7210

Scanner

Operation Manual

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Safety Summary

To ensure thorough understanding of all functions and to ensure efficient use of this instrument, please read the manual carefully before using. Note that ADC Corporation (hereafter referred to as ADC) bears absolutely no responsibility for the result of operations caused due to incorrect or inappropriate use of this instrument.

If the equipment is used in a manner not specified by ADC, the protection provided by the equipment may be impaired.

- **Warning Labels**

  Warning labels are applied to ADC products in locations where specific dangers exist. Pay careful attention to these labels during handling. Do not remove or tear these labels. If you have any questions regarding warning labels, please ask your nearest ADC dealer. Our address and phone number are listed at the end of this manual.

  Symbols of those warning labels are shown below together with their meaning.

  DANGER: Indicates an imminently hazardous situation which will result in death or serious personal injury.

  WARNING: Indicates a potentially hazardous situation which will result in death or serious personal injury.

  CAUTION: Indicates a potentially hazardous situation which will result in personal injury or a damage to property including the product.

- **Basic Precautions**

  Please observe the following precautions to prevent fire, burn, electric shock, and personal injury.

  - Use a power cable rated for the voltage in question. Be sure however to use a power cable conforming to safety standards of your nation when using a product overseas.
  - When inserting the plug into the electrical outlet, first turn the power switch OFF and then insert the plug as far as it will go.
  - When removing the plug from the electrical outlet, first turn the power switch OFF and then pull it out by gripping the plug. Do not pull on the power cable itself. Make sure your hands are dry at this time.
  - Before turning on the power, be sure to check that the supply voltage matches the voltage requirements of the instrument.
  - Connect the power cable to a power outlet that is connected to a protected ground terminal. Grounding will be defeated if you use an extension cord which does not include a protective conductor terminal.
  - Be sure to use fuses rated for the voltage in question.
  - Do not use this instrument with the case open.
  - Do not place anything on the product and do not apply excessive pressure to the product. Also, do not place flower pots or other containers containing liquid such as chemicals near this

product.

- When the product has ventilation outlets, do not stick or drop metal or easily flammable objects into the ventilation outlets.
- When using the product on a cart, fix it with belts to avoid its drop.
- When connecting the product to peripheral equipment, turn the power off.

- **Caution Symbols Used Within this Manual**

Symbols indicating items requiring caution which are used in this manual are shown below together with their meaning.

DANGER: Indicates an item where there is a danger of serious personal injury (death or serious injury).

WARNING: Indicates an item relating to personal safety or health.

CAUTION: Indicates an item relating to possible damage to the product or instrument or relating to a restriction on operation.

- **Safety Marks on the Product**

The following safety marks can be found on ADC products.

 : ATTENTION - Refer to manual.

 : Protective ground (earth) terminal.

 : DANGER - High voltage.

 : CAUTION - Risk of electric shock.

- **Replacing Parts with Limited Life**

The following parts used in the instrument are main parts with limited life.
Replace the parts listed below before their expected lifespan has expired to maintain the performance and function of the instrument.
Note that the estimated lifespan for the parts listed below may be shortened by factors such as the environment where the instrument is stored or used, and how often the instrument is used.
The parts inside are not user-replaceable. For a part replacement, please contact the ADC sales office for servicing.

Each product may use parts with limited life.
For more information, refer to the section in this document where the parts with limited life are described.

Main Parts with Limited Life

Part name	Life
Unit power supply	5 years
Fan motor	5 years
Electrolytic capacitor	5 years
LCD display	6 years
LCD backlight	2.5 years
Floppy disk drive	5 years
Memory backup battery	5 years

- **Hard Disk Mounted Products**

The operational warnings are listed below.

- Do not move, shock and vibrate the product while the power is turned on.
  Reading or writing data in the hard disk unit is performed with the memory disk turning at a high speed. It is a very delicate process.

- Store and operate the products under the following environmental conditions.
  An area with no sudden temperature changes.
  An area away from shock or vibrations.
  An area free from moisture, dirt, or dust.
  An area away from magnets or an instrument which generates a magnetic field.

- Make back-ups of important data.
  The data stored in the disk may become damaged if the product is mishandled. The hard disc has a limited life span which depends on the operational conditions. Note that there is no guarantee for any loss of data.

- **Precautions when Disposing of this Instrument**

When disposing of harmful substances, be sure dispose of them properly with abiding by the state-provided law.

Harmful substances: (1) PCB (polycarbon biphenyl)
(2) Mercury
(3) Ni-Cd (nickel cadmium)
(4) Other
Items possessing cyan, organic phosphorous and hexadic chromium and items which may leak cadmium or arsenic (excluding lead in solder).

Example: fluorescent tubes, batteries

Environmental Conditions

This instrument should be only be used in an area which satisfies the following conditions:

- An area free from corrosive gas
- An area away from direct sunlight
- A dust-free area
- An area free from vibrations
- Altitude of up to 2000 m

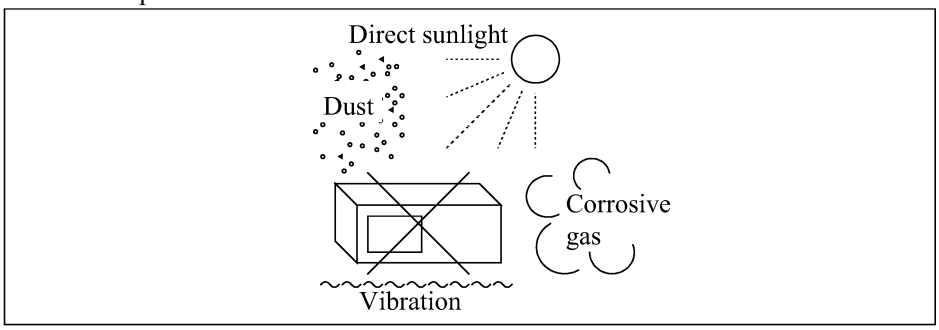


Figure-1 Environmental Conditions

- Operating position

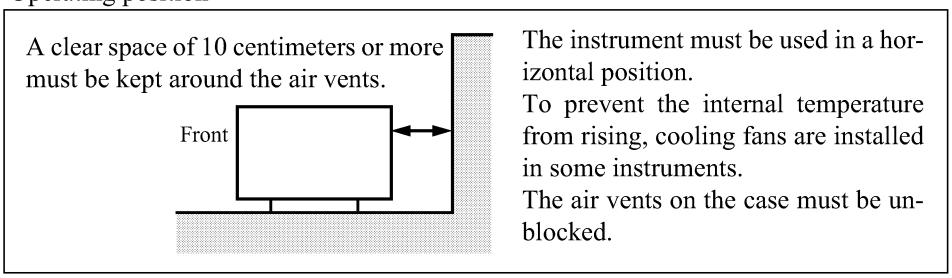


Figure-2 Operating Position

- Storage position

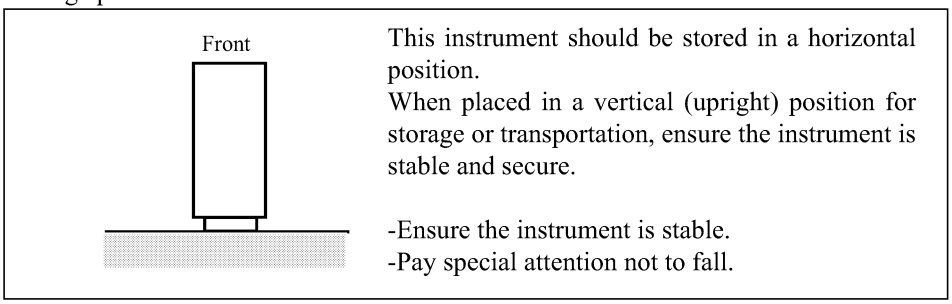


Figure-3 Storage Position

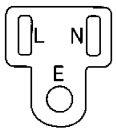
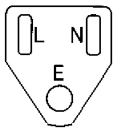
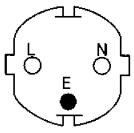
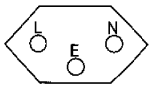
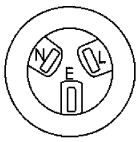
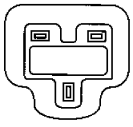
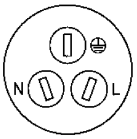
- The classification of the transient over-voltage, which exists typically in the main power supply, and the pollution degree is defined by IEC61010-1 and described below.

  Impulse withstand voltage (over-voltage) category II defined by IEC60364-4-443

  Pollution Degree 2

Types of Power Cable

Replace any references to the power cable type, according to the following table, with the appropriate power cable type for your country.

Plug configuration	Standards	Rating, color and length	Model number (Option number)
	PSE: Japan Electrical Appliance and Material Safety Law	125 V at 7 A Black 2 m (6 ft)	Straight: A01402 Angled: A01412
	UL: United States of America CSA: Canada	125 V at 7 A Black 2 m (6 ft)	Straight: A01403 (Option 95) Angled: A01413
	CEE: Europe DEMKO: Denmark NEMKO: Norway VDE: Germany KEMA: The Netherlands CEBEC: Belgium OVE: Austria FIMKO: Finland SEMKO: Sweden	250 V at 6 A Gray 2 m (6 ft)	Straight: A01404 (Option 96) Angled: A01414
	SEV: Switzerland	250 V at 6 A Gray 2 m (6 ft)	Straight: A01405 (Option 97) Angled: A01415
	SAA: Australia, New Zealand	250 V at 6 A Gray 2 m (6 ft)	Straight: A01406 (Option 98) Angled: ---------
	BS: United Kingdom	250 V at 6 A Black 2 m (6 ft)	Straight: A01407 (Option 99) Angled: A01417
	CCC:China	250 V at 10 A Black 2 m (6 ft)	Straight: A114009 (Option 94) Angled: A114109

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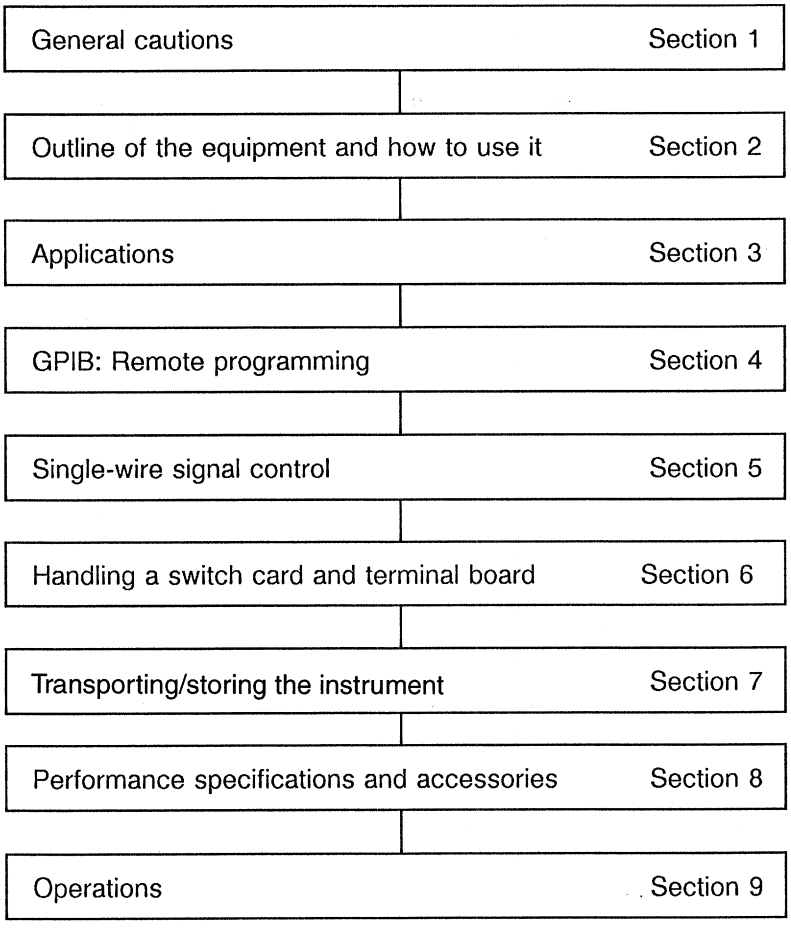
1. INTRODUCTION

This section explains how to use your operating manual, outlines the functions of the instruction, and gives general cautions and preparations for using the equipment for measurement work. Please read this section before starting your measurement work without fail.

1.1 How to Use This Manual

This operating manual gives a step-by-step explanation of the instruction in the following manner so that even those who are not familiarized with this type of measurement instrument will be able to use a wealth of functions provided by the scanner. If you are already familiarized with a scanner, you can use this machine only by reading "2.1 Parcel" and "Section 3 Applications".



1.2 7210 Product Outline and Its Configuration

1.2.1 Product Outline

The instruction is a scanner with a GPIB remote control capability, together with a variety of switching functions and 16-bit digital input/output functions.

There are four types of switching card (multiplexer, actuator, matrix, and transfer). A universal card is also available, which can be incorporated freely by the user.

The group of switching cards includes those for a high voltage to those with low-heat-generation electromotive force to provide for switching at various levels.

The built-in microprocessor makes possible both manual control by switch settings on the panel and programmable control by means of remote signals (GPIB) from an external controller.

- Types of switch card: Multiplexer, actuator, matrix, and transfer
- Max. No. of cards that can be stored: 5 cards
- Max. No. of channels: 50 channels
- Access, channel indication, condition setting: 10-digit display
- Trigger output signal, busy output signal, channel advance signal and start/stop input signal: These are available for input/output.
- Programming: Up to 100 steps
- Provision of a GPIB controller (complete remote control)
- Self-diagnostic functions to check the built-in ROM, RAM, panel LED and switch cards
- Provision of 16-bit digital input/output functions

1.2.2 Configuration

Main unit	7210 scanner
Switch card	72101A multiplexer (General use) 72101B multiplexer (General use) 72101C multiplexer (Long life, high voltage, 10 CH) R72101D multiplexer (Low-heat-generation electromotive force) 72101E multiplexer (High insulation resistance) 72101G multiplexer (Long life, high voltage, 10 CH) 72101H multiplexer (Long life, high voltage, 20 CH) 72101J multiplexer (For very small current) 72102A actuator (For general use) 72102C actuator (Long life, high voltage, 10 CH) 72102H actuator (Long life, high voltage, 20 CH) 72103A matrix (For general use) 72103B matrix (For general use) 72103C matrix (Long life, high voltage) 72104 universal 72106A transfer contact (General use)
Terminal board	72109A Input/output terminal card (General use) 72109B Input/output terminal card (High voltage) 72109D Input/output terminal card (with RC filter)

1.3 Before Using the Equipment

1.3.1 Checking the Appearance

Upon acceptance of your equipment, please check it for any damage caused in transit. Please check the switches on the panel in particular.

1.3.2 Checking the Appearances

The following items are provided as the standard appurtenances. Please check their quantities and ratings.

If you have found any damage and/or missing item, contact an ADC CORPORATION sales representative.

Item	Specification	Part code	Quantity	Remarks
Power cable	MP-43A	DCB-DD0717A	1	
Fuse	T0. 315A/250V	DFT-AAR315A	2	For AC 90 to 110V and AC 108 to 132V
	T0. 16A/250V	DFT-AAR16A		For AC 198 to 242V and AC 216 to 250V
Instruction manual	—	J7210	1	Japanese
	—	E7210		English

1.3.3 Power Fuse and Power Supply Voltage

The power fuse and power supply voltage are set at the time of factory shipment based on the specifications ordered. Please check them in the following manner.

(1) Power fuse

To replace the fuse, remove the power cable from the AC line connector beforehand without fail.

The power fuse is held on the fuse holder on the rear panel of the main unit. To replace the fuse, remove the cap of the fuse holder by turning it in the direction opposite to the arrow mark and replace the fuse with a new one of the specified rating.

Table 1-1 Power Fuse Specification

Power supply voltage	Fuse
90-110V	T0. 315A/250V
108-132V	
198-242V	T0. 16A/250V
216-250V	

WARNING

To always protect against fire, use a fuse of the same type and same rating.

(2) Power supply voltage

The power supply voltage is set at the time of factory shipment. It is indicated above the power cable outlet on the rear panel.

The power supply voltage should be AC100V ± 10% (120V, 220V ± 10%, 240V + 4%/ – 10%) with the frequency of 50Hz or 60Hz in the form of a sine curve.

To connect the power supply cable, it is necessary to turn the POWER switch off beforehand without fail.

1.3.4 Power Supply Cable

To connect the power supply cable, it is necessary to turn the POWER switch (provided on the front panel) off beforehand without fail. Connect the attached power supply cable to the AC LINE connector by fitting its concave face to the latter. The plug has three pins, the middle round one is for grounding.

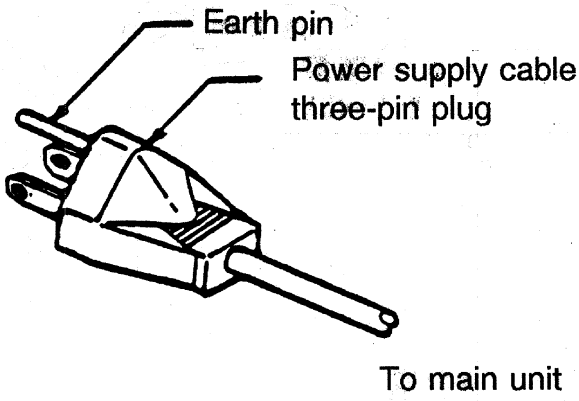


Figure 1-1 Power Cable Plug

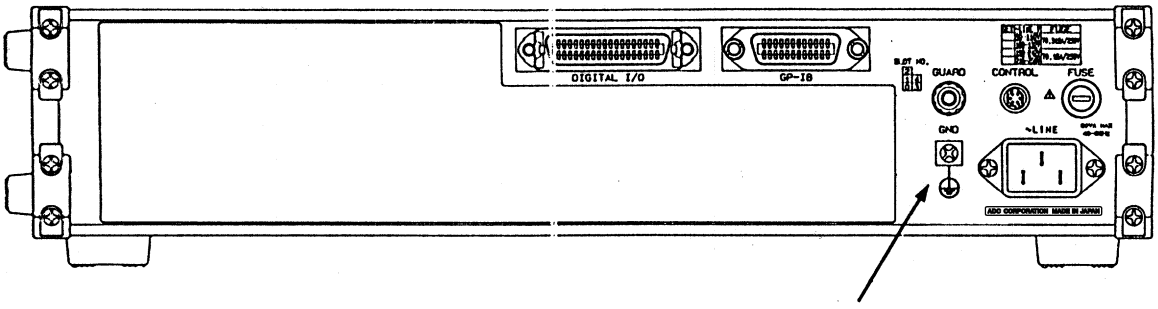


Figure 1-2 GND Terminal (Earth Terminal)

1.3.5 Ambient Environment

(1) Don't use the equipment in a place which is dusty, exposed to the direct rays of the sun or generates corrosive gases. The ambient temperature should be in the range from 0°C to +40°C and humidity 85% or less.

(2) The equipment's design takes AC power supply line noise fully into account. It is, however, recommended to use it in an environment with the lowest possible level of noise. If there is much noise, use a noise filter.

1.3.6 Switch Card

To mount a switch card on the 7210 main unit, it is necessary to turn the POWER switch of the main unit off beforehand without fail.

The switch card and an external device can be connected by using the input/output terminal or card edge connector. Don't apply power to the external device when the POWER switch of the 7210 is off.

Apply power to the external device after turning the POWER switch of the instruction on. Each switch card is in an unstable state when power is not applied to the instruction. Applying power to the external device in this state may cause it and/or the instruction to develop trouble.

1.3.7 Backup Battery Life Expectancy

Turning off the 7210 power causes the current control parameters to be saved. As a result, the same control parameters are set when the 7210 is turned on again.

If the last used control parameters are not set after turning the power on, the battery may need to be replaced.

If this occurs, contact an ADC CORPORATION sales representative.

2. HOW TO OPERATE THE SCANNER

2.1 Panel

See Figure 2-1.

2.1.1 Front Panel

① Power switch

② START/STOP

Used to start and stop scan sequence operations.

③ OPEN switch

Opens all the closed contacts in the switch card.

④ DIRECT switch

Provides direct control of the switch card.

⑤ MEMORY switch

Used to check or change the currently set control parameters.

⑥ Control parameter setting direct access switches

To set a control parameter, press the MEMORY switch and then the appropriate parameter switch to select the desired control parameter to check or change the parameter. In like manner, to access a specific control parameter, press the DIRECT switch and then the appropriate parameter switch to select and perform the desired type of direct access.

⑦ Digital I/O switch

Used to set a digital I/O function.

⑧ CE switch

Used for program/block setting. In the case of direct channel access, clears the data entered.

⑨ Shift switch

Used to reference program data or move the digit of input data.

⑩ DELETE switch

Deletes one character from the data just entered.

⑪ CHANGE switch

Used to set a control parameter or select program data for direct access.

⑫ EXECUTE switch

In the case of direct access, the switch functions as the execute key. In the case of control parameter setting, pressing this key causes the data entered to be stored and the control parameter setting mode to be reset.

⑬ NEXT switch

When the trigger mode is "MN"-MANUAL, this switch is used to advance the scan sequence by one step. In the case of control parameter setting, this switch is used to store the data entered, leaving the status of control parameter setting as is.

⑭ LOCAL switch

This switch is used to interrupt the control of the equipment by GPIB, making panel key input possible.

⑮ GPIB status lamp

⑯ Display

The display comprises 10 digits. The left two digits are a dot matrix LED and the right eight digits a seven-segment LED.

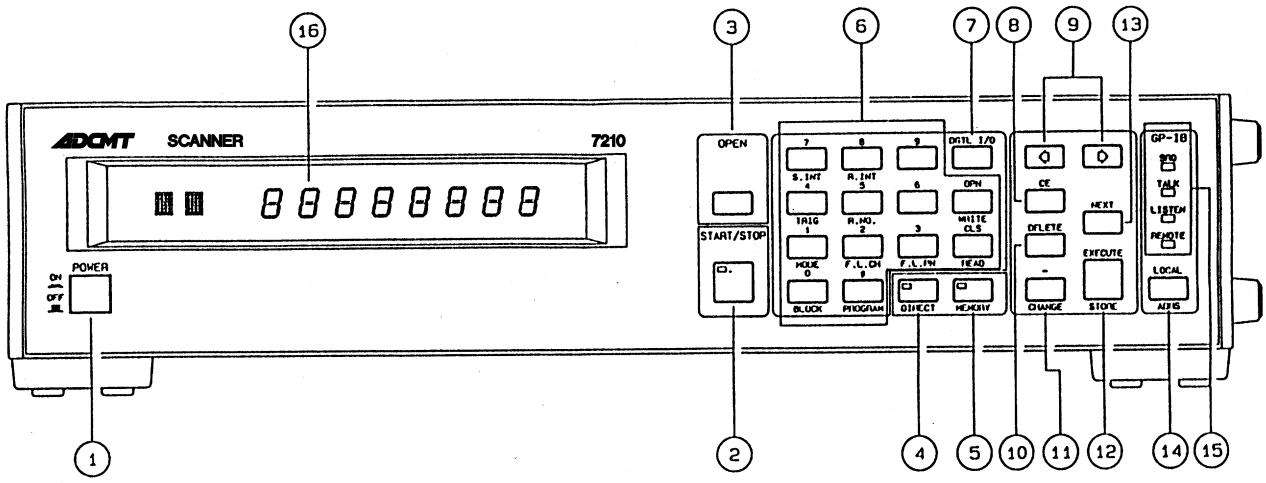


Figure 2-1 Panel

2.1.2 Rear Panel

⑰ Digital I/O connector

⑱ GPIB connector

⑲ GUARD terminal

⑳ Power cable

㉑ Fuse holder

㉒ GND terminal

㉓ CONTROL connector

A six-pin round connector with two input signals and two output signals.

㉔ Switch card and terminal board slots

Used to mound switch cards and terminal boards.

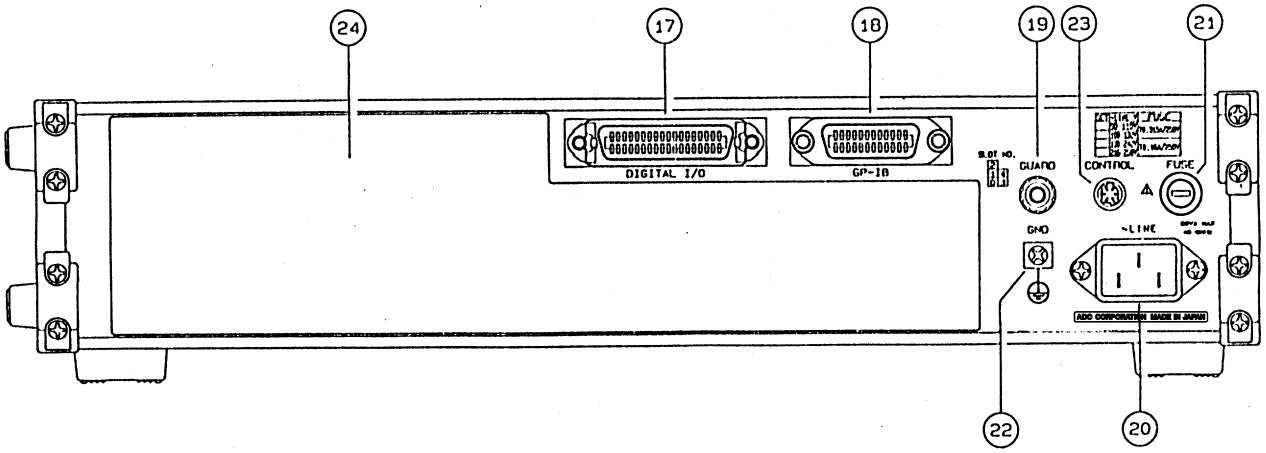


Figure 2-1 Panel (Cont'd)

2.2 Basic Operations

The following are the basic operations to start scanning after applying power to the instruction.

(1) Check that the power supply voltage is the same as the voltage indicated on the rear panel.

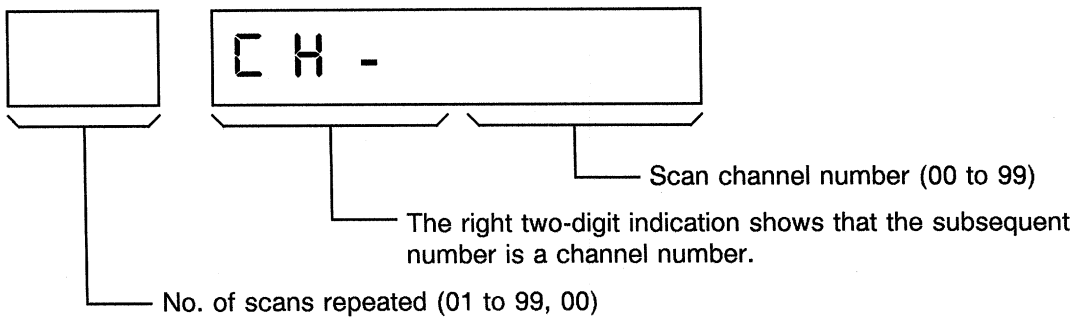
(2) Set the number assigned to the switch cared used and mount the card in the instruction. To connect the switch card and an external device, use the terminal board or the connector. (For the method of mounting a switch card and handling a terminal card, see Section 6.)

(3) Connect the power cable to the receptacle and turn the POWER switch on. (Turning the POWER switch on with the EXECUTE pressed causes the setting of each control parameter to be initialized as shown in Table 2-1.)
The automatic diagnostic function is automatically executed. If no error is found, "[*]" is indicated at the left side of the display (showing that the machine is in the input waiting mode) and all other panel lamps are turned off. If an error is detected, an error message that corresponds to the error is displayed. (For the types of error message and details of errors, see 2.5.) If no error is detected, all contacts of each switch card are opened.

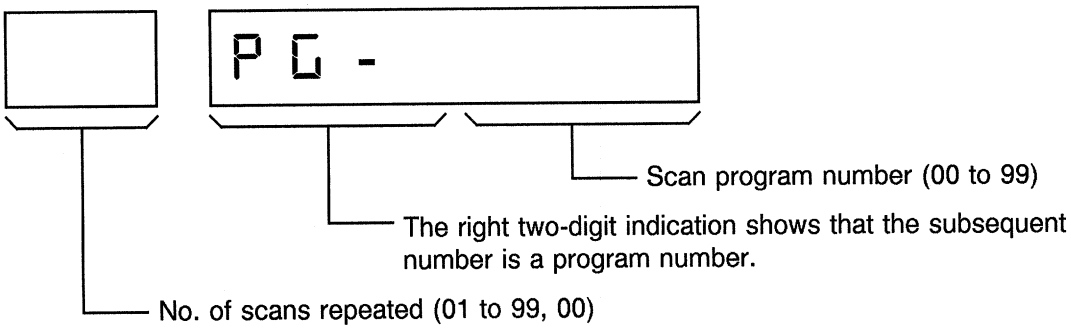
(4) If the operation mode is in after applying power, set each control parameter by following the specified operation and start scanning.
The following is how to start the scan sequence operation, not the direct channel access operation. (For the setting of each control parameter and the method of direct channel access, see 2.2.1 and 2.2.2.)
The following operations are for performing the scan sequence from the panel. For the method of performing the scan sequence by GPIB or single-line signals, see Section 4 or 5, respectively.

(5) To start the scan sequence, use the START/STOP switch. When the lamp corresponding to this switch is off, pressing the switch causes the lamp to be turned on and the scan sequence to be started.
If scanning is started, the current scan channel or scan program number and the number of scans repeated are displayed.
The data to be displayed and its format are shown below.

(a) Sequential mode



(b) Random mode



Note 1: The number of scans repeated is given in two digits. For the repetition of 100 or more times, only the right two digits are shown, with the highest significant digit omitted.

Note 2: If an uncounted card is accessed, all the eight decimal points in the right part of the display are turned on. The decimal points are turned of when accessing the card mounted.

Note 3: If the START lamp is turned on with the scanning sequence started, all the panel switches other than the START/STOP switch and NEXT switch are ignored. To make a control parameter change by pressing any switch other than these, therefore, it is in the first place necessary to stop the scan sequence by pressing the START/STOP switch.

(6) Upon completion of the scan sequence decided by specific control parameters, the START lamp goes out and "[*]" is indicated at the left side of the display. The number assigned to the channel or program last scanned is left displayed in the right part of the display. (But the machine is in the same state as the normal input waiting mode.)
Each contact point of each switch card is kept in the state in which it was last accessed. (If a scan sequence is performed by setting the control parameter for the number of repetitions (R.NO) at "0", scanning is repeated infinitely. In this case, press the START/STOP switch when you want to stop the scanning operation.)
Figure 2-2 gives the timing of the scan sequence operation in each trigger mode.

Table 2-1 Control Parameter Initialization Table

Control parameters to be initialized by turning the POWER switch on with the EXECUTE switch kept pressed	Control parameters to be initialized by turning the POWER switch on
• MODE : "SQ" (sequential) • F.L.CH : 0-9 • F.L.PN : 0-9 • TRIGGER : "MN" (MANUAL) • R.No. : 1 • S.INT : 1 second • R.INT : 1 second • BLOCK : No setting • PROGRAM : Setting no programs • Digital I/O mode (polarity) : 3 (All bits low true)	• Digital read buffer : All cleared • TRIGGER OUT signal delay time : None • TRIGGER OUT CH ADVANCE signal logic : Normal mode (Negative logic pulse specification) • S0/S1 mode : S1 mode (No SRQ signal is issued.) • Status byte : Cleared

(a) Manual ("MN") trigger

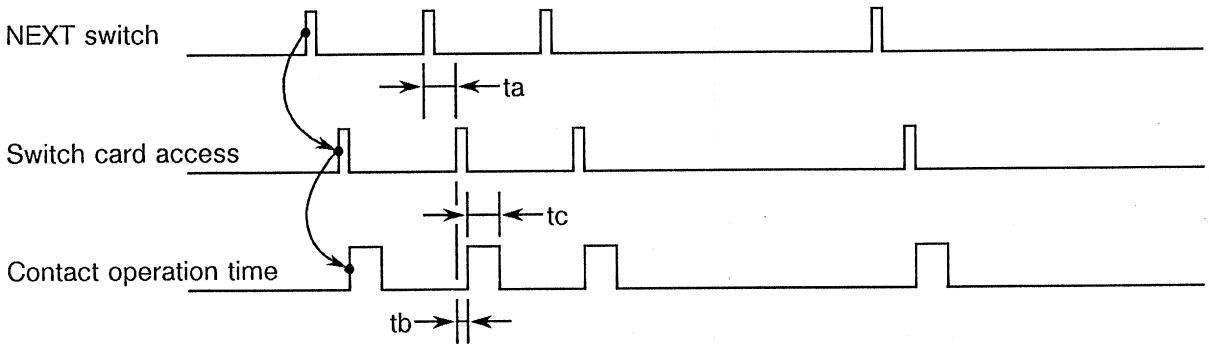


Figure2-2 Operation Timing in Each Trigger Mode

$ta = ta_1 + ta_2$

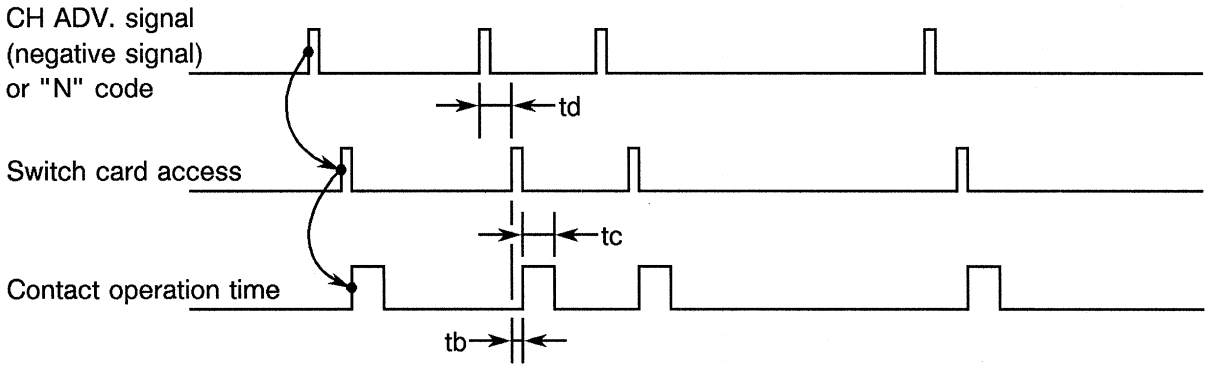
ta_1 : Time until the recognition of the pressing of the NEXT (0 to 10ms)

ta_2 : Time required to decide contact point control data from the number assigned to the channel or program to be accessed next
Sequential . . . 1ms max.
Random . . . . . 3ms max.

tb : Data transfer time for accessing the contact point . . . . . about 150μs

tc : Contact point operation time . . . . . about 2ms to 26ms
(This time varies with switch cards. In the case of a multiplexer, an extra time is required to open the contact point to perform the BBM operation.)

(b) External ("EX") trigger

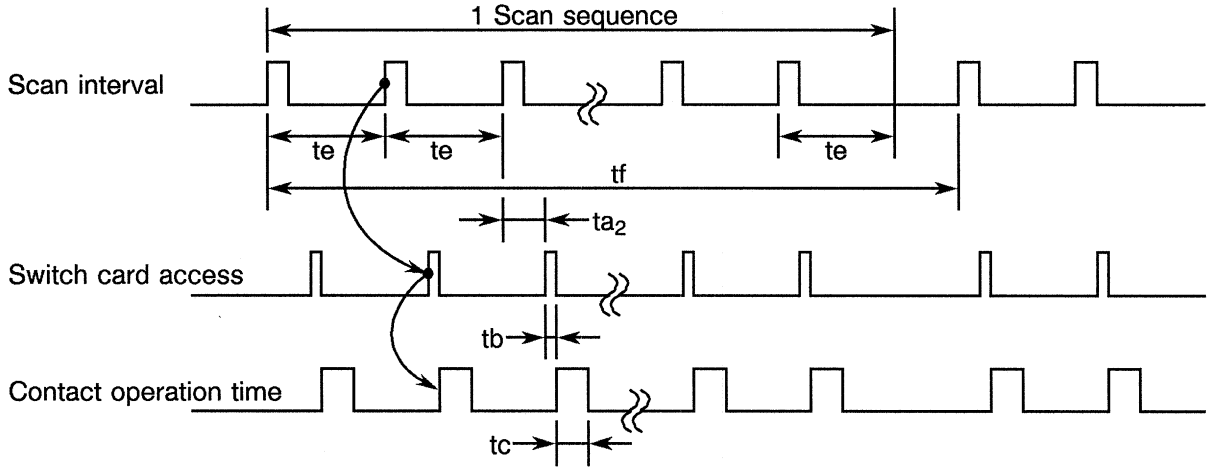


$td = td_1 + ta_2$

td_1 : Time until the recognition of the CH ADV signal or "N" code
CH ADV. . . . . 0 to 30μs
"N" code . . . about 1ms

Other ta2, tb, and tc . . . . Same as with (a) above

(c) AUTO ("AU") trigger



te : S.INT setting time

tf : R.INT setting time

Other ta_2, tb, and tc . . . . Same as with (a) above

Figure 2-2 Operation Timing in Each Trigger Mode (Cont'd)

2.2.1 Control Parameters and How to Set Them

The instruction is provided with nine control parameters to respond to various scanning conditions. The following is an explanation of these control parameters and how to set them on the panel.

These control parameters are all battery-backed up. Turning the POWER switch off does not affect their settings.

(1) MODE (Scan mode)

There are two types of scan mode the sequential mode ("SQ") in which scanning is made from the designated channel to the next designated channel one by one sequentially and the random mode ("RN") in which scanning is made from the designated program number to the next designated end program number step by step according to the internal scanning program.
The sequential mode is used when accessing a multiplexer alone. The random mode is used to access an actuator, a matrix or multiple different switch cards.
Figure 2-3 shows how to set the scan mode.

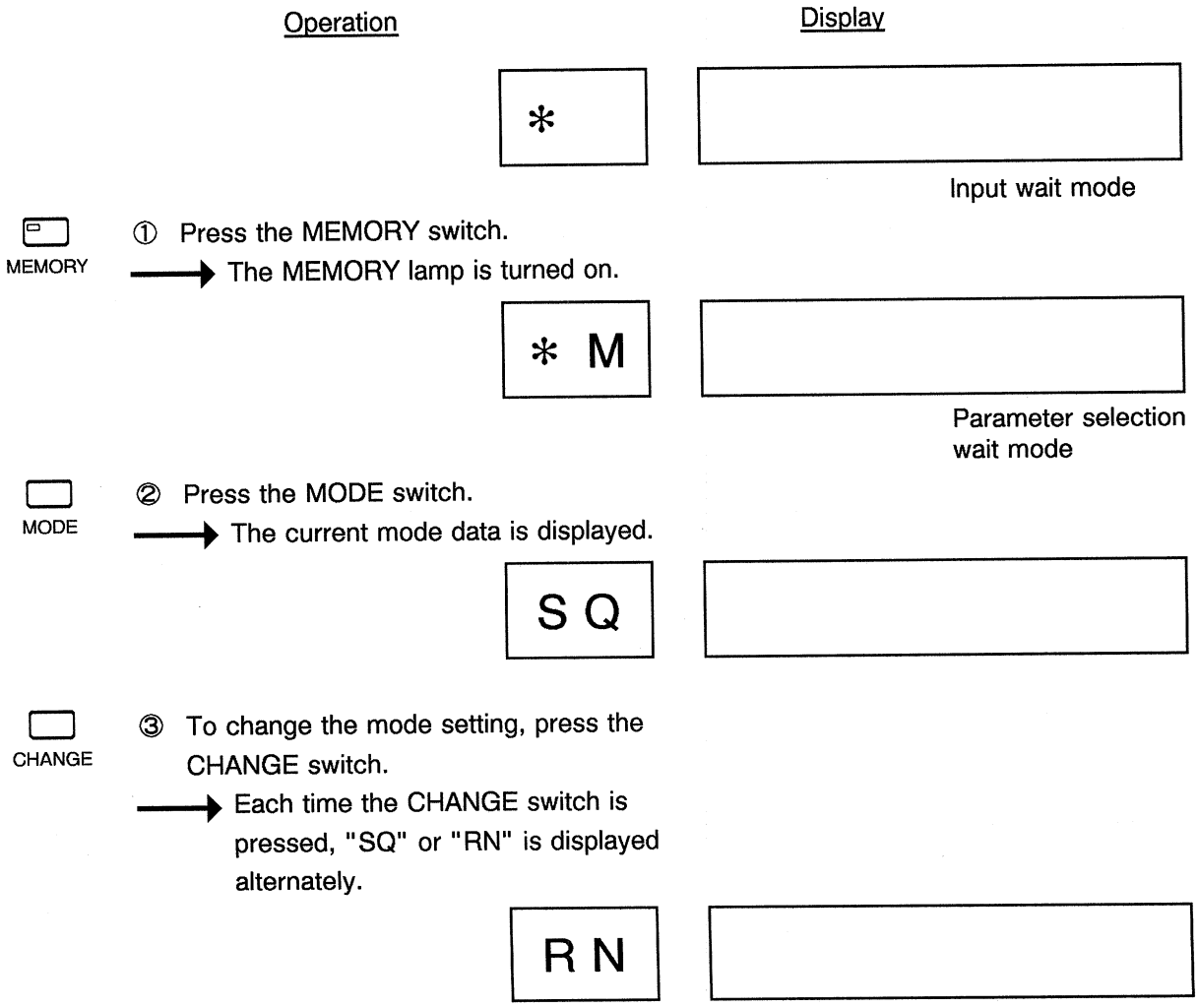


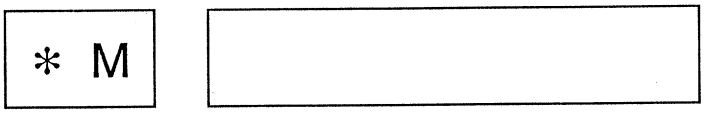
Figure 2-3 Scan Mode Setting

NEXT
or
STORE

④ If the desired mode data is displayed, press the NEXT or STORE switch.

