1 thru D30	NLD-000003-1	BR3402S	Light Emitting Diode
S41 thru S75	KSP-000250-1	1KSR001-00081-000	Switch
J81	JCR-AB034PX03-1	HIF3-34P-2.54DSA	Connector

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIT-74LS14-9	SN74LS14N	IC: Hex Schmitt-Trigger Inverter Low Power
IC2	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC3	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC4	SIT-74LS14-9	SN74LS14N	IC: Hex Schmitt-Trigger Inverter Low Power
IC5	SIT-74LS10-9	SN74LS10N	IC: Triple 3-Input Positive-NAND Gate Low Power
IC6	SIT-74LS245-9	SN74LS245N	IC: Octal bus Transceiver Low Power
IC7	SIT74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC8	SIS-000356C	*	IC: 32K bit UV EPROM
IC9	SIT-74LS138-9	SIT-74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC10	SMM-2114-8	HM472114P-4	IC: 4K bit Static RAM
IC11	SMM-2114-8	HM472114P-4	IC: 4K bit Static RAM
IC12	SIT-74LS30-9	SN74LS30N	IC: 8-Input Positive-NAND Gate Low Power
IC13 thru IC18	SMM-2114-8	HM4721149-4	IC: 4K bit Static RAM
IC19	SIA-4016-1	TC4016BP	IC: Quad Bilateral Switch
IC20	SMM-5514A-1	TC5514AP-2	IC: 4K bit CMOS RAM
IC21	SMM-5514A-1	TC5514AP-2	IC: 4K bit CMOS RAM
IC22	SIM-4011-1	TC4011BP	IC: Quad 2-Input NAND Gate
IC23	SMM-5514A-1	TC5514AP-2	IC: 4K bit CMOS RAM
IC24	SMM-5514A-1	TC5514AP-2	IC: 4K bit CMOS RAM
R31	RCB-AH33K-1-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R32	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33 kΩ ±5% 1/4W
R33	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100 kΩ ±5% 1/4W
C41 thru C53	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
C54	CSM-AC33P50V-1	33PF 50WV	C: FXD CER 33pF ±10% 50V
C55	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
C56	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
C57	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C58	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C59 thru C72	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
L76	LCL-T00084-1	LT-3	L: FXD Coil
	JCI-AD024JX01-2	DL2-24A	IC Socket
	MBM-10372A-1	401-9630A	Terminal

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer
IC2	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer
IC3	SIT-74LS08-9	SN74LS08N	IC: Quadruple 2-Input Positive AND Gate Low Power
IC4	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC5	SIT-74LS04-9	SN74LS04N	IC: Hex Inverter Low Power
IC6	SIT-74LS245-9	SN74LS245	IC: Octal bus Transceiver Low Power
IC7			Not assigned
IC8	SIM-68488-1	MC68488P	IC: General Purpose Interface Adapter
IC9	SIT-3448-2	MC3448AL	IC: Quad three-state bus Transceiver with Termination Network
IC10	SIT-3448-2	MC3448AL	IC: Quad three-state bus Transceiver with Termination Network
IC11	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC12	SIT-3448-2	MC3448AL	IC: Quad three-state bus Transceiver with Termination Network
IC13	SIT-3448-2	MC3448AL	IC: Quad three-state bus Transceiver with Termination Network
R20 thru R22	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R23	RAY-AA10K4-1	TMR4-103	R: FXD COM 10 kΩ
R24	RAY-AA10K4-1	TMR4-103	R: FXD COM 10 kΩ
R25			Not assigned
R26	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
C27	CSM-AC47P50V-1	7PF 50WV	C: FXD CER 47pF ±10% 50V
C28 thru C30	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
C31	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C32 thru C39	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C43	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
C45	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
S41	KSL-000034-1	MFS-201N6	Switch
S42	KSA-000691-1	7-171474-7	Switch
L44	LCL-T00084-1	LT-3	L: FXD Coil
J51	JCS-AC024JX03-1	57-20240-D35A	Connector
J52	JCP-AR010PX01-1	163740-8	Connector
	JCI-AD024JX01-1	ICN-246-S5	IC Socket
	MBM-10372A-1	401-9630A	Terminal

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC2	SIT-74LS08-9	SN74LS08N	IC: Quadruple 2-Input Positive AND Gate Low Power
IC3	SIT-74LS14-9	SN74LS14N	IC: Hex Schmitt-Trigger Inverter Low Power
IC4	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC5	SIT-7406-2	HD7406P	IC: Hex Inverter Buffer/Driver with Open-Collector High-Voltage Output
IC6	SIT-74LS123-9	SN74LS123N	IC: Dual Retriggerable Monostable Multivibrator with Clear Low Power
IC7	SIT-74LS00-9	SN74LS00N	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC8	SIT-74LS123-9	SN74LS123N	IC: Dual Retriggerable Monostable Multivibrator with Clear Low Power
IC9	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC10	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC11	SIT-74LS14-9	SIT-74LS14N	IC: Hex Schmitt-trigger Inverter Low Power
IC12	SIT-74LS74-9	SIT-74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC13	SIT-74LS244-9	SIT-74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC14	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC15	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC16	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC17	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC18 thru IC23	SIT-74LS374-9	SN74LS374N	IC: Octal D-type Flip Flop Low Power
R41	RCB-AH10-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R42	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/4W
R43	RCB-AH22K-1	RD25S 22KΩJ	R: FXD CAR 22 kΩ ±5% 1/4W
R44	RCB-AH15K-1	RD25S 13KΩJ	R: FXD CAR 15 kΩ ±5% 1/4W
R45	RCB-AH22K-1	RD25S 22KΩJ	R: FXD CAR 22 kΩ ±5% 1/4W
R46 thru R52	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/4W
R53 thru R55			Not assigned
R56	RAY-AA4R7K6-1	TMR6-472	R: FXD COM 4.7 kΩ
R57 thru R60	RAY-AA4R7K4-1	TMR4-472	R: FXD COM 4.7 kΩ
C66	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10µF ±20% 16V
C67	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1µF ±20% 50V
C68	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1µF ±20% 50V
C69	CTA-ACR1U35V-1	242M3502-104M	C: FXD ELECT TANTAL 1µF ±20% 35V
C70	CTA-AC1U50V-2	244M5002-150M	C: FXD ELECT TANTAL 1µF ±20% 50V
C71	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10µF ±20% 16V

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
C72	CTA-AC3R3U16V	242M1602-335M	C: FXD ELECT TANTAL 3.3μF ±20% 16V
C73	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C74	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C75	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C76	CTA-AC1U50V-2	244M-5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C77	CTA-AC1U50V-2	244M-5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C78 thru C80	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C86 thru C89	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C90	CSM-ACR1U50V-1	0.1UF 50WV	C: FXD CER 0.1μF +80, -20% 50V
S96	KSL-000034-1	MFS-201N6	Switch
K101 thru K104	KRR-000276-2	RRD51A05D	Reed Relay
J111	JCS-AC014JX02-1	57-40140	Connector
J112	JCS-AC050JX03-1	57-40500-D39	Connector
	MBM-10372A-1	401-9630A	Terminal

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIT-74LS20-9	SN74LS20N	IC: Dual 4-Input Positive-NAND Gate Low Power
IC2	SIT-74LS125-9	SN74LS125N	IC: Quadruple bus Buffer Gate with three-state Output Low Power
IC3	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC4	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC5	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear
IC6	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC7	SIT-74LS32-9	SN74LS32N	IC: Quadruple 2-Input Positive-OR Gate Low Power
IC8	SIT-7406-2	HD7406P	IC: Hex Inverter Buffer/Driver with Open-Collector High Voltage Output
IC9	SIT-74LS123-9	SN74LS123N	IC: Dual Retriggerable Monostable Multivibrator with Clear Low Power
IC10	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC11	SIM-5012-1	TC5012BP	IC: 3-state NON-Inverting Buffer
IC12	SIM-5012-1	TC5012BP	IC: 3-state NON-Inverting Buffer
IC13	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC14 thru IC19	SIM-5012-1	TC5012BP	IC: 3-state NON-Inverting Buffer
D26 thru D33	SDS-A54-1	UPA54H	Diode SI
D34 thru D41	SDS-A64-1	UPA64H	Diode SI
R46	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R47	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R48	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R49	RCB-AH47K-1	RD25S 47ΩJ	R: FXD CAR 47 kΩ ±5% 1/4W
R50 thru R73	RCB-AH15K-1	RD25S 15KΩJ	R: FXD CAR 15 kΩ ±5% 1/4W
R74	RCB-AH1R2K-1	RD25S 1.2KΩJ	R: FXD CAR 1.2 kΩ ±5% 1/4W
R74 thru R96	RCB-AH15K-1	RD25S 15KΩJ	R: FXD CAR 15 kΩ ±5% 1/4W
R97	RCB-AH3R3K-1	RD25S 3.3KΩJ	R: FXD CAR 3.3 kΩ ±5% 1/4W
R98	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R99			Not assigned
R100			Not assigned
R101	RAY-AA10K6-1	TMR6-103	R: FXD COM 10 kΩ
R102	RAY-AA68K6-1	TMR6-683	R: FXD COM 68 kΩ
R103	RAY-AA68K6-1	TMR6-683	R: FXD COM 68 kΩ
R104	RAY-AA10K6-1	TMR6-103	R: FXD COM 10 kΩ
R105 thru R110	RAY-AA68K6-1	TMR6-683	R: FXD COM 68 kΩ
C116	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C117 thru C120	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
C121	CTA-ACR47U35V-1	242M3502-474M	C: FXD ELECT TANTAL 0.47µF ±20% 35V
C122 thru C124	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1µF ±20% 50V
C125	CTA-ACR1U35V-1	242M3502-474M	C: FXD ELECT TANTAL 0.1µF ±20% 35V
C126 thru C130	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1µF ±20% 50V
J136	JCS-AC050JX03-1	57-40500-D39	Connector
S141	KSA-000689-1	7-171474-4	Switch
S142	KSL-000034-1	MFS-201N6	Switch
S143	KSL-000034-1	MFS-201N6	Switch
	MBM-10372A-1	401-9630A	Terminal

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC2	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC3	SIT-74LS20-9	SN74LS20N	IC: Dual 4-Input Positive-NAND Gate Low Power
IC4	SIT-74LS32-9	SN74LS32N	IC: Quadruple 2-Input Positive OR Gate Low Power
IC5	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC6	SIT-74LS00-9	SN74LS00N	IC: Quadruple 2-Input Positive-NAND Gate Low Power
IC7	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC8	SIT-74LS123-9	SN74LS123N	IC: Dual Retriggerable Monostable Multivibrator with Clear Low Power
IC9	SIT-74LS125-9	SN74LS125N	IC: Quadruple bus Buffer Gate with three-state Output Low Power
IC10	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC11 thru IC13	SIT-74LS374-9	SN74LS374N	IC: Octal D-Type Flip Flop Low Power
R21	RAY-AA10K6-1	TMR6-103	R: FXD COM 10 kΩ
R22	RCB-AH150K-1	RD25S 150KΩJ	R: FXD CAR 150 kΩ ±5% 1/4W
C29 thru C31	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C32	CTA-AC2R2U35V-1	242M3502-225	C: FXD ELECT TANTAL 2.2μF ±20% 35V
C33	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C34 thru C38	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
K61 thru K81	KRR-000276-2	RRD51A05D	Reed Relay
S91	KSL-000142-1	SL83-7H10-2-3	Switch
S92	KSA-000689-1	7-171474-4	Switch
J101	JCS-AC050JX03-1	57-40500-D39	Connector
	MBM-10372A-1	401-9630A	Terminal

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TR2730-550
ANALOG OUTPUT-I
BGJ-010174

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC2	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC3	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC4	SIT-74LS86-9	SN74LS86N	IC: Quadruple 2-Input Exclusive-OR Gate Low Power
IC5	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC6	SIM-4518-1	TC4518BP	IC: Dual BCD up Counter
IC7	SIT-74LS00-9	SN74LS00N	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC8	SIT-74LS161-9	SN74LS161N	IC: Synchronous 4-bit Counter Low Power
IC9	SIT-74LS123-9	SN74LS123N	IC: Dual Retriggerable Monostable Multivibrator with Clear Low Power
IC10	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC11	SIT-7406-2	HD7406P	IC: Hex Inverter Buffer/Driver with Open-Collector High Voltage Output
IC12	SIT-74LS08-9	SN74LS08N	IC: Quadruple 2-Input Positive AND Gate Low Power
IC13	SIA-4066-1	TC4066BP	IC: Quad Bilateral Switch
IC14	SIT-TL06-1	TL062CP	IC: Dual Operational Amplifier
IC15	SIA-4066-1	TC4066BP	IC: Quad Bilateral Switch
IC16	SIA-7805U-5	UPC7805H	IC: Voltage Regulator
IC17 thru IC19	SIA-TL062-1	TL062CP	IC: Dual Operational Amplifier
IC20	SIA-CP4604-1	CP4604	IC: DC-DC converter
CP31 thru CP34	SEC-PS2006-1	PS2006B	Photocoupler
D41	SDS-A54-1	UPA54H	Diode COM
D42	SDS-A64-1	UPA64H	Diode COM
D43	SDS-1S953-1	1S953	Diode SI
D44	SDS-1S953-1	1S953	Diode SI
R47 thru R50	RCB-AH330K-1	RD25S 330KΩJ	R: FXD CAR 330 kΩ $\pm$5% 1/4W
R51 thru R56	RCB-AK1K-1	RD50S 1KΩJ	R: FXD CAR 1 kΩ $\pm$5% 1/2W
R57 thru R62	RMF-AB14R6KFJ-1	RF 1/4N 14.7KΩSF	R: FXD Metal FLM 14.6 kΩ $\pm$1% 1/4W
R63 thru R68	RMF-AB150QFG-1	RF 1/4N 150ΩRF	R: FXD Metal FLM 150 Ω $\pm$1% 1/4W
R69	RCB-AH220K-1	RD25S 220KΩJ	R: FXD CAR 220 kΩ $\pm$5% 1/4W
R70	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ $\pm$5% 1/4W
R71	RCB-AH220K-1	RD25S 220KΩJ	R: FXD CAR 220 kΩ $\pm$5% 1/4W
R72	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ $\pm$5% 1/4W
R73	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ $\pm$5% 1/4W
R74	RCB-AH220K-1	RD25S 220KΩJ	R: FXD CAR 220 kΩ $\pm$5% 1/4W

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
R75	RCB-AH220K-1	RD25S 220KΩJ	R: FXD CAR 220 kΩ ±5% 1/4W
R76	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R77	RCB-AH220K-1	RD25S 220KΩJ	R: FXD CAR 220 kΩ ±5% 1/4W
R78	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R79	RCB-AH220K-1	RD25S 220KΩJ	R: FXD CAR 220 kΩ ±5% 1/4W
R80	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R81 thru R83	RMF-AB10KFJ-1	RF 1/4N 10KΩSF	R: FXD Metal FLM 10 kΩ ±1% 1/4W
R84	RMF-AB2KFJ-1	RF 1/4N 2KΩSF	R: FXD Metal FLM 2 kΩ ±1% 1/4W
R85	RMF-AB4R7KFJ-1	RF 1/4N 4.7KSF	R: FXD Metal FLM 4.7 kΩ ±1% 1/4W
R86 thru R89	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/4W
R90	RMF-AB9R1KFJ-1	RF 1/4N 9.1KΩ SF	R: FXD Metal FLM 9.1 kΩ ±1% 1/4W
R91	RMF-AB7R5KFJ-1	RF 1/4N 7.5KΩ SF	R: FXD Metal FLM 7.5 kΩ ±1% 1/4W
R92	RAY-AA180Q4-1	TMR4-181	R: FXD COM 180 Ω
R93	RAY-AA10K4-1	TMR4-103	R: FXD COM 10 kΩ
R94	RAY-AA10K4-1	TMR4-103	R: FXD COM 10 kΩ
R95	RVR-CD10K-1	RJ6X10KΩ	R: VAR CERMET 10 kΩ
R96	RVR-CD500-1	RJ6X500Ω	R: VAR CERMET 500 Ω
R97	RVR-CD10K-1	RJ6X10KΩ	R: VAR CERMET 10 kΩ
R98	RVR-CD500-1	RJ6X500Ω	R: VAR CERMET 500 Ω
R99	RVR-CD10K-1	RJ6X10KΩ	R: VAR CERMET 10 kΩ
R100	RVR-CD500-1	RJ6X500Ω	R: VAR CERMET 500 Ω
R101	RVR-CD500-1	RJ6X500Ω	R: VAR CERMET 500 Ω
R102	RVR-CD10K-1	RJ6X10KΩ	R: VAR CERMET 10 kΩ
R103	RVR-CD500-1	RJ6X500Ω	R: VAR CERMET 500 Ω
R104	RVR-CD10K-1	RJ6X10KΩ	R: VAR CERMET 10 kΩ
R105	RVR-CD500-1	RJ6X500Ω	R: VAR CERMET 500 Ω
R106	RVR-CD10K-1	RJ6X10KΩ	R: VAR CERMET 10 kΩ
R107	RVR-CD1K-1	RJ6X1KΩ	R: VAR CERMET 1 kΩ
R108	RVR-CD1K-1	RJ6X1KΩ	R: VAR CERMET 1 kΩ
C121	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7µF ±20% 25V
C122	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7µF ±20% 25V
C123 thru C128	CFM-AHR47U100V-1	ECQ-E1474KN	C: FXD Mylar 0.47µF 100V
C129	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1µF ±20% 50V
C130	CTA-AC10U16V-1	242M-1602-106M	C: FXD ELECT TANTAL 10µF ±20% 16V
C131	CTA-AB4R7U10V-1	221M1002-475M	C: FXD ELECT TANTAL 4.7µF ±20% 10V
C132 thru C135	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01µF +80, -20% 50V
C136	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1µF ±20% 50V
C137	CFM-AB1000P50V-1	501N5002-102K	C: FXD Mylar 1000pF ±10% 50V
C138	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1µF ±20% 50V
C139	CFA-AB2200P50V-1	501N5002-222K	C: FXD Mylar 2200pF ±10% 50V
C140 thru C146	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1µF ±20% 50V

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
C147	CTA-AC10U16V-1	242M1602-160M	C: FXD ELECT TANTAL 10μF ±20% 16V
S161	KSL-000141-1	SJ0435	Switch
S162	KSL-000141-1	SJ0435	Switch
S163	KSL-000140-1	SJ0235	Switch
J171	JTL-AG006PX03-1	F2035A-6P-M4	Terminal
J172	JTL-AG006PX03-1	F2035A-6P-M4	Terminal
J173	DCB-QQ0757X01-1	SMV2J-TR1X08X040	Flat Cable
	MBM-10372A-1	401-9630A	Terminal

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIM-4015-1	TC4015BP	IC: Dual 4-Stage Static Shift Register
IC2	SIM-5050-1	TC5050P	IC: Dual 50/64-Stage Static Shift Register
IC3	SIM-4015-1	TC4015BP	IC: Dual 4-Stage Static Shift Register
IC4	SIM-4069-1	TC4069BP	IC: Hex Inverter
IC5	SIM-4015-1	TC4015BP	IC: Dual 4-Stage Static Shift Register
IC6	SIA-TL082-1	TL082CP	IC: Dual Operational Amplifier
IC7	SIA-563-1	AD563JD/BIN	IC: 12 bit D/A Converter
IC8	SIM-4015-1	TC4015BP	IC: Dual 4-Stage Static Shift Register
IC9	SIM-4028-1	TC4028BP	IC: BCD to Decimal Decoder
R21	RMF-AB4R7KFJ-1	RF 1/4N 4.7KΩSF	R: FXD Metal FLM 4.7 kΩ ±1% 1/4W
R22	RMF-AB4R7KFJ-1	RF 1/4N 4.7KΩSF	R: FXD Metal FLM 4.7 kΩ ±1% 1/4W
C31 thru C36	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
	MBM-10372A-1	401-9630A	Terminal

TR2730-560
SERIAL OUTPUT
BGJ-010176

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIT-74LS04-9	SN74LS04N	IC: Hex Inverter Low Power
IC2	SIT-74LS30-9	SN74LS30N	IC: 8-Input Positive-NAND Gate Low Power
IC3	SIM-6850-4	MB8863NM	IC: Asynchronous Interface Adapter
IC4	SIM-4069-1	TC4069BP	IC: Hex Inverter
IC5	SIT-74LS20-9	SN74LS20N	IC: Dual 4-Input Postive-NAND Gate Low Power
IC6	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC7	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC8	SIT-74LS00-9	SN74LS00N	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC9	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC10	SIT-7497-1	SN7497N	IC: Synchronous 6-bit Binary Rate Multiplexer
IC11	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC12	SIT-74LS04-9	SN74LS04N	IC: Hex Inverter Low Power
IC13	SIT-74LS04-9	SN74LS04N	IC: Hex Inverter Low Power
IC14	SIT-74LS175-9	SN74LS175N	IC: Quad D-Type Flip Flop Low Power
IC15	SIT-75188-1	SN75188N	IC: Quad Line Driver
IC16	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC17	SIT-75189-1	SN75189AN	IC: Quad Line Receiver
IC18	SIT-74LS151-9	SN74LS151N	IC: 1-of-Data Selector/Multiplexer Low Power
IC19			Not assigned
IC20			Not assigned
Q31	STN-2SC1815-15	2SC1815GR	Transistor SI NPN
Q32 thru Q34			Not assigned
D41	SDS-1S953-1	1S953	Diode SI
D42	SDS-1S953-1	1S953	Diode SI
D43 thru D48			Not assigned
R61	RAY-AA10K4-1	TMR4-103	R: FXD COM 10 kΩ
R62	RAY-AA10K4-1	TMR4-103	R: FXD COM 10 kΩ
R63	RCB-AK2R2M-1	RD50S 2.2MΩJ	R: FXD CAR 2.2 MΩ ±5% 1/2W
R64	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R65	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R66	RCB-AH180-1	RD25S 180ΩJ	R: FXD CAR 180 Ω ±5% 1/4W
R67 thru R69			Not Assigned
R70	RCB-AK330-1	RD50S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/2W
R71	RCB-AH330K-1	RD25S 330KΩJ	R: FXD CAR 330 kΩ ±5% 1/4W
R72	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/4W
R73 thru R78			Not Assigned
R79 thru R81	RCB-AK330-1	RD50S 330ΩJ	R: FXD CAR 330 Ω ±5% 1/2W
R82	RCB-AK220-1	RD50S 220ΩJ	R: FXD CAR 220 Ω ±5% 1/2W

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
R83 thru R88			Not Assigned
R89	RCB-AH5R6K	RD25S 5.6KΩJ	R: FXD CAR 5.6kΩ ±5% 1/4W
R90 thru R92			Not Assigned
R93 thru R96	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1 Ω ±5% 1/4W
C101	CSM-AC33P50V-1	33PF 50WV	C: FXD CER 33pF ±10% 50V
C102	CSM-AC33P50V-1	33PF 50WV	C: FXD CER 33pF ±10% 50V
C103	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C104	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C105 thru C111	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C112	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C113	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C114	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C115	CSM-ACR1U50V-1	0.1UF 50WV	C: FXD CER 0.1μf +80, -20% 50V
C116 thru C118	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C119 thru C121	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
C122			Not Assigned
C123	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
CP131	SEC-PS2001-1	PS2001B	Photocoupler
CP132	SEC-PS2001-1	PS2001B	Photocoupler
CP133 thru CP135			Not Assigned
X141	DXD-000450-1	XU-108	Crystal
S151	KSA-000273-1	7-171474-8	Switch
J161 thru J164	JCS-AE009JX01-1	DE-9S	Connector
J165	JCP-AR010PX01-1	MCN4-10P-2.54DS	Connector
	MBM-10372A-1	401-9630A	Terminal

