MITSUBISHI

PROGRAMMABLE CONTROLLER

MELSEC-K

Instruction Manual

Optical Data Link System

MITSUBISHI ELECTRIC

(NA) 66042-A

CONTENTS

1. GENERAL DESCRIPTION

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1. GENERAL DESCRIPTION

The serial data link system permits data communication between plural programmable controllers and I/O units to reduce wiring works of decentralized, long-distance I/O equipment, allow decentralized control, and increase the total number of input/outputs.
The MELSEC-K series serial data link system is available in the type which utilizes coaxial cables or optical fiber cables for the transmission system. This instruction manual explains about the specifications, installation, programming, and external wiring of the optical data link system which utilizes optical fiber cables.

<table>
<tr><th colspan="2"></th><th colspan="5">Coaxial data link system</th><th colspan="5">Optical data link system</th></tr>
<tr><td rowspan="2">Master channel</td><td>CPU unit</td><td colspan="5">K3NCPU | K2CPU-S3 | K2HCPU | K2NCPU</td><td colspan="5">K3NCPUP2 (Link unit incorporated)</td></tr>
<tr><td>Link unit</td><td colspan="5">KJ71L2</td><td colspan="5">–</td></tr>
<tr><td rowspan="3">Local channel</td><td>CPU unit</td><td colspan="5">K3NCPU(P2) | K2CPU-S3 | K2HCPU | K2NCPU | K0</td><td colspan="5">K3NCPU(P2) | K2CPU-S3 | K2HCPU | K2NCPU | K0J1P</td></tr>
<tr><td>Link unit</td><td colspan="4">KJ71L3</td><td>K0DLS</td><td colspan="4">KJ71P3</td><td>–</td></tr>
<tr><td>Base unit</td><td colspan="4">Base unit which can be used for CPU unit</td><td>–</td><td colspan="4">Base unit which can be used for CPU unit</td><td>–</td></tr>
<tr><td rowspan="3">Remote channel</td><td>CPU unit</td><td colspan="3">–</td><td colspan="3">K0</td><td colspan="3">–</td><td colspan="3">K0J1P</td></tr>
<tr><td>Link unit</td><td colspan="3">KJ72L5</td><td colspan="3">K0DLS</td><td colspan="3">KJ72P5</td><td colspan="3">–</td></tr>
<tr><td>Base unit</td><td colspan="3">K12BN, K15BN, K18BN K18BE</td><td colspan="3">–</td><td colspan="3">K12BN, K15BN, K18BN K18BE</td><td colspan="3">–</td></tr>
<tr><td rowspan="3">Number of I/O link points</td><td>Master channel</td><td colspan="6">Max. 480 points</td><td colspan="4">Max. 2048 points</td></tr>
<tr><td>Local channel</td><td colspan="6" rowspan="2">Max. 480 points in total for all channels</td><td colspan="3" rowspan="2">Max. 512 points for 1 channel</td><td>Max. 128 points Y128 points for 1 channel</td></tr>
<tr><td>Remote channel</td><td>Max. 280 points for 1 channel</td></tr>
<tr><td rowspan="2">Data register link</td><td>Number of points</td><td colspan="6">Max. 24 points for 1 channel</td><td colspan="4">Max. 24 points for 1 channel</td></tr>
<tr><td>Used range</td><td colspan="6">D0 to 95</td><td colspan="4">D0 to 95</td></tr>
<tr><td colspan="2">Cable</td><td colspan="6">Coaxial cable</td><td colspan="4">Optical fiber cable</td></tr>
<tr><td colspan="2">Cable length</td><td colspan="6">Overall extension length 500m</td><td colspan="4">2km between channels</td></tr>
<tr><td colspan="2">Maximum number of slave channels</td><td colspan="6">7 units</td><td colspan="4">32 units</td></tr>
<tr><td colspan="2">Communication method</td><td colspan="6">Half duplex bit serial</td><td colspan="4">Half duplex bit serial</td></tr>
<tr><td colspan="2">Communication speed</td><td colspan="6">250KBPS</td><td colspan="4">500KBPS</td></tr>
<tr><td colspan="2">Transmission processing time (for 7 channels X: 32 points, Y: 32 points)</td><td colspan="6">24.8ms</td><td colspan="4">6.5ms</td></tr>
<tr><td colspan="2">Setting of intermittent control time</td><td colspan="6">Not provided</td><td colspan="4">Provided</td></tr>
<tr><td colspan="2">Automatic reconnection function</td><td colspan="6">Not provided</td><td colspan="4">Selectable by switch</td></tr>
<tr><td colspan="2">Setting of online/offline</td><td colspan="6">Not provided</td><td colspan="4">Provided</td></tr>
<tr><td colspan="2">Setting of channel number</td><td colspan="6">Slide switch on printed circuit board</td><td colspan="4">Digital switch on front of CPU unit</td></tr>
</table>

Table 1.1 Comparison between Coaxial Data Link System and Optical Data Link System

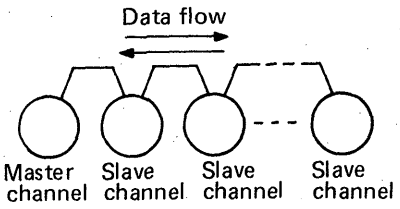
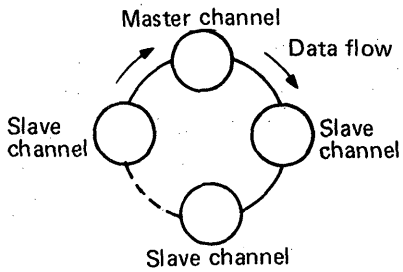
		Coaxial data link system	Optical data link system
Data flow			
Influence of failure	Power of 1 slave channel has been turned off	Specific slave channel is disconnected from the link system.	All channels are disconnected.
	Cable has been disconnected.	Specific slave channel and slave channels that follow are disconnected from the link system.	
Restoring procedure of communication error		After resetting the slave channel or turning on and then off the power, reset the master channel or turn off and then on the power.	When automatic reconnection is not selected After resetting the slave channel or turning on and then off the power, reset the master channel or turn off and then on the power. When automatic reconnection function is selected After the link system is restored, communication is automatically resumed.
Caution for installation		Provide jumper between TXD terminal and SG terminal of master channel and all slave channels.	Provide means to prevent foreign material, such as dust, from entering the sending and receiving portions of optical fiber cable and link unit.