→ Pressing the switch whichever you like causes the new data to be stored in the machine.

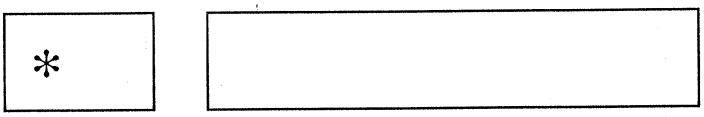
• Pressing the NEXT switch



Parameter selection wait mode

Pressing the NEXT switch causes the same state as that made after pressing the MEMORY switch.
Pressing the STORE switch causes the MEMORY lamp to be turned out and the input waiting mode to be set.

• Pressing the STORE switch



Input wait mode

Note 1: After the operation of ②, the pressing of any switch other than the CHANGE, NEXT and STORE switches is ignored.

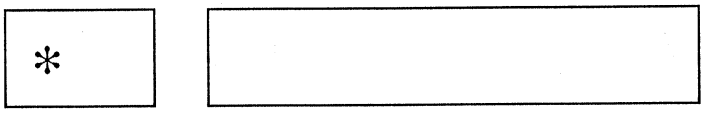
Note 2: To change more than one control parameter in succession, press the NEXT switch in the operation of ④. This makes it unnecessary to press the MEMORY switch when changing the next parameter.
(This applies also to other parameters.)

Figure 2-3 Scan Mode Setting (Cont'd)

(2) F.L.CH (First/last channel)

In the case of sequential scanning, indicates the scanning start and end channels of one sequence. The channel numbers 0 to 99 can be set.
Figure 2-4 shows how to set both first and last channels. The figure gives an example in which the first channel data is changed from 14 to 20 and the last channel data from 36 to 49, and also an example in which the channel number 48 is entered wrongly for 49.

Operation | Display



Input wait mode

MEMORY

① Press the MEMORY switch.

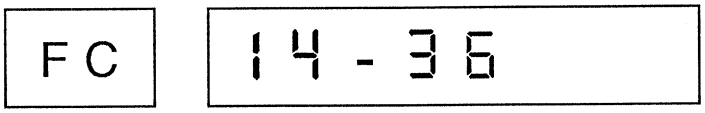
→ Same as Figure 2-3 ①.

Parameter selection wait mode

F.L.CH

② Press the F.L.CH switch.

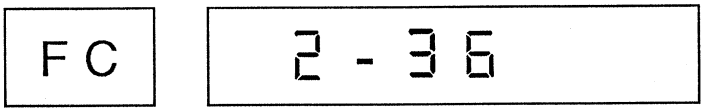
→ The current first and last channel data is displayed.



2

③ Press the switch "2".

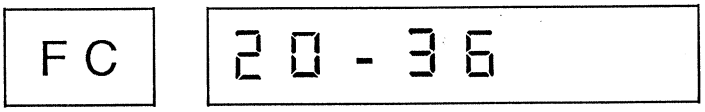
→ The first channel data displayed disappears and the number "2" entered is shown in the right digit of the first channel.



0

④ Press the switch "0".

→ The number "2" shown in ③ above is shifted by one digit to the left, with "0" shown in the right digit.



CHANGE

⑤ Press the CHANGE switch.

→ The left two-digit indication is changed to "LC".

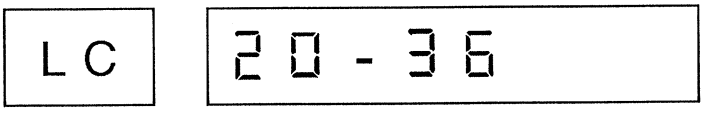
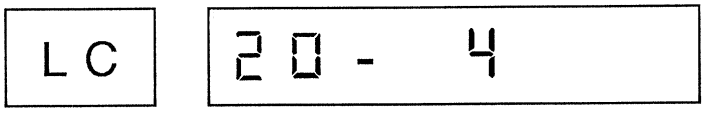


Figure 2-4 Setting First and Last Channels

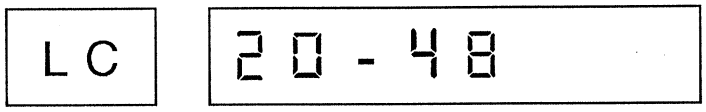
4

⑥ Press the switch "4".



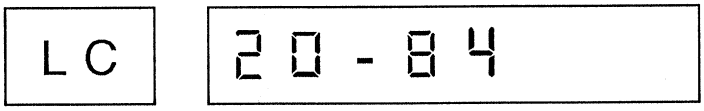
8

⑦ Press the switch "8". (Input error)



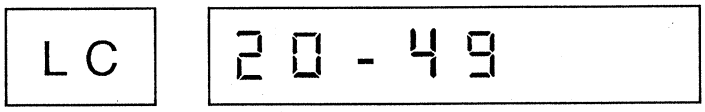
4

⑧ Press the switch "4".



9

⑨ Press the switch "9".



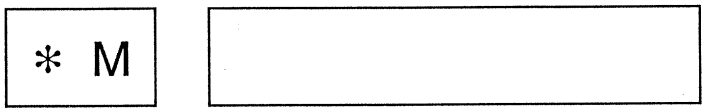
NEXT

or

STORE

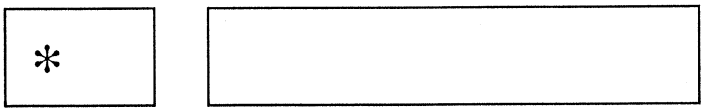
⑩ Press the NEXT switch or STORE switch.

• NEXT switch



Parameter selection wait mode

• STORE switch



Input wait mode

Note 1: The parameter selection wait mode is set after the operation of ① above. In this state, pressing the STORE causes the input wait mode to be returned, with no change in the setting. (This applies to other parameters, too.)

Note 2: To check the data currently set and leave it as is, perform the operation of ⑩ following the operation of ②. (This applies to other parameters, too.)

Note 3: After the operation of ②, any switches other than the ten number setting switches ("0" to "9"), and the CHANGE, NEXT and STORE switches are ignored.

Figure 2-4 Setting First and Last Channels (Cont'd)

(3) F.L.PN (First/last program number)

Indicates the scanning start program number of one sequence at the time of random scanning. The machine is provided with 100 steps of programs containing scanning data, each step being assigned a program number from 0 to 99. It is, therefore, possible to set 0 to 99 as a first/last program number.

Figure 2-5 shows how to set both first and last program numbers. The operations are similar to those for setting a first and last channels. Their explanation is therefore omitted.

The figure gives an example in which the first program number is changed from 0 to 7 and the last program number from 8 to 42. It also shows an example in which data is set wrongly as 24.

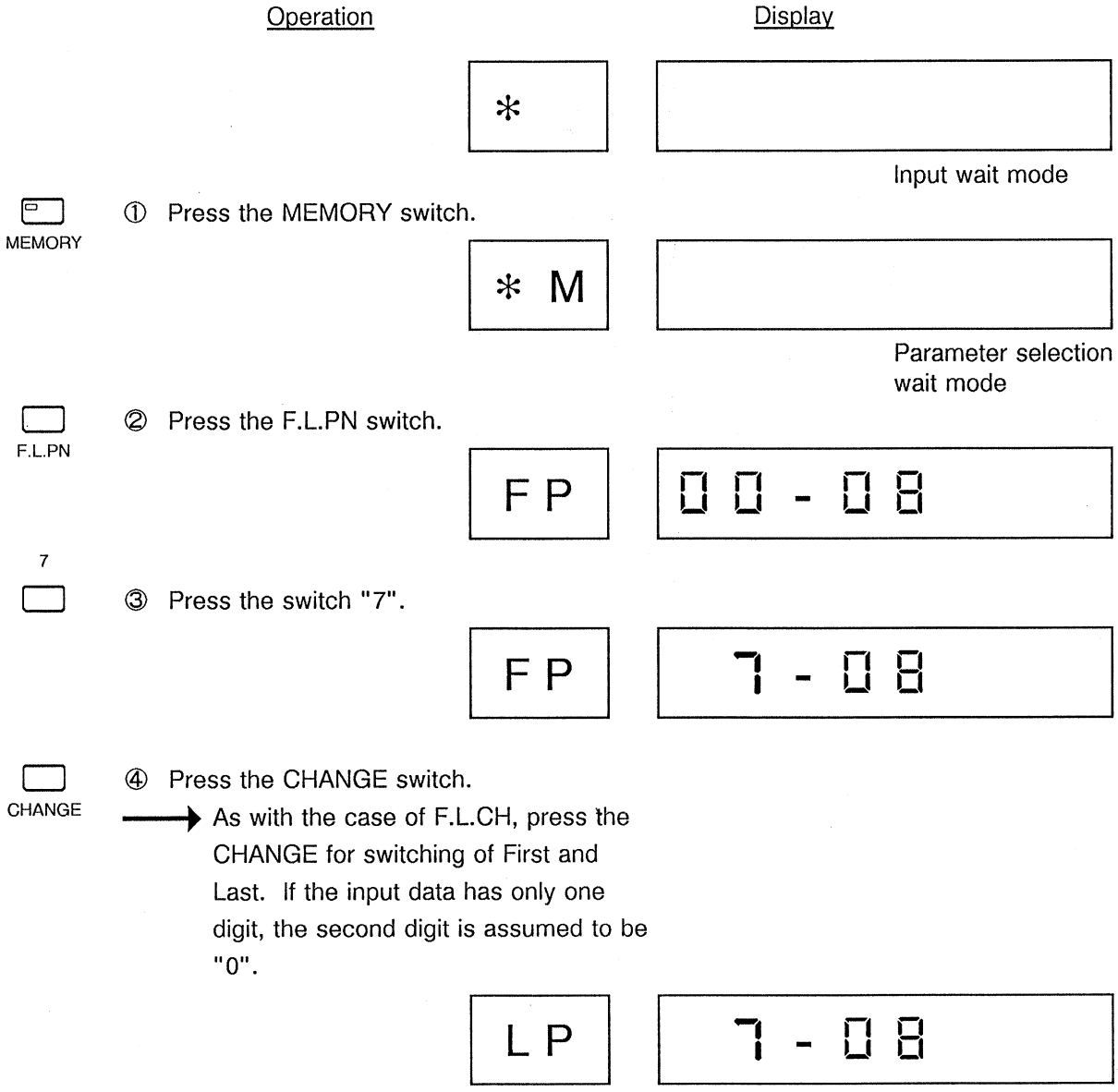
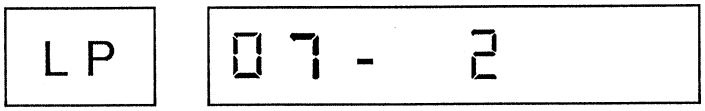


Figure 2-5 Setting First and Last Program Numbers

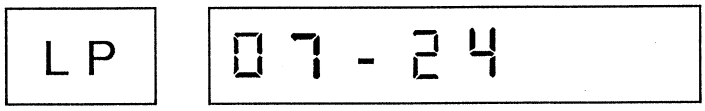
2

⑤ Press the switch "2".



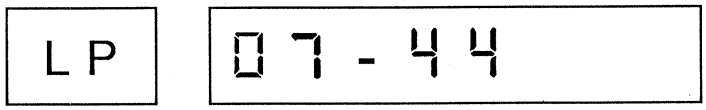
4

⑥ Press the switch "4". (Input error)



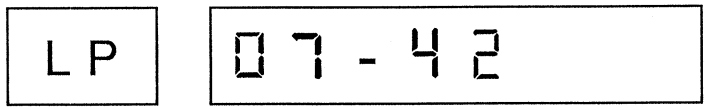
4

⑦ Press the switch "4".



2

⑧ Press the switch "2".



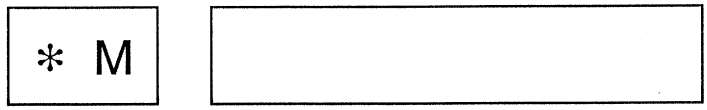
NEXT

or

STORE

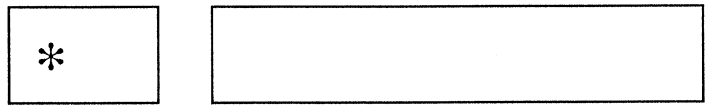
⑨ Press the NEXT switch or STORE switch.

• NEXT switch



Parameter selection wait mode

• STORE switch



Input wait mode

See also the notes given in Figure 2-4.

Figure 2-5 Setting First and Last Program Numbers (Cont'd)

(4) TRIGGER (Trigger mode)

Shows the means to advance scan sequence steps.
There are three modes available: MANUAL ("MN"), EXTERNAL ("EX"), and AUTO ("AU").
In the MANUAL mode, the sequence is advanced by pressing the NEXT switch on the panel.
In the EXTERNAL mode, the sequence is advanced by means of the "N" code from GPIB or the single-wire signal CH ADVANCE (channel advance).
In the AUTO mode, the sequence is advanced automatically at the time interval S.INT (step interval) and R.INT (repeat interval) set internally.
Figure 2-6 shows how to set a trigger mode. In this example, the mode is changed from "MN" to "AU".

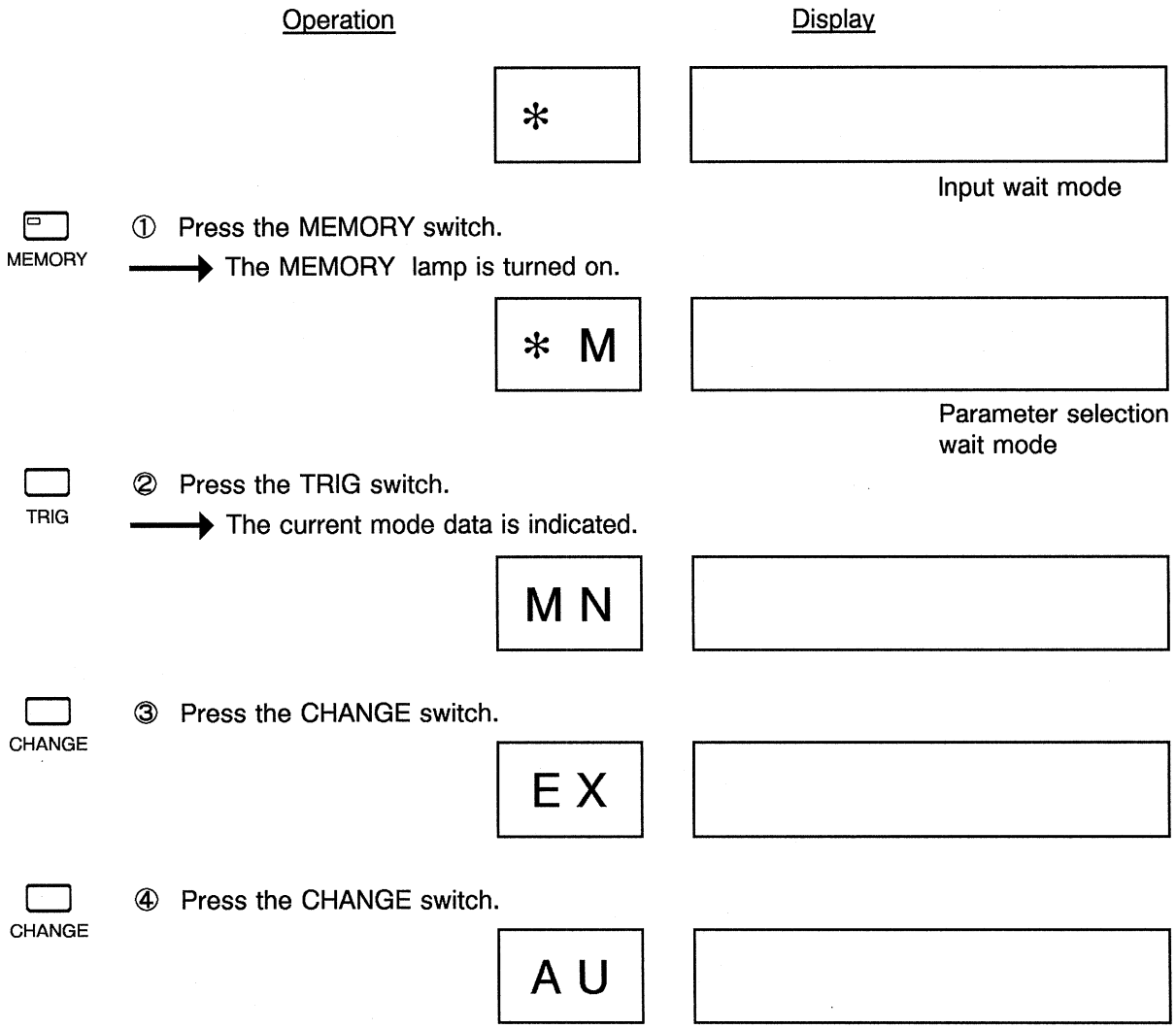


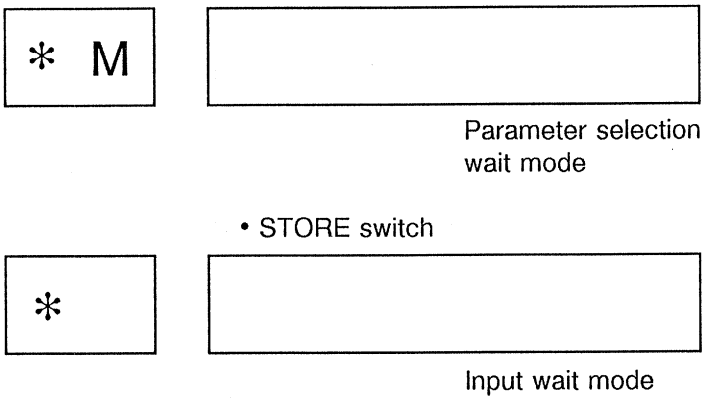
Figure 2-6 Setting the Trigger Mode

NEXT

or

STORE

⑤ With the desired mode data displayed, press the NEXT or STORE switch. Same as Fig.2-3 ④.



Note: Pressing the CHANGE switch caused the mode data to be changed cyclically in the manner "↳ MN → EX → AU → MN ⌟".

When the desired data is indicated, press the NEXT or STORE switch. See also the notes given in Figure 2-3.

Figure 2-6 Setting the Trigger Mode (Cont'd)

(5) R.NO (Repeat number)

Shows the number of repetitions of one scan sequence.
The number of repetitions can be set from 0 to 99. The numbers 1 to 99 represent just the number of repetitions. But the number "0" means that repetition is done infinitely. If "0" is set, the scanning operation is continued until the START/STOP switch is pressed.
Figure 2-7 shows how to set a repeat number. In this case, too, the operations are similar to those for setting first and last channels. No detailed explanation is, therefore, given here.
The figure shows a case in which the repeat number is changed from 10 to 40.

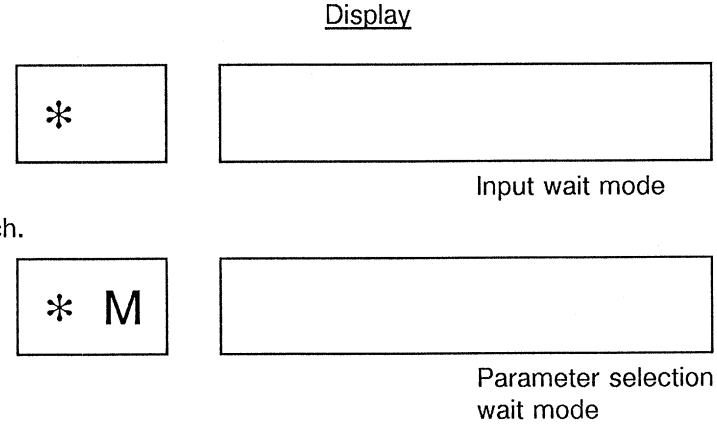


Figure 2-7 Setting a Repeat Number

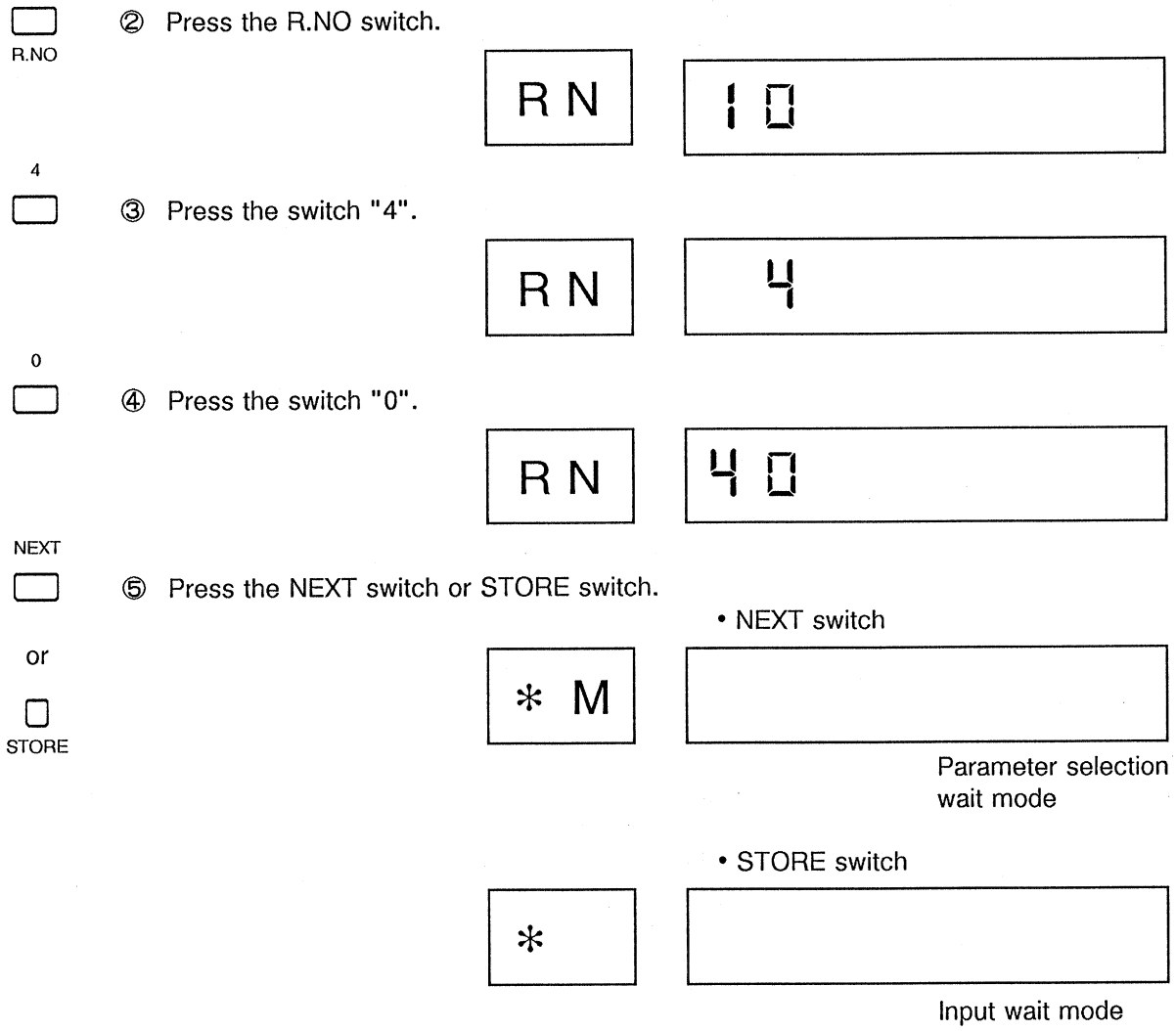


Figure 2-7 Setting a Repeat Number (Cont'd)

(6) S.INT (Step interval)

Shows the time required for transition from one step to the next in one sequence when the trigger mode is AUTO.

Time can be set in an integer from 0 to 999. The unit is available in ms, s or MN (ms: millisecond, s: second, MN: minute). The step interval depends on the operation time of the switch card.

Figure 2-8 shows how to set a step interval. The figure gives a case in which the setting is changed from 100ms to 5s. Since the time number and unit can be set independently, the sequence of setting may be reversed.

Note: These restrictions apply also to R.INT (repeat interval).

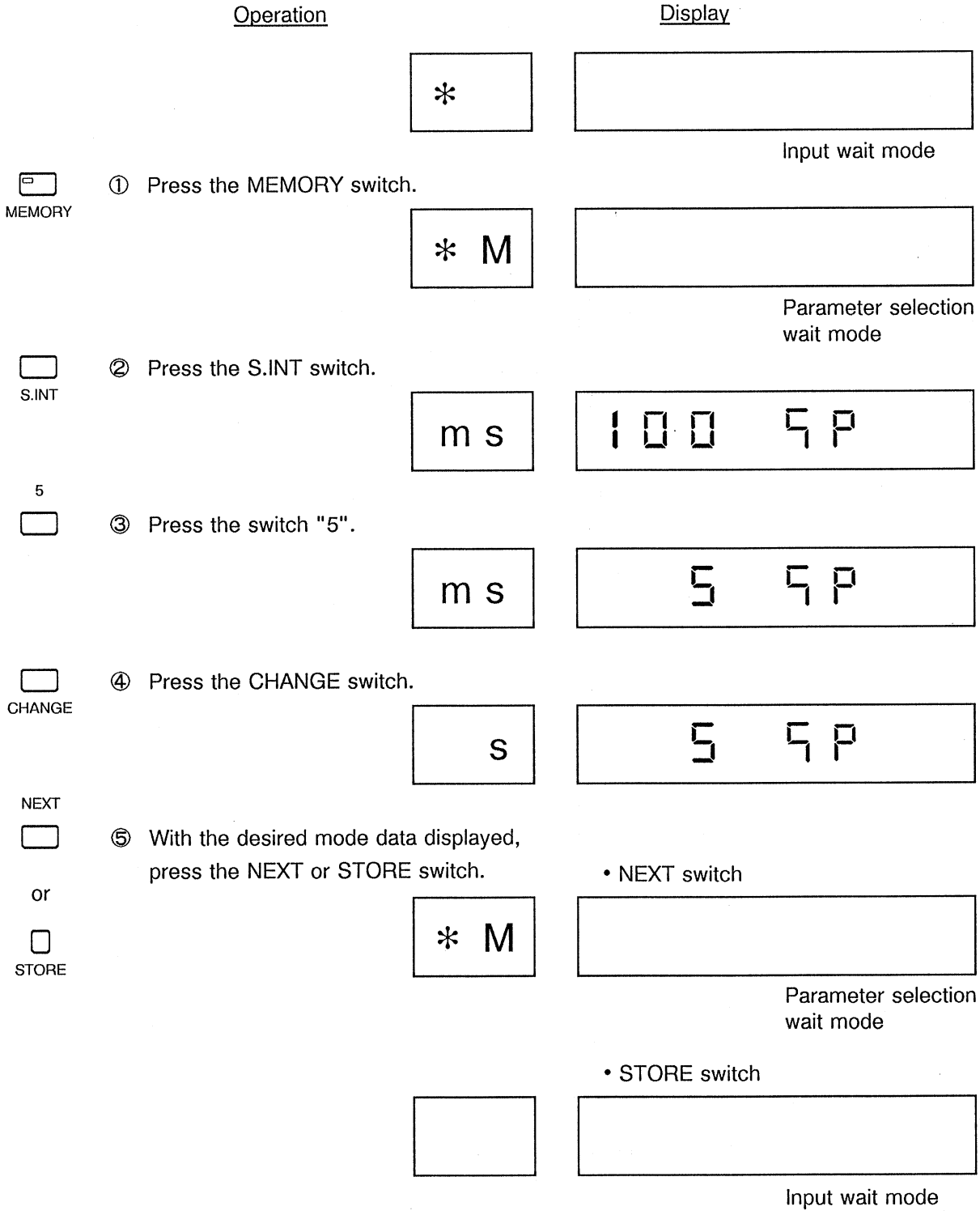


Figure 2-8 Setting a Step Interval

Note 1: After the operation of ②, it is possible to use the ten number setting switches "0" to "9", the CHANGE switch for unit setting, and the NEXT and STORE switches. All other switches are ignored even if pressed.

Note 2: The unit is set by using the CHANGE switch. Each time the switch is pressed, the unit data is changed cyclically in the manner "ms → s → MN". When the desired unit data is indicated, press the NEXT or STORE switch.

Figure 2-8 Setting a Step Interval (Cont'd)

(7) R.INT (Repeat interval)

Shows the time from the start of a scan sequence to the start of the next sequence when the trigger mode is AUTO.
The time can be set in the same manner as with S.INT (step interval), that is, in an integer from 0 to 999 and the unit of sm, s or MN.
If the repeat interval time is set shorter than the time required from the start to the end of one scan sequence, the interval time is ignored. In this case, the sequence operation interval is decided based on the time required for one scan sequence operation.
Figure 2-9 shows how to set a repeat interval. It gives a case in which the setting of 36 minutes is changed to 30 seconds.
The setting operations are almost the same as with S.INT (step interval) described above.

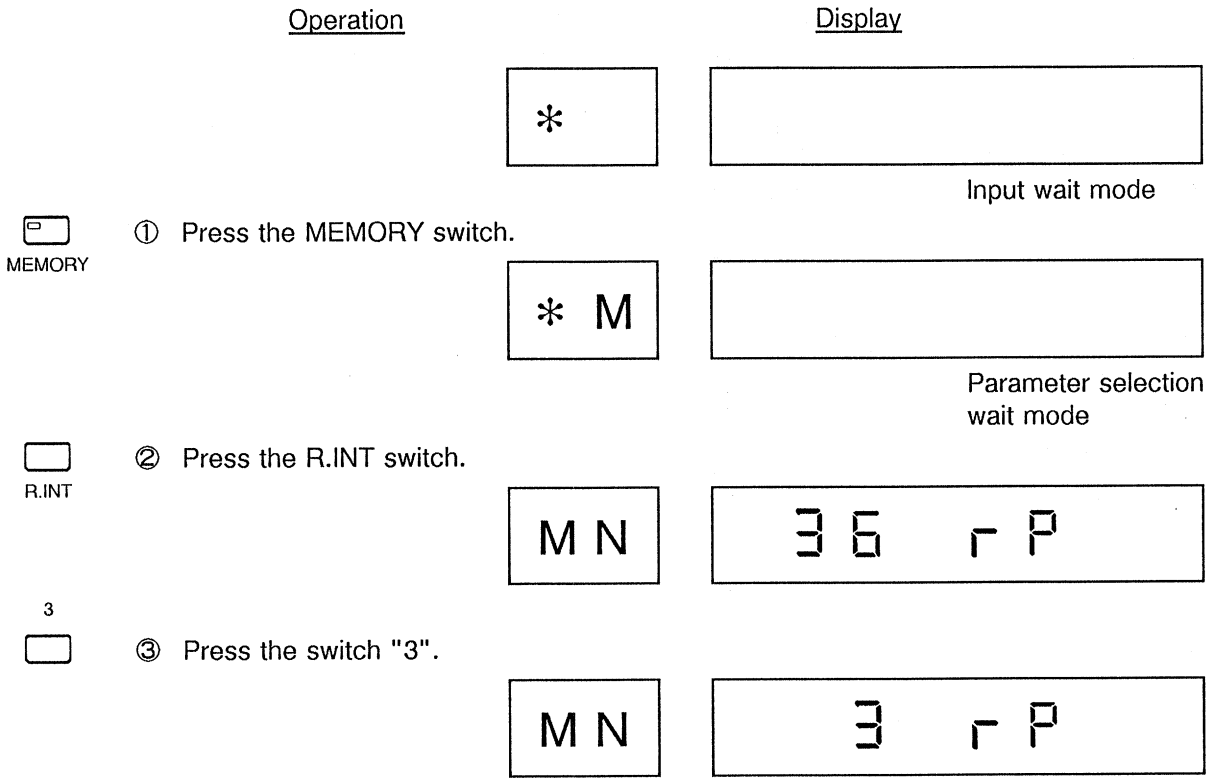
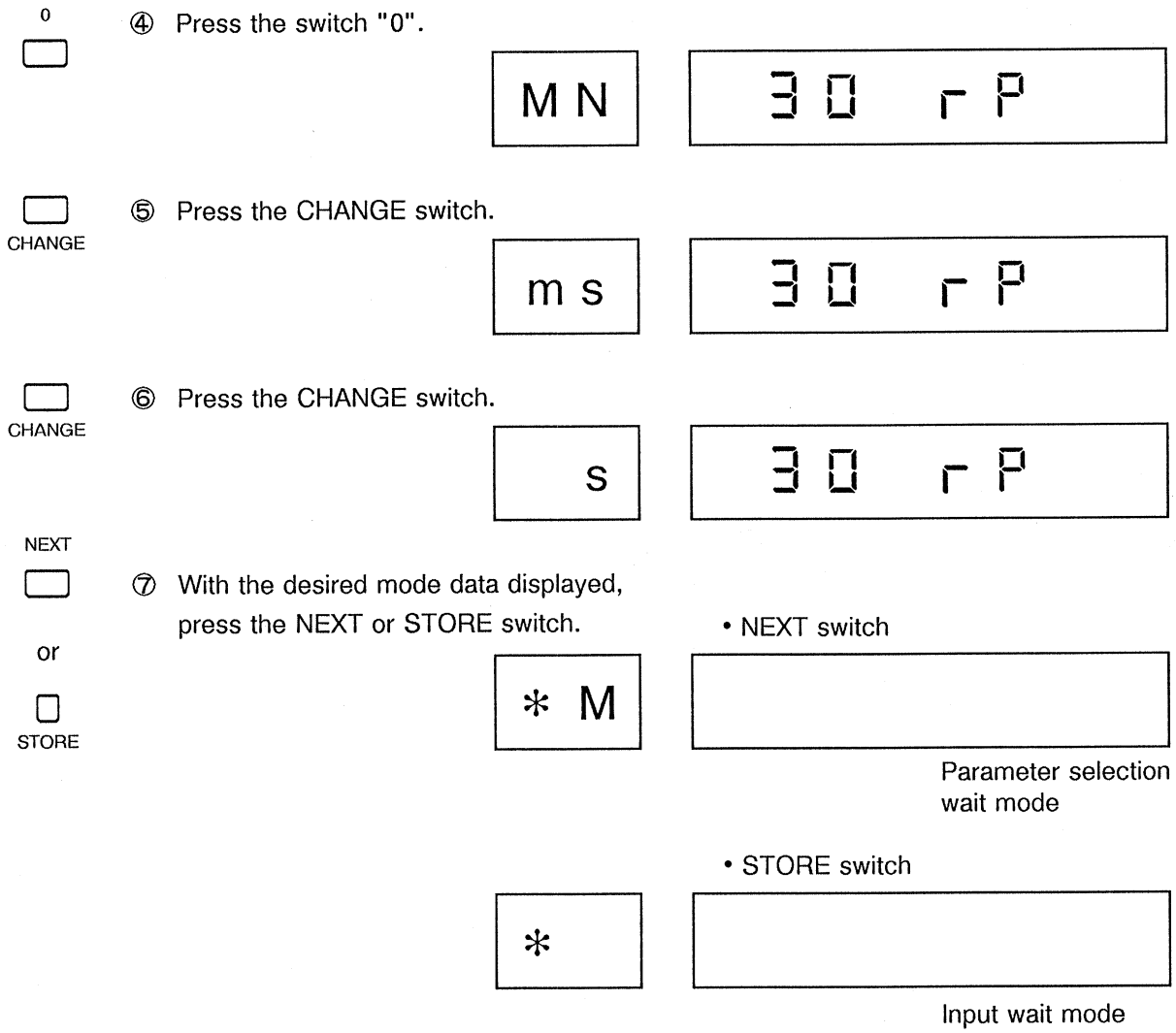


Figure 2-9 Setting a Repeat Interval



See also the notes given in Figure 2-8.

Figure 2-9 Setting a Repeat Interval (Cont'd)

(8) BLOCK (Block)

Normally, each multiplexer card is operated as a single card (10 CH). By setting a block, however, it is possible to connect multiple multiplexer cards to have them operate as a multiplexer with more than ten channels, e.g., 20 CH or 30 CH.

A block can be set by specifying the card numbers of the multiplexer cards to be connected. The block setting format is given below:

- Block format

  An-Bn

  An: max. 0 to 8, Bn: max. 1 to 9; An < Bn; Up to two blocks can be set.

  Note: To specify blocks of different types, it is necessary to ensure that there is no block data overlapping. Overlapping block data cannot be set.

  Example: "0-2, 1-4", or "1-3, 2-4"

The following are sample block settings and their meanings.

Example 1: "0-2, 3-4"

The three multiplexers with the card numbers 0, 1 and 2 are connected as a 30 CH multiplexer and the two multiplexers with the card numbers 3 and 4 as a 20 CH multiplexer.

Example 2: "0-4"

The five multiplexers with the card numbers 0 through 4 are connected as a 50 CH multiplexer.

Example 3: "0-1, 2-3"

The multiplexers with the card numbers 0 and 1, and 2 and 3, respectively, to make two blocks of a 20 CH multiplexer.

If no block is set, each multiplexer card is operated independently. If a block is set, only the channel specified in the block (of multiple cards) is closed.

CAUTION

If an expansion is made by using two or more multiplexer cards, specify a block without fail. Making the close operation without block specification may cause two or more channels to be closed simultaneously. This can damage the equipment depending on connection conditions

Figure 2-10 shows how to set a block. In the figure, the setting "0-2, 3-4" is changed to "0-1, 2-4".

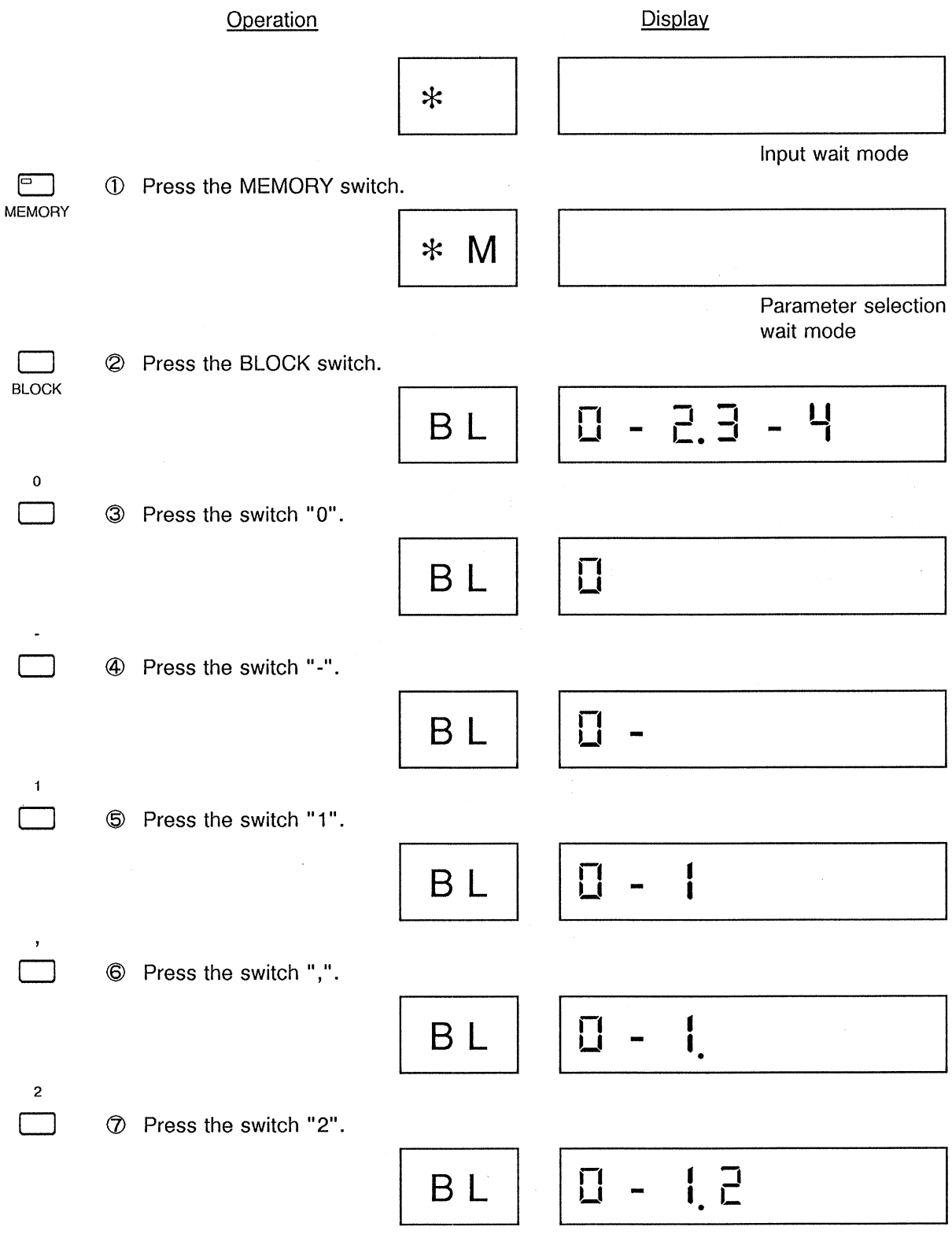
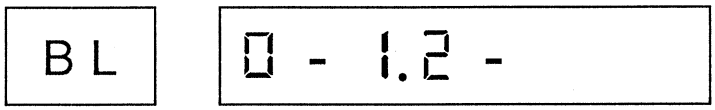


Figure 2-10 Setting a Block

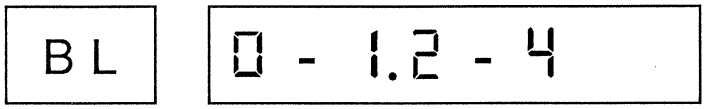
-

⑧ Press the switch "-".