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1 thru IC3	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC4	SIA-7905-U-5	UPC7905H	IC: Voltage Regulator
IC5			Not assigned
IC6	SIS-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC7	SIT-74LS04-9	SN74LS04N	IC: Hex Inverter Low Power
IC8	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC9	SIT-74LS08-9	SN74LS08N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC10	SIT-74LS02-9	SN74LS02N	IC: Quadruple 2-Input Positive NOR Gate Low Power
IC11	SIT-74LS00-9	SN74LS00N	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC12	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC13	SIT-74LS08-9	SN74LS08N	IC: Quadruple 2-Input Positive AND Gate Low Power
IC14	SIT-74LS374-9	SN74LS374N	IC: Octal D-Type Flip Flop Low Power
IC15	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC16	SMM-2116-6	MB8116HM	IC: 16K bit Dynamic RAM
IC17	SMM-2116-6	MB8116HM	IC: 16K bit Dynamic RAM
IC18	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC19	SMM-2116-6	MB8116HM	IC: 16K bit Dynamic RAM
IC20	SMM-2116-6	MB8116HM	IC: 16K bit Dynamic RAM
IC21	SIT-74LS377-9	SN74LS377N	IC: Octal D-Type Flip Flop Low Power
IC22	SMM-2116-6	MB8116HM	IC: 16K bit Dynamic RAM
IC23	SIT-74LS193-9	SN74LS193N	IC: Synchronous up/down Dual Clock Counter Low Power
IC24	SIT-74LS193-9	SN74LS193N	IC: Synchronous up/down Dual Clock Counter Low Power
IC25	SMM-2116-6	MB8116HM	IC: 16K bit Dynamic RAM
IC26	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC27	SIT-74LS193-9	SN74LS193N	IC: Synchronous up/down Dual Clock Counter Low Power
IC28	SMM-2116-6	MB8116HM	IC: 16K bit Dynamic RAM
IC29	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC30	SIT-74LS393-9	SN74LS393N	IC: Dual 4-bit Binary Counter Low Power
IC31	SMM-2116-6	MB8116HM	IC: 16K bit Dynamic RAM
IC32	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC33	SIT-74LS193-9	SN74LS193N	IC: Synchronous up/down Dual Clock Counter Low Power
R41 thru R44	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470 Ω ±5% 1/4W
R45	RAY-AA10K4-1	TMR4-103	R: FXD COM 10 kΩ
C61			Not assigned
C62	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V

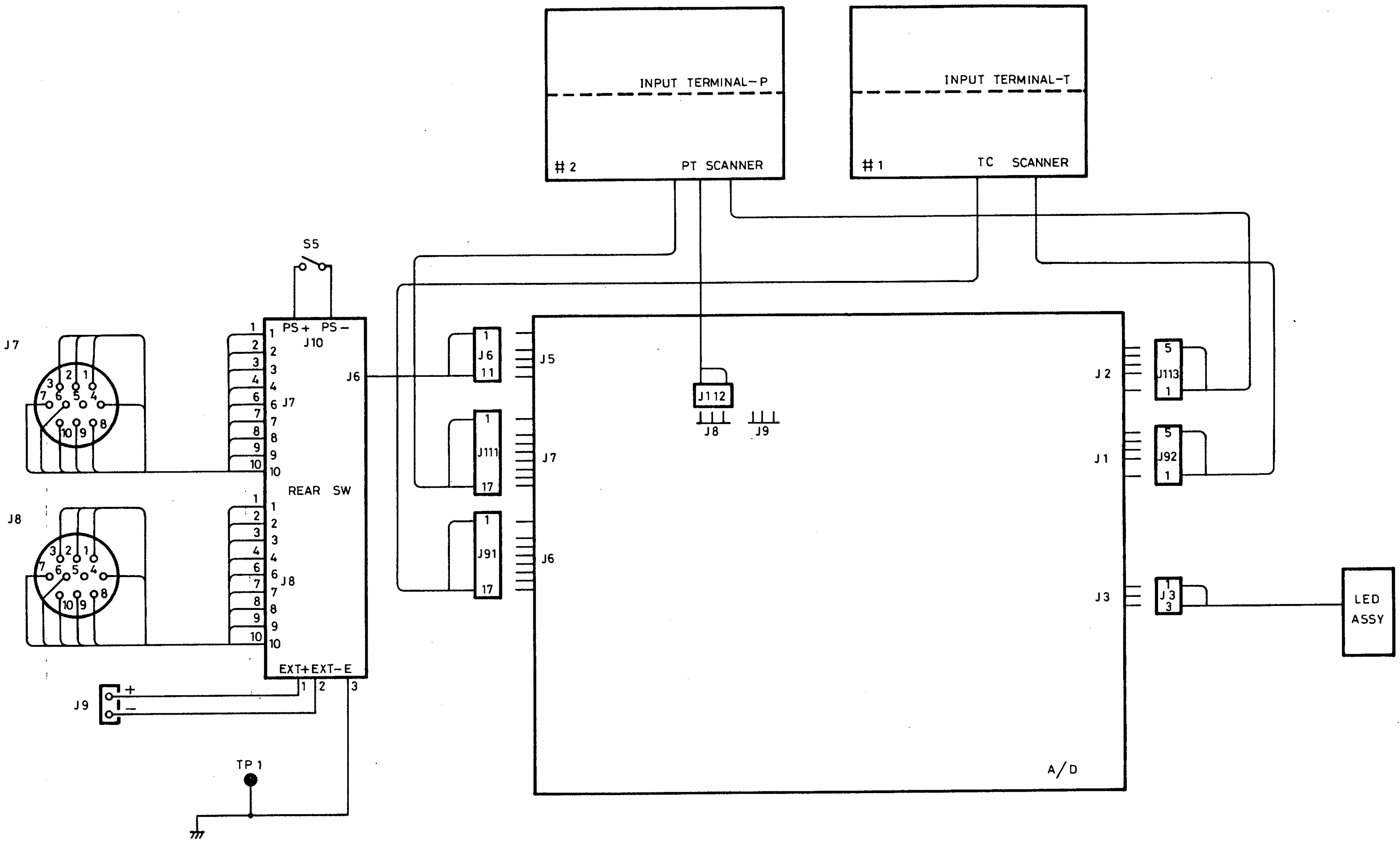
Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
C63 thru C65	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10µF ±20% 16V
C66 thru C68	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1µF ±20% 50V
C69 thru C71	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
C72 thru C77	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1µF ±20% 50V
C78	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
C79 thru C94	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1µF ±20% 50V
C95	CSM-ACR022U50V-1	0.022UF 50WV	C: FXD CER 0.022µF +80, -20% 50V
S101	KSL-000662-1	SSB023SL=6	Slide Switch
S102	KSL-000662-1	SSB023SL=6	Slide Switch
L105	LCL-T00084-1	LT-3	L: FXD Coil
C111 thru C126	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
	JCI-AD024JX01-1	ICN-246-S5	IC Socket
	MBM-010372A-1	401-9630A	Terminal

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIT-74LS14-9	SN74LS14N	IC: Hex Schmitt-Trigger Inverter Low Power
IC2	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC3	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC4	SIT-74LS02-9	SN74LS02N	IC: Quadruple 2-Input Positive NOR Gate Low Power
IC5	SIT-74LS390-9	SN74LS390N	IC: Dual Decade Counter Low Power
IC6	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC7	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC8	SIT-74LS390-9	SN74LS390N	IC: Dual Decade Counter Low Power
IC9	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC10	SIT-74LS14-9	SN74LS14N	IC: Hex Schmitt-Trigger Inverter Low Power
IC11	SIT-74LS390-9	SN74LS390N	IC: Dual Decade Counter Low Power
IC12	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC13	SIT-74LS390-9	SN74LS390N	IC: Dual Decade Counter Low Power
IC14	SIT-74LS390-9	SN74LS390N	IC: Dual Decade Counter Low Power
IC15	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC16	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC17	SIT-74LS390-9	SN74LS390N	IC: Dual Decade Counter Low Power
IC18	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC19	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC20	SIT-74LS390-9	SN74LS390N	IC: Dual Decade Counter Low Power
IC21	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC22	SIT-74LS390-9	SN74LS390N	IC: Dual Decade Counter Low Power
IC23	SIT-74LS390-9	SN74LS390N	IC: Dual Decade Counter Low Power
IC24	SIT-74LS244-9	SN74LS244N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC25	SIT-74LS132-9	SN74LS132N	IC: Quadruple 2-Input Positive-NAND Schmitt Trigger Low Power
IC26	SIA-T062-1	TL062P	IC: Dual Operational Amplifier
IC27	SIA-T062-1	TL062P	IC: Dual Operational Amplifier
D31	SDS-A54-1	UPA54H	Diode COM
D32	SDS-A64-1	UPA64H	Diode COM
D33	SDS-A64-1	UPA64H	Diode COM
D34 thru D37	SDS-1S953-1	1S935	Diode SI
R41	RAY-AA2R2K4-1	TMR4-222	R: FXD COM 2.2 kΩ
R42	RAY-AA4R7K4-1	TMR4-472	R: FXD COM 4.7 kΩ
R43	RAY-AA47K4-1	TMR4-473	R: FXD COM 47 kΩ
R44	RCB-AH22K-1	RD25S 22KΩJ	R: FXD CAR 22 kΩ ±5% 1/4W
R45	RCB-AH180K-1	RD25S 180KΩJ	R: FXD CAR 180 kΩ ±5% 1/4W
R46	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R47	RCB-AH22K-1	RD25S 22KΩJ	R: FXD CAR 22 kΩ ±5% 1/4W
R48	RCB-AH180K-1	RD25S 180KΩJ	R: FXD CAR 180 kΩ ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
R49	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7 kΩ ±5% 1/4W
R50	RCB-AH22K-1	RD25S 22KΩJ	R: FXD CAR 22 kΩ ±5% 1/4W
R51	RCB-AH180K-1	RD25S 180KΩJ	R: FXD CAR 180 kΩ ±5% 1/4W
R52	RCB-AH22K-1	RD25S 22KΩJ	R: FXD CAR 22 kΩ ±5% 1/4W
R53	RCB-AH180K-1	RD25S 180KΩJ	R: FXD CAR 180 kΩ ±5% 1/4W
R54	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R55	RCB-AH3R3K-1	RD25S 3.3KΩJ	R: FXD CAR 3.3 kΩ ±5% 1/4W
R56	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R57	RCB-AH3R3K-1	RD25S 3.3KΩJ	R: FXD CAR 3.3 kΩ ±5% 1/4W
R58	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R59	RCB-AH3R3K-1	RD25S 3.3KΩJ	R: FXD CAR 3.3 kΩ ±5% 1/4W
R60	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
R61	RCB-AH3R3K-1	RD25S 3.3KΩJ	R: FXD CAR 3.3 kΩ ±5% 1/4W
R62 thru R66	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10 kΩ ±5% 1/4W
C71	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
C72 thru C74	CTA-AC10U16V-1	242M1602-106M	C: FXD ELECT TANTAL 10μF ±20% 16V
C75 thru C87	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V
L95	LCL-T00084-1	LT-3	L: FXD Coil
S101	KSL-000141-1	SJ0435	Switch
S102	KSL-000141-1	SJ0435	Switch
S103	KSL-000662-1	SSB023SL-6	Slide switch
S104	KSL-000034-1	MFS-201N6	Slide switch
J111 thru J114	JCF-AB001JX02-1	BNC-071	Connector
J115	DCB-QQ0757X01-1	SMV2J-TR1X08X040	Flat Cable
	MBM-10372A-1	401-9630A	Terminal

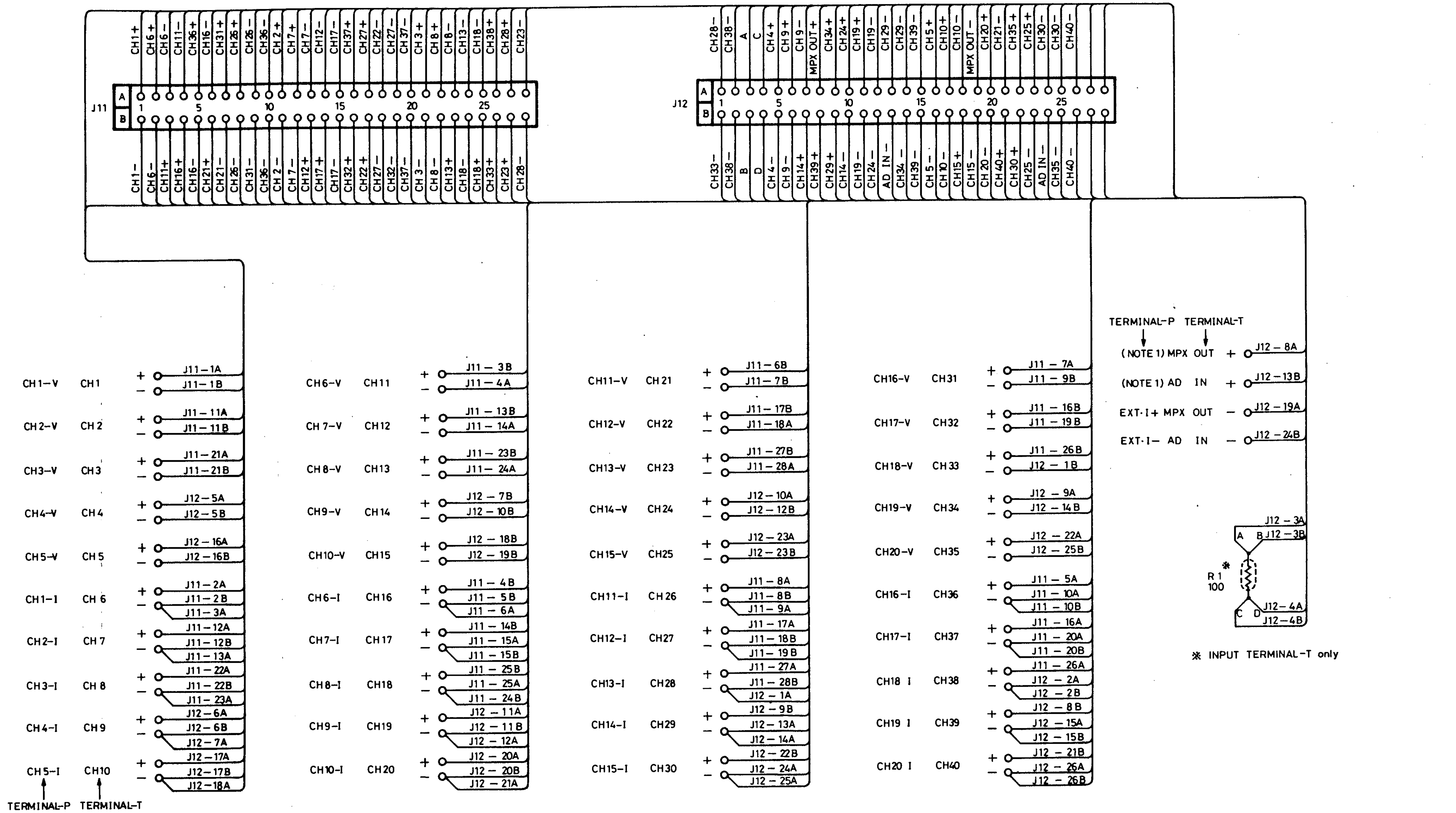
TR2730-580
PULSE COUNTER II
BLB-010244

Parts No.	ADVANTEST Stock No.	Mfr Stock No.	Description
IC1	SIT-74LS241-9	SN74LS241N	IC: Octal Buffer/Line Driver/ Line Receiver Low Power
IC2	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC3	SIT-74LS138-9	SN74LS138N	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC4	SIT-74LS32-9	SN74LS32N	IC: Quadruple 2-Input Positive-OR Gate Low Power
IC5	SIT-74LS32-9	SN74LS32N	IC: Quadruple 2-Input Positive-OR Gate Low Power
IC6	SIT-74LS125-9	SN74LS125N	IC: Quadruple bus Buffer Gate with three-state Output Low Power
IC7 thru IC12	SIT-74LS74-9	SN74LS74N	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
C21 thru C25	CTA-AC1U50V-2	244M5002-105M	C: FXD ELECT TANTAL 1μF ±20% 50V



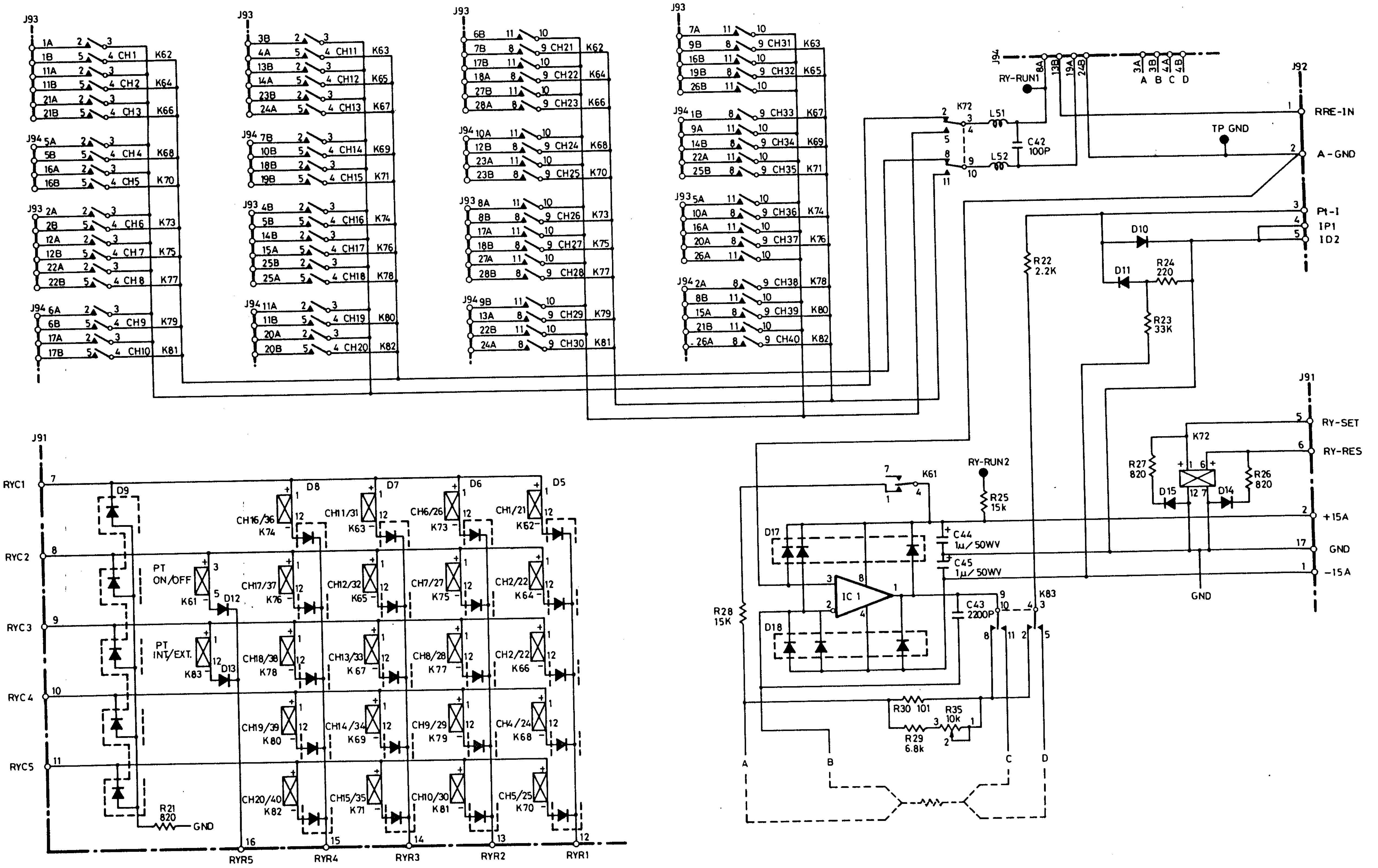
TR2741
SCHEMATIC SECTION

0017209-001-A



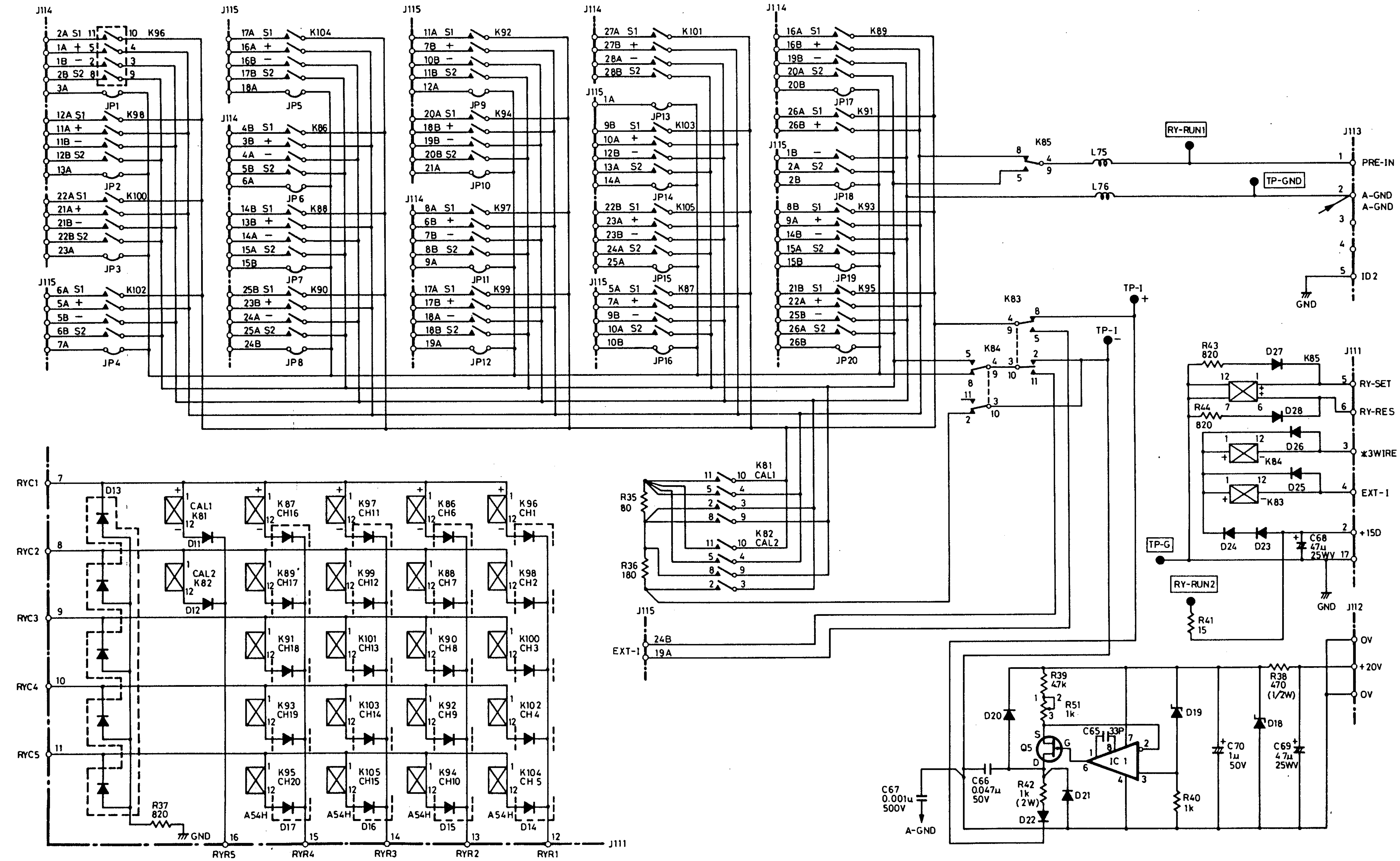
TR2741A/B/C/D/E
INPUT TERMINAL-T/P
BLL-010163