Table 1.1 Comparison between Coaxial Data Link System and Optical Data Link System (Continued)

MEMO

2. SPECIFICATIONS

2. SPECIFICATIONS

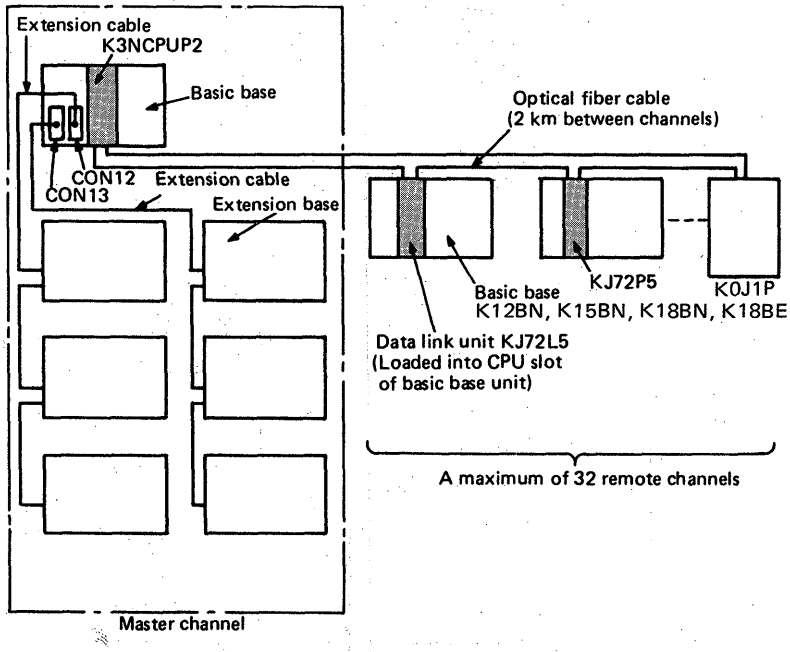
2.1 Performance Specifications

Item	Specifications
Communication speed	500 KBPS
Communication method	Semi-double bit serial (Full double bit serial for master test)
Synchronous communication	Frame synchronization
Transmission path	Loop type polling method
Max. transmission optical cable length	2 km maximum between channels
Number of connected stations	33 stations maximum (1 master channel, 32 slave channels)
Transmission code	Transparent code
Transmission format	Conforms to HDLC (Frame type)
Error control method	CRC (generating polynominal: $X^{16} + X^{12} + X^5 + 1$) and retry by overtime
Fail safe function	When error is detected, only a corresponding channel is disconnected.
Disconnection function	Forced disconnection is possible by switch.
Automatic reconnection function	Selection is possible by switch.
Optical connector	OD-9475B (NEC), FOJD-PL1-1-125G (JAE)
Transmission loss of optical connector	1 dB/piece
Optical fiber cable	Core diameter: 50 ± 3μm GI (quartz glass) Clad diameter: 125 ± 3μm
Transmission loss of optical fiber cable	Less than 3.5 dB/km (ON = 0.85μm)
Optical sending level	−25 dBm (peak)
Optical receiving level	−25 to −37 dBm (peak)
Operating ambient temperature	0 to 55°C
Storage ambient temperature	−10 to 75°C
Operating ambient humidity	10 to 90%RH (no dew condensation)
Storage ambient humidity	10 to 90%RH (no dew condensation)
Vibration resistance	Conforms to Class 3, IIB, JIS C 0911 (16.7 Hz, 3-mm double amplitude, 2 hrs.)
Shock resistance	Conforms to JIS C 0912 (10 g x 3 times in X, Y, and Z directions)
Operating ambience	Particularly dust and corrosive gas should be minimal.

Table 2.1 Performance Specifications

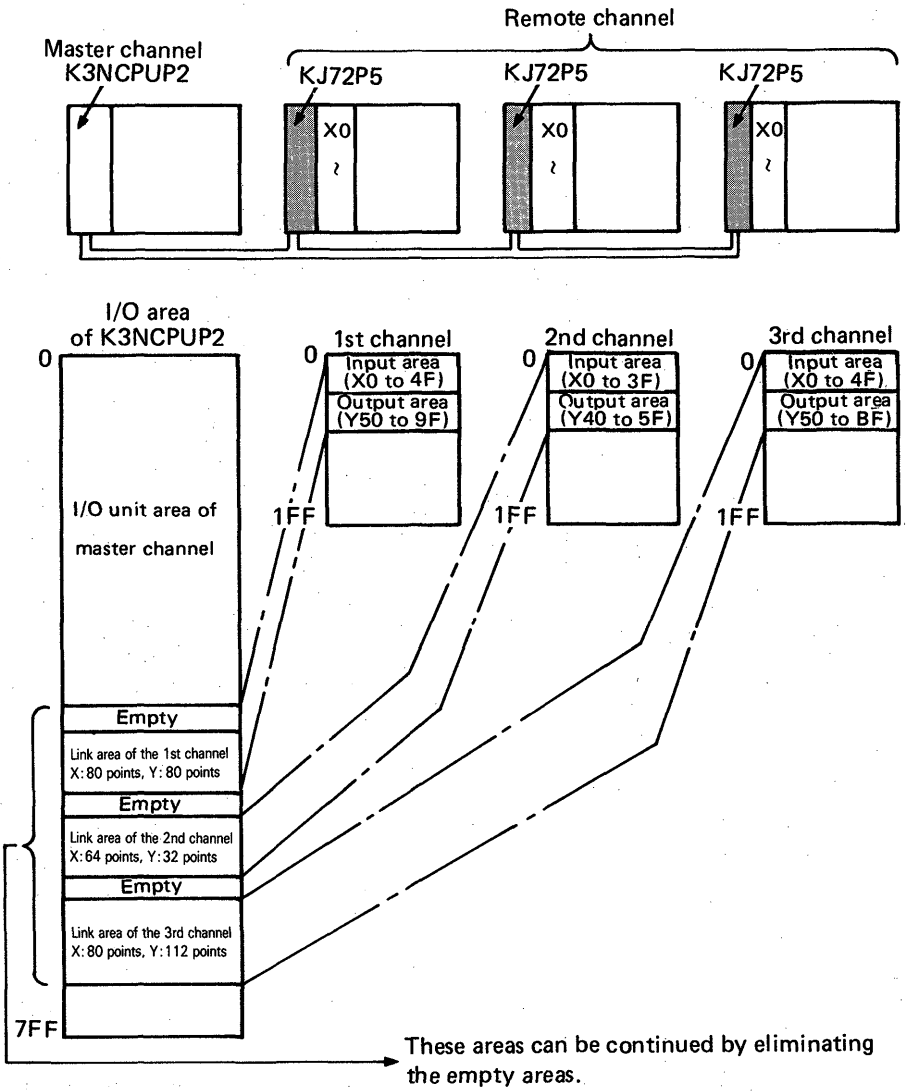
2.2 Remote I/O System

System which allows serial communication of I/O data between master and remote channels and is applied in order to reduce wiring work coats of long distance I/O.

		Optical data link system (Remote I/O system)
Configuration		
Master channel	CPU unit	K3NCPUP2 (Optical data link card incorporated)
	Data link unit	–
	Maximum number of link points	2048 points (A total of 32 channels)
	Maximum number of I/O points	2048 points – (total of link points)
Remote channel	Maximum number of link units	32 units
	Number of link points	Max. 512 points for 1 channel, a total of 2048 points for 32 channels
Total number of I/O points of system		Max. 2048 points
Restrictions		(1) The following special units cannot be loaded into the remote channel: ○ KN61, KN62, KT61, KD51E, KJ71L7, KJ71L4, KJ71L2, KJ71L3, KJ71P3

2

	Optical data link system (Remote I/O system)
Concept of link range	Explanation is made for a system which has 3 remote channels and I/O points as indicated below: 1st channel – X: 80 points, Y: 80 points 2nd channel – X: 64 points, Y: 32 points 3rd channel – X: 80 points, Y: 112 points