4

⑨ Press the switch "4".



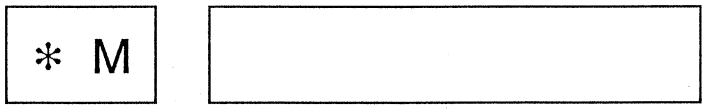
NEXT

⑩ Press the NEXT switch or STORE switch.

or

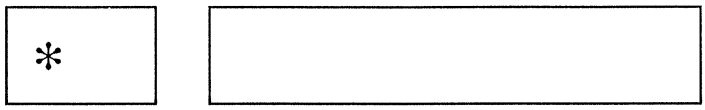
STORE

• NEXT switch



Parameter selection wait mode

• STORE switch



Input wait mode

Note 1: If data is input in a format other than the specified block setting format and then the NEXT or STORE switch is pressed, the message "Error" is given and the input wait mode is set. In this case, the previous setting remains unchanged.

Note 2: To reset the block setting, after the operation of ②, press the NEXT or STORE switch. If the block setting is already reset, nothing is displayed in the seven of the right eight display segments when performing the operation of ②.

Figure 2-10 Setting a Block (Cont'd)

(9) PROGRAM (Program)

Indicates the data used to control the opening and closing of each switch card during random scanning. Each program is shown by its number 0 to 99. Up to 100 steps can be set. Data of up to 30 characters can be set in one program.
The program data setting format is shown below. The format is decided by the type of the switch card used.

- Program format

"DATA1, DATA2, ... DATAn"

The actual format of DATAn depends on the type of the switch card used as follows.

(a) Multiplexer

XX . . . . . Select channel XX.

- Corresponding to channel No. (0 to 9) in one card
- Corresponding to card No. (0 to 9)

(b) Actuator and transfer

cXX . . . . . Close channel XX.
oXX . . . . . Open channel XX.

- Corresponding to channel No. (0 to 9) in one card
- Corresponding to card No. (0 to 9)

(c) Matrix

cXX-Y . . . . . Close the cross point of (XX, Y).
oXX-Y . . . . . Open the cross point of (XX, Y).

- Y data of the cross point (0 to 3)
- X data of cross point (0 to 39)

If the card number is n, the number XX is between the range of n×4 and n×4+3 for each card.

(d) Others

oo0 . . . . . Open all channels.
oo1 . . . . . Open all channels of the multiplexers.
oo2 . . . . . Open all channels of the actuators and transfers.
oo3 . . . . . Open all channels of the matrix.

The following are samples of data set in the program format given above and how the data operates.

Example 1: "43, o26, c3-2"

Channel 43 of the multiplexer is selected (channel 3 of card No. 4), and channel 26 of the actuator (channel 6 of card No. 2) is opened, and the cross point (cross point (3, 2) of card No. 0) of the matrix is closed.

Example 2: "oo1, c9-2"

All channels of the multiplexer are opened and cross point (9, 2) of the matrix (cross point (1, 2) of card No. 2) is closed.

Example 3: "c4, 012-1"

Channel 4 of the actuator (channel 4 of card No. 0) is closed and cross point (12, 1) of the matrix (cross point (0, 1) of card No.3) is closed.

Figure 2-11 shows how to set a program.
First, specify the program number of the desired program and then set program data. It is possible to shift the displayed data by using the switches "⇦" and "⇨".
The figure shows a case in which the data of program No. 0 is changed from "1, c20, c14-3" to "oo0, 0, c14-0", and the data of program No. 45 from "o38, o10-1" to "12, o39". Also, the previous data is checked by using a shift switch.

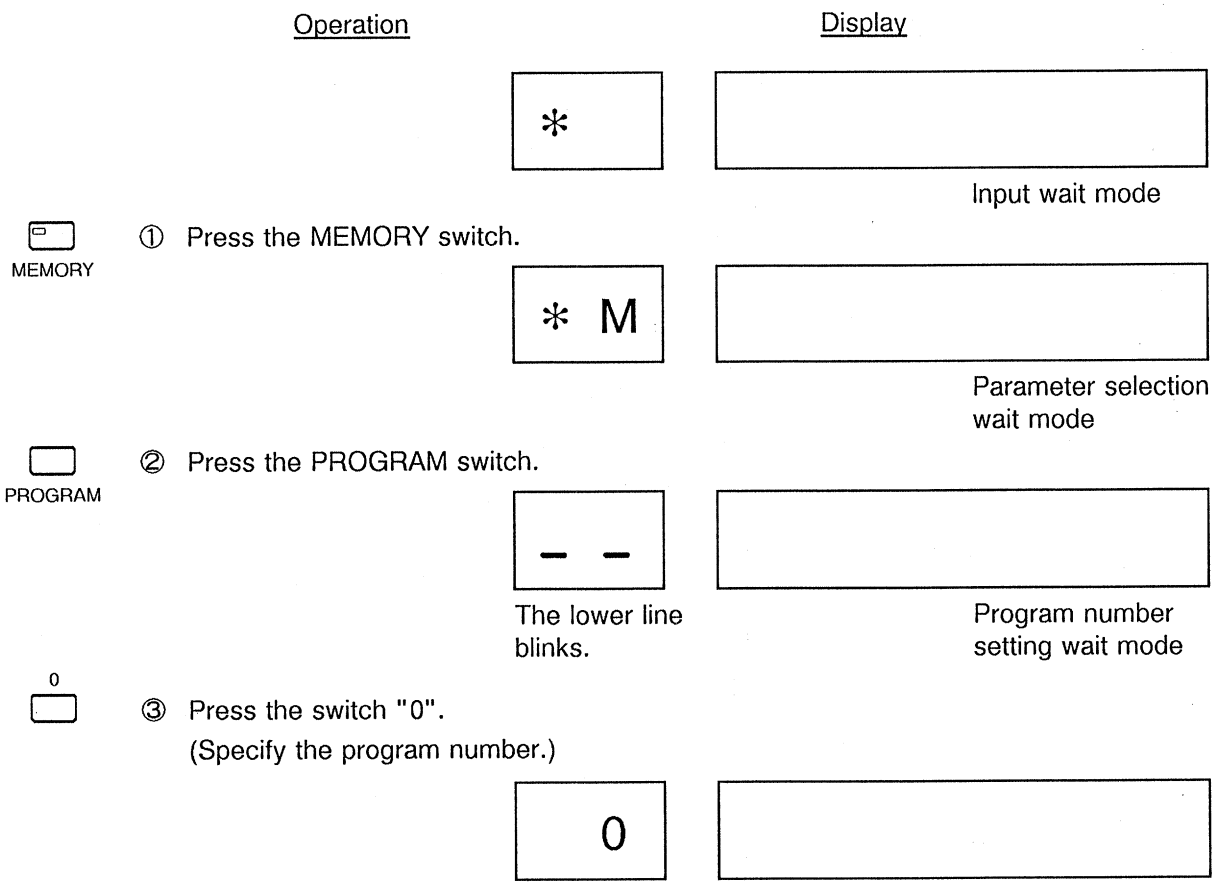
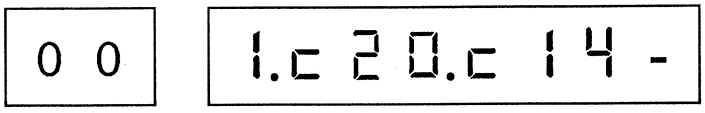


Figure 2-11 Setting a Program

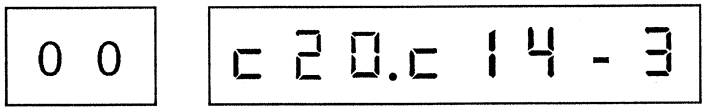
0

④ Press the switch "0".

→ If you want to see the content of the program, perform the operations of ⑤ and ⑥. If this is unnecessary, go to the operation of ⑦ after ④.



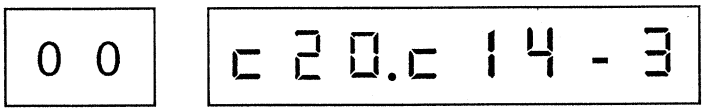
⑤ Press the "⇦" switch.



Shift mode

⑥ Press the "⇦" switch.

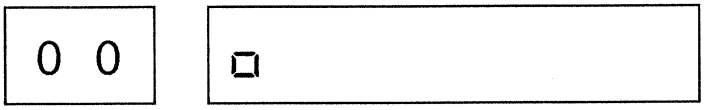
→ No change is made on the display because there is no data to be shifted. (The "⇨" switch is effective.)



Shift mode

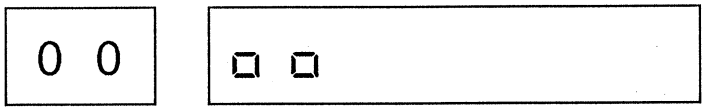
OPN

⑦ Press the OPN switch.



OPN

⑧ Press the OPN switch.



0

⑨ Press the switch "0".

,

⑩ Press the switch ",".

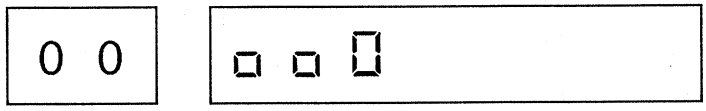
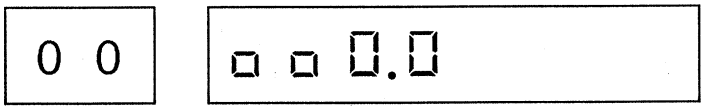


Figure 2-11 Setting a Program (Cont'd)

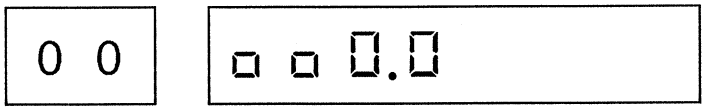
0

⑪ Press the switch "0".



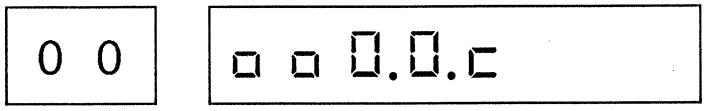
,

⑫ Press the switch ",".



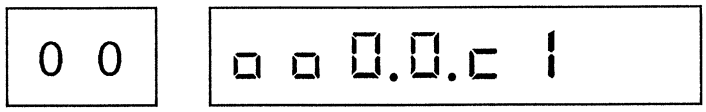
CLS

⑬ Press the CLS switch.



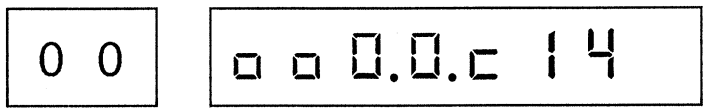
1

⑭ Press the switch "1".



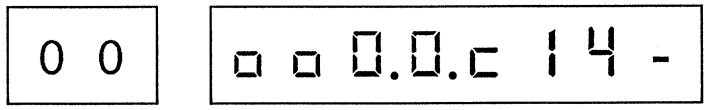
4

⑮ Press the switch "4".



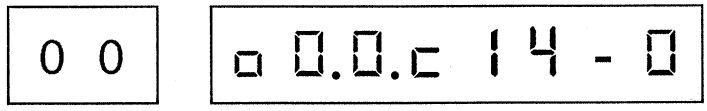
-

⑯ Press the switch "-".



0

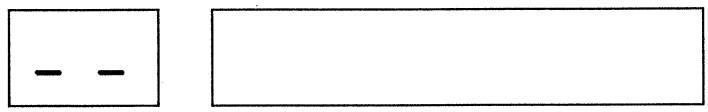
⑰ Press the switch "0".



NEXT

⑱ Press the NEXT switch.

→ The data entered in program No. 0 is stored.



The lower line blinks.

Program number setting wait mode

Figure 2-11 Setting a Program (Cont'd)

4

⑲ Press the switch "4".
(Specify the program number.)

4	

5

⑳ Press the switch "5".
→ The data currently set in program No. 45 is displayed.

45	▫38.▫ 10-1

1

㉑ Press the switch "1".

45	1

2

㉒ Press the switch "2".

45	12

,

㉓ Press the switch ",".

45	12.

OPN

㉔ Press the OPN switch.

45	12.▫

3

㉕ Press the switch "3".

45	12.▫3

9

㉖ Press the switch "9".

45	12.▫39

Figure 2-11 Setting a Program (Cont'd)

STORE

㉗ Press the STORE switch.

→ The data input to program No. 45 is stored and the input wait mode is set. To set the data of the next program, press the NEXT switch.

Input wait mode

Note 1: Pressing the CHANGE switch after ④ or ⑳ causes the program number to be incremented by one, making it possible to see the data for that program number.

Note 2: Input the program number in two digits without fail. (If the program has a single-digit number, add "0" before it.) With the input of a full two-digit number, the data for that program number is displayed.

Note 3: To check the program data only, press the NEXT or STORE key after checking the data by using the appropriate shift switch.

Note 4: If a switch card non-access state is to be set as program data, press the NEXT or STORE switch after deleting the displayed data by pressing the CE switch. (If no data is displayed when inputting a program number, that program is set in this state.)

Note 5: If a wrong program number or data is input, it is possible to correct a single character or all characters by using the DELETE or CE switch.

Note 6: If data is input out of the program format and the NEXT or STORE switch is pressed, the message "Error" is given and the parameter select wait mode or input wait mode is set. In this case, the previous data remains unchanged.

Note 7: A maximum of 30 characters can be input as data (including "-" and ","). After 30 characters have been input, no additional character can be input unless the DELETE switch or CE switch is pressed.

Note 8: The shift mode is effective only for the data already set. It is impossible to check the data currently being input by shifting.

Note 9: To program digital I/O functions, refer to 2.4.

Figure 2-11 Setting a Program (Cont'd)

2.2.2 Direct Access and How to Set It

A direct access is to control the opening and closing of each switch card not by a scan sequence but by a single command. That is, it controls each switch card by a single operation, not by a sequence of operations.

With the instruction, direct accessing is available in three types direct channel access, direct program access and direct digital I/O access. The following explains each of these types and how to set them.

(1) Direct channel access

The operations to start a direct channel access operation are almost the same as in the case of program data discussed previously: input the channel data that provides switch card opening and closing from the panel and finally press the EXECUTE switch. The opening and closing of each switch card is performed according to the channel data entered.

As with the case of program data, input data can contain a maximum of 30 characters. The same data format is used.

If data is input that does not in conformity with the data format and then the EXECUTE switch is pressed, the message "Error" is given and no access is made to any switch card. If wrong data is input, correct it by using the DELETE or CE switch and input the correct data again.

Figure 2-12 gives sample direct channel access operations. In the example, channel 8 of the multiplexer is selected, point (5, 2) of the matrix is closed and channel 14 of the actuator is opened.

Accessing of each card is done sequentially from the data input first. It takes about 500μs from the start of a switch card by certain access data to the start by the next switch card.

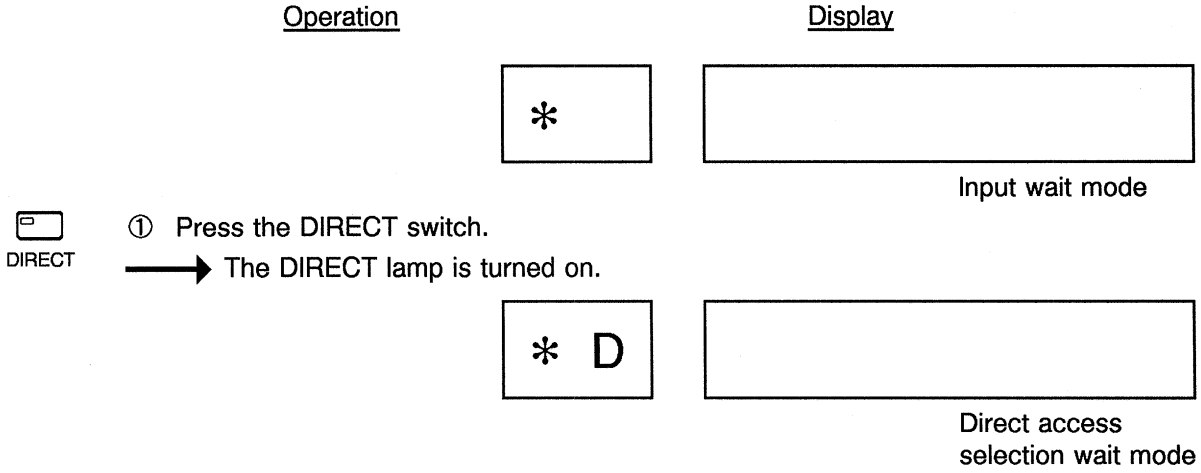
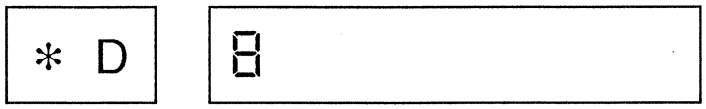


Figure 2-12 Setting a Direct Channel Access

8

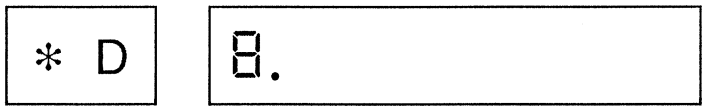
② Press the switch "8".



Direct channel access mode

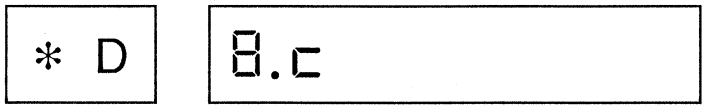
,

③ Press the switch ",".



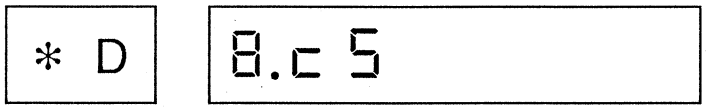
CLS

④ Press the CLS switch.



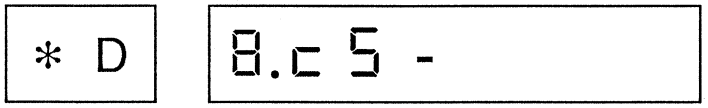
5

⑤ Press the switch "5".



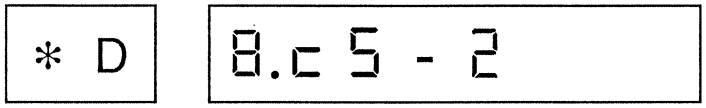
-

⑥ Press the switch "-".



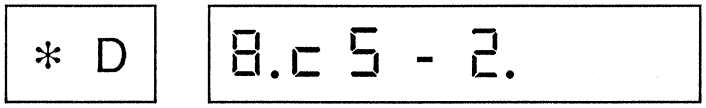
2

⑦ Press the switch "2".



,

⑧ Press the switch ",".



OPN

⑨ Press the OPN switch.

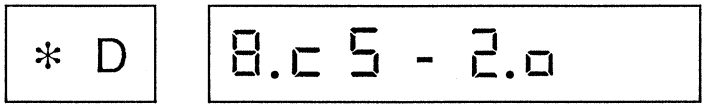
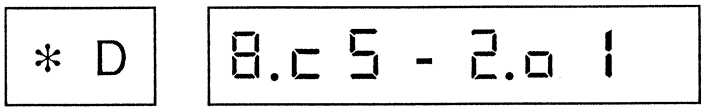


Figure 2-12 Setting a Direct Channel Access (Cont'd)

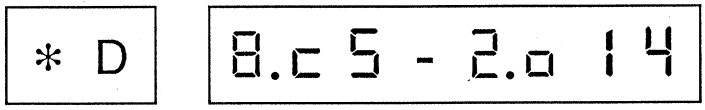
1

⑩ Press the switch "1".



4

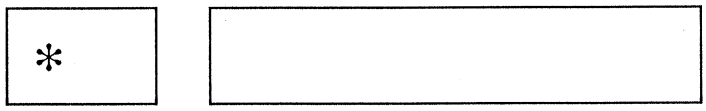
⑪ Press the switch "4".



EXECUTE

⑫ Press the EXECUTE switch.

→ The switch card is accessed according to the data input.



Input wait mode

Note 1: If access data is input and the EXECUTE switch is pressed for an unmounted switch card, the error message "....." is given. If the input data contains access data for a mounted switch card, the operation is performed normally.

Note 2: If wrong input data is input, it is possible to cancel all the input data by pressing the CE switch.

Note 3: In the direct access selection wait mode after ①, all switches other than PROGRAM, DIO, 0 to 9, OPN, CLS and EXECUTE are ignored.

Note 4: After ① through ⑪, press the DIRECT switch and you can return to the input wait mode. At this time, no switch card is accessed.

Figure 2-12 Setting a Direct Channel Access (Cont'd)

(2) Direct program access

The direct program access operation is to call the desired program from among those set in the process of control parameter setting by specifying its program number 00 to 99 and execute it in the direct access mode. No program change or addition can be made. To do this, start with control parameter setting again.

Figure 2-13 gives a sample direct program access operation. The example is to call program number 00, go to 01 and execute it.

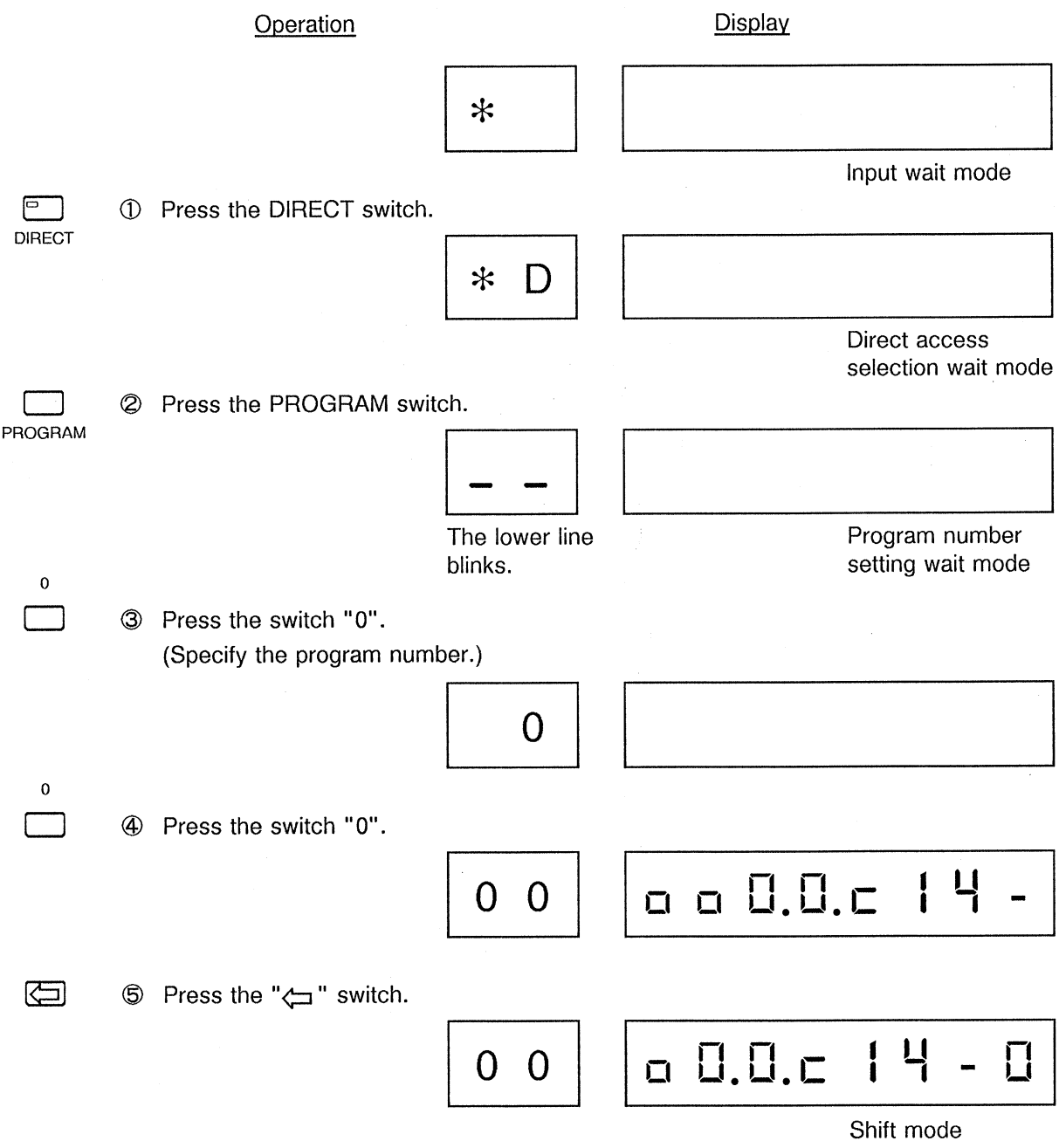
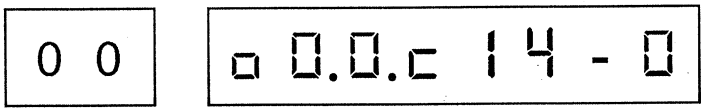


Figure 2-13 Setting a Direct Program Access

⑥ Press the "⇦" switch.

→ No change is made in the data displayed because there is no data to be shifted.



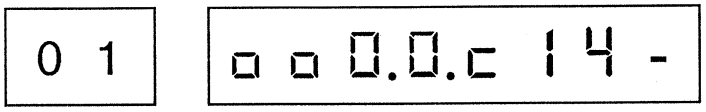
Shift mode

(The switch "⇨" is effective.)
At this time, the switches OPN, CLS and 0 to 9 are ignored even if pressed.

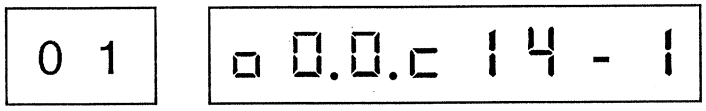
CHANGE

⑦ Press the CHANGE switch.

→ The program number is incremented by one and its content is displayed.



⑧ Press the "⇦" switch.



NEXT

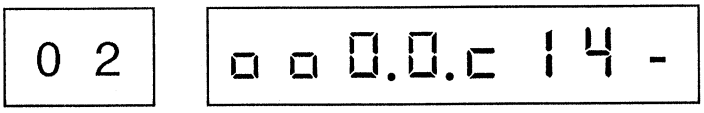
or

EXECUTE

⑨ Press the NEXT or EXECUTE switch.

→ Pressing either switch causes the program to be executed.

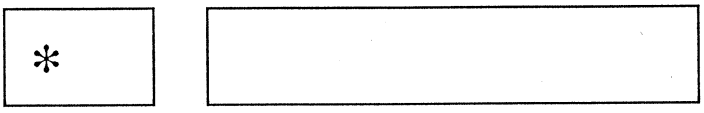
• NEXT switch



Direct program access mode

In the case of the NEXT switch, the program number is incremented by one and the direct program access mode is set. With the EXECUTE switch, the input wait mode is set.

• EXECUTE switch



Input wait mode

Figure 2-13 Setting a Direct Program Access (Cont'd)

Note 1: To go to the input wait mode directly from the direct program access mode without executing any program, press the DIRECT switch again.

Note 2: In ⑤, ⑥ and ⑧, the content of the program is checked. If no program content checking is needed, the operations of ⑤, ⑥ and ⑧ may be omitted.

Figure 2-13 Setting a Direct Program Access (Cont'd)

(3) Direct digital I/O access

The direct digital I/O access operation is to control the 16-bit digital I/O functions of the instruction directly.
For details, refer to 2.4.

2.3 Using the Universal Card (72104)

This card allows the user to configure the scanner freely.

For example, it is possible to provide the 7210 with part of the measurement equipment functions, such as a filter and amplifier, by using this card. External devices can be connected to the terminal board through the card edge connector.

(1) How to use the universal card

As shown in Figure 2-14, this card is in appearance the same as other cards.
The card is provided with the patterns of a power supply (5V) and GND.
It is possible to mount parts in the holes (pitch: 2.54mm) with a maximum height of 15mm.
For details, refer to Section 8.

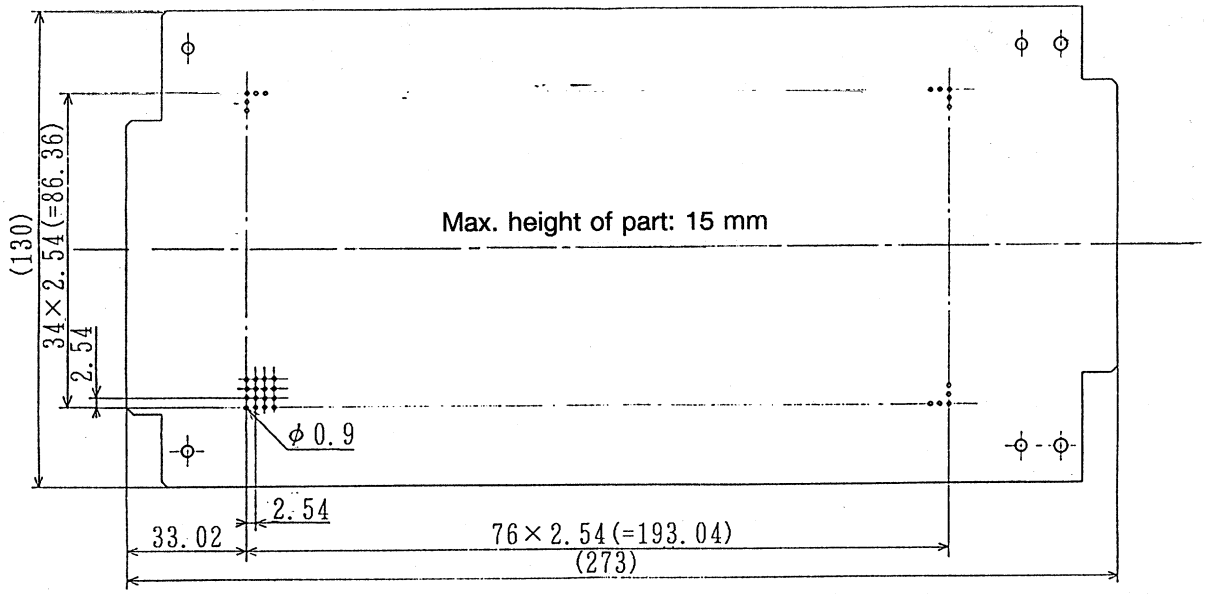


Figure 2-14 Universal Card

2.4 Using Digital I/O Functions

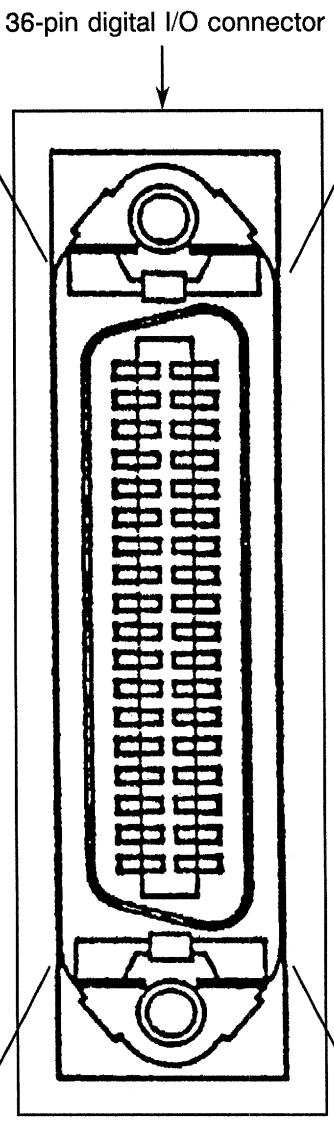
Digital I/O functions are provided with 16 input/output lines and 2 input lines. There are two signals (I/O DIR 1, 2) that show the directions of input and output and one strobe signal for data latching.

The functions can be used through programming at the time of random scanning or direct program scanning.

It is also possible to use a direct digital I/O access that controls input/output lines directly at the time of direct accessing.

(1) Digital I/O connector pin arrangement

Signal name	Pin No.
GND	36
GND	35
RESERVE	34
RESERVE	33
EXINT2	32
EXINT1	31
GND	30
GND	29
DIO15	28
DIO14	27
DIO13	26
DIO12	25
DIO11	24
DIO10	23
DIO09	22
DIO8	21
GND	20
GND	19

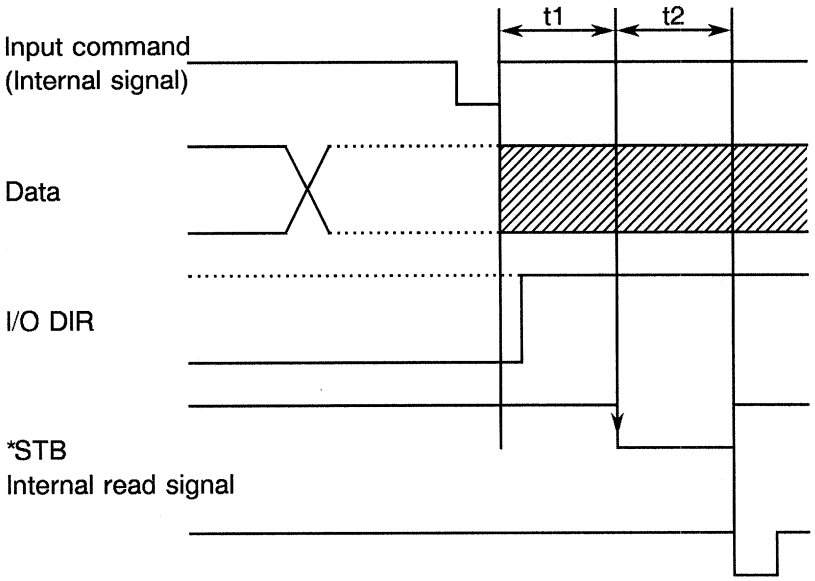


Pin No.	Signal name
18	GND
17	GND
16	RESERVE
15	*STB
14	I/ODIR2(H8 bytes)
13	I/ODIR1(L8 bytes)
12	GND
11	GND
10	DIO7
9	DIO6
8	DIO5
7	DIO4
6	DIO3
5	DIO2
4	DIO1
3	DIO0
2	GND
1	GND

Note: Pins 15 to 16 and 33 to 34 are reserved and should not be used.

(2) Data transfer timing/input timing

●Input timing



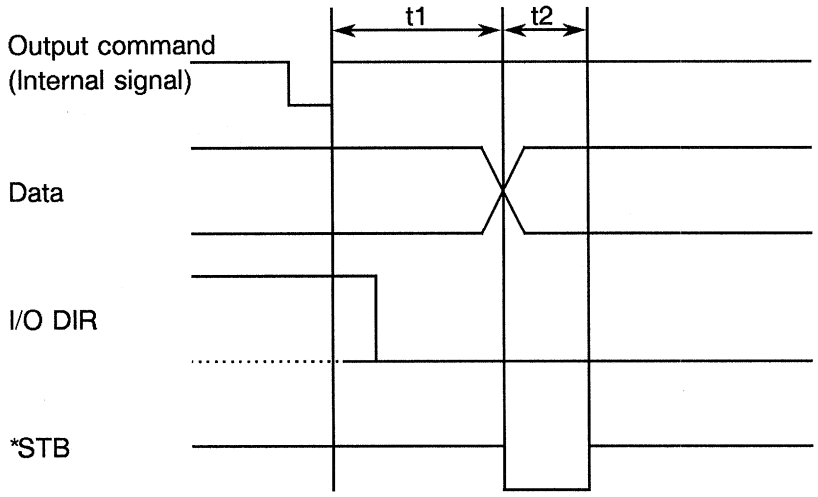
t1 ≒ 100μs

t2 ≒ 100μs

The input data is taken with the internal read signal t2 after the fall of the STB signal.

It is, therefore, necessary to synchronize the input data with the fall of the *STB signal or set before it.

●Output timing



t1 < 1ms

The data is latched on the bus after t1.

t2 ≒ 100μs

It is necessary to take the data after t2 by taking into consideration the time required for the bus to be stabilized.

Note: If, however, an input/output command is issued by GPIB, the handshake time and command conversion time are added.

(3) EXINT1, 2 input lines

Pins 31 and 32 of the digital I/O connectors are connected to the input lines EXINT1 and EXINT2. The lines are "Low true" and generate the GPIB SRQ signal to make an external SRQ request.
The following are the status bytes with SRQ issued.

EXINT1

MSB							LSB
0	1	0	1	0	0	0	0

EXINT2

MSB							LSB
0	1	1	0	0	0	0	0

These bits are cleared by serial polling. Please refer to "4.5 Service request".

2.4.1 Procedure for Using the Digital I/O Functions

① In the first place, set the digital I/O mode (polarity). Here the polarity of 16-bit data is set in the same manner as with control parameter setting.

② To input data, use Digital Read. To output data, use Digital Write.

③ To output data bit by bit with Digital Write instead of changing the data, set and output the data in the OPEN/CLOSE digital bits.

④ The operations of ② and ③ above are made part of the programs of steps 0 to 99 to provide input/output control in random scanning. They provide input/output control in the execution of a direct program access as well. Also, direct control can be made in a direct access.

The following is an explanation of the digital I/O mode (polarity), digital read/write, and OPEN/CLOSE digital bits and how to set them.

(1) Digital I/O mode (Polarity)

The example given here is to set a 16-bit polarity. There are four types of data:

Polarity data

0 : All bits . . . . . High true
1 : L8 bits . . . . . Low true
2 : H8 bits . . . . . Low true
3 : All bits . . . . . Low true

The following is the method to set the digital I/O mode (polarity).

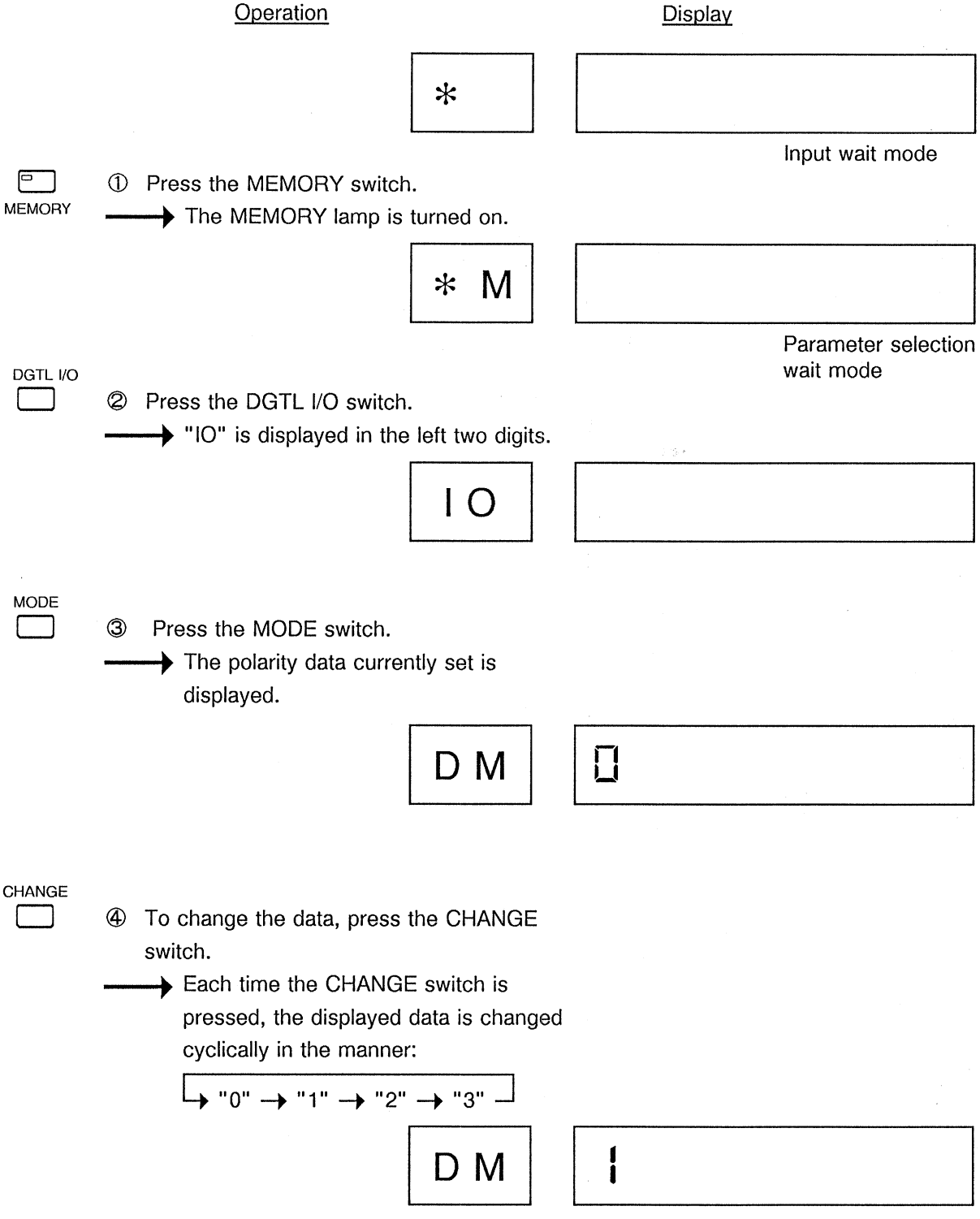


Figure 2-15 Setting the Digital I/O Mode

NEXT

or

STORE

⑤ If the desired data is displayed, press the NEXT or STORE switch.

