MITSUBISHI

PROGRAMMABLE CONTROLLER

MELSEC-A

User's Manual

External fault diagnosis module type AD51FD

MITSUBISHI ELECTRIC

REVISIONS

*The manual number is given on the bottom left of the back cover.

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INTRODUCTION

Thank you for choosing the Mitsubishi MELSEC-A Series of General Purpose Programmable Controllers. Please read this manual carefully so that the equipment is used to its optimum. A copy of this manual should be forwarded to the end User.

CONTENTS

1. INTRODUCTION

The AD51FD type external fault diagnosis module (referred to as AD51FD) reads device operating states from the PC CPU. This is then compared with the diagnosis data previously stored into the AD51FD, if a fault is detected, the alarm/fault data is stored in the buffer memory and memory card and output to the printer.
The alarm/fault data can be read by the PC CPU.

This manual gives the system configuration, specifications, settings and procedures to start running, performance specifications, functions, programming and so on for the AD51FD.

To use the AD51FD, the memory card, SW0GP-AD51FDPE type external fault diagnosis software package (referred to as AD51FDPE) and peripheral devices are required.

To operate the AD51FD, the fault diagnosis data must be created in advance using the A6GPP/A6PHP and the AD51FDPE and written into the AD51FD.The PC CPU creates the sequence program which is used for the fault diagnosis after reading the operation command to the AD51FD and fault diagnosis results, and writes it.The fault diagnosis starts after running the PC CPU and the AD51FD.

An additional manual for the AD51FD is shown below.

Manual name	Manual number
SW0GP-AD51FDPE type External Fault Diagnosis Software Package Operating Manual	IB(NA)66366

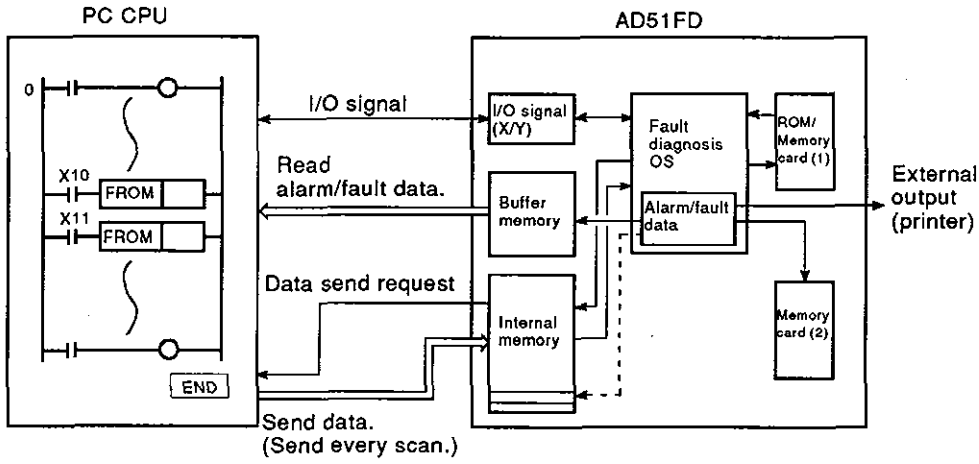
1.1 General Description of Fault Detection

This section describes the outline of fault diagnosis data communication between the PC CPU and the AD51FD, and the procedure for fault detection.

(1) Outline of fault diagnosis data communication

There are two procedures for data communication; 1) Communication procedure using the AD51FD, and 2) Communication procedure using a microcomputer program.
Usually, the fault diagnosis can be performed through the communication procedure using the AD51FD. Fault diagnosis required during each scan of the PC CPU can be performed by the communication procedure using the microcomputer program.
In this latter case, however, the applicable PC CPUs are limited.

(a) Communication using the AD51FD



- Data communication between the PC CPU and the AD51FD is executed during END processing of the sequence program.
- When the AD51FD sends a data send request to the PC CPU, receives the data from the CPU, and checks the operation between the fault diagnosis condition data and the data received to diagnose the existence of alarm or fault.
- When the AD51FD detects an alarm or fault, it sends a detection flag (X) to the PC CPU, writes the alarm or fault data to buffer memory, and simultaneously stores the data into the memory card (2) or internal memory. The alarm or fault data can be printed by setting the output destination to the printer using the AD51FDPE.
- The PC CPU reads the alarm or fault data from the AD51FD using the detection flag (X), and then executes the sequence operation according to the fault diagnosis.

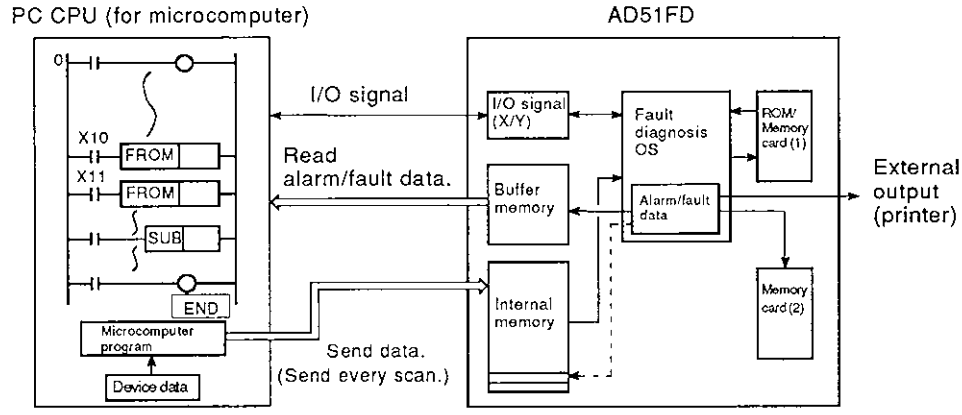
POINTS

(1) Communication using the AD51FD can be performed only with the PC CPUs described in Section 2.1.2.

(2) Communication is in 128 byte blocks of bit or word device data per scan. This reduces the effect on the PC CPU scan time. Fault diagnosis is executed after all the data has been received. (Refer to section 6.5.)

(b) Communication using microcomputer program

- Communication is possible only with a programmable controller which can process the fault diagnosis microcomputer proguram.



- By calling the microcomputer program in the sequence program, the microcomputer program is executed and sends the data to the AD51FD.

- The AD51FD send a data send request to the PC CPU, receives the data from the CPU, and checks the operation between the fault diagnosis condition data and the data received to diagnose the existence of alarm or fault.

- When the AD51FD detects an alarm or fault, it sends a detection flag (X) to the PC CPU, writes the alarm or fault data to buffer memory, and simultaneously stores the data into the memory card (2) or internal memory.
  The alarm or fault data can be printed by setting the output destination to the printer using the AD51FDPE.

- The PC CPU reads the alarm or fault data from the AD51FD using the detection flag (X), and then executes the sequence operation according to the fault diagnosis.

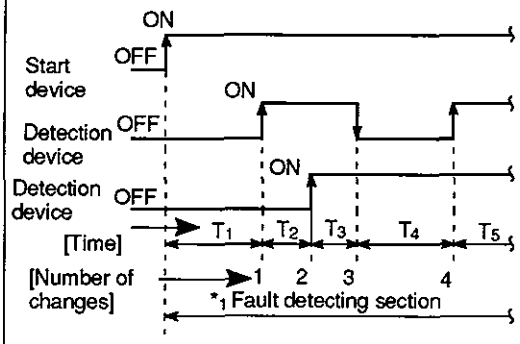
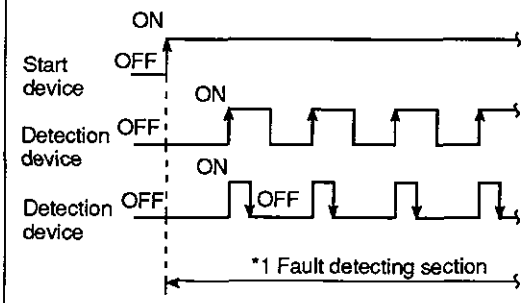
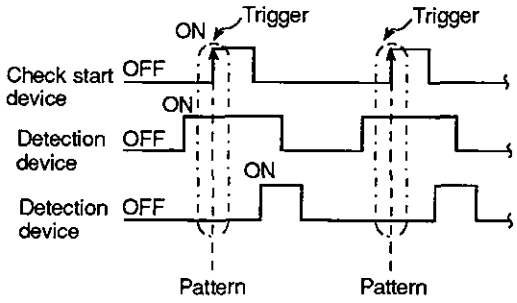
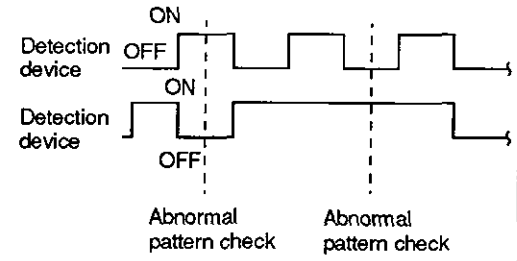
POINTS

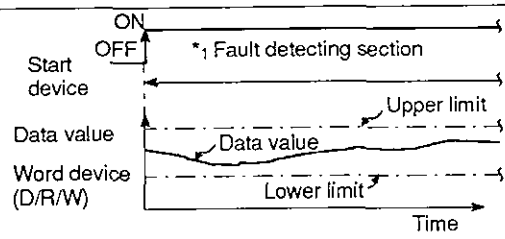
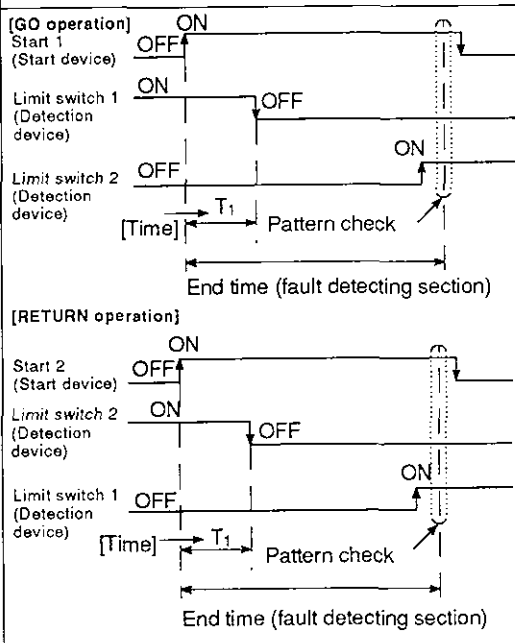
(1) Communication using the microcomputer program can be performed with PC CPUs other than the A0J2CPU, A3HCPU, and AnACPU described in Section 2.1.2.

(2) The communication is performed in receiving the data in maximum 3,900 bytes lumped from the microcomputer program per scanning of the PC CPU, and the fault diagnosis is executed.Therefore, the scan time of the PC CPU is made longer by the time necessary for executing the transmission processing of fault diagnosis data. (Refer to Section 6.6.)

(1) Fault detection procedure

The procedure for detecting the faults on the AD51FD falls into six checking methods as shown below. (For details, refer to Section 7.2.)

NO.	Fault detecting method	Operation	Description
1	Sequence/time check (Sequence check)		(1) Check that the detection device like I/O signal of control unit or internal relay and so on is operated ON/OFF as previously specified sequence and time (number of changes) in the fault detecting section, then the device which is not operated as previously specified is detected. (2) When the time check is performed, the alarm range is set, and the alarm is output when the time is within the range. (3) The fault detection only by sequence check can be performed without time setting.
2	Count check		(1) Check that the detection device like I/O signal of control unit or internal relay and so on is operated ON or OFF in the count previously specified in the fault detecting section, then the device in abnormal count is detected. The count can be set as "more", "less", "equal", and "more and less". (2) When the count check is performed, the alarm range is set, and the alarm is output when the count is within the range. (3) By setting the "Accumlative count execution", the count of detection device ON or OFF can be stored in the memory card as accumlative count data.
3	Normal pattern check		(1) Respecting the detection device like I/O signalof control unit or internal relay, etc., trigger the check start device ON/OFF and check that the detection device ON/OFF operation at the point corresponds to any of normal ON/OFF patterns previously specified. Then the pattern which does not correspond to the specified pattern is detected.(When corresponds,normal, and when not corresponds, faulty.)
4	Abnormal pattern check		(1) Respecting the detection device like I/O signal of control unit or internal relay, etc., check that the detection device ON/OFF operation does not correspond to the abnormal ON/OFF pattern previously specified while checking the abnormal pattern. If the detecting pattern corresponds to the abnormal pattern, the abnormality is detected. (When not corresponds, normal, and when corresponds, faulty.) (2) The abnormal pattern checking is performed in the regular checking.

NO.	Fault detecting method	Operation	Description
5	Upper/lower limit value check		(1) Check that the word device (D/R/W) value is in the range of the upper and lower limits specified in the fault detecting section. If out of the range,the abnormality is detected. (2) When the upper/lower limit value check is performed, alarm range is set, and alarm is output when the value is within the range.
6	Bidirectional operation check		(1) Bidirectional operations for one detected item are verified through pattern check or sequence/ time check using two limit switches. (2) Check that the operation of two limit switches (detection devices) for the reciprocating equipment like cylinder, etc. is taken with proper ON/OFF pattern at the operation end time, or is taken at the previously specified ON/OFF sequence and time. Then the device which does not take an operation with appropriate ON/OFF is detected. (3) When the time check is performed, the alarm range is set, and alarm is output when the time is within the range. (4) Either pattern check or sequence/time check is selected to set. (5) Pattern check is applicable for equipment like air cylinder, etc. of which the operation is prompt and completes within the processing time for the fault diagnosis. (Refer to Sections 6.5.3 and 6.6.3.)

*1: The fault detecting section is set as the range from start device ON/OFF to end device ON/OFF or end time. (For details, refer to Section 7.2.1.)

1.2 Features

(1) The program dedicated to fault diagnosis is installed in the hardware.

The fault diagnosis can be performed by only setting the fault condition data without creating the program for fault detection.

(2) Various fault detecting items

The fault detecting items fall into sequence/time check, count check, normal pattern check, abnormal pattern check, upper/lower limit value check, and bidirectional operation check, and the proper fault detecting item is selected according to the operation of control unit.

(3) The learning setting for fault detection condition data is available.

The setting of fault detection condition data can be performed through the learning setting.
After setting the items and devices for fault diagnosis, the setting is made easier by running the system, performing the sampling of the sequence program, learning the device operation, and using them as a condition data.

(4) The alarm can be output before detecting the fault.

By previously setting the alarm range for detecting items for sequence/time check, count check, upper/lower limit value check, and bidirectional operation check, the alarm is output before detecting the fault. Therefore, the corrective operation to control unit can be taken in advance.

(5) Contact and coil ON/OFF accumulative count can be counted.

By setting "Accumulative" when performing the count check, contact and coil ON/OFF accumulative count is counted, and the life diagnosis for contacts and coils can be performed.
The accumlative count is stored into the memory card when turning power OFF or resetting.

(6) Saving and printing fault data and external monitoring through the programmable controller can be performed.

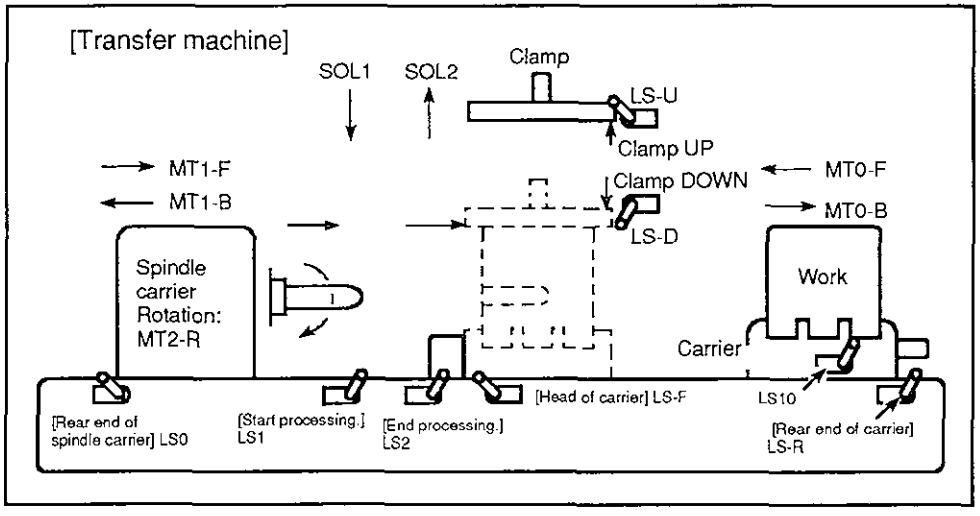
- Since the fault data is saved into the memory card on the AD51FD, the fault data can be read through the A6GPP/A6PHP to verify, and also printed.
- The fault data can be printed while performing the fault detection by setting the output destination to printer.
- Since the detection flag is output to the PC CPU while performing the fault detection, the fault contents can be read by the PC CPU and displayed outside using monitor unit, etc.

1.3 Example of Fault Diagnosis (Memory Capacity, Number of Detecting Items)

The fault diagnosis data setting is performed by selecting one optimum checking method or two or more checking methods in combination from six (6) checking methods according to the operation sequence of the control unit. The fault detecting data for the selected fault detecting method is created using the AD51FDPE.
The number of detecting items which is settable for the AD51FD is decided according to the total memory capacity which is used for each detecting item (detecting method) against the memory capacity of the AD51FD.

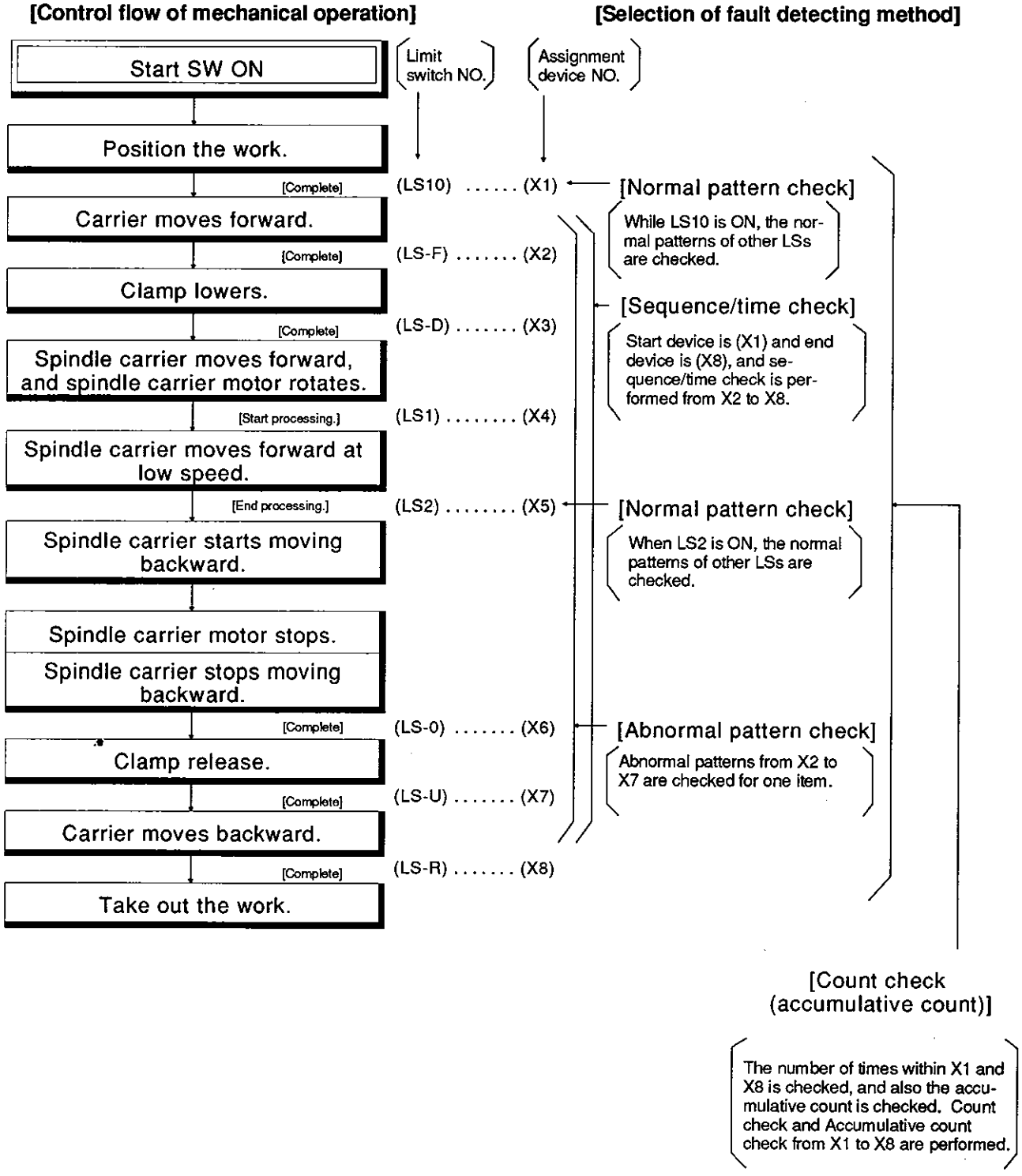
The following describes the selection and settings of the fault detecting method, memory capacity calculation, and number of items available for detection using a transfer machine as an example of fault diagnosis on a control unit.

(1) Operation of the control unit and selection of fault detecting method



[Control procedure]

1) Immediately after setting the work on the carrier, the carrier moves forward.
2) The clamp lowers to hold the work.
3) The spindle carrier moves forward, processing the work.
4) After completing the process, the spindle carrier moves backward to open the clamp. Then the carrier moves backward.
5) The work is taken out, and the operation is completed.



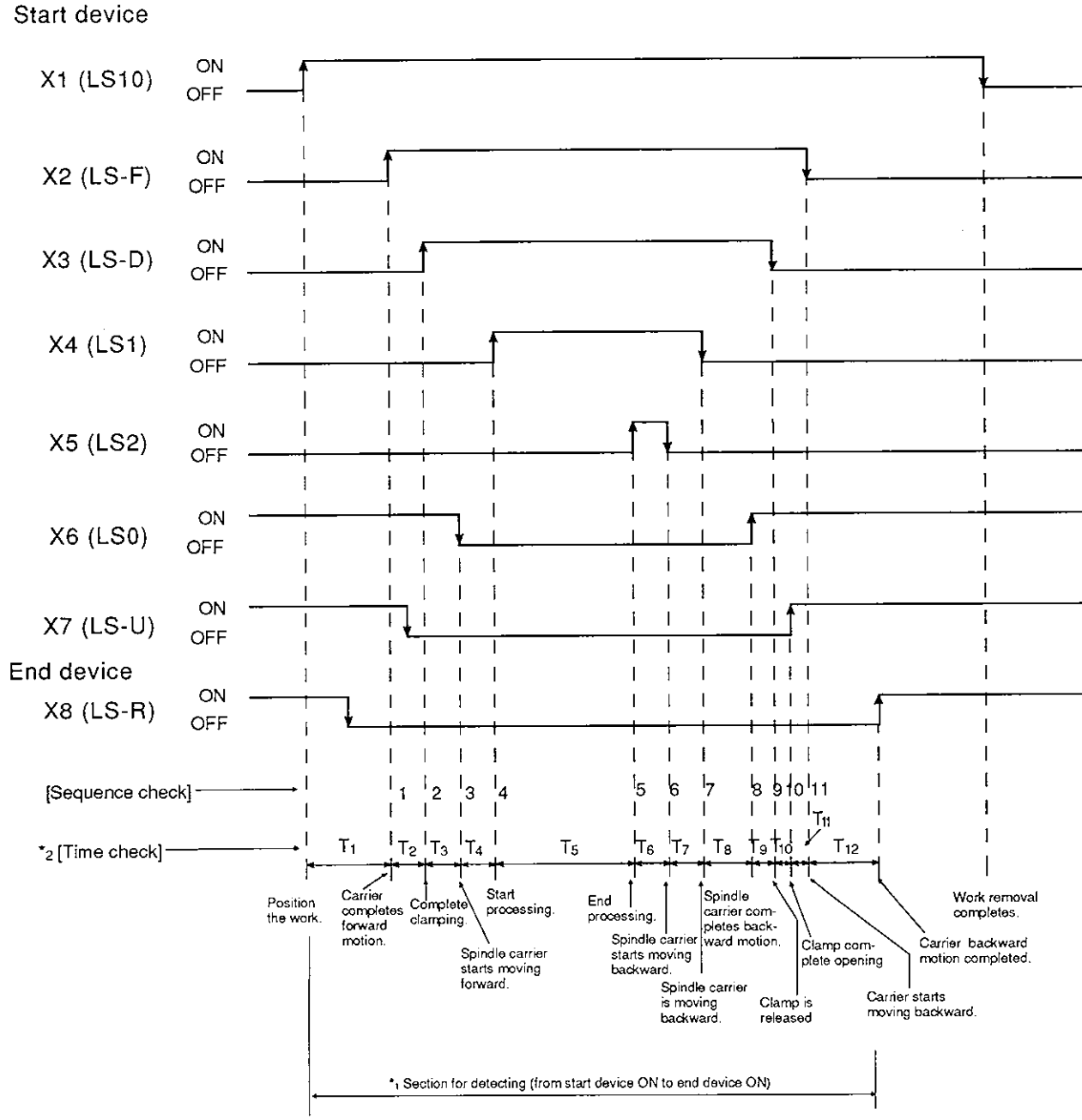
REMARK

[Upper/lower limit value check] and [bidirectional operation check] are not performed.

(2) Setting fault detecting method ..... (The following conditions are set using the AD51FDPE.)

(a) [Sequence/time check]

1) The start device is X1 and end device is X8, and the sequence/time check is performed from X2 to X8.



*1: The section for detecting can be set also as "From start device ON to end time".

*2: T_1 to T_{12} for time check are used to set the allowable time of change.
For alarm output, the change time of alarm output within T_1 and T_{12} is set.

REMARK

- When time check is not required, the setting of the time in T_1 to T_{12} is unnecessary.

(b) [Count check]

Two detecting conditions, count of limit switch ON/OFF within X1 to X8 and the accumulative count are set.

1) For the count check of ON, the detecting condition equivalent to the chart for (a) [Sequence/time check] is set.(Sequence and time checks are simultaneously performed.)

- Start device ... X1
  End device ... X8
- Number of ON times within X1 and X8 ... Once (equal) ... No alarm

2) For the alarm count, the life of limit switch is set for the detecting condition.

- Start device ... X1
  End device ... X8
- Number of ON times within X1 and X8 ... 200,000 times or more, Alarm 190,000 times

(c) [Normal pattern check]

For normal patterns, two detecting conditions equivalent to those when setting the work and ending the processing are set. ... Follows the chart of (a) [Sequence/time check].

1) When setting the work,

- Pattern check start device ... X1 ON
- X2 to X7 ... X2→OFF, X3→OFF, X4→OFF, X5→OFF, X6→ON, X7→ON

2) When ending the processing,

- Pattern check start device ... X5 ON
- X2 to X4, X6 to X7 ... X2→ON, X3→ON, X4→ON, X6→OFF, X7→OFF

(d) [Abnormal pattern check]

For abnormal patterns, one detecting condition according to the chart of (a) [Sequence/time check] is set.

1) The condition is set so that the detection is performed only when all the limit switches within X2 and X7 are ON from the work setting to work take-out.

- X2→ON, X3→ON, X4→ON, X5→ON, X6→ON, X7→ON

REMARK

The detecting conditions of abnormal patterns in each operation can also be set.

(e) [Upper/lower limit value check]

Since this example's control unit is not designed to process the data upper/lower limit values, it is not necessary to set them.
(Available for the control module which processes analog/digital values, etc.)

(f) [Bidirectional operation check]

Since the control module does not work according to two limit switches, the conditions are not set.

(3) Calculating the memory capacity of fault detecting item

(a) [Sequence/time check]

1) Memory capacity

Number of device points(6/16 ≒ 1)

$$= 24^{bytes} + \underbrace{(24 \times 2)}_{\substack{\text{Alarm/fault}\\ \text{comment}\\ \text{setting}}} + \underbrace{(4 \times 6)}_{\substack{\text{Number of}\\ \text{device}\\ \text{points}}} + \underbrace{[5 + 4 \times (1)] \times 11}_{\text{Number of changes}} = \underline{\underline{195 \text{ bytes}}}$$

(b) [Count check]

1) Memory capacity

$$= 21^{bytes} + \underbrace{(24 \times 1)}_{\substack{\text{Fault comment}\\ \text{setting}}} + \underbrace{(4 \times 8)}_{\substack{\text{Number of}\\ \text{device points}}} + \underbrace{(6 \times 8)}_{\substack{\text{Equal}\\ \text{Number}\\ \text{of device}\\ \text{points}}} = \underline{\underline{125 \text{ bytes}}}$$

2) Memory capacity

$$= 21^{bytes} + \underbrace{(24 \times 2)}_{\substack{\text{Alarm/fault}\\ \text{comment setting}}} + \underbrace{(4 \times 8)}_{\substack{\text{Number}\\ \text{of device}\\ \text{points}}} + \underbrace{(10 \times 8)}_{\substack{\text{Over}\\ \text{Number}\\ \text{of device}\\ \text{points}}} = \underline{\underline{181 \text{ bytes}}}$$

(c) [Normal pattern check]

1) Memory capacity
$= 12^{bytes} + (24 \times 1) + (4 \times 6) + [2 \times (1) \times 1] = 62$ bytes

Number of device points(6/16 ≒ 1)

Comment setting: (24×1)
Number of device points: (4×6)
Number of patterns: $[2 \times (1) \times 1]$

2) Memory capacity
$= 12^{bytes} + (24 \times 1) + (4 \times 5) + [2 \times (1) \times 1] = 58$ bytes

(d) [Abnormal pattern check]

1) Memory capacity
$= 6^{bytes} + (24 \times 1) + (4 \times 6) + [2 \times (1)] = 56$ bytes

Number of device points(6/16 ≒ 1)

Comment setting: (24×1)
Number of device points: (4×6)

(4) Total memory capacity in use

The capacities in items (a) to (d) in Section (3) are totaled.

Total memory capacity in use = 195 + 125 + 181 + 62 + 58 + 56
= 677 bytes

(5) Number of machines available for fault diagnosis and number of items which can be detected

"How many sets of transfer machines according to the example of fault diagnosis can the AD51FD type fault diagnosis module diagnose?" and "How many items can be detected?" are calculated as follows. The detecting method using communication with the AD51FD unit is applied.

- Number of machines which can be diagnosed
$=(65536 - 19)^{bytes}/677^{bytes} = 96$ sets

AD51FD memory: 65536
Fixed value for the AD51FD: 19
Memory capacity of one set of machines: 677

- Number of items which can be detected
$= 96^{sets} \times 6^{items} = 576$ items

Number of total machines: 96
Detecting items per machine: 6

REMARKS

- While operating the AD51FDPE, the remaining memory capacity for the AD51FD is displayed on the screen of the A6GPP/A6PHP. Please use it as a reference.

  [(Memory capacity used) = (Memory capacity of AD51FD) – (Remaining memory capacity)]

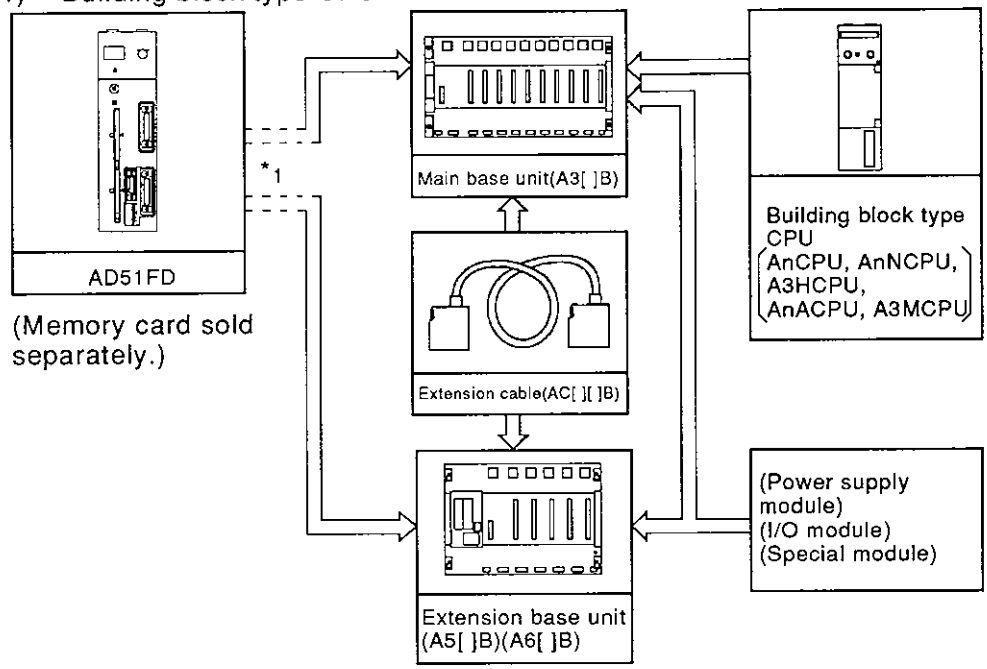
- For details of memory capacity calculation, refer to Section 6.3.