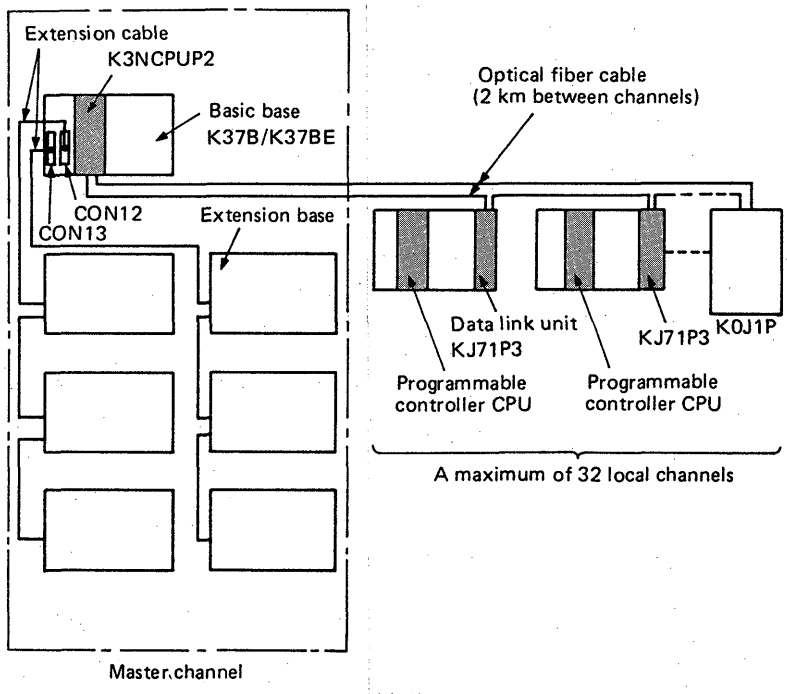


NOTE

The I/O areas of remote channel indicate the link areas specified by the initial program of master channel.

2.3 Local Programmable Controller System

System which allows serial data communication between master and local channels and is applied in order to expand the number of total I/O points and perform decentralized control.

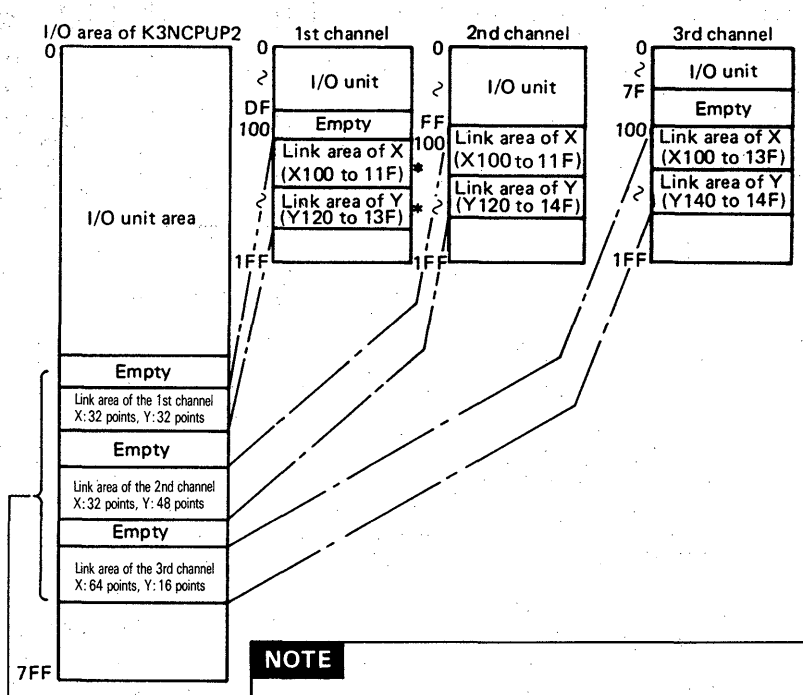
<table>
<tr><td colspan="2"></td><td colspan="5">Optical data link system (Local programmable controller system)</td></tr>
<tr><td colspan="2">Configuration</td><td colspan="5"> 
</td></tr>
<tr><td rowspan="4">Master channel</td><td>CPU unit</td><td colspan="5">K3NCPUP2 (Optical data link card incorporated)</td></tr>
<tr><td>Data link unit</td><td colspan="5">–</td></tr>
<tr><td>Maximum number of link points</td><td colspan="5">2048 points</td></tr>
<tr><td>Maximum number of I/O points</td><td colspan="5">2048 points – (total of link points)</td></tr>
<tr><td rowspan="3">Local channel</td><td>CPU unit</td><td>K3NCPU(P2)</td><td>K2NCPU</td><td>K2CPU-S3</td><td>K2HCPU</td><td>K0J1P</td></tr>
<tr><td>Maximum number of link units</td><td>(2048 points – 32 points) – (number of I/O points)</td><td colspan="3">(512 points – 32 points) – (number of I/O points)</td><td>128 points</td></tr>
<tr><td>Number of link points</td><td colspan="5">32 units</td></tr>
<tr><td colspan="2">Total number of I/O points of system</td><td colspan="5">(2048 points – total of link points) + (total of I/O points of local channels)</td></tr>
</table>

Optical data link system (Local programmable controller system)

Concept of link range

Explanation is made for a system which has 3 local channels and the number of I/O points and the number of X and Y link points as indicated below.

	Number of I/O Points	Number of X Link Points	Number of Y Link Points
1st channel	224 points	32 points	32 points
2nd channel	256 points	32 points	48 points
3rd channel	128 points	64 points	16 points



NOTE

**X and Y link areas of local channels indicate the link areas specified by the initial program of master channel.*

These areas can be continued by eliminating the empty areas.

2.4 Number of Link Points

	Master Channel	Local Channel			Remote Channel	
	K3NCPUP2	K3NCPU	K2NCPU K2HCPU K2CPU-S3	K0J1P	KJ72P5	K0J1P
Number of max. link I/O points	*3 2048	*1 (2048 – 32) – number of used I/O points	*2 (512 – 32) – number of used I/O points	256 Input: 128 points Output: 128 points	512	168
Number of max. data register link points	24	24	24	24	–	–

Table 2.4 Number of Link Points

*1: When the K3NCPU is used as a local channel, the number of maximum link I/O points is (2048 – 32) – number of used I/O points. However, there is the following restriction as a transfer

(32): Number of exclusively used I/O points of KJ71P3

(number of used I/O points): Used for its own channel without respect to link

condition:

Maximum link input points = 512
Maximum link output points = 512

Even if the number of maximum link points (512 + 512 = 1024) is used for both the input and output, the expression of $1024 \geqq (2048 - 32) -$ (number of used I/O points) should be satisfied.

*2: (512 – 32) – number of used I/O points

(32): Number of exclusively used I/O points of KJ71P3

(number of used I/O points): Used for its own channel without respect to link

*3: The number of maximum link I/O points of the K3NCPUP2 is 2048 points. Actually, the K3NCPUP2 has link images of 2048 points for input and output, respectively, i.e. X = 2048 (X00 to X7FF) and Y = 2048 (Y00 to Y7FF).

MEMO

3. HARDWARE CONFIGURATION AND HANDLING

3. HARDWARE CONFIGURATION AND HANDLING

3.1 List of Equipment

Type	Application	Weight (g)
K3NCPUP2	CPU unit on master channel side	2300
KJ71P3	Link unit on local programmable controller side	780
KJ72P5	Link unit on remote I/O side	780
K0J1P	Usable as local programmable controller and remote I/O channel	1300

See Section 7 for wiring optical fiber cables.