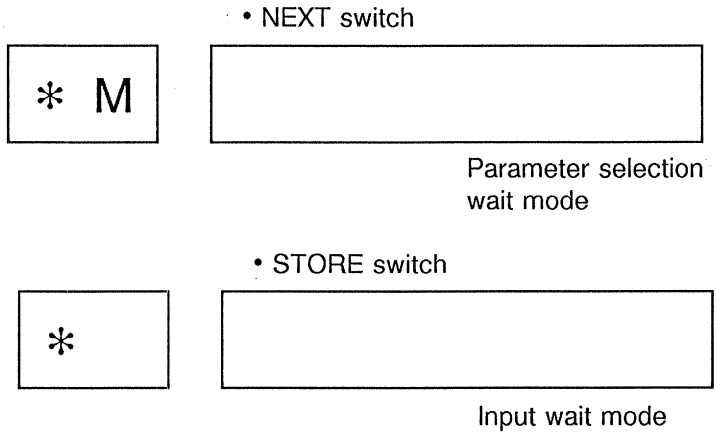


Figure 2-15 Setting the Digital I/O Mode (Cont'd)

(2) Digital read

This function is used to input 16-bit data. The example given here is to set port data. Port data shows the scope of the data to be input. There are three types of port data.

Port data

din.0

0 : Lower 8-bit data
1 : Higher 8-bit data
2 : 16-bit data

Digital read data is stored in the read buffer.
It is possible to store 1000 data in the read buffer.
If the read buffer becomes full, the SRQ signal of GPIB is issued, causing the bit of the status byte that shows that the read buffer is full to be set at 1.
When the buffer is full, no data is accumulated even if Digital Read is executed. It is, however, possible to see the latest data.
The following is how to set Digital Read. Two cases are given: programming Digital Read in program No. 00 and performing Direct Digital Read.

■ Programming Digital Read

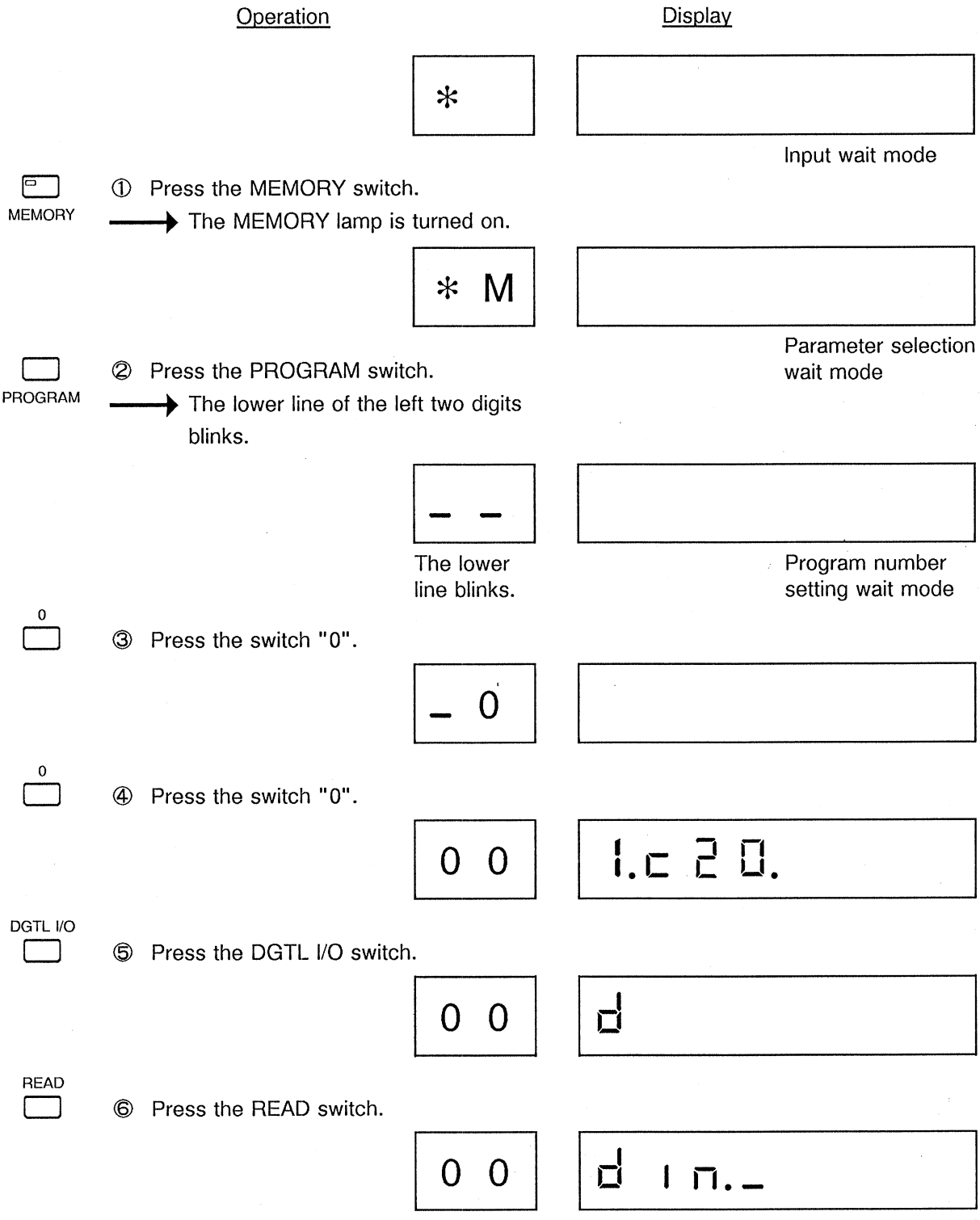


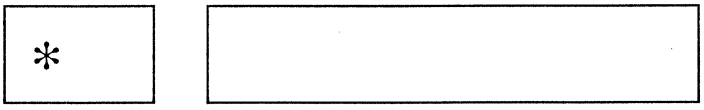
Figure 2-16 Setting Digital Read

2

⑦ Press the switch "2".

STORE

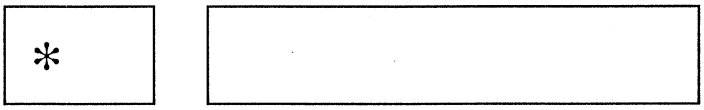
⑧ Press the STORE switch.
(To set the next program number data, press the NEXT switch.)
→ The digital read command input in program No. 00 is stored and the input wait mode is set.



Input wait mode

■ Direct Digital Read

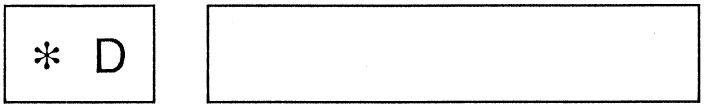
Operation	Display



Input wait mode

DIRECT

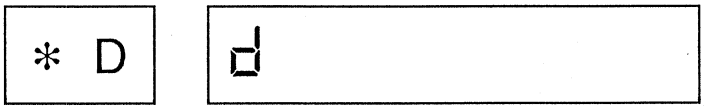
① Press the DIRECT switch.
→ The DIRECT lamp is turned on.



Direct access selection wait mode

DGTL I/O

② Press the DGTL I/O switch.



READ

③ Press the READ switch.

Figure 2-16 Setting Digital Read (Cont'd)

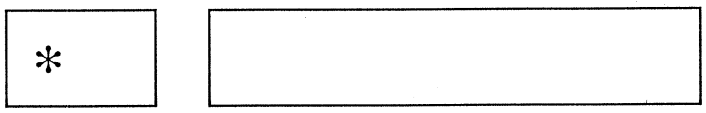
0

④ Press the switch "0".

EXECUTE

⑤ Press the EXECUTE switch.

→ The lower 8 bits of the data are read and taken into the read buffer.



Input wait mode

Note 1: Digital Read can be assigned only once to one program number. Also, only one direct digital read command can be executed.

Note 2: It is impossible to input a Digital Read statement and another switch card control command in one program statement or in one direct access statement.

Figure 2-16 Setting Digital Read (Cont'd)

(3) Digital read buffer

The digital read buffer can store 1000 pieces of 16-bit digital read data. With the digital read buffer, it is possible to:

① see the number of times the digital read buffer has been used up to the present;

② make a request for "read buffer full" by means of the SRQ signal of GPIB;

③ see the read data by specifying a data number 1 to 1000;

④ clear the read buffer.

The following shows how to do ①, ④ and ③.

■ Seeing the number of times the digital read buffer has been used up to the present and how to clear the buffer

Operation	Display
	*
	Input wait mode
MEMORY ① Press the MEMORY switch. → The MEMORY lamp is turned on.	* M
	Parameter selection wait mode
DGTL I/O ② Press the DGTL I/O switch.	I O
R.NO ③ Press the R.NO switch. → The read buffer counter displays numbers from 0 to 999. If the buffer is full, the message "FULL" is given.	R B 0 0 1

(To clear the read buffer here, go to ④. Otherwise, go to ⑤.)

CE ④ Press the CE switch. → A message is given indicating that the read buffer is to be cleared.	R B C L E A r

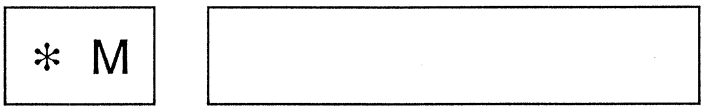
(If the read buffer is not to be cleared, press the CE switch again and you can return to ③.)

Figure 2-17 Referencing and Clearing the Digital Read Buffer

NEXT
or
STORE

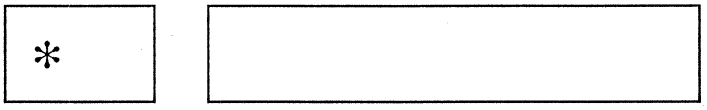
⑤ Press the NEXT switch or STORE switch.
→ If "CLEAR" is displayed, the read buffer is cleared.

• NEXT switch



Parameter selection wait mode

• STORE switch

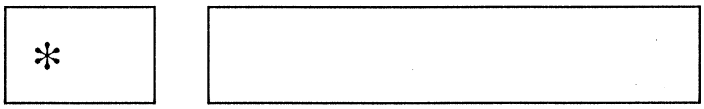


Input wait mode

Figure2-17 Referencing and Cliaring the Digital Read Buffer

■ Read data referencing

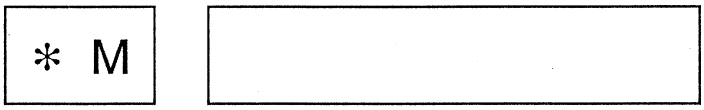
Operation Display



Input wait mode

MEMORY

① Press the MEMORY switch.
→ The MEMORY lamp is turned on.



Parameter selection wait mode

DGTL I/O

② Press the DGTL I/O switch.

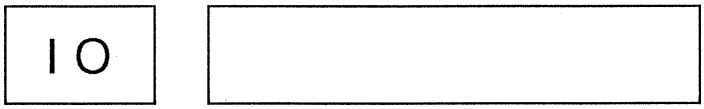


Figure 2-18 Referencing Read Data

READ

③ Press the READ switch.

→ The data No. input wait mode is set.
The data number should be between 1 to 999, or 0. (0 means the 1000th data.)
To see the latest read data, input "," alone in the data number input wait mode.

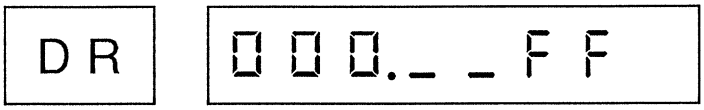
Data number input wait mode

0

④ Press the switch "0".

,

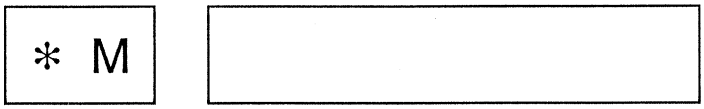
⑤ Press the switch ",".



NEXT

⑥ Press the NEXT switch or STORE switch.

• NEXT switch



Parameter selection wait mode

or

STORE

• STORE switch

Input wait mode

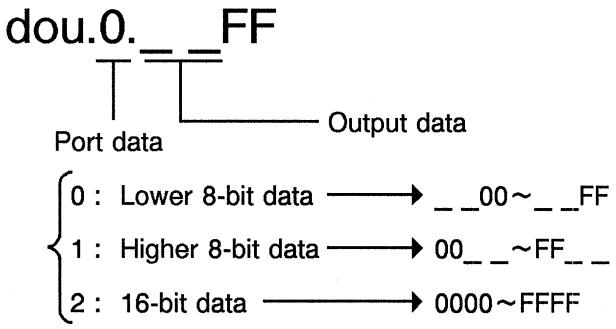
Note 1: Inputting "," is to show the end of the input data. For the 999th data, therefore, input "999,".

Note 2: It is impossible to change the buffer data here.

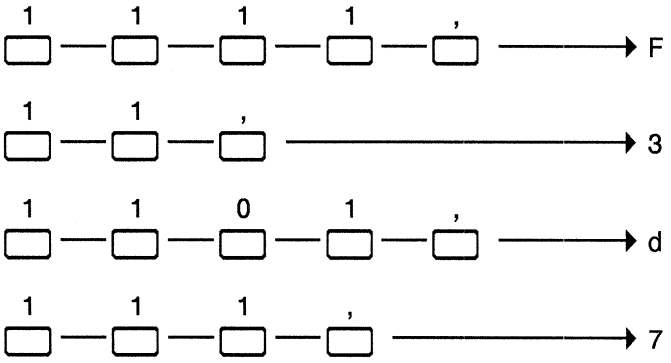
Figure 2-18 Referencing Read Data (Cont'd)

(4) Digital Write

This function is used to output 16-bit data. Here, as with the case of Digital Read, port data is to be set. Port data shows the scope of the data to be output. There are three types of port data. Then, output data is to be set.
It needs setting in a bit pattern comprising 1 and 0 and is to be partitioned every four bits.



Output data needs setting in a bit pattern comprising 1 and 0 which is to be partitioned every four bits. To set F3d7, for example, press keys in the following manner:



The following is the method to set Digital Write. The example shows how to program Digital Write in program number 00 and how to perform Direct Digital Write.

■ Digital Write programming

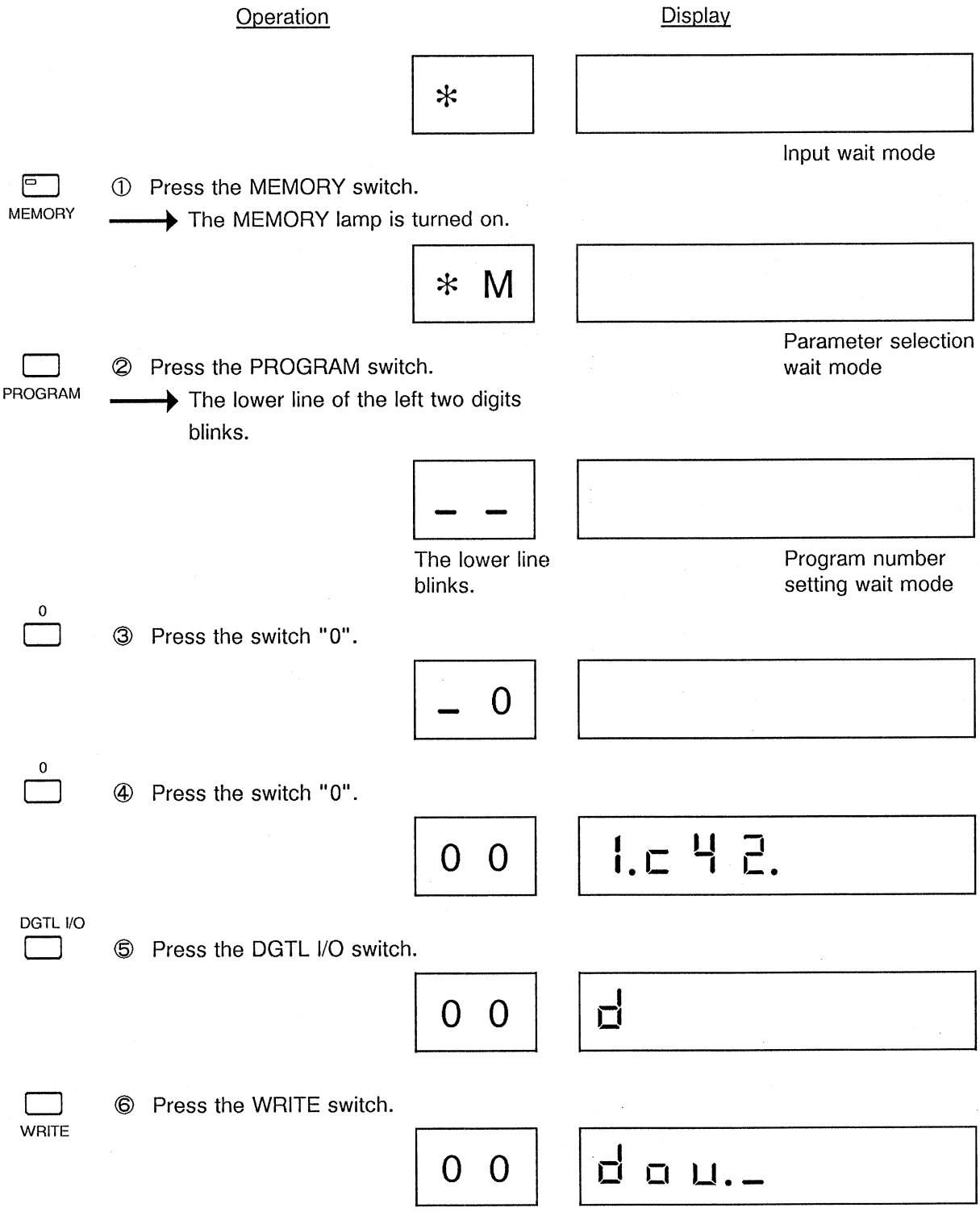
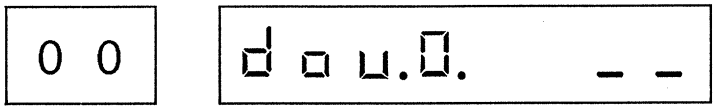


Figure 2-19 Setting Digital Write

0

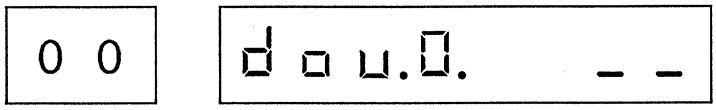
⑦ Press the switch "0".

→ The port data is set in the lower 8 bits.



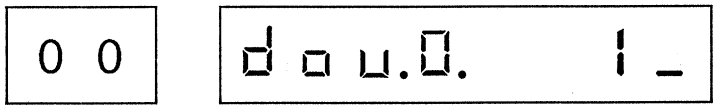
⑧ Press the switch "⇨".

→ The second digit from the right blinks.



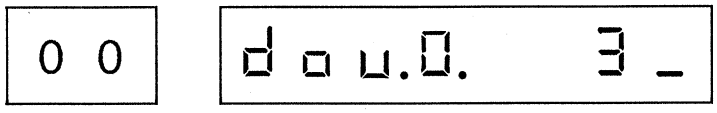
1

⑨ Press the switch "1".



1

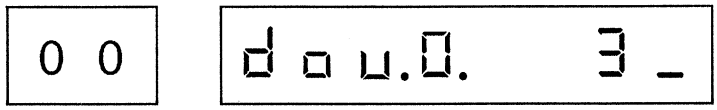
⑩ Press the switch "1".



,

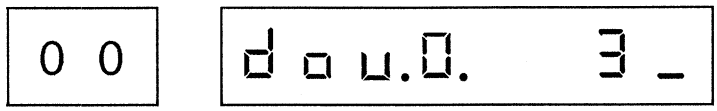
⑪ Press the switch ",".

→ The higher 7 to 4 bits are set.



⑫ Press the switch "⇨".

→ The digit at the right side blinks.



Blinking

0

⑬ Press the switch "0".

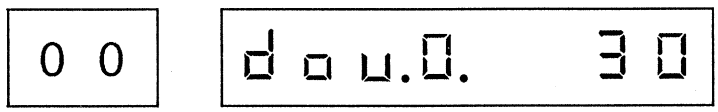


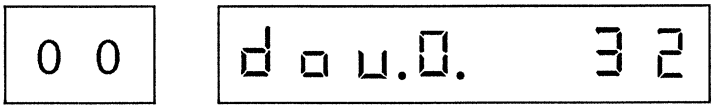
Figure 2-19 Setting Digital Write (Cont'd)

1

⑭ Press the switch "1".

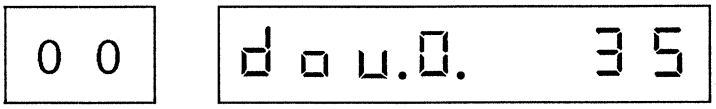
0

⑮ Press the switch "0".



1

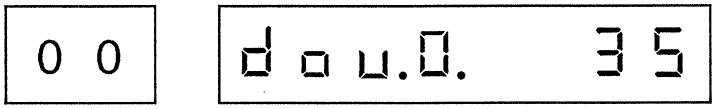
⑯ Press the switch "1".



,

⑰ Press the switch ",".

→ The lower 3 to 0 bits are set.
If an input error is made, input the correct data every four bits by using the switch "1" or "0".



STORE

⑱ Press the STORE switch.

→ The Digital Write command is written in program number 00 and the input wait mode is set.

Input wait mode

Figure 2-19 Setting Digital Write (Cont'd)

■ Setting Direct Digital Write

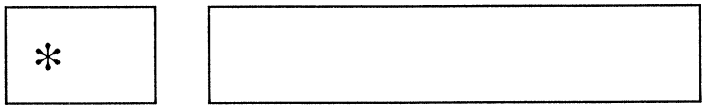
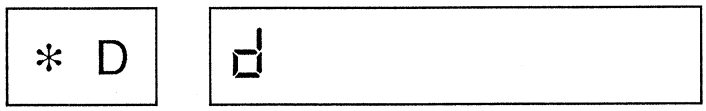
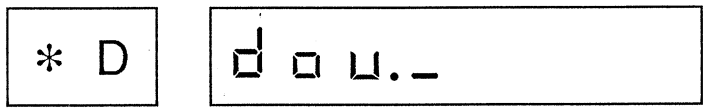
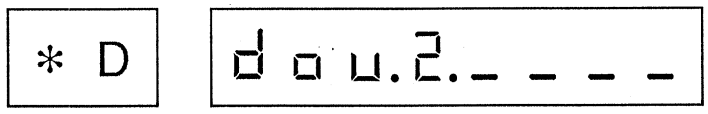
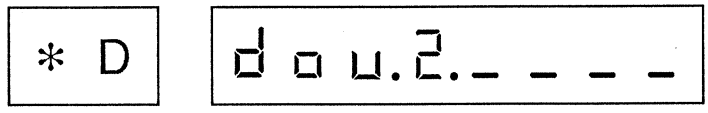
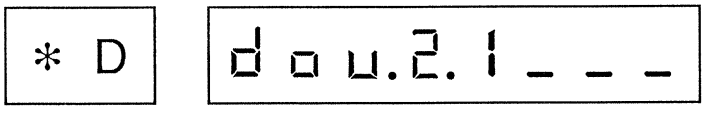
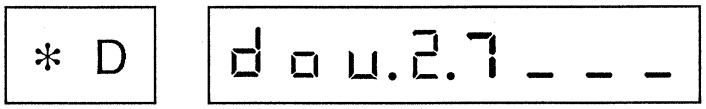
Operation	Display
	
	Input wait mode
DIRECT ① Press the DIRECT switch. → The DIRECT lamp is turned on.	
	Input wait mode
DGTL I/O ② Press the DGTL I/O switch.	
WRITE ③ Press the WRITE switch.	
2 ④ Press the switch "2". → The port data is set in the 16-bit data.	
⑤ Press the switch "⇨". → The highest digit blinks.	
	Blinking
1 ⑥ Press the switch "1".	

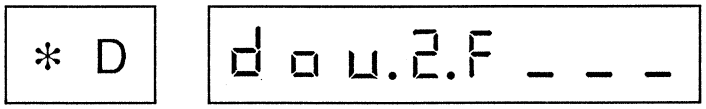
Figure 2-19 Setting Digital Write (Cont'd)

1 ⑦ Press the switch "1".

1 ⑧ Press the switch "1".

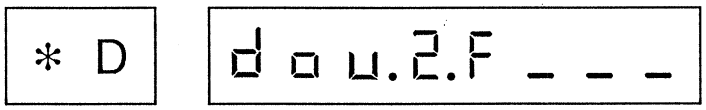


1 ⑨ Press the switch "1".



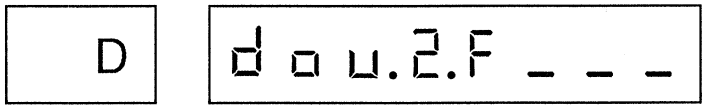
, ⑩ Press the switch ",".

→ The highest 15 to 12 bits are set.



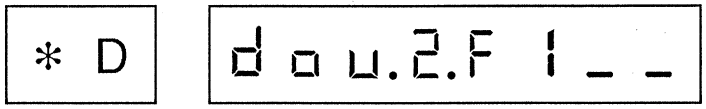
⑪ Press the switch "⇨".

→ The next digit blinks.

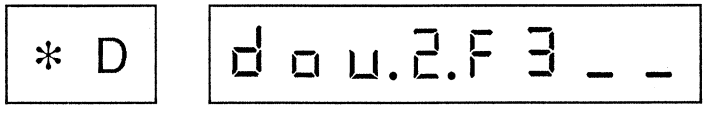


Blinking

1 ⑫ Press the switch "1".



1 ⑬ Press the switch "1".

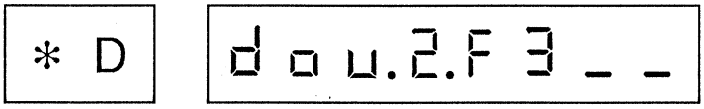


, ⑭ Press the switch ",".

→ The next 11 to 8 bits are set.

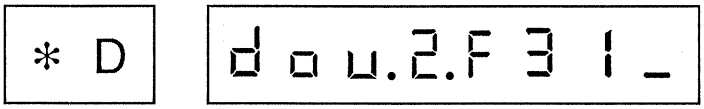
Figure 2-19 Setting Digital Write (Cont'd)

⇨ ⑮ Press the switch "⇨".
→ The next digit blinks.

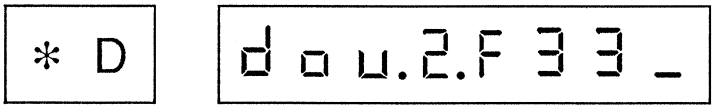


Blinking

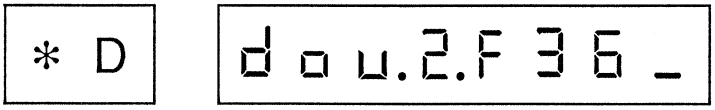
1 ⑯ Press the switch "1".



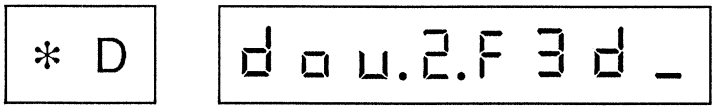
1 ⑰ Press the switch "1".



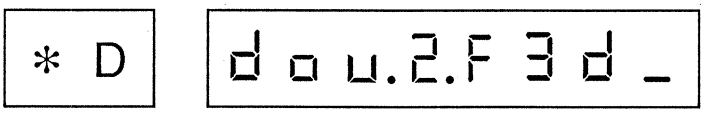
0 ⑱ Press the switch "0".



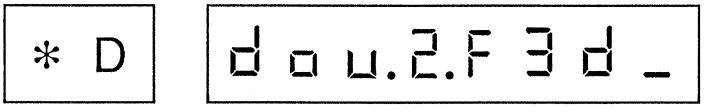
1 ⑲ Press the switch "1".



, ⑳ Press the switch ",".
→ The next 7 to 4 bits are set.



⇨ ㉑ Press the switch "⇨".
→ The lowest digit blinks.



Blinking

1 ㉒ Press the switch "1".

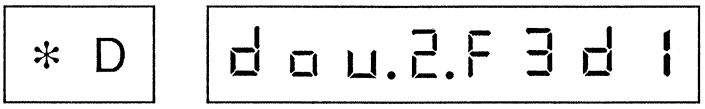
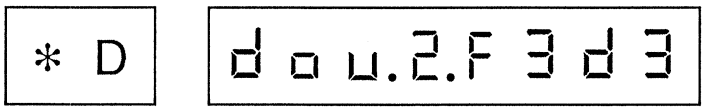


Figure 2-19 Setting Digital Write (Cont'd)

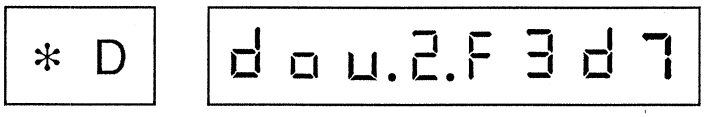
1

㉓ Press the switch "1".



1

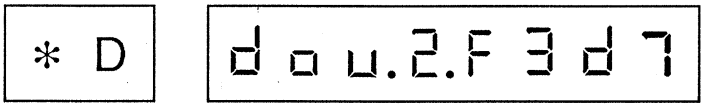
㉔ Press the switch "1".



,

㉕ Press the switch ",".

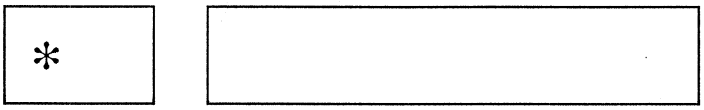
⟶ The lowest 3 to 0 bits are set.



EXECUTE

㉖ Press the EXECUTE switch.

⟶ The 16-bit data of F3d7 is output.



Input wait mode

Note 1: The data change operations of ③ and ④ are done by using the DELETE switch. The data change operations of ⑤ through ㉕ are done by shifting digits by means of the " ⇨ " and " ⇦ " switches.

Note 2: Input data is changed every 4 bits. For example, pressing the switch "1" in succession causes the display to give a cyclic change of →1→3→7→F→.

Figure 2-19 Setting Digital Write (Cont'd)

(5) OPEN/CLOSE digital bits

These bits are used to output 16-bit data.

The difference from Digital Write is that the bits can be set in the unit of 0 to 15 bits. The bits set in the digital I/O mode (polarity) are changed and output with OPEN/CLOSE being false/true.

Example: With the polarity set at 0 (all bits : High true), setting

od0.od1.cd2.

causes the following to be output:

	MSB ... LSB
① Bit 0 open	××××××××××××××0
② Bit 1 open	××××××××××××××0 0
③ Bit 2 close	××××××××××××××1 0 0

(The bits marked with × are not changed.)

As shown above, output is made in the sequence ①→②→③.
The following are the characteristics of the OPEN/CLOSE bits and how to set them.

- These bits can be set in the same manner as with OPN/CLS of other switch card.
- These can be set in a program an direct channel access data.
- These can be set together with the OPN/CLS data of any other switch card.

■ Programming the OPEN/CLOSE digital bits

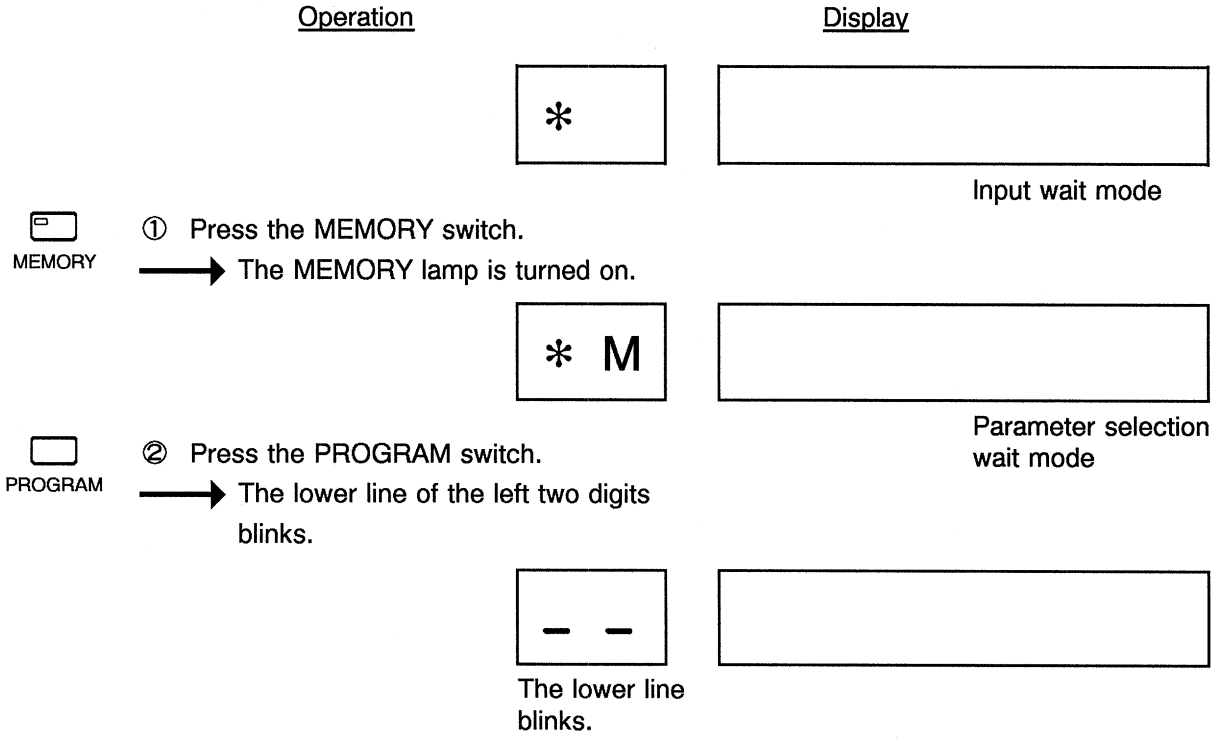
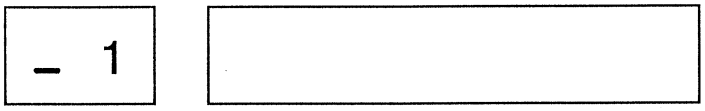


Figure 2-20 Setting the OPEN/CLOSE Digital Bits

1

③ Press the switch "1".



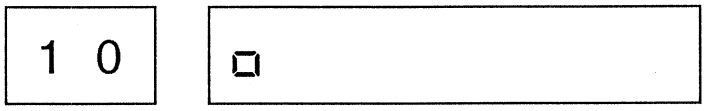
0

④ Press the switch "0".

→ The currently set program data is displayed.

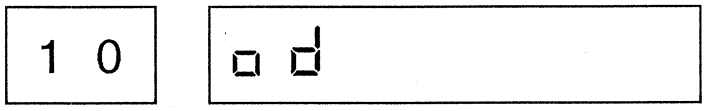
OPN

⑤ Press the OPN switch.



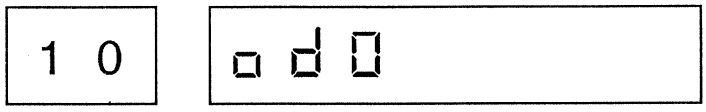
DGTL I/O

⑥ Press the DGTL I/O switch.



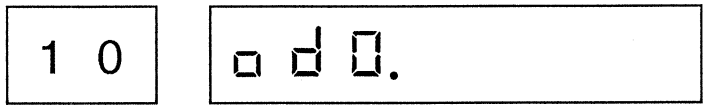
0

⑦ Press the switch "0".



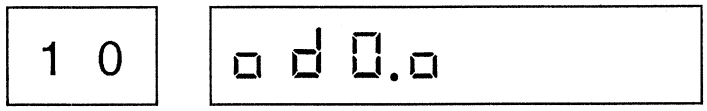
,

⑧ Press the switch ",".



OPN

⑨ Press the OPN switch.



DGTL I/O

⑩ Press the DGTL I/O switch.

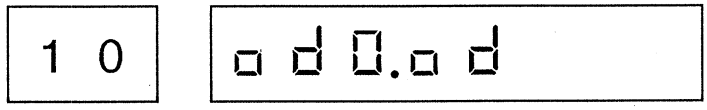


Figure 2-20 Setting the OPEN/CLOSE Digital Bits (Cont'd)

1

⑪ Press the switch "1".

1 0	ad0.ad1

,

⑫ Press the switch ",".

1 0	ad0.ad1.

CLS

⑬ Press the CLS switch.

1 0	ad0.ad1.c

DGTL I/O

⑭ Press the DGTL I/O switch.

1 0	ad0.ad1.cd

2

⑮ Press the switch "2".

1 0	d0.ad1.cd2

,

⑯ Press the switch ",".

1 0	d0.ad1.cd2.

STORE

⑰ Press the STORE switch.
(To set the next program number data in succession, press the NEXT switch.)
→ The data input in program number 10 is stored and the input wait mode is set.

*	

Input wait mode

Note 1: For a direct channel access, too, set and execute ⑤ through ⑮.

Note 2: Programming or direct channel access can be performed in combination with the OPN/CLS data of any other switch card.

Figure 2-20 Setting the OPEN/CLOSE Digital Bits (Cont'd)

2.5 Self Diagnosis

This function is to check the panel lamps and switch cards for normal operation. The function is executed by the GPIB command. It is also executed automatically when power is turned on.

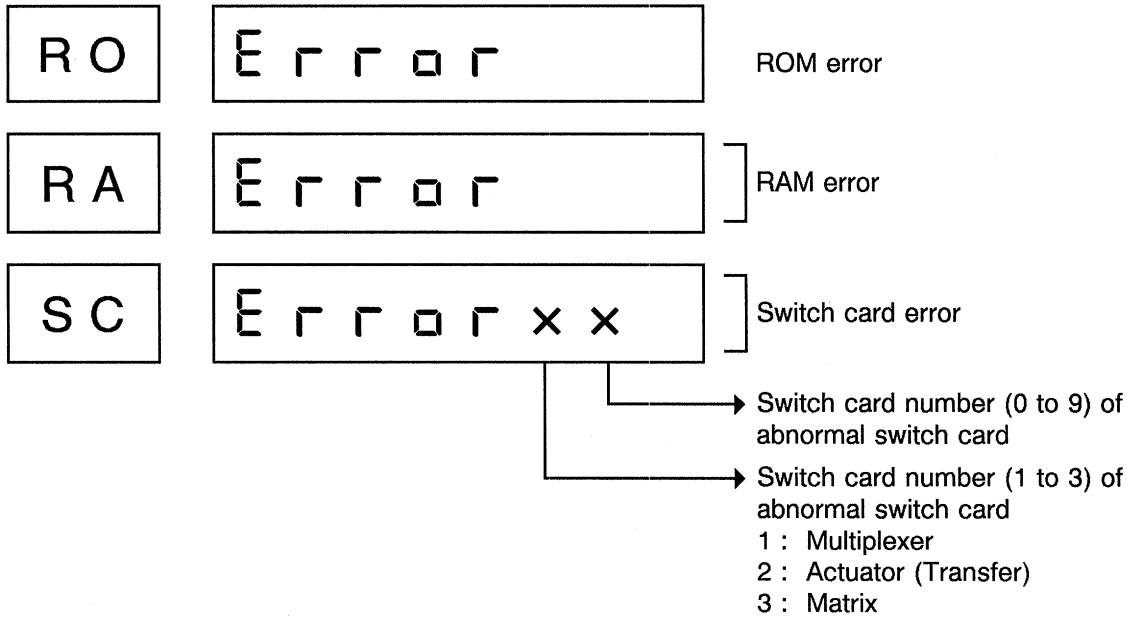
As for the memory, ROM such checking and RAM read/write checking are performed.

For the switch cards, dummy data is sent to control each contact point and based on the response signal to the data, whether the operation of the control card in each card is operated normally is judged.

If no abnormal condition is found, all the lamps and panel display are turned on and then the input wait mode is set.

If an abnormal condition is found in memory and/or switch card checking, the message corresponding to that error is given.

The following is the error messages given in the event of specific errors. In this state happens, please contact an ADC CORPORATION sales representative.



Note: Executing the self-diagnostic function causes all the contacts of the switch cards are made open.

Figure 2-21 Error Messages

3. APPLICATIONS

The 7210 is a series of highly flexible switching devices.
This section gives some sample systems using the 7210.

3.1 Small-Size Data Recording System

Figure 3-1 gives a configuration block diagram of the system.

This system is used, for example, to measure data that changes in time and characteristic data of parts, such as a Zener diode and solenoid resistance. Measured data itself can be used as the final data.

The system consists of a scanner, digital multi-function meter and digital recorder. The scanner uses a multiplexer card with as many channels as the number of parts to be measured.

This system provides the scanner with the role of controller. Control parameters, such as the first and last channels and scan interval, from the panel to control the system as a whole.

The 7210 and the digital-function meter are connected via a dedicated control signal cable that conveys "TRIGGER" and "COMPLETE" signals.

The data measured on the digital multi-function meter are sent to the digital recorder by means of a 50-pin data output cable (MO-01/MO-26).

In the "SCANNER" mode, the digital recorder can be used to print channel numbers as well as measurement data.

The scanner's TRIGGER OUT signal is used as the measurement starting signal for the digital multi-function meter. Since it is possible to set a settling time by the 7210, it is possible to delay the start of measurement until the internal circuit is settled completely after the signal is applied to the digital multi-function meter.

To operate the system, set the measurement function and range of the digital multi-function meter, and set the sample mode in "EXT". Then, set the digital recorder in a RUN state and finally start the scanner. Data is measured and printed at the time intervals set on the scanner.

For the operations of each system device, refer to their respective instruction manuals.

Note: When using the TR6198 in the "SCANNER" mode, don't use the PRINT COMMAND signal as a signal to advance the sequence of the 7210. If the same sequence operation is repeated twice or more, the channel number is skipped.