0017209-002-A



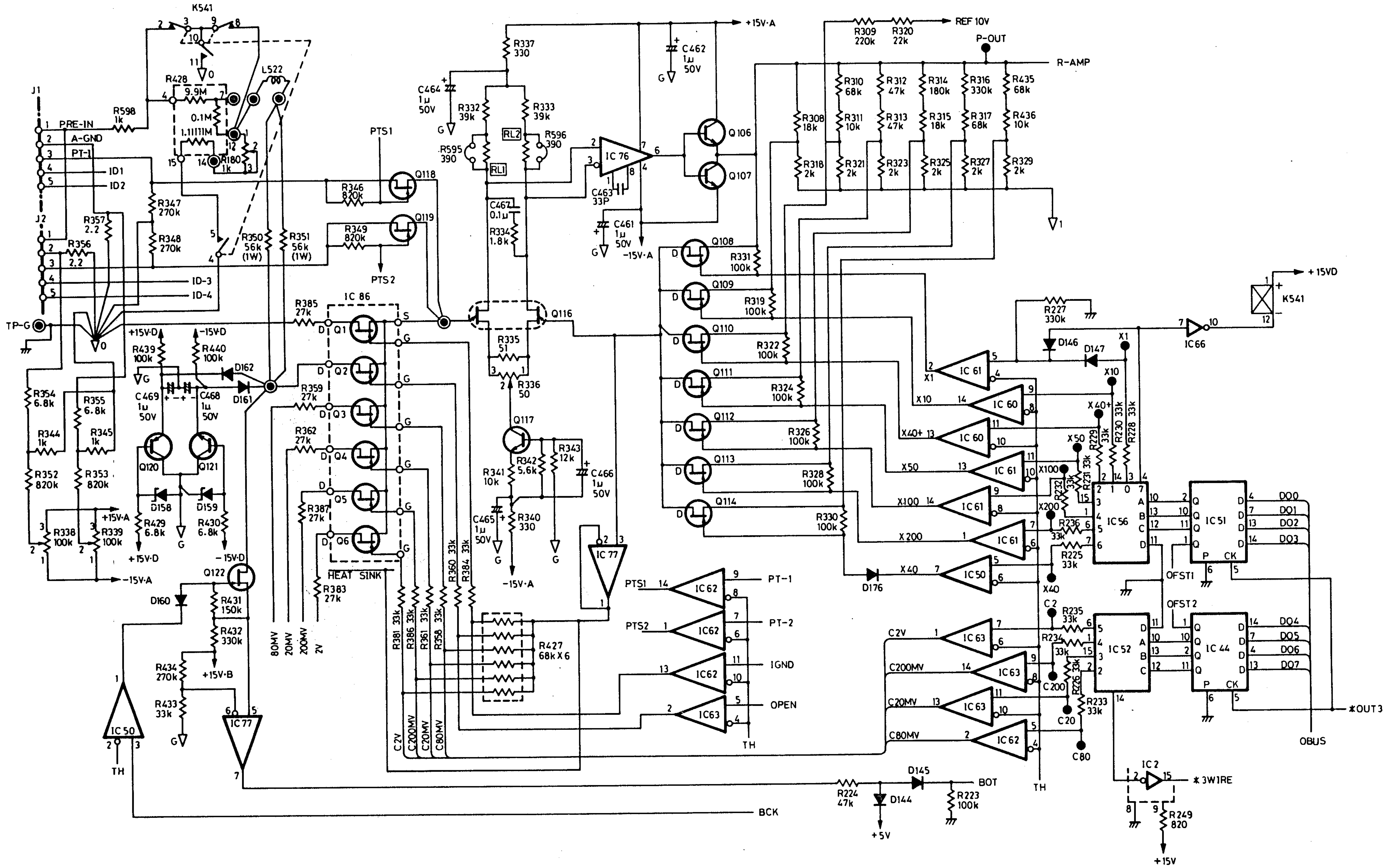
TR2741A/B/E
TC SCANNER I/II
BLG-010165x01/02

0017209-003-A



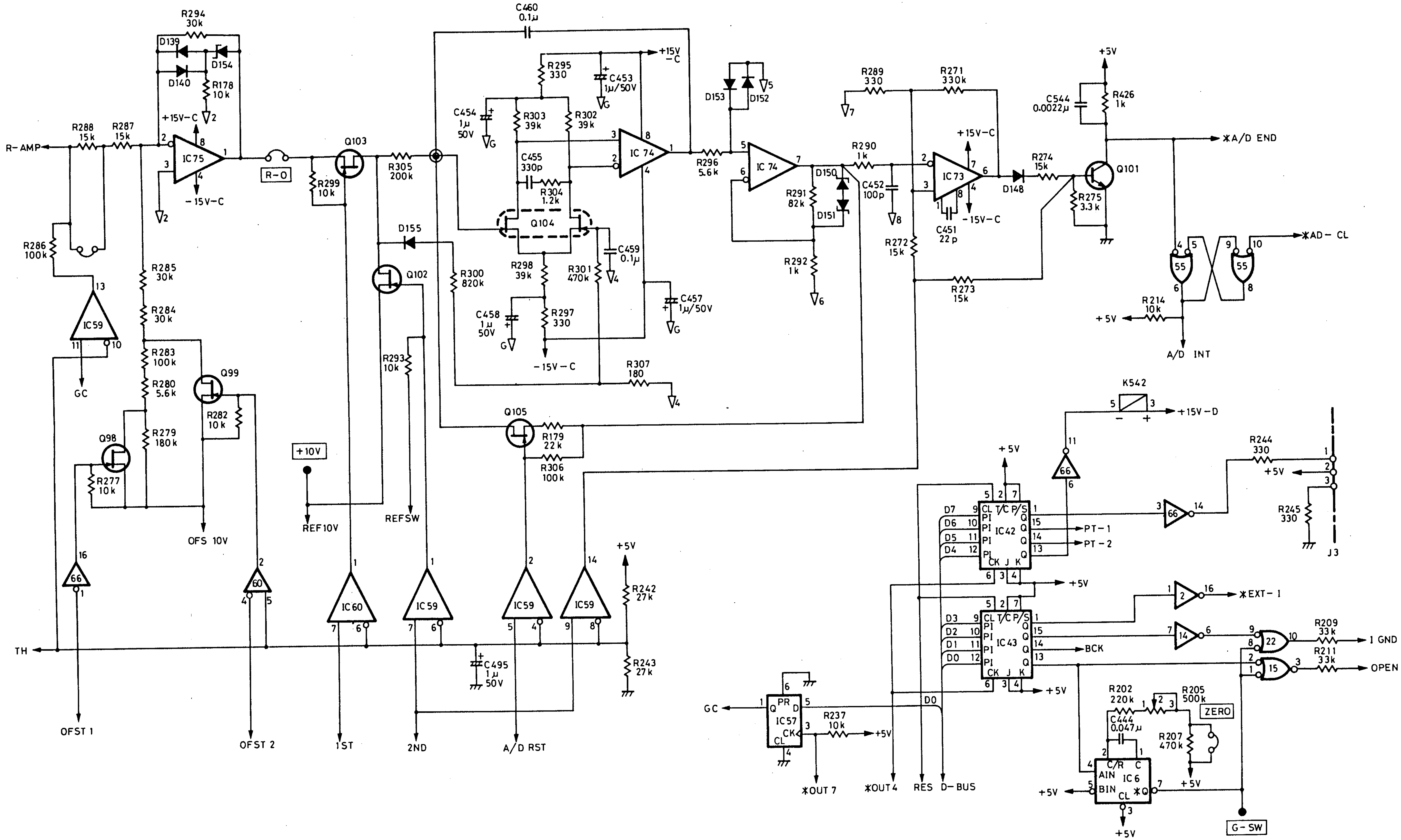
TR2741C/D/E
PT SCANNER I/II
BLG－010164x01/02

0017209－004－A



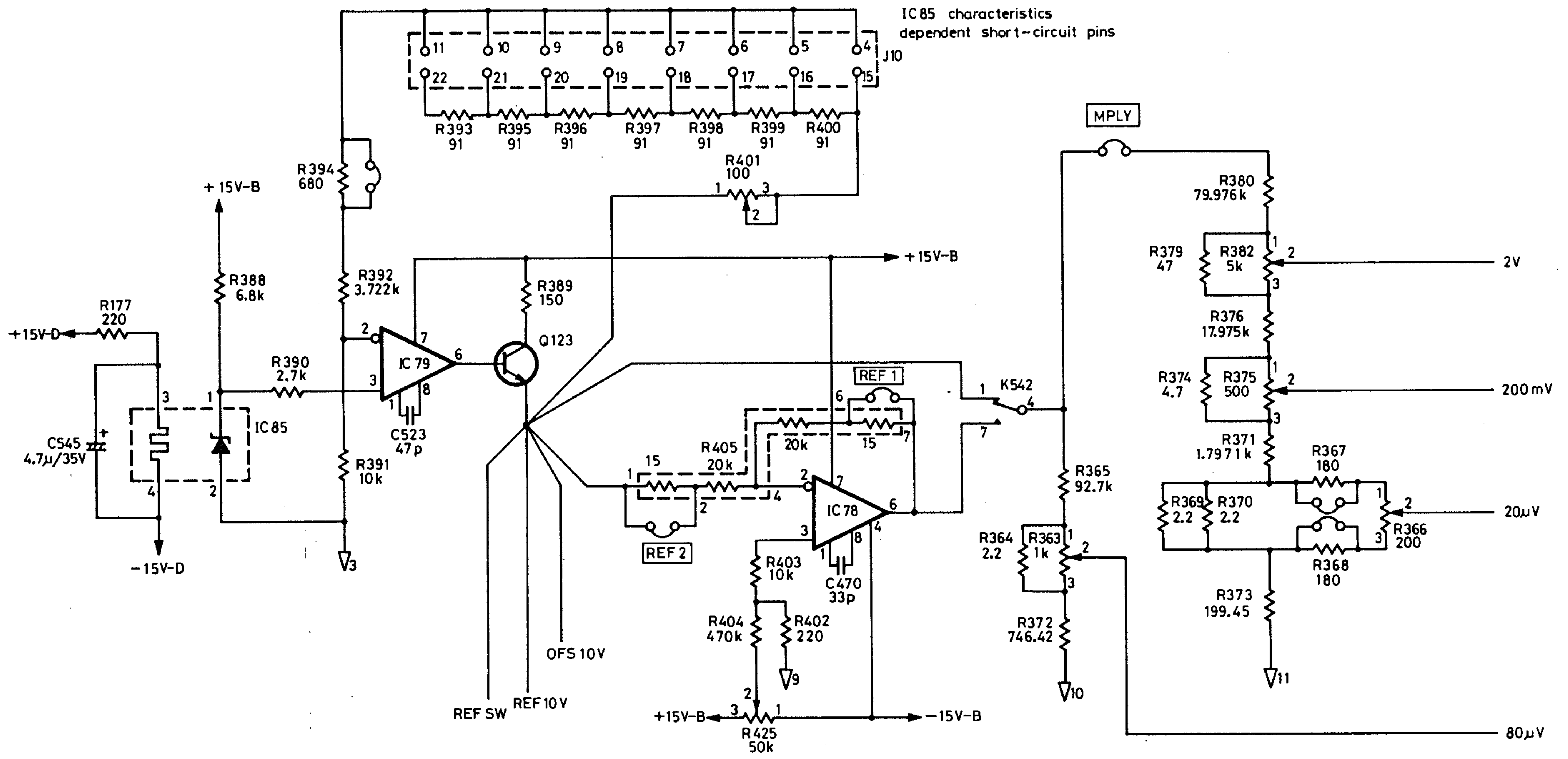
TR2741A/B/C/D/E
A/D CONVERTER
BLM-010166 1/9

0017209-005-A



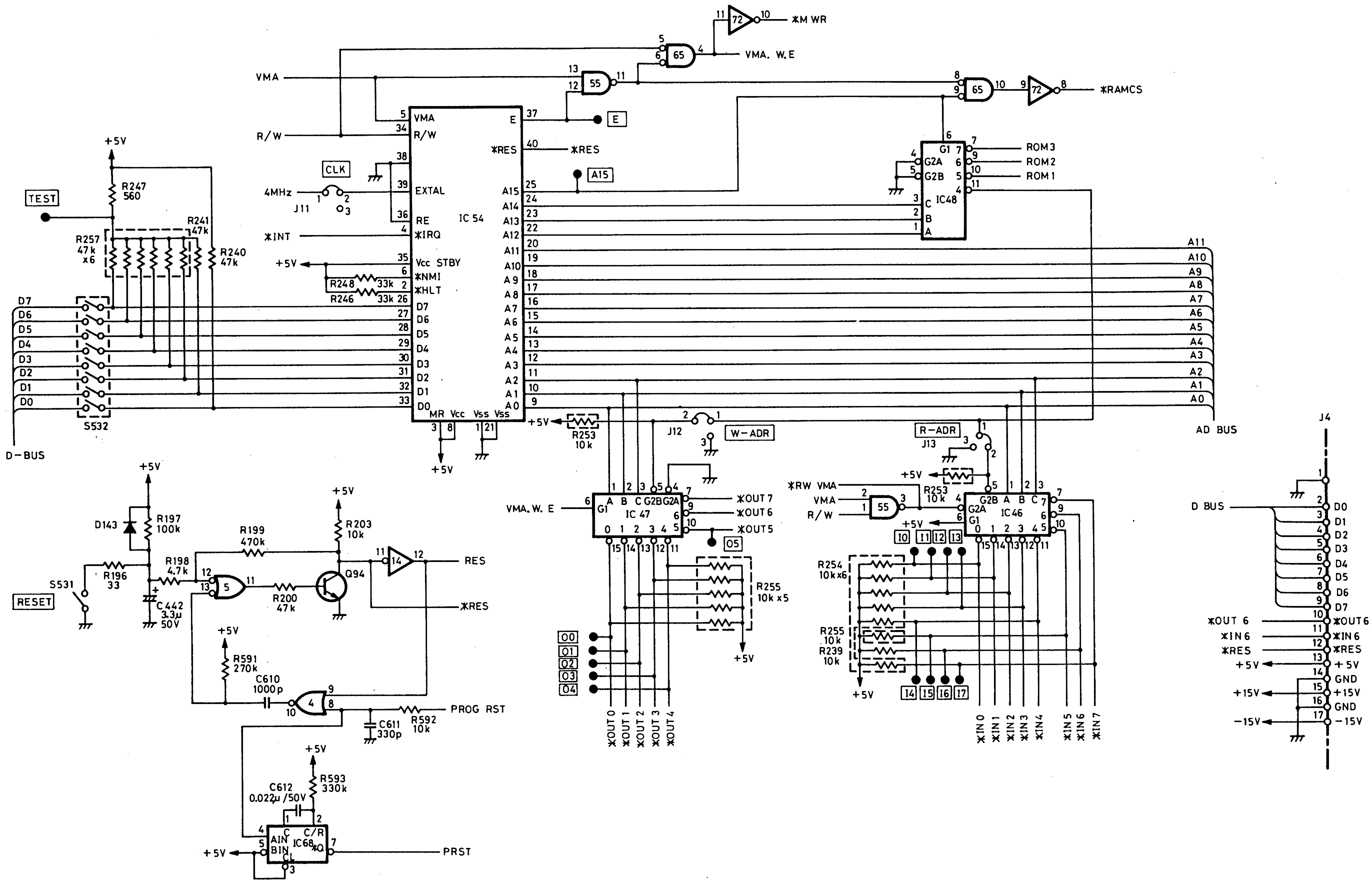
TR2741A/B/C/D/E
A/D CONVERTER
BLM-010166 2/9