2. SYSTEM CONFIGURATION

2.1 PC CPU System to Use the AD51FD

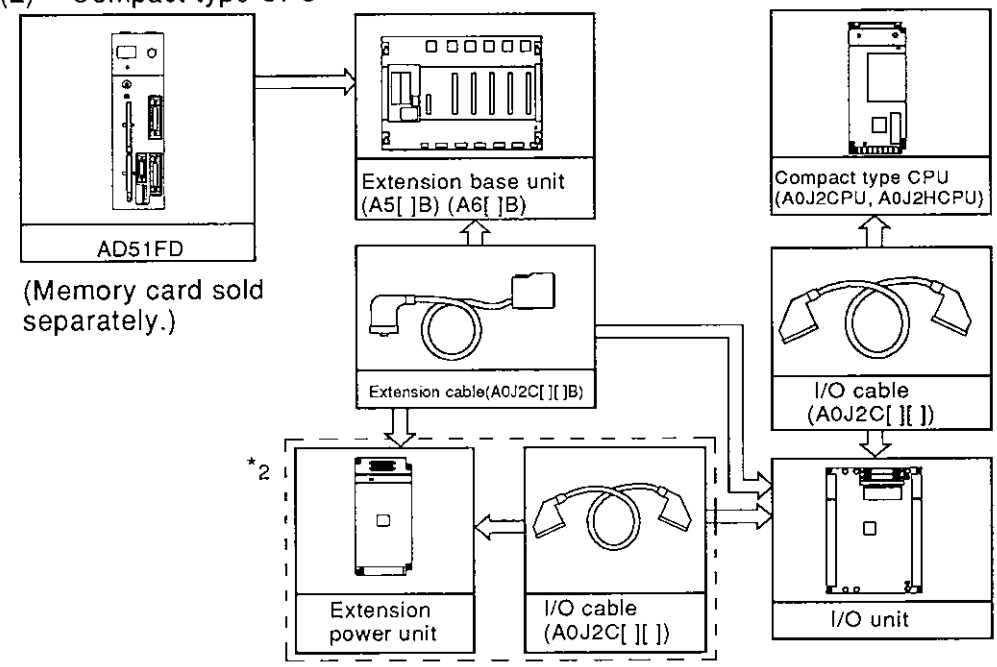
2.1.1 Overall configuration

(1) Building block type CPU



*1: The AD51FD can be installed in either of two base units.

(2) Compact type CPU



*2: These are required when using the A5[ ]B type extension base unit, but not required when using the A6[ ]B type extension base unit. (The usage of power supply module dedicated for the A6[ ]B type is required.)

2.1.2 Applicable CPU

PC CPU	Building block type CPU	A1N, A2N(S1), A3NCPU (P21/R21) ····· [AnNCPU] A1, A2(S1), A3CPU (P21/R21) ····· [AnCPU] *1 A3HCPU (P21/R21) A3MCPUR (P21/R21) *1 A2A, A2A-S1, A3ACPU (P21/R21) ····· [AnACPU] A73CPU (P21/R21)
	Compact type CPU	*1 A0J2CPU (P23/R23) A0J2HCPU (P21/R21)

*1: The A3HCPU, AnACPU, and A0J2CPU cannot be used with a microcomputer program for fault diagnosis.

2.1.3 Cautions on system configurations

(1) Only one AD51FD module can be used per PC CPU. If the AD51FD module is used with any of the following list of modules, then a maximum of two modules can be used with the PC CPU except when an AnA type CPU is used. Then the maximum number of modules is six, including the AD51FD module.

- AD51 (S3) type intelligent communication module
- AD51H type intelligent communication module
- AD57G type graphic control module
- AJ71C21 (S1) type terminal interface module
- AJ71C22 (S1) type multidrop link system module
- AJ71C23 type host controller high-speed link module
- AJ71C24 (S3/S6/S8) type computer link module
- AJ71P41 type SUMINET interface module
- AJ71E71 type Ethernet interface module

(2) When the AD51FD is used for the A3HCPU, AnACPU, and A0J2CPU, fault diagnosis for communicating method using a microcomputer program cannot be performed.

(3) In a MELSECNET (II) data link system, the AD51FD can be loaded into master stations and local stations.
The AD51FD module cannot be used in a remote I/O station.

(4) Except for the following, the AD51FD can be installed into the main base unit or extension base unit slot.

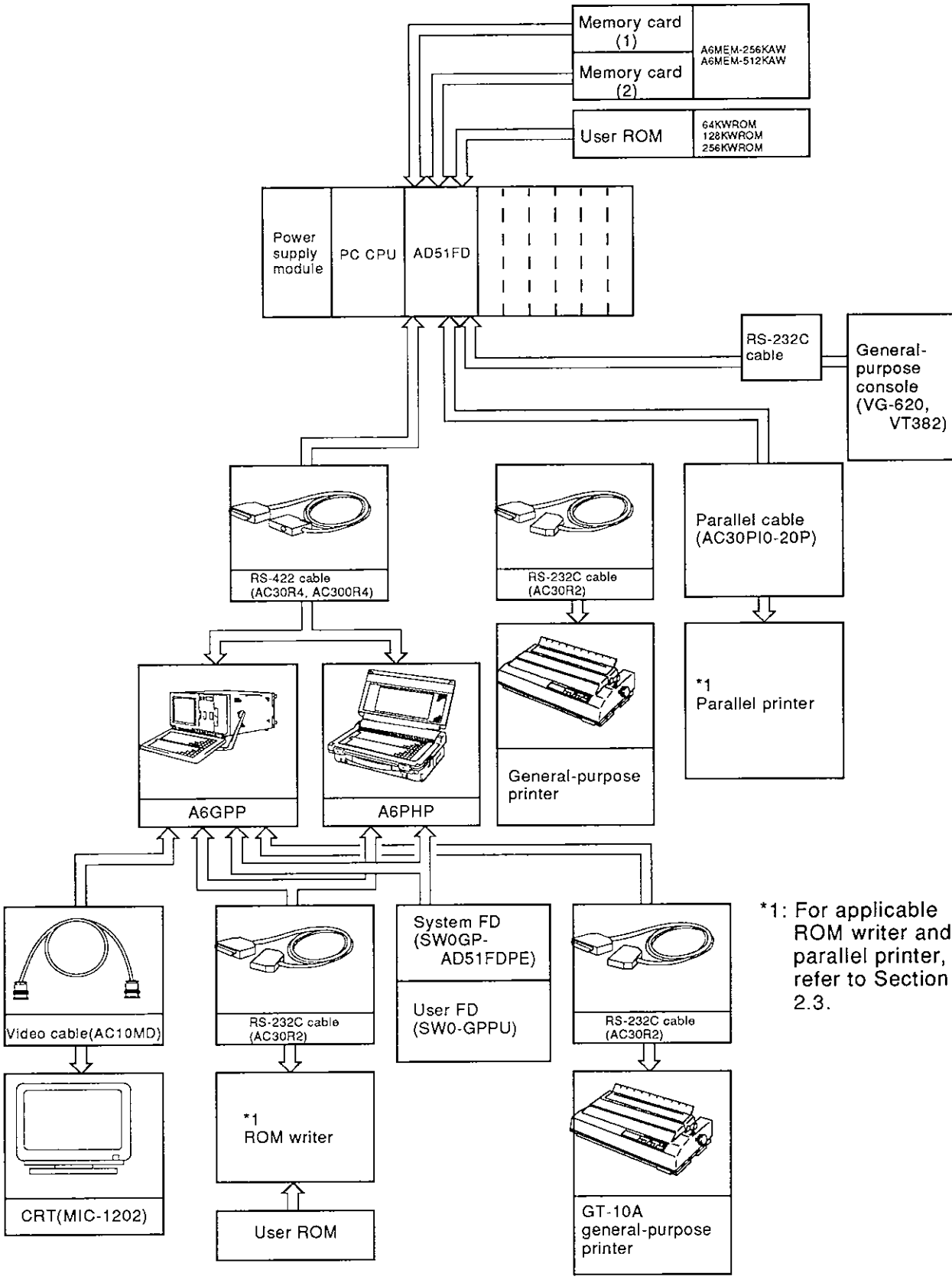
(a) If an AD51FD module must be used on an extension base unit with no built-in power supply (A55B or A58B), it is important to consider (a) the power supply capacity of the main base unit and (b) the voltage drop along the extension cables.

(b) For the A73CPU, AD51FD can be installed only on the extension base units.

(c) The AD51FD must not be installed into the last slot of the 7th extension base unit when an A3CPU(P21/R21) is used on the main base unit.

2.2 Peripheral Device System to Use the AD51FD

2.2.1 Overall configuration



*1: For applicable ROM writer and parallel printer, refer to Section 2.3.

2.2.2 Cautions on system configurations

(1) Usage of memory for the AD51FD

(a) Memory card (1) ...
- To save the fault diagnosis condition data (RAM)
- To save the accumulative count data
- To save the comment
- The learning data is saved into memory card (1) as a condition data.

(b) Memory card (2) ...
- To save the fault result data

(c) User ROM .....
- Required only when fault diagnosis condition data is written into ROM to avoid them from being erased.

(d) Main Memory .....
- To write the fault diagnosis condition data and fault data. However, all the data are cleared by turning off the power supply.

(2) ROM writer for AD51FD

(a) The ROM writer described in Section 2.3 is used to write data to the ROM.

(b) The ROM writer function and A6WU type P-ROM writer unit installed into the A6GPP are not available.

(3) Usage when the AD51FD is connected with general-purpose terminal equipment
When the AD51FD is connected with the VG-620 and VT-382 general-purpose console, the terminal can be used only as a display device for the diagnosed fault result data (memory card (2)) output from the AD51FD, but cannot be used as I/O console.

2.2.3 Precautions for combination of memory card, ROM, and main memory

(1) The following table shows the combination of main memory for the AD51FD.
When the main memory is used, all the data are cleared by turning off the power supply.

Combination No.	Memory card (1)	Memory card (2)	User ROM	Main memory (RAM)
1	Condition data (Learning data) Accumulative count data, comment	Fault result data	———	———
2	Condition data (Learning data) Accumulative count data, comment	Fault result data	Condition data (without learning function)	———
3	Condition data (Learning data) Accumulative count data, comment	———	Condition data (without learning function)	Fault result data (cleared by power OFF)
4	Condition data (Learning data) Accumulative count data, comment	———	———	Fault result data (cleared by power OFF)
5	———	Fault result data	Condition data (without learning function)	———
6	———	Fault result data	———	Condition data (Learning data) (cleared by power OFF)
7	———	———	Condition data (without learning function)	Fault result data (cleared by power OFF)
8	———	———	———	Condition data (Learning data) Fault result data (cleared by power OFF)

POINT

When error occurrs, the memory card (1) is necessary to output the comment of device. If the memory card (1) is not installed, the comment cannot be output.

2.3 Peripheral Equipment

Location	Article	Type	Remarks
Programmer	Intelligent GPP	A6GPPE	———
	Handy graphic programmer	A6PHPE	———
Floppy disk	Floppy disk for system booting	SW0GP-AD51FDPE	Condition data setting, alarm and fault data display, microcomputer package adding
	Floppy disk for user	SW0-GPPU	To save data (2DD)
RAM card	Memory card (with battery backup, with write-protection)	A6MEM-256KAW	256 Kbytes Access time 200ms
		A6MEM-512KAW	512 Kbytes Access time 200ms
User ROM	EP-ROM	64KWROM	128 Kbytes
		128KWROM	256 Kbytes
		256KWROM	512 Kbytes
*1 ROM writer	PECKER11	PKW1100	Adapter type (RX-1) Manufactured by AVAL
	PECKER30	PKW3100	B adapter or D adapter Manufactured by AVAL
*1 General-purpose terminal equipment	CRT	VG-620	12" monochrome CRT Manufactured by VICTOR
		VT-382	12" monochrome CRT Manufactured by DEC
RS-232C printer	Printer	General-purpose printer	For printing fault data (available for the A6GPP/A6PHP)
		GT-10A	For A6GPP/A6PHP connection (unavailable for printing fault data)
		———	———
*1 Parallel printer	Printer	M6265-1	For printing fault data ... AD51FD connection (MITSUBISHI)
		VP-1500	For printing fault data ... AD51FD connection (EPSON)
		HG-3000	For printing fault data ... AD51FD connection (EPSON)
Connecting cable	RS-422 cable	AC30R4	Length: 3m (cable attached to A6GPP/A6PHP)
		AC300R4	Length: 30m (for connecting A6GPP/A6PHP)
	RS-232C cable	AC30R2	For connecting RS-232C printer Length: 3m For connecting ROM writer
	Parallel cable	AC30PIO-20P	For connecting parallel printer Length: 3m

*1: Applicable equipments are shown.
Applicable equipment: Products in specifications (standard) which can be connected with our units.
These equipment should be used according to the specifications (standard).

3. SPECIFICATIONS

3.1 General Specifications

General specifications

Item	Specifications				
Operating ambient temperature	0 to 55 °C (32 to 131°F)				
Storage ambient temperature	–20 to 75 °C (–4 to 167°F)				
Operating ambient humidity	10 to 90% RH, no condensation				
Storage ambient humidity	10 to 90% RH, no condensation				
Vibration resistance	** Conforms to JIS C 0911.	Frequency	Acceleration	Amplitude	Sweep count
		10 to 55Hz	———	0.075mm (0.003in.)	10 times *(1 octave /minute)
		55 to 150Hz	9.8m/s^2 (1g)	———	
Shock resistance	Conforms to JIS C 0912 (98m/s^2 (10g), 3 times x 3 directions)				
Noise durability	By noise simulator of 1500 Vpp noise voltage,1 μs noise width and 25 to 60 Hz noise frequency				
Dielectric withstand voltage	1500 VAC for 1 minute across AC external terminals and ground 500 VAC for 1 minute across DC external terminals and ground				
Insulation resistance	5 MΩ or larger by 500 VDC insulation resistance tester across AC external terminals and ground				
Grounding	Class 3 grounding; when impossible to ground, available without grounding				
Operating atmosphere	Free from corrosive gasses. Dust should be minimal.				
Cooling method	Self-cooling				

REMARKS

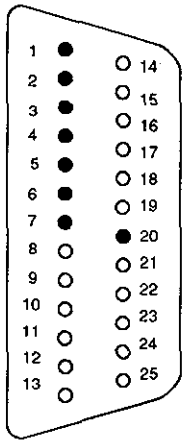
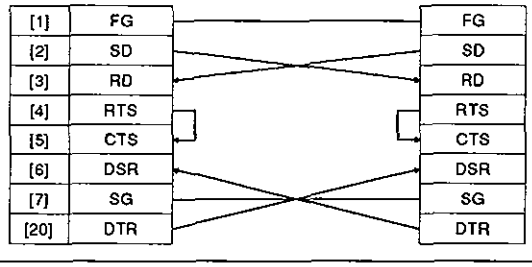
* One octave indicates a change from the initial frequency to double or half frequency. For example, any of the changes from 10Hz to 20Hz, from 20Hz to 40Hz, from 40Hz to 20Hz, and 0Hz to 10Hz are referred to as one octave.

** JIS: Japanese Industrial Standard

3.2 Specifications of Interface with External Equipment

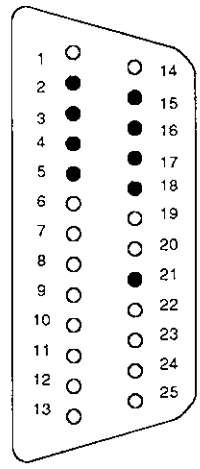
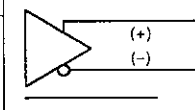
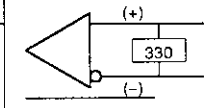
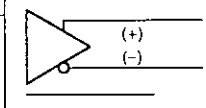
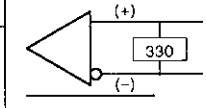
3.2.1 RS-232C interface

The following table shows the AD51FD RS-232C interface (CH1) specifications.

<table>
<tr><th colspan="2">Item</th><th colspan="5">Specifications</th></tr>
<tr><td colspan="2">Transmission method</td><td colspan="5">Conforms to EIA, RS232C.</td></tr>
<tr><td colspan="2">Synchronous method</td><td colspan="5">Asynchronous method</td></tr>
<tr><td rowspan="8">USART mode setting</td><td>Baud rate</td><td colspan="5">Selected from 300, 600, 1200, 2400, 4800, and 9600 BPS.</td></tr>
<tr><td rowspan="2">Parity bit</td><td colspan="5">No parity</td></tr>
<tr><td colspan="5">Parity: Even/odd parity</td></tr>
<tr><td rowspan="2">Stop bit</td><td colspan="5">1 bit</td></tr>
<tr><td colspan="5">2 bit</td></tr>
<tr><td rowspan="2">Character data bit</td><td colspan="5">Data 7 bit</td></tr>
<tr><td colspan="5">Data 8 bit</td></tr>
<tr><td>Communication control</td><td colspan="5">Control by DTR terminal</td></tr>
<tr><td>Connector specifications</td><td colspan="2">  </td><td>Pin No.</td><td>Abbreviation of signal</td><td>Signal direction Inside ↔ Outside</td><td>Description</td></tr>
<tr><td colspan="2"></td><td>1</td><td>FG</td><td></td><td>Frame ground</td></tr>
<tr><td colspan="2"></td><td>2</td><td>SD</td><td>→</td><td>Send data</td></tr>
<tr><td colspan="2"></td><td>3</td><td>RD</td><td>←</td><td>Receive Data</td></tr>
<tr><td colspan="2"></td><td>4</td><td>RTS</td><td>→</td><td>Request to send</td></tr>
<tr><td colspan="2"></td><td>5</td><td>CTS</td><td>←</td><td>Clear to send</td></tr>
<tr><td colspan="2"></td><td>6</td><td>DSR</td><td>←</td><td>Data send ready</td></tr>
<tr><td colspan="2"></td><td>7</td><td>SG</td><td></td><td>Signal ground</td></tr>
<tr><td colspan="2"></td><td>20</td><td>DTR</td><td>→</td><td>Data Terminal ready</td></tr>
<tr><td>Connection</td><td colspan="6">  </td></tr>
<tr><td>Connected unit</td><td colspan="6">Printer ... General-purpose printer
General-purpose console ... VG-620, VT-382</td></tr>
</table>

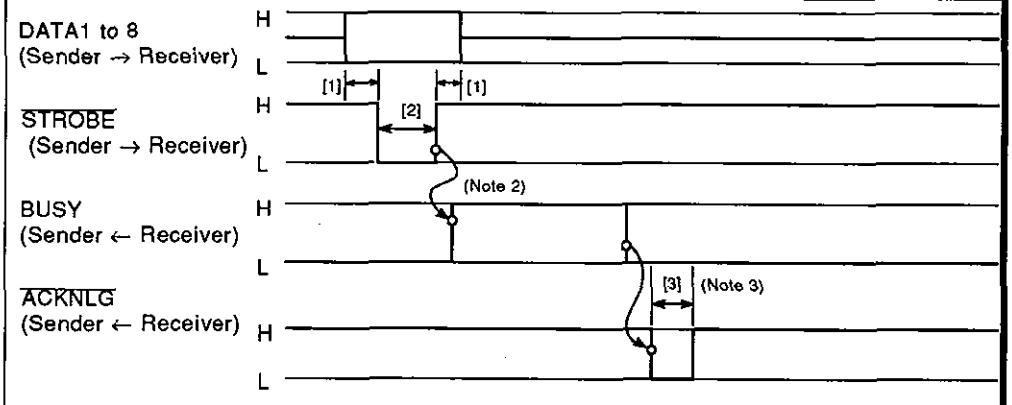
3.2.2 RS-422 interface

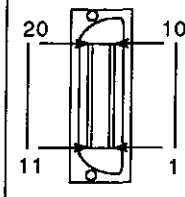
The following table shows the AD51FD RS-422 interface (CH2) specifications.

<table>
<tr><th>Item</th><th colspan="6">Specifications</th></tr>
<tr><td>Transmission method</td><td colspan="6">Conforms to EIA, RS-422.</td></tr>
<tr><td>Synchronous method</td><td colspan="6">Asynchronous method</td></tr>
<tr><td>Transmission speed</td><td colspan="6">9600 BPS</td></tr>
<tr><td>USART mode setting</td><td colspan="6">Automatic setting by operating system for system booting</td></tr>
<tr><td rowspan="6">Connection specifications</td><td>Appearance of connector</td><td colspan="2">Abbreviation of signal</td><td>Block diagram</td><td>Pin No.</td><td>Signal direction</td></tr>
<tr><td rowspan="5">  </td><td rowspan="2">Send data</td><td>SDA</td><td rowspan="2">  </td><td>[3]</td><td rowspan="2">→ Outside</td></tr>
<tr><td>SDB</td><td>[16]</td></tr>
<tr><td rowspan="2">Received data</td><td>RDA</td><td rowspan="2">  </td><td>[2]</td><td rowspan="2">← Outside</td></tr>
<tr><td>RDB</td><td>[15]</td></tr>
<tr><td rowspan="2">Clear to send</td><td>CSA</td><td rowspan="2">  </td><td>[5]</td><td rowspan="2">→ Outside</td></tr>
<tr><td>CSB</td><td>[18]</td></tr>
<tr><td rowspan="2">Request to send</td><td>RSA</td><td rowspan="2">  </td><td>[4]</td><td rowspan="2">← Outside</td></tr>
<tr><td>RSB</td><td>[17]</td></tr>
<tr><td>Signal ground</td><td>SGA</td><td></td><td>[21]</td><td></td></tr>
<tr><td>Connecting cable</td><td colspan="6">AC30R4 ..... (Attached cable for A6GPP/A6PHP)
AC300R4.... (Sold separately.)</td></tr>
<tr><td>Connected unit</td><td colspan="6">A6GPP, A6PHP</td></tr>
</table>

3.2.3 Parallel interface

The following table shows the AD51FD parallel interface (CH3) specifications.

<table>
<tr><th colspan="2">Item</th><th colspan="10">Specifications</th></tr>
<tr><td colspan="2">Standard in conformity</td><td colspan="10">Conforms to centronics.</td></tr>
<tr><td colspan="2">Insulation method</td><td colspan="10">Photocoupler insulation</td></tr>
<tr><td colspan="2" rowspan="2">Signal level</td><td>Input</td><td colspan="9">V_{IH}=2V, V_{IL}=0.8V</td></tr>
<tr><td>Output</td><td colspan="9">V_{OH}=2.4V, V_{OL}=0.5V</td></tr>
<tr><td colspan="2">Timing chart</td><td colspan="10"> 

(Note 1) 1) Minimum 1.0 μs
2) Minimum 1.0 μs, maximum 500 μs 3) Minimum 2 μs
(Note 2) The BUSY signal goes ON at the leading or falling edge of STROBE.
(Note 3) At the falling edge of the BUSY signal, ACKNLG is transmitted within 100μs.
The BUSY signal is canceled after ACKNLG is received.</td></tr>
<tr><td rowspan="7">Connector (AD51FD side) used</td><td>Model name</td><td colspan="10">10220-52A2JL (Manufactured by SUMITOMO 3M)</td></tr>
<tr><td rowspan="6">Pin arrangement</td><td>Appearance of connector</td><td>NO.</td><td>Signal name</td><td>NO.</td><td>Signal name</td><td>NO.</td><td>Signal name</td><td>NO.</td><td>Signal name</td></tr>
<tr><td rowspan="5"> 
</td><td>1</td><td>CHASIS GND</td><td>6</td><td>NC</td><td>11</td><td>DATA8</td><td>16</td><td>DATA3</td></tr>
<tr><td>2</td><td>ACKNLG</td><td>7</td><td>INIT</td><td>12</td><td>DATA7</td><td>17</td><td>DATA2</td></tr>
<tr><td>3</td><td>DATA6</td><td>8</td><td>DATA1</td><td>13</td><td>PE</td><td>18</td><td>GND</td></tr>
<tr><td>4</td><td>DATA5</td><td>9</td><td>STROBE</td><td>14</td><td>SLCT</td><td>19</td><td>ERROR</td></tr>
<tr><td>5</td><td>DATA4</td><td>10</td><td>BUSY</td><td>15</td><td>GND</td><td>20</td><td>GND</td></tr>
<tr><td colspan="2">Connecting cable</td><td colspan="10">AC30PIO-20P..... (Sold separately.)</td></tr>
</table>

3.3 Memory Card Interface Specifications

3.3 Memory Card Interface Specifications

(1) Interface specifications

The following table shows the AD51FD memory card (1)/(2) interface specifications.

Item	Memory card interface	
	1	2
Data stored	• Condition data (learning data) • Accumulative count • Comment	• Fault data
Applicable memory card	• A6MEM-256KAW .....256 Kbytes • A6MEM-512KAW ..... 512 Kbytes	

3.4 ROM Socket Specifications

The following table shows the specifications for the AD51FD ROM socket and EP-ROM which is available.

(1) ROM socket specifications

Item	Specifications
Number of pins	40 pins (plug-in type)
Applicable EP-ROM	64KWROM (128 Kbytes) 128KWROM (256 Kbytes) 256KWROM (512 Kbytes)

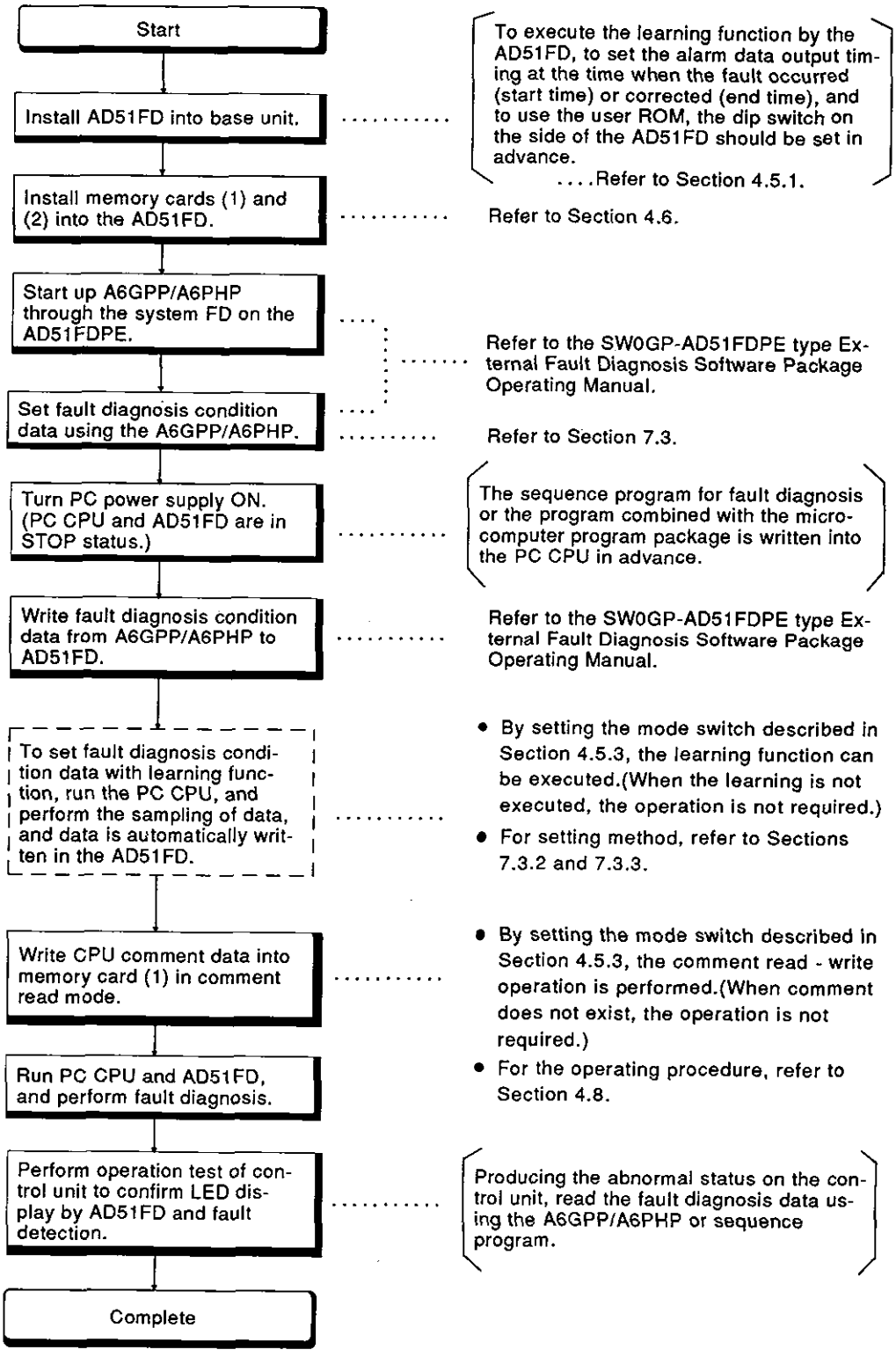
(2) Applicable EP-ROM specifications

Item \ Type	64KWROM	128KWROM	256KWROM
Memory specifications	EP-ROM (Only read is enabled.)		
Memory capacity	128 Kbytes	256 Kbytes	512 Kbytes
Structure	40 pin IC package		
Data stored	Condition data		

4. PRE-OPERATION SETTINGS AND PROCEDURES

4.1 Pre-operation Procedures

The AD51FD system start up procedure is shown below.



4.2 Handling Instructions

This section describes the AD51FD handling instructions.

(1) Since the case, terminal block connector, and pin connector of this PC are made or plastic, do not drop them or subject them to mechanical shock.

(2) Do not remove the printed circuit board of any module from its case. Removal may cause board damage.

(3) When wiring, take care to prevent entry of wire offcuts into the module. If any conductive debris enters the module, make sure that it is removed.

(4) Tighten the module mounting screws and terminal screws as indicated below.

Screw	Tightening Torque Range (Kg.cm)
Module mounting screw (M4 × 0.7 screw)	8 to 12

(5) To attach the module to the base, press the module against the base so that the latch locks securely. To detach the module, push in the latch. Then, after the latch is disengaged from the base, pull the module toward you.

(The User's Manual of each building block-type CPU gives details.)

4.3 Installation Environment

Never install the module system in the following environmens:

(1) Locations where the ambient temperature is outside the range of 0 to 55°C.

(2) Locations where the ambient humidity is outside the range of 10 to 90% RH.

(3) Locations where dew condensation takes place due to sudden temperature changes.

(4) Locations where there are corrosive and/or combustible gasses.

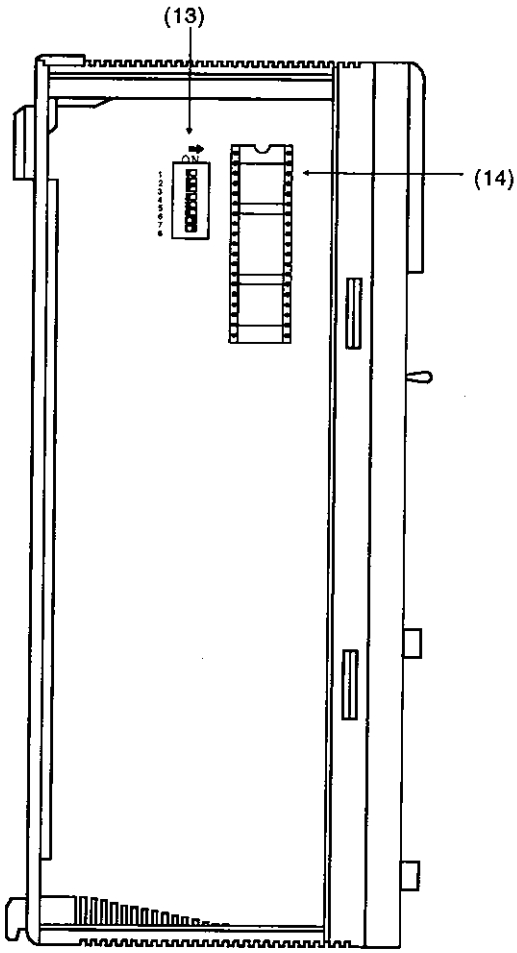
(5) Locations where there is a high level of conductive powder (such as dust and iron filings, oil mist, salt, and organic solvents).

(6) Locations exposed to the direct rays of the sun.