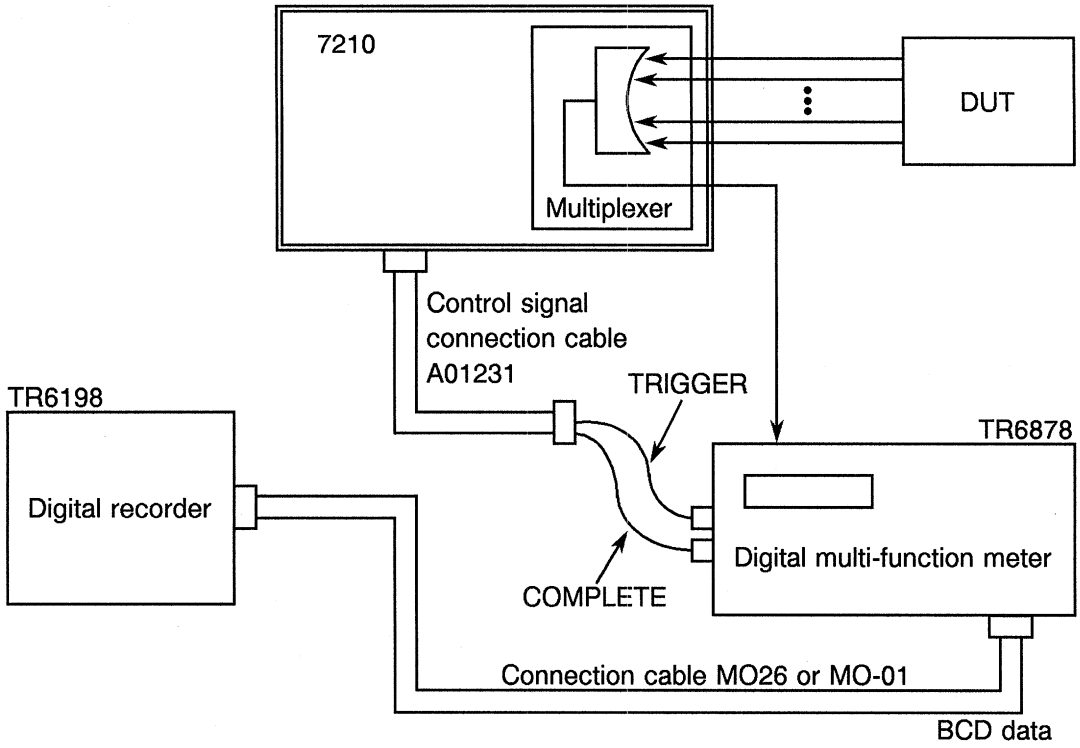


Figure 3-1 Small-Size Data Collection System Block Diagram

3.2 Automatic Electronic Circuit/Electronic Parts Testing System

The matrix card of the 7210 can be used effectively to test the characteristics of electronic circuits and parts. Figure 3-2 gives a sample integrated analog IC testing system.

The matrix card allows any cross point to be opened and closed. Because of its contact point configuration, it is possible to connect any input/output in the X direction to any input/output in the Y direction. It is, therefore, possible to add the input and output of all measurement instruments and generators connected to individual pins of the IC concerned by connecting the measurement instrument and generator group in the Y direction and the IC pins in the X direction.

Since the matrix card has 4×4 cross points, it is possible to use multiple cards to make a combination of 8×8, for example, depending on the numbers of the measurement instruments and generators and IC pins used. (To use multiple cards to make a matrix of many cross points, connect X and Y of each card. By doing this, it is possible to obtain various connection point configurations such as 8×8.)

Testing can be done by connecting the specified measurement instruments and generator to the appropriate IC pins according to measurement conditions. Since a maximum of 100 steps of cross point control information can be programmed in the 7210, it is possible to provide 100 different measurement conditions. When performing a direct channel access from the controller, it is possible to create more than 100 measurement conditions.

This example used a matrix card alone. It is, however, recommended to use a combination of matrix, multiplexer and actuator cards to make the most suitable system for specific tests.

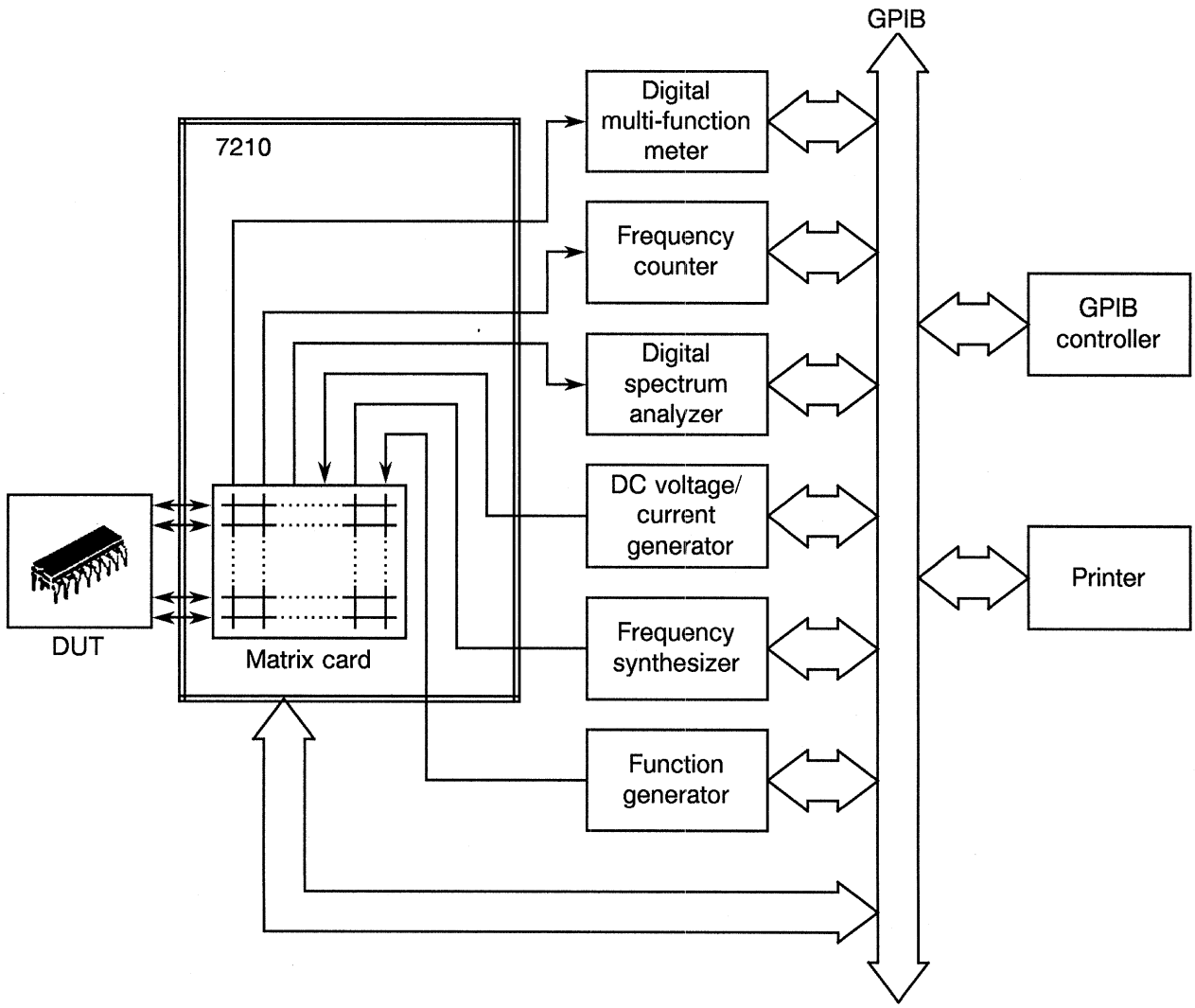


Figure 3-2 Block Diagram of Automatic Electronic Circuit/Parts Testing System

3.3 PCB Testing System

Normally, a PCB is tested by putting the board in an operating condition. But the circuit board to be tested seldom functions alone. To operate it usually requires connecting some external auxiliary circuits. And it is usual that such external auxiliary circuits undergo changes in their operating conditions depending on test items.

The 7210 can be used for this type of board testing as well. Figure 3-3 gives a sample board test system configuration.

The sample system uses an actuator card for the above-mentioned external auxiliary circuits. It generates various external circuit conditions according to test items. (The actuator can also be used for sequence control.)

The sample system applies the voltage and current and measures signals by means of multiplexer cards and thereby tests PCBs. It is also possible to add matrix cards as needed.

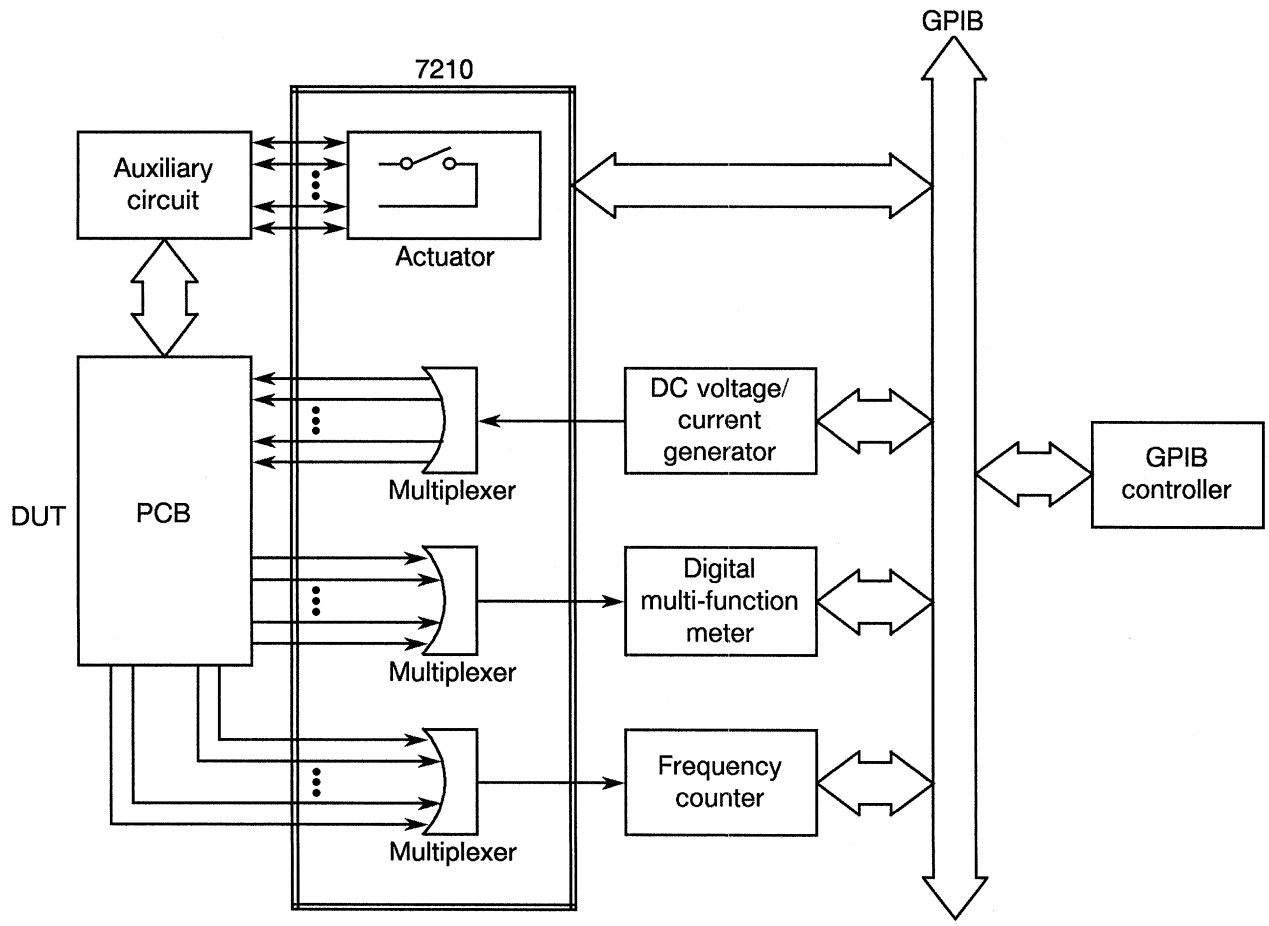


Figure 3-3 PCB Testing System Block Diagram

4. GPIB INTERFACE

The instruction is provided with a GPIB interface and is therefore capable of control by means of a measurement bus based on the IEEE 488-1978 specifications. (GPIB: General Purpose Interface Bus)

4.1 How to Use the GPIB Interface

(1) Rear panel

Figure 4-1 shows the GPIB interface panel.

① GPIB connector

This is an IEEE488 bus-compatible 24-pin connector. Since this is a piggyback-type connector, it is possible to make a pile of standard bus cables. But it should be avoided to pile three or more connectors.

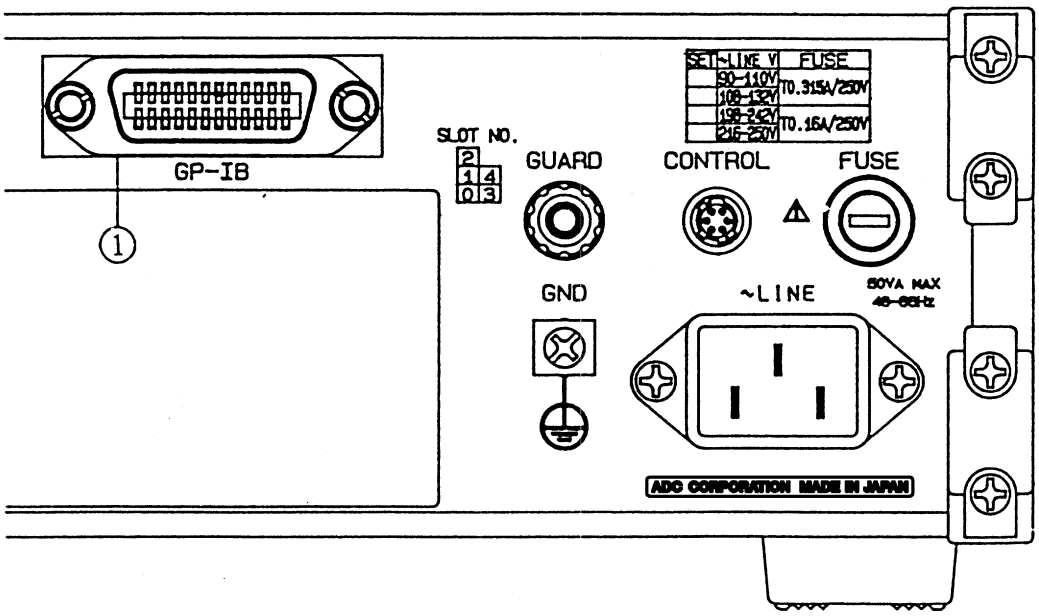


Figure 4-1 Rear Panel

(2) Address setting

With the BPIB, the device address of the instruction is set by using switches on the panel. It is possible to set ADDRESSABLE/ONLY as well. Figure 4-2 shows the method of address setting. In the figure, both ADDRESSABLE and address are set at "1".

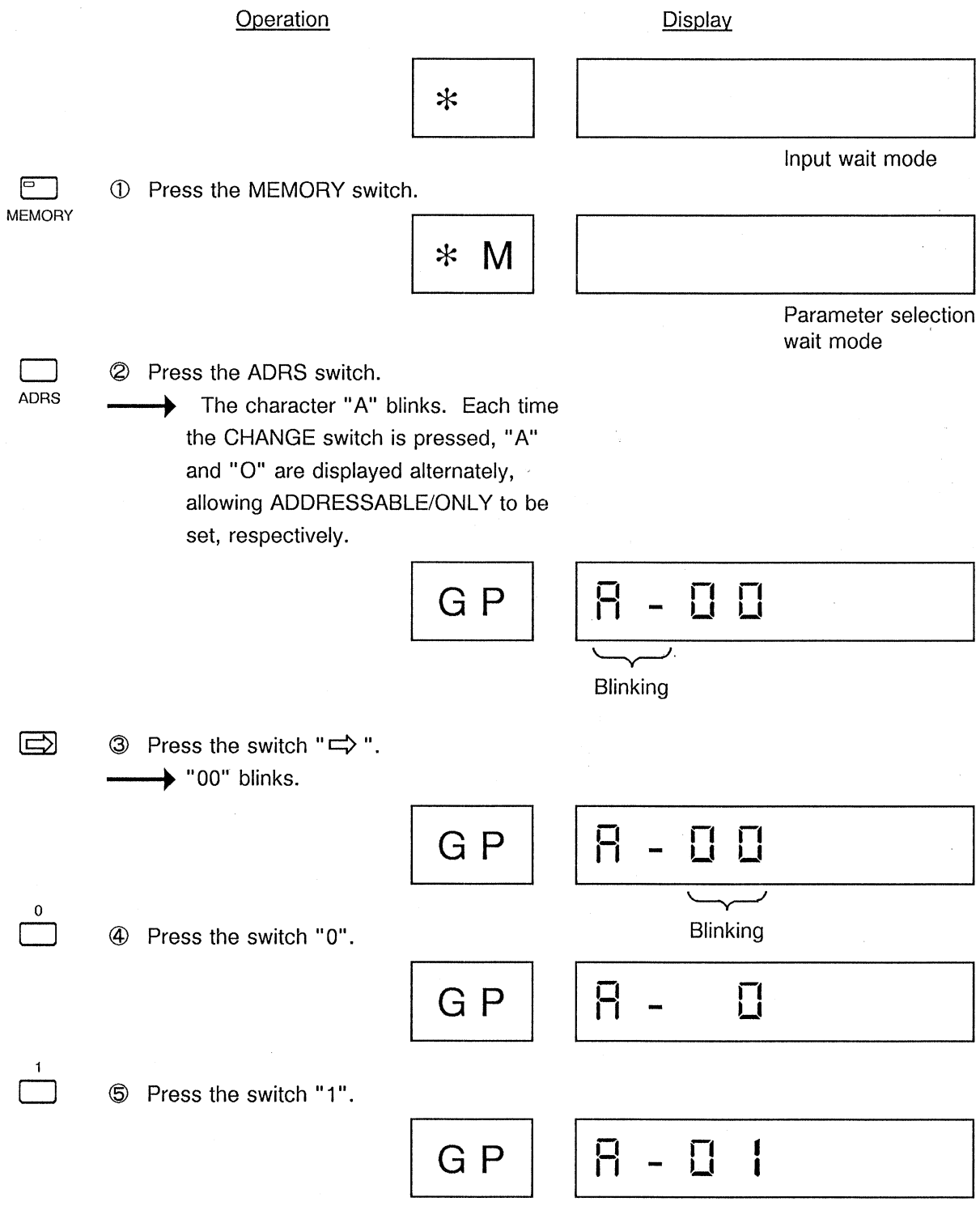


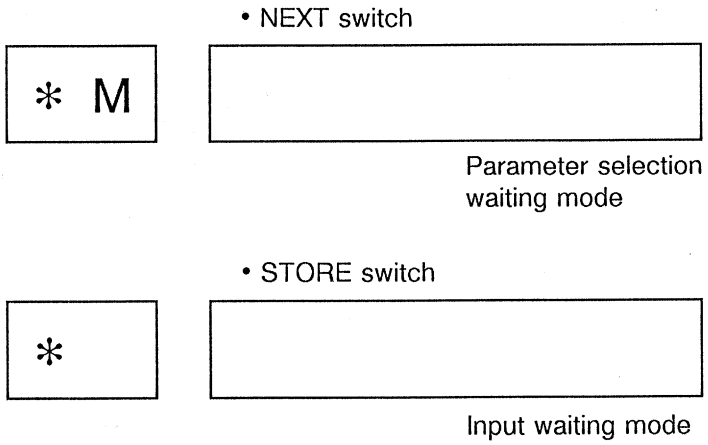
Figure 4-2 Address and Other Data Setting

NEXT

or

STORE

⑥ Press the NEXT switch or STORE switch.
⟶ The data input is set.



Note 1: After the operation of ⑤, it is possible to change the setting of "A" by using the switch " ⇦ ".

Note 2: Addresses can be set from 0 to 30.

Note 3: If "ONLY" is set, the "LISTEN ONLY" mode is established. That is, the instruction is fixed as "listener".

Figure 4-2 Address and Other Data Setting (Cont'd)

(3) Preparations for operation

① Connect the instruction and the component units such as controller by means of a bus cable.

② Make the necessary switch card wiring.

③ Set the addresses of the instruction and component units.

Note: When connecting or removing the GPIB bus cable, disconnect the power cable in advance without fail.

Table 4-1 gives an address code table. Use the table when checking the GPIB bus line checking, etc.

Table 4-1 Address Code Table

ASCII code character		Decimal code
LISTEN	TALK	
SP	@	0
!	A	1
"	B	2
#	C	3
$	D	4
%	E	5
&	F	6
'	G	7
(	H	8
)	I	9
*	J	10
+	K	11
,	L	12
-	M	13
.	N	14
/	O	15
0	P	16
1	Q	17
2	R	18
3	S	19
4	T	20
5	U	21
6	V	22
7	W	23
8	X	24
9	Y	25
:	Z	26
;	[	27
<	\	28
=	]	29
>	~	30

4.2 Standard

- Reference standard : IEEE STANDARD 488-1978
  (DIGITAL INTERFACE FOR PROGRAMMABLE INSTRUMENTATION)
- Interface function : Table 4-2 is a list of the interface functions.

Table 4-2 Interface Functions

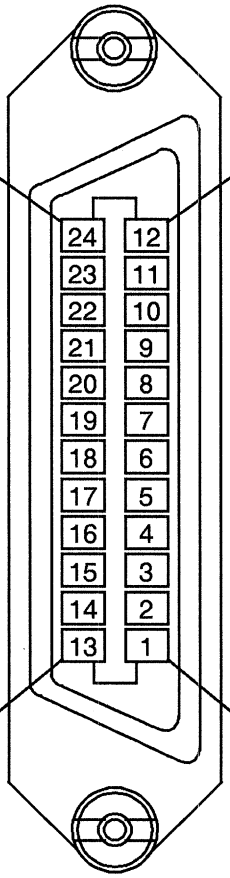
Code	Function
SH1	Source handshake function
AH1	Acceptor handshake function
T6	Basic talker function Serial poll function Listener reset function with listener specification
L3	Basic listener function Listen only mode function Listener reset function with talker specification
SR1	Service request function
RL1	Remote/local switching function
PR0	No parallel poll function
DC1	Device clear function (The "SDC" and "DCL" commands can be used.)
DT1	Device trigger function (The "GET" command can be used.)
C0	No controller function
E2	Use of three-state bus driver

- Code used : ASCII code

- Connector pin arrangement:

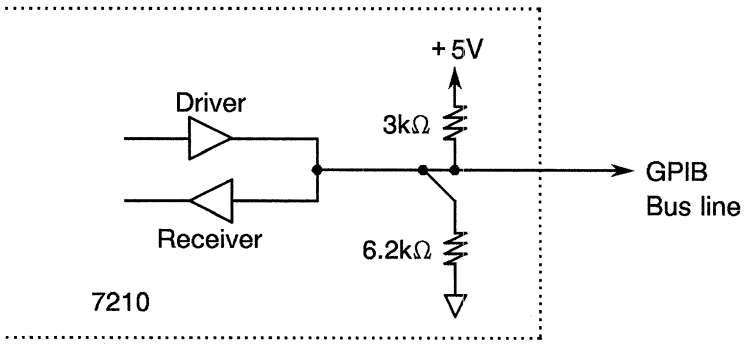
24-pin GPIB connector

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
DIO8	16
DIO7	15
DIO6	14
DIO5	13



Pin No.	Signal Name
12	SHIELD
11	ATN
10	SRQ
9	IFC
8	NDAC
7	NRFD
6	DAV
5	EOI
4	DIO4
3	DIO3
2	DIO2
1	DIO1

- Logic level : Logic 0 ("HIGH" state) : +24V or more
  Logic 1 ("LOW" state) : +0.4V or less
- End of signal line : Each of the 16 bus lines is terminated as shown below:



- Driver specifications : LOW state output voltage : +0.4V or less, 48mA
  HIGH state output voltage : +2.4V or more, −5.2mA
- Receiver specifications : LOW state : +0.6V or less
  HIGH state : +2.0V or more

4.3 Listener Format

(a) Control parameter related

Item	Code	Description
Scan mode	M00	Sets the sequential scan mode.
	M01	Sets the random scan mode.
Channel No.	FCxx	Sets the first channel. xx : 0 to 99
	LCxx	Sets the last channel. xx : 0 to 99
Program No.	FPxx	Sets the first program No. xx : 0 to 99
	LPxx	Sets the last program No. xx : 0 to 99
Trigger mode	TR0	MANUAL
	TR1	EXTERNAL
	TR2	AUTO
No. of repetitions	RNxx	No. of scan repetitions xx : 0 to 99
Step interval	SIxxxTd	Sets the step interval time. xxx : 0 to 999 d : Time unit { 0 : ms 1 : s 2 : min.
Repeat interval	RIxxxTd	Sets the repeat interval time. xxx : 0 to 999 d : Time unit { 0 : ms 1 : s 2 : min.
Block setting/ resetting	SB ...G	$SBA_0 - B_0$, $A_1 - B_1G$ Adds G at the end of data without fail.
	RB	Reset
Program	Mnn, ...G	Mnn, DATA1, ...DATAnG Program No. nn: 0 to 99
	Mnn, G	No access is made to the switch card as program data.

(b) Direct access related

Item	Code	Description
Direct channel access	DI, ...G	DI, DATA1, ..., DATAnG Accesses the switch cards that correspond to DATA1 to DATAn.
Direct program access	DPMnn	Accesses the switch card that corresponds to the data programmed in program No. nn (nn : 0 to 99).

(c) Digital I/O related

Item	Code	Description
Digital I/O mode (polarity) setting	DMx	DMx └ Polarity data { 0 : 16 bits High true 1 : Lower 8 bits Low true 2 : Higher 8 bits Low true 3 : 16 bits Low true
Bit data setting	ODxx CDxx	ODxx . . . . . Opens (false) the specified bit. CDxx . . . . . Closes (true) the specified bit. xx : 0 to 15
Digital Write setting	DWx, Hdddd DWx, dddddd	DWx, └ Port data { 0 : L8 bits 1 : H8 bits 2 : 16 bits • HEX data H dddd : 00 to FF 0000 to FFFF • Decimal data dddddd : 0 to 255 – 32768 to 32767
Digital Read setting	DRx	DRX └ Port data { 0 : L8 bits 1 : H8 bits 2 : 16 bits
Digital read buffer clearing	BC	Clears the digital read buffer.

- The digital I/O mode (polarity) cannot be set with a direct channel access or a program.

  Example: Sending "DI, DM0G" and "M00, DM0G" causes an error.
  It is necessary to set "DM0" correctly.

- Bit data can be set with a direct channel access and a program. But bit data alone cannot be set.

  Example: Sending "OD0" and "CD1" causes an error.
  It is necessary to make a correct setting as "DI, OD0G" and "M00, CD1G".

- Digital Read/Write should be set in the following manner:

  Sample program: "M00, DW0, 255G" or "M00, DR0G"

  Sample direct access: "DW0, HFF" or "DR0"

  Note 1: Only one Digital Read/Write can be set for one program number. (It is impossible to set more than one Digital Read/Write or set Digital Read/Write in combination with other switch cards.)

  Note 2: It is impossible to include Digital Read/Write in a direct channel access ("DI, ...G").

  Example: Sending "DI, DW0, 255G" and "DI, DR0G" causes an error.

  Note 3: Direct Digital Read/Write can be executed during a scan sequence operation (when the START lamp is on).
  But the setting of bit data is ignored during a scan sequence operation.

(d) Service request related

Item	Code	Description
Service request	S0	Sends an SRQ.
	S1	Sends no SRQ.

(When power is applied or when the "DCL" or "SDC" command or the program code "C" is received, the S1 mode is set.)

(e) Delimiter related

Item	Code	Description
Block delimiter specification	DL0*	Specifies a block delimiter to CR LF (EOI).
	DL1	Specifies a block delimiter only to LF.
	DL2	Specifies a block delimiter only to (EOI).

* Indicates an initial value.

(f) Operation related

Item	Code	Description
Operation	E	Starts a scan sequence operation.
	H	Stops the scan sequence operation.
	N	Advances the scan sequence when the trigger mode is set as EXTERNAL.
	C	Code used to set the device in the initial state. Stops the scan sequence operation and opens all contact points of the switch card concerned.

(g) Referencing the currently set data
(The data is output with the following talker specification.)

Item	Code	Description
Control parameter related	RMO	References the scan mode.
	FLC	References the first and last channels.
	FLP	References the first and last program numbers.
	RTR	References the trigger mode.
	RRN	References the number of repetitions.
	RSI	References the step interval time.
	RRI	References the repeat interval time.
	RSB	References the block setting.
	RMnn	References the block data. (nn : 0 to 99)
Referencing of data input in Digital Read	RD**** RDH**** (HEX. specification)	**** : Can be set from 1 to 1000. The latest input data can be set with 0.
	RDB (Binary specification)	All data from 1 to 1000 is output in a binary form.

(Cont'd)

Item	Code	Description
Execution of self-diagnostic function and referencing of error data	TS	Executes the self-diagnostic function when power is turned on.
Referencing of the digital read buffer	RRB	References the number of buffers used 1 to 1000.
Referencing of digital I/O mode (polarity)	IOM	References the digital I/O polarity data (0 to 3).

(h) Status byte mask function

Item	Code	Description
Status byte mask specification	MSdd (dd = 0 to 63)	If a mask is specified, the corresponding bit is not made "1" even when a status byte factor arises.

(When power is applied, or the "DCL" or "SDC" command or the program code "C" is received, a state is set which is in effect the same as mask cleared (sending of MS0).)

- Program

  Format: "Mnn, DATA1, ..., DATAn G"

  The program data ____ is stored in program number nn (0 to 99). The format of the ____ part is the same as with the case of local setting from the panel. See 2.2.1-(9). (c ... close, o ... open: The characters are made uppercase.)
  If no access is to be made to a switch card as program data, describe "Mnn, G".

- Direct channel access related

  Format: "DI, DATA1, ..., DATAn G"

  Access is made to the switch card that corresponds to the data marked by ____. The format is the same as the above-described program format except that "Mnn," is replaced by "DI,". For the format of the ____ part, see Figure 2-11. (In this case, to, the letters c and o are made uppercase.)

- Service request related

  "S0" : Service request sending mode
  "S1" : No service request is sent.
  (When power is applied, or the "DCL" or "SDC" command or the program code "C" is received, this mode is set.)

- Other program codes

  "E" : Used to start a scan sequence operation. Equivalent to START for local operation.

  "H" : Used to stop the scan sequence operation. Equivalent to STOP for local operation.

  "N" : Used to advance the scan sequence when the trigger mode is set as EXTERNAL ("EX").
  Each time this code is set, the sequence is advanced by one. The code is ignored is the trigger mode is other than "EX" and when the scan sequence is yet to be started.

  "C" : Used to put the device in the initial state.
  Setting this code causes the scan sequence operation to be stopped and all contact points of the switch cards mounted to be opened. At the same time, the non-service request sending mode ("S1") is set and the previously set status byte is cleared.

Note 1: The space code "␣" (space) in a string is ignored.

Note 2: Send the "LF" (12_8) to the end of each string as terminator. (Both "CR" and "LF" may be sent.)
If "LF" is not to be sent, output the single line signal "EOI" when sending the last character. (Both "LF" and "EOI" may be sent.)
If neither the "LF" code or the "EOI" signal is output, the operation stops in a handshake state because the end of the string cannot be detected.

Note 3: If an undefined code is received, the program code just before the code is accepted but all subsequent codes are ignored.
At this time, if the "S0" mode is set, "SRQ" is sent as a syntax error.

Note 4: Any code other than the direct digital read/write commands and program codes "N", "H" and "C"" is ignored during a scan sequence operation (when the START lamp is on).
To set a control parameter, etc., it is necessary to program the machine such that the setting can be made after stopping the scan sequence operation by the program code "H" or "C", or the "SDC" or "DCL" command.

Note 5: To stop the scan sequence operation, use the program code "H" or "C", or the "SDC" or "DCL" command. If these codes or commands are set during a scan sequence operation, the scan operation does not stop until its execution comes to an end.
(Handshaking is terminated before the operation actually comes to an end.) To set a control parameter or start a scan operation in succession, it is necessary to have the wait time until the current scan operation is terminated. (The wait time varies with scanning conditions. It is about 130ms maximum.)
With the program code "C" and the "SDC" and "CDL" command, the opening operations of all contact points are involved in addition to the scan sequence stopping operation. It is therefore necessary to wait for that time (max. 130sm).

Note 6: A status byte mask is set with data from 0 to 63:

MS0 : Mask clearing
MS1 : Status byte D0 bit mask
MS2 : D1 bit mask
MS4 : D2 bit mask
MS8 : D3 bit mask
MS16 : D4 bit mask
MS32 : D5 bit mask

To mask more than one bits, setting should be made by adding the values that correspond to the bits. (Example: D0, D1 bit mask ... MS3)

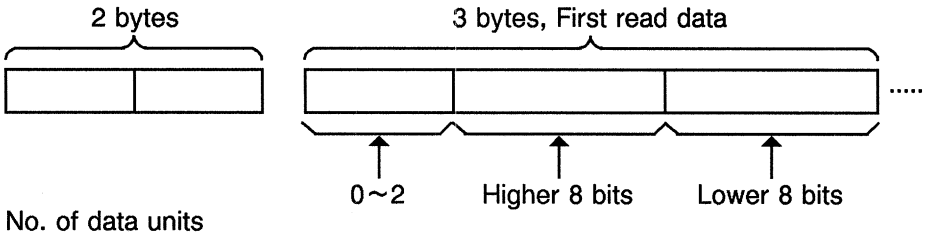
Note 7: For binary output of the digital read buffer, the unit of output of read data is binary data of three bytes. EOI made true is output with the last data.
The format is such that the first two bytes give the number of data units and the subsequent three bytes the read data.
If no read data is found in the buffer, the first two bytes (0) are output and EOI is made true simultaneously.
If the buffer is already full, all data from 1 to 1000 is output every three bytes up to 3,000 bytes following the number data (03E8). But the latest data input after the buffer became full is not stored in buffers from 1 to 1,000 and cannot therefore be output. In this case, reference the latest data by using RD0 or RDH0.

4.4 Talker Format

The command to reference the currently set data (cf. 4.3 Listener format - (g)) is sent to the R7210 and with the first talker specification thereafter, the desired data is output. The following is the format used for that purpose.

Code to be sent	Talker format	(BD) : Block delimiter
RMO	SQ (BD) RN (BD)	
FLC	FLCdd – dd (BD)	dd : 00 to 99
FLP	FLPdd – dd (BD)	dd : 00 to 99
RTR	AU (BD) EX (BD) MN (BD)	
RRN	RNdd (BD)	dd : 00 to 99
RSI	SIddd MS (BD) SIddd ␣S (BD) SIddd MN (BD)	ddd : 000 to 999
RRI	RIddd MS (BD) RIddd ␣S (BD) RIddd MN (BD)	ddd : 000 to 999
RSB	SBA_0 – B_0, A_1 – B_1G (BD) RB (BD)	
RM nn Program number	Mnn, DATA1, DATA2, ...,DATAn G (BD) Mnn, G (BD)	nn : 00 to 99

(Cont'd)

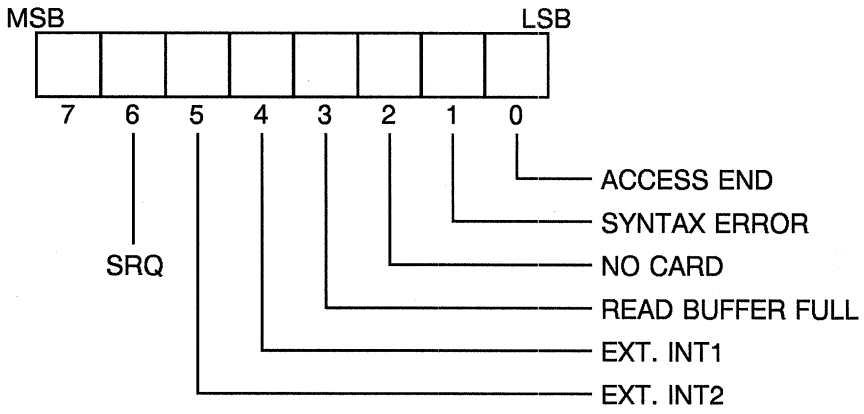
Code to be sent	Talker format (BD) : Block delimiter
RDnnnn nnnn : 0 to 1000	L, ddd (BD) H, ddd (BD) } ddd : 0 to 255 W, dddddd (BD) dddddd : −32768 to 32767
RDHnnnn nnnn : 0 to 1000	L, dd (BD) H, dd (BD) } dd : 0 to FF W, dddd (BD) dddd : 0 to FFFF
RDB	 No. of data units Binary data from 0 to 1000 0 : Lower 8 bits 00000000 00000000 1 : Higher 8 bits ≀ ≀ 2 : 16 bits 11111111 11111111 The three-byte read data is output every three bytes as many as the number of data units. With the output of the last data, EOI is made true.
TS	TEST _OK (BD) ERROR _ROM (BD) ERROR _RAM (BD) ERROR _CA dd (BD) dd : Card number Card type 1 : Multiplexer 2 : Actuator (transfer) 3 : Matrix
RRB	RB_ddd (BD) ddd : 0 to 999 RB_RULL1000 (BD)
IOM	DM_d (BD) d : 0 to 3

4.5 Service Request

In the "SO" mode, if the status bytes D0, D1, D2, D3, D4 and D5 are made 1, a service request is made to the controller.

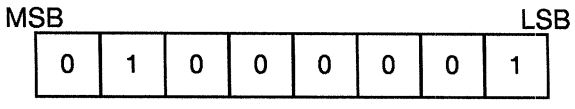
If a service request is sent, the status byte is sent upon receipt of the "SPE" command with the execution of serial polling from the controller. (The status byte is sent also in the "S1" mode.)

4.5.1 Status Byte



① Service request with the end of switch card contact point operation (ACCESS END)

- Sequential scan operation
  A service request is sent when the contact points of the switch cards from the first channel to the last channel have been accessed and the open/close operation of each contact point has been ended.
- Random scan operation
  A service request is sent when all the contents of one program have been executed. Even when one program accesses more than one contact point, the service request is made upon execution of the program.
- Direct channel access
  A service request is sent upon completion of the first direct channel access. As with random scanning, even when more than one contact point is accessed in one time, a service request is sent upon completion of the direct channel access concerned.
  In this case, the following status byte is sent upon receipt of the "SPE" command. The status byte is cleared when the contact point is accessed in the case of sequential scanning, when the contact point with the content of the next program step is accessed in the case of random scanning, and when the contact point with the content of the next direct channel access is accessed in the case of direct channel access, respectively.



ASCII code : A
Decimal code : 65

② Service request due to SYNTAX error (SYNTAX ERROR)

In remote programming, if undefined program code is used or if the designated constant setting range is exceeded, a service request is sent. The status byte is as shown below. It is not cleared until the next program line is programmed correctly.

MSB							LSB
0	1	0	0	0	0	1	0

ASCII code : B
Decimal code : 66

③ Service request due to access to non-existent switch card (NO CARD)

In a scan sequence operation or a direct channel access operation, if the card accessed is not mounted in the machine, a service request is sent.
The following status byte is sent by the "SPE" command. It is not cleared until some existent switch card is accessed.

MSB							LSB
0	1	0	0	0	1	0	0

ASCII code : D
Decimal code : 68

④ Service request due to digital read buffer full (READ BUFFER FULL)

A service request is issued when the 1,000 buffers become full with the reading of digital data.
The following is the status byte.
It is not cleared until "BC" (Buffer Clear) is sent by the GPIB command or the buffer clear operation is done by the panel switch.

MSB							LSB
0	1	0	0	1	0	0	0

ASCII code : H
Decimal code : 72

⑤ Service request (EXT.INT1) by external signal (EXINT1)

A service request is made when a "low true" signal is input to digital I/O connector EXINT1.
The following status byte is sent and cleared by the "SPE" command.

MSB							LSB
0	1	0	1	0	0	0	0

ASCII code : P
Decimal code : 80

⑥ Service request (EXT.INT2) by external signal (EXTINT2)

A service request is made when a "low true" signal is input to digital I/O connector EXINT2.
The following status byte is sent and cleared by the "SPE" command.

MSB							LSB
0	1	1	0	0	0	0	0

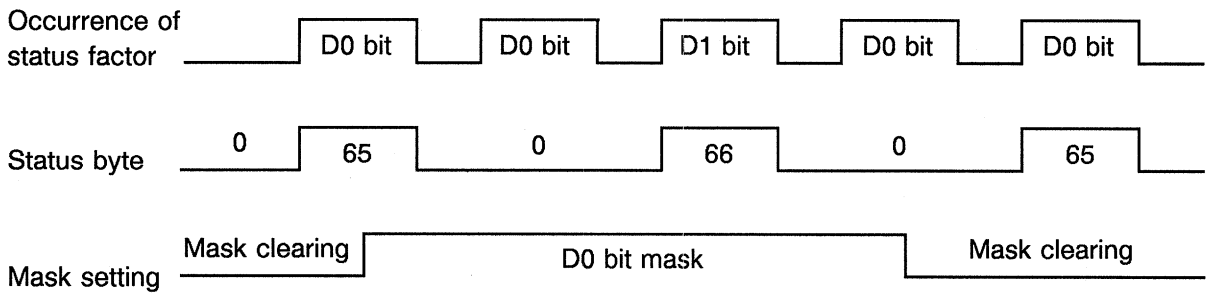
ASCII code : ‘
Decimal code : 96

If the above service request factors arise simultaneously, all the bits of the status bytes corresponding these factors are set.