0017309-006-C



TR2741A/B/C/D/E
A/D CONVERTER
BLM-010166 3/9

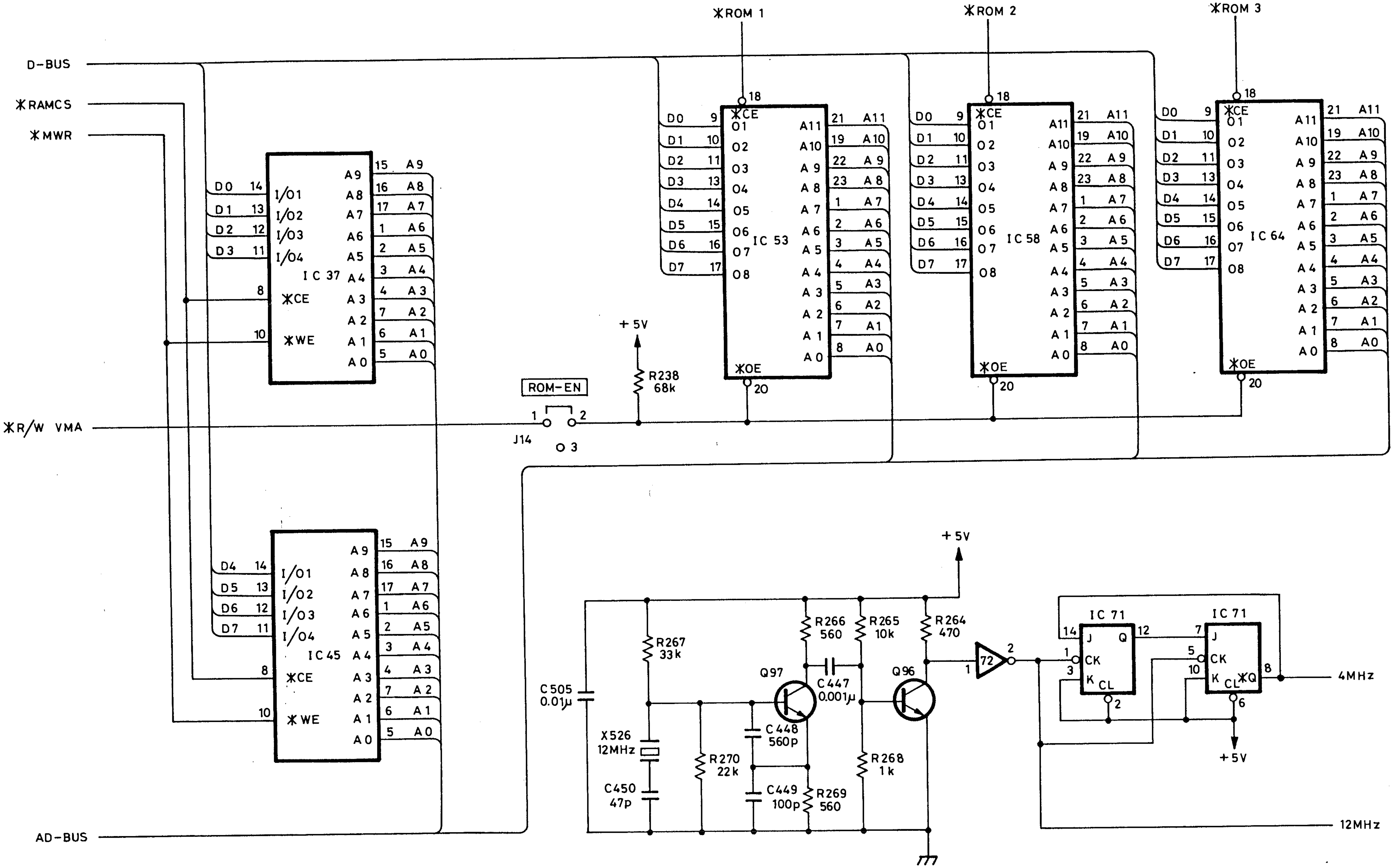
0017209-007-A



TR2741A/B/C/D/E
A/D CONVERTER
BLM-010166 4/9

0017209-008-A

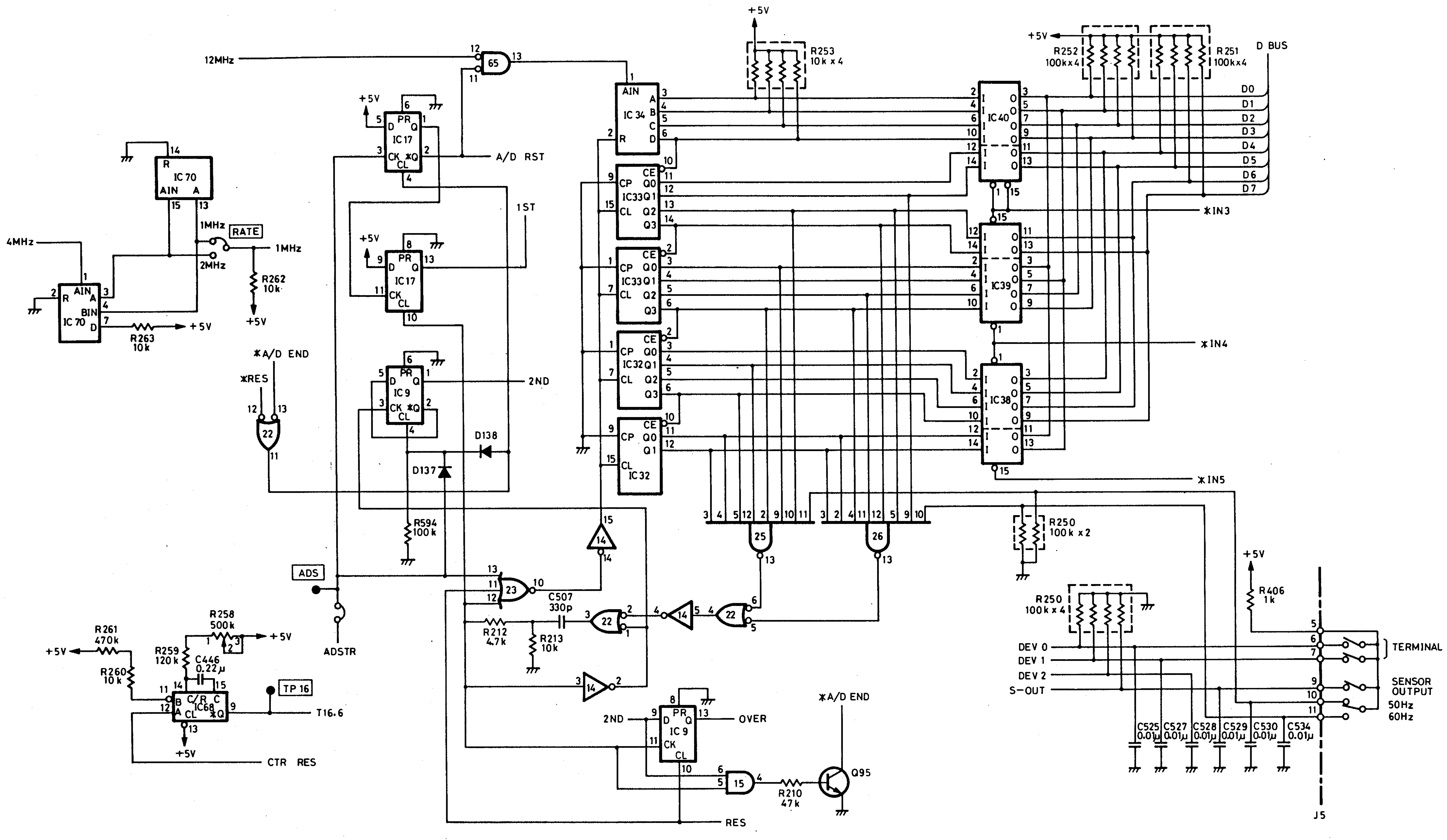
8



0017209-009-A

TR2741A/B/C/D/E
A/D CONVERTER
BLM - 010166 5/9

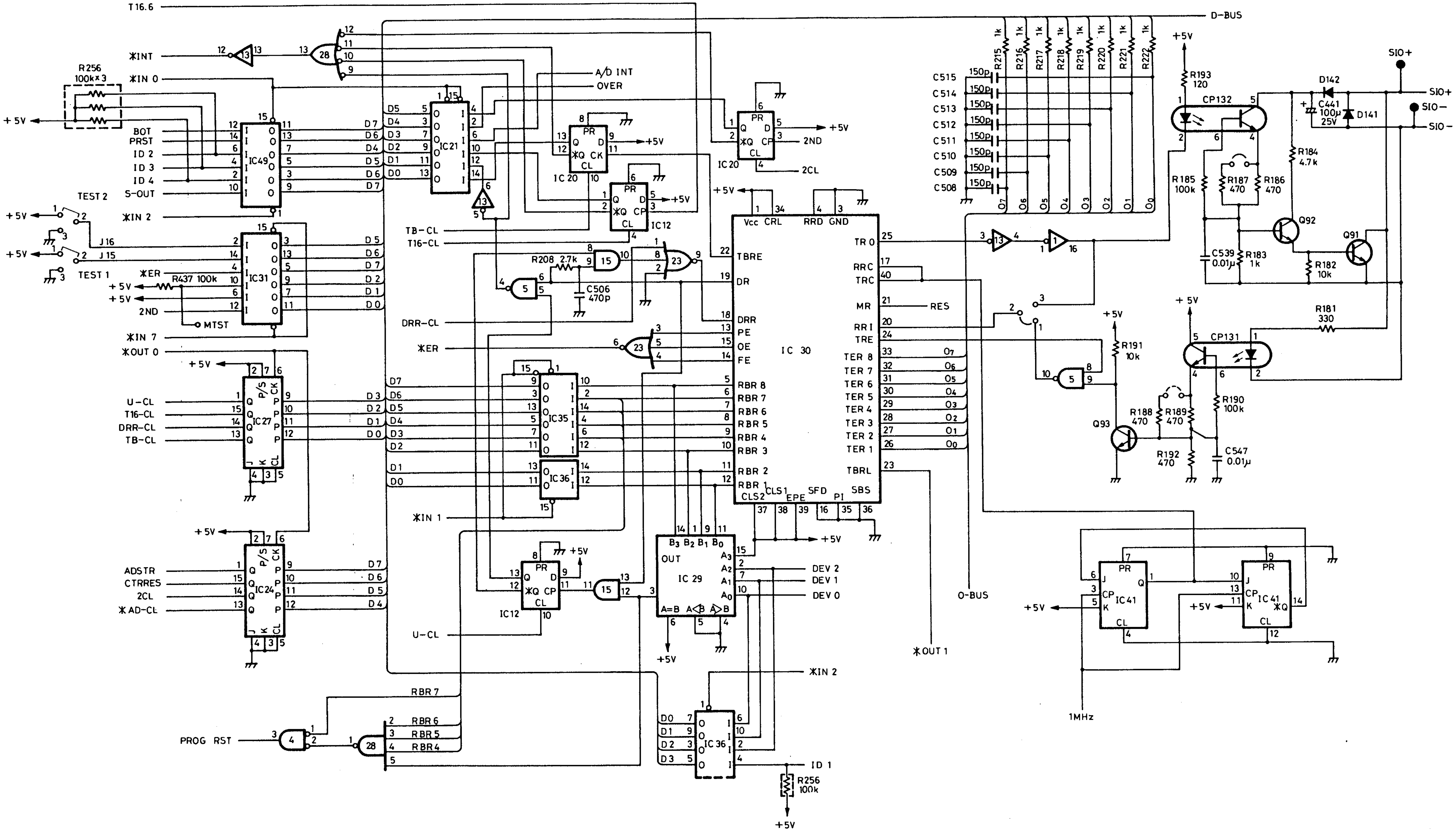
9



TR2741A/B/C/D/E
A/D CONVERTER
BLM-010166 6/9

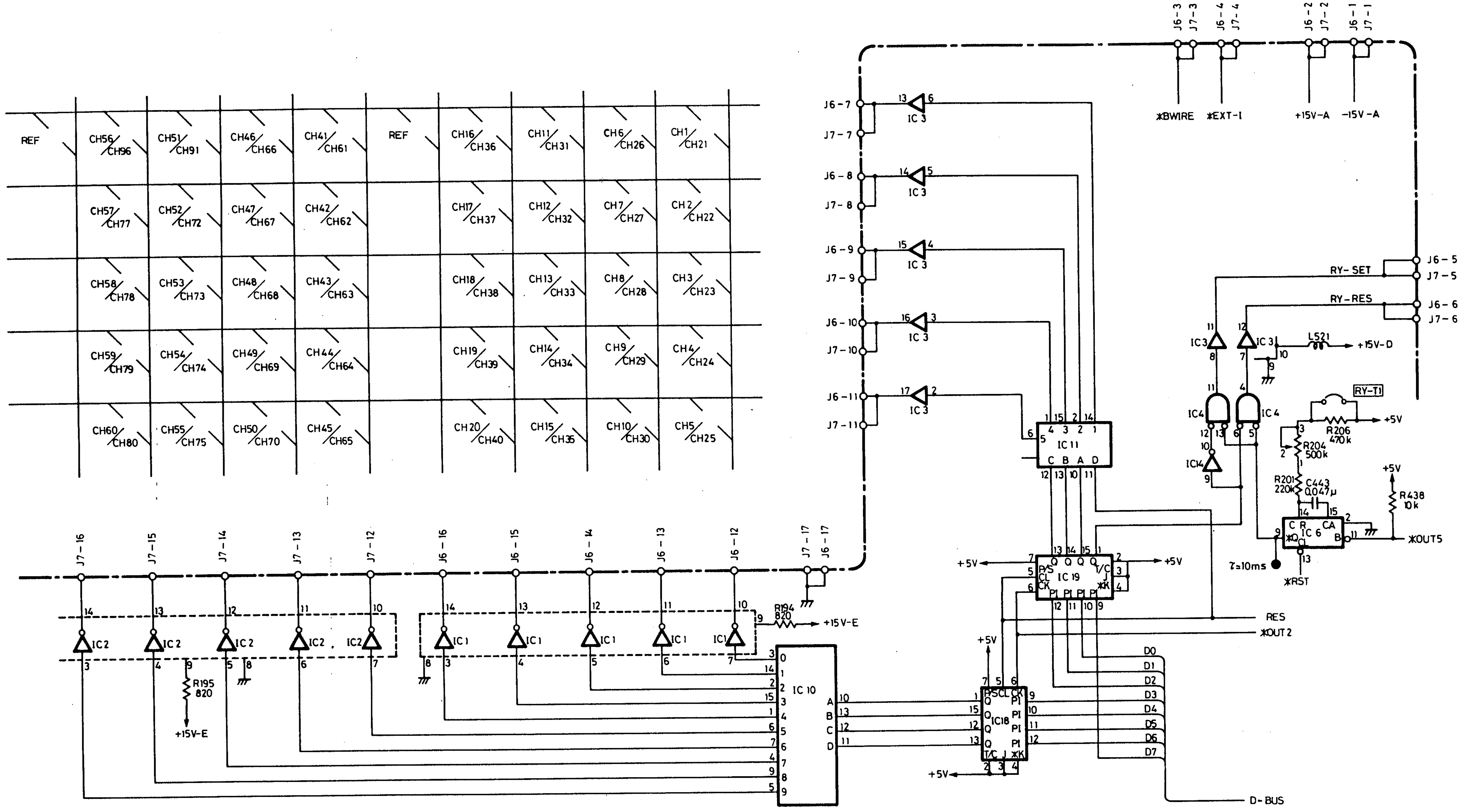
0017209-010-A

10



TR2741A/B/C/D/E
A/D CONVERTER
BLM - 010166 7/9

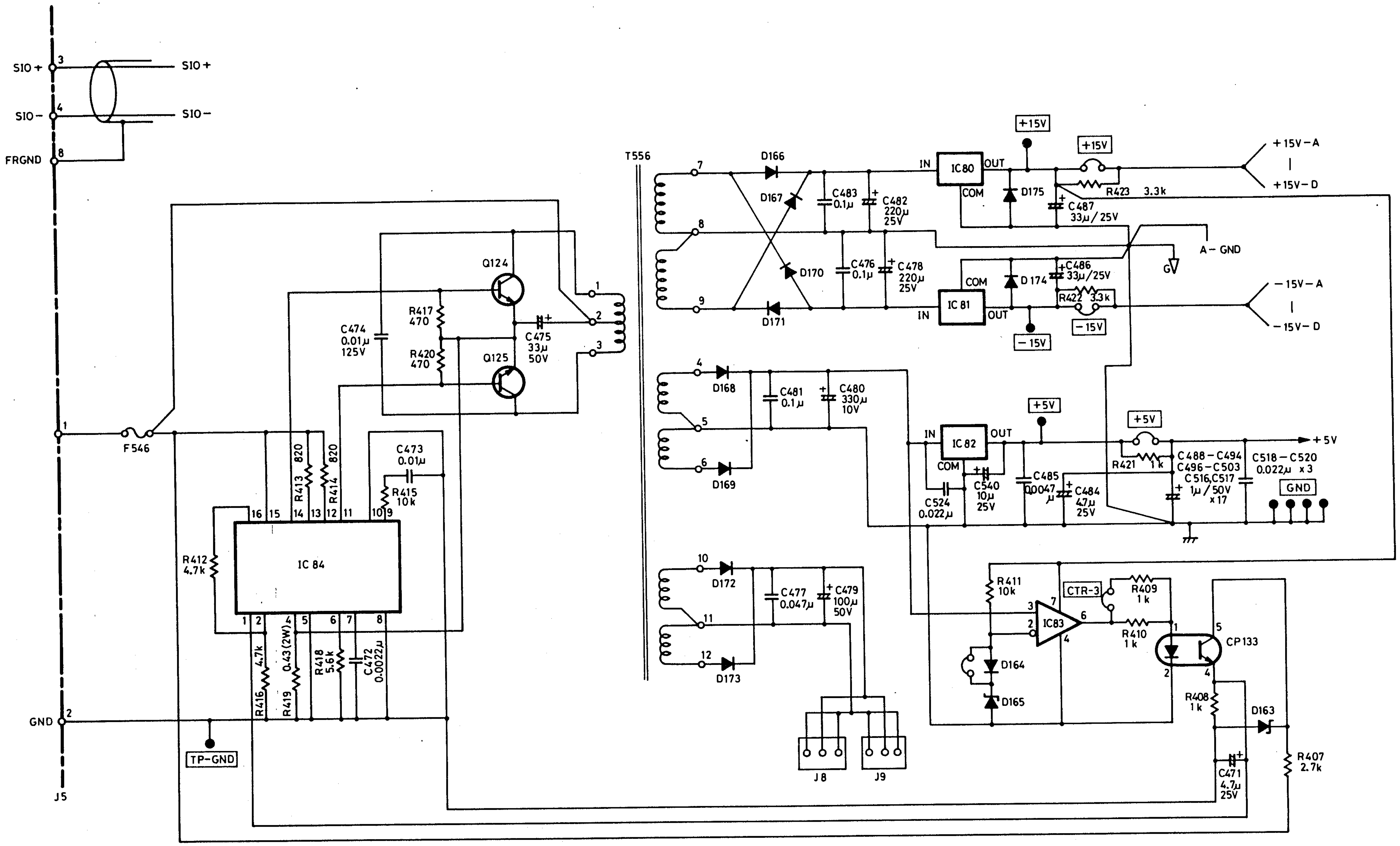
0017209-011-A



0017209-012-A

TR2741A/B/C/D/E
A/D CONVERTER
BLM－010166 8/9

12



0017209-013-A

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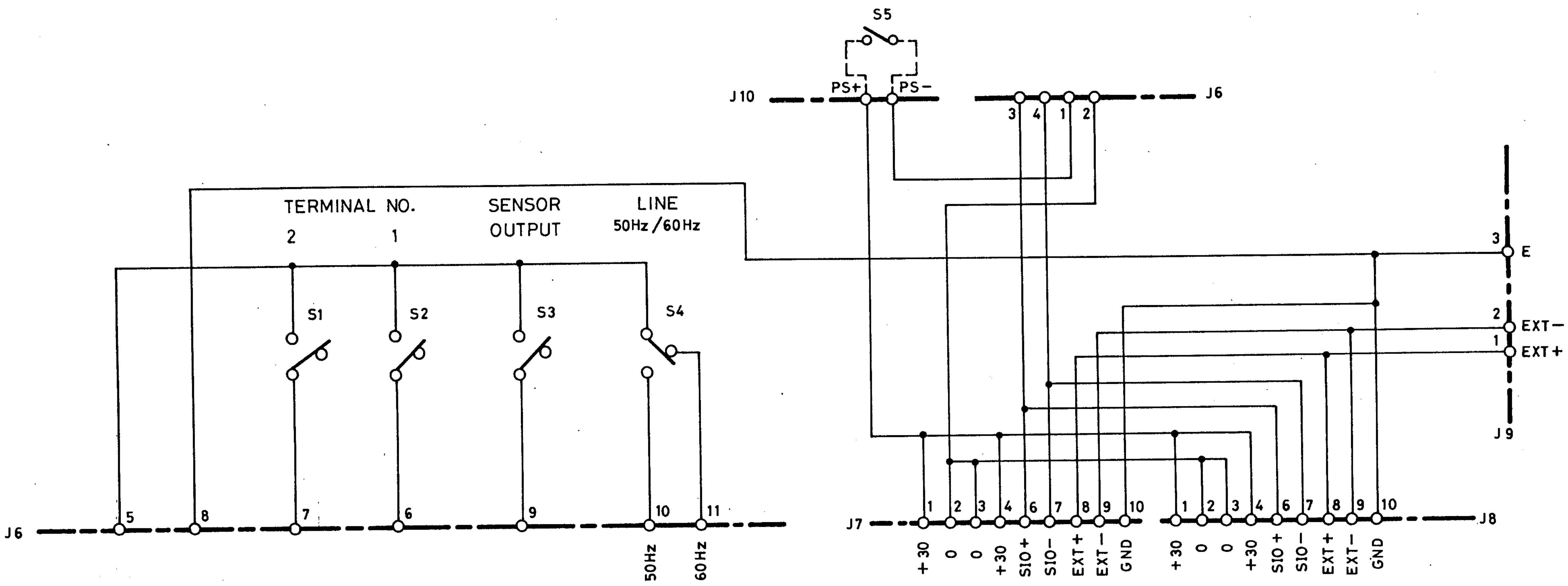
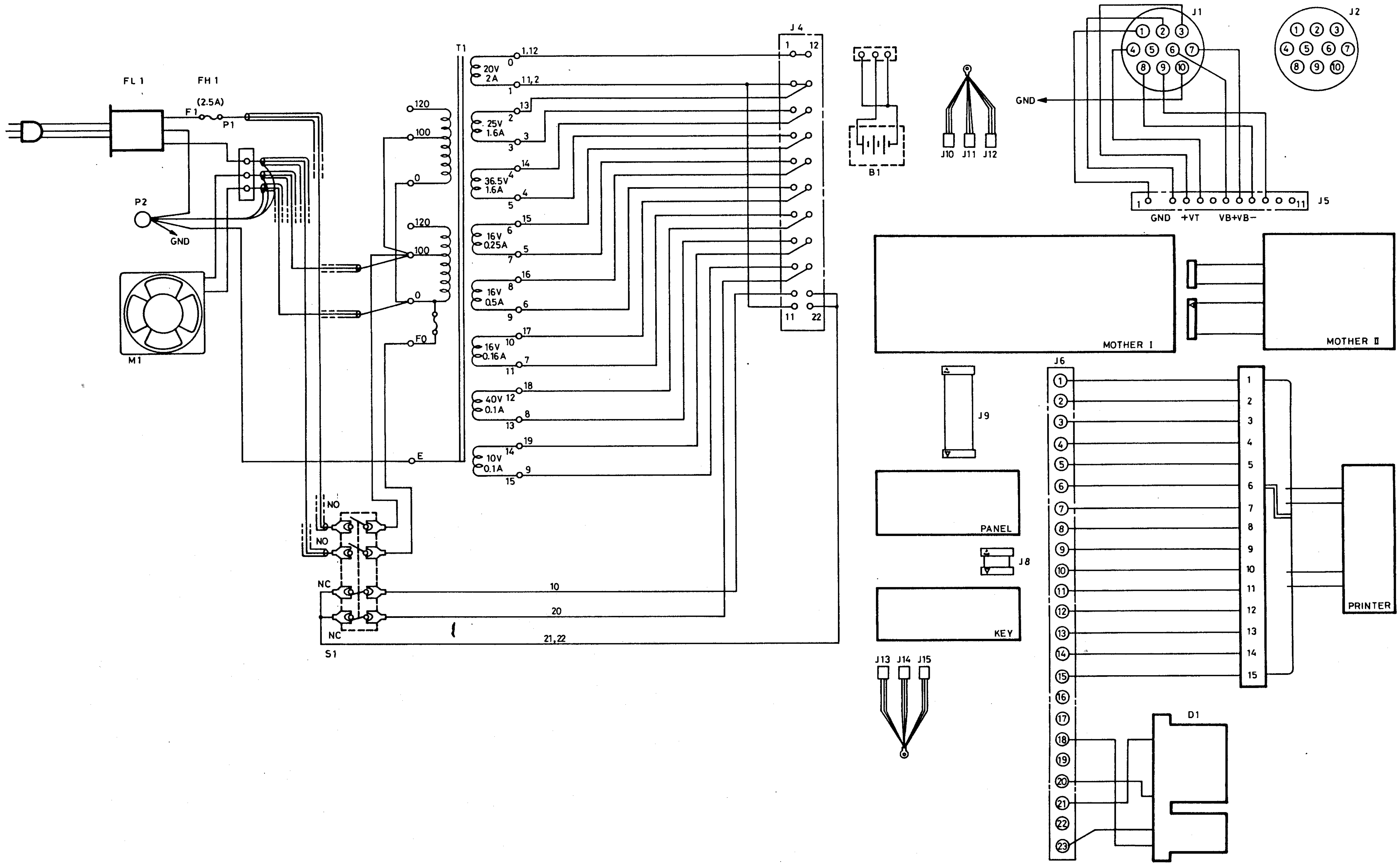
TR2741A/B/C/D/E
A/D CONVERTER
BLM-010166 9/9