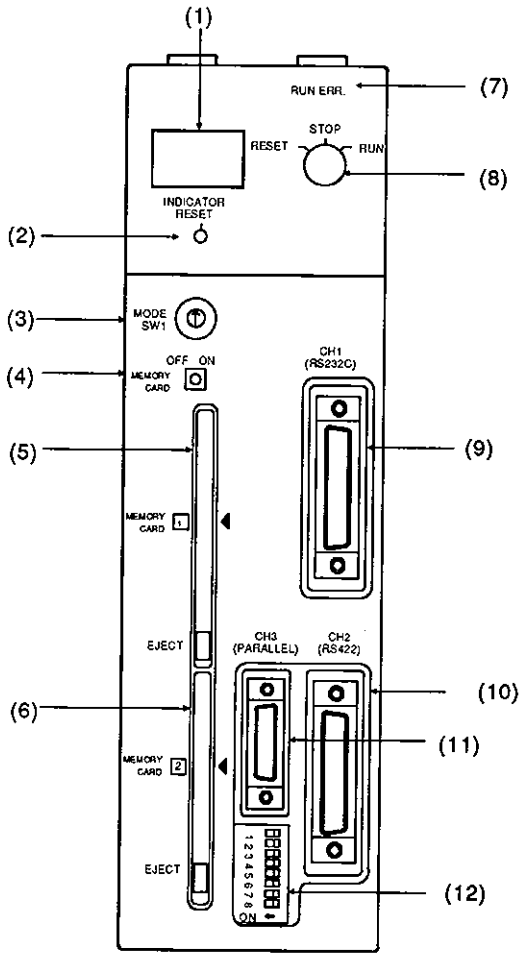
(7) Locations where strong power and magnetic fields are generated.

(8) Locations where vibration and shock are directly transmitted to the main module.

4.4 Nomenclature



(Side view)



(Front view)

No.	Name	Description
(1)	Display	(1) Operation message display

Message	Display mode	Description
BOOT	—	In system booting
INIT	RUN mode	In installing condition data, and executing initial processing
OK	RUN, learning mode	Memory card is detachable. (Stop communicating with memory card.)
STOP	RUN mode	In stopping fault diagnosis processing
RUN	RUN mode	In executing fault diagnosis processing
STUD	Learning mode	In executing learning function processing
READ	Comment mode	In reading comment
END	Learning mode, comment	Learning comment read end

(2) Error message, error code display (For details, refer to Section 9.1.)
The error message and error code are continuously displayed until the display is reset using indicator reset switch or RUN-STOP-RESET switch.

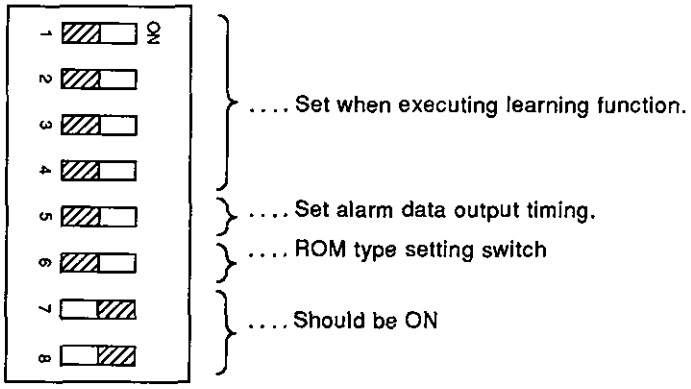
<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>(2)</td><td>Indicator reset switch</td><td>• Deletes the contents displayed on the screen.
• If the display factor is remained, the contents can be re-displayed. And, in case many errors occurred, the next eight (8) errors in maximum are displayed in each resetting.</td></tr>
<tr><td>(3)</td><td>Mode setting switch</td><td>• Selects RUN mode, learning mode (1)/(2), or comment read mode. (For details, refer to Section 4.5.3.)</td></tr>
<tr><td>(4)</td><td>Memory card access switch</td><td>• Operates communication between AD51FD and memory card or change of memory card. (Refer to Section 4.6.)
ON ... While executing communication with memory card, the memory card cannot be exchanged.
OFF... The communication with memory card is stopped, the [OK] is displayed on the screen. Then the memory card can be exchanged.</td></tr>
<tr><td>(5)</td><td>Memory card (1) interface</td><td>Slot to install memory card (1) which stores fault diagnosis condition data (learning data), accumulative count and comment. ..... (For details, refer to Sections 3.3 and 4.6.)</td></tr>
<tr><td>(6)</td><td>Memory card (2) interface</td><td>Slot to install memory card (2) which stores the fault data in fault diagnosis result. ..... (For details, refer to Sections 3.3 and 4.6.)</td></tr>
<tr><td>(7)</td><td>LED for running condition display</td><td>LED to display abnormality in operation
<table><tr><th>LED name</th><th>Items to be checked</th></tr><tr><td>RUN</td><td>• ON ... Normally running. OFF ... Running is stopped.</td></tr><tr><td>ERROR</td><td>• ON ... Error occurred. OFF ... Normally running.
(Error items are displayed on the screen.)</td></tr></table></td></tr>
<tr><td>(8)</td><td>RUN - STOP - RESET switch</td><td>• RUN ... Execute fault diagnosis processing, learning function and fault data output.
• STOP ... Stop (the communication with A6GPP/A6PHP is possible. ... Condition data write/read, etc.)
• RESET . Reset the H/W for the AD51FD. (Clear data received, and alarm data when held.)</td></tr>
<tr><td>(9)</td><td>Connector for RS-232 interface (CH1)</td><td>• For RS-232C cable connection (25 pins socket type) ..... (For details, refer to Section 3.2.1.)</td></tr>
<tr><td>(10)</td><td>Connector for RS-422 interface (CH2)</td><td>• For RS-422 cable connection ..... (For details, refer to Section 3.2.2.)</td></tr>
<tr><td>(11)</td><td>Connector for parallel interface (CH3)</td><td>• For parallel interface cable connection ..... (For details, refer to Section 3.2.3.)</td></tr>
<tr><td>(12)</td><td>Dip switch for setting the printer</td><td>• Communication mode setting switch for printer which prints alarm/fault data ..... (For details, refer to Section 4.5.2.)</td></tr>
<tr><td>(13)</td><td>Dip switch for setting learning function, alarm data output timing, and ROM type</td><td>• Sets learning function run condition, alarm data output timing, and memory capacity of ROM installed. ..... (For details, refer to Section 4.5.1.)</td></tr>
<tr><td>(14)</td><td>ROM socket</td><td>• Slot to install the user ROM created ..... (For details, refer to Sections 3.4 and 4.7.)</td></tr>
</table>

4.5 Settings

4.5.1 Dip switch for setting learning function, alarm data output timing, and ROM type

(1) AD51FD dip switch settings at shipment (on side view of AD51FD)

[Setting at shipment]



(2) Dip switch setting contents

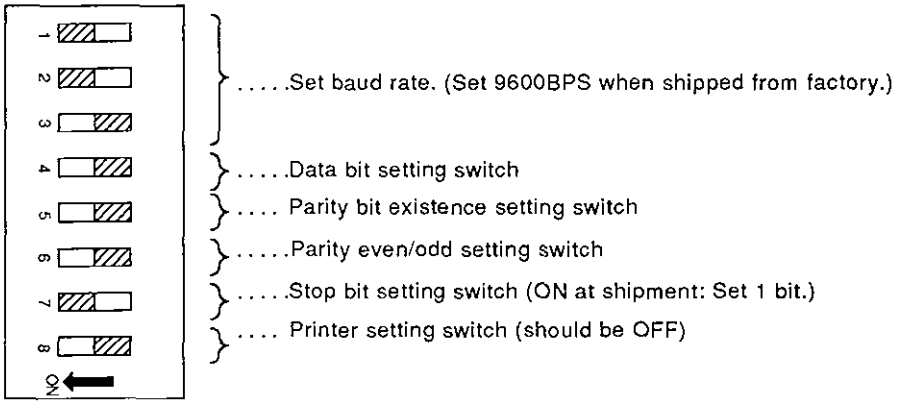
Switch No.	Name	Switch setting
1 2	Learning function, sampling times setting switch	Sampling times / Switch No. — Once: 1 OFF, 2 OFF; 10 times: 1 ON, 2 OFF; 100 times: 1 OFF, 2 ON; *1 65535 times: 1 ON, 2 ON *1:Sets the "RUN-STOP-RESET switch" on the AD51FD to RUN to do sampling, and by setting the switch to STOP before completing the learning, the sampling stops. The data sampled before setting the switch to STOP is regarded as learning data.
3	Learning function set value select switch	OFF ... Regards maximum and minimum values as set values. ON ..... Regards average decentralized value as set value.
4	Set value/alarm value select switch	OFF ... Regarding learning values as set value, automatically sets alarm value according to n% of alarm value. ON ..... Regarding learning value as alarm value, automatically set the set value according to n% of alarm value.
5	Alarm data output timing setting switch	OFF ... Outputs when alarm occurs. (The alarm time is not output.) ON ..... Alarm data is held until the following conditions occur. By occurrence of condition, alarm data and alarm time are output. 1) When failure occurs (including failures on other items), 2) When fault diagnosis item reaches the end (device triggering or time), 3) When AD51FD is set from RUN to STOP, 4) When Y12 is set from diagnosis start (ON) to diagnosis stop (OFF),

Switch No.	Name	Switch setting
6	ROM type setting switch	OFF ... When using memory capacity 128/256 Kbyte ROM, or not using, ON ..... When memory capacity 512 Kbyte ROM,
7	—	Do not operate.
8		Should be ON (with terminal resistor)

4.5.2 Dip switch for setting the printer

(1) Setting AD51FD dip switch at shipment

[Setting at shipment] ... Set for A7(N) PR.



(2) Dip switch setting contents

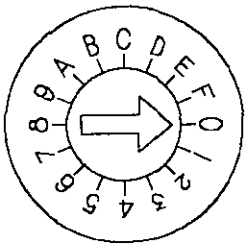
Switch No.	Name	Switch setting
1 2 3	Baud rate setting switch	See table below
4	Data bit setting switch	OFF ..... Set 8 bits. ON ..... Set 7 bits.
5	Parity bit existence setting switch	OFF ..... Parity bit present. ON ..... No parity bit present.
6	Parity even/odd setting switch	OFF ..... Even parity ON ..... Odd parity
7	Stop bit setting switch	OFF ..... Stop bit 2 bits ON ..... Stop bit 1 bit
8	Printer setting switch	Should be OFF

Switch No. / Baud rate	1200	2400	4800	9600	19200
1	OFF	ON	OFF	ON	OFF
2	OFF	OFF	ON	ON	OFF
3	OFF	OFF	OFF	OFF	ON

(3) Dip switch setting method for printer

Printer model / Switch No.	General-purpose printer
1	Set ON/OFF according to the specification of general-purpose printer.
2	
3	
4	
5	
6	
7	
8	OFF

4.5.3 Mode setting switch

	Switch NO.	Description
 [Setting at shipment]	0	• RUN mode (1)... Executes fault diagnosis with condition data already set.
		• RUN mode (2)... Executes learning after setting the learning function from the A6GPP/ A6PHP, then executes fault diagnosis.
	1	• Learning function mode (1)... Executes learning according to the condition data already set, and after completing the learning, fault diagnosis starts.
	2	• Learning function mode (2)... Executes learning according to the condition data already set, and after completing the learning, fault diagnosis stops.(After learning, this mode is used to check and correct the condition data.)
	3	• Comment read mode... Reads the comment of PC CPU, and writes it in the memory card (1).
	4 to F	(Unusable)

(1) To execute fault diagnosis using the AD51FD, or to execute the learning function in communication with the A6GPP/A6PHP, set switch to "0". (The switch is set to "0" when the AD51FD is shipped from the factory.)

(2) After the AD51FD automatically sets condition data by learning, set the switch to "1" to execute fault diagnosis.
When the switch is set to "1", learning is executed whenever the power is supplied to the PC CPU.
In case learning is executed only the first time and succeeding leanings are not required, use according to the procedure described in Section (3).

(3) To set condition data after letting the AD51FD execute learning once using the learning function, set the switch to "2".
After completing learning, the AD51FD stops. Set the mode setting switch to "0", and execute fault diagnosis.

(4) When comments are written in the PC CPU, and the device comment is output when an error occurs, write the comment in the AD51FD memory card (1) before executing fault diagnosis through the comment read mode with the switch set to "3".
(For operating procedure, refer to Section 4.8.)

(5) Switch settings "4" to "F" are not available. Do not operate them.

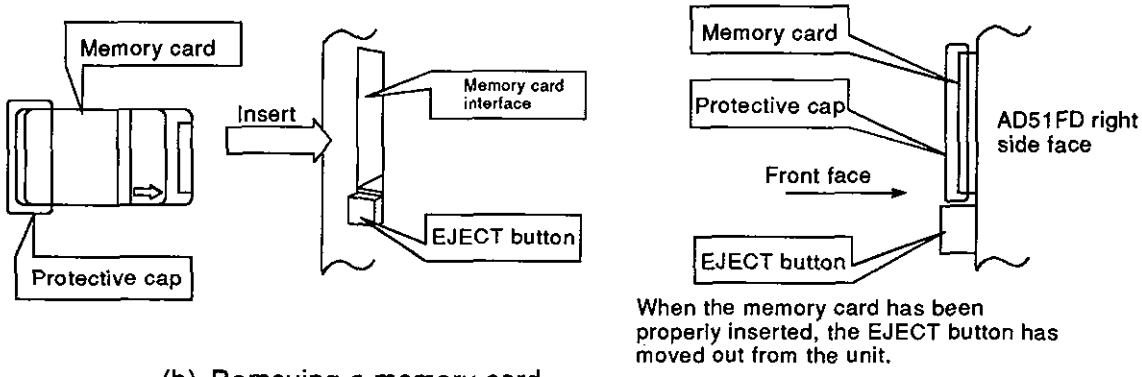
4.6 Inserting and Removing Memory Cards

(1) How to insert and remove memory cards when the power is OFF

This section describes the memory card installing and removing procedure.
When inserting or removing a memory card while the power is ON, follow the procedure given in Section (2).

(a) Inserting a memory card

When inserting a memory card , make sure the card is inserted with the arrow to the right side. Push the memory card in firmly until it is securely installed in the connector.
If the memory card is properly installed in the connector, the EJECT button will move out.
After inserting the memory card, make sure that the EJECT button has moved out, as shown below.



When the memory card has been properly inserted, the EJECT button has moved out from the unit.

(b) Removing a memory card

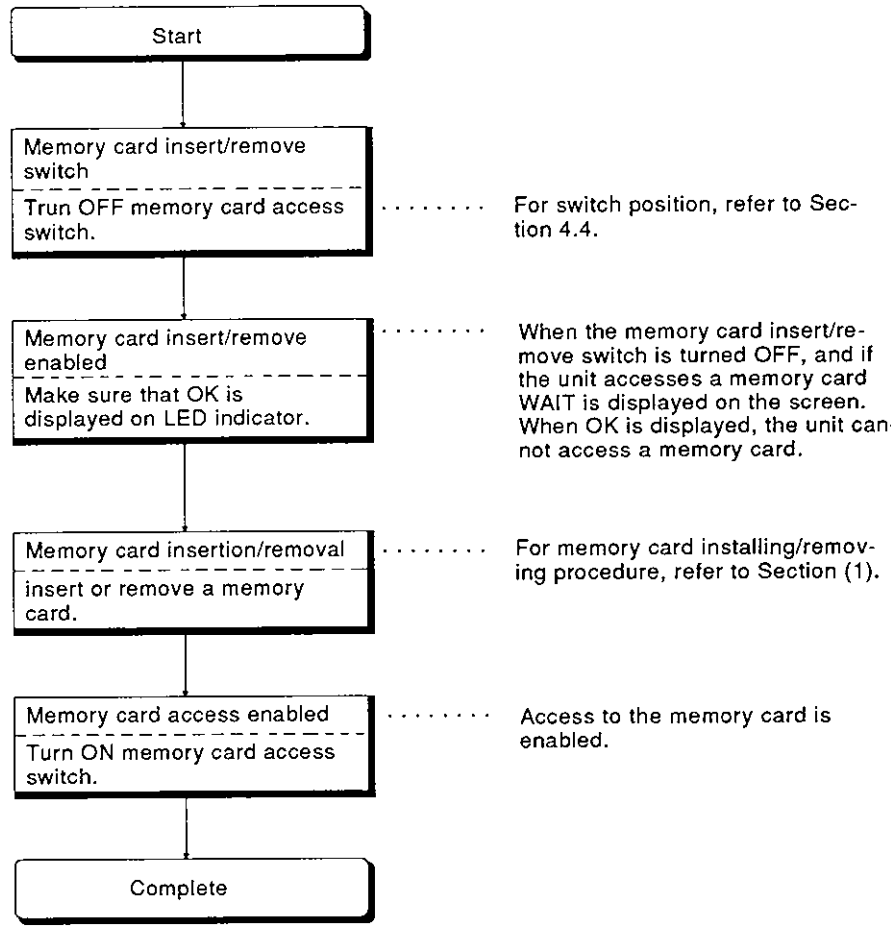
Press the EJECT button firmly to remove the memory card.
Pressing the EJECT button dislodges the memory card from the connector and slides it forward. The card can then be pulled out by hand.

POINT

Handle the memory card with the protective cap to protect the memory from being damaged due to static electricity when installing or removing the memory card.
For details on how to handle the memory card, refer to the Manuals attached to the memory card.

(2) How to insert and remove memory cards when the power is ON

When the power is ON, the following procedure must bė followed to insert or remove memory cards (after making sure the AD51FD is not accessing a memory card).



POINTS

(1) When inserting or removing a memory card when the power is ON, follow the procedure shown in Section (2).
If a memory card is inserted or removed while the AD51FD is accessing the memory card, the data in that memory card will be cleared.

(2) The memory card access switch is used for both memory cards (1) and (2).

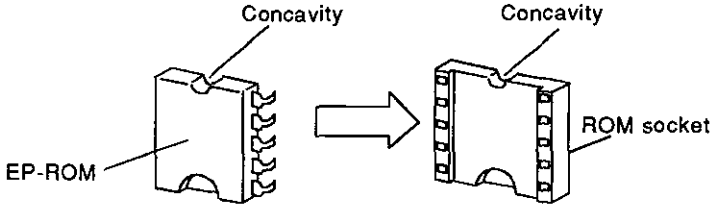
4.7 Inserting and Removing the EP-ROM

The section gives the procedures and precautions when inserting or removing an EP-ROM in or out of the ROM socket.

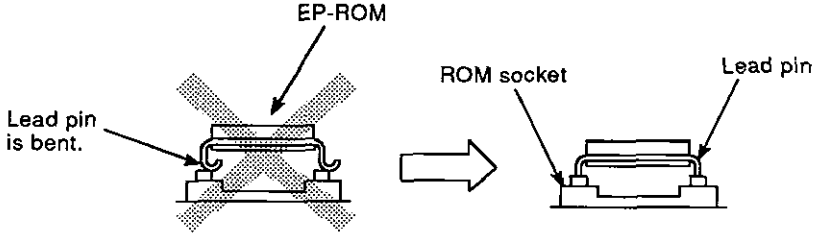
(1) Inserting the EP-ROM

(a) Do not touch memory lead pins with the hand or fingers.
Static electricity may clear the memory, or a pin may be bent.

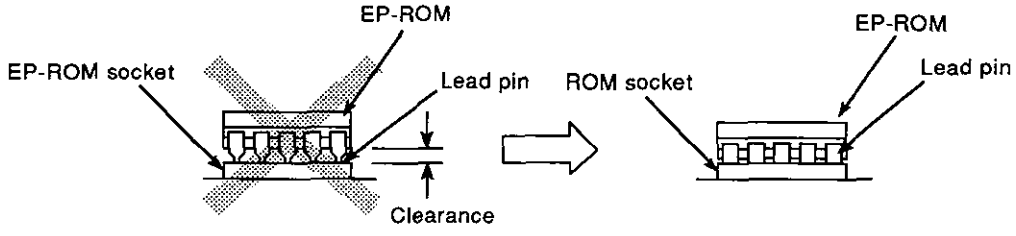
(b) When inserting the EP-ROM, make sure the concavity of the EP-ROM matches the concavity of the ROM socket.
If the EP-ROM is inserted incorrectly, the memory will be cleared when the power is turned ON.



(c) Be very careful not to bend EP-ROM memory lead pins when inserting the EP-ROM.
If an EP-ROM pin is bent, when the power supply is turned ON, normal reading cannot be executed and the memory may even be cleared.



(d) After the EP-ROM is inserted, make sure it is set firmly in the socket without a clearance.

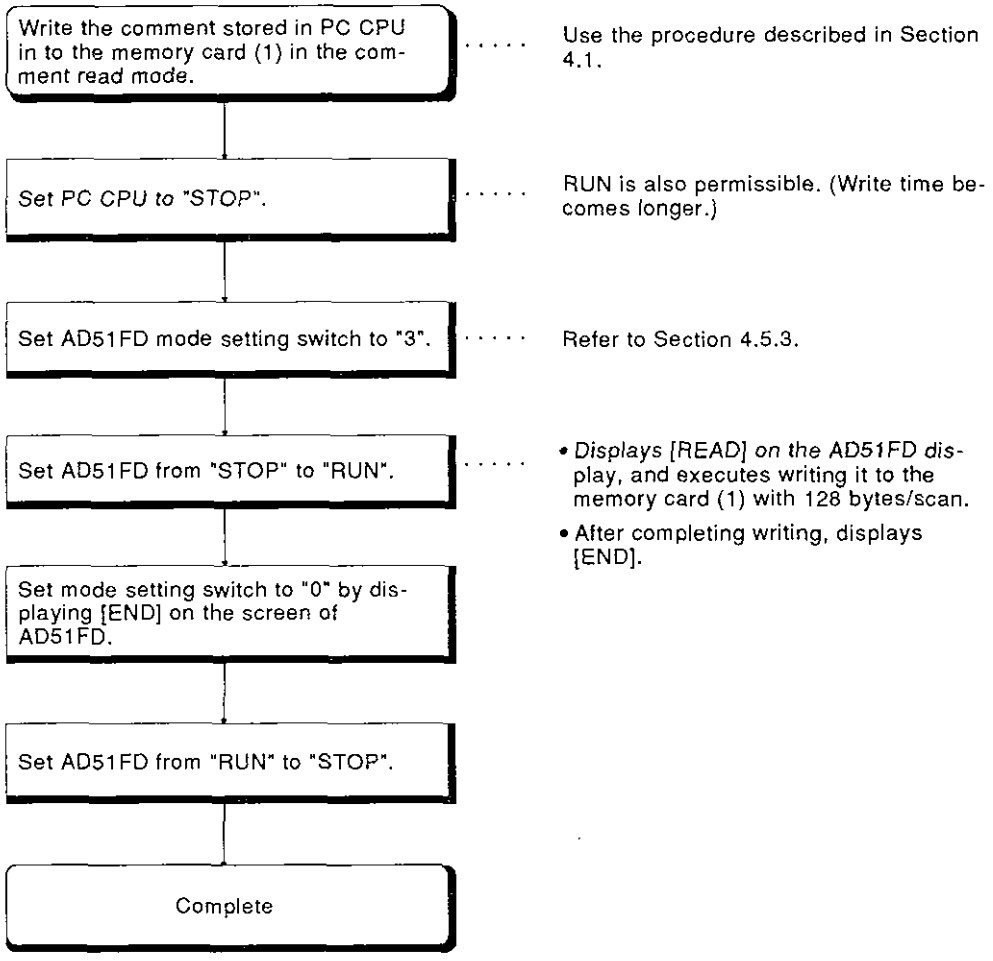


(2) Removing EP-ROM

Use a special pulling tool (for 40-pin ICs) to remove the EP-ROM from the ROM socket.

4.8 Procedure for Writing Comments to Memory Card (1)

When comments are written in the PC CPU, and the device comment is output when executing fault diagnosis, write the comment in the memory card (1) before executing fault diagnosis using the procedure shown below.



POINT

If any comments are added to the PC CPU, or the comments in the PC CPU are changed. The comments should be written in the memory card (1) again as per the procedure shown above.

5. MEMORY CARD BATTERY REPLACEMENT

5.1 When Should the Battery be Replaced?

(1) The AD51FD verifies whether battery power to a memory card inserted in MEMORY CARD1 or MEMORY CARD2 is low.

When the AD51FD detects low battery power or the PC CPU detected a AD51FD error (×12 is ON), an error message is displayed on the LED indicator.

(2) The contents of a memory card can be retained about 39 hours after the low battery error message is displayed on the LED indicator and the AD51FD power is OFF.

However, when the low battery error message is displayed, the battery should be replaced as soon as possible.

(3) The memory card is battery-backed only during AD51FD power OFF. Mitsubishi recommends that the battery should be replaced at certain intervals as shown below.

Operating Condition \ Model		A6MEM-256KAW	A6MEM-512KAW
When the memory card is battery-backed	Minimum guaranteed lifetime	1900 Hr	900 Hr
	Real lifetime (typical)	11300 Hr	5900 Hr
Working time after the low battery error message is given (ambient temperature: 25 °C)		79 Hr	39 Hr

(Note) Mitsubishi cannot guarantee the backup performance if a new battery is used after five years of storage. It should be replaced.

5.2 Replacing the Battery

IMPORTANT

To replace the battery, install a memory card in MEMORY CARD1 or MEMORY CARD2, and make sure that power to the AD51FD module is ON.
If this is not followed, all data in the memory card will be cleared because the memory card is not backed up by a capacitor.

(1) Preparing for replacement

Set memory card access switch to OFF (Stop communication).
..... (Set it to ON after replacing batteries.)

(2) Replacing method

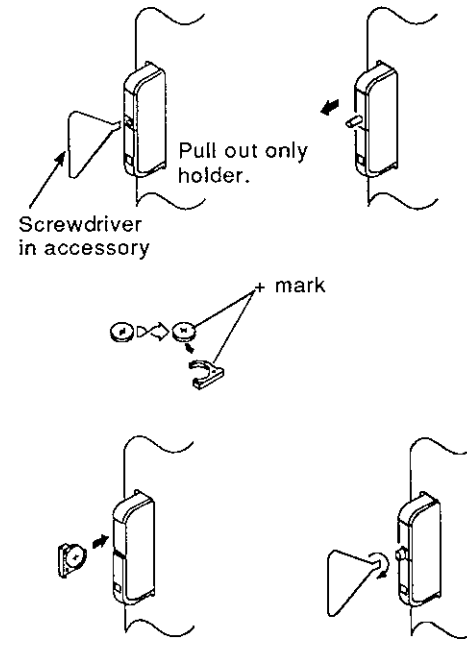
(a) Prepare a lithium battery (model BR2325 or equivalent).

(b) Loosen the holder screw 4 to 5 mm, and pull the battery holder from the memory card.

(c) Put the new battery in the battery holder.

(d) Insert the holder completely into the memory card, fix it with screw.

(e) Attach the protective cap.



POINT

The instruction manual included in the memory card package gives details about memory card handling.

6. PERFORMANCE SPECIFICATIONS

6.1 Performance Specifications

Item				Performance specifications
Fault diagnosis data communication				(1) Communicate with AD51FD ... (All applicable CPUs are available.) (2) Communicate with microcomputer program ... (Only applicable CPUs to microcomputer program are available.)
Fault detection applicable device				(1) Bit device ... X, Y, M, L, S, B, F, T, C (2) Word device ... D, W, R (Refer to Section 6.2.)
Fault detection start/end device				Any one of X, Y, M, L, S, B, F, T, C (Refer to Section 6.2.)
Fault detection end time setting				0 to 65535 (unit: 10ms, 100ms, second, minute)
Fault/alarm comment registration				24 characters (English, numerical, special character)
Fault detecting method	Number of detection items			Total number of detection type which are set in the range of memory capacity. (1 detection item = 1 detection type) (For details, refer to Section 6.3.)
	Detecting class	Sequence/time check	Number of device points	1 to 128 points/item ... (Excluding start/end devices)
			Number of changes	1 to 255
			Time changed	0 to 65535 (0: endless) ... (unit: 10ms, 100ms, second)
			Alarm value	1 to 65535 (time) (0: no alarm value) ... (settable by change)
				-1 to -100% (rate in time) ...(Set in constant rate to the whole time changed)
		Count check	Number of device points	1 to 128 points/item ... (Excluding start/end devices)
			Count	1 to 2147483647 times
			Conditions	More, Less, Equal, More and less
			Alarm value	1 to 2147483647
				-1 to -100% ... (Set in constant rate to all times.)
			Accumulative Count	Items to be detected: Maximum 36 items Number of device points: Maximum 4608 points (Holding count when module power OFF)
		Normal pattern check	Number of normal pattern registered	1 to 255 patterns/item
			Number of device points	1 to 128 points ... (common in each pattern, excluding start device)
		Abnormal pattern check	Number of abnormal patterns registered	1 pattern/item
			Number of device points	1 to 128 points
		Upper/lower limit value check	Number of device points	1 point/item(Only word device is available. Excluding start/end device)
			Condition	More and less
			Alarm value	-32768 to 32767
		Bidirectional operation check	Number of device points	Start up 2 points, limit 2 points/item
			Time changed	0 to 65535 (0: endless) ... (unit: 10ms, 100ms, second)
			Alarm value	1 to 65535 (time) (0: no alarm value) ... (Settable per change)
			Check classification	Select pattern check or sequence/time check

Item	Performance specifications
Fault detection condition data storage area	Memory card (1) or user ROM
Accumulative count/fault detection result storage area	Memory card (1)/(2) ... (See Section 6.4.)
Fault detection result output destination	• Memory card (2), buffer memory • A6GPP/A6PHP (through RS-422) • Print (through parallel/RS-232C) • Display on general-purpose terminal equipment (through RS-232C)
Number of I/O points (points)	48 points (I/O assignment ... 16 points vacant in first half, and 32 points special function unit in second half)
DC 5V internal current consumption (A)	1.0
External dimensions mm (inch)	250(9.84)(H)×76(2.99)(W)×120(4.72)(D)
Weight (kg)	0.9

6.2 Fault Detection Applicable Device

This section describes the device range and usable detection class. for fault detection applicable device.

(1) Bit device (for A3ACPU)

Device	Device range	Detection class.
X	X0000 to X07FF	• Sequence/time check • Count check • Normal pattern check • Abnormal pattern check • Bidirectional operation check
Y	Y0000 to Y07FF	
M	M0000 to M8191	
L	L0000 to L2047	
S	S0000 to S2047	
B	B0000 to B0FFF	
F	F0000 to F2047	
T (contact)	T0000 to T1023	
C (contact)	C0000 to C1023	

(2) Word device (for A3ACPU)

Device	Device range	Detection class.
D	D0000 to D6143	• Upper/lower limit value check
W	W0000 to W0FFF	
R	R0000 to R8191	

NOTES

- Word device is used only as a device for upper/lower limit value check.
- The extension file register, timer (T) and counter (C) are not available.

POINTS

(1) Special relays (after M9000) and special registers (after D9000) in the PC CPU cannot be used as fault detection devices.

(2) The fault detection applicable device differs in the usable device range according to the applicable CPU.
The fault detection condition data should be prepared within the device range for the CPU used.

(3) To execute the fault diagnosis using microcomputer program, the received data capacity varies according to the number of points and types of fault detection applicable device. ... Calculate it referring to Section 6.6.2.

6.3 AD51FD Memory Capacity and Calculation of Number of Detection Item

(1) AD51FD fault detection memory capacity

(a) Communication using AD51FD

Memory capacity = (65536 $-^{*1}$ 19) bytes

$*_1$: AD51FD dedicated memory area

(b) Communication using microcomputer program

Memory capacity = [65536 $-^{*1}$ (18 + 4n)] bytes

$*_1$: AD51FD dedicated memory area
n : Types of detection applicable device (1 to 12)
(Example) : When using X, Y, D, n=3.

(2) Calculating memory capacity per detection type

Detection type	Calculation	Item changed
Sequence/time check	[Memory capacity] ^{bytes} = 24 + 24m + 4n + [5 + 4 x *(n/16)] x C * : Round up to integer at decimal point.	m: User comment setting 0 ... No setting 1 ... Set either alarm or fault. 2 ... Set both alarm and fault. n: Number of device points (1 to 128) C: Number of Changer/Number of patterns (1 to 255) L: Condtions More ... 10n Less ... 10n Equal ... 6n More and less ...18n
Count check	[Memory capacity] ^{bytes} = 21 + 24m + 4n + L	
Normal pattern check	[Memory capacity] ^{bytes} = 12 + 24m + 4n + [2 x *(n/16)] x C * : Round up to integer at decimal point.	
Abnormal pattern check	[Memory capacity] ^{bytes} = 6 + 24m + 4n + 2 x *(n/16) * : Round up to integer at decimal point.	
Upper/lower limit value check	[Memory capacity] ^{bytes} = 28 + 24m	
Bidirectional operation check	[Memory capacity] ^{bytes} = 100 + 24m_1 + 24m_2 (GO) (RETURN)	

(a) Memory capacity used

[Memory capacity used] ^{bytes} = { Total of memory capacity values calculated in each item by *detection type*. }

(3) Calculating number of items to be detected

Condition: [Memory capacity used] < [AD51FD memory capacity]

[Number of items to be detected] = { Total of number of items in each detection type calculated in the "Memory capacity used". }

POINT

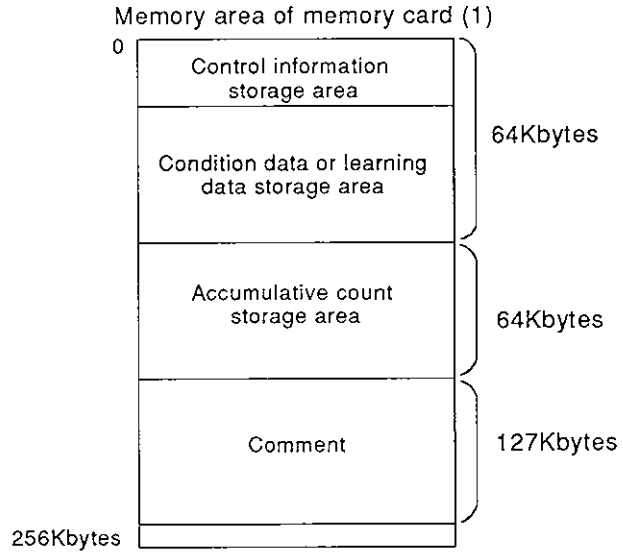
(1) The settable remaining memory capacity is indicated on the right top of the screen when setting condition data using AD51FDPE. The detection condition data should be set within the range of remaining memory capacity.