If the program code "C" and the "SDC" and "DCL" commands are received, the status byte is made "0".

The following is the timing of status byte mask setting.

<When setting MS1 (D0 bit mask)>



4.5.2 Device Trigger Function

It is possible to start a scan sequence operation by using the "GET" command as with the case when the program code "E" is received.

4.5.3 Device Clear Function

With the "SDC" and "DCL" commands perform the same operation as with the case when the program code "C" is received.

4.6 General Cautions for Operation

(1) Use of ONLY mode

To use the instruction in the ONLY mode, it is necessary to set the mode from the panel. It is also necessary to put in the ONLY mode the device to be connected via the bus line.
To use the instruction in the ONLY mode, don't use (operate) the controller simultaneously. Otherwise, the operation of the controller cannot be guaranteed.

(2) Interrupt from the controller in during data transmission between devices

With the GPIB system, it is possible to transmit data between devices other than the controller. In the course of data transmission between devices (during handshaking), to make an interrupt to switch the controller to the serial poll mode or add a new listener, it is necessary to stop the data transmission and give priority to the interrupt operation of the controller. The data transmission is resumed after completion of the interrupt processing.
To perform data transmission between devices, programming should be made such that the controller can recognize the state of the data transmission.

(3) Switching from local to remote operation

To switch the instruction from a local operation to a remote GPIB operation, the switching should be done when the instruction is in the input wait mode. In any other mode (e.g., control parameter setting mode or direct channel access mode), while switching to the remote operation is done normally, the mode in the previous local operation state is reset if the machine is switched again to the local operation.

(4) Switching from remote to local operation

When the single bus signal "REN" is "true", the instruction is put in the remote mode and the REMOTE lamp is turned on. (In this state, no manual operation from the panel can be made.) Switching from the remote state to a local state is done with the sending of the address specification command "GTL" from the controller or by pressing the LOCAL switch. (If the address specification command "LLO" has been set in advance, it is impossible to reset the remote state by using the LOCAL switch.)

4.7 Sample Programs

For programming, refer to 4.9 "Remote programming".

Sample programs using the HP-216 are given below. (The device address of this machine is set at "1".)

4.8 Standard Bus Cable

The cables to connect measurement instruments and the bus cables to connect the controller and other devices should not be made unnecessarily long. Bus cables should be within the specified lengths. The total bus cable length should not exceed (the number of devices to be connected to the bus) × 2m and be less than 20m.

ADVANTEST provides the following standard bus cables:

Table 4-3 Standard Bus Cables
(to be purchased separately)

Length	Name
0.5m	408JE-1P5
1m	408JE-101
2m	408JE-102
4m	408JE-104

4.9 Remote Programming

Example 1: Program to scan a 30 CH multiplexer sequentially and measure and read the data of each channel by a digital voltage meter (DVM)
(The device address of the DVM is set at "2".)

When the controller is the HP216:

```
10    ! 7210 GPIB PROGRAM 1
20    DIM D(30, 10)
30    CLEAR 701
40    OUTPUT 701; "MO0, RN1, TR1"
50    OUTPUT 701; "FCO, LC29, SBO-2G"
60    TRIGGER 701
70    !
80    FOR T = 1 TO 30
90    WAIT . 001
100   TRIGGER 702
110   ENTER 702;D(T, 10)
120   OUTPUT 701;"N"
130   NEXT T
140   !
150   ! "measurement data transaction !!"
160   END
```

Explanation of program

10 : Comment statement

20 : Secures a data area to read measurement data for 30 channels.

30 : Set the scanner in the initial state.

40 : Specifies the sequential scan mode, sets the number of repetitions at "1", and sets the EXTERNAL trigger mode.

50 : Sets the first channel at "0" and the last channel at "29", and specifies a block to connect three multiplexer cards (card Nos. 0, 1 and 2) to make a 30 CH multiplexer.

60 : Starts a scan sequence

70 : Comment statement

80 : Specifies a loop operation to measure channels 0 through 29 sequentially.

90 : Waits for the contact point operation time (about 1ms).

100 : Starts measurements by the DVM.

110 : Reads the measured data into the specified area.

120 : Scans the next channel.

130 : Repeats the operations of 90 through 120 30 times from channel 0 to channel 29.

140 : Comment statement

150 : Executes the processing that corresponds to the measured data for the program numbers subsequent to this number.

Example 2: Program to perform scanning through direct channel access
(The program uses a combination of multiplexer, actuator and matrix switch cards. Card numbers are set at 0 and 1 for the multiplexer cards, 2 for the actuator, and 0 and 1 for the matrix.)

When the controller is the HP216:

```
10    ! 7210 GPIB PROGRAM 2
20    DIM A$(5)  [40]
30    A$(1) = "DI, 1, 14, C28, C29, CO-1, C4-2, C5-3G"
40    A$(2) = "DI, 5, C21, O29, CO-3, O5-3G"
50    A$(3) = "DI, 6, 12, OO2, O4-2, C6-2G"
60    A$(4) = "D1, 0, 10, C22, C23, C24, C7-0G"
70    A$(5) = "DI, 2, 13, O22, C27, C5-1, C0-1G"
80    CLEAR 701
90    OUTPUT 701;"RB"
100   FOR T = 1 TO 5
110   OUTPUT 701;A$(T)
120   !"measurement & transaction program !!"
130   NEXT T
140   OUTPUT 701;"DI, OO0G"
150   END
```

Explanation of the program

10 : Comment statement

20 : Secures a channel access data area.

30 : Stores the channel access data in A$(1).

- Multiplexer ; Selects channels 1 and 14.
- Actuator ; Closes channels 28 and 29.
- Matrix ; Closes (0,1), (4,2) and (5,3).

40 : Stores the channel access data in A$(2).
- Multiplexer ; Selects channel 5.
- Actuator ; Closes channel 21 and opens channel 29.
- Matrix ; Closes (0,3) and closes (5,3).

50 : Stores the channel access data in A$(3).
- Multiplexer ; Selects channels 6 and 12.
- Actuator ; Opens all channels.
- Matrix ; Opens (4,2) and closes (6,2).

60 : Stores the channel access data in A$(4).
- Multiplexer ; Selects channels 0 and 10.
- Actuator ; Closes channels 22, 23 and 24.
- Matrix ; Closes (7,0).

70 : Stores the channel access data in A$(5).
- Multiplexer ; Selects channels 2 and 13.
- Actuator ; Opens channel 22 and closes channel 27.
- Matrix ; Closes (5,1) and (0,1).

80 : Puts the scanner in the initial state. (Opens all channels.)

90 : Resets the block specification to allow each multiplexer card to operate independently.

100 : Specifies a loop to perform the direct channel access operation five times.

110 : Loads the specified channel access data from the data area and executes the scan operation.

120 : Normally, a measurement or processing program that corresponds to each scanning state is created in this part.

130 : Executes the direct channel access operation five times sequentially.

140 : Opens all channels.

Example 3: Program to execute the scan sequence operation in the random mode, determines the end of contact point operations with SRQ and perform the corresponding processing

When the controller is the HP216:

```
10      ! 7210 GPIB PROGRAM 3
20      ON INTR 7 GOSUB Srq
30      CLEAR 701
40      OUTPUT 701; "M4, C3, C7, C0-0, C1-2G"
50      OUTPUT 701; "M5, C2, O7, C5-0, C6-1G"
60      OUTPUT 701; "M6, C9, O0-0, C7-3G"
70      OUTPUT 701; "M7, OO2, C4, O7-3G"
80      OUTPUT 701; "M8, C8, C9, C0-3, C1-1G"
90      OUTPUT 701; "M9, C5, O8, O0-3, C0-1G"
100     OUTPUT 701; "M10, O2, C0, O0-1G"
110     OUTPUT 701; "M11, C5, C6, C0-2, O5-0G"
120     OUTPUT 701; "M12, O6, C7, C0-3, C5-2G"
130     OUTPUT 701; "M13, C9, O5-2, C7-1G"
140     OUTPUT 701; "MO1, TR2, RN5, FP4, LP13"
150     OUTPUT 701; "SI4T1, RI1T2, S0"
160     N = 0
170     TRIGGER 701
180     ENABLE INTR 7;2
190     ! "main transaction !!"
200     GOTO 190
210 Srq:    ! SRQ TRANSACTION
220         S = SPOLL(701)
230         IF S < > 65 THEN 280
240         N = N + 1
250     ! measurement & execute !!
260     ENABLE INTR 7;2
270     RETURN
280     ! transaction for other instrument !!
290     ENABLE INTR 7;2
300     RETURN
310     END
```

Explanation of program

10 : Comment statement

20 : Defines an interrupt processing routine.

30 : Puts the scanner in the initial state.

40 to 130 : Sets scan data in program numbers 4 to 13.

140 : Specifies the random scan mode and AUTO trigger mode, and sets the number of repetitions of scanning at 5, the first program number at 4 and the last program number at 13.

150 : Sets the step interval at 4 seconds and the repeat interval at one minute and specifies the "S0" mode to sent an SRQ.

160 : Clears the scan repetition counter.

170 : Starts a scan sequence operation.

180 : Enables an interrupt from the GPIB.

190 : Describes a main processing routine.

200 : Continues the main operation.

210 : Interrupt processing routine name.

220 : Polls the 7210 to read its status.

230 : Branches to 280 in the event of a non-7210 interrupt.

240 : Advances the scan counter.

250 : Executes the measurement and other processing corresponding to the scan status.

260 : Enables an interrupt from the GPIB.

270 : Returns to the main processing routine.

280 : Processing for an interrupt from some other device.

290 : Enables an interrupt from the GPIB.

300 : Returns to the main processing routine.

5. SINGLE-LINE SIGNAL CONTROL

This function is used to control the instruction from outside by means of single-line signals.

This can be used to build small systems by connecting a controller, digital recorder and other devices without a GPIB interface.

5.1 Control Signal Input/Output Connector

Type of connector (Hirose Electric)
7210 side : HR10-7R-6S
Cable side : HR10-7P-6P

Figure 5-1 shows the relationships between control data input/output signals and pin numbers.

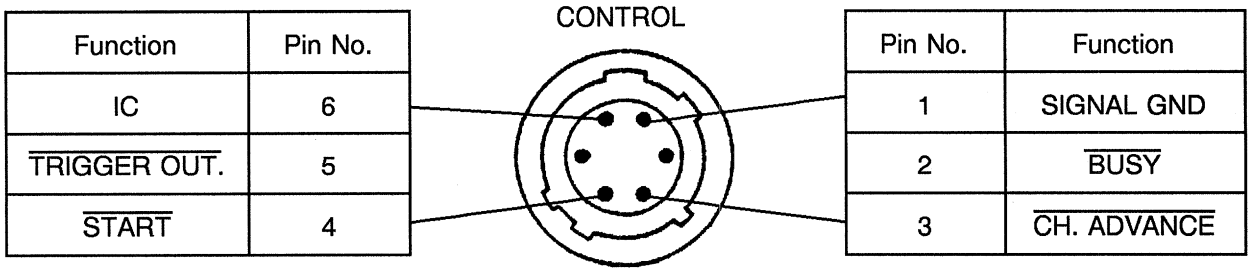


Figure 5-1 Control Data Input/Output Pins

5.2 Signal Level

(a) BUSY output: Negative logic pulse signal

High level : +3.0V to +5.25V, −0.5mA max.
Low level : 0 to +0.4V, 8mA max.
Pulse width : Varies with scanning conditions.

(b) CH ADVANCE input: Positive or negative logic pulse signal

High level : +2.0V to +5.25V
Low level : 0 to +0.6V
Pulse width : 100μs or more (Activated at the rise of a pulse)

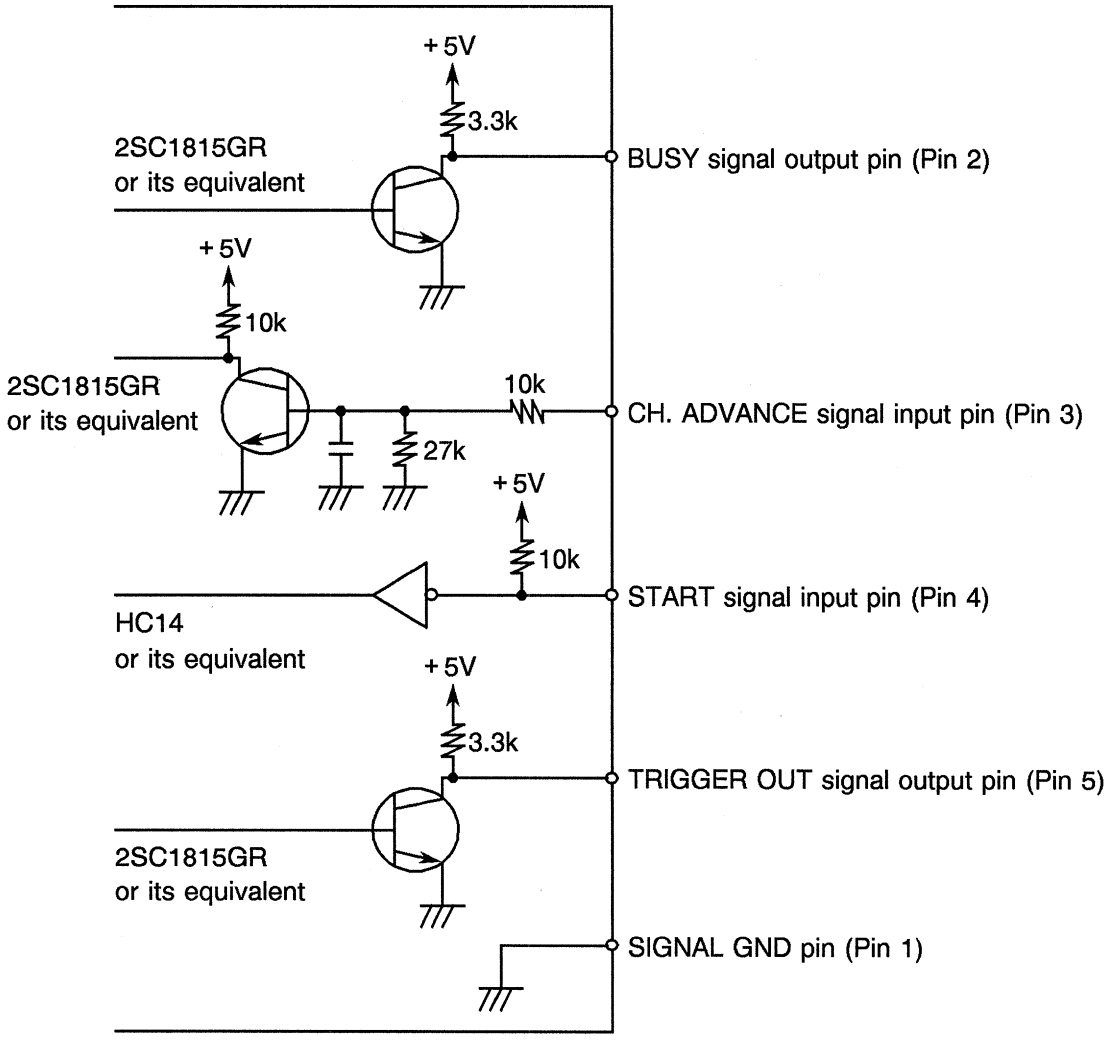
(c) START input: Negative logic level signal

High level : +2.0V to +5.25V
Low level : 0 to +0.5V

(d) TRIGGER OUT output: Positive or negative logic pulse signal

High level : +3.0V to +5.25V, −0.5mA max.
Low level : 0 to +0.4V, 8mA max.
Pulse width : About 500μs

5.3 Input/Output Circuits



5.4 Explanation of Control Signals

(a) BUSY signal

In a scan sequence operation, the signal is sent is sent to TRUE (Lo level) at the start of a sequence and is made FALSE (Hi level) upon completion of that sequence.
When using a digital recorder (TR6198), for example, this signal can be used to perform printing with a demarcation between one sequence and the next one.

(b) CH ADVANCE signal

In a scan sequence operation, this signal is used to advance a sequence. When the trigger mode is "EX", a sequence is advanced by one each time a pulse is input.
By programming, it is possible to select either positive logic or negative logic for this signal. At the time of factory shipment, the signal is set in negative logic. To set the signal in positive logic, refer to Figure 8-1 "Adaptor mode setting".

(c) START signal

This signal is used to control the start and stop of a scan sequence operation. The scan sequence operation is started or stopped by setting this signal at TRUE (Lo level) or FALSE (Hi level), respectively.
When this signal is set at TRUE, the START lamp on the panel is turned on. If it is set at FALSE, the lamp goes out.
If a scan sequence operation is started with this signal, it is impossible to stop the operation by using the START/STOP switch on the panel. (The scan sequence operation can be stopped only by setting the signal at FALSE or when all the specified sequence operations come to an end.) If a scan sequence operation is started by using the START/STOP switch on the panel, the operation does not stop even if this signal is at FALSE.

(d) TRIGGER OUT signal

In accessing a switch card, this signal is output upon completion of the OPEN/CLOSE operation of each contact point.
By setting a DELAY time, it is possible to delay the output of the TRIGGER OUT signal. The logic of the signal is the same as with the CH. ADVANCE discussed in (b) above. To set it in positive logic, see Figure 8-1 "Adaptor mode setting".

5.5 Control Method

The following is the general control procedure with the single-line signals discussed above.

① Set each control parameter on the panel according to the desired scanning conditions.

② Make the START signal TRUE to start a scan sequence operation.

③ With the output of the TRIGGER OUT signal, the operations of the measurement instrument, generator, etc. are performed.

④ With the occurrence of the CH. ADVANCE signal, the sequence is advanced and the operation of ③ above is repeated.

⑤ Upon completion of all sequence operations, make the START signal FALSE. (The START signal is to be made FALSE upon output of the last TRIGGER OUT signal.)

5.5.1 Setting a DELAY Time

The instruction is capable of delaying the TRIGGER OUT signal to be output after completion of a contact point operation by setting a DELAY time as well as by setting S.INT (step interval) and R.INT (repeat interval) times.

Hence, the settling time of the measurement system is taken into account to output "TRIGGER OUT" signals.

Figure 5-2 shows how to set a DELAY time. A DELAY time can be set from 10s to 1ms in the unit of 1ms. The example sets a DELAY time of 10ms.

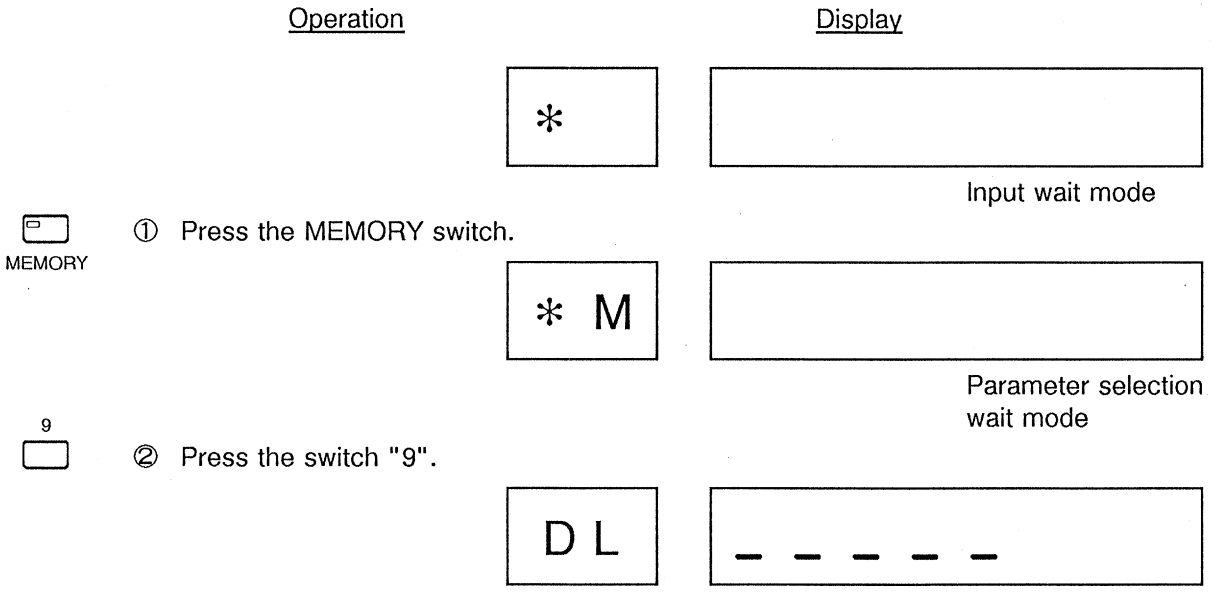
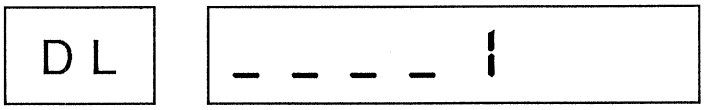


Figure 5-2 Setting a DELAY Time

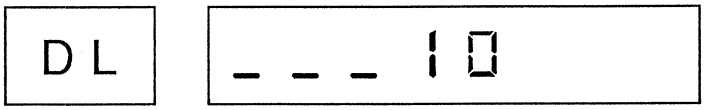
1

③ Press the switch "1".



0

④ Press the switch "0".



NEXT

or

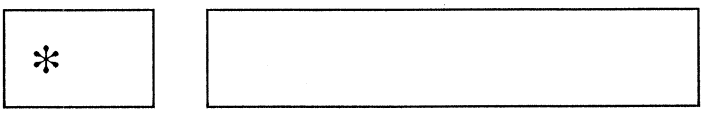
STORE

⑤ Press the NEXT switch or STORE switch.

• NEXT switch

Parameter selection wait mode

• STORE switch

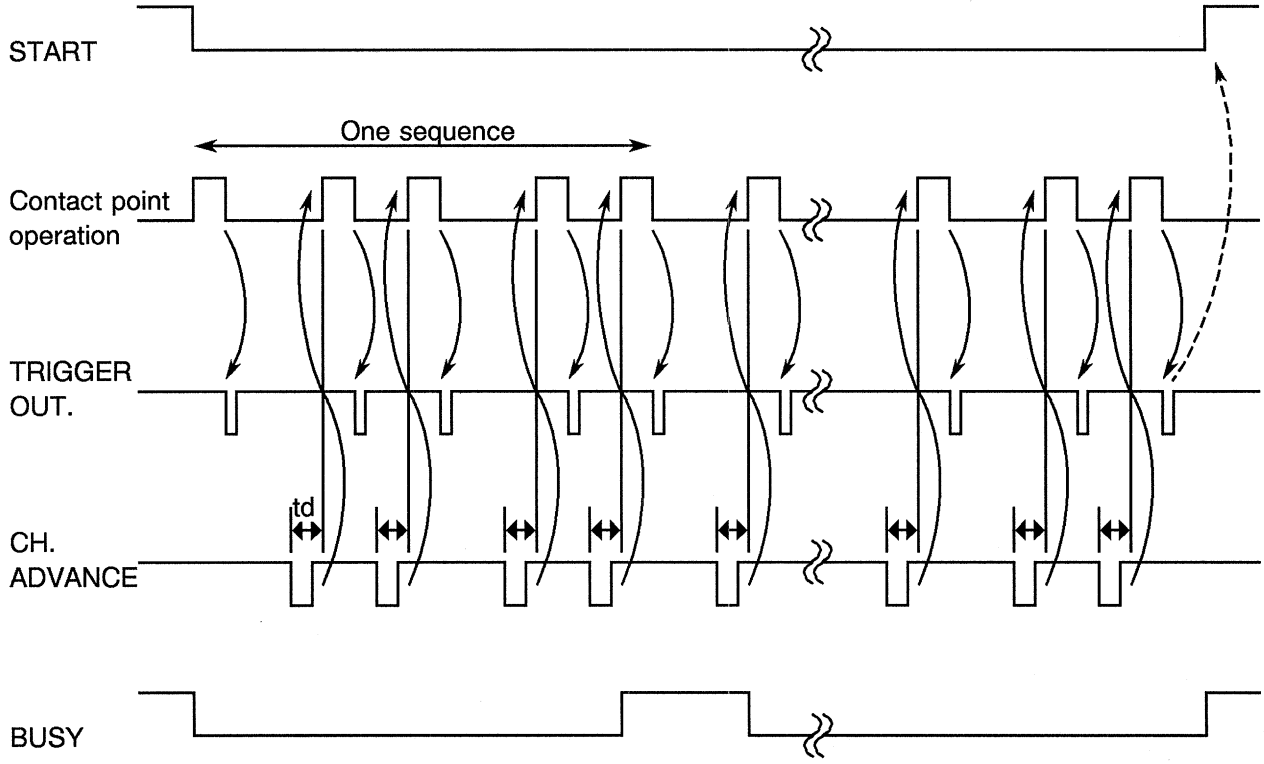


Input wait mode

Figure 5-2 Setting a DELAY Time (Cont'd)

5.6 Operation Timing

Figure 5-3 shows the timing of operations controlled by single-line signals. The example shows a case in which a DELAY time is set at 0.



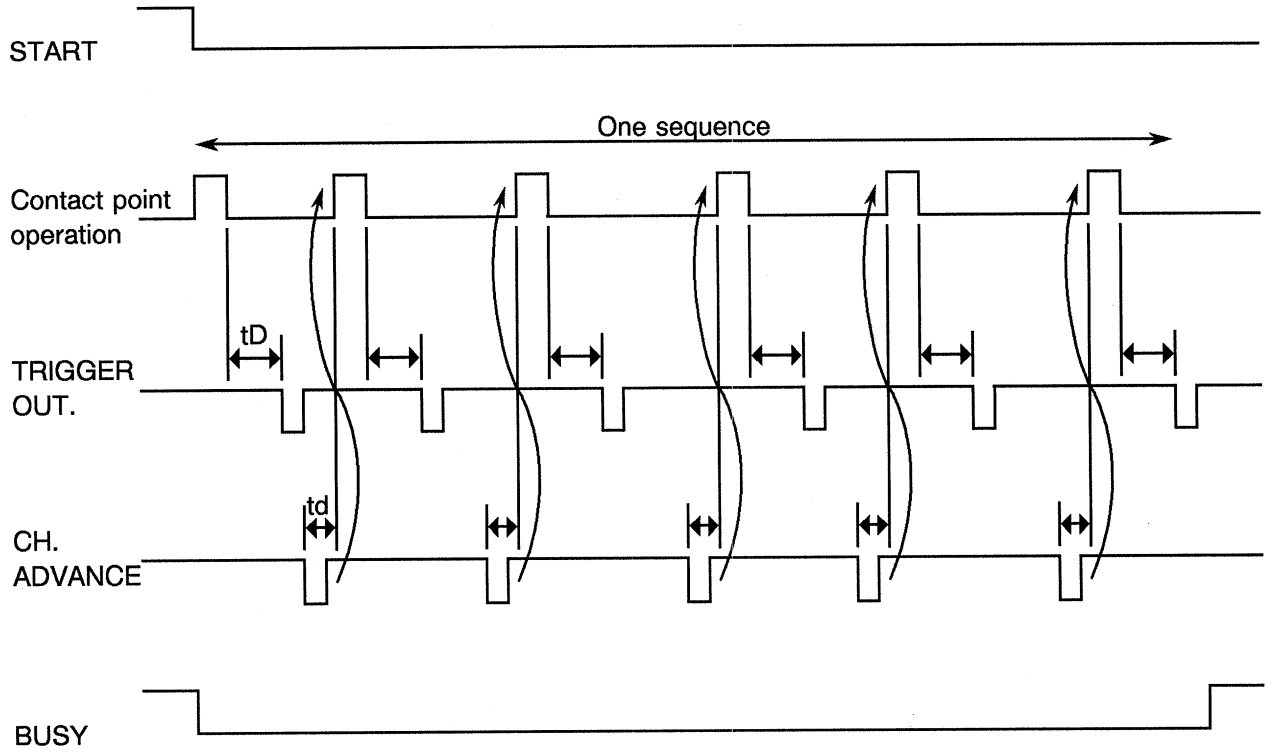
td : Time from the input of a CH. ADVANCE signal to the start of a contact point operation
About 300μs (Sequential scan)
About 600μs (Random scan)

Note: All CH. ADVANCE signals input during a contact point OPEN/CLOSE operation are ignored.

Figure 5-3 Timing with Single-Line Signal Control

Note: Pin 6 of the control signal connector is an IC for internal use. Make sure that no signal line is connected to it.

The following is the operation timing with a DELAY time set. (See Figure 5-4.)



tD : DELAY time set
td : Time from the input of a CH. ADVANCE signal to the start of a contact point operation
About 300μs (Sequential scan)
About 600μs (Random scan)

Note: All CH. ADVANCE signals input during a contact point OPEN/CLOSE operation are ignored.

Figure 5-4 Timing with Single-Line Signal Control

6. HOW TO HANDLE A SWITCH CARD AND TERMINAL BOARD

As discussed in Section 1, the 7210 is the main unit to control scanning operations. It can serve as a switching device in combination with switch cards, which actually perform switching operations, and other external units.

The following is how to handle a switch card and terminal board.

6.1 Switch Card

Switch cards can be classified broadly into four types by contact point configuration — multiplexer, actuator, matrix and transfer.

(1) Setting a card number

The 7210 can house up to five switch cards. To identify individual switch cards, therefore, it is necessary to assign a card number to each card.
Card numbers from 0 to 9 can be assigned for each card type (multiplexer, actuator, matrix, and transfer). That is, the same card number may be assigned to switch cards of different types. Also, if the same card number is assigned to different switch cards of the same type, these cards perform the same operations without giving rise to any problem. (This method is used when using multiplexers with six lines per channel, for example.) In the case of the 72103 Series, however, is the same card number is assigned to switch cards of the same type with different contact points, they do not function normally. (Don't assign the same card number to the 72103A/ 72103C and 72103B.)
Figure 6-1 shows how to set a card number. (This method applies to all cards.)
Table 6-1 shows the correspondence between card numbers 0 to 9 and channel numbers.

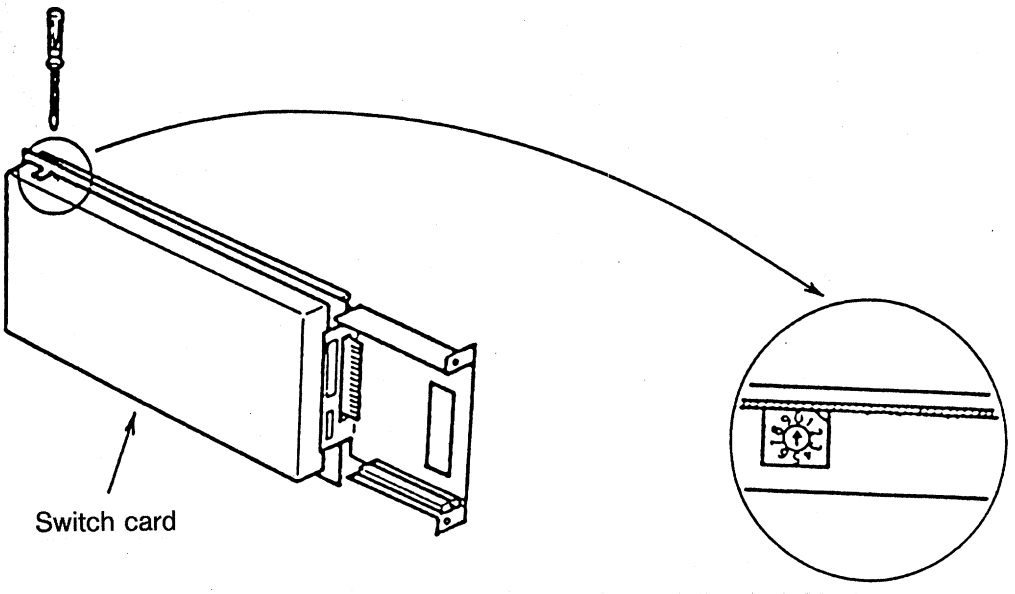


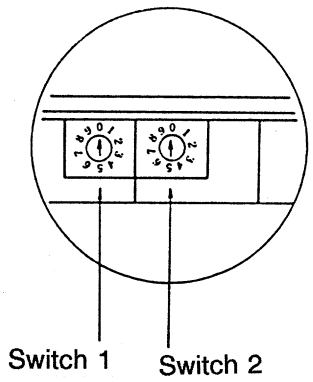
Figure 6-1 Setting a Card Number

Table 6-1 Correspondence between Card Numbers and Channel Number

Card type / Card number	Multiplexer	Actuator (Transfer)	Matrix
0	0 to 9 CH	0 to 9 CH	X: 0 to 3 Y: 0 to 3
1	10 to 19 CH	10 to 19 CH	X: 4 to 7 Y: 0 to 3
2	20 to 29 CH	20 to 29 CH	X: 8 to 11 Y: 0 to 3
3	30 to 39 CH	30 to 39 CH	X: 12 to 15 Y: 0 to 3
4	40 to 49 CH	40 to 49 CH	X: 16 to 19 Y: 0 to 3
5	50 to 59 CH	50 to 59 CH	X: 20 to 23 Y: 0 to 3
6	60 to 69 CH	60 to 69 CH	X: 24 to 27 Y: 0 to 3
7	70 to 79 CH	70 to 79 CH	X: 28 to 31 Y: 0 to 3
8	80 to 89 CH	80 to 89 CH	X: 32 to 35 Y: 0 to 3
9	90 to 99 CH	90 to 99 CH	X: 36 to 39 Y: 0 to 3

6.1.1 Setting a Card Number for H-Type Switch Card

In the case of an 72101H / 72102H switch card with 20 channels, it is necessary to assign a card number every ten channels.



- Switch 1
  Used to assign a card number to the left side channel card as viewed from the rear.
- Switch 2
  Used to assign a card number to the right side channel card as viewed from the rear.

6.2 Mounting a Switch Card

Figure 6-2 shows how to attach a switch card to the 7210. The 7210 is provided with five slots to house switch cards. There is no restriction as to which slot to use. Insert your switch card into any desired slot.

① Turn the POWER switch of the 7210 off.

② Each slot is covered with a blind patch. Remove it from the slot you use. Don't remove the blind patches of the other slots.

③ Insert the switch card along the guide rail and fix it with an M3×8 screw. Be careful not to turn the switch card upside down.

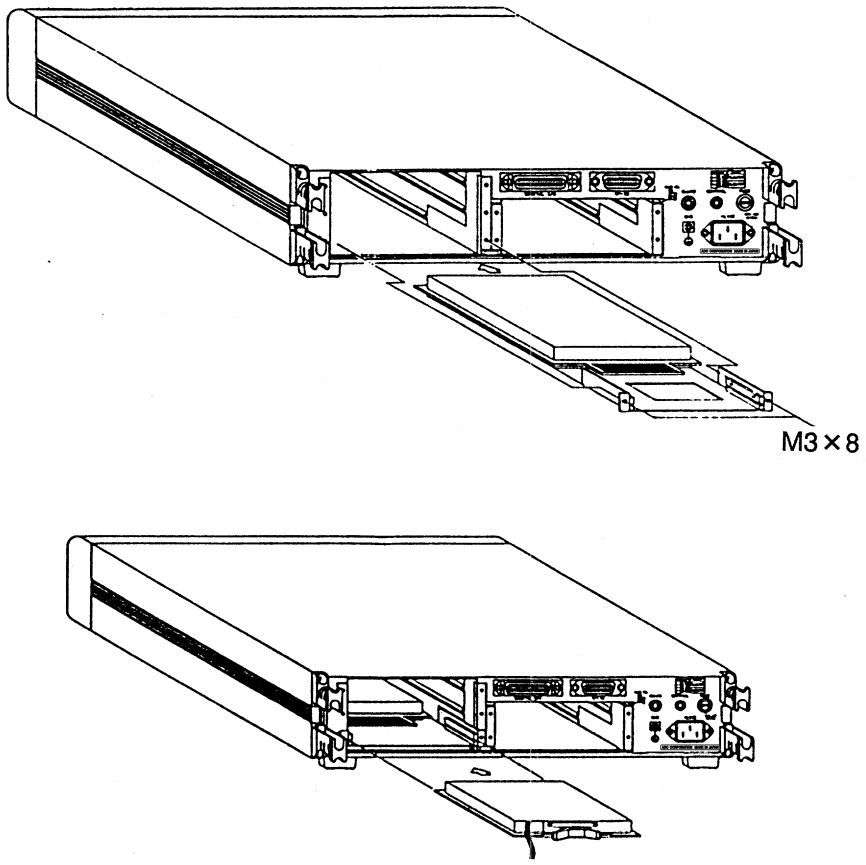


Figure 6-2 Mounting a Switch Card

6.3 Switch Card Drive Capacity

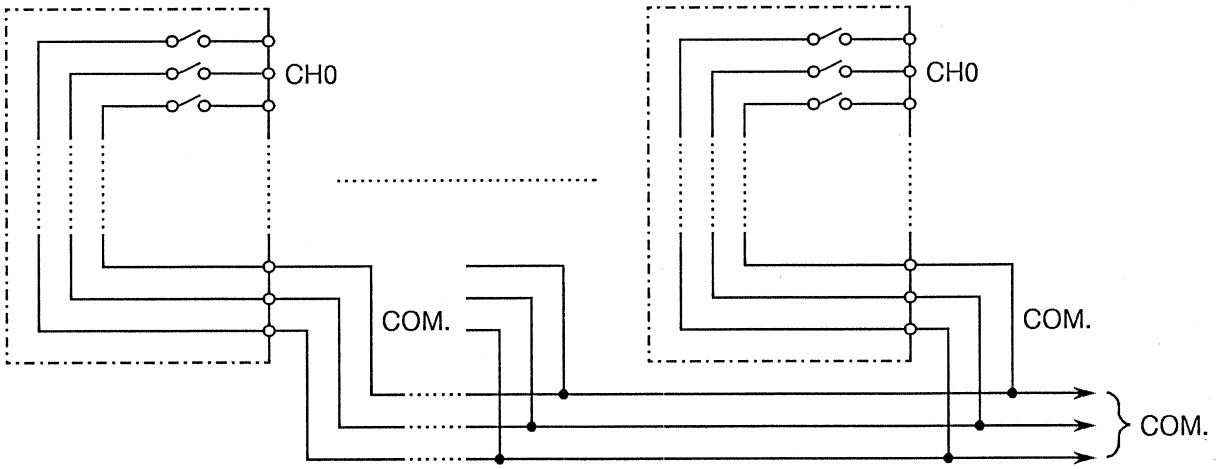
The switch drive capacity, that is, the number of channels which can be closed simultaneously, of the instruction is 0.8A (0°C to 28°C) max. To operate switch cards, therefore, the total current should be kept below 0.8A by checking the consumption current of each switch card (see 1.4).

6.4 Combining Switch Cards

It is possible to add to the number of channels by connecting multiple switch cards (multiplexer: 10 CH./card; matrix: 4×4 CH./card).

The following shows how to connect switch cards to add to multiplexer and matrix channels, respectively.

- Multiplexer

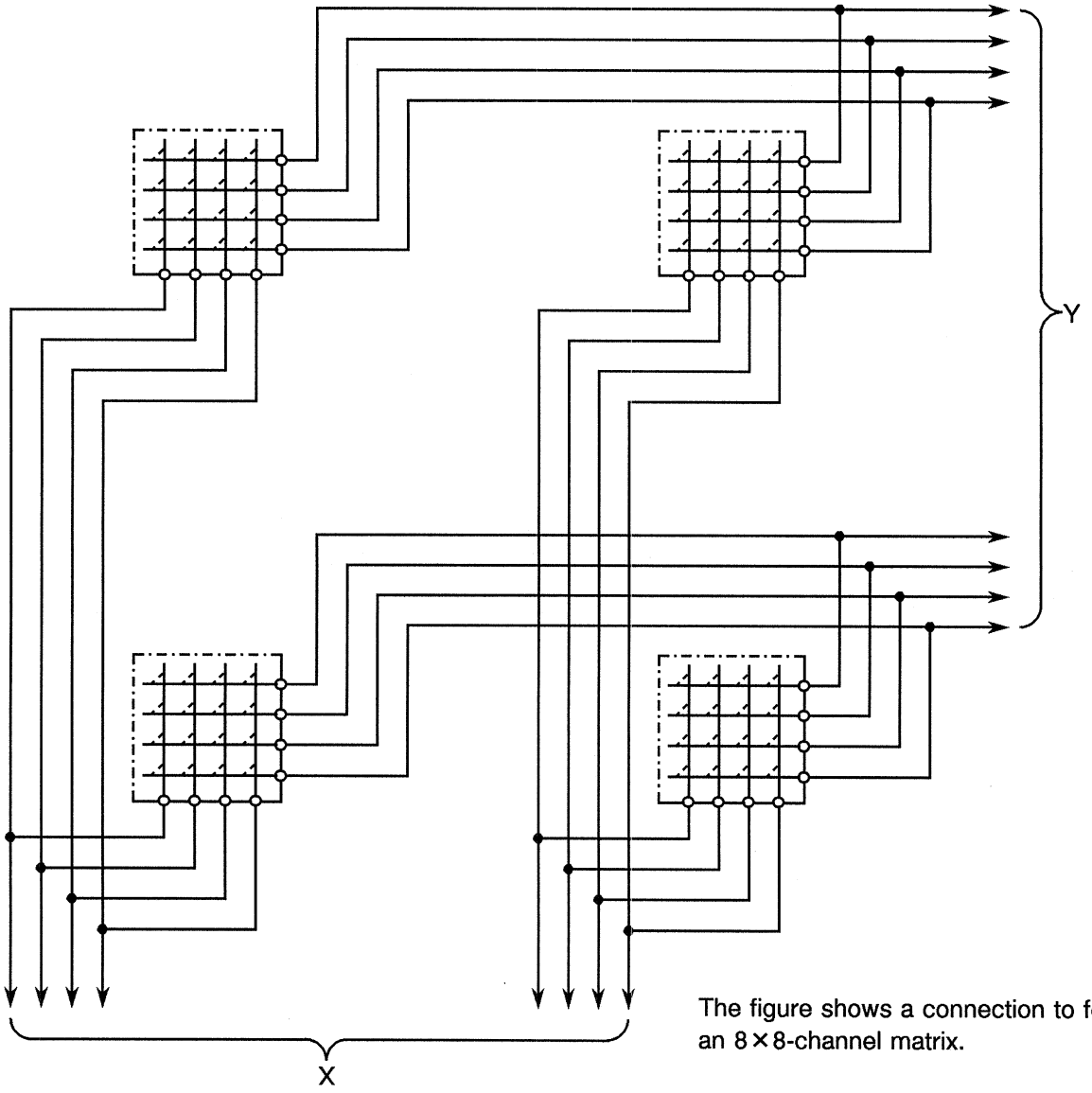


By connecting the COM terminal of each switch card, it is possible to use them a multiplexer of 20 CH, 30 CH, etc.