0017209-014-A

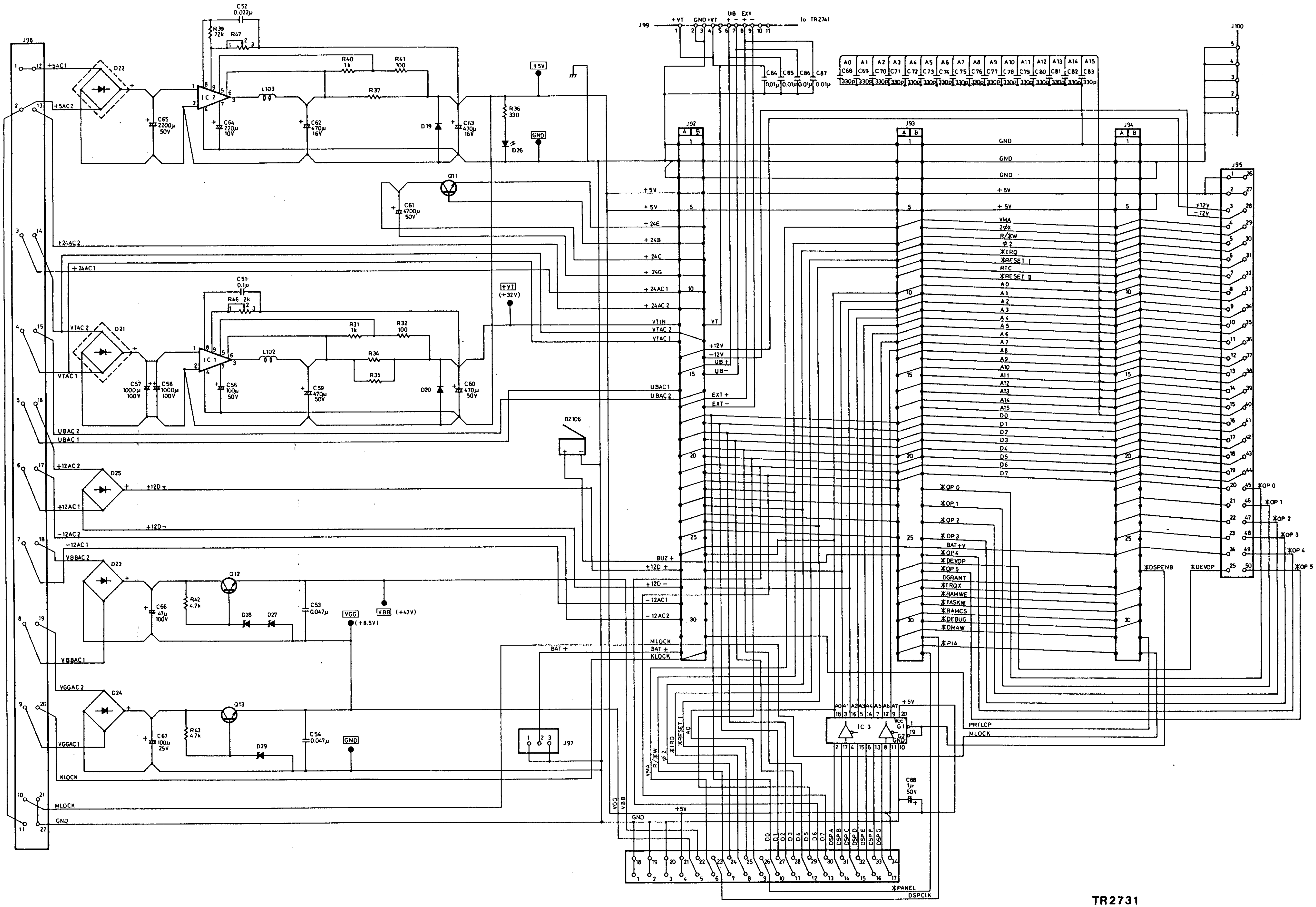
TR2741A/B/C/D/E
REAR SWITCH
BLC-010168



TR2731
SCHEMATIC SECTION

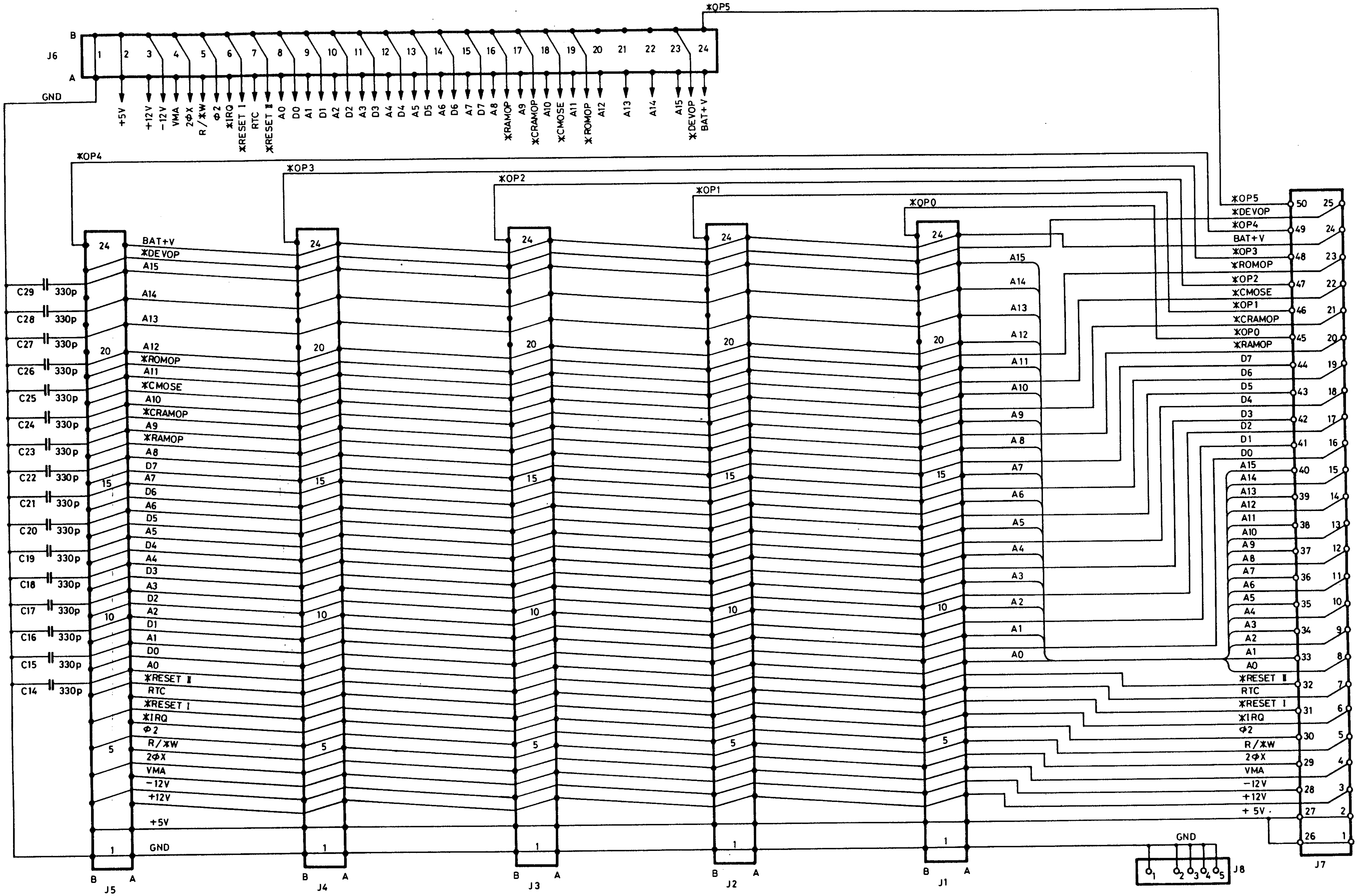
0016209-001-A

15



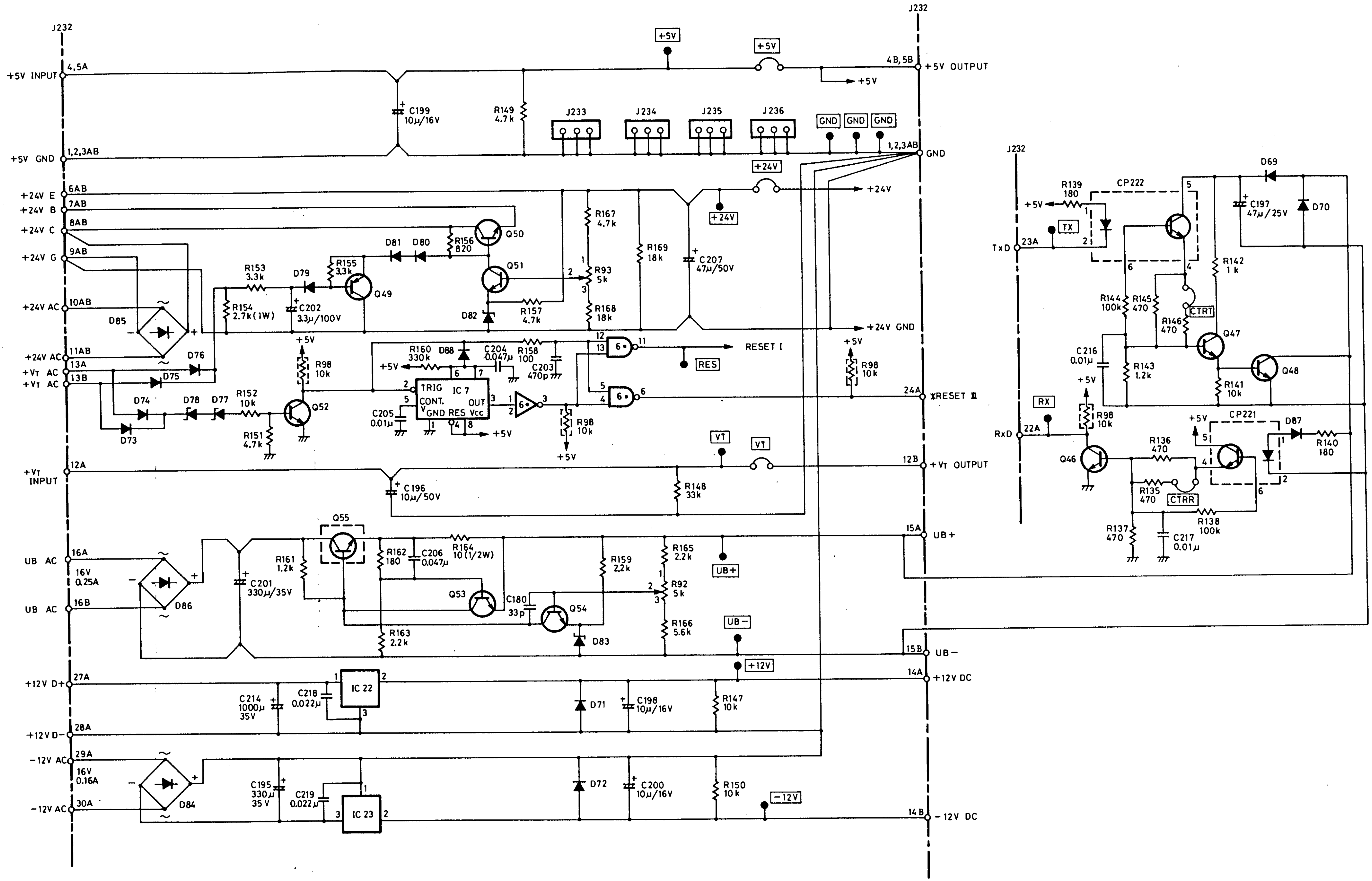
TR2731
MOTHER BOARD I
BLH-010156

0016209-002-A



TR2731
MOTHER BOARD II
BLG-010389

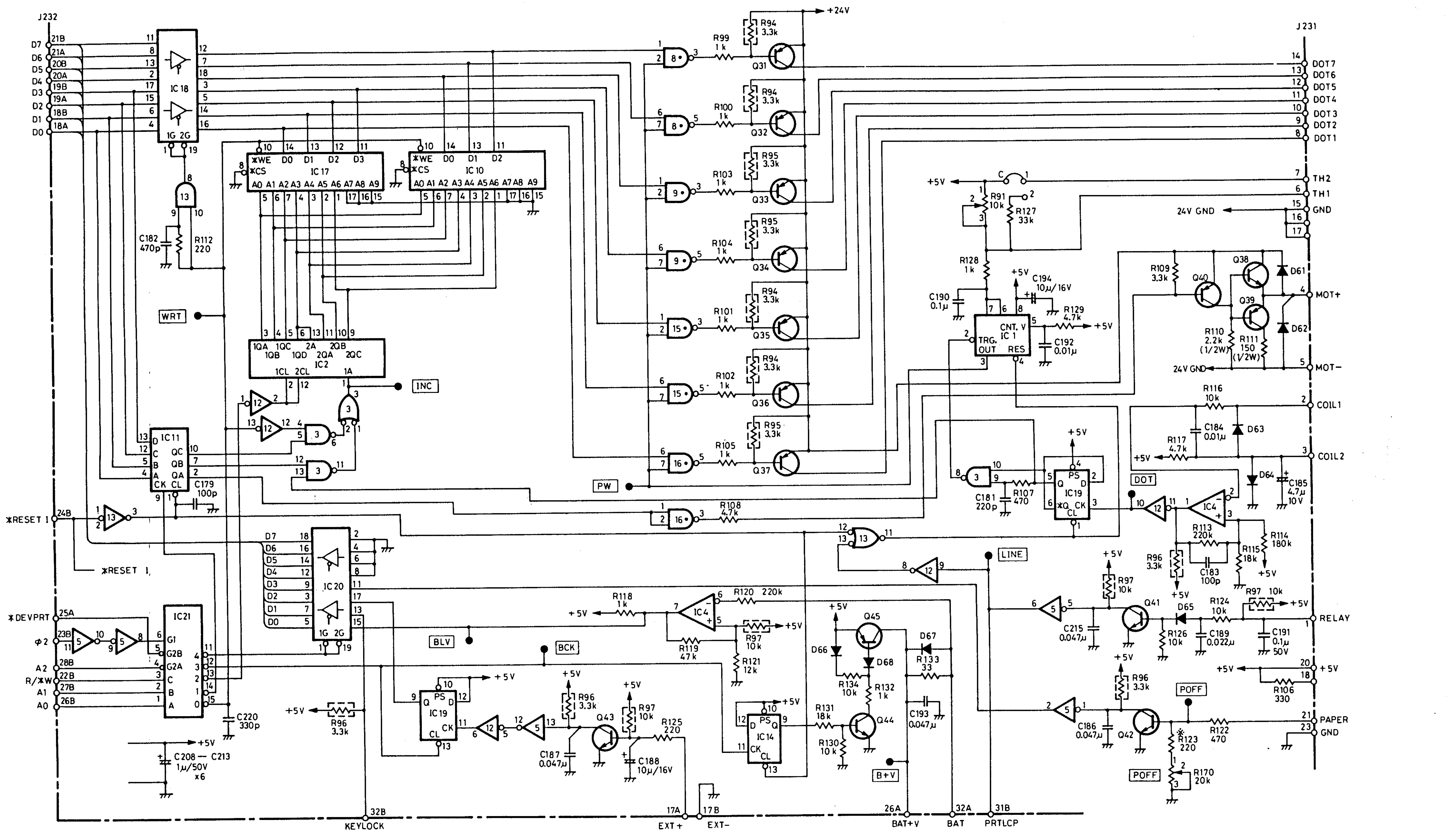
0016209−003−A



0016209-004-A

TR2731
PRINTER & POWER
BLN-010158 1/2

18



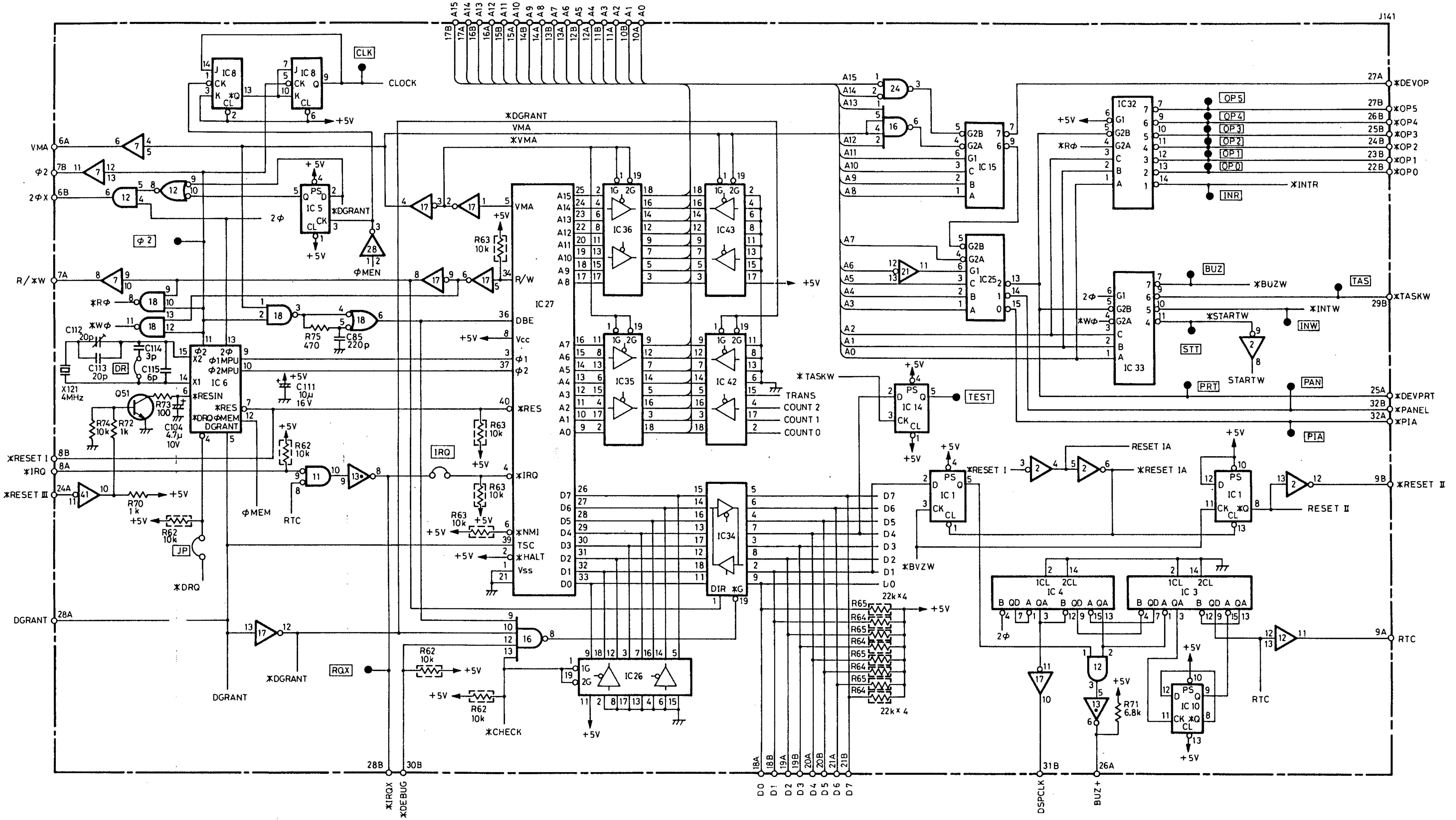
0016210 -005- B

TR2731

PRINTER & POWER

BLN-010158 2/2

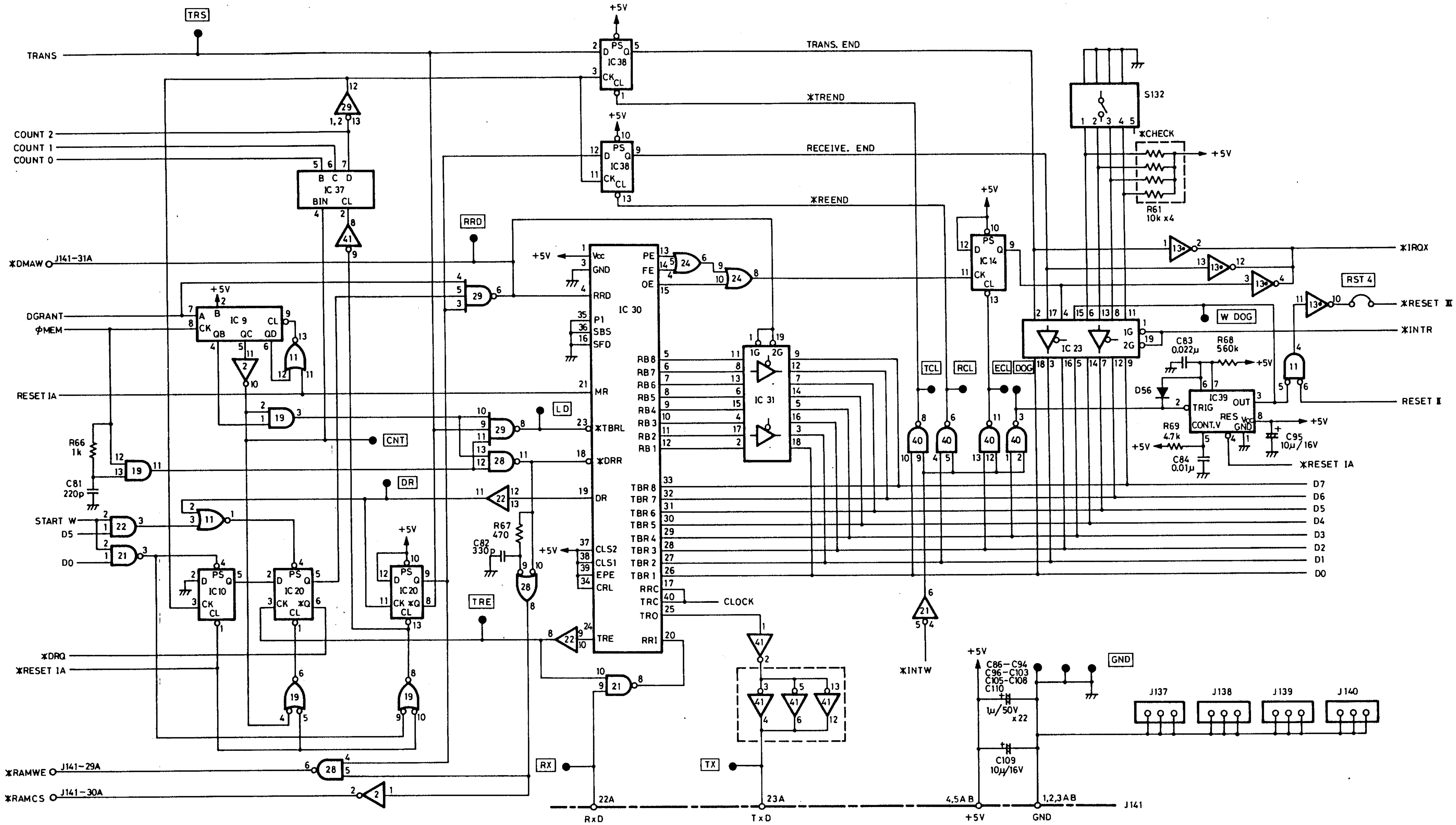
19



TR2731
CPU BOARD
BLN-010159 1/2

0016309-006-B

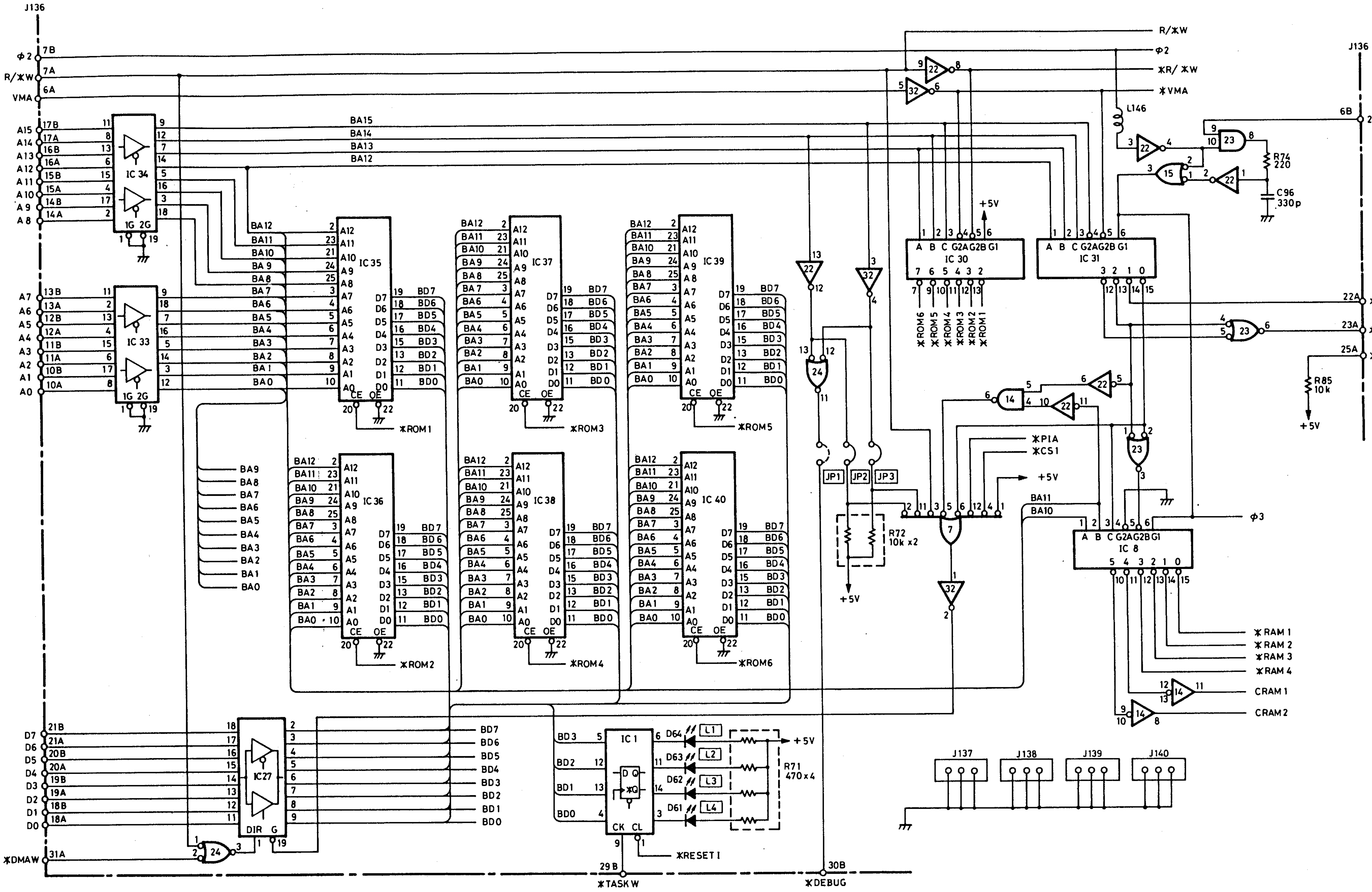
20



TR2731
CPU BOARD
BLN-010159 2/2

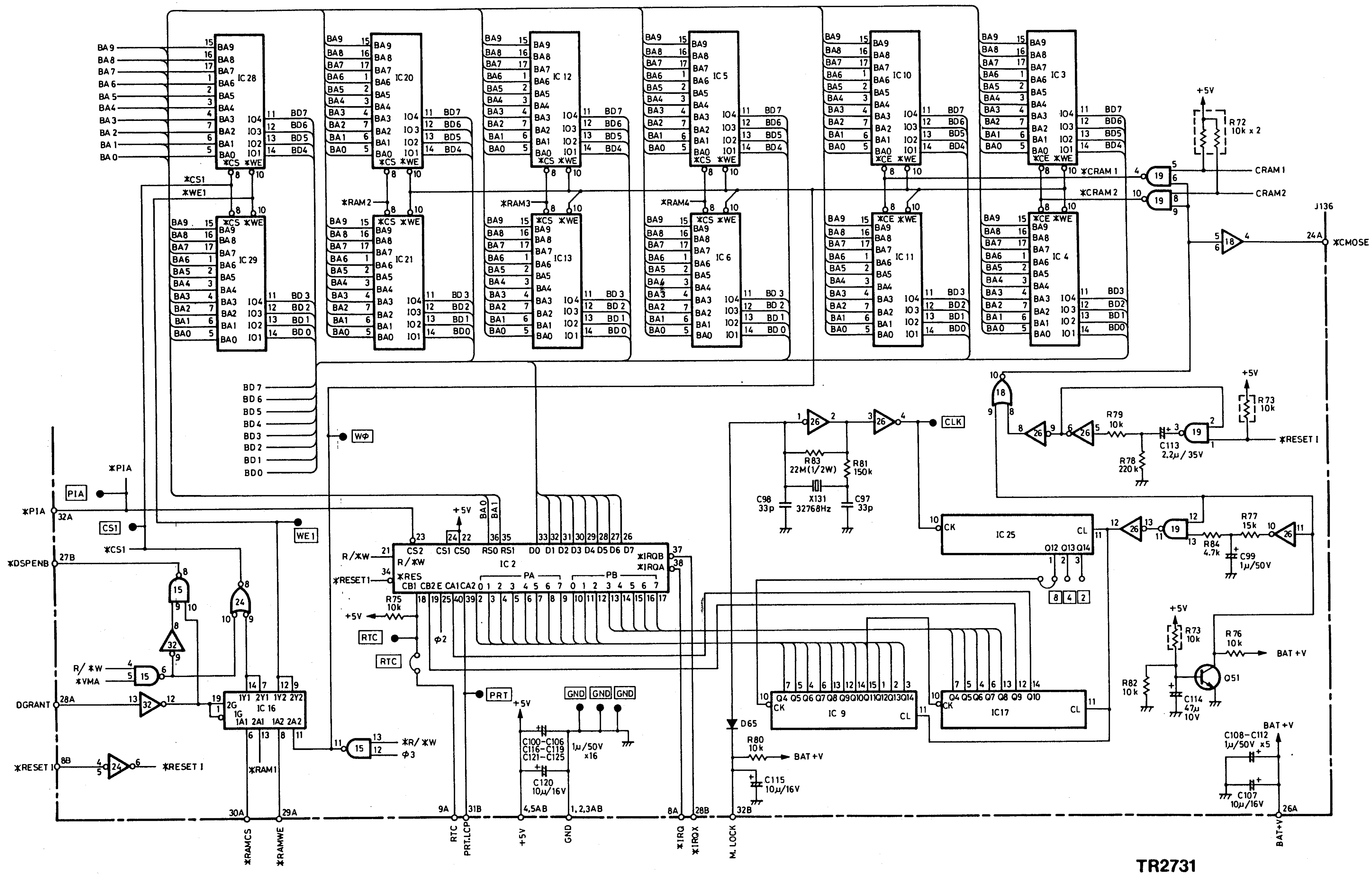
0016209 - 007 - A

2/



0016209-008-A

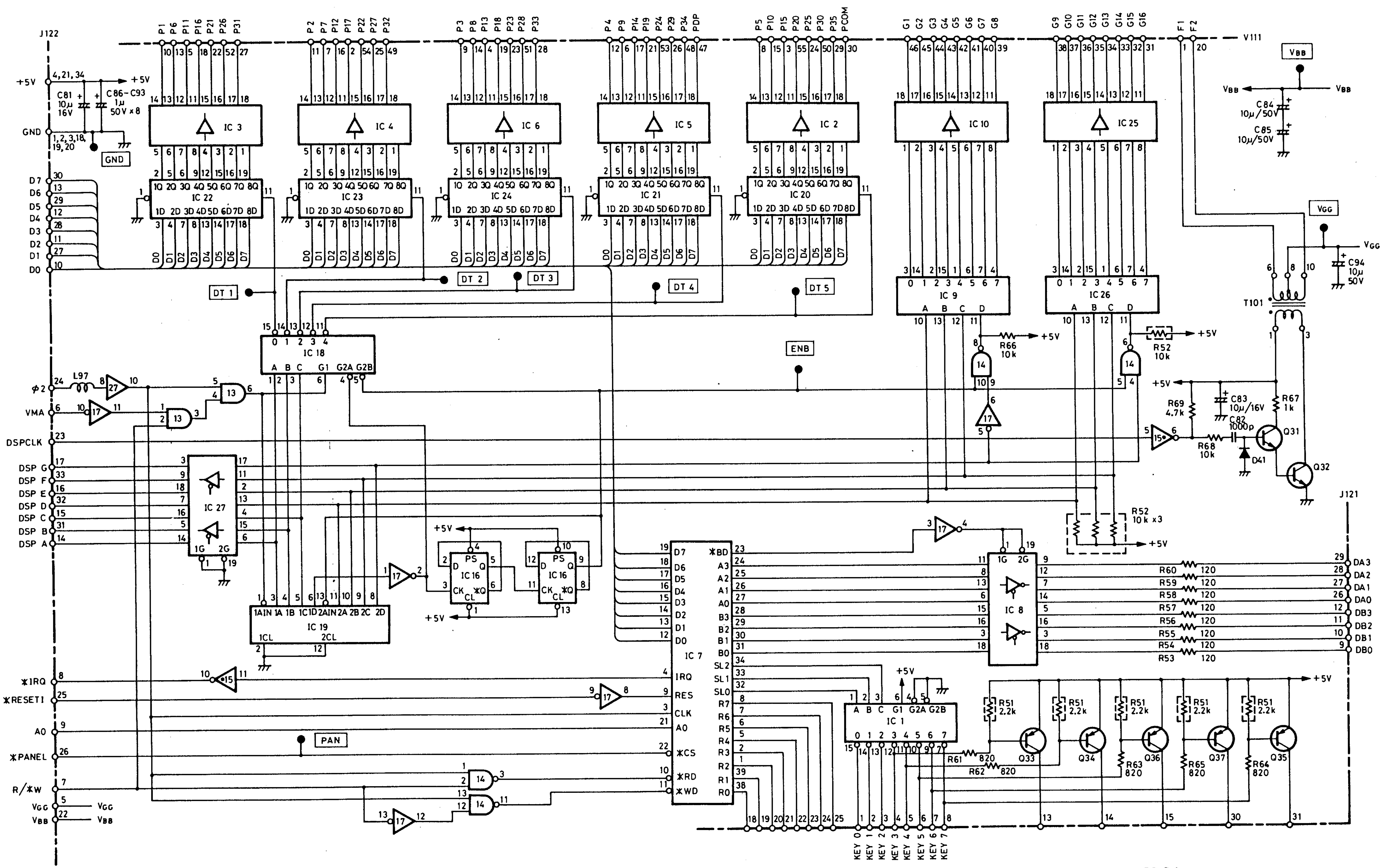
TR2731
MEMORY
BLN-010160 1/2



TR2731
MEMORY
BLN-010160 2/2

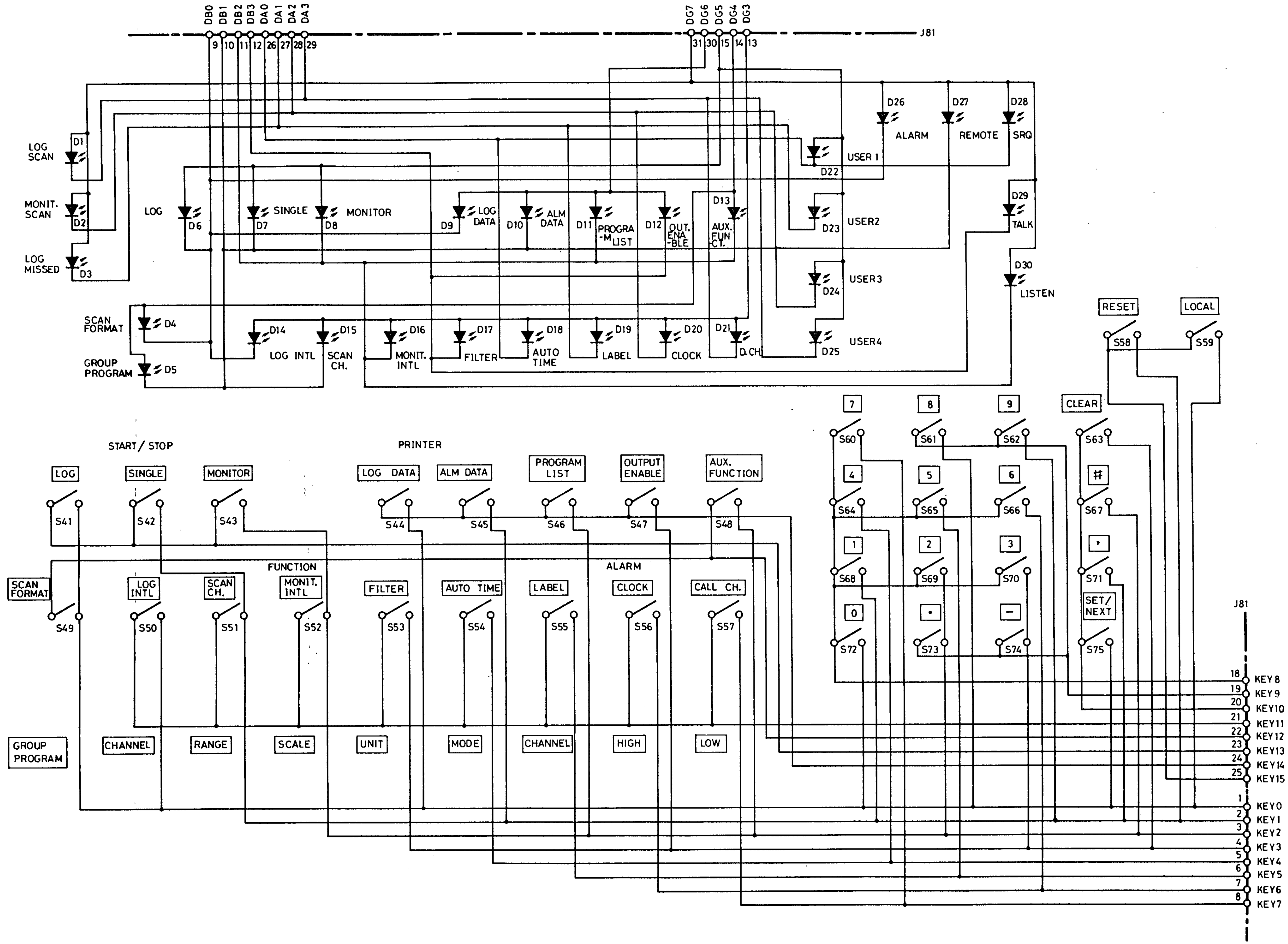
0016209 - 009 - A

23



TR2731
PANEL SECTION
BLJ-010161

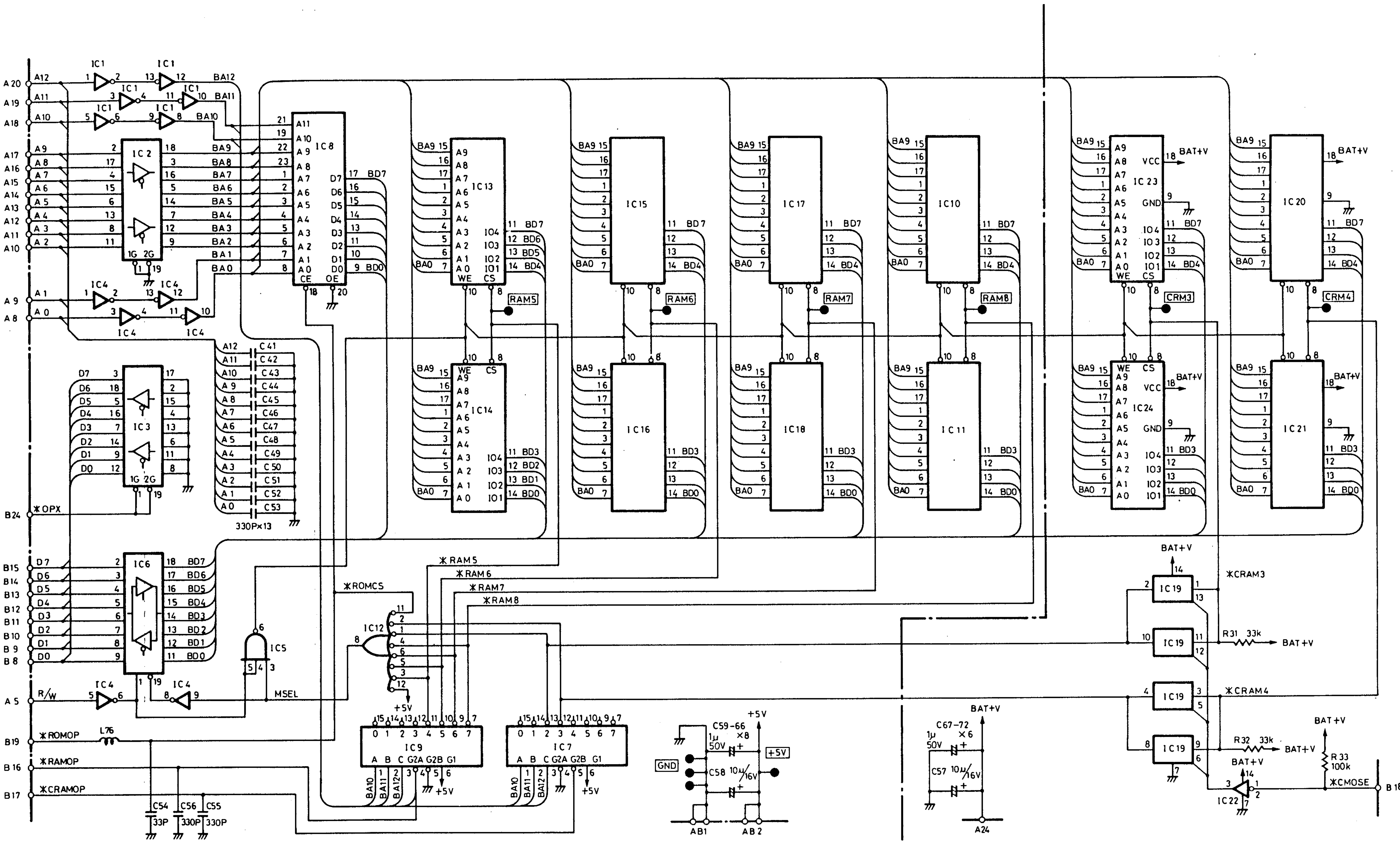
0016209-010-A



TR2731
KEY BOARD
BLJ-010162

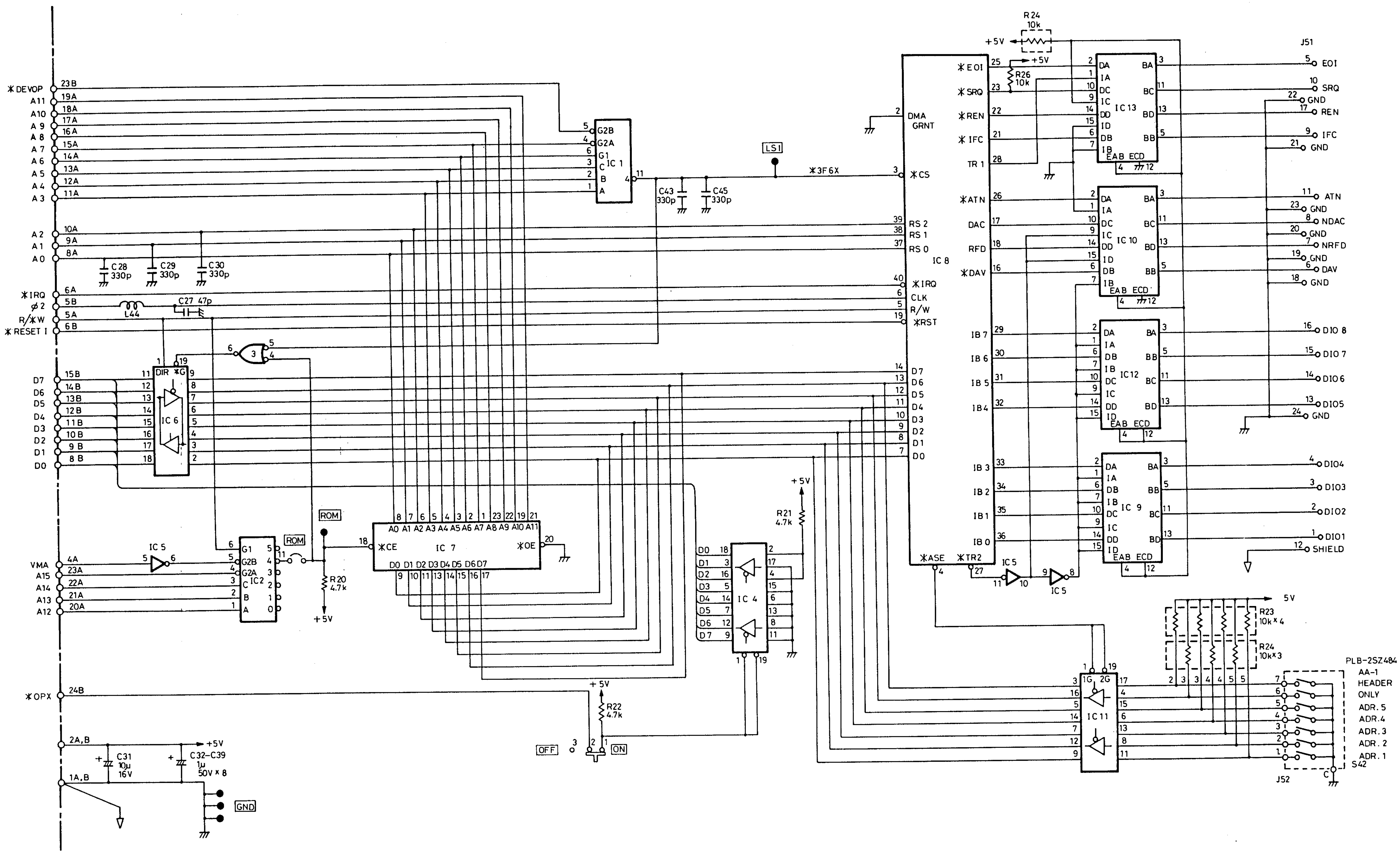
0016209—011—A

25



TR2730-010
MEMORY/AUX. FUC.
BGJ-010169

0016209-012-A

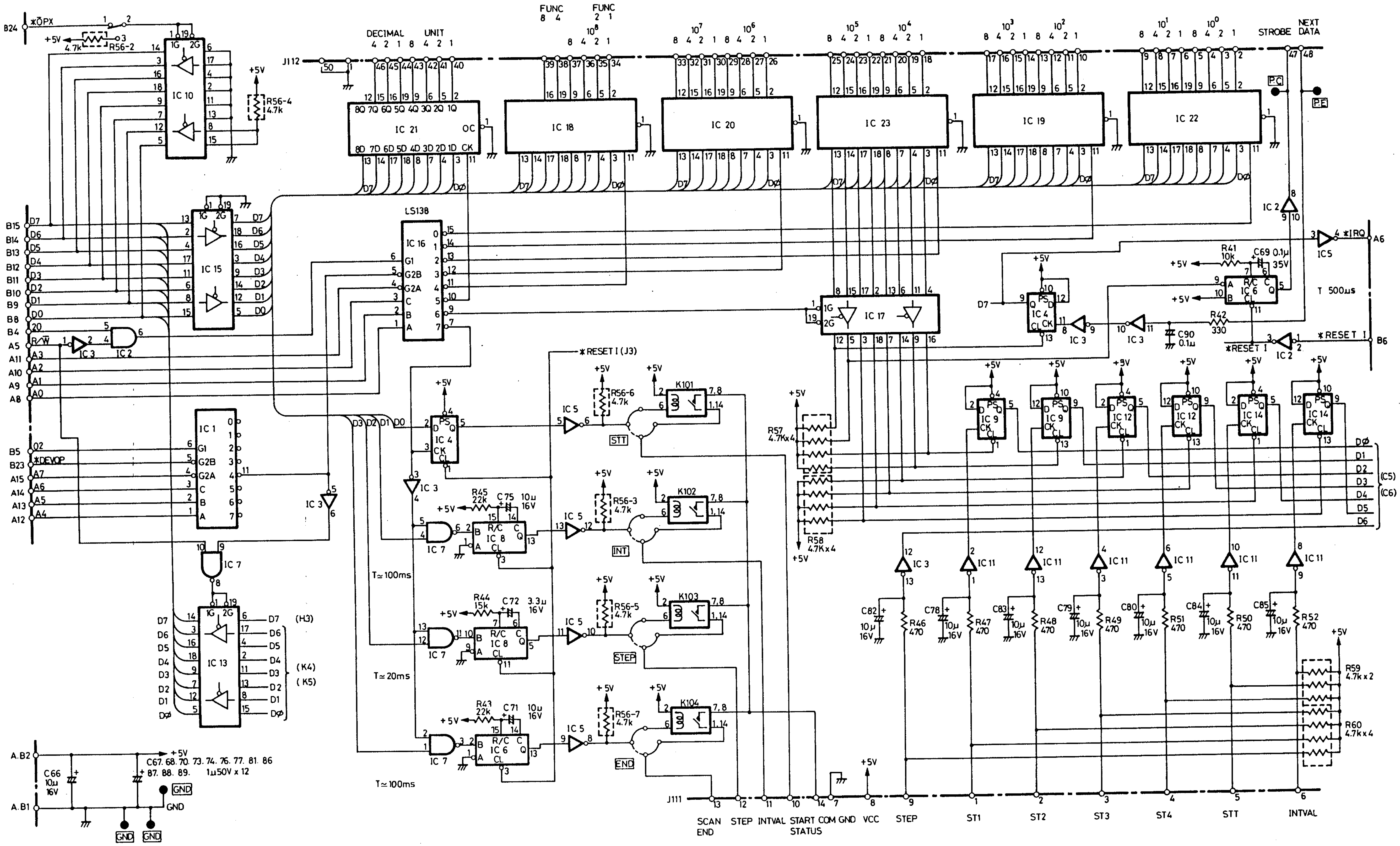


0016402-013-D

TR2730 - 510

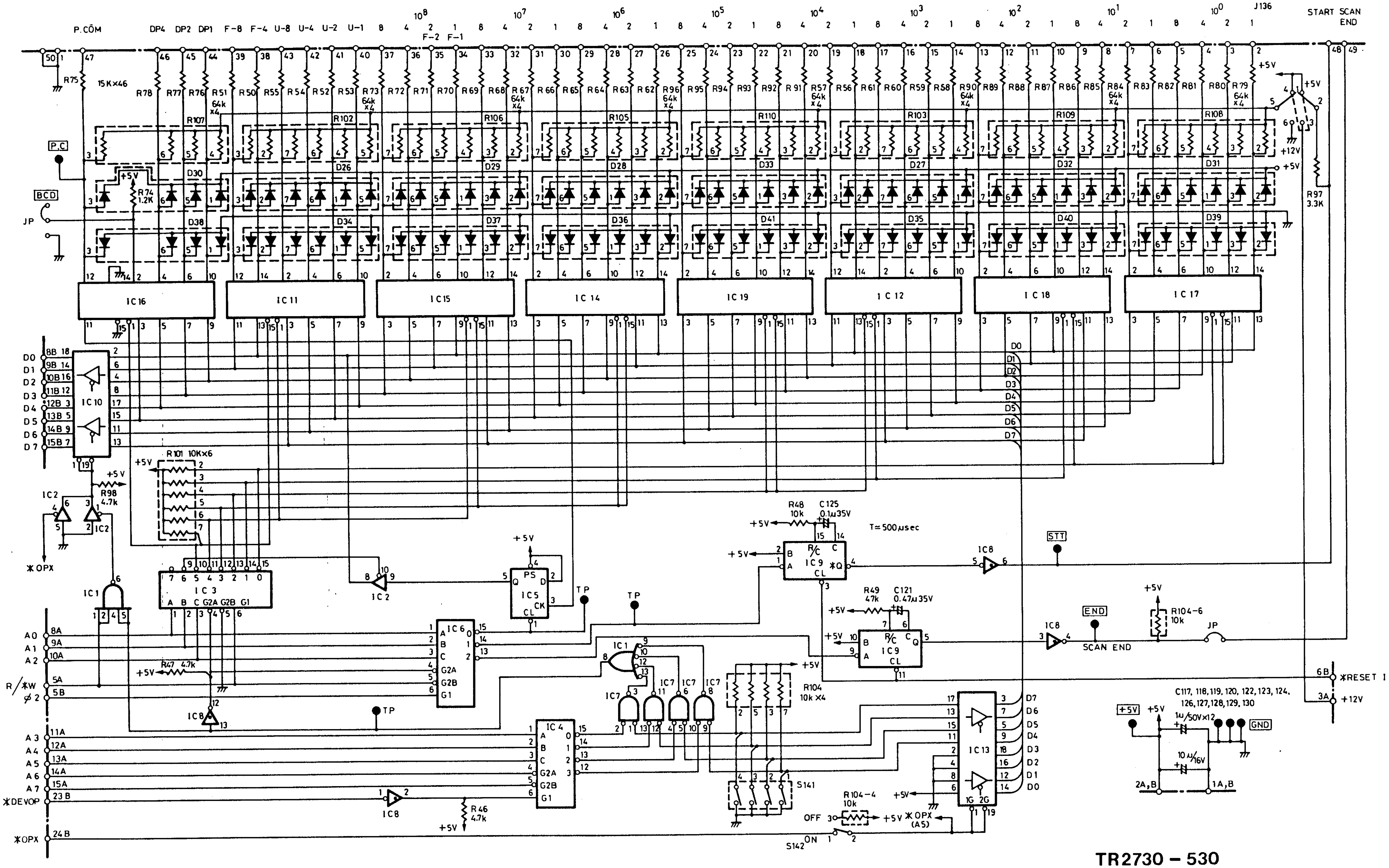
GP - IB

BGJ - 010170



TR2730 — 520
BCD OUTPUT
BGJ — 010171

0016209 — 014 — A

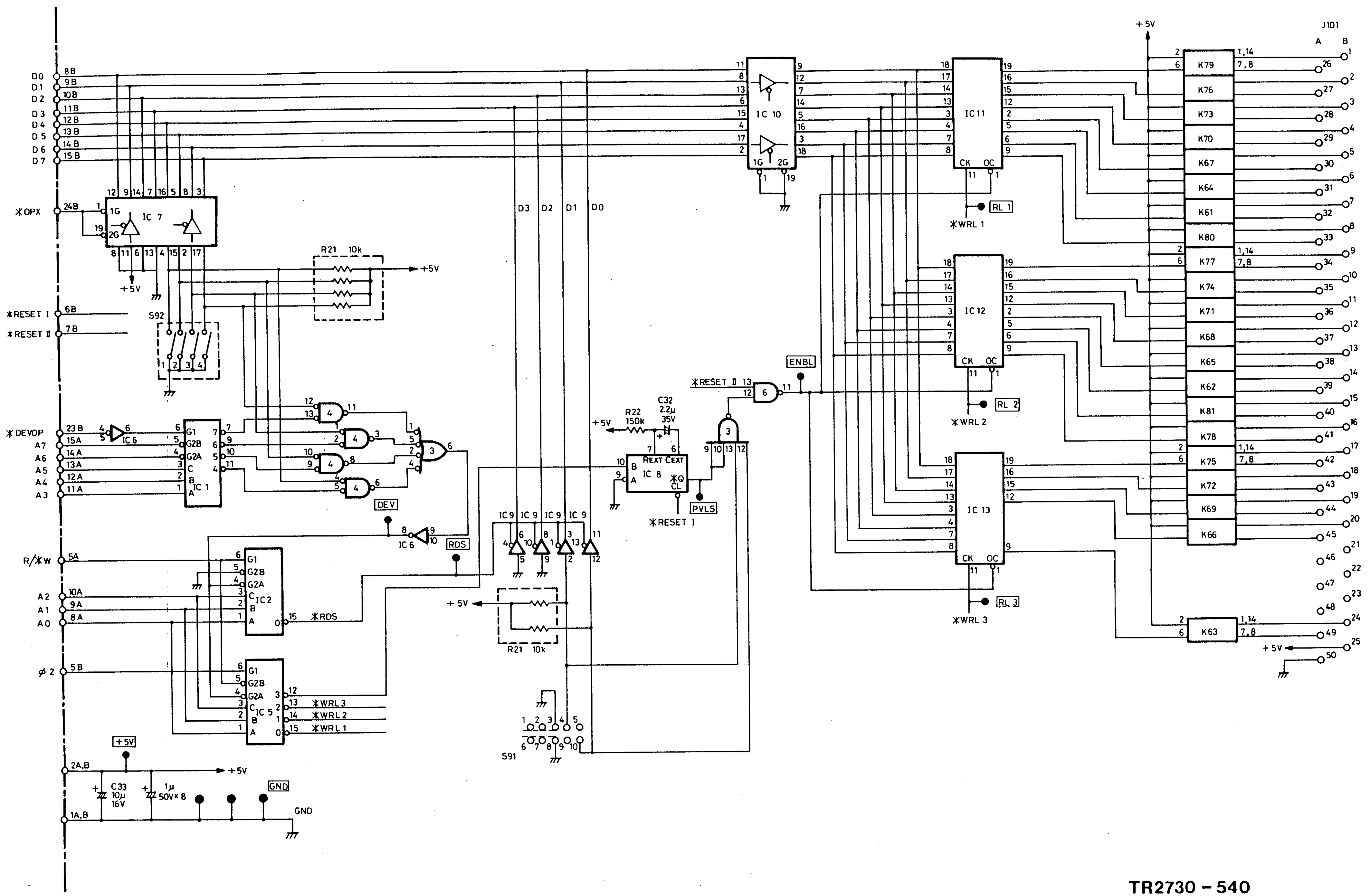


TR2730 – 530

BCD INPUT

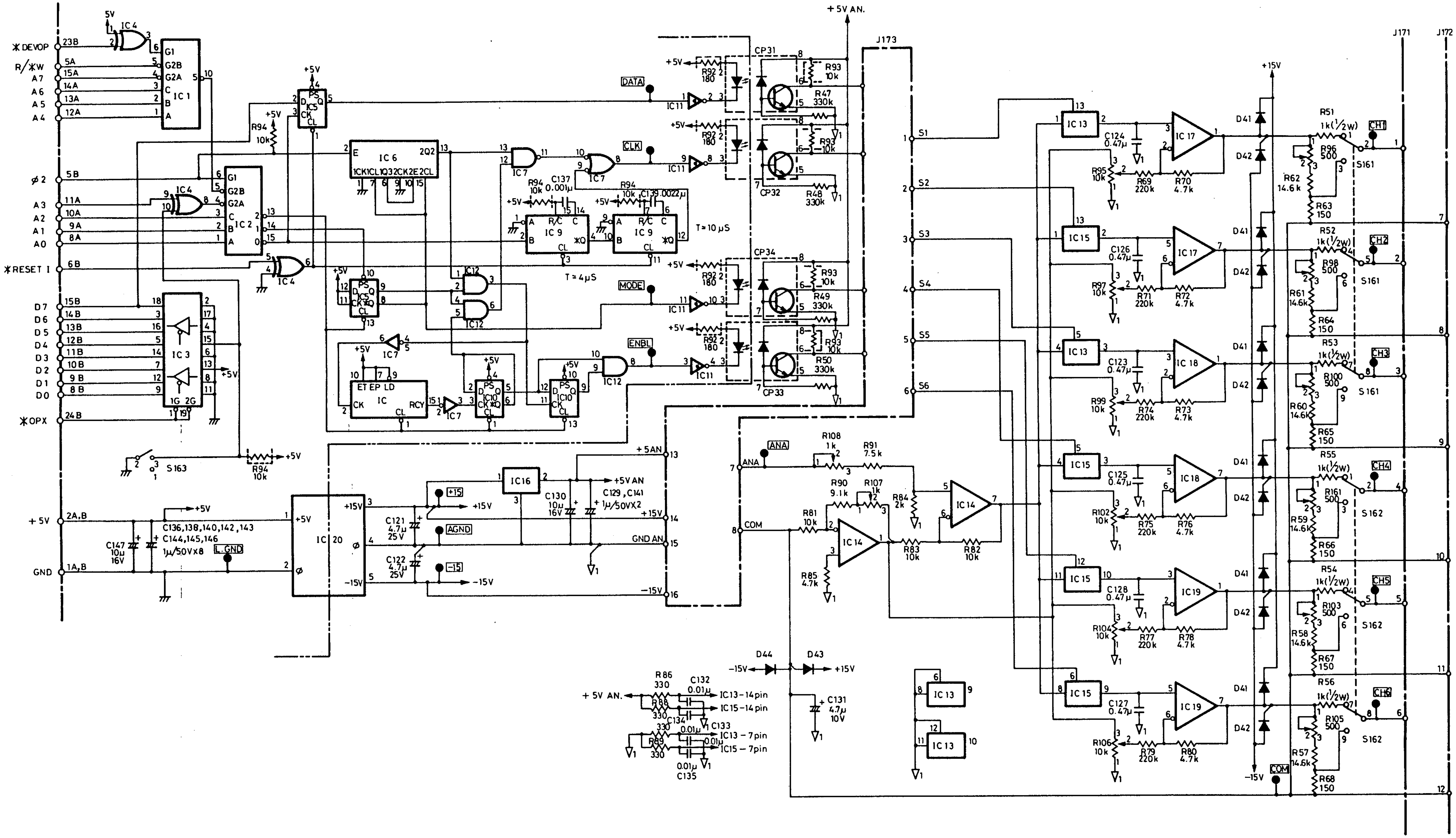
BGJ – 010172

0016209–015–A



TR2730 - 540
RELAY OUTPUT
BGJ - 010173

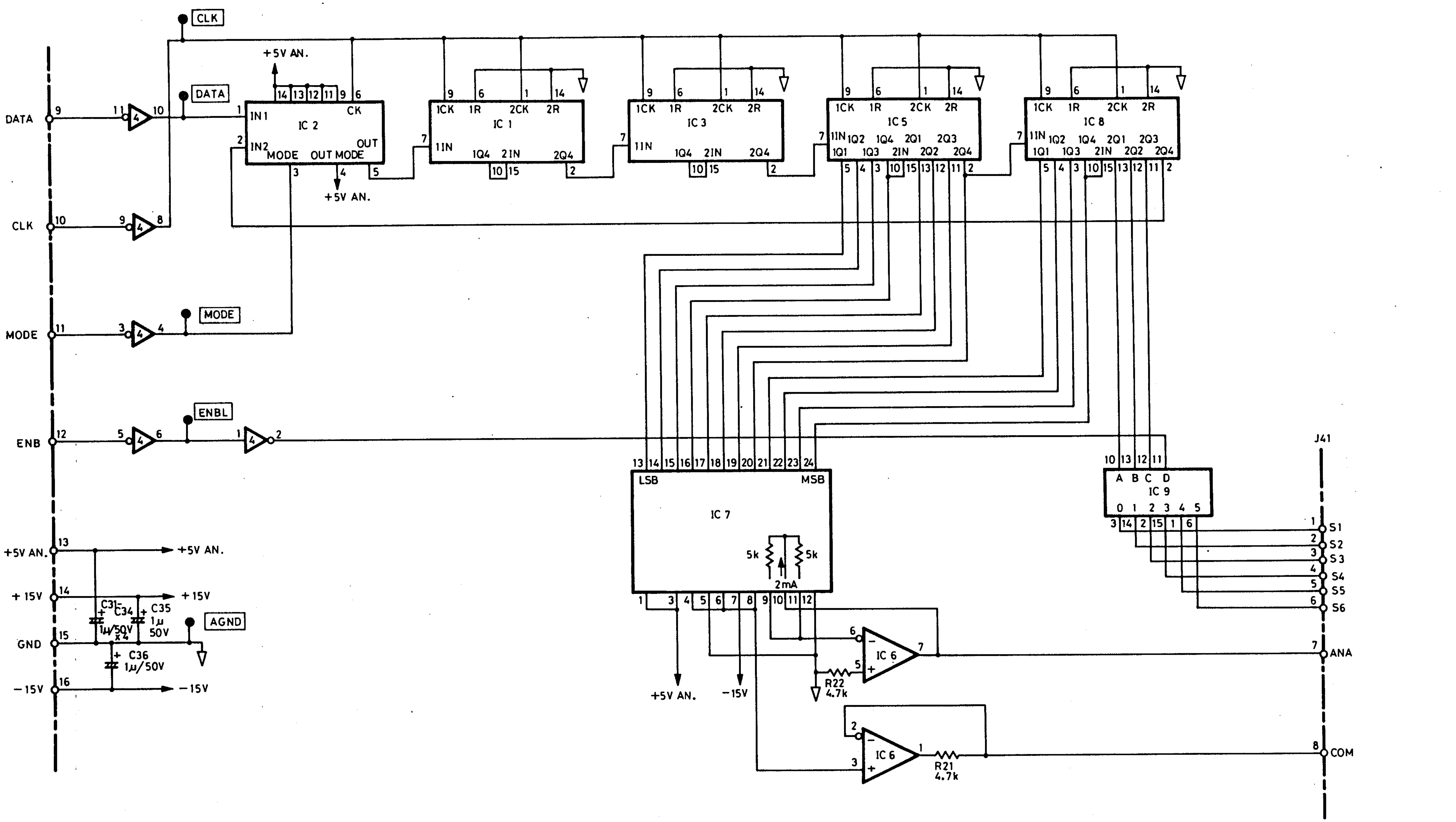
0016209-016-A



0016209-017-A

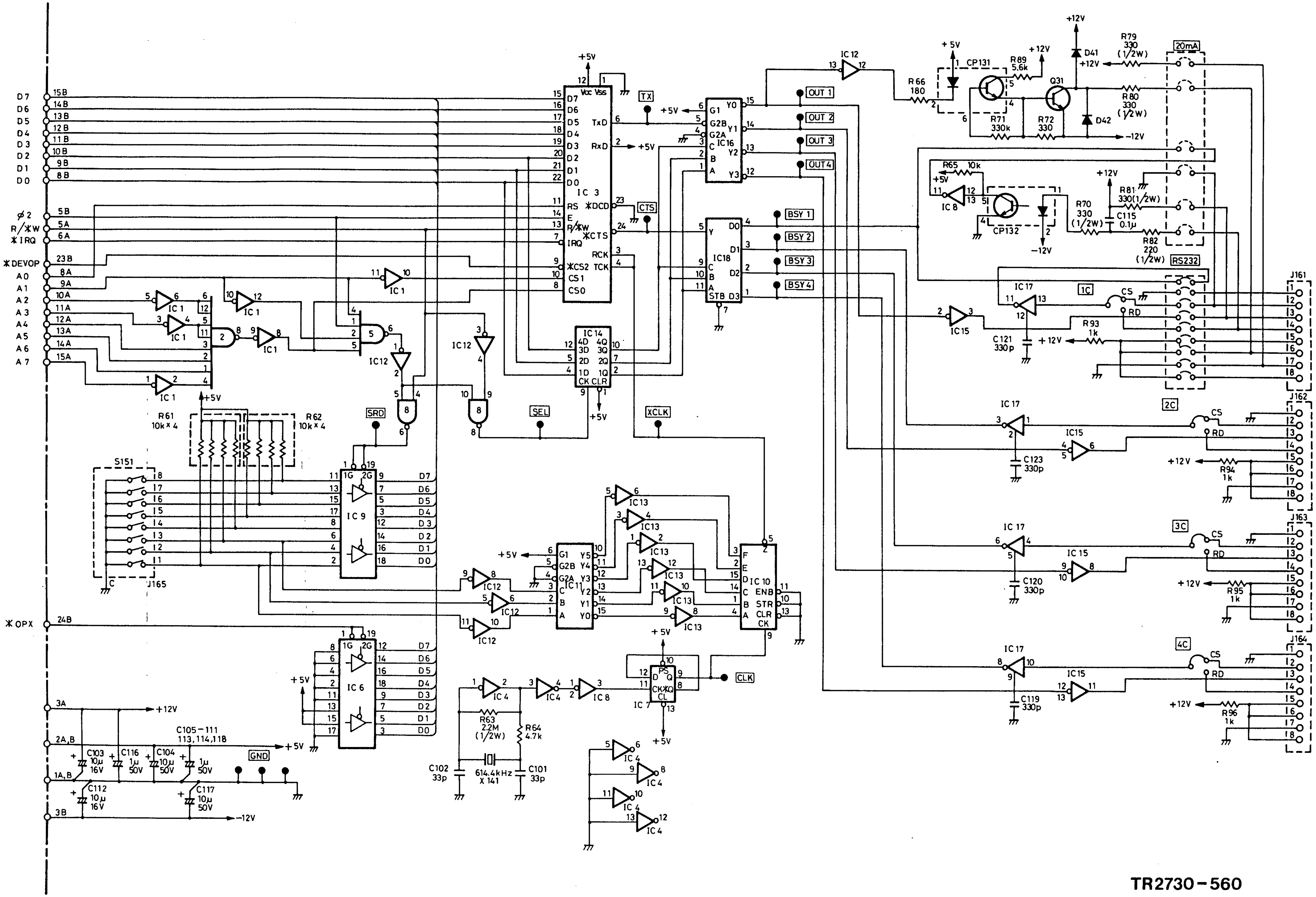
TR2730-550
ANALOG OUTPUT I
BGJ-010174

31



TR2730-550
ANALOG OUTPUT II
BLB-010175

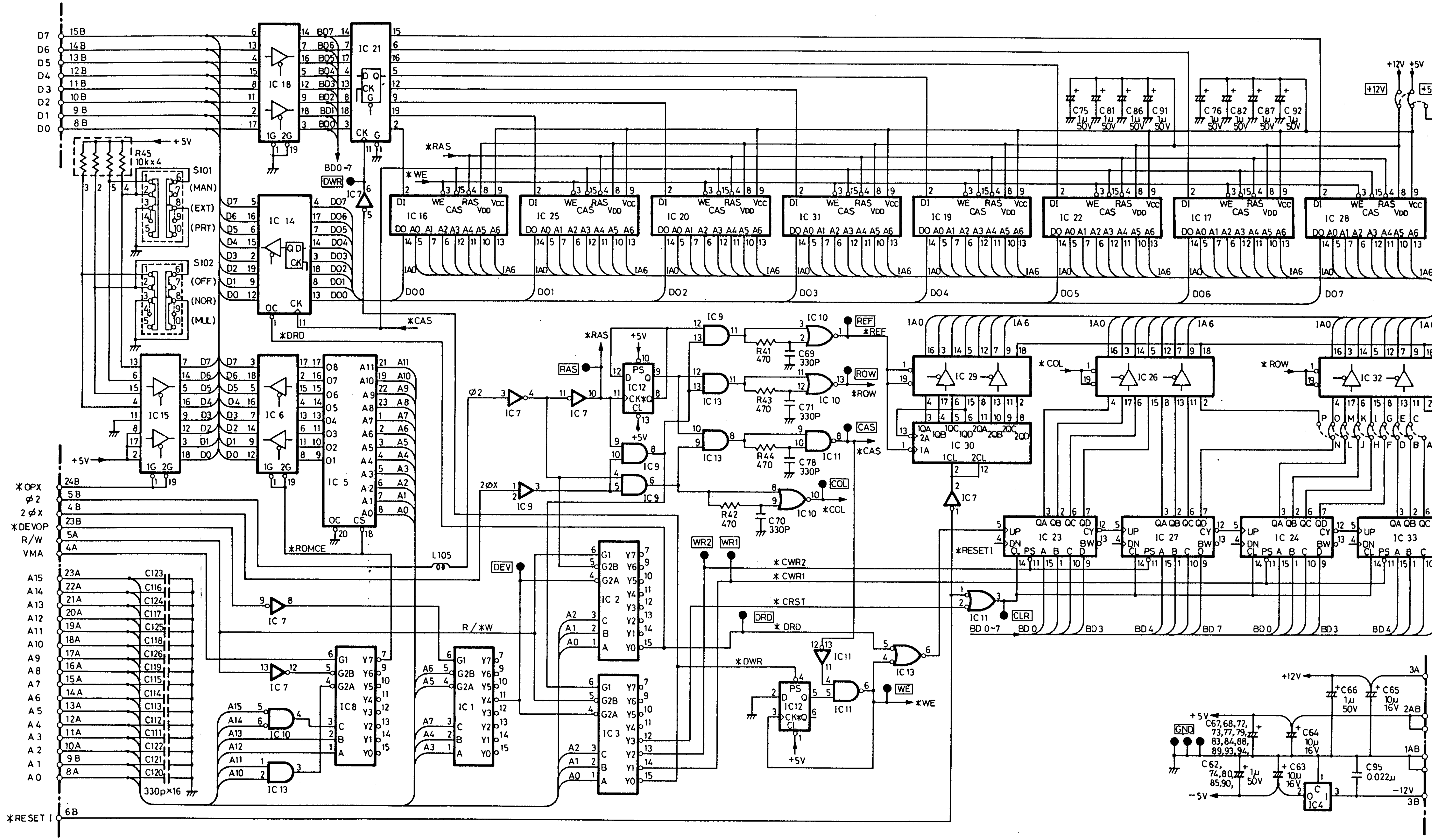
0016209-018-A



TR2730 – 560
SERIAL OUTPUT
BGJ – 010176

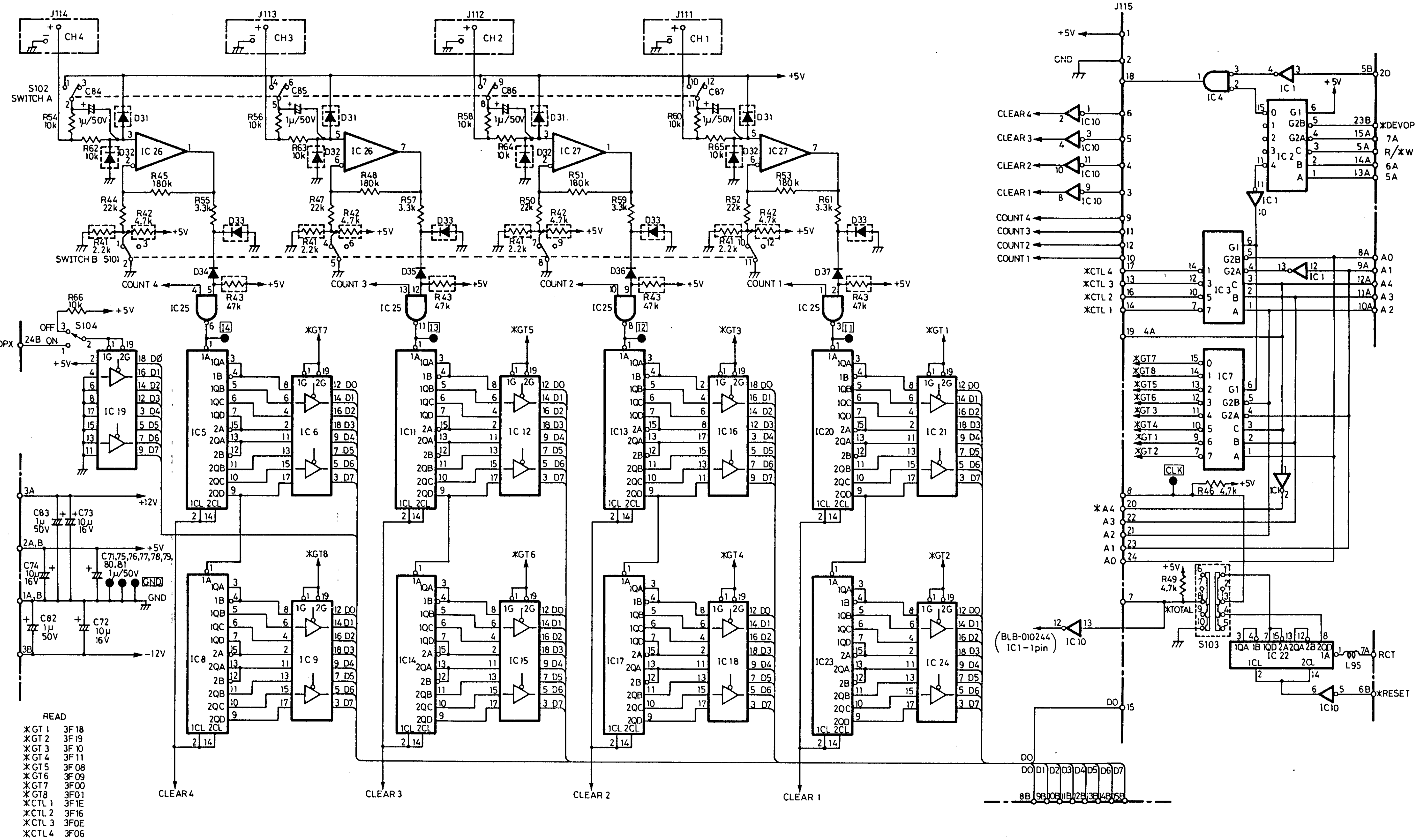
0016310 – 019 – B

33



0016312-021-B

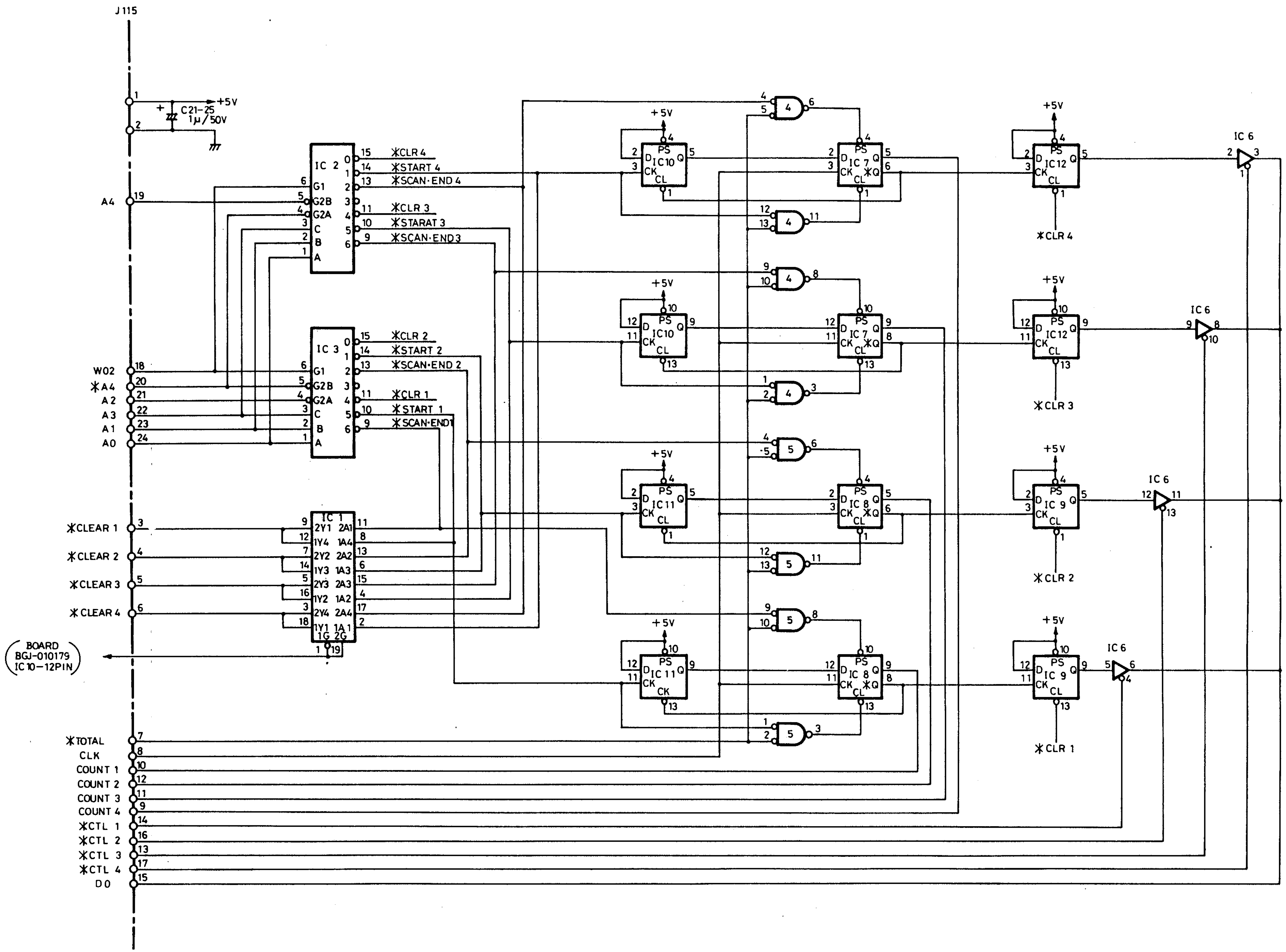
TR2730-570
DATA MEMORY
BGJ-010178



0016312 -022- B

TR2730-580
PULSE COUNTER I
BGJ-010179

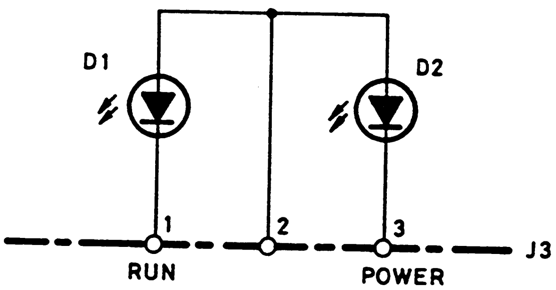
35



0016209-023-A

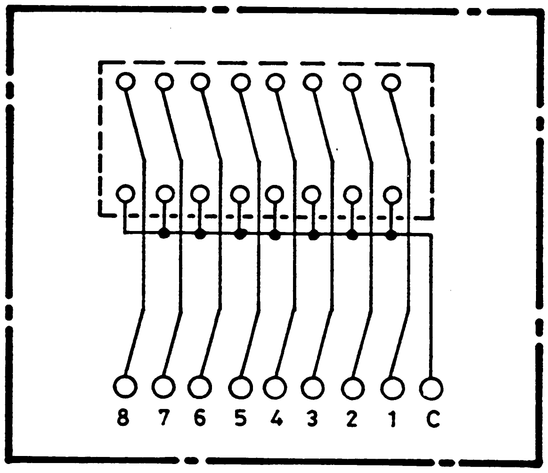
TR2730-580
PULSE COUNTER II
BLB-010244

36



0017209-015-A

TR2741A/B/C/D/E
LED ASSEMBLY
BKB-010167



TR2730-560
SW BOARD

0016209-020-A

APPENDIX

ABBREVIATION LIST

(1) Panel printed letters

Abbreviation	Function	Description
ALM DATA	Alarm Data	Selects Alarm Print mode.
ALPHA.	Alphabet	Specifies uppercase and lowercase alphabetic character and special characters and symbols.
AV	Average	Specifies the primary arithmetic operation (average of specified number of scan data) or secondary arithmetic operation (average of channels in the specified group).
AUX.FUNCTION	Auxiliary Function	Specifies alarm comments or secondary arithmetic operations.
SCAN CH.	Scan Channel	Specifies the input channel range for log scan.