(Memory capacity used) = (AD51FD memory capacity) – (Remaining memory capacity)

6.4 Memory Map of Memory Card

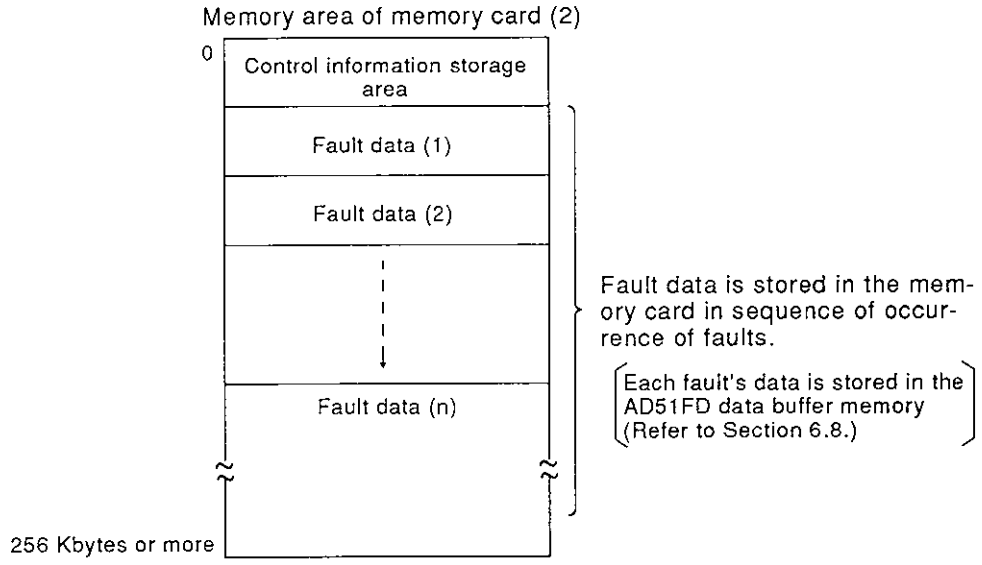
(1) Memory map of memory card (1)

The following shows the memory map of memory card (1) which is used to store fault detection condition data, accumulative count, and comment.



(2) Memory map of memory card (2)

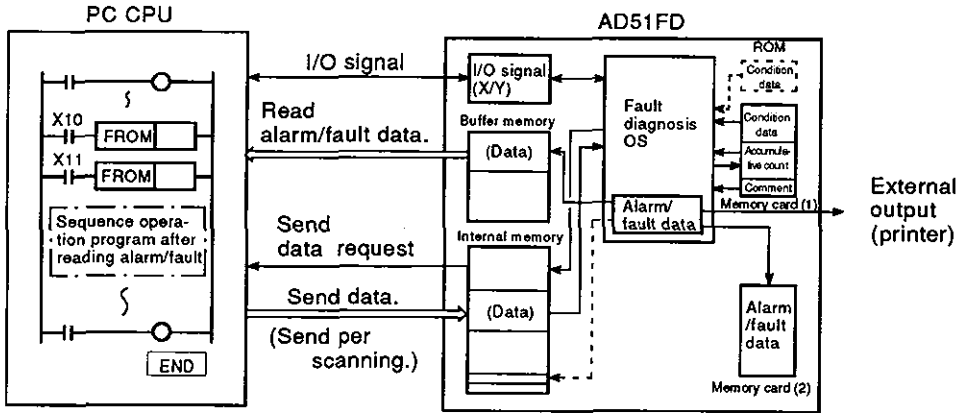
The following shows the memory map of memory card (2) which is used to store fault detection result.



6.5 Data Communication with PC CPU Using AD51FD

This section describes the data communicating procedure in which the AD51FD gives a request to send data to the PC CPU, receives the data and executes fault diagnosis.

6.5.1 Data communicating method using AD51FD



(1) Data communication on normal state

(a) The AD51FD reads condition data, accumulative count, and comments from ROM/memory card (1) on running state.

(b) The AD51FD receives fault diagnosis data by 128 bytes at END processing in each scanning.

(c) The AD51FD checks the action between the data received and condition data at the time after all the data requested are received, and diagnoses the existence of alarm and/or fault.

(d) When the accumulative count is set in device, the accumulative count is written in memory card (1) when power OFF.

(2) Data communication when alarm occurred

(a) When the "alarm" is detected while executing fault diagnosis processing, the AD51FD performs the following processing.

1) Switches alarm detection flag (X11) for I/O signal ON, and sends it to the PC CPU.

2) Writes alarm data in buffer memory, memory card (2) or internal memory, and outputs it.

(b) The PC CPU reads alarm data and performs sequence operation.

(3) Data communication when fault occurred

(a) When the "fault" is detected while executing fault diagnosis processing, the AD51FD performs the following processing.

1) Switches fault detection flag (X10) for I/O signal ON, and sends it to the PC CPU.

2) Writes fault data in buffer memory, memory card (2) or internal memory, and outputs it.

(b) The PC CPU reads fault data, and performs sequence operation.

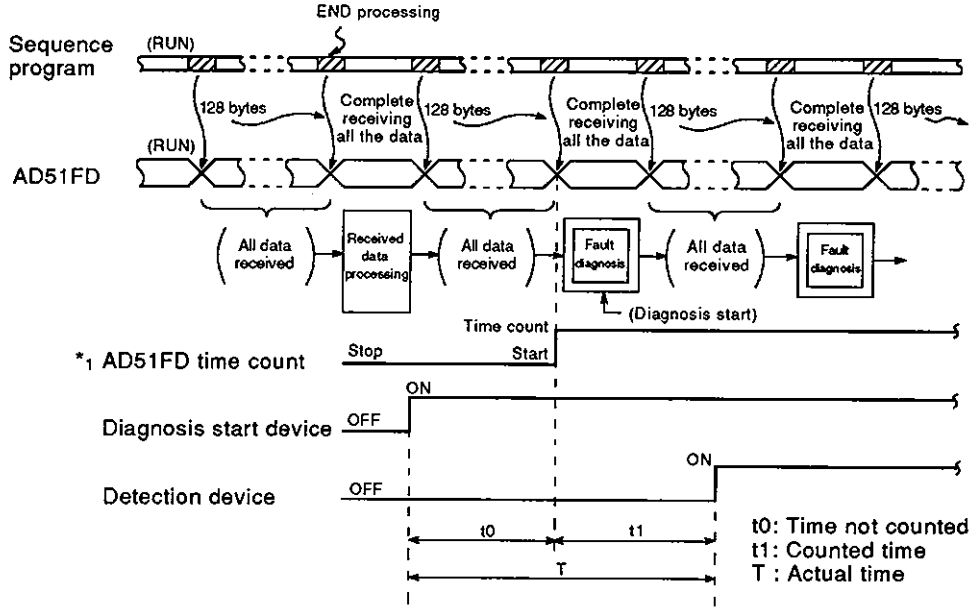
6.5.2 AD51FD fault diagnosis data receiving procedure

The AD51FD performs fault diagnosis processing after receiving all the data in the device on the AD51FD RUN state and completing data receiving processing in the AD51FD. (Repeat "completing receiving all the data → fault diagnosis")

(1) Data capacity received in each scanning by the PC CPU

Received data capacity	Remarks
Maximum 128 bytes/scan in each device	• For number of scan times until all the data are received, refer to Section (4)..... (On next page)

(2) Action when executing fault diagnosis



*1 : The AD51FD time count is started at fault diagnosis start point after setting the diagnosis start device to ON.

(3) Number of scan times until completing receiving all data

Number of scan times until completing receiving all the data = Sum total of times when scan times calculated in each device shown in the Table below is summed using the applicable CPU

Applicable CPU	Device	Number of points receivable per scan	Description
AnACPU A3HCPU A3MCPU A0J2CPU	X Y M,L,S B F T C	1024 points/scan in each device (in unit of 16 points)	(1) Even if only one device exists in each device, it requires to scan once. (Example) For X0, X10 used → 1 scan For Y10, Y1F used → 1 scan For D100, D150 used → 1 scan (2) Bit device receives 1024 points/512 points per scanning in unit of 16 points/8 points from younger number of device used per device. (Example) Use between X000 and X1FF → 1 scan Use between X400 and X5FF → 1 scan Use between Y200 and Y3FF → 1 scan Use between Y600 and Y7FF → 1 scan (3) Word device receives 64 words per scanning from younger number of device used per device. (Example) Use between D0 and D10 → 1 scan Use between D100 and D163 → 1 scan (4) M, L, S are regarded as same device.
	D R W	64 words/scan in each device	
CPU other than the above	X Y M,L,S B F T C	512 points/scan in each device (in unit of 8 points)	
	D R W	64 words/scan in each device	

[Calculation of number of scan times]

- Bit device .. Use between X00 and X1FF 1scan
  Use between X200 and Y3FF 1scan
  Use between M100 and M500 ..... 1scan

- Word device ... Use between D0 and D63 ..... 1scan
  Use between D100 and D150 ... 1scan
  5scan

(Top of younger number) (Last number) Receiving completion scan times

(The number of points used in this range is not limited.)

POINT

The number of scan times may be lessened by setting all the devices used in fault diagnosis at the same time on the sequence program. Especially, it is useful to summarize internal relay and data register in advance.

6.5.3 Fault diagnosis processing time

(1) Fault diagnosis processing time

This time shows the period from time when the AD51FD receives all the fault diagnosis data to the time when it completes the fault diagnosis.

$$\text{Fault diagnosis processing time} = \left[\left[\text{Number of special units (Refer to Section 2.1.3.)} + \text{Peripheral device monitoring existence (Exists .....1, Not exist ....0)} + 2\right] \times \left[\text{Number of scan times until completing receiving all data}^{*1}\right] \times \left[\text{PC CPU maximum scan time}\right]_{ms}\right] + \left[(2^{ms})^{*2} \times (\text{Number of items detected})\right]$$

*1: Number of scan times in Section 6.5.2
*2: AD51FD fault diagnosis time

(2) AD51FD interrupting time to the PC CPU

When the PC CPU is processing END, the AD51FD interrupts the PC CPU for receiving 128 bytes data. By interruption, the PC CPU scan time will become longer by interrupting time shown in the following table.

PC CPU	Interrupting time
AnNCPU, AnCPU	1.2ms
A3HCPU, A3MCPU	0.8ms
AnACPU	2.4ms

6.5.4 Precautions on data communication

(1) In case the scan time of sequence program is shorter than the AD51FD fault diagnosing time, the AD51FD receives data in END processing after completing fault diagnosis.

(2) The time counting up to the detection device changed before starting fault diagnosis (time count start) is not performed correctly. (Refer to Section 6.5.2.)

(3) In case the special unit of which the number of units combined with AD51FD is limited (Refer to Section 2.1.3) is used, the unit which has requested to interrupt (data communication) earlier has a priority of communication with the PC CPU (CPU communicates only once.), and scanning time until all the data in the AD51FD are received may become longer.

(4) If the fault of the AD51FD was displayed on the screen using the A6GPP/A6PHP, the AD51FD stops fault diagnosis processing and displays the fault. The fault diagnosis starts immediately after completing the fault display.

(5) For the detection device changed in the PC CPU after receiving data, fault diagnosis is performed by triggering the next data receiving.

(6) The detection device to execute data communication must retain ON or OFF status for over the "fault diagnosis processing time".

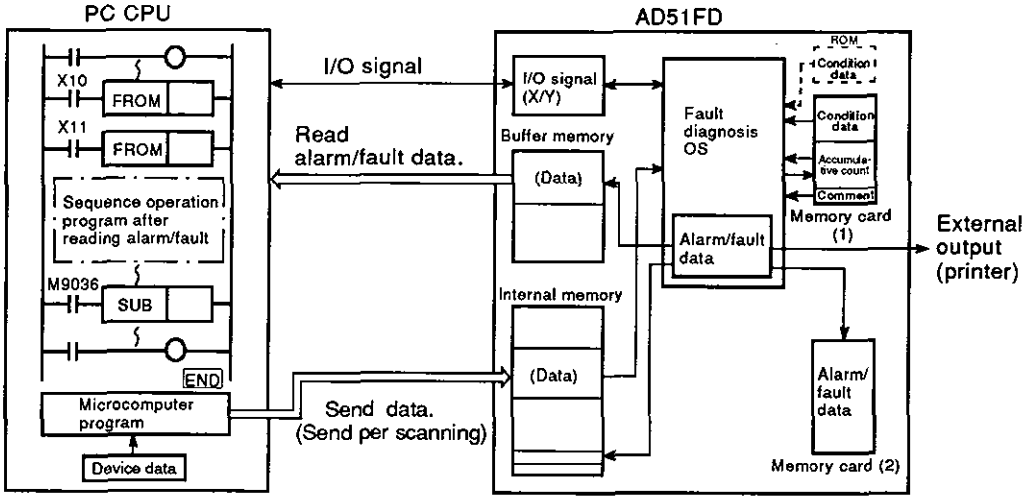
POINT

The detection device which changes in "OFF → ON → OFF" or "ON → OFF → ON" within "fault diagnosis processing time" cannot be set.
If the detection device is set, the normal ON/OFF is not accepted due to the data receiving timing, and error diagnosis may be caused.

6.6 Data Communication with AD51FD Using Microcomputer Program

This section describes the data communication method in case the AD51FD receives data using microcomputer program on the PC CPU, and performs the fault diagnosis.
Only the CPU on which microcomputer program for fault diagnosis is available can perform the data communication processing.

6.6.1 Data communicating procedure with AD51FD



(1) Data communication on normal state

(a) The AD51FD reads condition data, accumulative count, and comments from ROM/memory card (1) on running state.

(b) The AD51FD checks the operation between the data received and condition data, receives maximum 3900 bytes of fault diagnosis data sent by microcomputer program of PC CPU at each scan, and diagnoses the existence of alarm and/or fault.

(c) When the accumulative count is set in device, the accumulative count is written into memory card (1) when power OFF.

(2) Data communication when alarm occurs

(a) When the "alarm" is detected while executing fault diagnosis processing, the AD51FD performs the following processing.

1) Switches alarm detection flag (X11) for I/O signal ON, and sends it to the PC CPU.

2) Writes alarm data in buffer memory, memory card (2), or internal memory, and outputs it.

(b) The PC CPU reads alarm data, and performs sequence operation.

(3) Data communication when fault occurs

(a) When a "fault" is detected while executing fault diagnosis processing, the AD51FD performs the following processing.

1) Switches fault detection flag (X10) for I/O signal ON, and sends it to the PC CPU.

2) Writes fault data in buffer memory, memory card (2), or internal memory, and outputs it.

(b) The PC CPU reads fault data, and performs sequence operation.

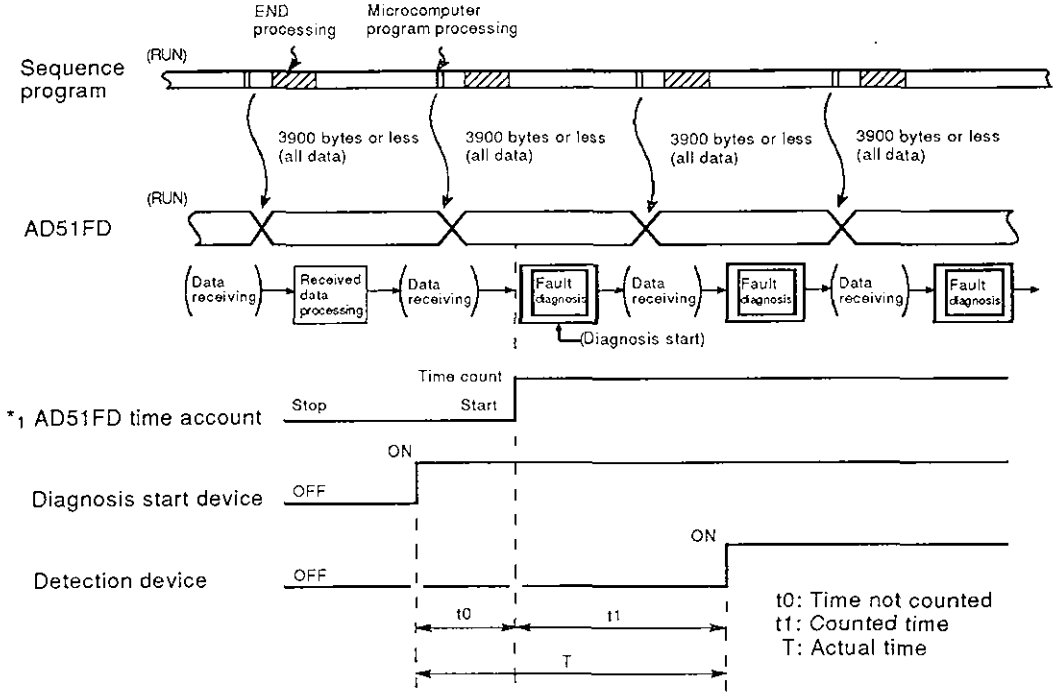
6.6.2 AD51FD fault diagnosis data receiving procedure

The AD51FD performs fault diagnosis processing after receiving all the data in the device using the microcomputer program on the AD51FD RUN state and completing data receiving processing in the AD51FD.
(Repeat "Data receiving → fault diagnosis")

(1) Data capacity received in each scanning by PC CPU (Number of data sent by microcomputer program)

Received data capacity	Remarks
Maximum 3900 bytes	Receive fault diagnosis data in maximum 3900 bytes in each microcomputer program processing. For details, refer to Section (4). ... (on next page)

(2) Action when executing fault diagnosis



*1 : The AD51FD time count is started at fault diagnosis start point after setting the diagnosis start device to ON.

(3) Received data capacity in each number of points and type of fault detection applicable device

The number of device points and type of device which is available for communication using microcomputer program vary according to applicable CPUs.

Applicable CPU	Received data capacity calculation	Item changed
Microcomputer applicable CPUs other than A3MCPU	$3900^{\text{bytes}} \geq {}^{*1}\underbrace{(M_1/8)\times 2+(4\times N_1)}_{\text{Bit device}}+\underbrace{(M_2\times 2)+(4\times N_2)}_{\text{Word device}}$ $*_1$: Round down at decimal place.	M_1: Number of total bit device points used N_1: Type of bit device (1 to 9) M_2: Number of total word device points used N_2: Type of word device (1 to 3)
A3MCPU	$3900^{\text{bytes}} \geq {}^{*2}\underbrace{(M_1/16)\times 2+(4\times N_1)}_{\text{Bit device}}+\underbrace{(M_2\times 2)+(4\times N_2)}_{\text{Word device}}$ $*_2$: Round down at decimal place.	

[Calculation]

- When using A3NCPU

  M_1 ... 512 points

  N_1 ... 5 types (X, Y, M, B, F)

  M_2 ... 50 points

  N_2 ... 2 types (D, W)

$(M_1/8) \times 2 + (4 \times N_1) + (M_2 \times 2) + (4 \times N_2)$
$= (512/8) \times 2 + (4 \times 5) + (50 \times 2) + (4 \times 2) = 256 \text{ bytes} < 3900 \text{ bytes}$

POINT

The data capacity received from fault diagnosis using microcomputer program is 3900 bytes in maximum.
In case the received data capacity is over 3900 bytes, it cannot be received. Please lessen the number of device points.

6.6.3 Fault diagnosis processing time

(1) Fault diagnosis processing time

This time shows the period from the time when the AD51FD receives all the fault diagnosis data to the time when it completes the fault diagnosis.

$$\text{Fault diagnosis processing time} = \left(\left(\text{Interrupting time of microcomputer program} \right)^{*1}_{ms} \times 2 \right) + \left((1.3^{ms}) \times (\text{Number of items to be detected}) \right)^{*2}$$

*1: Interrupting time shown in Section (2)

*2: AD51FD fault diagnosis time

(2) AD51FD interrupting time to PC CPU using microcomputer program

The AD51FD performs data communication in maximum 3900 bytes, and receives device data from the PC CPU while executing the microcomputer program.

By microcomputer program communication, the PC CPU scan time will become longer by the interrupting time shown in the following table.

PC CPU	Interrupting time
AnNCPU, AnCPU, A73CPU, A0J2HCPU	$\left(30 \times \frac{\text{Number of bytes used}}{3900 \text{ bytes}}\right)$ ms
A3MCPU	$\left(20 \times \frac{\text{Number of bytes used}}{3900 \text{ bytes}}\right)$ ms

6.6.4 Precautions on data communication

(1) Since the scan time of the sequence program becomes longer by the data communication processing time (interrupting time) for the communication time using the microcomputer program, please take the time into consideration for the sequence program processing.

(2) The interval of fault diagnosis execution becomes the scan time of sequence program.

(3) In case the scan time of the sequence program is shorter than the AD51FD fault diagnosis time, the AD51FD receives data in the microcomputer program processing after completing fault diagnosis.

(4) If the fault of AD51FD is displayed on the screen using the A6GPP/A6PHP, the AD51FD stops fault diagnosis processing and displays the fault. The fault diagnosis starts immediately after completing the fault display.

(5) The detection device to execute data communication must retain ON or OFF status when the time is over the "fault diagnosis time".

POINT

The detection device which changes in "OFF → ON → OFF" or "ON → OFF → ON" within "fault diagnosis processing time" cannot be set.

If the detection device is set, the normal ON/OFF is not accepted due to the data receiving timing, and error diagnosis may be caused.

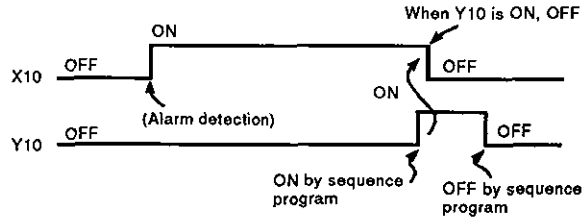
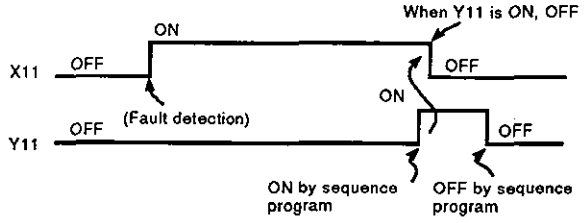
6.7 I/O Signal to PC CPU

This section explains the AD51FD I/O signal to the PC CPU.

(1) The I/O number shows the case where the AD51FD is installed to slot 0, 1. If the AD51FD is installed on other than slot 0, 1, the I/O number which is assigned by the AD51FD is applied.

(2) The AD51FD I/O number occupies 48 points in which the first 16 points (X/Y00 to X/Y0F) are vacant and the second 32 points (X/Y10 to X/Y2F) are used.

(1) Input signal ... (Signal direction: AD51FD → PC CPU)

Device No.	Signal name	Action condition
X10	Alarm detection flag	• When AD51FD is on alarm detection status, set OFF to ON. • By switching Y10 from OFF to ON, X10 is switched from ON to OFF. 
X11	Fault detection flag	• When AD51FD is on fault detection, X11 is from ON to OFF. • By switching Y11 from OFF to ON, X11 is switched from ON to OFF. 
X12	AD51FD error	• ON ... Error to be displayed on AD51FD occurs. • OFF ... AD51FD normally operates.
X13 to X16	*1 (Unusable)	————

X17	Fault diagnosis flag	• ON ... In diagnosis execution • OFF ... Diagnosis stops. (Used for external display)
X18	Learning flag	• ON ... In learning execution • OFF ... Learning stops. (Used for external display)
X19	AD51FD system RUN flag	• ON ... AD51FD system start up completed (Ready to execute fault diagnosis.) • OFF ... AD51FD system operation stops. (Not ready to execute fault diagnosis.) (Y12: Used for interlocking fault diagnosis start/stop.)
X1A to X1C	*1 (Unusable)	———
X1D	AD51FD down	• ON ... AD51FD H/W abnormality occurs. • OFF ... AD51FD normally operates.
X1E to X2F	*1 (Unusable)	———

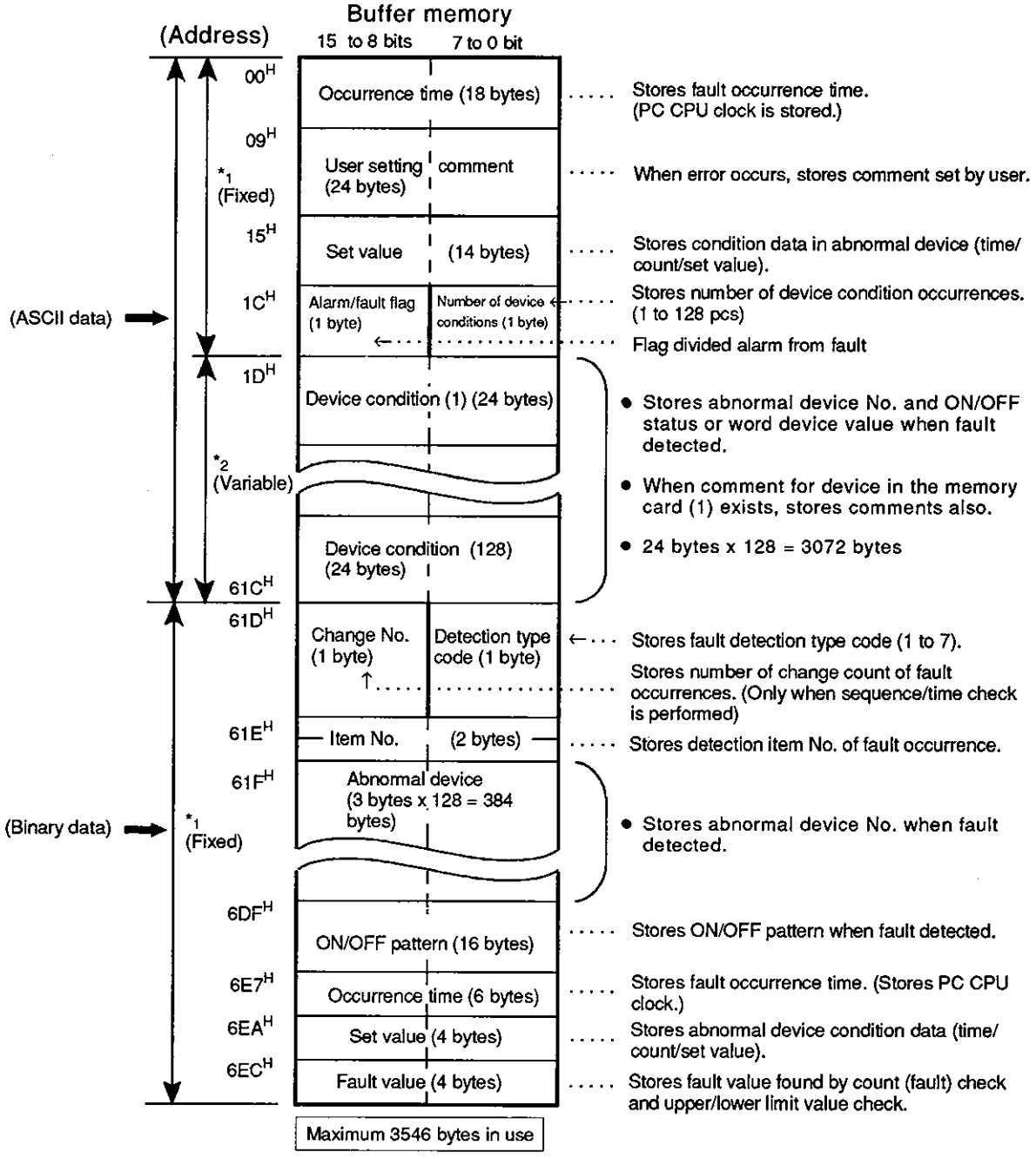
(2) Output signal (signal direction: PC CPU → AD51FD)

Device No.	Signal name	Action condition
Y10	Alarm data read completion/alarm detection flag reset	• When Y10 is OFF → ON, clear buffer memory and set X10 to OFF. • After setting X10 to OFF, Y10 is set to OFF. (For action, refer to the item which explains X10.)
Y11	Fault data read completion/fault detection flag reset	• When Y11 is OFF → ON, clear buffer memory and set X11 to OFF. • After setting X11 to OFF, Y11 is set to OFF. (For action, refer to the item which explains the X11.)
Y12	Fault diagnosis start/stop	• ON ... Fault diagnosis starts. • OFF ... Fault diagnosis stops.
Y13 to Y2F	*1 (Unusable)	———

*1 : The device numbers which indicates "Unusable" are already used for OS, and are not usable. If these numbers are used, error operation may be caused.

6.8 AD51FD Buffer Memory

The detected contents are stored in the AD51FD buffer memory while executing alarm/fault detection.
(For output format to buffer memory, refer to Section 7.4.2.)
The following shows the structure of AD51FD memory.



*1: Memory capacity fixed ..... • Writes in memory card (2).

*2: Memory capacity variable .. • Stores only fault occurrence device condition out of 3072 bytes.

• The memory capacity to the memory card (2) is (24^{bytes} x number of fault occurrence devices).

POINTS

(1) The buffer memory of AD51FD is only one. By reading or resetting the data in each alarm or fault occurrence using the sequence program, the following data is entered in the buffer memory.

(2) The ASCII data is used to read in the PC CPU and to display in the sequence operation.

(3) Binary data is used to process by reading in the personal computer in high order.
(*Available also on the PC CPU.*)

7. FUNCTIONS OF THE AD51FD

7.1 Function List

This section shows the functions of the AD51FD. For details, refer to the sections shown in the Reference column.

Function			Description	Section reference
Fault detection	Sequence /time check	Sequence /time	The sequence/time of changes by the bit device ON/OFF are checked.	Section 7.2.2
		Sequence	The sequence of change by bit device ON/OFF is checked.	
		Alarm range	Alarm value for time check is specified, and the range from the alarm value to the fault set value can be set as an alarm range.	
	Count check	Count	The count of bit device ON/OFF is checked.	Section 7.2.3
		Alarm range	Alarm value for count check is specified, and the range from the alarm value to the fault set value can be set as an alarm range.	
		Accumulative count	Accumulative ON/OFF count of contact and coil is stored into the memory card (1), and the life is diagnosed.	
	Normal pattern check		Normal ON/OFF pattern of bit device is checked.	Section 7.2.4
	Abnormal pattern check		Abnormal ON/OFF pattern of bit device is checked.	Section 7.2.5
	Upper /lower limit value check	Upper /lower limit value	Upper/lower limit value of word device is checked.	Section 7.2.6
		Alarm range	Alarm value for upper/lower limit value check is specified, and the range from the alarm value to the fault set value can be set as an alarm range.	
	Bidirectional operation check	Sequence /time	Sequence/time of change by ON/OFF of two bit devices (limit 1, 2) for bidirectional operation are checked.	Section 7.2.7
		Alarm range	Alarm value is specified for time check, and the range from the alarm value to the fault set value can be set as an alarm range.	
Condition data setting	Manual setting/correction		Fault condition data is set and corrected using the peripheral device, and the data is written into the AD51FD.	Section 7.3.1
	Learning setting		• Data of each device is sampled according to the fault condition data written into the AD51FD from the peripheral device, and the sampling data is automatically set as a condition data. • For time, count, and upper/lower limit value, average decentralized value or maximum/minimum value of the data can be selected as a set value.	Section 7.3.2
	Learning/manual setting		• Sampling data by learning setting is read with the peripheral device and written into the AD51FD after checking and correcting.	Section 7.3.3
Fault diagnosis output			• Output contents ..... Fault occurrence time, comment, set value, and device condition • Output destination ... Printer, general-purpose terminal through RS-232C] Output to either of them. ... Printer through parallel] ... Fault monitoring with peripheral device through RS-422 ... Memory card (2) ... CPU through buffer memory (Read by FROM instruction)	Section 7.4
Self-diagnosis function			Self-diagnosis results are displayed on the display device on the front side of the AD51FD.	Section 9.1

7.2 Fault detecting procedure

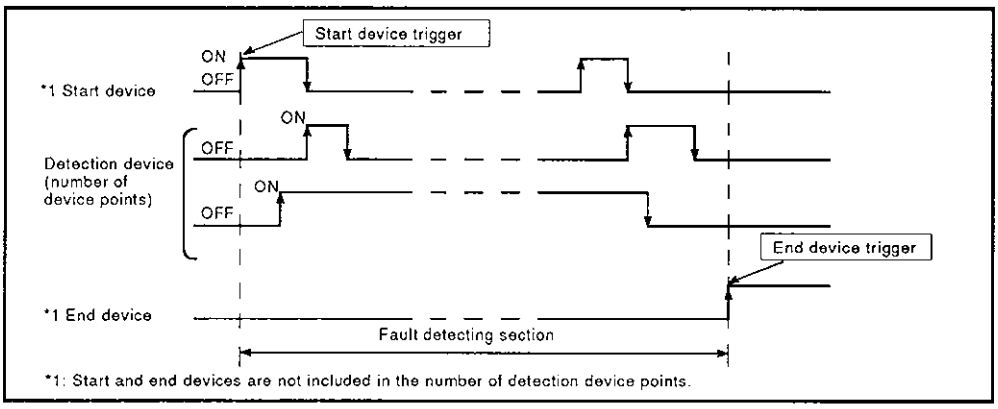
The AD51FD compares the operation of the detection device for which condition has already been set with that of the device received from the PC CPU in the section for detection, and determines whether fault exists or not. This section describes the procedure for setting the fault detecting section and procedure for detecting the fault.