CAUTION

When connecting two or more multiplexer cards, it is necessary to specify blocks. Performing a CLOSE operation without block specification could cause two or more channels to be closed simultaneously and damage the measurement instrument depending on connection conditions.

- Matrix
  Connect X and Y of each card to add to the number of channels.



The figure shows a connection to form an 8×8-channel matrix.

6.5 Cautions on Using R72101D and 72101E

6.5.1 Cautions on Using R72101D (Low Thermoelectromotive Force Switch Card)

The R72101D is a switch card designed to keep thermoelectromotive force down to $\pm 0.2\mu V$ at the switch contact points.

To obtain the full performance of the R72101D, care should be given to the following.

(1) To prevent unnecessary thermoelectromotive force from arising, don't use the R72101D in an environment where temperature changes widely.

(2) If there is a flow of air, there may arise a difference in temperature at terminals and switches. To prevent this, it is attach a cover to the terminal board cards (72109 Series) and a blind patch to any unused slot on the rear side of the 7210 without fail.

(3) Use wires of the same metal for terminal board wiring.

6.5.2 Cautions on Using 72101E (High Insulation Resistance Switch Card)

The R72101E is a switch card designed to keep the insulation resistance between terminals at a level equal to or higher than $10^{11}\Omega$.

To obtain the full performance of the 72101E, care should be given to the following.

(1) The insulation resistance is guaranteed within the following temperature and humidity ranges. Use the card within the ranges.

$10^{11}\Omega$ or more
<Temperature +23°C ± 5°C, Humidity, 60%RH or less>

$10^{10}\Omega$ or more
<Temperature, 0°C to +40°C, Humidity, 85%RH or less>

(2) Humidity and dust can deteriorate the insulation resistance.

(3) Don't tough the PCB parts and patterns of the switch card (a combination with a terminal board) with your hand. (Use clean gloves, etc.)

(4) Use wires covered with high-insulation fluororesin for terminal board wiring.

6.6 Terminal Board

A screw-type dedicated terminal board is provided to facilitate wiring to each switch card. (72109 Series)

The terminal board can be used with every switch card. (The 72109B is dedicated for use with a multiplexer card.)

Wiring to a terminal board is done by removing its cover as shown in Figure 6-3. (No terminal board is required of the 72101C, 72101E, 72101G, 72101H, 72101J, 72102C, 72102H and 72103C because these switch cards are already provided with a terminal board.)

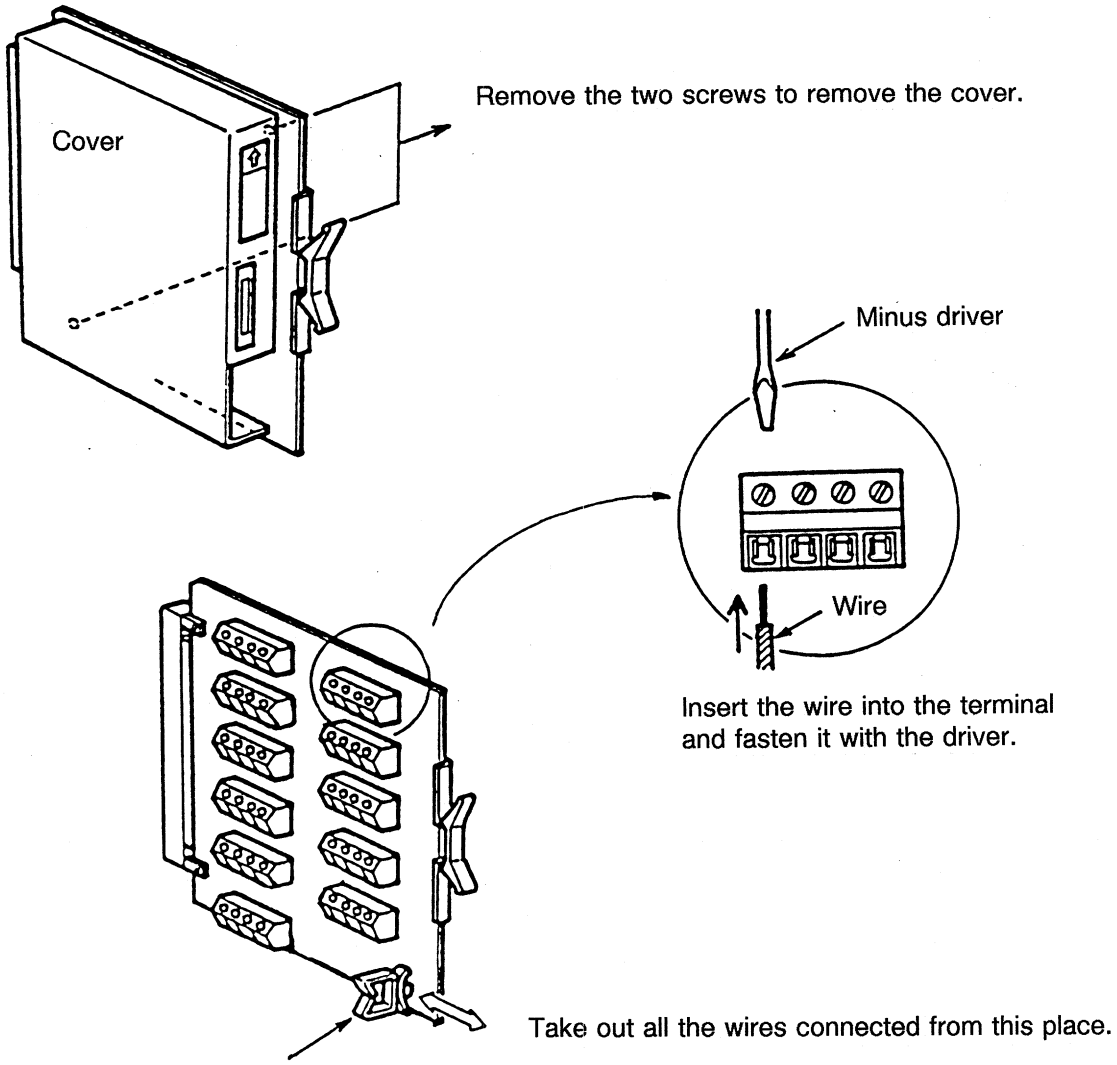


Figure 6-3 Removing the Terminal Board Cover and Terminal Board Wiring

6.7 Using a Terminal Board

The terminal board can be used with all types of switch card: multiplexer, actuator (transfer) and matrix. Different switch cards use different terminals as explained below. To connect a switch card to a terminal board, refer to the switch card contact point configurations given in 8.1.7 and 8.1.8.

Figure 6-4 gives the terminal arrangements of the switch card and the corresponding channel numbers. (The 72109B is omitted because it is dedicated for multiplexer cards.)

(a) Multiplexer

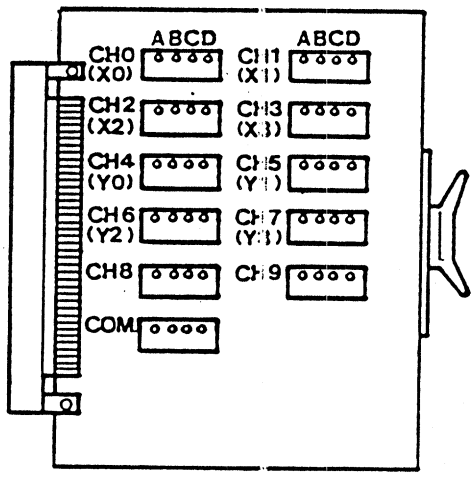
Use CH 0 to CH9 and COM terminals A, B and C.

(b) Actuator (transfer)

Use A, B, C, and D of the CH0 to CH9 and terminals.

(c) Matrix

Use A, B, C and D of the (X0) to (X3) and (Y0) to (Y3) terminals.

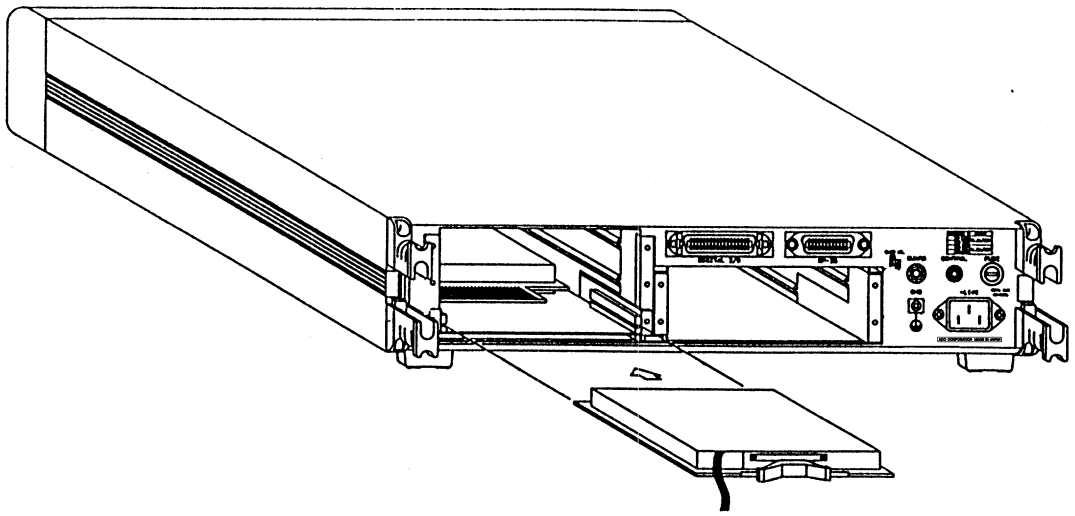


Note: The figure shows the 72109A and 72109D.

Figure 6-4 Terminal Arrangement and Channel Numbers

6.8 Connecting a Terminal Board and Switch Card

Figure 6-5 shows how to connect a switch card and a terminal board. Connection should be made by providing wiring and placing a cover in advance.



Attach the terminal board along the board guide of the switch card.

Figure 6-5 Attaching a Terminal Board

If no terminal board is used to connect a switch card and an external device, use Nippon Koku Electronics Industries' PRBS-48-A10 PCB connector or its equivalent to do wiring.

Table 6-3 gives the correspondence between pin numbers and signal names.

Note: To attach a connector, make sure that the upper side is pin 1. Attaching the connector in the reversal direction can cause the switch card to develop trouble.

Table 6-2 Switch Card Connector Pin Numbers and Signal Names

Pin number	A	b
1	CH0 (X0) A	CH1 (X1) A
2	CH0 (X0) B	CH1 (X1) B
3	CH0 (X0) C	CH1 (X1) C
4	CH0 (X0) D	CH1 (X1) D
5	CH2 (X2) A	CH3 (X3) A
6	CH2 (X2) B	CH3 (X3) B
7	CH2 (X2) C	CH3 (X3) C
8	CH2 (X2) D	CH3 (X3) D
9	CH4 (Y0) A	CH5 (Y1) A
10	CH4 (Y0) B	CH5 (Y1) B
11	CH4 (Y0) C	CH5 (Y1) C
12	CH4 (Y0) D	CH5 (Y1) D
13	CH6 (Y2) A	CH7 (Y3) A
14	CH6 (Y2) B	CH7 (Y3) B
15	CH6 (Y2) C	CH7 (Y3) C
16	CH6 (Y2) D	CH7 (Y3) D
17	CH8 A	CH9 A
18	CH8 B	CH9 B
19	CH8 C	CH9 C
20	CH8 D	CH9 D
21	COM A	IC
22	COM B	IC
23	COM C	IC
24	COM D	IC

* Don't use the IC pin.

7. TRANSPORTING AND STORING THE INSTRUCTION

7.1 Storage

If you do not use the instruction for an extended period of time, cover it with a vinyl cloth or contain it in a cardboard box for storage in a low-temperature place not exposed to the sunlight.

7.2 Transportation

When transporting the instruction, use the packing material used to deliver it to you from the factory. If the material was lost, take the following measures.

(1) Wrap the instruction with a vinyl cloth or the like.

(2) Contain the wrapped machine in a cardboard box of a thickness of 5mm or more in thickness with shock absorbing material (50mm or more in thickness) inside the box to enclose the instruction.

(3) Also put the accessories in the box, cover them with shock absorbing material, close the box and bind it with packaging ropes.

8. SPECIFICATIONS AND ACCESSORIES

8.1 Specifications

8.1.1 7210 Scanner

Control	:	Manual (on the panel) or remote (GPIB, single-line control)
No. of channels	:	Up to five switch cards can be mounted. Multiplexer, actuator (transfer) . . . . 50 CH max. Matrix . . . . . 80×4-line cross points max.
Switch structure	:	Floating and guarded
Display	:	LED 10 digits (Character height: 10mm, Color: red) (Access channel display; condition setting display)
Input/output terminals	:	Rear panel
Trigger output	:	Trigger output signal to the digital multi-function meter and other measurement instruments TTL level; positive or negative pulse (pulse width: about 500μs)
Busy output	:	Signal to show the time from the start and end of one scan sequence TTL level, negative pulse
Channel advance input	:	Scan advance input signal from the printer, digital multi-function meter, etc. TTL level, positive or negative pulse (Pulse width: about 100μs)
Start/stop signal	:	Input signal to start/stop the scanner from outside., TTL level, negative logic
Data memory	:	Capable of control parameters including the switching program (100 steps max.) in random scanning. Capable of digital input data (1,000) Capable of retaining the memory for about 5 years by means of battery backup. (Storage temperature: +5°C to +45°C)
Switch drive capacity	:	(No. of channels capable of simultaneous closing); With in 0.8A of the total switch card driving currents.
GPIB function	:	SH1, AH1, T6, L3, SR1, RL1, PR0, DC1, DT1, C0, E2 Specifications in conformity with IEEE Standard 488-1978
Self-diagnostic function	:	Execution of built-in ROM, RAM panel LED and switch card self-diagnosis

Power source : The power source voltage can be changed as follows.
(Specification: AC90V to 110V)

48Hz to 66Hz	Option No.	32	42	44
	Power source voltage	108V to 132V	198V to 242V	216V to 250V

Power consumption : 32VA or less

Operating environment : Temperature ..... 0°C to +40°C
Humidity ..... RH85% or less

Storage temperature : +5°C to +45°C (Memory content guaranteed)
−25°C to +70°C (Memory content not guaranteed)

Dimensions : About 424 in width x 88 in height×450 in depth (mm)

Weight : 7210 only ..... About 8kg
With five switch cards and five terminal boards .... About 13kg

Control parameters:

(1) MODE (Scan Mode)

Selection of scan mode
SEQUENTIAL (SQ) : Scanning from the first channel to the last channel sequentially. (Multiplexer card only)
RANDOM (RN) : Scanning according to the switching program set in advance

(2) F.L.CH (First/Last Channel)

Setting the starting and end channels in the "SEQUENTIAL" scanning mode
<FC: 0 to 99; LC: 0 to 99>

(3) F.L.PN (First/Last Program Number)

Setting the starting and end program numbers in the "RANDOM" scanning mode
<FP: 0 to 99; LP: 0 to 99>

(4) TRIGGER

Selecting the means to advance the sequence
MANUAL "MN" : Advancing the sequence step by step manually
AUTO "AU" : Advancing steps automatically at the time interval set by S.INT/R.INT
EXTERNAL "EX" : Advancing steps by external signals (GPIB, CH ADV.)

(5) R.NO (Repeat Number)

Setting the number of repetition of the sequence
<RN: 0 to 99>

(6) S.INT (Step Interval)

Setting the scan step interval in the "AUTO" trigger mode
<ms, s, MN, 000 to 999>

(7) R.INT (Repeat Interval)

Setting the sequence interval in the "AUTO" trigger mode
<ms, s, MN, 000 to 999>

(8) BLOCK

Setting card numbers according to the number of channels and making blocks when using multiple multiplexer cards as a multi-channel (20, 30, ..., 50) multiplexer.
It is possible to specify up to two blocks.

(9) PROGRAM

Setting scanning information (program) to control each switch in random scanning
One step: 30 characters max.
100 steps max. (Program number: 0 to 99)

(10) DELAY

Setting a delay time to delay the TRIGGER OUT signal to be output after the end of a contact point operation 1 to 10s in the unit of 1ms

Direct access:

(1) Direct channel access

It is possible to open and close switches directly even without starting the scan sequence.
It is possible to set up to 30 characters

(2) Direct program access

It is possible to execute the scan information (program) set by the PROGRAM control parameter without starting random scanning. (The content of the program cannot be changed.)

(3) Direct digital I/O access

It is possible to input/output 16-bit data directly by dividing the digital input/output timing.

Digital I/O performance:

(1) No. of input/output bits

- Data line
  16-bit bi-directional

- Interrupt line

  EXINT1
  EXINT2 } Two lines

  Low true (Pulse width: 100µs or more)
  The GPIB SRQ signal is sent with "true". (S0 mode)

- Control signal output

  I/O DIR1
  I/O DIR2 } Two lines

  Signal to show the data input/output direction
  LOW : Output direction (WRITE operation)
  HIGH : Input direction (READ operation)
  (TTL level, level signal)

  *STB
  Signal to show the strobe timing of data latch
  Low true (Pulse width: 100µs)

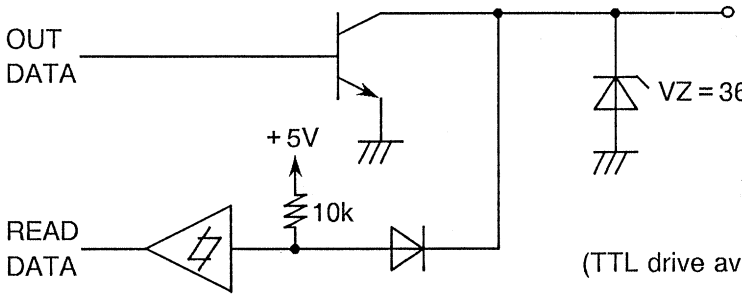
(2) Input/output connector

57LE-40360-77CO (DDK)

- Cable side connector
  57 Series of 36-terminal connectors, e.g., 57-30360 (DDK)

(3) Input/output lines

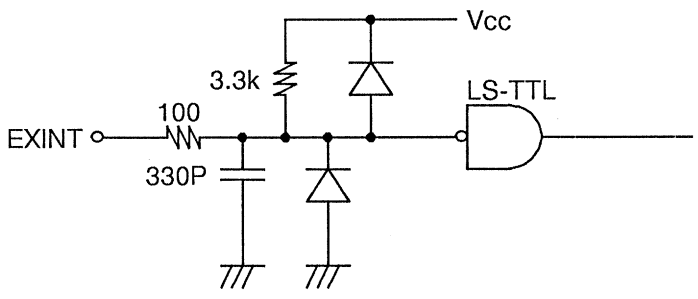
- Data line (The following is one of the 16 lines.)



Open collector output
V_{OL} = 0.8V 150mA
V_{OH} = 30V (MAX)
(V_{OH} without load: 2.4V 0.2mA)
$3V \leq V_{IN} \leq 30V$
$0V \leq V_{IN} \leq 0.8V$

(TTL drive available with internal pull-up resistance)

- Interrupt line



· Input level = LS-TTL level
· Negative logic pulse signal
· Pulse width = 100µs or more

8.1.2 Performance of 72101A MULTIPLEXER CARD A (General Purpose)

No. of channels	:	10 channels, 3 lines/ch.
Switch type	:	Dry lead relay
Thermoelectromotive force	:	10μV or less
Switching time	:	3ms or less
Max. contact rating	:	Voltage .... 100V peak Current .... 0.5A (without conductive load) Power 50W
Max. input	:	200V peak (between terminals)
Insulation resistance	:	$10^{10}\Omega$ or more (between terminals)/ +23°C ± 5°C, 60%RH or less $10^{8}\Omega$ or more (between terminals)/ +40°C, 85%RH or less
Signal route resistance	:	500mΩ or less (including the input/output contact resistance)
Electrostatic capacity	:	15pF or less (switch off, between signal routes) 75pF or less (switch on, between signal routes)
Frequency characteristic	:	50Ω at terminal < ± 0.3dB/100kHz, < ± 0.5dB/1MHz, < – 3dB/10MHz
Cross talk	:	50Ω at terminal < – 50dB/100kHz, < – 40dB/1MHz, < – 30dB/10MHz
Power consumption (Drive current)	:	20mA × No. of closed channels (0 or 1)
Contact point life	:	10^{8} times or more (mechanical)
Switching timing	:	B.B.M (Break-Before-Make)
Input/output connector	:	PCB card edge (Pitch between pins: 3.175mm) Nippon Koku Electronic Industries' PBRS-48 Series or its equivalent
Contact point structure	:	Multiplexer card structure
Input/output terminal board	:	72109A, 72109B, 72109D

8.1.3 Performance of 72101B MULTIPLEXER CARD B (General Purpose)

No. of channels	:	10 channels, 4 lines/ch.
Switch type	:	Mechanical relay (air-tight, filled with N_2)
Thermoelectromotive force	:	1μV or less
Switching time	:	26ms or less
Max. contact rating	:	Voltage .... 40V peak Current .... 1A (without conductive load) Power 40W
Max. input	:	200V peak (between terminals)
Insulation resistance	:	$10^{10}\Omega$ or more (between terminals)/ + 23°C ± 5°C, 60%RH or less $10^{8}\Omega$ or more (between terminals)/ + 40°C, 85%RH or less
Signal route resistance	:	500mΩ or less (including the input/output contact resistance)
Electrostatic capacity	:	5pF or less (switch off, between signal routes) 20pF or less (switch on, between signal routes)
Frequency characteristic	:	50Ω at terminal < ± 0.3dB/100kHz, < ± 0.5dB/1MHz, < – 2dB/10MHz
Cross talk	:	50Ω at terminal < – 50dB/100kHz, < – 40dB/1MHz, < – 30dB/10MHz
Power consumption (Drive current)	:	1mA
Contact point life	:	10^{8} times or more (mechanical)
Switching timing	:	B.B.M (Break-Before-Make)
Input/output connector	:	PCB card edge (Pitch between pins: 3.175mm) Nippon Koku Electronic Industries' PBRS-48 Series or its equivalent
Contact point structure	:	Multiplexer card structure
Input/output terminal board	:	72109A, 72109D

8.1.4 Performance of 72101C MULTIPLEXER CARD (LONG LIFE and HIGH VOLTAGE)

No. of channels	:	10 channels, 3 lines/ch.
Switch type	:	Mercury lead relay
Thermoelectromotive force	:	20μV or less
Switching time	:	6ms or less
Max. contact rating	:	Voltage .... 300V peak Current .... 1A (without conductive load) Power 50W
Max. input	:	500V peak
Insulation resistance	:	$10^{10}\Omega$ or more (between terminals)/ +23°C ± 5°C, 60%RH or less $10^{8}\Omega$ or more (between terminals)/ +40°C, 85%RH or less
Signal route resistance	:	500mΩ or less (including the input/output contact resistance)
Electrostatic capacity	:	15pF or less (switch off, between signal routes) 80pF or less (switch on, between signal routes)
Frequency characteristic	:	50Ω at terminal < ± 0.3dB/100kHz, < ± 0.5dB/1MHz, < – 3dB/10MHz
Cross talk	:	50Ω at terminal < – 50dB/100kHz, < – 40dB/1MHz, < – 30dB/10MHz
Power consumption (Drive current)	:	40mA × No. of closed channels (0 or 1)
Contact point life	:	10^{9} times or more (mechanical)
Switching timing	:	B.B.M (Break-Before-Make)
Contact point structure	:	Multiplexer card structure
Input/output terminal	:	Built in the switch card Note: If this card is used, two slots are occupied.

8.1.5 Performance of R72101D MULTIPLEXER CARD D (LOW THERMAL OFFSET)

No. of channels	: 10 channels, 3 lines/ch.
Switch type	: Low thermalelectromotive force mechanical relay (air-tight, filled with N_2)
Thermoelectromotive force	: $\pm 0.2\mu$V or less ($+23°C \pm 5°C$) $\pm 0.3\mu$V or less ($+23°C \pm 10°C$)
Switching time	: 26ms or less
Max. contact rating	: Voltage .... 40V peak Current .... 500mA (without conductive load) Power 20W
Max. input	: 200V peak (between terminals)
Insulation resistance	: $10^{10}\Omega$ or more (between terminals)/ $+23°C \pm 5°C$, 60%RH or less $10^{8}\Omega$ or more (between terminals)/ $+40°C$, 85%RH or less
Signal route resistance	: 500mΩ or less (including the input/output contact resistance)
Electrostatic capacity	: 5pF or less (switch off, between signal routes) 20pF or less (switch on, between signal routes)
Frequency characteristic	: 50Ω at terminal $< \pm 0.3$dB/100kHz, $< \pm 0.5$dB/1MHz, < -2dB/10MHz
Cross talk	: 50Ω at terminal < -50dB/100kHz, < -40dB/1MHz, < -30dB/10MHz
Power consumption (Drive current)	: 1mA
Contact point life	: 10^8 times or more (mechanical)
Switching timing	: B.B.M (Break-Before-Make)
Input/output connector	: PCB card edge (Pitch between pins: 3.175mm) Nippon Koku Electronic Industries' PBRS-48 Series or its equivalent
Contact point structure	: Multiplexer card structure
Input/output terminal board	: 72109A, 72109D

8.1.6 Performance of 72101E MULTIPLEXER CARD E (LOW LEAKAGE)

No. of channels	:	10 channels, 3 lines/ch.
Switch type	:	Dry lead relay
Thermoelectromotive force	:	20μV or less
Switching time	:	3ms or less
Max. contact rating	:	Voltage .... 100V peak Current .... 200mA (without conductive load) Power 10W
Max. input	:	200V peak (between terminals)
Insulation resistance	:	$10^{11}\Omega$ or more (between terminals)/ + 23°C ± 5°C, 60%RH or less $10^{10}\Omega$ or more (between terminals)/ + 40°C, 85%RH or less
Signal route resistance	:	500mΩ or less
Electrostatic capacity	:	20pF or less (switch off, between signal routes) 80pF or less (switch on, between signal routes)
Frequency characteristic	:	50Ω at terminal < ± 0.3dB/100kHz, < ± 0.5dB/1MHz, < – 3dB/10MHz
Cross talk	:	50Ω at terminal < – 50dB/100kHz, < – 40dB/1MHz, < – 30dB/10MHz
Power consumption (Drive current)	:	50mA × No. of closed channels (0 or 1)
Contact point life	:	10^8 times or more (mechanical)
Switching timing	:	B.B.M (Break-Before-Make)
Input/output connector	:	Built in the switch card
Contact point structure	:	Multiplexer card structure

8.1.7 Performance of 72101G MULTIPLEXER CARD (LONG LIFE and HIGH VOLTAGE)

No. of channels	:	10 channels, 2 lines/ch.
Switch type	:	Mercury lead relay
Thermoelectromotive force	:	100μV or less
Switching time	:	6ms or less
Max. contact rating	:	Voltage .... 1000V peak Current .... 1A (switching at 50V) 5mA (switching at 1000V) Power ..... 50W (5W: switching at 300V or more)
Max. input	:	1000V peak
Insulation resistance	:	$10^{10}\Omega$ or more (between terminals)/ + 23°C ± 5°C, 60%RH or less $10^{8}\Omega$ or more (between terminals)/ + 40°C, 85%RH or less
Signal route resistance	:	500mΩ or less (including the input/output contact resistance)
Electrostatic capacity	:	15pF or less (switch off, between signal routes) 80pF or less (switch on, between signal routes)
Frequency characteristic	:	50Ω at terminal < ± 0.3dB/100kHz, < ± 0.5dB/1MHz, < – 3dB/10MHz
Cross talk	:	50Ω at terminal < – 50dB/100kHz, < – 40dB/1MHz, < – 30dB/10MHz
Power consumption (Drive current)	:	50mA × No. of closed channels (0 or 1)
Contact point life	:	10^{9} times or more (mechanical)
Switching timing	:	B.B.M (Break-Before-Make)
Input/output terminal	:	Built in the switch card
No. of slots used	:	Two slots
Contact point structure	:	Multiplexer card structure

8.1.8 Performance of 72101H MULTIPLEXER CARD H (LONG LIFE and HIGH VOLTAGE)

No. of channels	:	10 channels (2 sets), 3 lines/ch.
Switch type	:	Mercury lead relay
Thermoelectromotive force	:	20μV or less
Switching time	:	6ms or less
Max. contact rating	:	Voltage .... 300V peak Current .... 2A (without conductive load) Power 50W
Max. input	:	300V peak
Insulation resistance	:	$10^{10}\Omega$ or more (between terminals)/ + 23°C ± 5°C, 60%RH or less $10^{8}\Omega$ or more (between terminals)/ + 40°C, 85%RH or less
Signal route resistance	:	500mΩ or less (including the input/output contact resistance)
Electrostatic capacity	:	15pF or less (switch off, between signal routes) 80pF or less (switch on, between signal routes)
Frequency characteristic	:	50Ω at terminal < ± 0.3dB/100kHz, < ± 0.5dB/1MHz, < – 3dB/10MHz
Cross talk	:	50Ω at terminal < – 50dB/100kHz, < – 40dB/1MHz, < – 30dB/10MHz
Power consumption (Drive current)	:	40mA × No. of closed channels (0 or 1)
Contact point life	:	10^{9} times or more (mechanical)
Switching timing	:	B.B.M (Break-Before-Make)
Contact point structure	:	Multiplexer card structure
Input/output terminal	:	Built in the multiplexer card Note: If this card is used, two slots are occupied.

8.1.9 Performance of 72101J MULTIPLEXER CARD J (LOW CURRENT)

No. of channels	:	10 channels, 2 lines/ch.
Switch type	:	Dry lead relay
Thermoelectromotive force	:	200μV or less
Switching time	:	9ms or less
Max. contact rating	:	Voltage .... 200V peak Current .... 1A (without conductive load) Power 50W
Max. input	:	400V peak
Insulation resistance	:	$10^{14}\Omega$ or more (between HI-LO)/ +23°C ±5°C, 60%RH or less $10^{13}\Omega$ or more (between HI-LO)/0 to +40°C, 85%RH or less
Signal route resistance	:	1mΩ or less (including the input/output contact resistance)
Electrostatic capacity	:	15pF or less (switch off, between HI-LO CH.) 80pF or less (switch on, between HI-LO CH.)
Frequency characteristic	:	50Ω at terminal < ±0.3dB/100kHz, < ±0.5dB/1MHz, < −3dB/10MHz
Cross talk	:	50Ω at terminal < −50dB/100kHz, < −40dB/1MHz, < −30dB/10MHz
Power consumption (Drive current)	:	50mA × No. of closed channels (0 or 1)
Contact point life	:	10^9 times or more (mechanical)
Switching timing	:	Between CH., B.B.M (Break-Before-Make)
Input/output connector	:	Tajimi Musen's tri-axial connector Receptacle .... BRA102-BR or its equivalent Plug ..... TXA104-P or its equivalent
No. of slots used	:	Two slots.

8.1.10 Performance of 72102A ACTUATOR CARD A (General Purpose)

No. of channels	:	10 channels, 2 lines/ch.
Switch type	:	Dry lead relay
Thermoelectromotive force	:	10μV or less
Switching time	:	2ms or less
Max. contact rating	:	Voltage .... 100V peak Current .... 0.5A (without conductive load) Power 50W
Max. input	:	200V peak (between terminals)
Insulation resistance	:	$10^{10}\Omega$ or more (between terminals)/ +23°C ±5°C, 60%RH or less $10^{8}\Omega$ or more (between terminals)/ +40°C, 85%RH or less
Signal route resistance	:	500mΩ or less (including the input/output contact resistance)
Electrostatic capacity	:	8pF or less (switch off, between signal routes) 12pF or less (switch on, between signal routes)
Frequency characteristic	:	50Ω at terminal < ±0.2dB/100kHz, < ±0.3dB/1MHz, < – 1dB/10MHz
Cross talk	:	50Ω at terminal < – 50dB/100kHz, < – 40dB/1MHz, < – 30dB/10MHz
Power consumption (Drive current)	:	15mA × No. of closed channels (0 or 10)
Contact point life	:	10^{8} times or more (mechanical)
Switching timing	:	By programming
Input/output connector	:	PCB card edge (Pitch between pins: 3.175mm) Nippon Koku Electronic Industries' PBRS-48 Series or its equivalent
Contact point structure	:	Actuator card structure
Input/output terminal board	:	72109A, 72109D

8.1.11 Performance of 72102C ACTUATOR CARD C (LONG LIFE and HIGH VOLTAGE)

No. of channels	:	10 channels, 2 lines/ch.
Switch type	:	Mercury lead line
Thermoelectromotive force	:	20μV or less
Switching time	:	3ms or less
Max. contact rating	:	Voltage .... 300V peak Current .... 1A (without conductive load) Power 50W
Max. input	:	500V peak (between terminals)
Insulation resistance	:	$10^{10}\Omega$ or more (between terminals)/ + 23°C ± 5°C, 60%RH or less $10^{8}\Omega$ or more (between terminals)/ + 40°C, 85%RH or less
Signal route resistance	:	500mΩ or less (including the input/output contact resistance)
Electrostatic capacity	:	8pF or less (switch off, between signal routes) 12pF or less (switch on, between signal routes)
Frequency characteristic	:	50Ω at terminal < ± 0.2dB/100kHz, < ± 0.3dB/1MHz, < – 1dB/10MHz
Cross talk	:	50Ω at terminal < – 50dB/100kHz, < – 40dB/1MHz, < – 30dB/10MHz
Power consumption (Drive current)	:	25mA × No. of closed channels (0 or 10)
Contact point life	:	10^{9} times or more (mechanical)
Switching timing	:	By programming
Contact point structure	:	Actuator card structure
Input/output connector	:	Built in the actuator card Note: If this card is used, two slots are occupied.

8.1.12 Performance of 72102H ACTUATOR CARD H (LONG LIFE and HIGH VOLTAGE)

No. of channels	:	10 channels (2 sets), 2 lines/ch.
Switch type	:	Mercury lead relay
Thermoelectromotive force	:	20μV or less
Switching time	:	3ms or less
Max. contact rating	:	Voltage .... 300V peak Current .... 2A (without conductive load) Power 50W
Max. input	:	500V peak (between terminals)
Insulation resistance	:	$10^{10}\Omega$ or more (between terminals)/ + 23°C ± 5°C, 60%RH or less $10^{8}\Omega$ or more (between terminals)/ + 40°C, 85%RH or less
Signal route resistance	:	500mΩ or less (including the input/output contact resistance)
Electrostatic capacity	:	8pF or less (switch off, between signal routes) 12pF or less (switch on, between signal routes)
Frequency characteristic	:	50Ω at terminal < ± 0.2dB/100kHz, < ± 0.3dB/1MHz, < − 1dB/10MHz
Cross talk	:	50Ω at terminal < − 50dB/100kHz, < − 40dB/1MHz, < − 30dB/10MHz
Power consumption (Drive current)	:	25mA × No. of closed channels (0 or 20)
Contact point life	:	10^{9} times or more (mechanical)
Switching timing	:	By programming
Contact point structure	:	Actuator card structure
Input/output connector	:	Built in the switch card Note: If this card is used, two slots are occupied.

8.1.13 Performance of 72103A MATRIX CARD A (General Purpose)

No. of channels	:	4×4 channels, 4 lines/ch.
Switch type	:	Dry lead relay
Thermoelectromotive force	:	10μV or less
Switching time	:	2ms or less
Max. contact rating	:	Voltage .... 100V peak Current .... 0.5A (without conductive load) Power 50W
Max. input	:	200V peak (between terminals)
Insulation resistance	:	$10^{10}\Omega$ or more (between terminals)/ +23°C ±5°C, 60%RH or less $10^{8}\Omega$ or more (between terminals)/ +40°C, 85%RH or less
Signal route resistance	:	650mΩ or less (including the input/output contact resistance)
Electrostatic capacity	:	40pF or less (switch off, between signal routes) 80pF or less (switch on, between signal routes)
Frequency characteristic	:	50Ω at terminal < ±0.3dB/100kHz, < ±0.5dB/1MHz, < −3dB/10MHz
Cross talk	:	50Ω at terminal < −50dB/100kHz, < −40dB/1MHz, < −30dB/10MHz
Power consumption (Drive current)	:	30mA × No. of closed channels (0 or 16)
Contact point life	:	10^{8} times or more (mechanical)
Switching timing	:	By programming
Input/output connector	:	PCB card edge (Pitch between pins: 3.175mm) Nippon Koku Electronic Industries' PBRS-48 Series or its equivalent
Contact point structure	:	Matrix card structure
Input/output terminal board	:	72109A, 72109D

8.1.14 Performance of 72103B MATRIX CARD B (General Purpose)

No. of channels	:	4×4 channels, 4 lines/ch.
Switch type	:	Mechanical relay (air-tight, filled with N_2)
Thermoelectromotive force	:	1μV or less
Switching time	:	13ms or less
Max. contact rating	:	Voltage .... 40V peak Current .... 1A (without conductive load) Power 40W
Max. input	:	200V peak (between terminals)
Insulation resistance	:	$10^{10}\Omega$ or more (between terminals)/ +23°C ±5°C, 60%RH or less $10^{8}\Omega$ or more (between terminals)/ +40°C, 85%RH or less
Signal route resistance	:	650mΩ or less (including the input/output contact resistance)
Electrostatic capacity	:	20pF or less (switch off, between signal routes) 50pF or less (switch on, between signal routes)
Frequency characteristic	:	50Ω at terminal < ±0.3dB/100kHz, < ±0.5dB/1MHz, < −2dB/10MHz
Cross talk	:	50Ω at terminal < −50dB/100kHz, < −40dB/1MHz, < −30dB/10MHz
Power consumption (Drive current)	:	1mA
Contact point life	:	10^{8} times or more (mechanical)
Switching timing	:	By programming
Input/output connector	:	PCB card edge (Pitch between pins: 3.175mm) Nippon Koku Electronic Industries' PBRS-48 Series or its equivalent
Contact point structure	:	Matrix card structure
Input/output terminal board	:	72109A, 72109D

8.1.15 Performance of 72103C MATRIX CARD C (LONG LIFE and HIGH VOLTAGE)

No. of channels	:	4×4 channels, 4 lines/ch.
Switch type	:	Mercury lead relay
Thermoelectromotive force	:	20μV or less
Switching time	:	3ms or less
Max. contact rating	:	Voltage .... 300V peak Current .... 1A (without conductive load) Power 50W
Max. input	:	500V peak
Insulation resistance	:	$10^{10}\Omega$ or more (between terminals)/ +23°C ±5°C, 60%RH or less $10^{8}\Omega$ or more (between terminals)/ +40°C, 85%RH or less
Signal route resistance	:	650mΩ or less (including the input/output contact resistance)
Electrostatic capacity	:	40pF or less (switch off, between signal routes) 80pF or less (switch on, between signal routes)
Frequency characteristic	:	50Ω at terminal < ±0.3dB/100kHz, < ±0.5dB/1MHz, < −3dB/10MHz
Cross talk	:	50Ω at terminal < −50dB/100kHz, < −40dB/1MHz, < −30dB/10MHz
Power consumption (Drive current)	:	60mA × No. of closed channels (0 or 16)
Contact point life	:	10^{9} times or more (mechanical)
Switching timing	:	By programming
Contact point structure	:	Matrix card structure
Input/output connector	:	Built in the matrix card Note: If this card is used, two slots are occupied.