Table 3.1 List of Equipment

3.2 System Configuration

The hardware configuration example is shown in Fig. 3.1.

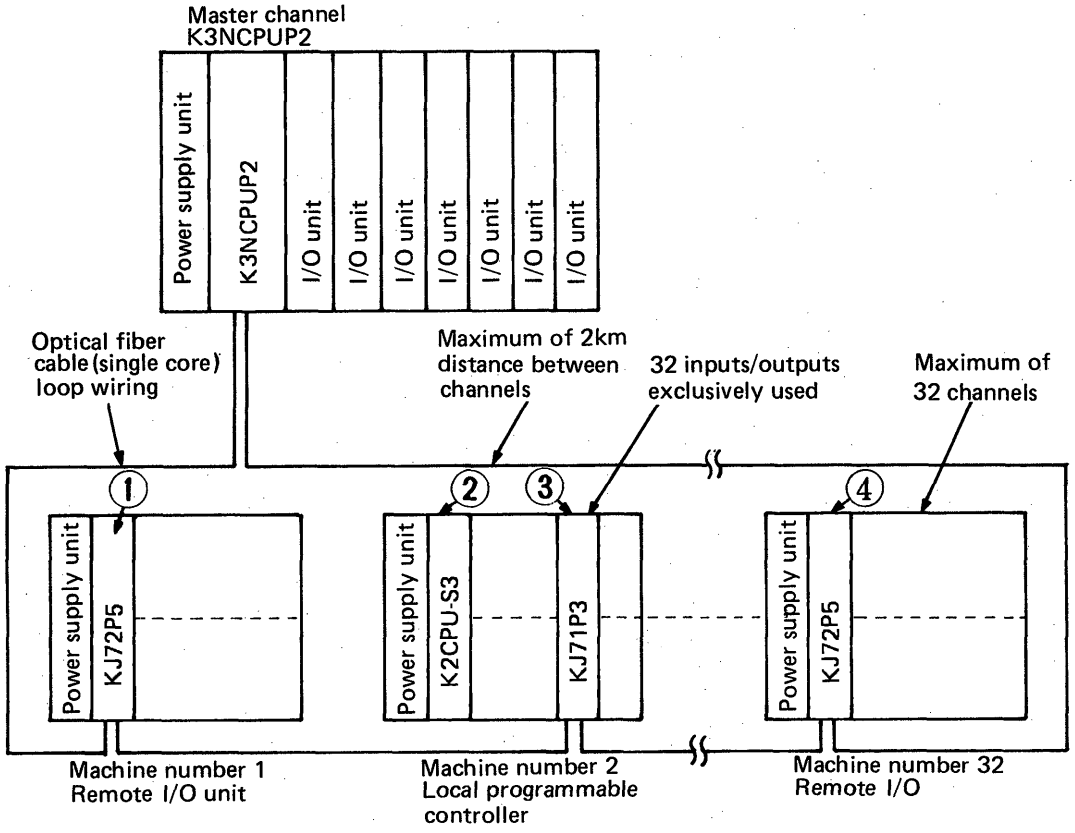


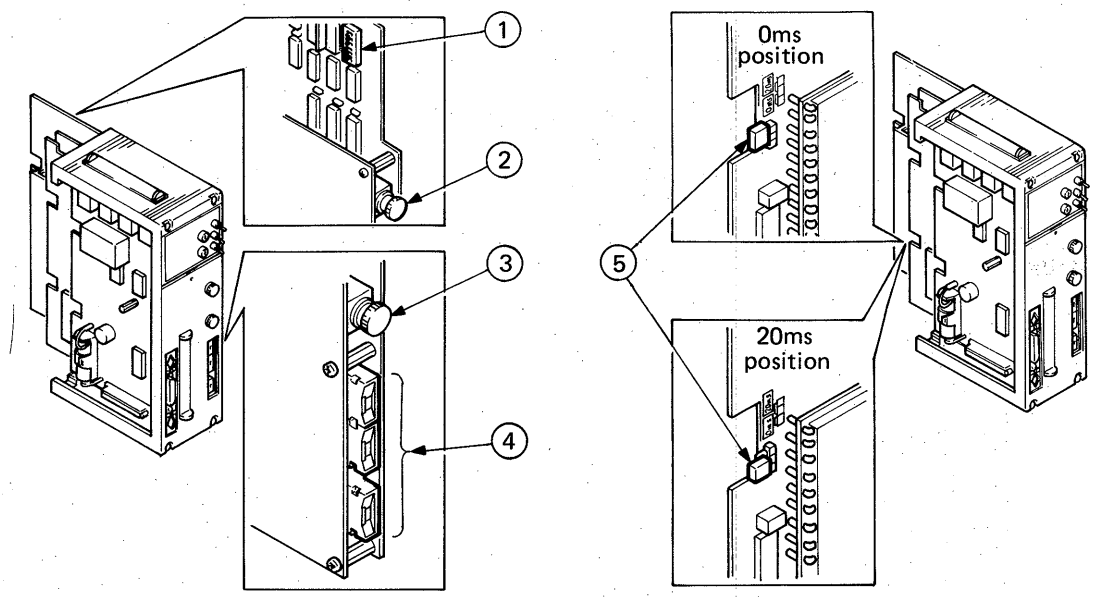
Fig. 3.1 System Configuration Example

①: Load KJ72P5 into the CPU position of basic base unit (K18BE, K18BN, K15BN, K12BN). (The K0J1P can also be used as remote I/O.)

②: The CPU unit used for local programmable controller is K3NCPU, K2CPU-S3, K2HCPU, K2NCPU or K0J1P.

③: Load KJ71P3 into desired position except I/O slot, which will be used for link program, and I/O slot which is being used for link program.

3.3 K3NCPUP2 Hardware



① Remove the rear cover before use. Unload the 4th printed circuit board for optical link. Set the internal slide switches according to the purpose of use.

CAUTION

Since the printed circuit board is packaged with electronic parts which will be adversely affected by static electricity, be careful not to directly touch the conductive area and electrical parts when handling.

Switch Position	Function	
1	For setting intermittent control time	--- See Section 3.7 (page 24).
2		
3		
4	Keep at OFF position. (Not used.)	--- Be sure to keep switches 4, 5 and 6 at OFF position. Switches 4, 5 and 6 are used for factory setting test. Therefore, if they are moved to ON position, normal operation cannot be performed.
5		
6		
7	OFF to fix intermittent control time	--- See Section 3.6 (page 23).
8	For selecting automatic reconnection function	--- When a slave channel is disconnected from the link system due to error or offline mode selection, the automatic reconnection function automatically reconnects the slave channel with the link system when the error is remedied or online mode is selected.

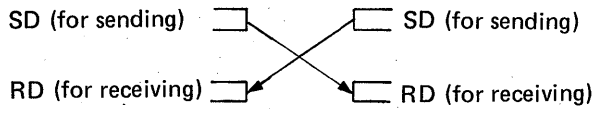
See Table 3.2 (page 27).