7.2.1 Procedure for setting the fault detecting section

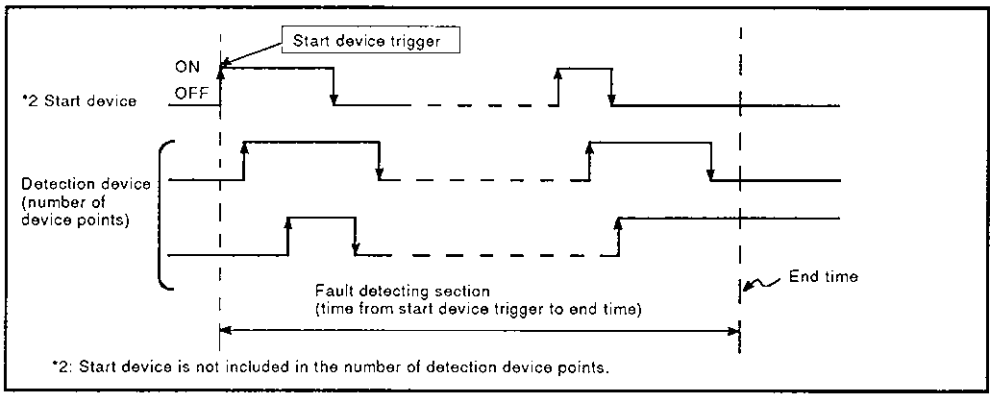
The fault detecting section is the section in which fault detection is performed on the AD51FD.
(The section is set when sequence/time check, count check, upper/lower limit value check, and bidirectional operation check are performed.)

The following two methods are available for setting the section.

(1) Method to set start/end conditions triggering bit device (OFF → ON or ON → OFF)



(2) Method to set start condition triggering the bit device (OFF → ON or ON → OFF) and end condition according to the time from start to end.



POINT

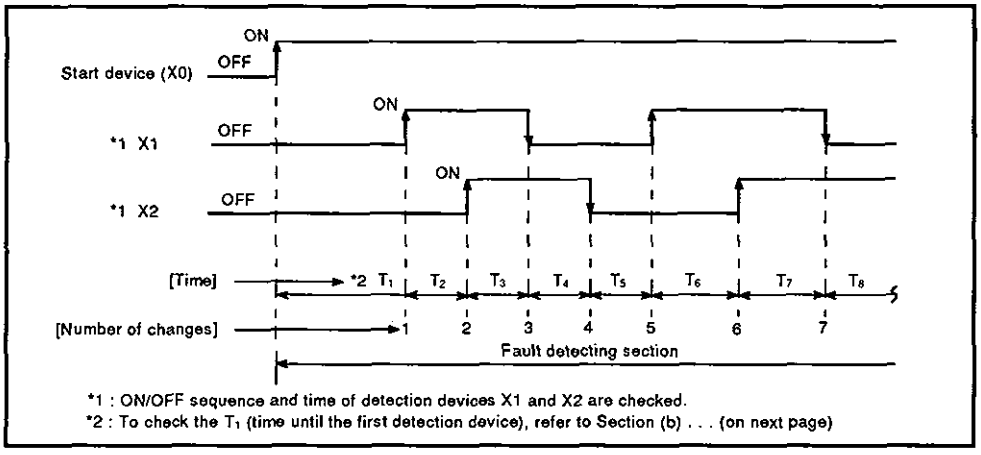
If dummy (no ON/OFF change) bit device is set as an end device, the time from fault diagnosis start triggering the start device to the PC CPU power OFF is regarded as the fault detecting section.

7.2.2 Fault detection by sequence/time check

For fault detection by sequence/time check, two methods are available; to check the sequence and time simultaneously and to check only the sequence. When checking the time, an alarm range can be set.

(1) Sequence/time check

Whether the detection device goes ON/OFF in the specified sequence and within the specified time is checked.
This method is used when the sequence and the time of change are always constant and sequence and time are both checked.



(a) At the sequence/time check, incorrect sequence, time over, and malfunction are checked.

1) Incorrect sequence ---- Determined as a fault if the sequence of sampled ON/OFF data is different from the specified one.
Determined as a fault if the device does not go ON/OFF in the sequence set when fault detecting section ends.

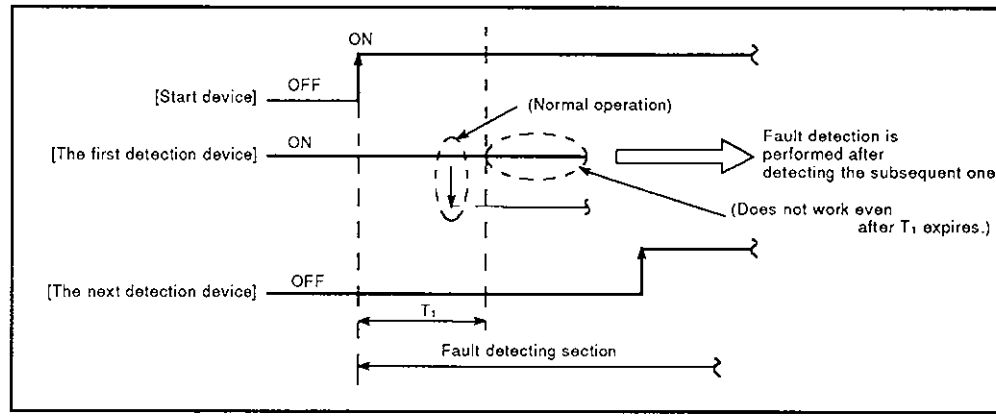
2) Time over ---------- Determined as a fault if the detection device does not go ON/OFF even after the preset time expires.

NOTE

The time check from fault diagnosis start by switching the start device ON/OFF to the first detection device ON/OFF is performed according to the procedure described in Section (b) shown on the next page.

3) Malfunction ---------- Determined as a fault if ON/OFF operation of the detection device cannot be detected in the fault detecting section. (Start device is regarded as a faulty device.)

(b) Time check from the fault diagnosis start to the first detection device ON/OFF

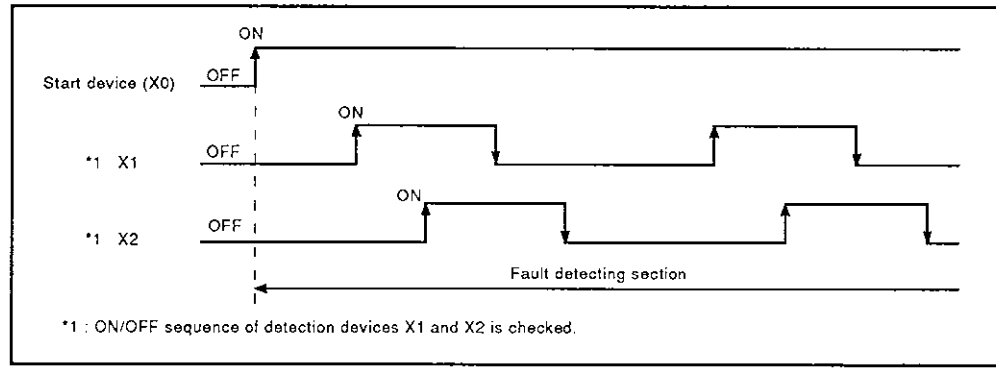


1) At time check, time over fault is not output even after the preset time (T_1) expires, and the next fault is output when the subsequent operations are detected.

- Time over ------- Determined as "Time over" if change (OFF) of the first detection device is detected after T_1 expires.
- Incorrect sequence -- Determined as "Incorrect sequence" if change (ON/OFF) of the next detection device is detected after T_1 expires.
- Malfunction ------ Determined as "Malfunction" if ON/OFF operation of the first detection device and other detection devices cannot be detected in the fault detecting section. (Start device is regarded as a faulty device.)

(2) Sequence check

Whether the detection device goes ON/OFF in the specified sequence is checked.
This method is used when changing sequence is constant but changing time varies every time, or when changing time check is not necessary.



(a) At sequence check, incorrect sequence and malfunction are checked.

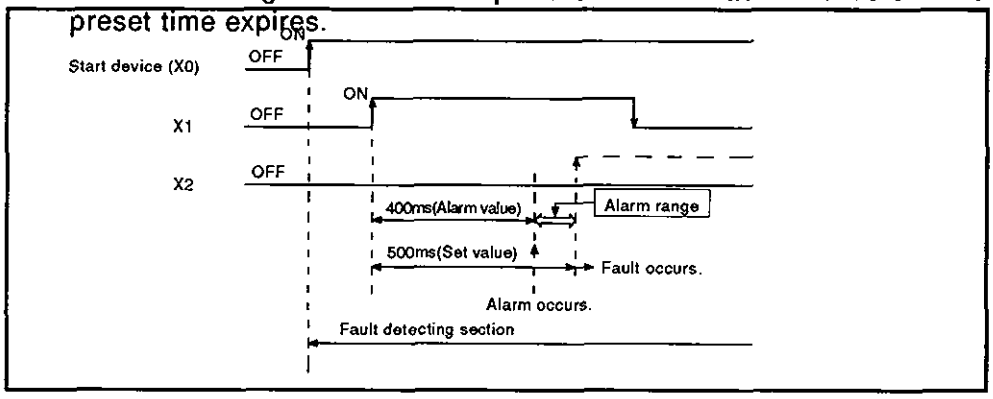
1) Incorrect sequence
- Determined as a fault if the sequence of sampled ON/OFF data is different from the specified one.
- Determined as a fault if the device does not go ON/OFF in the sequence set when the fault detecting section ends.

2) Malfunction
- Determined as a fault if ON/OFF operation of the detection device cannot be detected in the fault detecting section. (Start device is regarded as a faulty device.)

(3) Alarm range

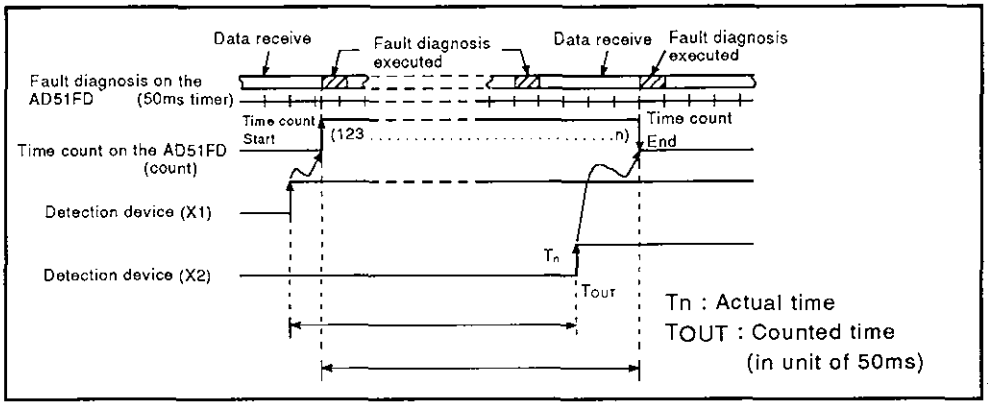
At sequence/time check, an alarm value is specified for time check, and the range from the alarm value to the fault set value can be set as an alarm range.

The alarm range is used to output the alarm in advance before the preset time expires.



(a) The alarm value should be smaller than the set value.
...(Alarm value < Set value)
If the alarm value is equal to "0" or "set value", time check is performed as no alarm value.

(4) Counting method for time check



(a) Time check on the AD51FD is executed by the count on 50 msec timer.

(b) Time is counted from the fault diagnosis execution after receiving the detection device (X1) ON to the fault diagnosis execution after receiving the detection device (X2) ON. The counted time is as shown below.

Counted time (msec) = 50msec x Number times that 50msec is counted

POINTS

(1) Since the counted time may become longer, unlike the actual time, some extra time should added when setting the time set value.

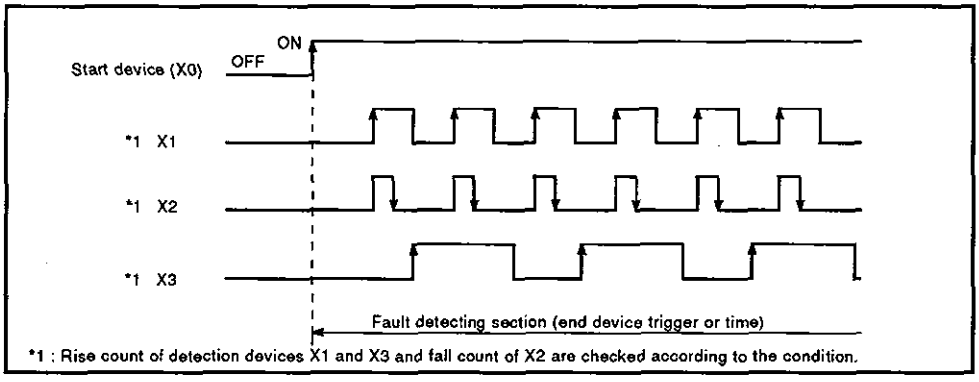
(2) Time check is not performed if ON/OFF data of two detection devices for which time check is to be performed are received before executing the fault diagnosis.
(For example, time check in one scan cannot be set.)

7.2.3 Fault detection by count check

At fault detection by count check, whether the preset rise (ON) or fall (OFF) count of detection device in the fault detecting section coincides with that of the received detection device is checked.
At count check, accumulative count and alarm range can be set.

(1) Count check

(a) Select the rise or fall count of each detection device among four conditions, "More", "Less", "Equal", and "More and less", and set it. At count check, accumulative count and alarm range can be set.



(b) At count check, excessive count, insufficient count, and non-coincident count are checked.

1) Excessive count ----- Determined as a fault if ON/OFF count of detection device exceeds the preset count in the fault detecting section when the conditions "More" and "More and less" are set.

2) Insufficient count ----- Determined as a fault if ON/OFF count of detection device does not reach the preset count in the fault detecting section when the conditions "More" and "More and less" are set.

3) Non-coincident count ----- Determined as a fault if ON/OFF count of detection device is not equal to the preset count in the fault detecting section when the condition "Equal" is set.

NOTES

(1) Accumulative count should not be set when checking the ON/OFF operation at count check. If set, accumulative count is read from memory card (1) when power is ON or when the system is reset, cumulative count is performed, and, as a result, fault will occur.

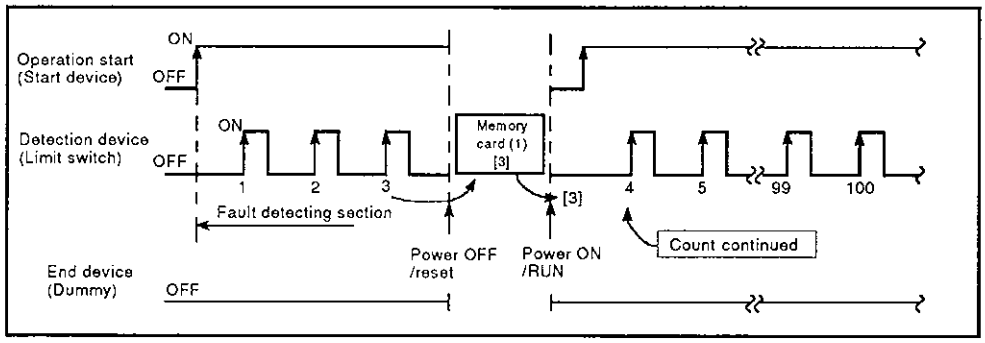
(2) When counting the accumulative count, set a new detecting item separately.

(2) Accumulative count

(a) At accumulative count check, the fault diagnosis can be performed to detect the life of limit switches, etc. by setting the accumulative count of life (set value) and alarm count (alarm value).

(b) Accumulative count is counted for all the devices in detecting items when presence (execute) is set at accumulative count execution existence setting for each detecting item for count check.

(c) When power is OFF or the PC CPU/AD51FD is reset, if learning instruction is received while the AD51FD runs, the accumulative count is stored into the memory card (1). And when power is ON or recovering to normal condition, the accumulative count is read from the memory card (1), and counting is continued.



(d) Accumulative count cannot be read and partially deleted.
All the accumulative count data can be deleted using the peripheral device of the A6GPP/A6PHP.

(e) Memory card (1) should be installed when accumulative count check is executed.

(f) When fault occurs, accumulative count of all the devices in the accumulative count fault detecting items is cleared to 0.
Therefore, detection devices with the same fault count should be grouped by each detecting item when setting the accumulative count.

POINT

When performing the fault diagnosis by accumulative count, the fault detecting section end should be set as the point of ON of dummy bit device which does not go ON/OFF on sequence program. End device will not go ON, and period until power cut/reset will be included in the fault detecting section, and accumulative count can be counted.

(3) Alarm range

(a) At count check, alarm value is set, and the range between the alarm value and the set value can be set as an alarm range.

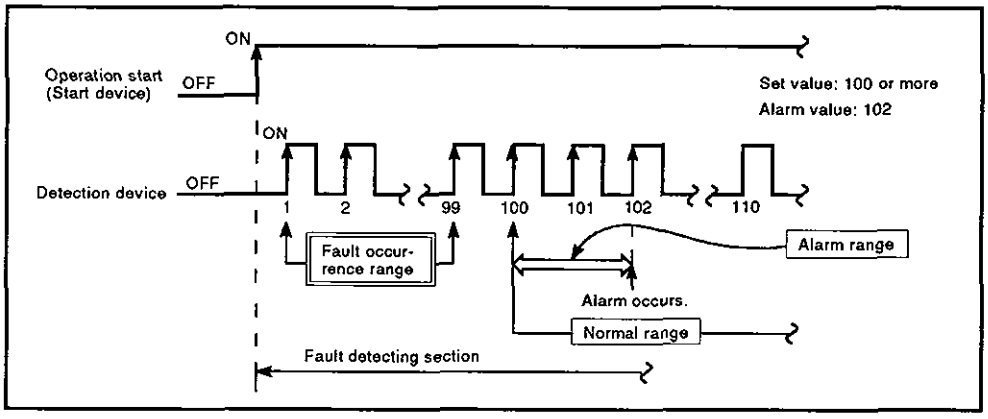
(b) The range of alarm value varies according to the condition as shown below.

Condition (normal value setting)	Alarm value range	Check contents
More	[Alarm value] > Set value	Insufficient count check
Less	[Alarm value] < Set value	Excessive count check
Equal (=)	*1 ————	Non-coincident count check
More and less	Lower limit set value < [Alarm value] < Upper limit set value	Insufficient count check and excessive count check

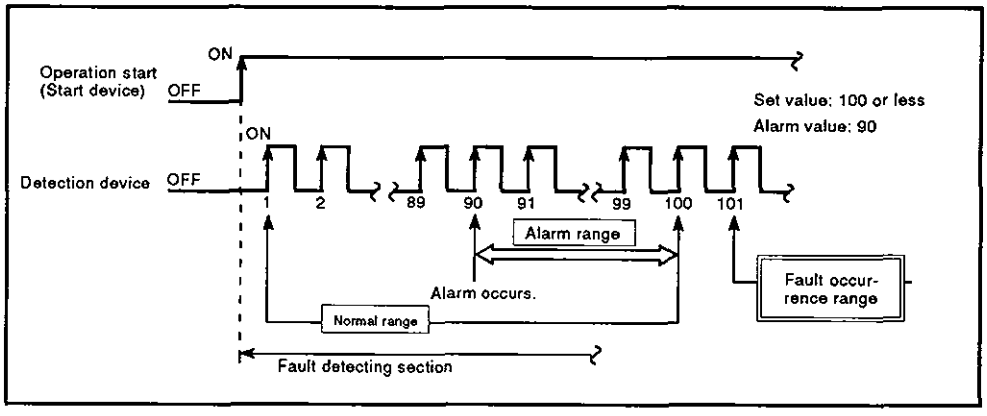
*1: The range cannot be set for "equal (=)" because there is no range.

(4) Fault detection according to the condition

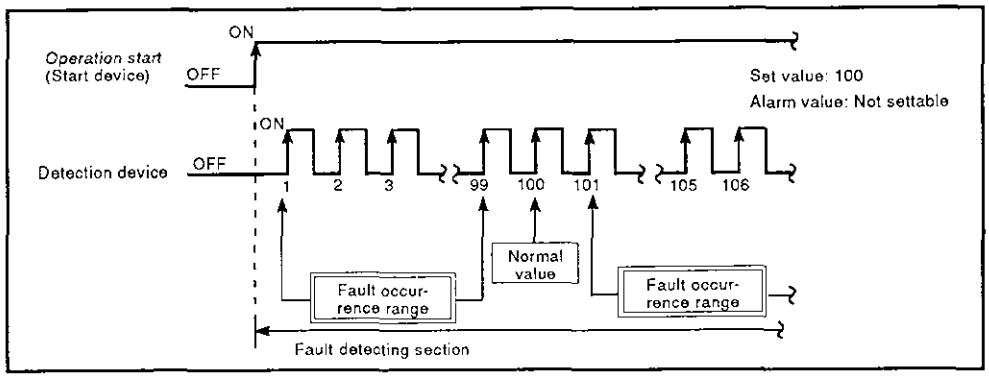
(a) When the set value is "More" ... (Fault occurs if count is insufficient when detection ends.)



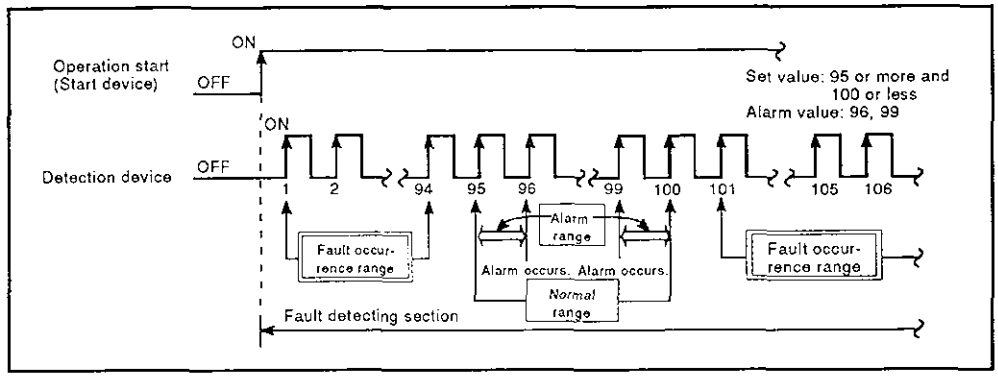
(b) When the set value is "Less" ... (Fault occurs if count is excessive when detection ends.)



(c) When the set value is "Equal" ... (Fault occurs if count is not equal to the set value when detection ends.)



(d) When the set value is "More and less" ... (Fault occurs if count is out of the set value range when detection ends.)

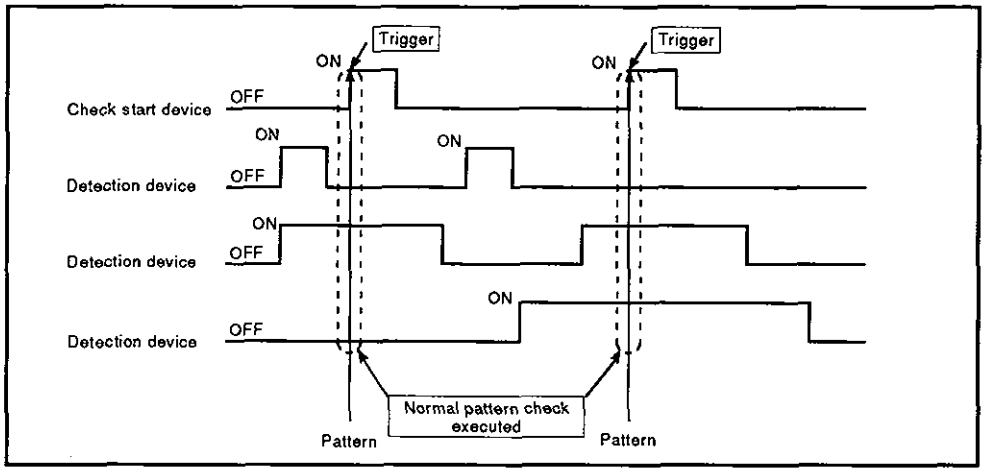


7.2.4 Fault detection by normal pattern check

At fault detection by normal pattern check, the preset normal detection device ON/OFF pattern at the trigger (ON/OFF) point of check start device is compared with the received detection device ON/OFF pattern at the trigger point, and whether they coincide with each other is checked.

(1) Normal pattern check

(a) Triggering ON or OFF of check start device, ON/OFF pattern of detection device in normal condition is checked.



(b) At normal pattern check, pattern non-coincidence is checked.

1) Non-coincident pattern ... Determined as a fault if the received pattern does not coincide with the preset normal pattern.

(c) At normal pattern check, pattern is compared with all the normal patterns set in one detecting item, and if it coincides any one of the patterns, it is regarded as normal.

NOTES

(1) When many normal patterns are set in one detecting item, if the pattern coincides with any of normal patterns, it is determined as a normal pattern even if the pattern does not coincide with the condition of detection device when trigger occurs.

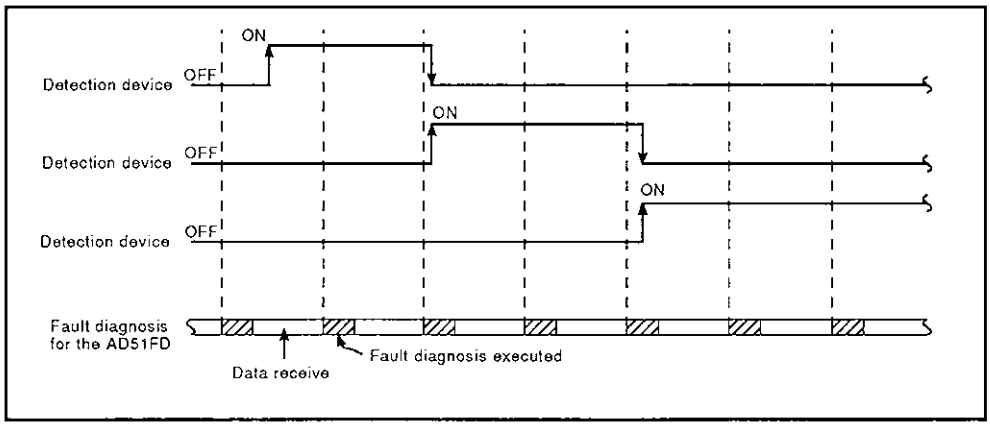
(2) To perform normal pattern check for only detection device status at the trigger point, only one pattern should be set for one detecting item.

7.2.5 Fault detection by abnormal pattern check

At fault detection by abnormal pattern check, the preset ON/OFF pattern of detection device in abnormal condition is compared with the received ON/OFF pattern of detection device, and whether they coincides with each other is checked.

(1) Abnormal pattern check

(a) ON/OFF pattern of detection device is checked every time fault detection is performed.



(b) At abnormal pattern check, abnormal pattern coincidence is checked.

1) Coincident abnormal pattern ...Determined as a fault if the received pattern coincides with the preset abnormal pattern.

(c) At abnormal pattern check, pattern is compared with only one abnormal pattern in one detecting item.

NOTE

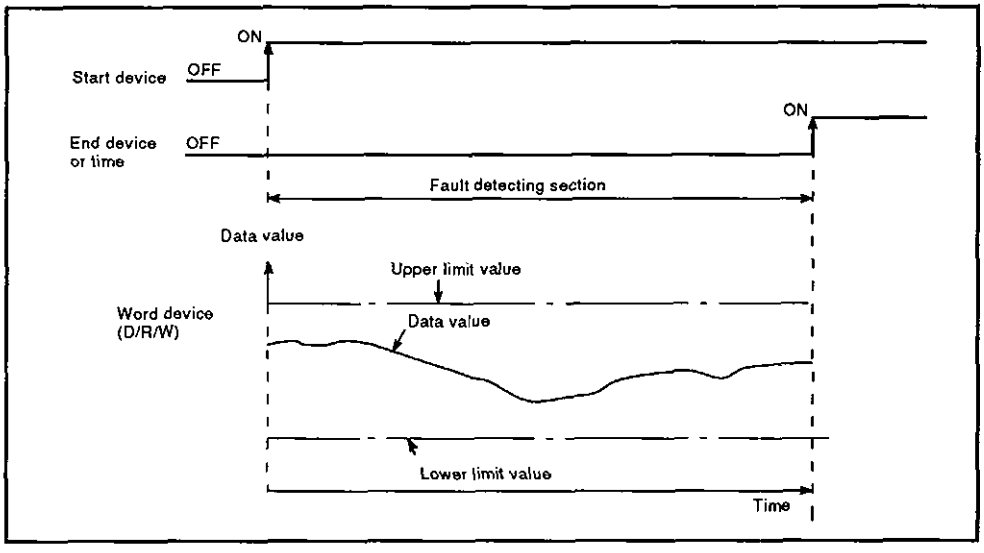
For abnormal pattern, pattern of other than normal ON/OFF operation of detection device is set.
If pattern which will occur in normal condition is set, fault will occur.

7.2.6 Fault detection by upper/lower limit value check

At fault detection by upper/lower limit value check, whether the received data value is included in the preset range between upper and lower limit values of word device is checked.
Alarm range can be set for both upper and lower limit values.

(1) Upper/lower limit value check

(a) Upper and lower limit values of word device are checked every time fault diagnosis is performed in the fault detecting section.



(b) Upper/lower limit value check is performed outside the upper and lower limit values.

1) Upper limit value over ... Determined as a fault if the data value is over the preset upper limit value.

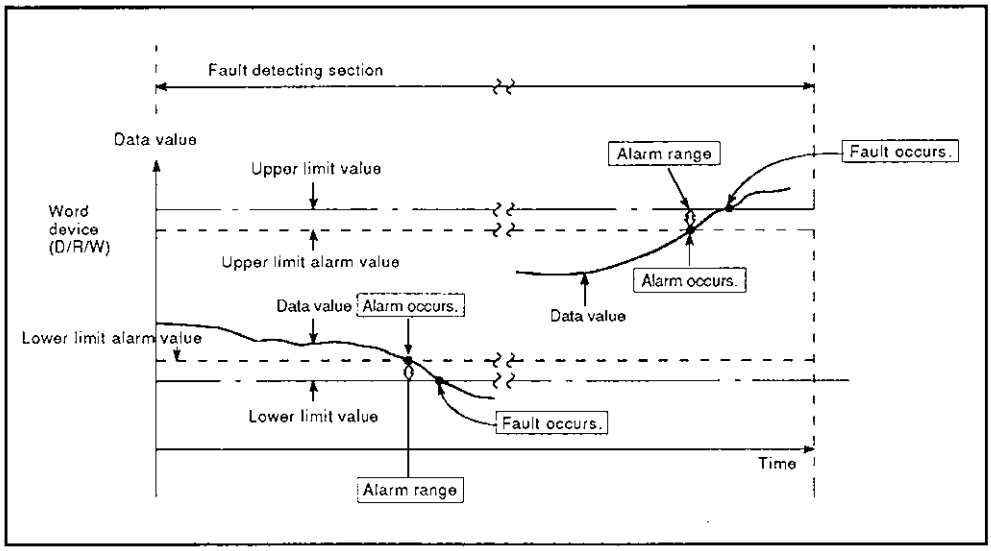
2) Lower limit value over ... Determined as a fault if the data value is lower than the preset lower limit.

(2) Alarm range

(a) In upper/lower limit value check, alarm values for upper and lower limit values can be specified to set the alarm range.