CALL CH.	Call Channel	Specifies the single channel continuous display mode.
GND	Ground	Ground terminal
LOG INTL	Log Interval	Specifies data logging conditions such as interval mode or interval time for log scan.
MONIT.INTL	Monitor Interval	Specifies interval time for monitor scan.
MULT.INTL	Multiple Interval	Specifies the multi-interval mode and output data for each interval channel group after storing data, when the TR2730-570 option card is used.
NORM.	Normal	Outputs data in the scan order while storing input data, when the TR2730-570 option card is used.
MX	Maximum	Specifies the primary arithmetic operation (maximum of the specified number of scan data) or secondary arithmetic operation (maximum of the specified group).
MN	Minimum	Specifies the primary arithmetic operation (minimum of the specified number of scan data) or secondary arithmetic operation (minimum of the specified group).
TL	Total	Specifies the total of the specified number of scan data for primary arithmetic operation.

Abbreviation	Function	Description
ΔN		Specifies inter-channel difference computation for the primary arithmetic operation.
ΔI		Specifies differences computation from the initial value for the primary arithmetic operation.
Δt		Specifies the difference computation from the preceding measurement data for the primary arithmetic operation.

(2) Display characters

Abbreviation	Function	Description
AVE	Average mode	a. Indicates that the input average mode is specified for the Filter function of the SCAN FORMAT.
	Average	b. Indicates that the average of the specified number of scan data is specified for the primary arithmetic operation.
Ave	Average	Indicates that the average of the channels in the specified group (logged at the same time) is specified for the secondary arithmetic operation.
all	all channel scan	Indicates that the interval mode is set to All Channel Scan mode during MONIT. INTL programming.
COMP ERR	Computing Error	Indicates that a computation error is generated in TR2731.
c	column	Analog output digit select code
d	day	Day
Dev	Deviation	Indicates that deviation computation is specified for the secondary arithmetic operation.
DIV	Division	Indicates that division computation is specified for the secondary arithmetic operation.
DLY	Delay mode	Indicates that the delay mode is selected for the Filter function.
ETC ERR	Etcetera Error	Indicates that measurement is attempted in an uncalibrated fange.

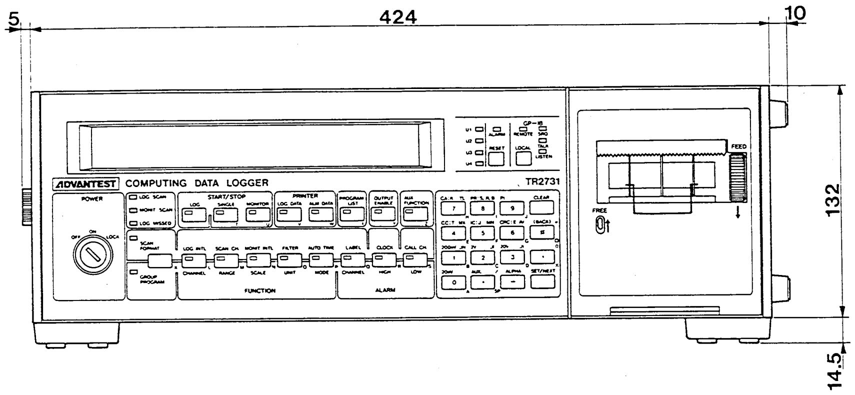
Abbreviation	Function	Description
ext	External Interval Junction	Indicates that the interval mode is set to the External Interval mode during LOG INTL programming.
FIL	Filter	Indicates that the Filter mode is selected.
G	Group Channel	Indicates group channel programming enabled.
h	hour	Hour
int	Internal Reference Junction	Indicates that the internal reference junction compensation is specified for a thermocouple range.