Content	Slide Switch Position 8 Setting	
	Master Channel	Slave Channel
Whole system is automatically reconnected	OFF	OFF
Whole system is automatically reconnected except the set slave channel	OFF	ON
Whole system is not automatically reconnected	ON	ON/OFF

3

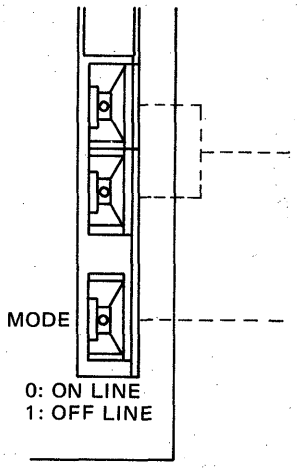
② SD ③ RD

- Connector for connecting an optical fiber cable. When connecting the cable, remove the connector cover, positively insert the connector of optical fiber cable, turn it clockwise, and securely connect it.
- Be careful not to touch the core at the center of optical connector or not to apply dust to the core.
- When the optical fiber cable is not connected, be sure to mount the connector cover.



Be sure to connect the optical fiber cables from SD (for sending) to RD (for receiving) and from RD (for receiving) to SD (for sending).

④ Mode setting digital switch



Be sure to set the upper 2 digital switches to "00". Factory-set to "00".

Mode setting digital switch

0	Online (Should always be "0" normally)
1	Offline (Set when slave channel is put to master test)
2 ~ 9	Cannot be set. (Unused)

Caution: Setting the mode switch from 0 to 9 and from 0 to 1 gives the same result. Therefore, exercise special care for the control of mode switch during operation.

⑤ Instantaneous power failure setting select connector

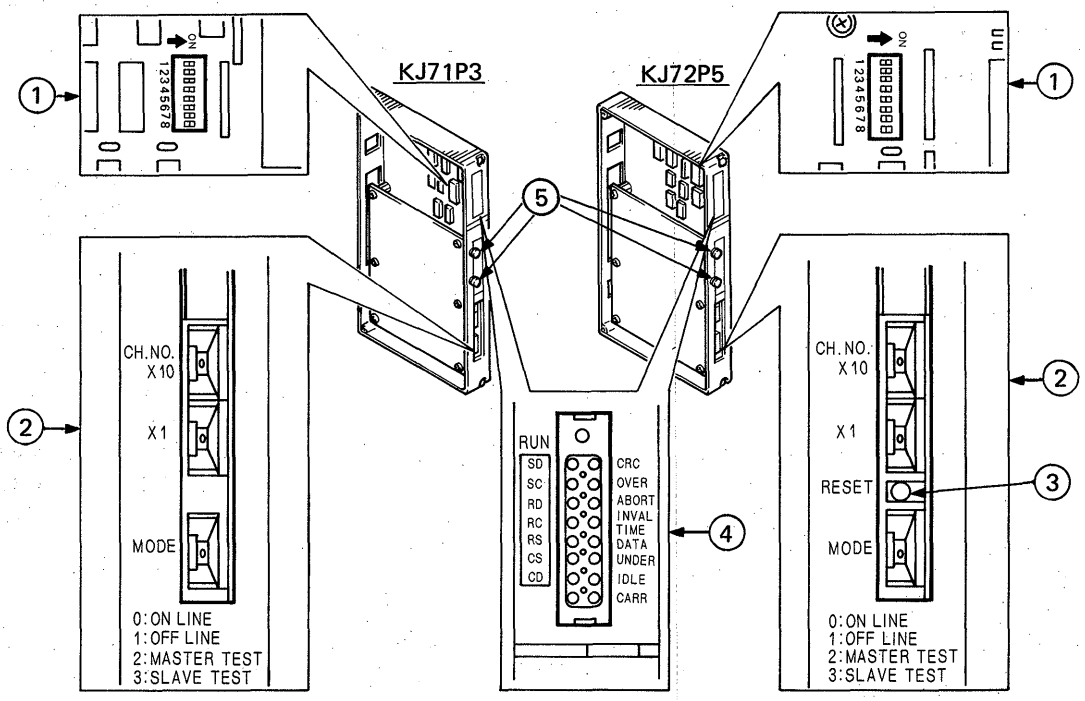
In regards to only the combinations of version products indicated in the following table, the setting of instantaneous power failure setting select switch to the 20ms position allows continuance of data link without stop if instantaneous power failure of within 20 ms occurs.

		Unit Name	Version Number
Master channel	CPU	K3NCPUP2	505LC and thereafter
	Basic base	K37B, K37BE	505B and thereafter
	Extension base	K65BN, K68BN, K68BE	410B and thereafter
Local channel	CPU	K3NCPU	505FA and thereafter
		K3NCPUP2	505LC and thereafter
		K2NCPU	504CB and thereafter
	Basic base	K37B, K37BE	505B and thereafter
		K12BN, K15BN, K18BN, K18BE	410B and thereafter
	Extension base	K65BN, K68BN, K68BE	410B and thereafter
Remote channel		K0J1P	No relation

Check the version by the DATE column of rating plate attached to the product.

- 20 ms instantaneous power failure is not available for products which are not indicated in the above table.
- When a product not indicated in the above table is included in the system, 20 ms instantaneous power failure cannot be performed, either. Be sure to set the instantaneous power failure setting select connector of each unit (units which allow instantaneous power failure such as K3NCPU(P2) and K2N) to the 0ms position. If the connector is set to the 20ms position, output is provided by mistake when the power is turned on or off.

3.4 KJ71P3 and KJ72P5 Hardware



① Before use, set the internal slide switches according to the purpose of use.

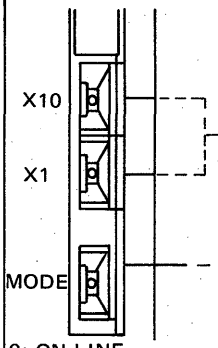
CAUTION

Since the printed circuit board is packaged with electronic parts which will be adversely affected by static electricity, be careful not to directly touch the conductive area and electrical parts when handling.

Switch Number	Function	
1	For setting intermittent control time	See Section 3.7 (page 24).
2		
3		
4	Keep at OFF position. (Not used.)	Be sure to keep switches 4, 5 and 6 at OFF position. Switches 4, 5 and 6 are used for factory setting test. Therefore, if they are moved to ON position, normal operation cannot be performed.
5		
6		
7	OFF to fix intermittent control time	See Section 3.6 (page 23).
8	For selecting automatic reconnection function	When a slave channel is disconnected from the link system due to error or offline mode selection, the automatic reconnection function automatically reconnects the slave channel with the link system when the error is remedied or online mode is selected.

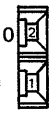
See Table 3.2 (page 27).

Content	Slide Switch Number 8 Setting	
	Master Channel	Slave Channel
Whole system is automatically reconnected	OFF	OFF
Whole system is automatically reconnected except the set slave channel	OFF	ON
Whole system is not automatically reconnected	ON	ON/OFF

② 

These 2 digital switches are used to set channel number when remote I/O or local programmable controller is used.

[Example]



When the channel number is 21, the range setting is 0 to 32.

0	Online
1	Offline
2	Master test
3	Slave test
4 ~ 9	Do not set.

Caution: Setting the mode switch from 0 to 9 and from 0 to 1 gives the same result. Therefore, exercise special care for the control of mode switch during operation.

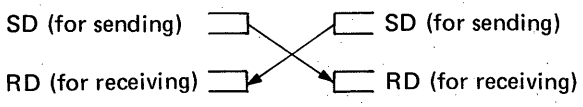
③ Reset switch (KJ72P5)

When the operation of system is resumed after error has occurred and remedied (not for the start or automatic reconnection of optical data link system), press the RESET switch to start the operation of system. See Table 3.2 (page 27).