(b) Upper and lower limit alarm values are set within the range between the upper and lower limit values.
... (Lower limit value < Alarm value < Upper limit value)

(3) Alarm/fault detection



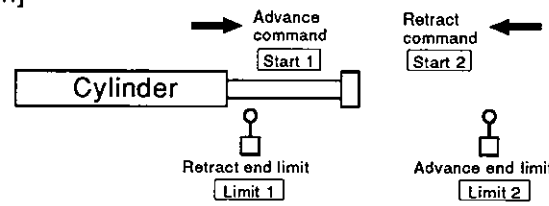
7.2.7 Fault detection by bidirectional operation check

At fault detection by bidirectional operation check, bidirectional ON/OFF pattern of preset two detection devices at the end time or sequence/time of the detection device in the fault detecting section is compared with that of the received detection device, and whether they coincide with each other is checked. Alarm range can be set for time check.

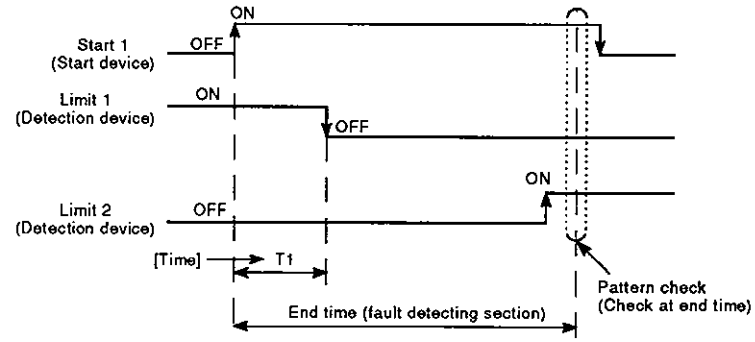
(1) Bidirectional operation check

(a) This method is used when pattern check or sequence/time check is performed for two limits (two detection devices) at advance and retract ends in the reciprocating operation of a cylinder, etc.

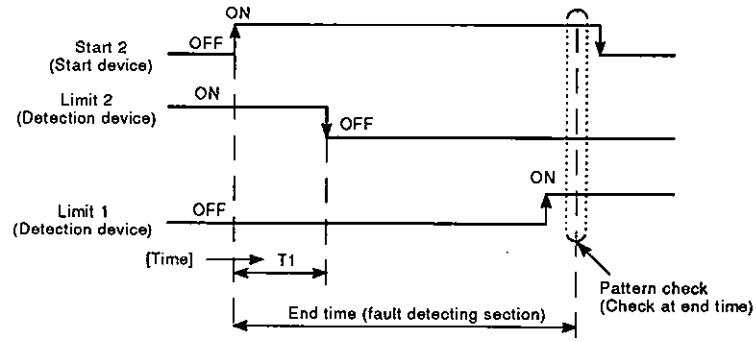
[Configuration]



[Advance (GO) operation] ... Contact A operation



[Retract (RETURN) operation] ... Contact A operation



POINTS

(1) For bidirectional operation check, only four bit devices, start devices for start 1 and 2 and detection devices for limit 1 and 2, can be used, and variables are 2-variation fixed. (See the above figure.)
(2) Bidirectional operation of detection devices for limit 1 and 2 can be checked by selecting either of contact A action for both limit 1 and 2 or contact B operation for both limit 1 and 2.

(2) How to use the pattern check and sequence/time check for limit

Bidirectional operation check is performed by selecting either pattern or sequence/time in AD51FDPE software package.
Usage according to type is shown below.

Check type	Usage
Pattern	• Applied to the equipment of which limit changes ON → OFF/ OFF → ON within the fault diagnostic processing time (Refer to Sections 6.5.3 and 6.6.3). • Applied to the equipment of which limit changes ON or OFF near the fault diagnostic processing time. (When determined as an erroneous diagnosis in sequence/time check)
Sequence/time	• Applied to the equipment of which limit changes ON or OFF over the fault diagnostic processing time (Refer to Sections 6.5.3 and 6.6.3). • : For an air cylinder, etc. which moves quickly, use pattern check to avoid erroneous diagnosis.

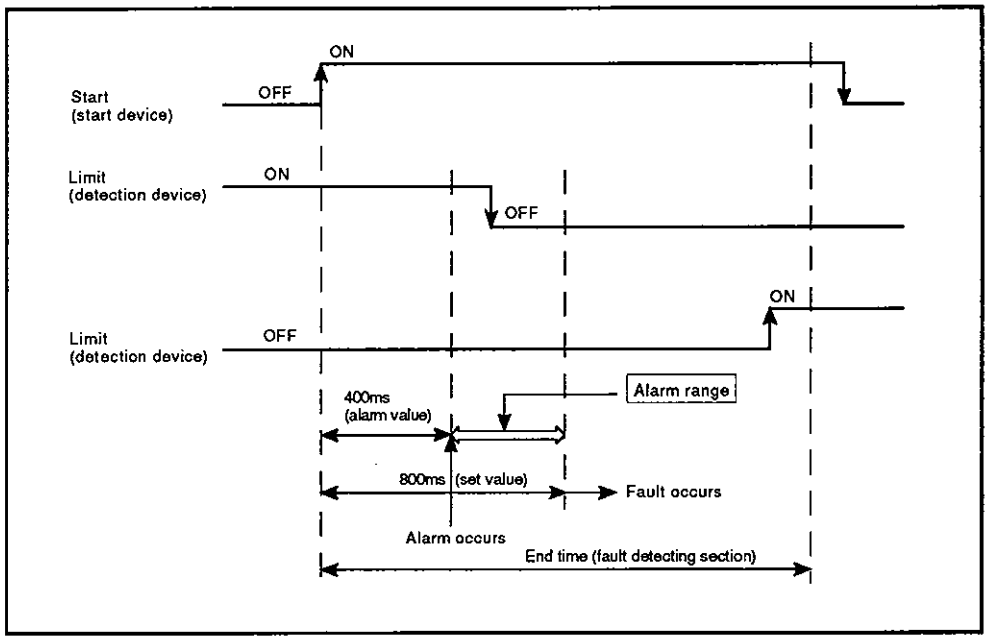
(3) How to perform the bidirectional operation check

Check type	Fault content	Checking method
Pattern	LS return fault	• Determined as "LS return fault" if pattern check at end time detects the first limit has not changed.
	LS operation fault	• Determined as "LS operation fault" if pattern check at end time detects the next limit has not changed.
	SOL error	• Determined as "SOL abnormality" (start device abnormality) if pattern check at end time detects both limit 1 and 2 have not changed.
	———	• Determined as normal without performing diagnosis if start device is OFF at end time. • If start device is OFF before end time, diagnosis is stopped and start device wait state is given. (Normal) • Detection for incorrect sequence and time over is performed.
Sequence/ time	Time over	• Determined as "Time over" if OFF operation of limit for which T_1 is set is detected after T_1 expires. • Determined as "Time over" if limit does not change and ON operation of the next limit is detected after T_1 expires. • Determined as "Time over" if ON operation of the next limit cannot be detected before end time (within the fault detecting section) after normal operation of the limit for which T_1 is set is detected.
	Incorrect sequence	• Determined as "Incorrect sequence" if ON operation of the next limit is detected within T_1 time before limit for which T_1 is set changes. • Determined as "Incorrect sequence" if ON operation of the next limit is detected before the limit changes.
	Malfunction	• Determined as "Malfunction" if ON/OFF operation of two limits cannot be detected before end time (within the fault detecting section). (Start device at start time is regarded as faulty device.)

(4) Alarm range

When sequence/time check for bidirectional operation is performed, alarm value can be specified for changing time from start (start device) to the first limit switch (detection device), and the range from the alarm value to the fault set value can be set as an alarm range.

The alarm range is used when alarm is output in advance before the preset time expires.



(a) Alarm value should be smaller than set value
... (Alarm value < Set value)

If "0" or the value equal to the "Set value" is set as an alarm value, check is performed as no alarm value.

(5) Counting method at time check

- Refer to Section 7.2.2(4) "Counting method at time check".
- Count the time between start (start device) and limit (detection device).

7.3 Method for Setting the Fault Detection Condition Data

To set the fault detection condition data, three methods are available; by manual setting, learning setting, and learning/manual setting.

> Condition data is set with the A6GPP/A6PHP using the AD51FDPE.
> For operation, refer to the operating manual for the software package.

7.3.1 Method by manual setting

By this method, all the condition data are set with the A6GPP/A6PHP and written into the AD51FD.
The contents to be set are shown below.

(1) Initial setting

(a) Alarm and fault data output destination

- PC CPU -
- RS-232C interface or parallel interface - - - - - -

(Bidirectional output is available.)

(Either of the above only)

[If memory card (2) is installed, data is automatically output into memory card.]

(b) Device reading method

- Reading by the AD51FD (module only)- - -
- Reading by microcomputer program- - - - -
  (Module + microcomputer program)

(Select either of the two.)

(c) M, L, S setting

Set depending on; the internal relay (M, L, S) set by parameter of the PC CPU.

(d) Device range ... (Set only when fault diagnosis by microcomputer program is performed.)

Set the range of bit device and word device to be detected.

(2) Setting the condition data

(a) Setting the item condition

Set detection type and alarm/fault comment.

(b) Setting each item

Set start device and end device, or time, detection device, operation set value, and alarm value of each item.

7.3.2 Method by learning setting

With the learning function, the basic condition required for the AD51FD to learn by A6GPP/A6PHP is set and written into the AD51FD. After writing, the PC CPU and control unit are operated to perform learning at normal operating condition, and after completing learning, fault diagnosis is performed.

(1) Learning method
Two learning methods are available as shown below.

	Learning method	Operation
1	Method by setting the learning condition of AD51FD (setting the dip switch)	(1) Set the dip switch, located on the side of the AD51FD, for setting the learning function according to the learning method.(Dip switches No.1 to No.4 are set.) ... Refer to Section 4.5.1. (2) Set the mode setting switch located on the front view of the AD51FD to "1", learning function mode (1). (After learning, fault diagnosis is started.) ...Refer to Section 4.5.3. (3) Operate the PC CPU and control unit and perform learning on all the detecting items.Display "In execution (STUD)/End (END)" on the display device. [Note]: The side dip switch should be set before installing the AD51FD in base unit.
2	Method by setting the learning condition of A6GPP/A6PHP	(1) Connect A6GPP/A6PHP when AD51FD is running (mode setting switch is "0" or "1"), and use the "Learning function" of the software package. (2) AD51FD stops diagnosis processing by learning instruction of the A6GPP/A6PHP and stores accumulative count into the memory card (1). (3) Operate the PC CPU and control unit, and perform learning on all the detecting items. [For operation, refer to the operating manual for SW0GP-AD51FDPE.]

(2) Learning contents

Data type	Contents to be set in AD51FD in advance	Contents to be learned
Sequence/time check	(1) Start device (2) End device or time (3) Detection device (4) Alarm -(n)% value and in unit of time [Automatic setting can be performed only by specifying -(n)%.]	(1) Learns all the ON/OFF sequences of detection device in the fault detecting section.(Not learns when setting is performed in advance.) (2) Learns time set value and alarm value according to the ON/OFF sequence in the fault detecting section.(According to the maximum value or average decentralized value.) (3) After learning, set value/alarm value is automatically set according to *1 alarm -(n)% value.
	*1: Automatic setting method according to alarm -(n)% value 1) When set value is learned → Alarm value = Set value (1-n/100) (Round up decimal places.) 2) When alarm value is learned → Set value = Alarm value/(1-n/100) (Round up decimal places.)	

NOTE

If fault diagnosis only for sequence check is performed by learning, refer to Section 7.3.3 ... After learning, clear the time set value by manual setting.

Detection type	Contents to be set in AD51FD in advance	Contents to be learned
Count check	(1) Start device (2) End device or time (3) Alarm –(n)% value ... (for automatic setting) (4) Detection device and ON/OFF condition (5) Condition (More, Less, More and less) (6) When condition is "Equal", set the set value in advance. (Not learned.)	(1) Learns ON/OFF count in the fault detecting section. More ... Minimum value or average centralized value Less ... Maximum value or average decentralized value Equal ... Not learned More and less ... Minimum/maximum value or average decentralized value (2) After learning, set value/alarm value is automatically set according to alarm –(n) % value. (Automatic setting method is the same as that for sequence/time check.)
Normal pattern check	(1) Start device (2) Number of detected patterns (3) Detection device	(1) Learns as many ON/OFF conditions of detection device as the number of detected patterns triggering the start device ON/OFF.
Abnormal pattern check	(All the items should be set.)	(Not learned)
Upper/lower limit value check	(1) All the set contents are written.	(1) Learns upper/lower limit value in the fault detecting Section. More and less ... Minimum /maximum value or average decentralized value (2) After learning, alarm –(n)% value is automatically calculated according to the value set in advance and alarm value, and set value /alarm value is automatically set. (Automatic setting method is the same as that for sequence/time check.)
Bidirectional operation check	(1) All the set contents are written.	(1) Learns time set value and alarm value. (By maximum value or average decentralized value) (2) After learning, alarm –(n)% value is automatically calculated according to the changing time set in advance, and set value/alarm value is automatically set. (Automatic setting method is the same as that for sequence/time check. *: Pattern is not learned.

(3) Learning complete

(a) After learning as many data as the number of sampling times of all the detecting items or specified detecting items (only when performed by A6GPP/A6PHP), and "Complete" is displayed, learned data is written into OS and memory card (1), and fault diagnosis is performed.

(b) If AD51FD is stopped running or forcibly ended by peripheral device before displaying the learning complete, data sampled so far is regarded as learned data, so all the learned data may not have been sampled. Also, since fault diagnosis is not performed after learning, set the mode setting switch to "0", RUN mode, to perform fault diagnosis after reading the learned data and checking it.

(4) Average decentralized value

Set value/alarm value obtained when learning the sampling data by setting the average decentralized value is processed in the AD51FD as shown below to make it learned value.

(a) Formula for calculating the average and deviation

(Average) ... $m=\frac{1}{n}\sum_{i=1}^{n} ti$	n : Number of sampling times
	ti: Sampling data (first time to nth time)
(Deviation) ... $\sigma=\frac{1}{n}\sum_{i=1}^{n} (ti-m)$	m, σ : Round down decimal places.

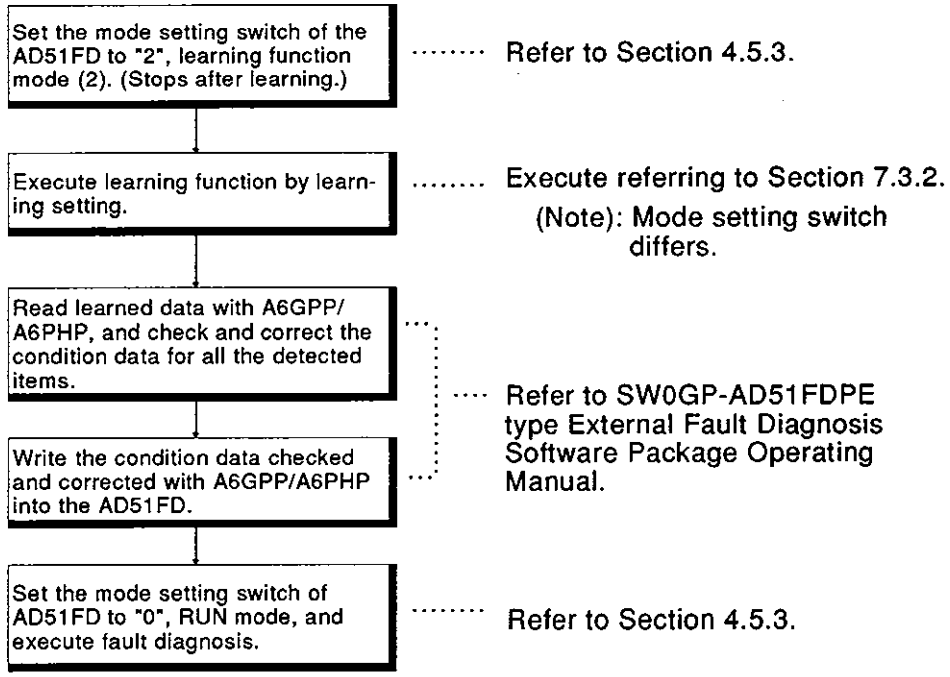
(b) Average decentralized value according to the detection type

Detection type	Average decentralized value (learned value)
Sequence/time check	Average decentralized value of time = m + σ
Count check	(1) Average decentralized value of "More" = m − σ
	(2) Average decentralized value of "Less" = m + σ
	(3) Average decentralized value of "More and less" = (m − σ) to (m + σ)
Upper/lower limit value check	Average decentralized value of upper/lower limit values = (m − σ) to (m + σ)

7.3.3 Method by learning/manual setting

By this method, condition data learned by executing the learning function is read to A6GPP/A6PHP, checked and corrected, and written into the AD51FD again to perform fault diagnosis.

(a) Operation is as shown below.

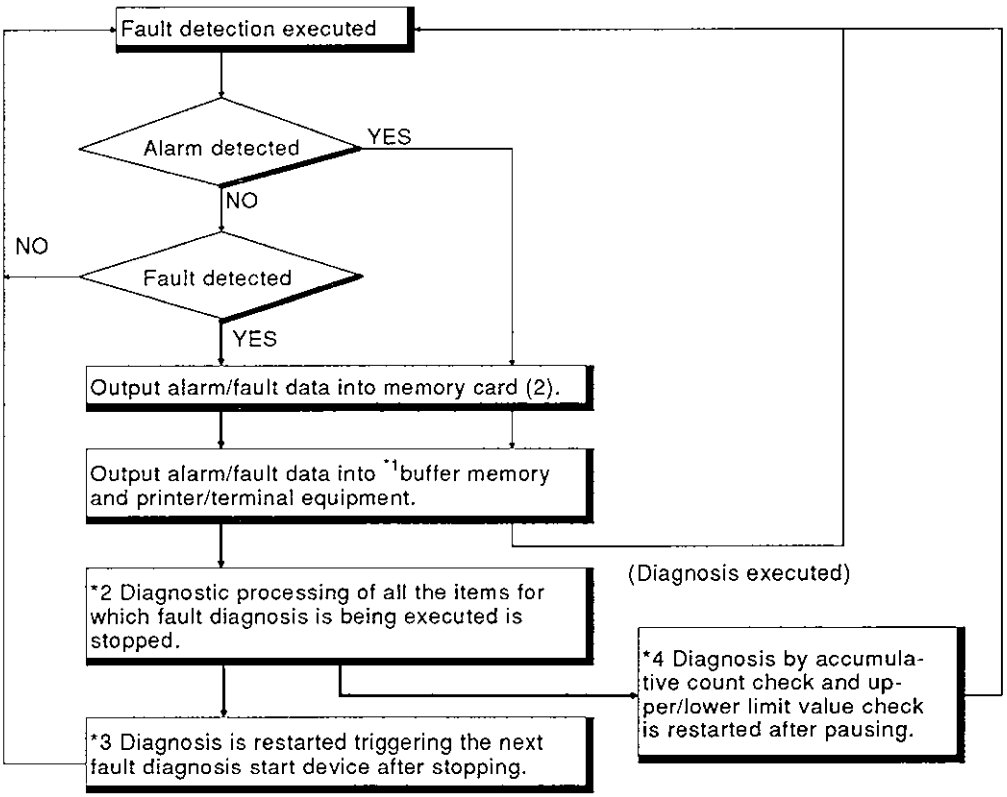


7.4 Output Procedure and Output Format of Fault Diagnosis

7.4.1 Operation and output method in fault detection

This section describes the operation of AD51FD and procedure to output alarm/fault data when alarm or fault is detected.

(1) Operation when fault is detected



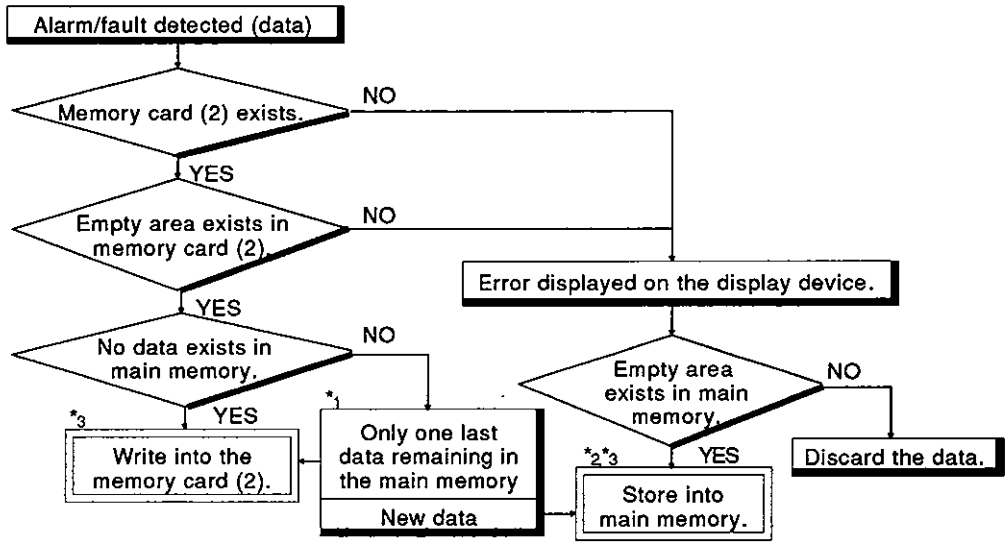
*1: Alarm/fault data is stored into buffer memory of AD51FD.(Detection flags X10 and X11 are ON.)
The PC CPU executes read sequence operation processing by FROM instruction from AD51FD when alarm/fault detection flag is ON.

*2: Diagnosis of items for which fault has been detected and detecting item for which other fault detection is being executed ends.

*3: Fault diagnosis for detecting item for which fault has been detected is restarted triggering the start device after fault recovery, and for other normal detecting item, triggering the next start device after stopping.

*4: For normal detecting items for accumulative count check and upper/lower limit value check, fault diagnosis is restarted after pausing and completing the fault output.

(2) Output procedure to memory card (2) or main memory

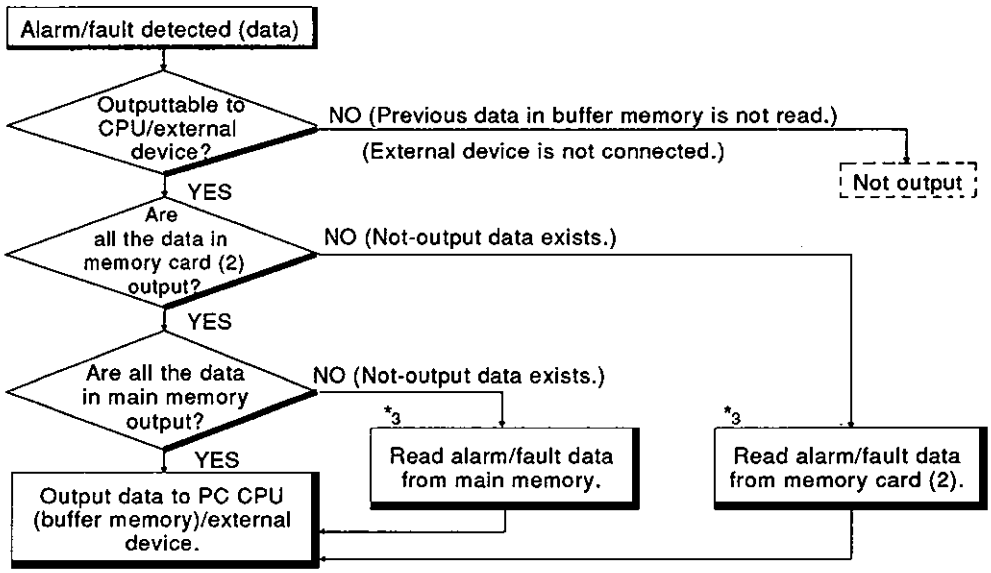


*1: Output procedure used when memory card (2) is installed after alarm/fault occurs or when memory card (2) is replaced because there is no empty area.

*2: All the data in main memory are cleared when power is turned OFF.

*3: All the data in memory card (2)/main memory are cleared when condition data is rewritten from A6GPP/A6PHP.

(3) Output procedure to the PC CPU (buffer memory)/external device (printer, general-purpose console)



*3: If data not output yet exists in memory card (2) or main memory, read the data, and repeat to output the data until all the data are output.

7.4.2 Output format of alarm/fault data

Alarm/fault data is output to output destination in two types of output formats, ASCII and binary formats as shown below.

Output format [Output destination]	Output item	Output data
ASCII • Binary memory • Memory card (2) • Printer/general-purpose terminal	Occurrence time (18 bytes)	1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 Bytes Y Y / M M / D D H H : M M : S S Year/month/day Hour:minute:second (Note) 1. Output only when clock function is set to PC CPU. Not output by PC CPU without clock function. 2. For alarm, output varies according to the setting of dip switch for alarm data output timing. (Refer to Section .4.5.1)
	Comment (24 bytes)	(1) Alarm/fault comment set with A6GPP/A6PHP by user is output. (2) The following comment is output when default comment is set. [Sequence/time check and bidirectional operation check] 24 bytes Fault occurs. ... *Operation failure* ... Incorrect sequence ... FaultΔtimeΔover Alarm occurs. ... AlarmΔtimeΔover [Count check] Fault occurs. ... FaultΔladderΔover ... FaultΔladderΔunmatch ... FaultΔladderΔinsufficient Alarm occurs. ... AlarmΔladderΔover ... AlarmΔladderΔunmatch ... AlarmΔladderΔinsufficient [Normal/abnormal pattern check] ... No default comment [Upper/lower limit value check] Fault occurs. ... FaultΔupperlimitΔover ... FaultΔupper limitΔunder Alarm occurs. ... AlarmΔupper limitΔover ... AlarmΔupper limitΔunder [Bidirectional operation check ... (pattern)] Fault occurs. ... LS recovery fault ... LS malfunction ... SOL abnormal

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<table>
<tr><th>Output format [output destination]</th><th>Output item</th><th>Output data</th></tr>
<tr><td rowspan="3">ASCII
• Buffer memory
• Memory card (2)
• Printer/general-purpose terminal</td><td>Set value (14 bytes)</td><td>(1) Condition data (time/count/set value) of faulty device is output.
[Sequence/time check and bidirectional operation check]
1 2 3 4 5 6 7 8 9 0 1 2 3 4 Bytes
X X X X X s e c . . . . . (Only when time over)
Space
[Count check]
1 2 3 4 5 6 7 8 9 0 1 2 3 4 Bytes
X X X X X X X X X X . . . . . (Maximum 10 columns)
Space
[Normal/abnormal pattern check] . . . . None
[Upper/lower limit value check]
1 2 3 4 5 6 7 8 9 0 1 2 3 4 Bytes
X X X X X . . . . . (Maximum 5 columns)
Space</td></tr>
<tr><td>Number of device conditions Alarm fault flag (2 bytes)</td><td>Alarm/fault flag (0: Alarm, 1: Fault) → Higher byte Lower byte ← Number of device conditions (1 to 128)</td></tr>
<tr><td>Device condition (1 point 24 bytes)
At count check (fault) and upper/lower limit value check, "16 bytes" of device comment is continuously output.</td><td>[Sequence/time check and bidirectional operation check] . . .
[Count check ... alarm] . . . . . : . . . . Condition (ON/OFF state) of device on which alarm/fault occurs
[Normal/abnormal pattern check] . . . Condition (ON/OFF state) of device which has non-coincident/coincident pattern
1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 Bytes
X 1 0 0 1 . . . .
Device No. ON/OFF state Comment registered in PC CPU
• Sequence/time
• Count (alarm)
• Normal/abnormal pattern
• Bidirectional operation
[Count check ... fault] . . . . . Condition of device on which fault occurs
1 2 3 4 5 6 7 8 9 4 5 Bytes to 0
X 1 0 0 1
Device No. ON/OFF state Value when fault occurs Comment (16 bytes)
[Upper/lower limit value check] Condition of device on which alarm/fault occurs
1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 Bytes to 0
D 1 0 0 0 2 3 0 0 0
Device No. Device content Comment (16 bytes)</td></tr>
</table>

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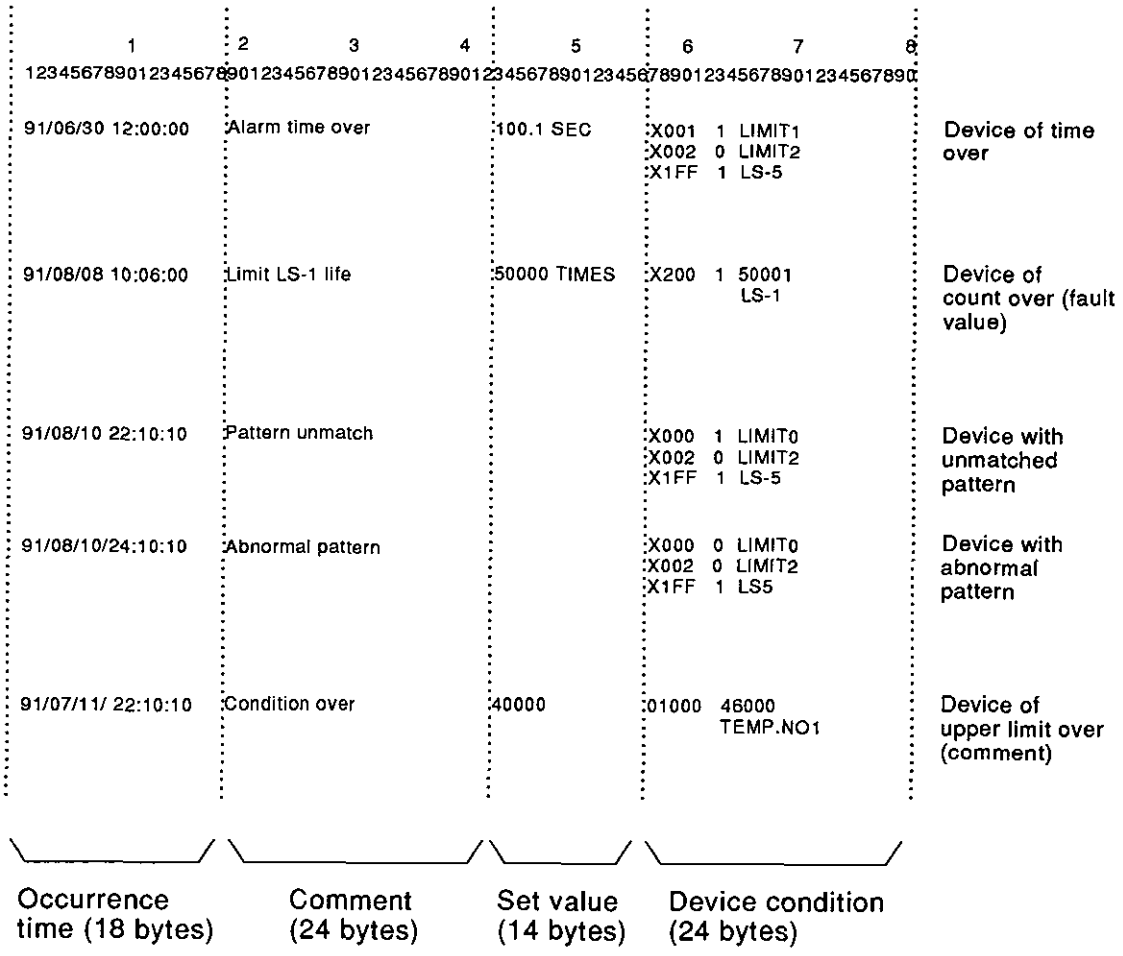
Output format [Output destination]	Output item	Output data
Binary value • Buffer memory • Memory card (2)	Detection type code (1 byte)	0 | 0 (1 byte: Lower byte of address $61D^H$) 1: Incorrect sequence (sequence/time) 2: Count 3: Normal pattern 4: Abnormal pattern 5: Upper/lower limit value 6: Time over (sequence/time) 7: Malfunction (sequence/time) 8: LS recovery fault (bidirectional operation) 9: LS malfunction (bidirectional operation) A: SOL abnormal (bidirectional)
	Change No. (1 byte)	• Number of changes on which fault occurs is displayed. (Only for sequence/time check) 1 byte (higher byte of address $61D^H$) 0 | 0 — 0: End device; 1 to 255: Number of changes
	Item No. (2 bytes)	Higher byte | Lower byte 0 0 1 0 (Example) 10H ... Item No. 16
	Abnormal device (3 bytes)	1st byte | 3rd byte | 2nd byte X X 0 1 F F Device type | Device No. [Device type] 1 : D, 2 : W, 3 : R, 4 : X, 5 : Y, 6 : M, 7 : L, 8 : S, 9 : B, A : F $61E^H$: (Higher byte) (Lower byte) 2nd byte | 1st byte 1st byte | 3rd byte 3rd byte | 2nd byte Stored in buffer memory by repeating the above.
	ON/OFF pattern (16 bytes)	• The patterns for 128 points are allocated in sequence of setting detection devices. ... (ON/OFF states of devices set) • ON/OFF state of abnormal device No. is checked. (Example) Sequence: X0, Y10, M1, X1; Fault 127 126 125 124 to 3 2 1 0 Bit 0 0 1 1 X1 M1 Y10 X0
	Occurrence time (6 bytes)	1 2 3 4 5 6 Bytes Year Month Day Hour Minute Second (Note) Output only when clock function is set in PC CPU.
	Set value (4 bytes)	• Condition data (hour/count/set value) of fault detection device is output. 1 2 3 4 Bytes
	Fault value (4 bytes)	• Fault value of count (fault) check and upper/lower limit value (alarm/fault) check is output. 1 2 3 4 Bytes

7.4.3 Output format to printer and general-purpose terminal



7.5 Operation Condition of PC CPU and Operation of AD51FD

(1) This section describes the operation and detecting procedure of running AD51FD according to the operation condition of PC CPU (key switch
condition).