8.1.16 Performance of 72104 UNIVERSAL CARD

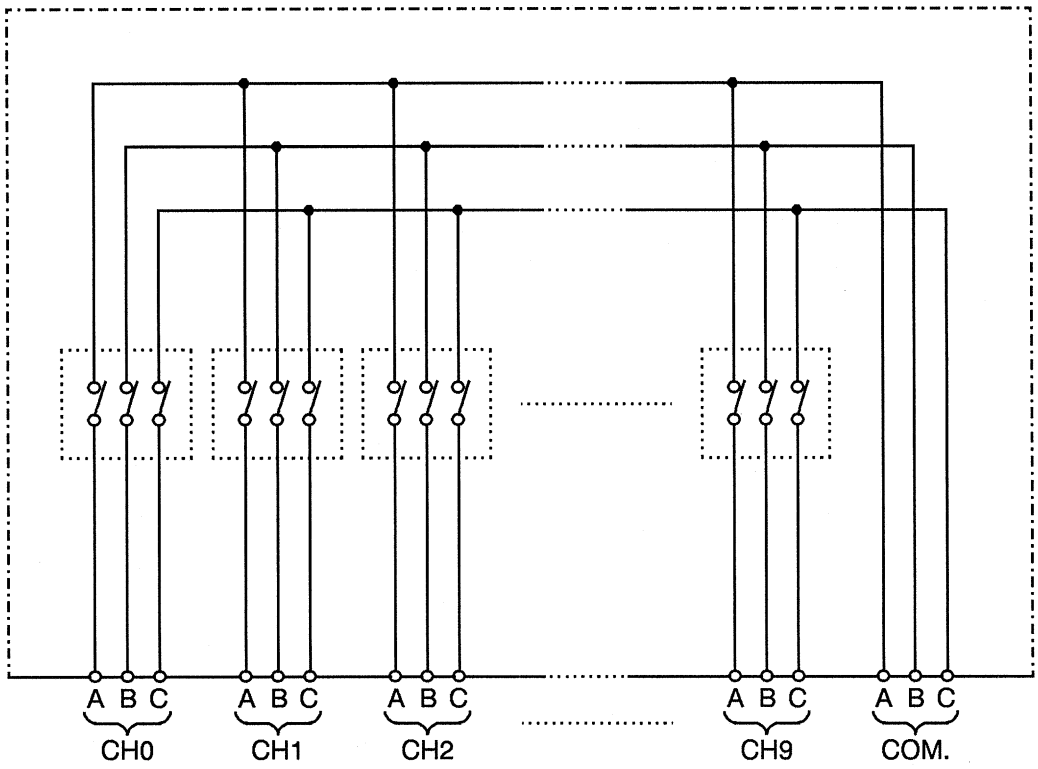
Area available for PCB mounting	:	86mm × 193mm
Pitch between part mounting holes	:	2.54mm
Hole diameter	:	0.9mm
Max. height of a part	:	15mm
Lead length	:	3mm or less
Max. voltage applicable to a terminal	:	40V DC, 40V peak
Input/output connector	:	PCB card edge (pitch between pins: 3.175mm) Nippon Koku Industries' PBRS-48 Series or its equivalent
Input/output terminal board	:	72109A, 72109B, 72109D

8.1.17 Performance of 72106A TRANSFER CARD A (General Purpose)

No. of channels	: 10 channels, transfer contact point
Switch type	: Dry lead relay
Thermoelectromotive force	: 70μV or less
Switching time	: 2ms or less
Max. contact rating	: Voltage .... 30V peak Current .... 0.1A (without conductive load) Power 3W
Max. input	: 100V peak (between terminals)
Insulation resistance	: $10^9\Omega$ or more (between terminals)/ + 23°C ± 5°C, 60%RH or less $10^8\Omega$ or more (between terminals)/ + 40°C, 85%RH or less
Signal route resistance	: 300mΩ or less (including the input/output contact resistance)
Electrostatic capacity	: 8pF or less (switch off, between N.O-COM) 8pF or less (switch on, between N.O-COM)
Frequency characteristic	: 50Ω at terminal < ± 0.3dB/100kHz, < ± 0.5dB/1MHz, < – 2dB/10MHz
Cross talk	: 50Ω at terminal < – 50dB/100kHz, < – 40dB/1MHz, < – 30dB/10MHz
Power consumption (Drive current)	: 40mA × No. of closed channels (0 or 10)
Contact point life	: 5×10^7 times or more (mechanical)
Switching timing	: By programming
Input/output connector	: PCB card edge (Pitch between pins: 3.175mm) Nippon Koku Electronic Industries' PBRS-48 Series or its equivalent
Input/output terminal board	: 72109A, 72109D

8.1.18 Switch Card Contact Point Structure

(1) MULTIPLEXER CARD (72101 Series, except the 72101J)



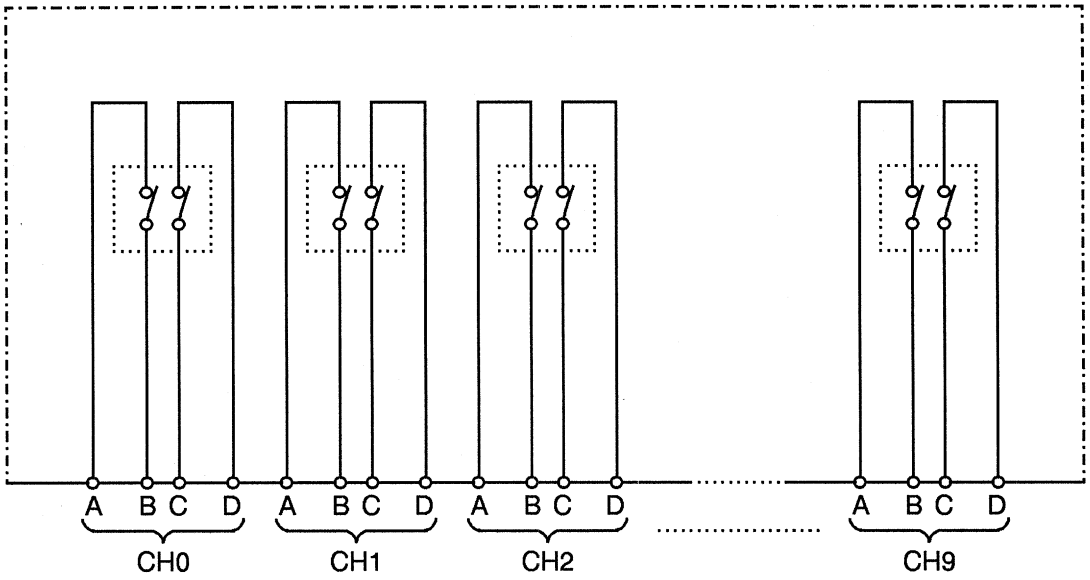
By turning any one of CG0 to CH9 on (CLOSE), it is possible to make each channel and each COM terminal (A, B, C) conductive.

The 72101H has CH0 to CH19.

The 72101B is of four-line type.

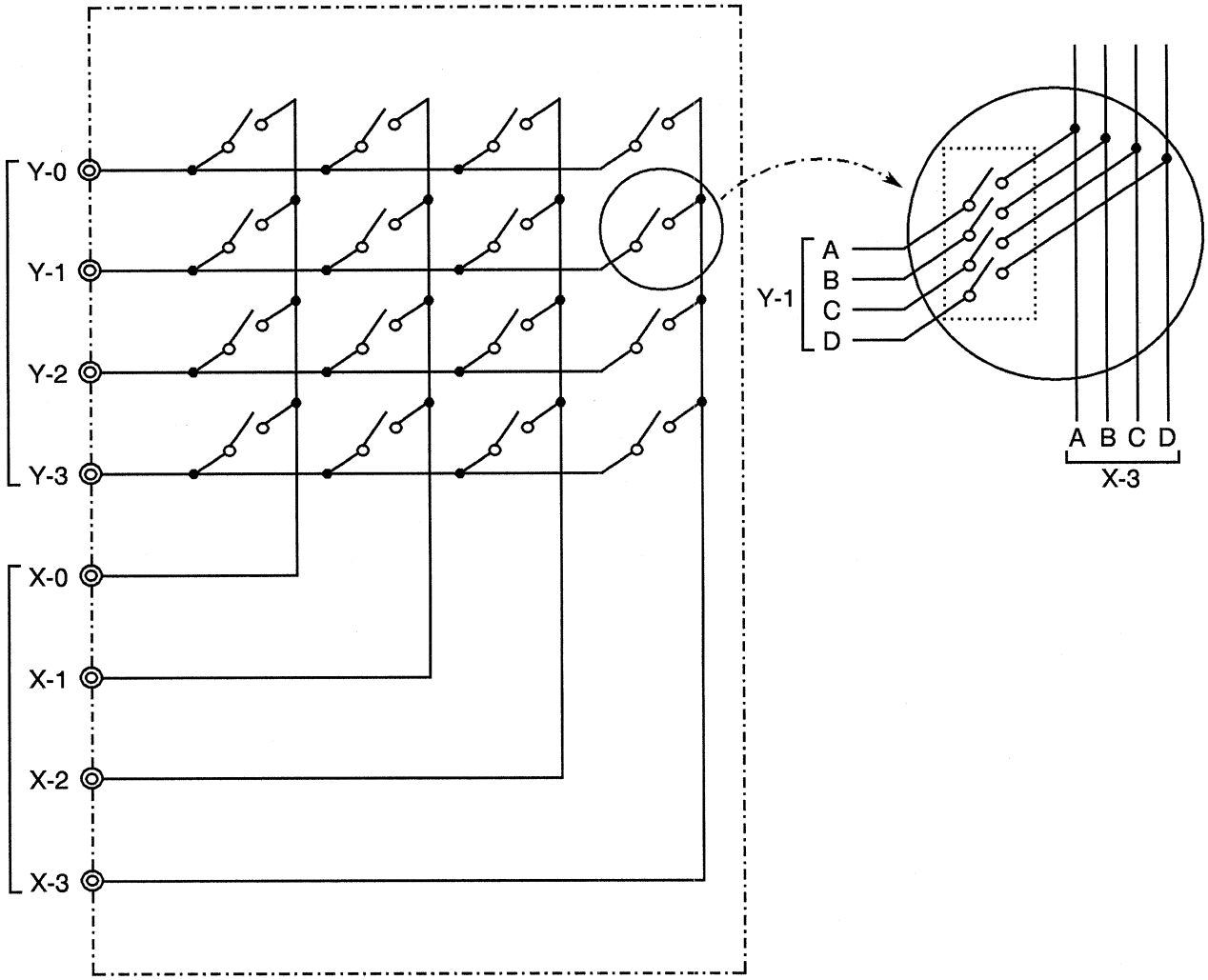
The 72101G is of two-line type.

(2) ACTUATOR CARD (72102 Series)



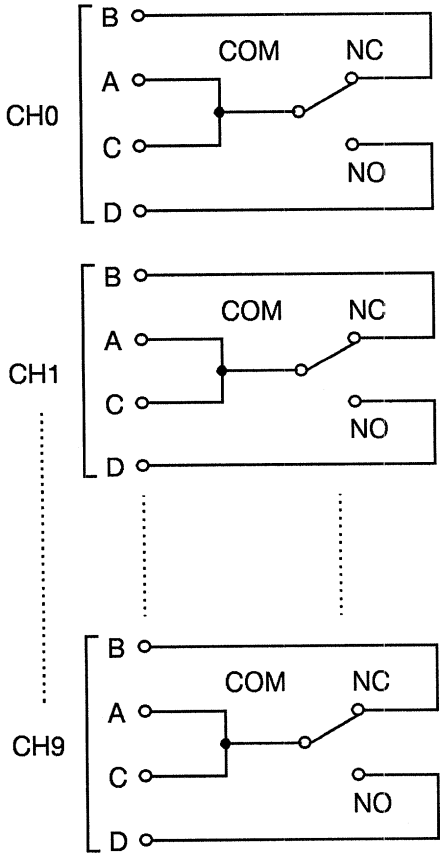
By turning any of CH0 through CH9 on (CLOSE) (multiple channels available), it is possible to make the A-B and C-D terminals of each channel conductive.
The 72102H has CH0 through CH19.

(3) MATRIX CARD (72103 Series)



By turning any section of X-n and Y-m on (CLOSE), it is possible to make any X (4ch.) and Y (4 ch.) channels conductive.

(4) TRANSFER CARD (72106 Series)



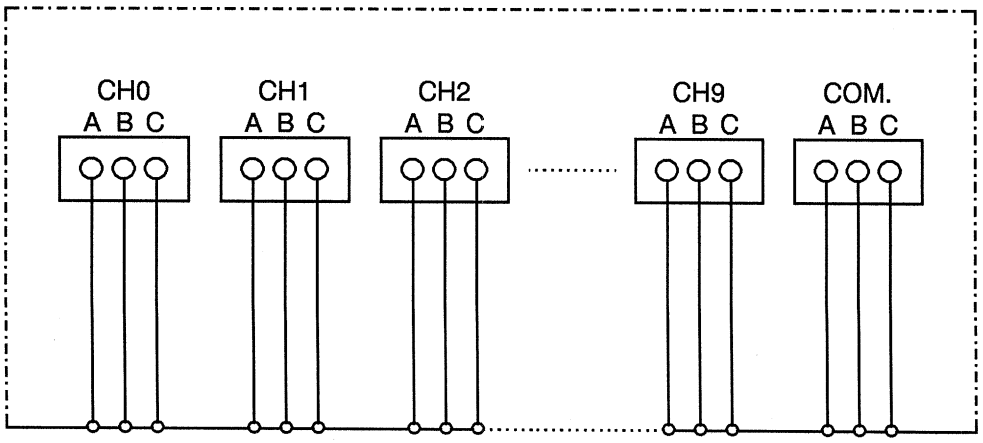
By turning any channel of CH0 through CH9 on (CLOSE) (multiple channels available), it is possible to make the A-D and C-D terminals of each channel conductive. By turning any channel off (OPEN), the A-B and C-B terminals are made conductive.

8.1.19 Performance of 72109A INPUT/OUTPUT TERMINAL A

Input/output terminal	:	Screw-type block terminal (Wire diameter: 0.5 to 1.5mm^2)
No. of terminals	:	44 terminals 4×10 ch. +4 (COM)
Withstanding voltage between terminals	:	120V
Insulation resistance	:	$10^{10}\Omega$ or more (between terminals)/ +23°C ±5°C, 60%RH or less $10^{8}\Omega$ or more (between terminals)/ +40°C, 85%RH or less
Electrostatic capacity	:	4pF or less (between terminals)
Switch card	:	72101A/72101B/R72101D 72102A 72103A/72103B 72106A 72104

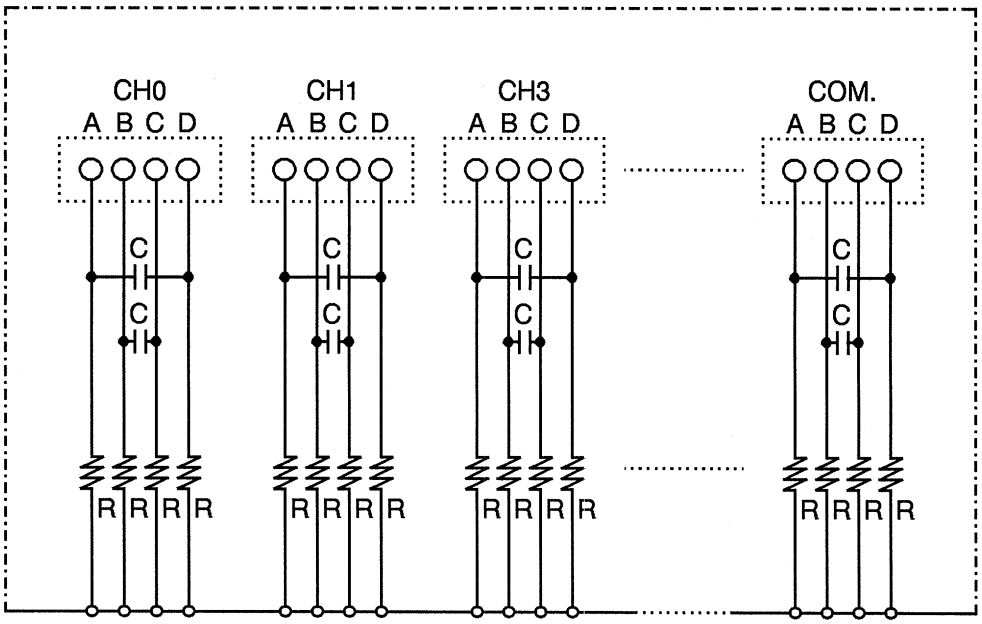
8.1.20 Performance of 72109B INPUT/OUTPUT TERMINAL B

Input/output terminal	:	Screw-type block terminal
No. of terminals	:	33 terminals 3×10 ch. +3 (COM)
Voltage between terminals	:	1000V
Insulation resistance	:	$10^{10}\Omega$ or more (between terminals)/ +23°C ±5°C, 60%RH or less $10^{8}\Omega$ or more (between terminals)/ +40°C, 85%RH or less
Electrostatic capacity	:	4pF or less (between terminals)
Switch card	:	72101A
Structure	:	



8.1.21 Performance of 72109D INPUT/OUTPUT TERMINAL D

Input/output terminal	:	Screw-type block terminal
No. of terminals	:	44 terminals 4×10 ch. +4 (COM)
Withstanding voltage between terminals	:	50V peak
Insulation resistance	:	$10^9\Omega$ or more (between terminals) / +23°C ±5°C, 60%RH or less $10^8\Omega$ or more (between terminals)/ +40°C, 85%RH or less
Electrostatic capacity	:	0.001pF or less (between terminals)
Filter constant	:	As shown below
Switch card	:	72101A/72101B/R72101D 72102A 72103A/72103B 72104 72106A
Circuit structure	:	



R : 100Ω
C : 0.001μF

8.2 Accessories

TR1140	(Scanner adaptor)
MO-26	(TR1140-TR1140 connection cable)
MC-78	(TR1140-TR7210 connection cable)
MO-01	(TR1140-TR6198 connection cable)
A01231	(7210 trigger complete signal connection cable)
A01009-050	(Input cable TRIAX-TRIAX connector 0.5m)
A01009-100	(Input cable TRIAX-TRIAX connector 1m)
A01009-150	(Input cable TRIAX-TRIAX connector 1.5m)
A01009-200	(Input cable TRIAX-TRIAX connector 2m)
A01010	(Input cable TRIAX-clip 1m)
A01011-050	(Input cable TRIAX-BNC connector 0.5m)
A01011-100	(Input cable TRIAX-BNC connector 1m)
A01011-150	(Input cable TRIAX-BNC connector 1.5m)
A01011-200	(Input cable TRIAX-BNC connector 2.0m)
A01012-050	(Input cable TRIAX-M type connector 0.5m)
A01012-100	(Input cable TRIAX-M type connector 1m)
A01012-150	(Input cable TRIAX-M type connector 1.5m)
A01012-200	(Input cable TRIAX-M type connector 2m)
SSI-01	(Multiplexer card switch status indicator)
SSI-02	(Actuator card switch status indicator)
SSI-03	(Matrix card switch status indicator)
SSI-04	(Multiplexer card switch status indicator)

The switch status indicator can be used only with 7210 Series cards with input/output capability. The status of contact point opening/closing is indicated by the LED lamp corresponding to each switch contact point.

It is used in connection with a switch card instead of an input/output card.

8.2.1 Using the TR1140 SCANNER ADAPTOR

The TR1140 is used to make a local system using a measurement instrument with BCD data output capability with the DVM having no "TRIGGER" or "COMPLETE" terminal. To connect the TR1140, set the "adaptor" mode by using the panel switch.

With this setting, the CONTROL, TRIGGER OUT and CH. ADVANCE signals of the R7210 are made positive logic pulses.

Figure 8-1 shows how to set the adaptor mode.

The equipment is set in the "normal" mode at the time of factory shipment, that is, the TRIGGER OUT an DH. ADVANCE signals are made negative logic pulses.

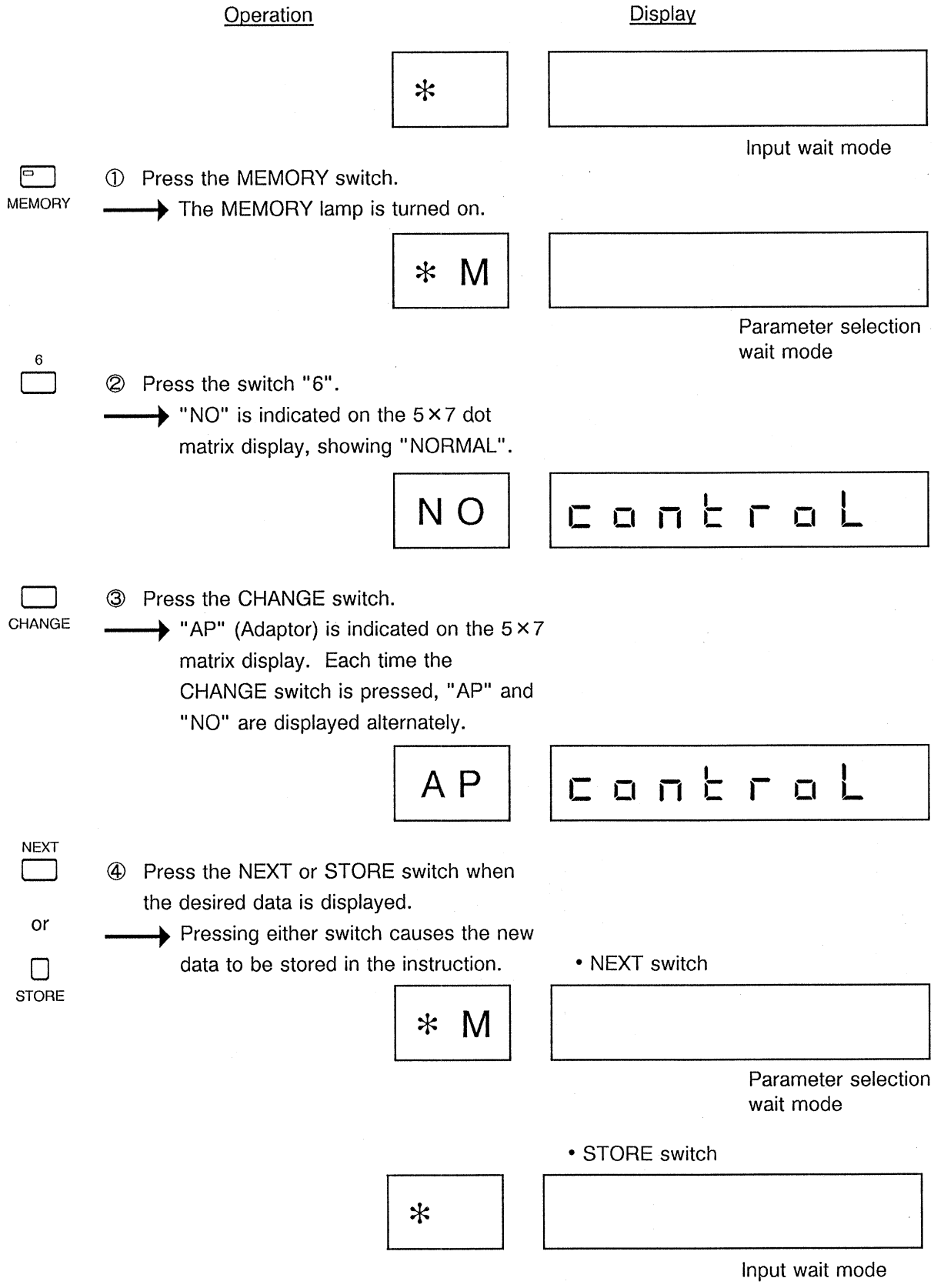


Figure 8-1 Setting the Adaptor Mode

Figure 8-2 shows a sample local system block diagram.

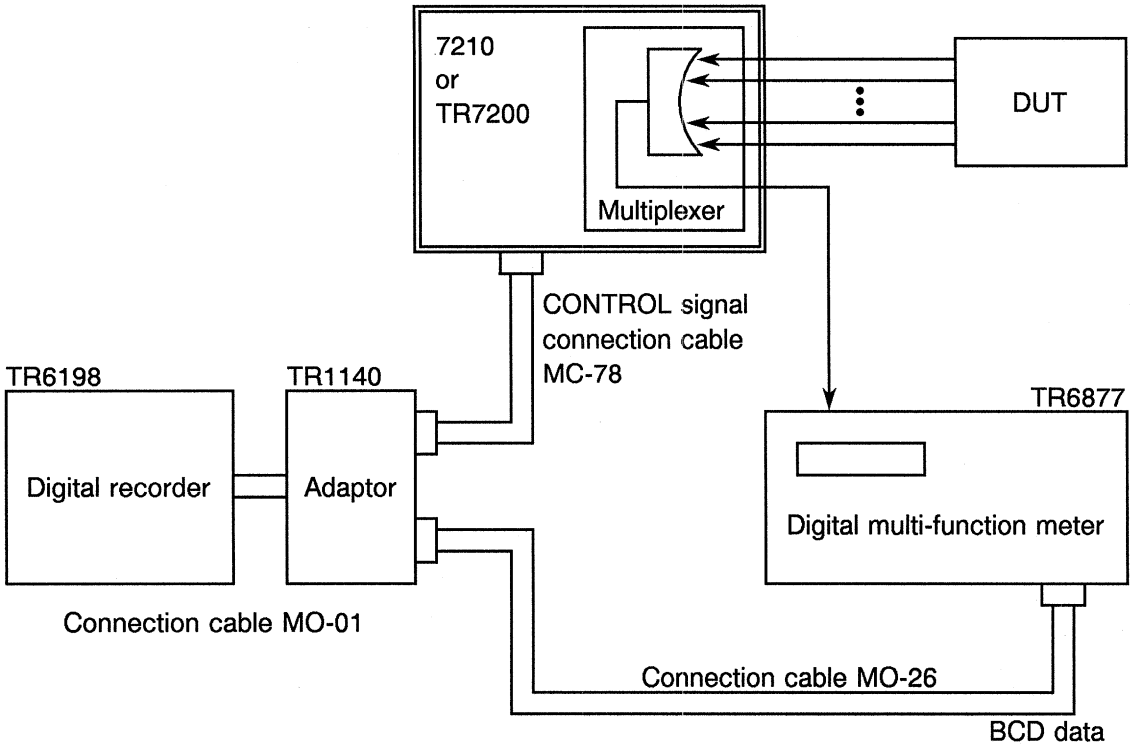


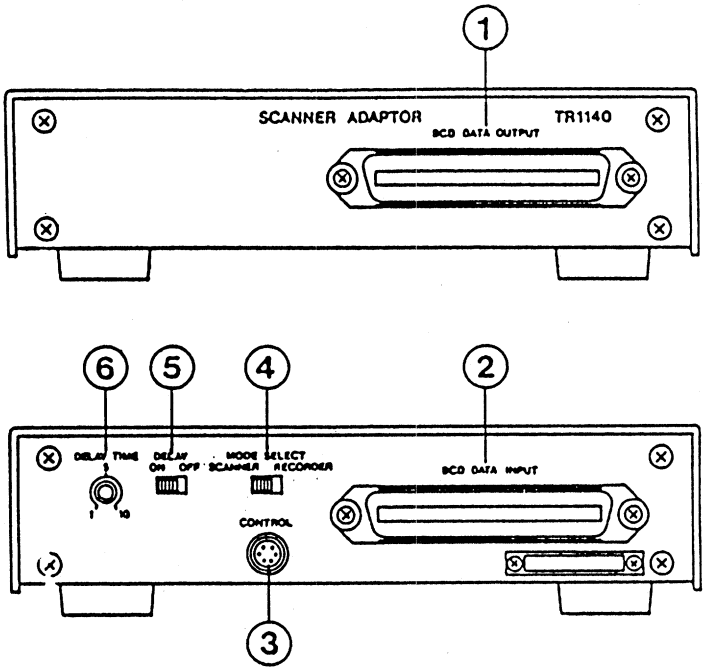
Figure 8-2 Local System Block Diagram

(1) Using the TR1140 scanner adaptor

The TR1140 is used to make a local system using a scanner such as the 7210 and TR7200, the TR6198 digital recorder and a measurement instrument with BCD data output (e.g., the TR6877 and TR6875).

By using the TR1140, it is possible to make loop operations of the scanner, recorder and measurement instrument available.

- Panel operation



① Data output connector

This connector is connected to the connector of the digital recorder by a cable.
Connector used: Daiichi Electronic Industries 57-40500

② Data input connector

This connector is used to the BCD output connector of a measurement instrument by using a cable.
Connector used: Daiichi Electronic Industries 57-40500

③ Control connector

This connector is connected to the CONTROL connector of the R7210, TR7200, etc., by using a cable (MC-78).
Connector used: Hirose Electric HR10-7R-6S

④ MODE SELECT switch

This switch is used to make a loop of the recorder and the measurement instrument or a loop of the recorder, measurement instrument and scanner.
If this switch is turned to the RECORDE side, the data input connector and the data output connector are connected direct, making a loop of the recorder and the measurement instrument.
If it is turned to the SCANNER side, a loop is made of the recorder, the measurement instrument and the scanner. In this case, the TRIGGER OUT signal from the scanner becomes the measurement start signal for the measurement instrument. P.END from the recorder is connected as the CH ADVANCE signal of the scanner.

⑤ DELAY switch

This switch is effective only when the switch of ④ is set to the SCANNER side.
If the DELAY switch is turned to the OFF side, the TRIGGER OUT signal from the scanner becomes the measurement start signal for the measurement instrument.
If it is set to the ON side, a measurement start signal is output to the measurement instrument with a delay of the specified time after the output of the TRIGGER OUT signal.

⑥ DELAY TIME volume

If the switch of ⑤ is turned to the ON side, the DELAY TIME volume is used to set a time for which the output of a measurement start signal to the measurement instrument is waited after the output of the TRIGGER OUT signal.
The range of time setting is from about 200ms to 10s. The time is made longer by turning the volume to the arrow direction.
(This is used when the settling time of the measurement instrument is required.)

(2) Setting for building a system with an 7210, TR7200, TR1140, TR6198, and digital multi-function meter (e.g., the TR6877 and TR6875)
The following setting should be made when using a combination of an 7210 (TR7200 scanner), TR1140 (adaptor), TR6198 (digital recorder) and digital multi-function meter as shown in Figure 8-2.

(a) Device setting

- 7210

  TR7200

  ┌ TRIGGER : "AUTO"
  │ S.INT : Ta (Note)
  │ R.INT : Tb (Note)
  └ Others : Any setting is available.

- TR6198

  ┌ PRINT INTERVAL : CONTINUOUS
  └ SCANNER switch (Rear panel) : 1

- Digital multi-function meter

  SAMPLING MODE : EXT. (TR6877)
  HOLD (TR6875)
  Measurement function, range, etc. : Any setting is available.

- TR1140

  MODE SELECT : SCANNER
  DELAY : Any setting is available.

(b) Operation sequence

① Set conditions for each device.

② Turn the START/STOP switch of the TR6198 on.
(The RUN lamp is turned on.)

③ Press the START/STOP switches of the 7210 and TR7200 to start a scan sequence operation.

④ After completion of the above operations, a series of operations including channel scanning, digital multi-function meter measurement and measured data printing are done automatically at the time intervals specified by S.INT and R.INT of the 7210 and TR7200.

Note: The operation of the system is controlled by the 7210 and TR7200. However, S.INT and R.INT need setting as follows:

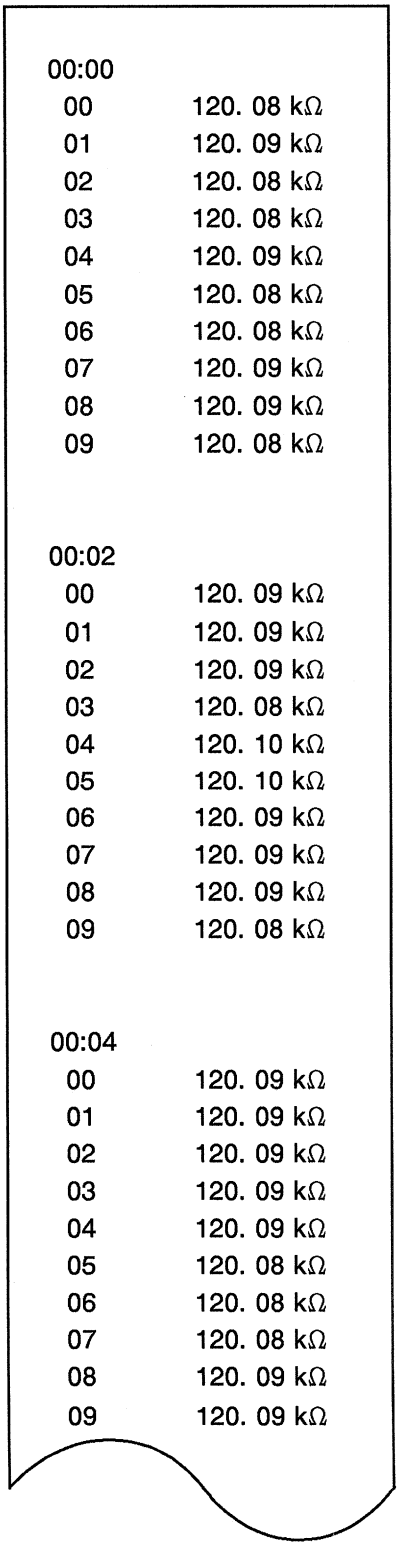
S.INT (Ta) > TR1140 DELAY time + digital multi-function meter measurement time + TR6198 printing time × 2 (When the DELAY time of the 7210 is 0.)

R.INT (Tb) > S.INT × (No. of scan channels − 1) + TR1140 DELAY time + digital multi-function measurement time + TR6198 printing time × 4 (When the DELAY time of the 7210 is 0.)

The printing time of the TR6198 is 0.4 to 0.8 second.

(c) Sample printing

The following is a sample of printing of a case in which ten 120kΩ resistances were measured at INT = 10 seconds and R.INT = 2 minutes.



00:00
00 120. 08 kΩ
01 120. 09 kΩ
02 120. 08 kΩ
03 120. 08 kΩ
04 120. 09 kΩ
05 120. 08 kΩ
06 120. 08 kΩ
07 120. 09 kΩ
08 120. 09 kΩ
09 120. 08 kΩ

00:02
00 120. 09 kΩ
01 120. 09 kΩ
02 120. 09 kΩ
03 120. 08 kΩ
04 120. 10 kΩ
05 120. 10 kΩ
06 120. 09 kΩ
07 120. 09 kΩ
08 120. 09 kΩ
09 120. 08 kΩ

00:04
00 120. 09 kΩ
01 120. 09 kΩ
02 120. 09 kΩ
03 120. 09 kΩ
04 120. 09 kΩ
05 120. 08 kΩ
06 120. 08 kΩ
07 120. 08 kΩ
08 120. 09 kΩ
09 120. 09 kΩ

9. EXPLANATION OF OPERATIONS

9.1 Outline

Figure 9-1 gives a configuration block diagram for the 7210 Series. The 7210 has a built-in μCPU to control the operations of the system as a whole. The switch cards that actually switch signals are isolated by guard structure.

The following is an outline of system operation based on the figure.

9.2 Operation

The operation of the system as a whole is controlled by the CPU and the programs stored in the ROM.

For the contact point open/close operation, the CPU decides which contact point of which switch card should be accessed based on the scanning control data stored in the RAM.

The data (24 bits) selected by the CPU is converted to serial data in the "PARALLEL⇒SERIAL" circuit and is applied to the "SERIAL⇒PARALLEL" circuit of the switch control section through the photo-coupler. The data converted to parallel data in this circuit is applied to every switch card. The card examines the data. Access is made to the selected contact point of the switch card selected based on the data.

The SWITCH CONTROL section performs complete static operations upon completion of the serial-to-parallel conversion of data. This prevents logic noise from being superimposed to the contact point signal to be connected to the switch card.

Control of scanning operations is done by processing the information read from the panel switches, GPIB interface and single-line signals.

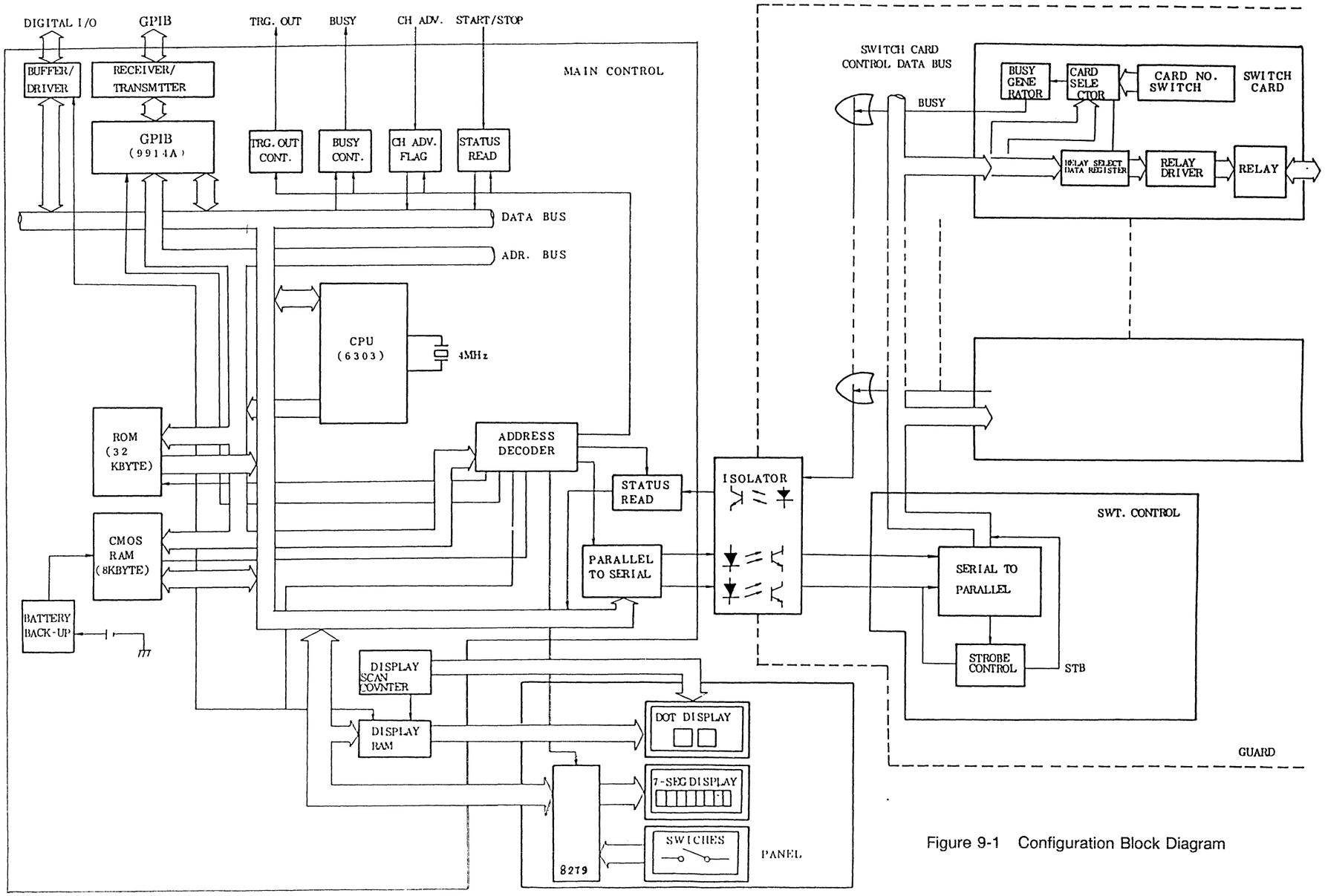
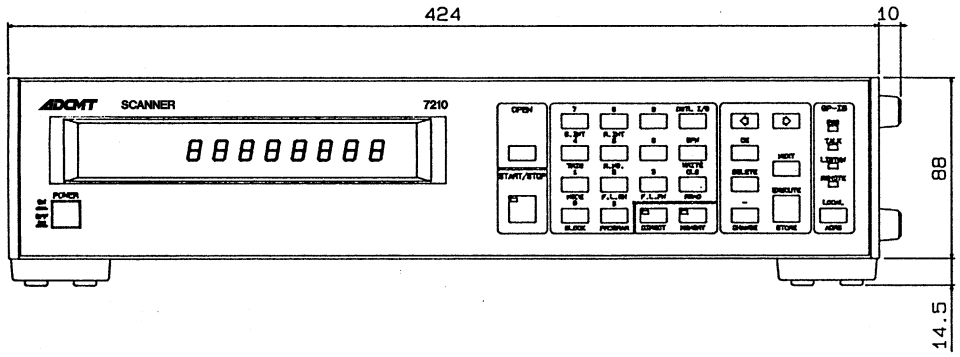
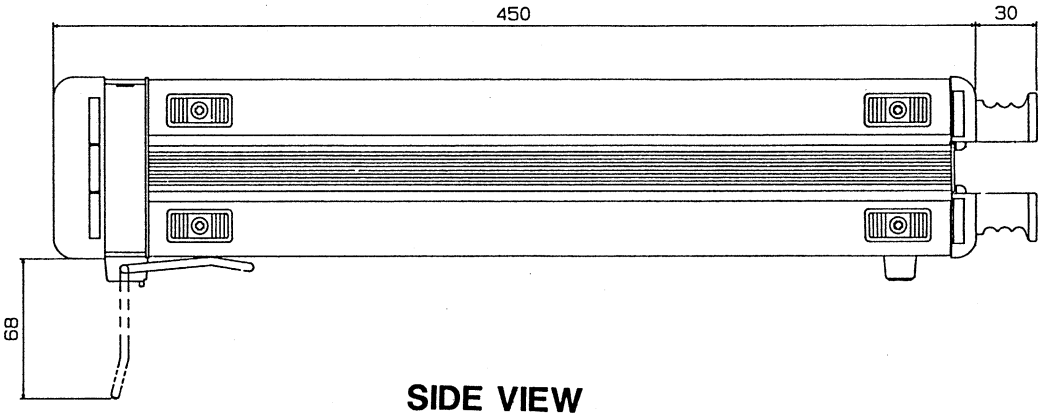


Figure 9-1 Configuration Block Diagram

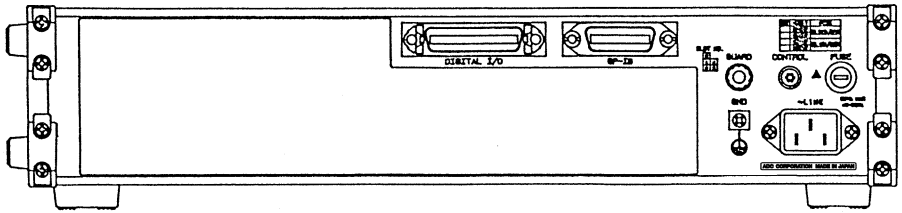


FRONT VIEW



SIDE VIEW

Unit : mm



REAR VIEW

7210EXT1-709-B

7210
EXTERNAL VIEW

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