④ LED display: The front LED displays allow checking of optical data link state.

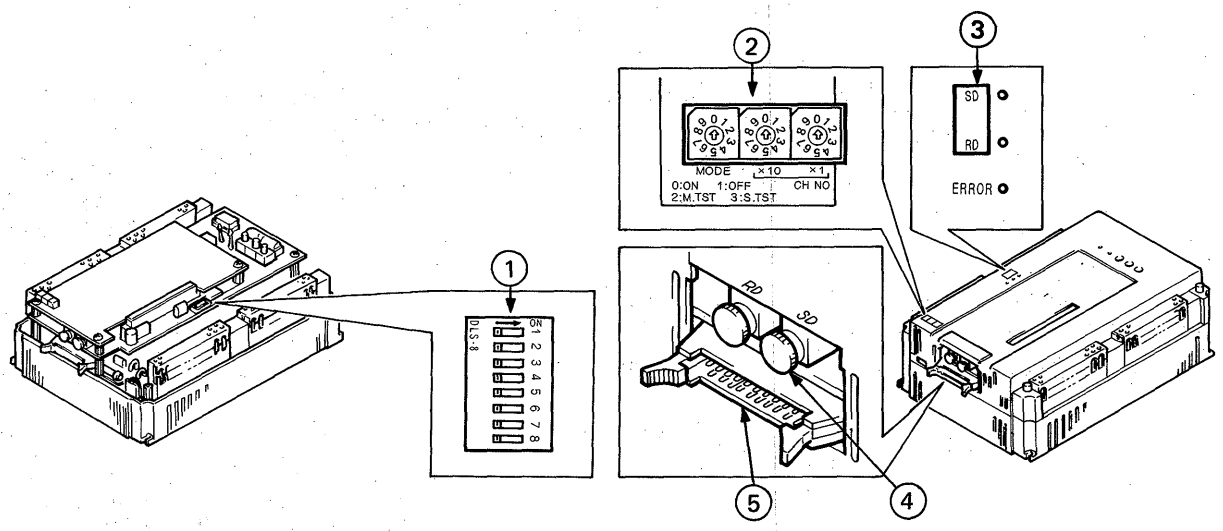
Display	Description	Contents	Condition
RUN	CPU RUN	Optical link CPU is running normally.	Turns on when hardware is normal.
SD	Send Data	Send data	
SC	Send Clock	Send clock	
RD	Receive Data	Receive data	
RC	Receive clock	Receive clock	
RS	Request to Send	Request to send	Dimly lit when sending and receiving are normal.
CS	Clear to Send	Sending is possible	
CD	Carrier Detect	Carrier detect	
CRC	CRC Error	Code check error	Turns on when error is detected.
OVER	Overrun Error	Data receiving delay error	
ABORT. INVAL	Aborted or Invalid Frame Error	Data are all "1".	
TIME	Time Over	Time over error	
DATA	Data Error	Receive data error	
UNDER	–	(Not used)	Off
IDLE			
CARR			

⑤
- Connector for connecting an optical fiber cable. When connecting the cable, remove the connector cover, positively insert the connector of optical fiber cable, turn it clockwise, and securely connect it.
- Be careful not to touch the core at the center of optical connector or not to apply dust to the core.
- When the optical fiber cable is not connected, be sure to mount the connector cover.



Be sure to connect the optical fiber cables from SD (for sending) to RD (for receiving) and from RD (for receiving) to SD (for sending).

3.5 K0J1P Hardware

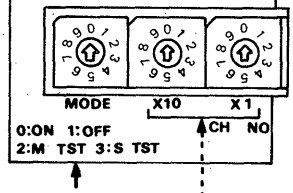


(1) Before use, remove the front cover and set the internal slide switches according to the purpose of use.

Switch Number		Independent Programmable Controller	Remote I/O	Local Programmable Controller
1	Not used			
2	Not used			
3		OFF	ON	OFF
4		OFF	OFF	ON
5	Not used			
6	Not used			
7	Not used			
8		OFF	ON	

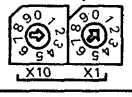
Automatic Reconnection	No Automatic Reconnection
OFF	ON

(2) Mode and channel number setting rotary switch



These 2 digital switches are used to set channel number when remote I/O or local programmable controller is used.

Example

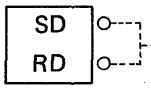


Indicates channel number 32. Set to "00" for independent programmable controller.

Setting Number	Mode
0	Online
1	Offline
2	Master test
3	Slave test
4 ~ 9	Do not set. (Do not use.)

The switching of mode switch number is valid at power-on and reset. However, switching between online and offline is always valid.

③ Sending, receiving and link error indicator LEDs during optical data link



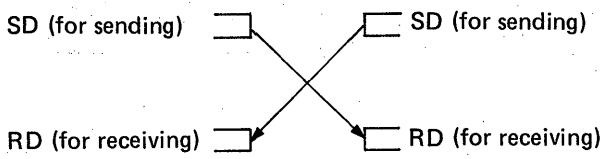
SD is an LED for indicating sending and RD for indicating receiving. During normal communication, both LEDs are lit dimly.

ERROR

- Lit when optical communication is abnormal. For example, breakage of optical fiber cable and improper connection of optical connector.
- When master test and slave test are conducted, this LED is used for judgement. See Section 5.3.4 (page 72).
- When the scan time of master programmable controller is 250 ms or longer, this LED is lit during over time. See Section 5.3.1 (page 62).

④

- Connector for connecting an optical fiber cable. When connecting the cable, remove the connector cover, positively insert the connector of optical fiber cable, turn it clockwise, and securely connect it.
- Be careful not to touch the core at the center of optical connector or not to apply dust to the core.



Be sure to connect the optical fiber cables from SD (for sending) to RD (for receiving) and from RD (for receiving) to SD (for sending).

⑤ Connector for extension cable

When the extension unit (E32, E56) is connected, connect the extension cable K0J-61CBL or K0J-61CBL2 to this connector.

3.6 Intermittent Control Time (Set on the master channel side)

In the remote I/O system, the K3NCPUP2 performs the sending and receiving of data between the master channel and remote channels at each OUT F100 instruction of sequence processing. For this reason, if the sequence operation processing time is too short, the the data in the preceding sending may not be fully processed by the remote channel. To allow the remote channel to fully process the data, the master channel provides a delay before the next data sending. This delay is called the intermittent control time. (Operation processing time of programmable controller + X/Y communication time between programmable controller CPU and optical link unit)