Operation condition of PC CPU	Operation of running AD51FD	Detecting method of AD51FD
RUN	• Executes fault diagnosis.	• Detects according to the fault diagnosis start/stop signal (Y12) of AD51FD.
STOP/PAUSE	• Pauses keeping the fault diagnostic data.(Restarts fault diagnosis at STOP/PAUSE → RUN.)	
RESET operation	• AD51FD clears all the received data and executes fault diagnosis from initial condition. (If alarm data is kept, clear them.) • If accumulative count check is performed, data is written into memory card (1), and data is read at the time of RESET recovery and is set.	• Operation condition is detected by hardware interruption of AD51FD.

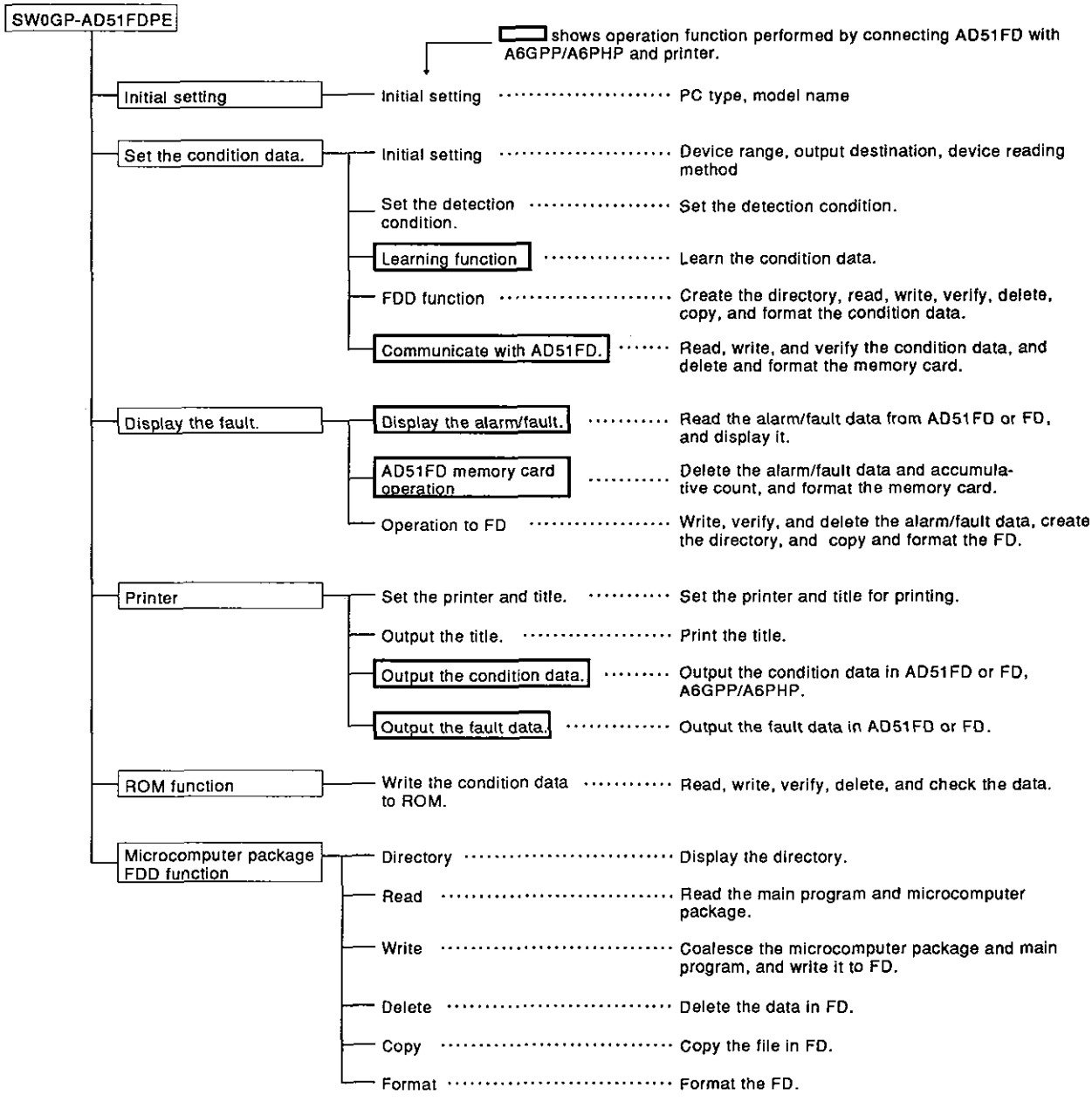
REMARK

• For operation of RUN-STOP-RESET switch of AD51FD, refer to Section 4.4.

7.6 Fault Diagnosis Data Operation Function List

This section describes operation functions which are performed by A6GPP/A6PHP, such as setting the condition data of fault diagnosis, monitoring the fault data, printing out, writing the condition to ROM, and coalescing the microcomputer package.

For details of operation, refer to the SW0GP-AD51FDPE type External Fault Diagnosis Software Package Operating Manual.



8. PROGRAMMING

This chapter describes the sequence program and microcomputer program which are written to the programmable controller to execute fault diagnosis through AD51FD.

To execute fault diagnosis through microcomputer program, PC CPU which can process the microcomputer program for fault diagnosis is required.

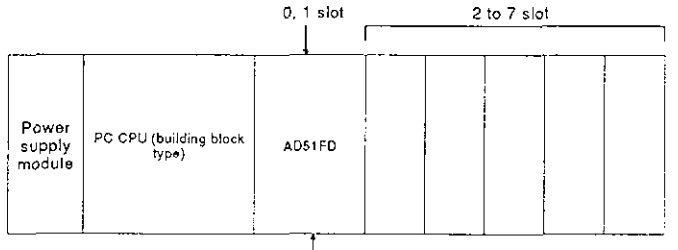
POINTS

(1) To set fault diagnosis method in communication through AD51FD or communication through microcomputer program, examine and select the number of bytes of data received through one communication and effects on scan time of programmable controller, and then, perform programming. (For details, refer to Sections 6.5 and 6.6.)

(2) To output alarm/fault occurrence time, set "clock data" to PC CPU in test mode of A6GPP/A6PHP without fail..... (Refer to user's manual for the PC CPU.)
After setting the clock data, turn on "M9028 (clock data read request) using the sequence program, and refresh the clock data without fail.

8.1 Programming in Communication through AD51FD

This section describes the programming when PC CPU and AD51FD are set as shown below.



[Number of I/O points] ····· 48 points (000 to 02F)

[I/O assignment] ····· 16 points vacant in the first half (000 to 00F)
32 points special unit in the second half (010 to 02F)

(1) Slot to install the AD51FD ... slot 0, 1

(2) I/O signal of AD51FD ... X/Y10 to X/Y2F

(3) First 2 columns of head I/O number in executing FROM instruction to AD51FD ... H01

REMARK

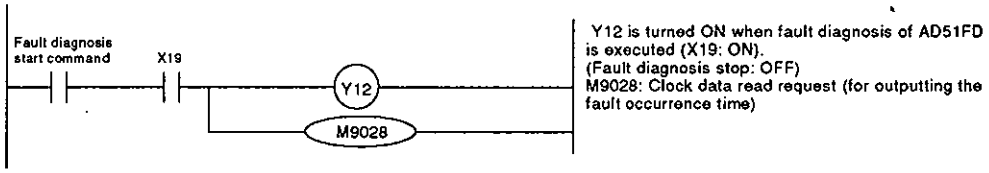
If AD51FD is installed to slot 0, 1 of extension base of A0J2H/A0J2CPU, I/O number becomes 64 point assignment (100 to 13F). Therefore, I/O signal of AD51FD becomes "X/Y110 to X/Y12F", and first 2 columns of the head I/O number when FROM instruction is executed becomes "H11".

8.1.1 Basic programming

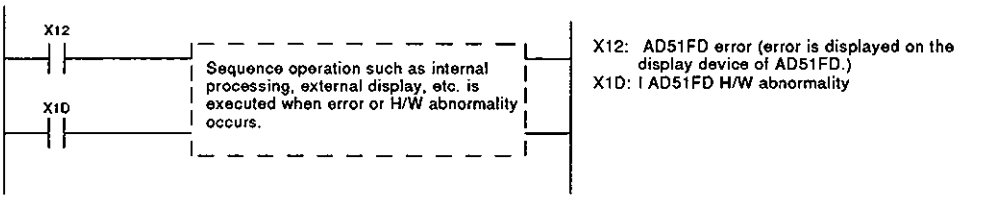
This section describes the basic program to AD51FD.

(1) I/O signal processing program

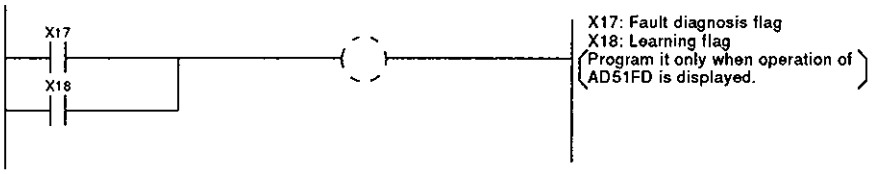
(a) Starting/stopping fault diagnosis



(b) Detecting the abnormality of AD51FD



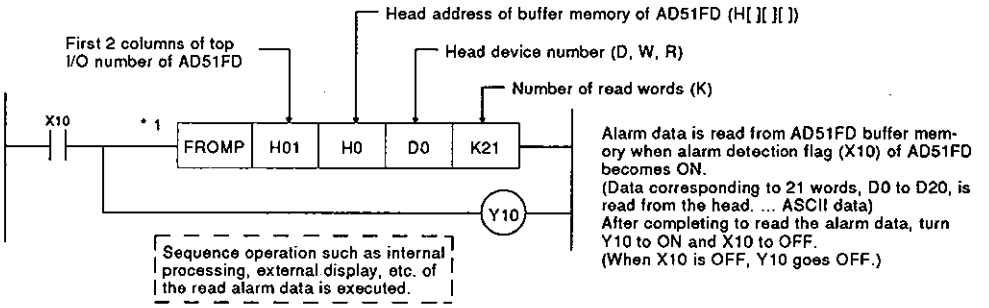
(c) Displaying the operation of AD51FD



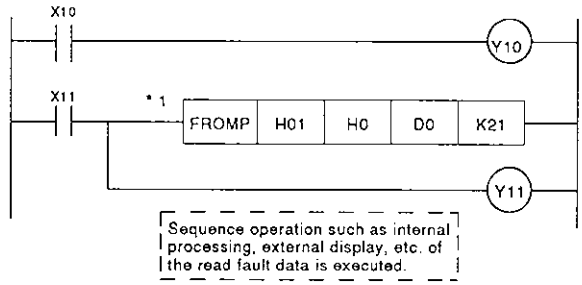
(2) Program to read the alarm/fault data

... [Read necessary part of data from buffer memory. (Refer to Section 6.8.)]

(a) Reading the alarm data

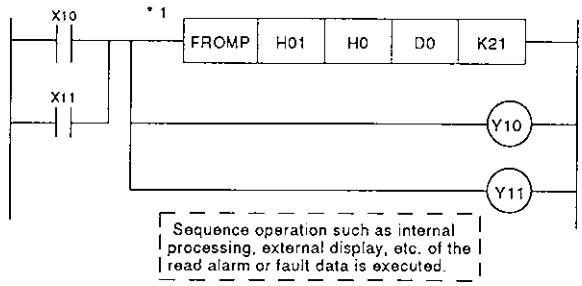


(b) Reading the fault data



When alarm occurs, reset the AD51FD to read the fault data.
Fault data is read from AD51FD buffer memory when fault detection flag (X11) of AD51FD becomes ON.
(Data corresponding to 21 words, D0 to D20, is read from the head. ... ASCII data)
After completing to read the fault data, turn Y11 to ON and X11 to OFF.
(When X11 is OFF, Y11 goes OFF.)

(c) Reading the alarm/fault data ... (When reading the data to the same device and displaying it on the same display device)



Alarm/fault data is read from AD51FD buffer memory when either of alarm/fault detection flag becomes ON.
(Data corresponding to 21 words, D0 to D20, is read from the head. ... ASCII data)
After completing to read the alarm or fault data, turn Y10/Y11 to ON and X10/X11 to OFF.
(When X10/X11 is OFF, Y10/Y11 goes OFF.)

*1: Since there is no FROM instruction in A0J2CPU (P23/R23), data should be made in pulse using internal relay.

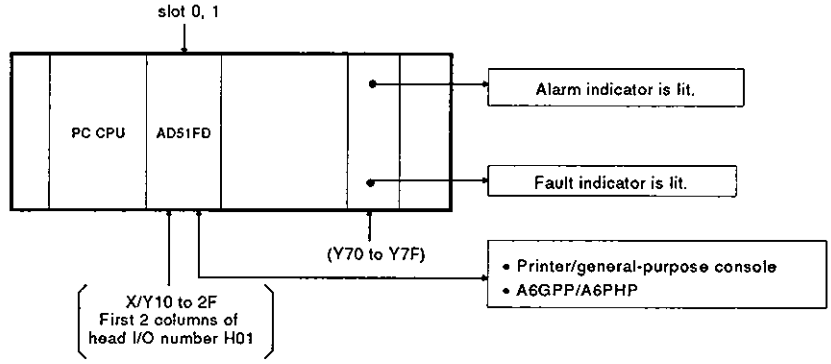
8.1.2 Program example only by I/O signal processing

Reading of alarm/fault data by sequence program can be omitted when printing/displaying the alarm/fault data from each interface of AD51FD or when reading the alarm/fault data with A6GPP/A6PHP.

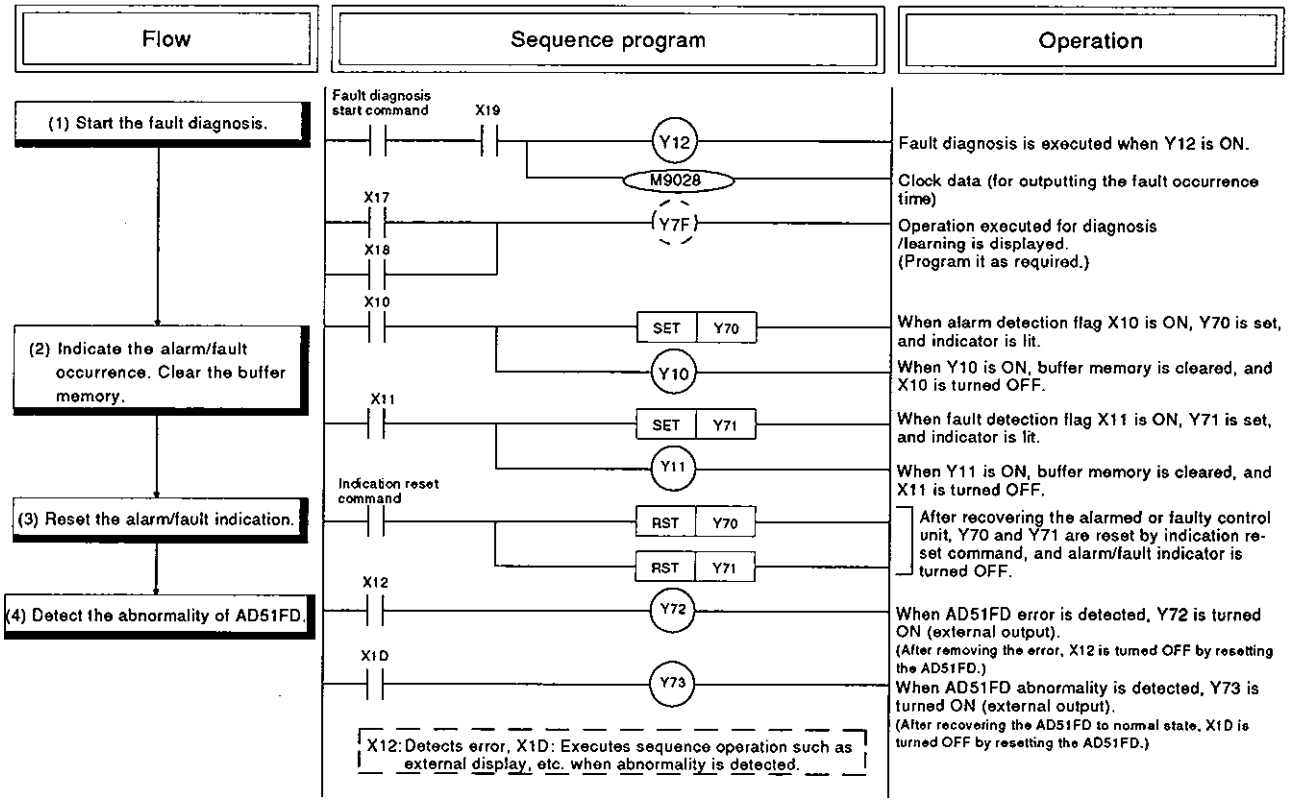
The following is the program example by I/O signal of AD51FD.

(1) Program condition

- Alarm/fault data in buffer memory is not read. ... (Output from AD51FD directly.)
- Lamp lighting output on alarm/fault indicator from PC CPU is performed.
- For installing the AD51FD, refer to Section 8.1.
- Configuration is as shown below.



(2) Program sequence and executed contents are shown in "Flow" column and description of the program in "Operation" column.



8.1.3 Program example by reading the buffer memory (ASCII/binary)

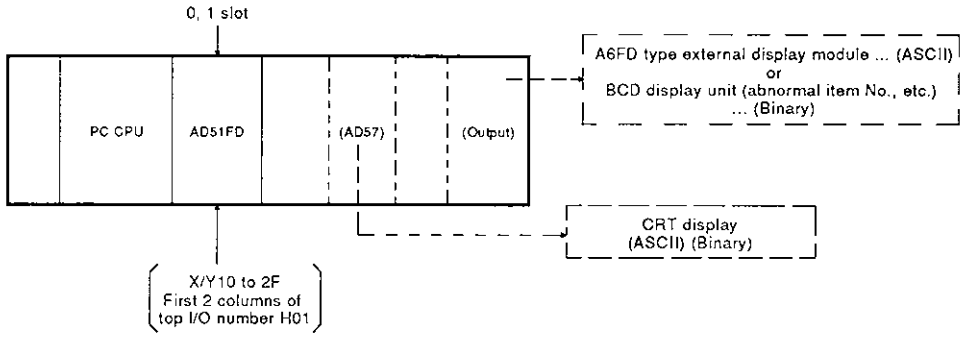
Buffer memory contains the ASCII data which can output the alarm/fault status to A6FD type external display module and occurrence time, comments, to AD57 type display module, and binary data which can output occurrence time, abnormal item No., abnormal device, etc. to BCD display unit, etc.

The following is the program example to read the ASCII/binary data by sequence program.

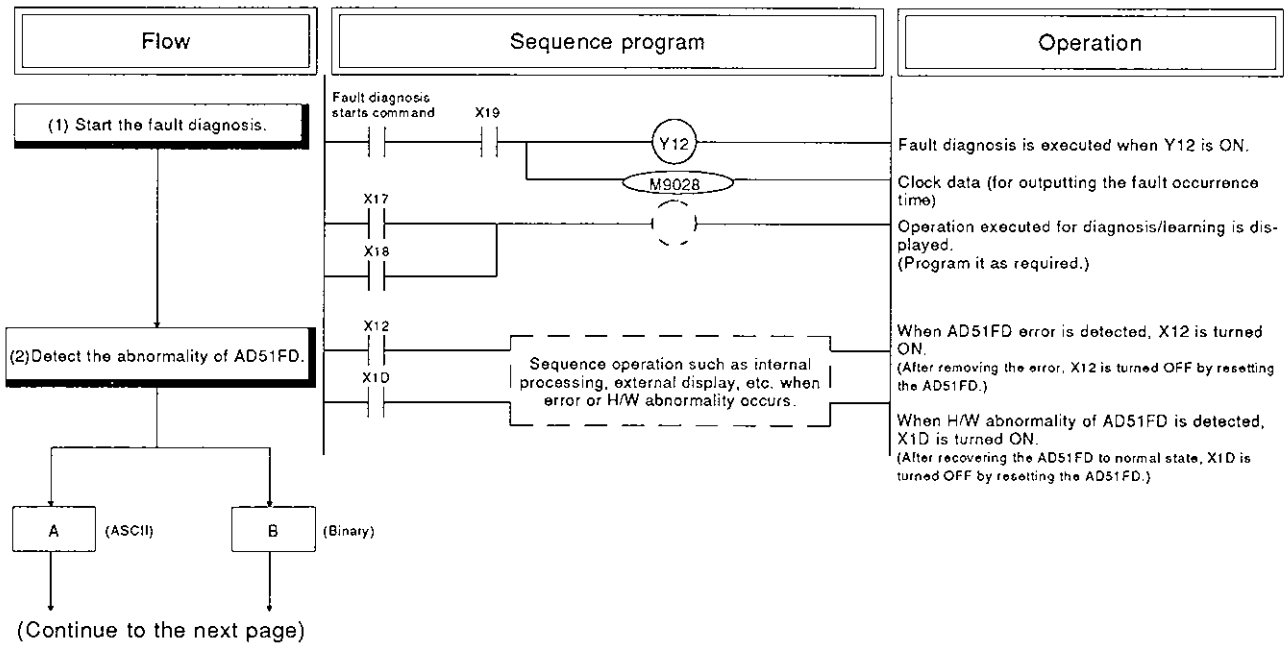
For program to output the read data to each module, refer to the manual for each module.

(1) Program condition

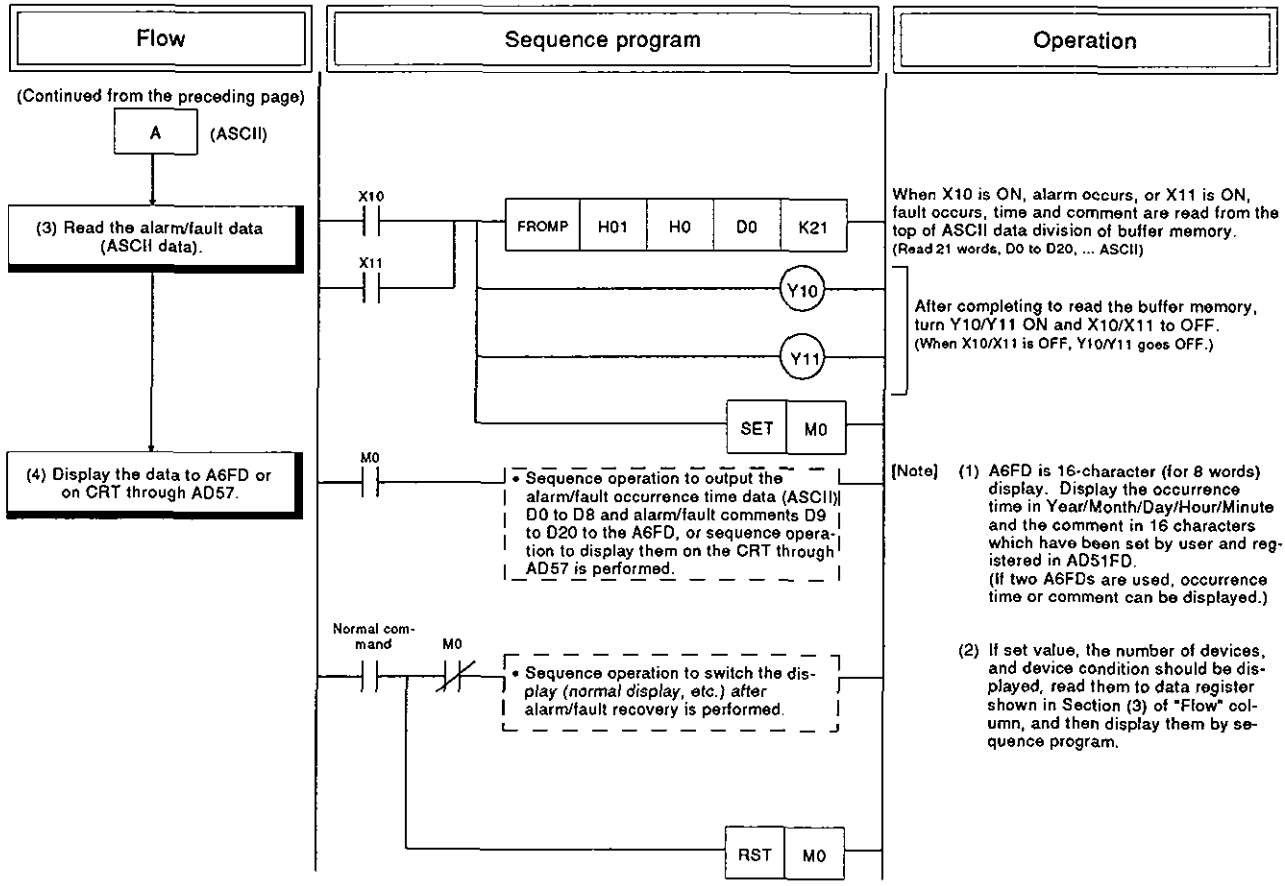
- For installing the AD51FD, refer to Section 8.1.
- To read and display the alarm/fault data of buffer memory, select ASCII or binary data.
- Configuration is as shown below.

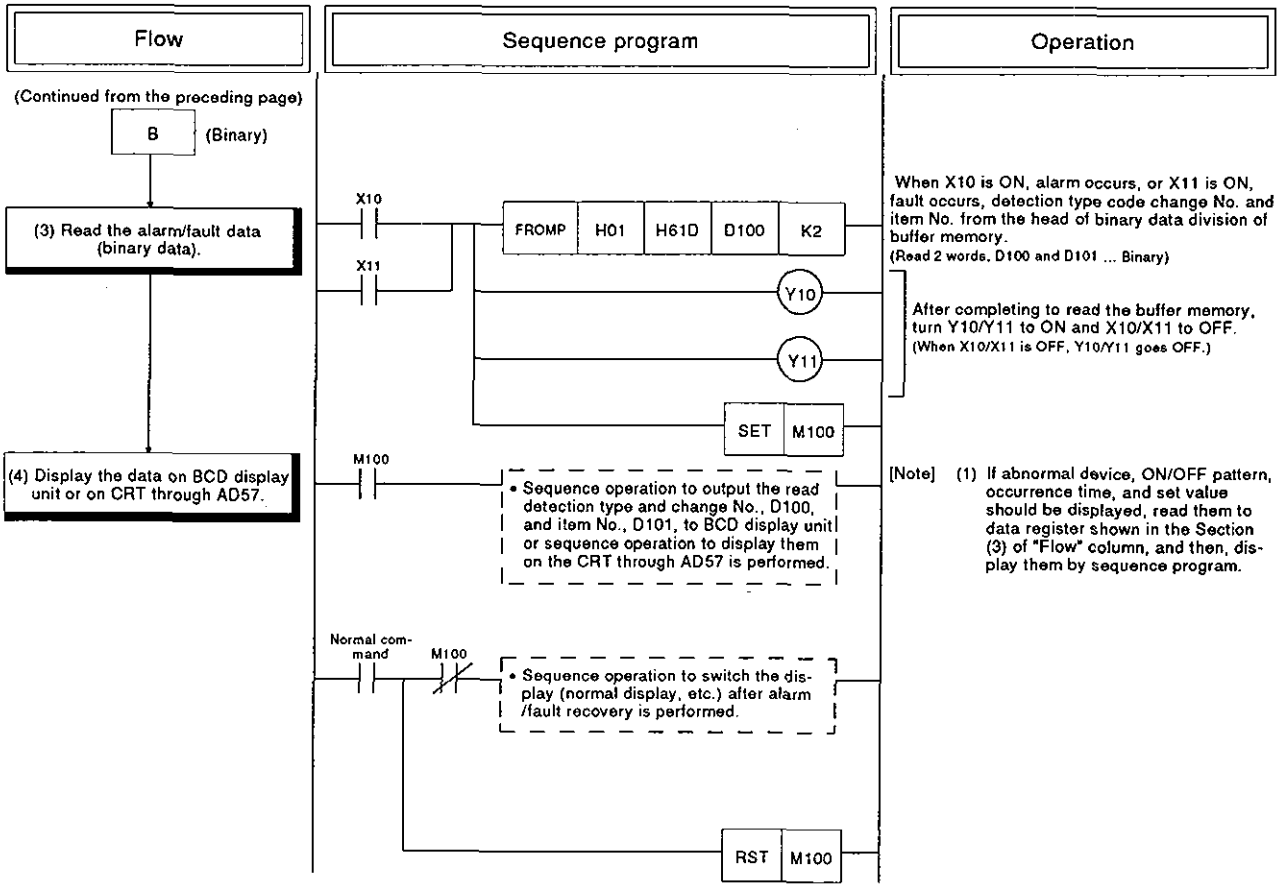


(2) Program sequence and executed contents are shown in "Flow" column and description of the program is in "Operation" column.



(Continue to the next page)


Flow
Sequence program
Operation
(Continued from the preceding page)
A
(ASCII)
(3) Read the alarm/fault data (ASCII data).
(4) Display the data to A6FD or on CRT through AD57.
X10
X11
FROMP
H01
H0
D0
K21
Y10
Y11
SET
M0
When X10 is ON, alarm occurs, or X11 is ON, fault occurs, time and comment are read from the top of ASCII data division of buffer memory.
(Read 21 words, D0 to D20, ... ASCII)
After completing to read the buffer memory, turn Y10/Y11 ON and X10/X11 to OFF.
(When X10/X11 is OFF, Y10/Y11 goes OFF.)
M0
• Sequence operation to output the alarm/fault occurrence time data (ASCII) D0 to D8 and alarm/fault comments D9 to D20 to the A6FD, or sequence operation to display them on the CRT through AD57 is performed.
Normal command
M0
• Sequence operation to switch the display (normal display, etc.) after alarm/fault recovery is performed.
RST
M0
[Note] (1) A6FD is 16-character (for 8 words) display. Display the occurrence time in Year/Month/Day/Hour/Minute and the comment in 16 characters which have been set by user and registered in AD51FD.
(If two A6FDs are used, occurrence time or comment can be displayed.)
(2) If set value, the number of devices, and device condition should be displayed, read them to data register shown in Section (3) of "Flow" column, and then display them by sequence program.


Flow
Sequence program
Operation
(Continued from the preceding page)
B
(Binary)
(3) Read the alarm/fault data (binary data).
(4) Display the data on BCD display unit or on CRT through AD57.
X10
X11
FROMP
H01
H61D
D100
K2
Y10
Y11
SET
M100
When X10 is ON, alarm occurs, or X11 is ON, fault occurs, detection type code change No. and item No. from the head of binary data division of buffer memory.
(Read 2 words, D100 and D101 ... Binary)
After completing to read the buffer memory, turn Y10/Y11 to ON and X10/X11 to OFF.
(When X10/X11 is OFF, Y10/Y11 goes OFF.)
M100
• Sequence operation to output the read detection type and change No., D100, and item No., D101, to BCD display unit or sequence operation to display them on the CRT through AD57 is performed.
Normal command
M100
• Sequence operation to switch the display (normal display, etc.) after alarm /fault recovery is performed.
RST
M100
[Note] (1) If abnormal device, ON/OFF pattern, occurrence time, and set value should be displayed, read them to data register shown in the Section (3) of "Flow" column, and then, display them by sequence program.