LBL	Label	Indicates label programming enabled.
LNR ERR	Linearize Error	Indicates that the data is outside the linearization capability range.
log	log scan mode	Indicates that the log scan is specified as the object to be compared during ALARM group channel programming.
LOW BAT.	Low Battery	Indicates that the internal battery requires recharging.
MAX	Maximum	Indicates that the maximum of the specified number of scan data is specified for the primary arithmetic operation.
Max	Maximum	Indicates that the maximum of the channels in the specified group is specified for the secondary arithmetic operation.
MIN	Minimum	Indicates that the minimum of the specified number of scan data is specified for the primary arithmetic operation.
Min	Minimum	Indicates that the minimum of the channels in the specified group is specified for the secondary arithmetic operation.
mPi(M)	Multiple interval mode	Indicates that the Multi-interval is selected for the interval mode during LOG INTL programming. "M" denotes the Multi-interval mode.
M	Monitor Channel	Indicates that monitor channel number settings is enabled for MONIT. INTL programming.
m	minute	Minute
mon	monitor scan mode	Indicates that the monitor scan is selected as the object to be compared during ALARM group channel programming.
MUL	Multiplication	Indicates that multiplication computation is specified for the second ary arithmetic operation.

Abbreviation	Function	Description
m/L	monitor/log scan mode	Indicates that the scan mode is selected, during ALARM group channel programming, in which limit identification is performed during monitor scan and, if a limit error is detected, log scan is automatically started from that point.
N		Multiple
P-P	peak to peak	Indicates that the difference computation between the maximum and minimum in the specified group is specified for the secondary arithmetic operation.
RJC ERR	Reference Junction Error	Indicates that the temperature is outside the room temperature compensation capability range.
S	second	Second
SEL	selective channel scan	Indicates that the selective channel scan mode is selected during MONIT. INTL programming.
SgL	single interval mode	Indicates that the interval mode is set to Single Interval mode during LOG INTL programming.
SD	Standard Deviation	Indicates that the standard deviation computation in the specified group is specified for the secondary arithmetic operation.
SP	Stop	Indicates the measurement end time for AUTO TIME programming.
ST	Start	Indicates the measurement start time for AUTO TIME programming.
SUB	Subtraction	Indicates that subtraction computation from the specified channel is specified for the secondary arithmetic operation.
TTL	Total	Indicates that the total computation of the specified number of scan data is specified for the primary arithmetic operation.
t		Indicates that the timer mode is specified for CLOCK programming.