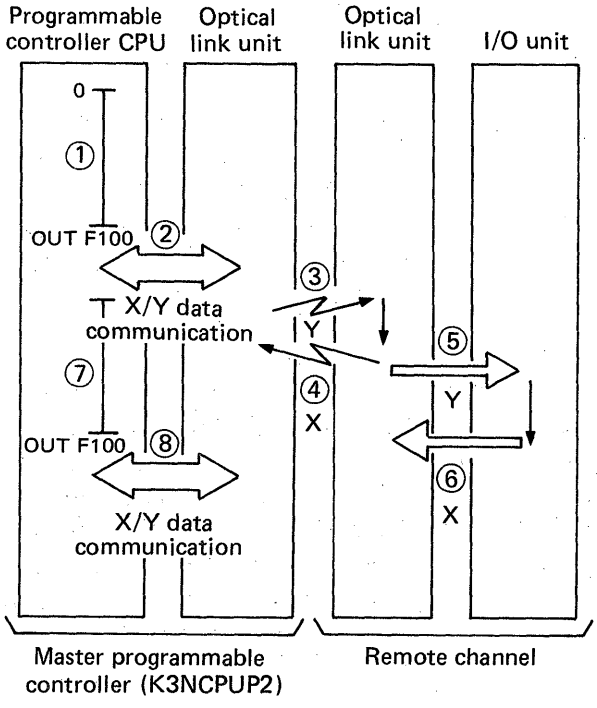


Fig. 3.1

① Sequence program operation from step 0 to OUT F100
② After OUT F100 operation, X and Y data in the range specified by the initial program are communicated between the programmable controller CPU and optical link unit.
③ Y data are transferred to the optical link unit of remote channel.
④ X data in its own channel are transferred from the optical link unit of remote channel to the optical link unit in the K3NCPUP2.
⑤ After X/Y data are transferred between the optical link unit of remote channel and the optical link unit in the K3NCPUP2, Y data are output to the output card in its own channel (remote channel).
⑥ After Y data are output to the output card, input data are input from the input card to the optical link unit (remote channel).
⑦ After the transfer of X data in 4 , the programmable controller CPU initiates the sequence program operation, beginning with step 0.
⑧ Same as ② .

The above ① to ⑧ indicate the data communication of a normal link system. Under the following conditions, however, it is required to set the intermittent control time.

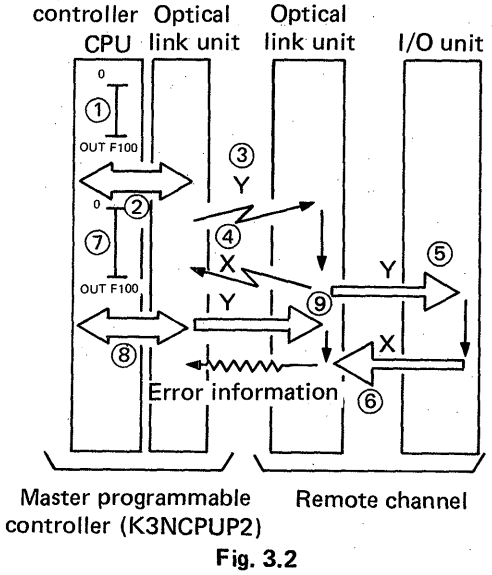


Fig. 3.2

If the sequence program of programmable controller CPU is short as shown in Fig. 3.2, Y data are sent from the optical link unit of master channel to the remote channel as shown by ⑨ although the optical link unit of remote channel is communicating X/Y data in ⑤ to ⑥. At this time, error information is returned from the optical link unit of master channel to the optical link unit of remote channel, and at the same time, the preceding X data are transferred. Each time the master programmable controller receives error information, it elongates the present operation processing time (step 0 to step 0) by 5 ms and at the same time, adds "1" to the contents of internal data register DA04.

3.7 Setting Procedure of Intermittent Control Time

Intermittent Control Time / Switch Number	Intermittent Control Time							
	0	1	2	3	4	5	6	7
	5 ms	10 ms	15 ms	20 ms	25 ms	30 ms	35 ms	40 ms
1	OFF	ON	OFF	ON	OFF	ON	OFF	ON
2	OFF	OFF	ON	ON	OFF	OFF	ON	ON
3	OFF	OFF	OFF	OFF	ON	ON	ON	ON

Table 3.1 Intermittent Control Time Setting

The intermittent control time can be set within the range of 5 and 40 ms according to the above Table 3.1.
However, if the sequence operation processing time of K3NCPUP2 is 40 ms or longer, the setting of intermittent control time is not required.

Determination of intermittent control interval

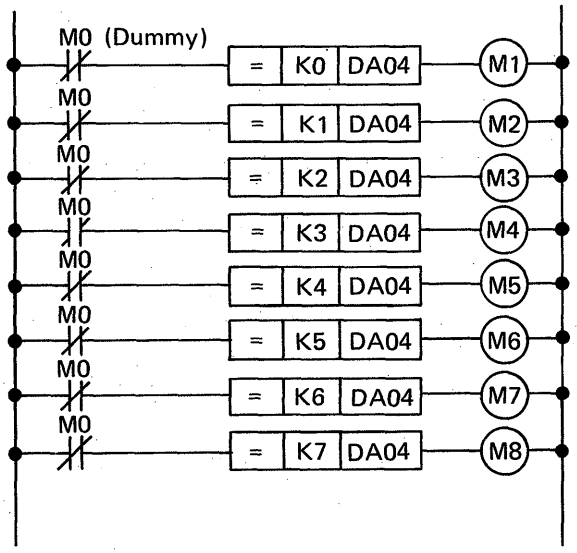


Fig. 3.3

Insert the program shown in Fig. 3.3 into the location behind the initial program and set the intermittent control time during test run. The intermittent control time can be determined by checking which coil of M1 to M8 is on by monitoring of PU or GPP. For instance, when M5 is on, the intermittent control time required is 25 ms. Therefore, set SW3 to the ON position.
After the setting, the program shown in Fig. 3.3 is not required. Therefore, it is recommended to delete it. After the setting of intermittent control time, however, if error information is transferred from the remote channel again, "1" is automatically added to the contents of DA04 (see Section 3.7), and as a result, the intermittent control time is elongated by 5 ms. If longer time is inconvenient, move SW7 to the OFF position. Then the set control time can be fixed.

DA03: Stores the states of switches 1 to 3 which have been converted into 0 to 7 as shown in Table 3.1.
DA04: In the initial state, stores the contents of DA03. During run, stores temporary values which have been converted into 0 to 7 after comparison with the actual intermittent control time.

3.8 Optical Link Interface

The optical link interface circuit is shown in Fig. 3.4. Each state of interface is explained below.

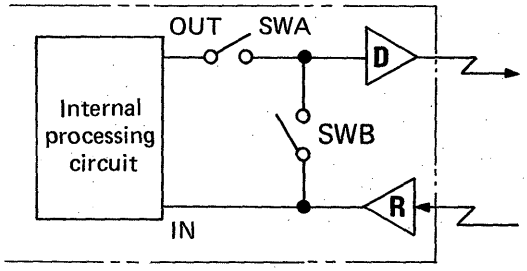


Fig. 3.4 Optical Link Unit Interface Circuit

Data receiving - online

During data receiving in the online mode, SWA is open and SWB is closed as shown in Fig. 3.5. Send data from the exterior are input to the internal processing circuit through the receiver (R), and at the same time, sent from the driver (D) to the next channel via SWB.

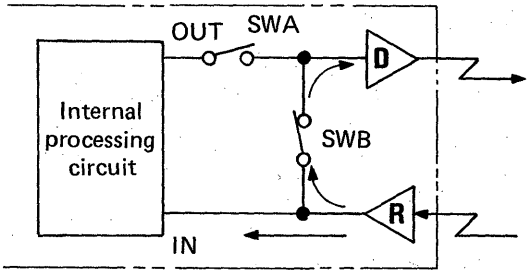


Fig. 3.5 Online – Data Communication

Data sending - online

During data sending in the online mode, SWA is closed and SWB is open as shown in Fig. 3.6. Send data transferred from the internal processing circuit are sent from the driver (D) to the next channel via SWA.