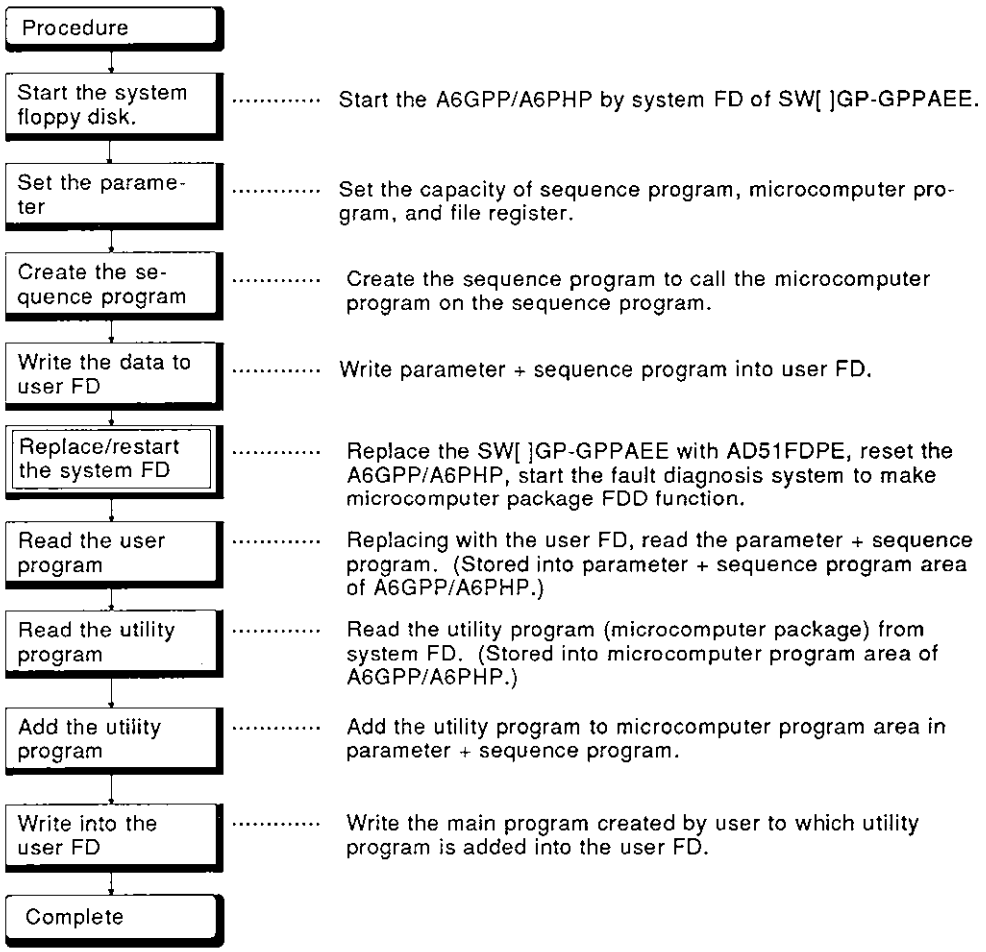
8.2 Programming by Microcomputer Program

This section describes the procedure, memory area, special relay, special register, dedicated command, and program example for performing fault diagnosis of AD51FD by microcomputer program of PC CPU.

8.2.1 Procedure to create the program

This section describes the procedure to add the utility program to sequence program created by user and write it to FD for user. Write the program into the PC CPU separately using A6GPP/A6PHP.

> For operating method to add the utility program, refer to the SW0GP-AD51FDPE type External Fault Diagnosis Software Package Operating Manual.



REMARK

To write the main program, to which utility program is added, into the PC CPU, restart the program using the SW[ ]GP-GPPAEE, read it from the user FD, and then write it.

8.2.2 Memory area of microcomputer program

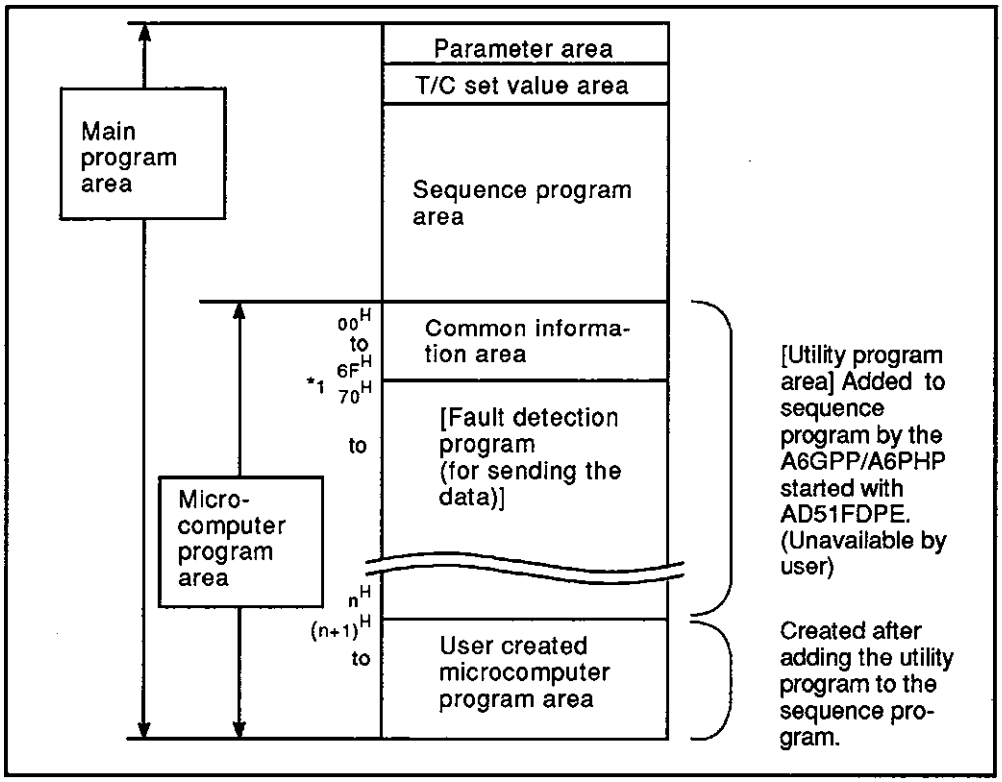
(1) Memory area to store the microcomputer package

(a) Microcomputer package is stored in the microcomputer program area of main program.

(b) To store the microcomputer package into the microcomputer program area, 00^H to $6F^H$ (112 bytes) of microcomputer program area becomes the common information area.

(c) The head address of microcomputer package is displayed on the GPP when coalescing with the sequence program.
The displayed head address becomes the head address to store the microcomputer package.

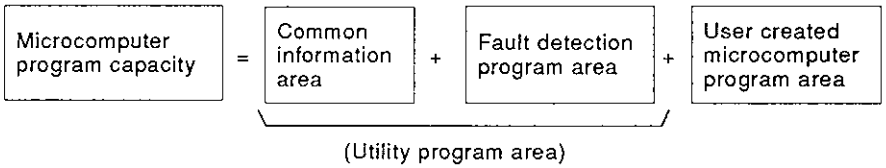
(d) Memory map is as shown below.



*1: 1) The head address to store only microcomputer package (AD51FDPE) for fault diagnosis into the microcomputer program area is "70^H".
2) To store AD51FDPE and other utility package simultaneously, the head address of the microcomputer package is decided according to the storing sequence.

(2) Calculating the microcomputer program capacity

Capacity of microcomputer program is calculated as follows to set the parameter.



Item		Memory capacity
Common information area		112 bytes
Fault detection program area	AnNCPU, AnCPU A73CPU, A0J2HCPU	3.5 Kbytes
	A3MCPU	2.5 Kbytes
User created microcomputer program area		(Set value)

POINTS

(1) When microcomputer package is added to the sequence program, clear all the microcomputer program area. When microcomputer program for user is created, create it after adding the utility program to the sequence program.

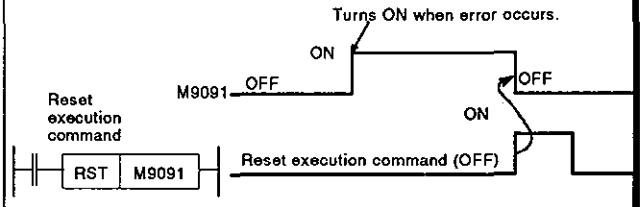
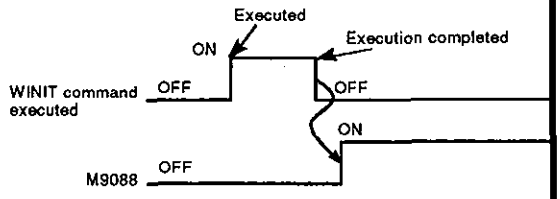
(2) Common information is stored at the head (00^H to $6F^H$) of microcomputer program area.

(3) Do not change the sequence program capacity by setting the parameter after adding the microcomputer package to the sequence program. If sequence program capacity is changed, information added to the microcomputer program does not move and remains in the area intact, and only the head (00^H) position of microcomputer program area moves.
And, as a result, head information of microcomputer program becomes unstable and cannot be executed. If sequence program capacity is changed, add the microcomputer package to the sequence program again.

8.2.3 Special relay/special register list

The following shows the special relays and special registers for microcomputer package.

(1) Special relay

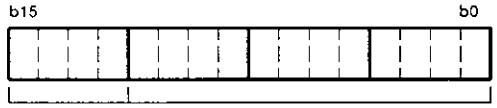
Device No.	Name	Description
M9091	Error detection flag	• Turns ON when error is detected while executing the microcomputer package. • Turns OFF when RST command is executed. (Turns OFF by reset key operation on the PC CPU or by forced reset by peripheral device.) • Timing chart 
M9088	WINIT command execution complete flag	• Turns ON when initial setting command execution is completed in work area for fault detection. • Timing chart 

(2) Special register

Device No.	Name	Description
D9090	Head device to store input data	• Register to set the device code and head device number (hexadecimal number) of the device in which input data is stored • For setting the head device to D9090, refer to the Section (3) shown below.
D9091	For storing the error code	• Register to store the error code corresponding to the error cause when error is detected while executing the microcomputer package • Error code is reset by RST command or MOV command. (Cleared by reset key operation on the PC CPU or forced reset by peripheral device, or setting 0 for current value.) • For details of error codes, refer to Section 9.2.

(3) Method for setting the head device to D9090 ... (Set in hexadecimal number.)

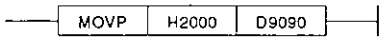
[Data structure of D9090].....



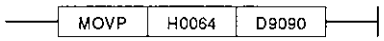
Device code Device number

Device of CPU (device number)	Device code	Device number	Set number to D9090 (Device code + device number)
Data register (D0 to D1023)	0	000^H to $3FF^H$	0000^H to $03FF^H$
Link register (W0 to W3FF)	1	000^H to $3FF^H$	1000^H to $13FF^H$
File register (R0 to R4095)	2	000^H to FFF^H	2000^H to $2FFF^H$
File register (R4096 to R8191)	3	000^H to FFF^H	3000^H to $3FFF^H$

(Specification example)



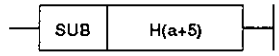
..... H2000=R0 becomes the head device number.

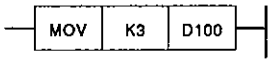


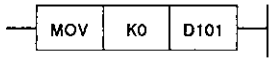
..... H0064=D100 becomes the head device number.

8.2.4 Initial setting command in work area for fault detection (WINIT command)

(1) WINIT command is the set command in work area for microcomputer package.

<table>
<tr><th>Command</th><th>Subroutine address</th><th>Input data</th></tr>
<tr><td rowspan="2">WINIT</td><td> 

a: Head address to store the microcomputer package for fault diagnosis (hexadecimal number)</td><td>1) Input assignment number (1 to 4) of device used in work area for microcomputer package to [D/W/R head device].
(Example) 

.... Input "3", file register (R) to D100.
<table>
<tr><th>Assignment number</th><th>Device in use</th></tr>
<tr><td>1</td><td>Data register (D)</td></tr>
<tr><td>2</td><td>Link register (W)</td></tr>
<tr><td>3</td><td>File register (R)</td></tr>
<tr><td>4</td><td>Unused area in memory cassette</td></tr>
</table>
2) Input the head number of device used in work area for microcomputer package to [D/W/R head device + 1] (next device).
{Input only when D, W, and R are used. Not necessary if unused area in memory cassette is used.}
(Example) 

.... Input "0" to D101. *1 (Use R0 to R25.)
*1: For work area, 26 devices from the specified head device are occupied. (Other cannot be used.)</td></tr>
<tr><td>Remarks:</td><td>The WINIT command is executed by performing initial setting after setting the data by sequence program using D/W/R register corresponding to the continuous two words, specifying the head device to D9090 and executing the SUB command. ... (Refer to Section 8.2.6.)</td></tr>
</table>

NOTE

When file register (R) is used, set the number of register points to be used in advance by setting the parameter.

(2) Device range for work area according to the PC CPU type for which microcomputer package can be used

PC CPU	Device range
A1NCPU(P21/R21), A1CPU(P21/R21)	* D0 to D1023 * W0 to W3FF
A2NCPU(P21/R21), A2CPU(P21/R21) A2NCPU(P21/R21)-S1, A2CPU(P21/R21)-S1, *1A0J2HCPU(P21/R21)	* D0 to D1023 * W0 to W3FF * R0 to R4095 *2 * Unused area in memory cassette
A3NCPU(P21/R21), A3CPU(P21/R21) A73CPU(P21/R21)	* D0 to D1023 * W0 to W3FF *2 * Unused area in memory cassette
A3MCPU(P21/R21)	* R0 to R8191 *1 * Unused area in memory cassette

*1: Since A0J2H is not equipped with memory cassette, use D/W/R.

*2: Since the area is the same as that of block No.1 in extension file register when using SW0GHP-UTLPC-FN1, block No.1 cannot be used as an extension file register.

8.2.5 Fault detection data transfer command (DT command)

Command	Subroutine address	Input data
DT	SUB | H(a + 8) a: Head address to store the microcomputer package for fault diagnosis (hexadecimal number)	None

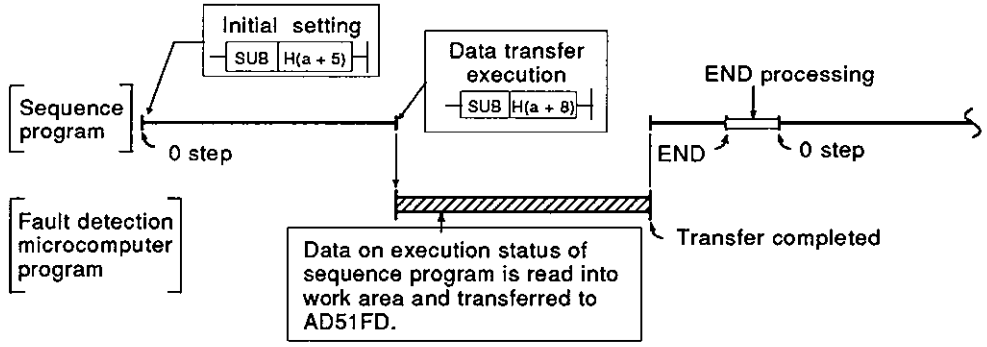
(1) Function

DT command is used to transfer the device condition of all the devices set by condition data to AD51FD.

(2) Operation

Data transfer is executed when SUB command is executed by sequence program and microcomputer package is called.
When executing the fault diagnosis, data transfer command should be executed at each scan.

(3) Fault detection data transfer executing timing



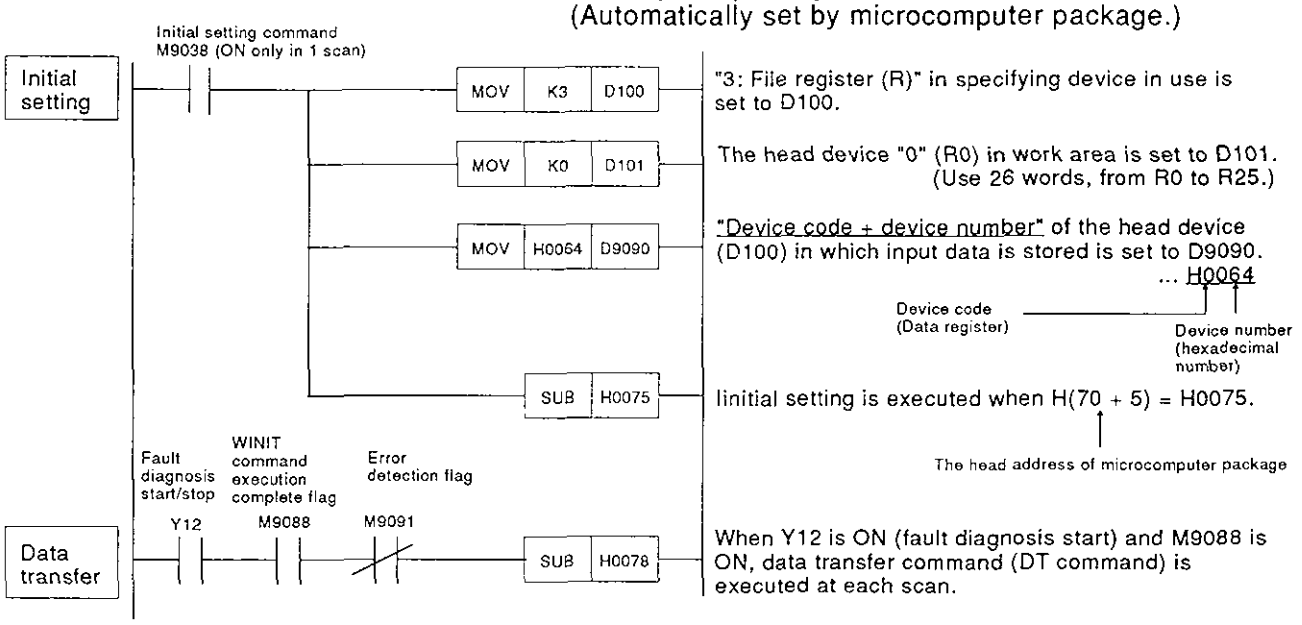
8.2.6 Basic program

Execution program of initial setting command (WINIT command) which runs the microcomputer package and fault detection data transfer command (DT command) is added to the sequence program described in Section 8.1.

(1) Execution program for microcomputer package is described below.

(a) Program condition

- Head address of microcomputer package ... 70^{H}
- Input device in executing the WINIT command
  Head device in work area for microcomputer package ..... File register R0 to R25
  (Automatically set by microcomputer package.)



(2) If error code (D9091) in microcomputer program should be read, create sequence program.

(3) The I/O signal processing program and alarm/fault data read program are the same as described in Section 8.1.1.

8.2.7 Program example

Program examples are shown below.

(1) Program example only by I/O signal processing ... (Refer to Section 8.1.2.)
Add basic program shown in Section 8.2.6 before [(1) Fault diagnosis start] in "Flow" column of program example shown in Section 8.1.2.

(2) Program example by reading buffer memory (ASCII/binary) ... (Refer to Section 8.1.3)
Add basic program shown in Section 8.2.6 before [(1) Fault diagnosis start] in "Flow" column of program example shown in Section 8.1.3.

9. TROUBLESHOOTING

In error detection of AD51FD, error message and error code displayed on the display device, and LED indication on the front side of the AD51FD are available.

This chapter describes error messages, error codes, LED indication, and troubleshooting against abnormal operation of AD51FD.

9.1 Error message, error code displayed on the display device

(1) Error message list

Error message	Error description	Corrective action
BAT1	Battery voltage of memory card (1) lowers.	Replace the battery according to the replacing method described in Chapter 5.
BAT2	Battery voltage of memory card (2) lowers.	Replace the battery according to the replacing method described in Chapter 5.
INIE	Memory card (1) or user ROM in which condition data is stored is not installed.	Install memory card (1), and store condition data. Or, install the ROM in which condition data is stored.
KEYE	Power is supplied setting the RUN-STOP-RESET switch to "RESET" position.	Set the switch to "STOP/RESET" position, and reset AD51FD or supply the power again.

(2) Error code list

Code No. (H)	Error description	Corrective action
[ ]901 [ ]904 [ ]906 [ ]9E3	Memory card access error occurs.	• Reset AD51FD, and recommunicate.
[ ]902 [ ]903	When reading the condition data or fault data from the A6GPP/A6PHP, relevant data is not found.	• Read the data stored in memory card. • Stop reading the data into formatted memory card.
[ ]905	Memory capacity of memory card is insufficient.	• Replace the memory card. • Store the fault data into FD, and delete the fault data.
[ ]90F	Drive to be formatted is specified improperly.	Specify the drive properly.
[ ]984	Critical error occurs on memory card.	Replace the memory card.
[ ]9C1	Memory card is not installed or is in failure.	Install or replace the memory card.
[ ]9C2	Memory card is write-protected.	Release the write protection.
[ ]9C3	Memory card is improperly formatted.	Format the memory card again.
[ ]9E5	Memory size of the memory card is not proper when formatting the memory card.	Set the card size properly.

[ ]mark: When memory card (1) is in error ... "1" is displayed.
When memory card (2) is in error ... "2" is displayed.

(Continue to the next page.)

(2) Error code list (continued)

Code No. (H)	Error description	Corrective action
A05 A07 A11 A62	Communication error occurs.	Reset and recommunicate.
A61	Invalid request is made from A6GPP/A6PHP. (Example) Learning instruction is given during learning.	Reset the display device, and execute operation with correct procedure.
A83	Transmission/receiving error occurs.	Reset, and transmit/receive the data again.
A93	Baud rate is specified improperly.	Set the baud rate properly.
AA1	Printer of parallel interface is in failure.	Check the printer to enable normal operation.
B40 B41 B46	• PC CPU stops due to an error, or it is in failure. • I/O assignment is not proper. • X/Y used in system on AD51FD is used. • AD51FD is in failure.	• Recover the PC CPU to normal condition, and reset the AD51FD. • Set the I/O assignment of AD51FD properly. • Correct the sequence program. • Check X1D, and check or replace the AD51FD.
1000	Mode setting switch is not set properly.	Set the switch properly.
1002	Setting of PC CPU is not matched.	Match the PC CPU type name (PC type).
1003	Contents of condition data is not correct. (Sum check error)	Write the condition data again.
1004	Device value is not correct, or device is not specified.	Correct the device value, or specify the device.
1510	Parallel error	Check the parallel printer and connecting cable.
1520	RS232C error	Check the RS232C printer and connecting cable.
1530	• Main memory to store the fault data is insufficient. • Fault data cannot be stored.	• Store the fault data into FD, and delete the fault data. • Reset, and delete the fault data.
1A01	Memory for learning is insufficient.	Learn the items one by one.
1A02	• Learning operation cannot be performed. • At sequence/time check and bidirectional operation check, total of changing time exceeds the end time when learning the time.	If indicator reset switch is pressed, item No. of the items which cannot be learned is displayed. Execute the following processings for the item No. (Up to 5 items are displayed every time AD51FD is reset.) • Perform learning again. • Read the learning data using A6GPP/A6PHP, and correct the time.

- If the code which is not indicated in "Code No." column is displayed on the display device of AD51FD, reset and recommunicate.
- If invalid code is displayed even after resetting, H/W may be in failure. Consult your nearest Mitsubishi representative with details.

9.2 Error Code While Executing the Microcomputer Program

Error which occurs while executing the microcomputer program is detected on the PC CPU side.

Since error code is stored in special data register D9091 for microcomputer package, read it by sequence program or PC diagnosis of A6GPP/A6PHP, and take necessary corrective action.

Error code (Decimal)	Command name	Error description	Corrective action
45	WINIT	• Data setting to D9090 contains an error.	• Check and correct the data set by sequence program.
46	WINIT	• Input data error (device specification error)	• Check and correct the assignment number of device in use.
47	WINIT	Input data error (device number error) • Unused area does not exist. • No work area is available.	• Check the unused area, and set available device. • Correct the data so that the area corresponding to 26 words can be used for device in use.
48	WINIT	• Memory-protected memory area is specified.	• Correct the area to outside of the memory-protected area, or release the memory protection.
49	WINIT	• Microcomputer package is not registered.	• Register the microcomputer package and write it into PC CPU.
50	WINIT	• File register does not exist when specifying the file register (R). • Specified device number does not exist.	• Correct the register into the file register range, or change the device number. • Correct the device number into the device range of PC CPU.
51	WINIT	• AD51FD is not installed.	• Install the AD51FD.
52	DT	• Work area is destroyed.	• Reset the PC CPU, and recommunicate. • If communication cannot be made, write the main program into the PC CPU again, and recommunicate.
53	DT	• Control bus with AD51FD contains an error. (Hardware error on CPU module, AD51FD module, base unit)	• Install the CPU module and AD51FD module again, and recommunicate. • If communication cannot be made, replace the module in failure.
54	DT	• No response is given from AD51FD. • AD51FD is reset.	• Set AD51FD to "RUN".
55	DT	• AD51FD is reset. • AD51FD is in failure.	• Set AD51FD to "RUN". • Check AD51FD, and if AD51FD down is detected, replace it.

9.3 When the RUN LED Turns OFF

Check item	Corrective action
Is POWER LED of power supply unit lit?	• If POWER LED is lit, check the power supply unit, and recover it.
Is AD51FD normally installed? Is base unit normally operated?	• Install AD51FD securely so that there is no gap or looseness between AD51FD and base unit. • If there is bending or stain on connector for AD51FD and base unit, remove it. • Check if base unit supplies 5V power by replacing it with another unit or installing AD51FD to another slot. If any abnormality is found, replace the base unit.
Is RUN-STOP-RESET switch set to STOP/RESET?	• Set the switch to RUN.
Is H/W normal?	• Set RUN-STOP-RESET switch to RESET, and then set to RUN again. • Repeat to turn power supply unit ON/OFF in RUN status. (Check if H/W abnormality occurs due to noise, etc.) • If RUN LED is not still lit, AD51FD is in H/W abnormality. Consult your nearest Mitsubishi representative with details.

9.4 When the ERROR LED Turns ON

Check item	Corrective action
Is error message or error code displayed on display device?	• Remove the error according to the displayed error message or error code referring to the list shown in Sections 9.1 and 9.2. • Reset the display device with indicator reset switch. (If two or more errors occur, the next error is displayed. Recover and reset.) • Set RUN-STOP-RESET switch to RESET, and then to RUN.
Is H/W normal? (Not displayed on the display device.)	• Set RUN-STOP-RESET switch to RESET, and then to RUN again. • Repeat to turn power supply unit ON/OFF in RUN status. (Check if H/W abnormality occurs due to noise, etc.) • If ERROR LED does not still go OFF, AD51FD is in H/W abnormality. Consult your nearest Mitsubishi representative with details.

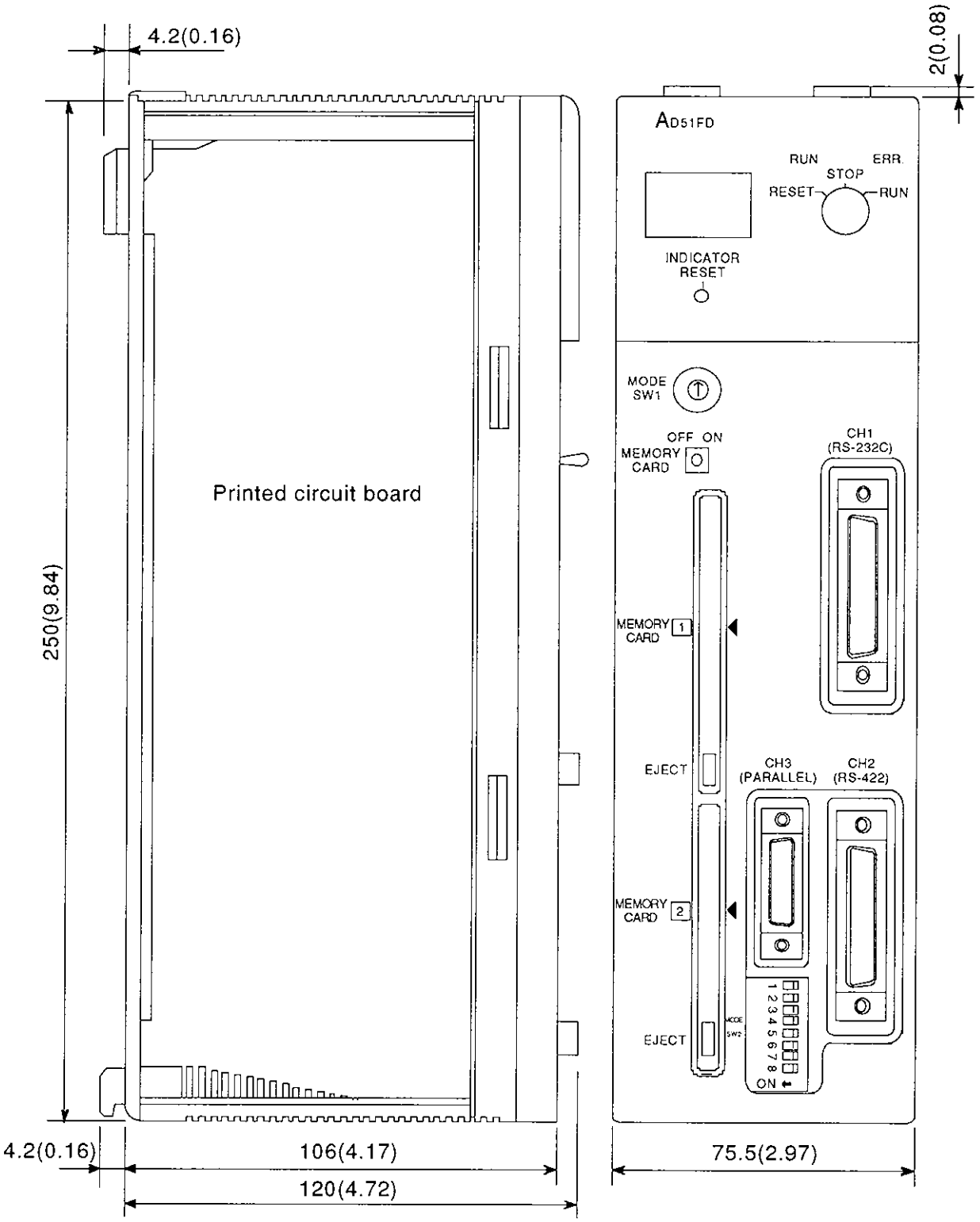
9.5 When AD51FD Does Not Operate Correctly

Cause	Check item	Corrective action
LED indication on the front is abnormal.	• Is RUN LED OFF?	• Take necessary corrective action referring to Section 9.3.
	• Is ERROR LED ON?	• Take necessary corrective action referring to Section 9.4.
Displayed content on the display device on the front is abnormal.	• Is error code or error message displayed?	• Take necessary corrective action referring to Sections 9.1 and 9.2.
	• Is indication normal?	• Reset the display device with indicator reset switch. • Reset it with RUN-STOP-RESET switch.
Data communication is not performed. (AD51FD does not indicate error.)	• Is PC CPU side normal?	• Operate the PC CPU normally according to the troubleshooting described in the manual for PC CPU.
	• Is AD51FD abnormality detected on PC CPU side?	• Install A6GPP/A6PHP to PC CPU, monitor the I/O signal of special M and special D AD51FD, check the contents of abnormality, and recover AD51FD to normal status.
	• Does output number (Y [ ][ ][ ]) of fault diagnosis start command in sequence program coincide with I/O assignment number of AD51FD?	• Check the I/O assignment number of AD51FD, and correct the sequence program.
	• Is mode setting switch on the front set to "0" (or "1")?	• Set the mode setting switch to "0".
	• Is AD51FD normally installed to base unit? • Is base unit normal?	• Install AD51FD securely so that there is no gap or looseness between AD51FD and base unit. • If there is bending, stain, or foreign matter on connector for AD51FD and base unit, remove it.
Fault diagnosis action is abnormal.	• Is condition data set on AD51FD matched with operation of sequence program (control unit)?	• Read the fault data store the A6GPP/A6PHP to AD51FD, and correct the condition data of faulty part according to the operation of control unit.
	• Is abnormality found when unit other than PC CPU is operated?	• Since noise in PC CPU and AD51FD causes abnormality, take necessary corrective action against the noise.
Data is not output to printer.	• Is printer setting dip switch on the front set properly according to the printer?	• Set the switch according to the printer referring to Section 4.5.2. • If general-purpose printer is used, set the switch according to the printer in use.
	• Does printer cable in use conform to the specification? Is the cable normal?	• Use the printer cable which conforms to the specification. • If cable is abnormal, replace it.
	• Check the printer in use.	• Check if there is any abnormality on the printer in use.
	• Is AD51FD normal?	• Remove the abnormality on AD51FD.
Not accessible through RS-422.	• Is RS-422 cable normal?	• If abnormal, replace it.
	• Does foreign matter, stain, etc. adhere on connector for AD51FD?	• Remove the foreign matter, stain, etc. to avoid contact failure.
	• A6GPP/A6PHP side displays error.	• Recover the content of error display.
	• Is AD51FD normal?	• Remove the abnormality on AD51FD.

If all the check items are normal, H/W maybe abnormal.
Consult your nearest Mitsubishi repesentative with details.

APPENDIX

APPENDIX 1 OUTSIDE DIMENSIONS



unit : mm(inch)

IMPORTANT

(1) Design the configuration of a system to provide an external protective or safety inter locking circuit for the PCs.

(2) The components on the printed circuit boards will be damaged by static electricity, so avoid handling them directly. If it is necessary to handle them take the following precautions.

(a) Ground human body and work bench.

(b) Do not touch the conductive areas of the printed circuit board and its electrical parts with and non-grounded tools etc.

Under no circumstances will Mitsubishi Electric be liable or responsible for any consequential damage that may arise as a result of the installation or use of this equipment.

All examples and diagrams shown in this manual are intended only as an aid to understanding the text, not to guarantee operation. Mitsubishi Electric will accept no responsibility for actual use of the product based on these illustrative examples.

Owing to the very great variety in possible applications of this equipment, you must satisfy yourself as to its suitability for your specific application.

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