var (V)	Variable interval mode	Indicates that the interval mode is set to the Variable Interval mode during LOG INTL programming. "V" denotes the Variable Interval mode.
ΔN ΔI Δt		Indicates that the inter-channel difference (ΔN), difference from the initial value (ΔI), and difference from the preceding data (Δt) computations are specified for the primary arithmetic operation.

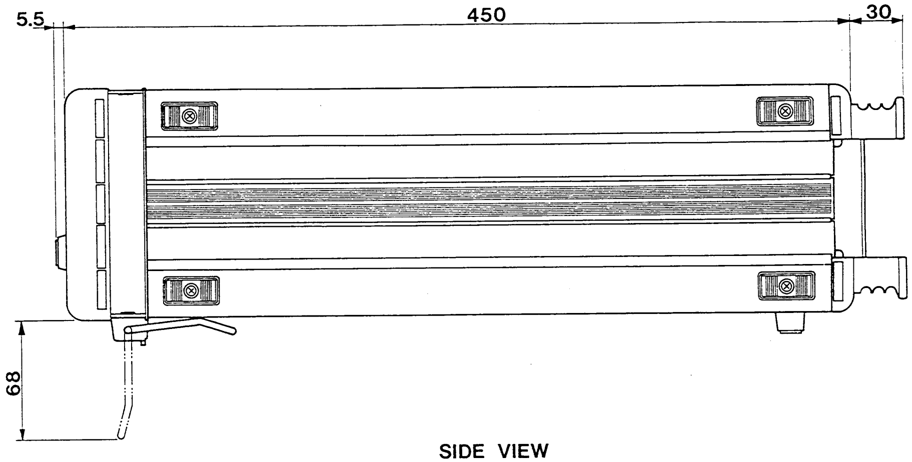
(3) Printer characters

Abbreviation	Function	Description
AV	Average	Indicates the computation results for the primary arithmetic operation (average of the specified number of scan data) or secondary arithmetic operation (average of the channels in the specified group).
DE	Deviation	Indicates that the deviation computation in the specified group is specified for the secondary arithmetic operation.
DV	Division	Indicates the division computation is specified for the secondary arithmetic operation.
H	High	Indicates that an upper limit error is generated in the ALARM programming.
L	Low	Indicates that a lower limit error is generated in the ALARM programming.
ML	Multiplication	Indicates that multiplication computation is specified for the secondary arithmetic operation.
MX	Maximum	Indicates the computation results for the primary arithmetic operation (maximum of the specified number of scan data) or secondary arithmetic operation (maximum of the channels in the specified group).
MN	Minimum	Indicates the computation results for the primary arithmetic operation (minimum of the specified number of scan data) or secondary arithmetic operation (minimum of the channels in the specified group).
PP	Peak to Peak	Indicates that the difference computation between the maximum and minimum in the specified group (logged at the same time) is specified for the secondary arithmetic operation.
SB	Subtraction	Indicates that subtraction computation is specified for the secondary arithmetic operation.
SD	Standard Deviation	Indicates that the standard deviation computation within the specified group (logged at the same time) is specified for the secondary arithmetic operation.
TL	Total	Indicates that the total computation of the specified number of scan data is specified for the primary arithmetic operation.

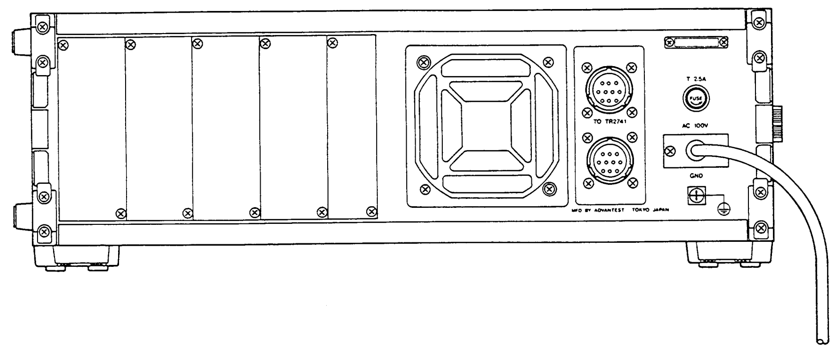
Abbreviation	Function	Description
ΔN Δi Δt		Indicates that inter-channel difference (ΔN), difference from the initial value (ΔI), and difference from the preceding data (Δt) computations are specified for the primary arithmetic operation.



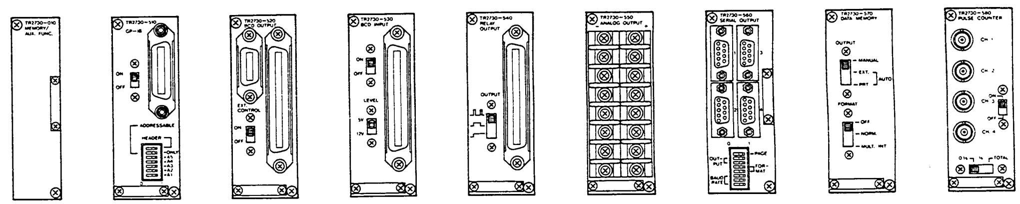
FRONT VIEW



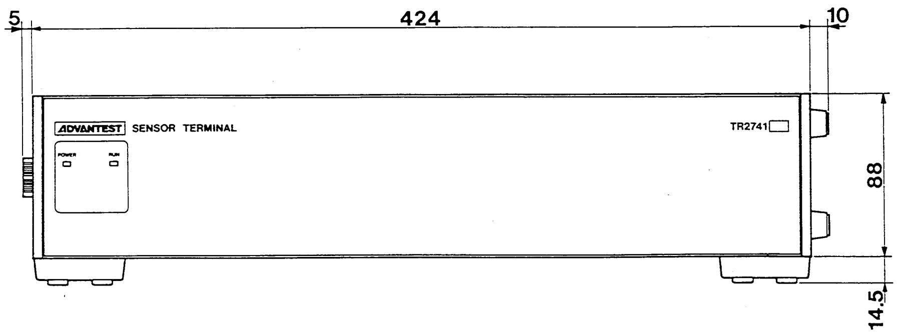
SIDE VIEW



REAR VIEW



TR2731
EXTERNAL VIEW



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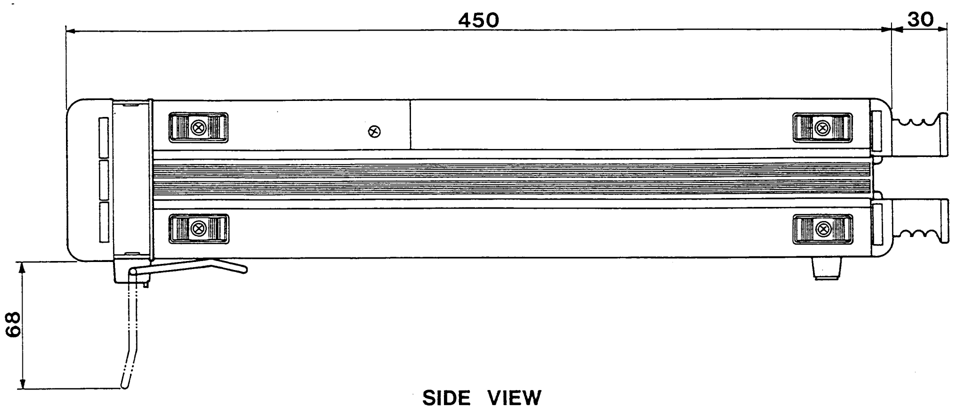

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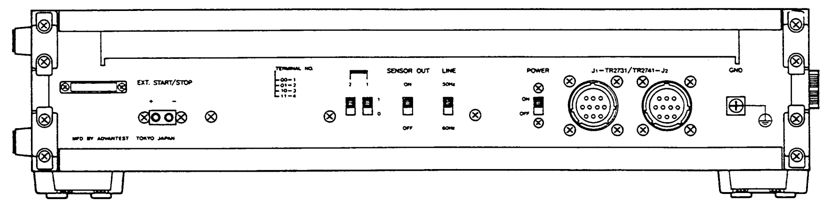

REAR VIEW

TR2741
EXTERNAL VIEW