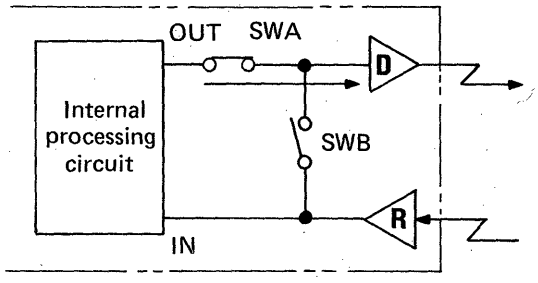


Fig. 3.6 Online – Data Communication

Offline

In the offline mode, SWA is open and SWB is closed as shown in Fig. 3.7. (The state is the same as that of data receiving.) Send data from the exterior are sent to the next channel via the receiver (R), SWA and the driver (D). For the offline mode, the internal processing circuit is automatically stopped.

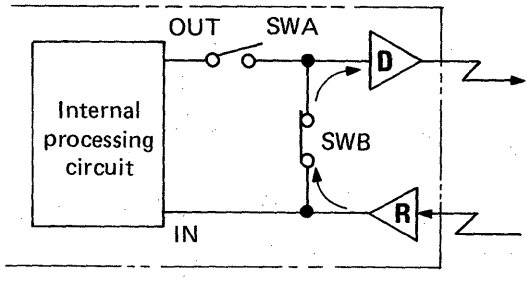
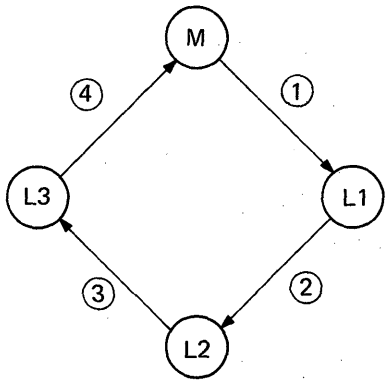


Fig. 3.7 Offline

3.9 Link Data Flow in Optical Link Loop



The flow of data is explained by use of the optical data link system which consists of 3 local programmable controllers.

After the system is started, the master programmable controller (M) transfers link data to the local programmable controllers (L1 → L2 → L3) in due order.

(1) Link data is transferred from M to L1 ①

(2) Link data is transferred from L1 to M ② → ③ → ④

(3) Link data is transferred from M to L2 ① → ②

(4) Link data is transferred from L2 to M ③ → ④

(5) Link data is transferred from M to L3 ① → ② → ③

(6) Link data is transferred from L3 to M ④

As indicated by (1) to (6), data is transferred in order of M → L and L → M.

3.10 Concept of Channel Numbers in Optical Link Loop

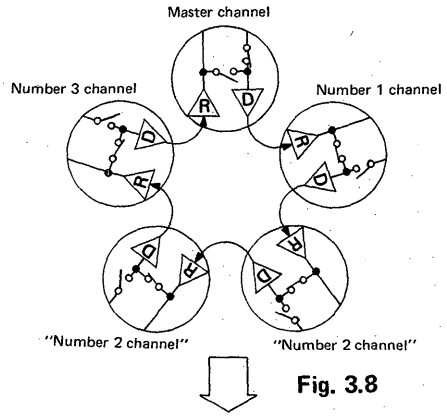


Fig. 3.8

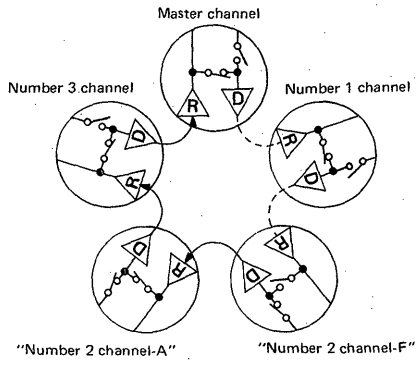


Fig. 3.9

As shown in Fig. 3.8, when the same channel numbers exist inside a link loop (in this example, there are two Number 2 channels), send data from the master channel are sent to each channel, each channel receives only the data which is required at its own channel, and processing is continued.

The example of data sending from the slave channel to the master channel is shown in Fig. 3.9. In this instance, data are sent from Number 2 channel to the master channel. In this case, however, since there are two Number 2 channels, the send data of the first Number 2 channel (Number 2 channel-F) are merely sent to the adjacent Number 2 channel (Number 2 channel-A) and are not transferred to the master channel (because the switch across R and D of Number 2 channel-A is open). Therefore, when the same channel numbers exist within a link loop, the master channel receives data from the last channel in relation to the master channel (in this example, only the data of Number 2 channel-A are transferred to the master channel). Accordingly, since normal link data transfer cannot be performed, avoid setting the same channel numbers in the loop.

Automatic Reconnection Mode	Slave Channel to Be Re-set			RESET Switch	
	ONLINE-OFFLINE switch	Re-setting of channel number	ONLINE-OFFLINE switch	Master channel	Re-set slave channel
All channel sutomatic reconnection mode	Offline ⇨	Re-setting of channel number ⇨	Online ⇨	Not required	
Master channel is in automatic reconnection mode. Slave channels to be re-set are not in automatic reconnection mode.				Not required ⇨	Reset
Master channel is not in automatic reconnection mode. Slave channels are in automatic reconnection mode.		*: Slave channels are 01 to 32.		Reset ⇨	Not required
All channels are not in automatic reconnection mode. *1				Reset ⇦	Reset

*1: *To reset the system in the all channel automatic reconnection mode, be sure to reset the slave channels and then the master channel.*

Table 3.2 Channel Number Re-setting Method and Syatem Resetting Method after Re-setting

MEMO

4. PROGRAMMING

4. PROGRAMMING

4.1 Number of Link Points

Up to 2048 points are used for X (X0 to X7FF) and Y (Y0 to Y7FF), respectively, for data link. These link points are divided in units of 16 points for a maximum of 32 channels.

4.2 Number of I/O Points

[Master channel]

A maximum of 55 I/O units can be loaded.

Number of I/O points = 2048 points–number of link points

[Local channel]

The number of I/O points is calculated by the following expression:

Number of I/O points = [*] points -32 points – number of link points

(Number of total link points assigned to its own channel)

(Number of exclusively used points of KJ71P3)

*K2CPU-S3, K2HCPU, K2NCPU: 512
K3NCPU: 2048

Note 1: Since the K0J1P has a built-in link unit, its link points are 256 points.

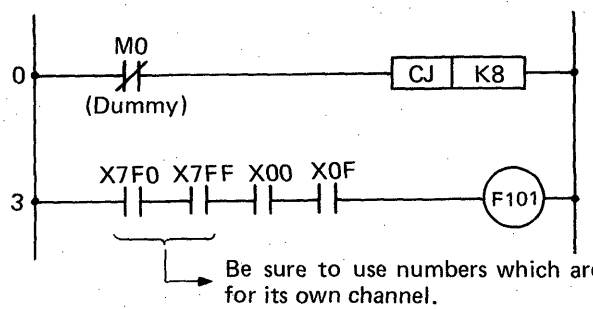
[Remote channel]

KJ72P5: 512
K0J2P: 168

See Table 2.4 (Page 13) "List of Link Points".

CAUTION

1. When the K3NCPUP2 is not used for data link, be sure to write the following initial program at the beginning of program. If the initial program is not written, error (A07) will occur.

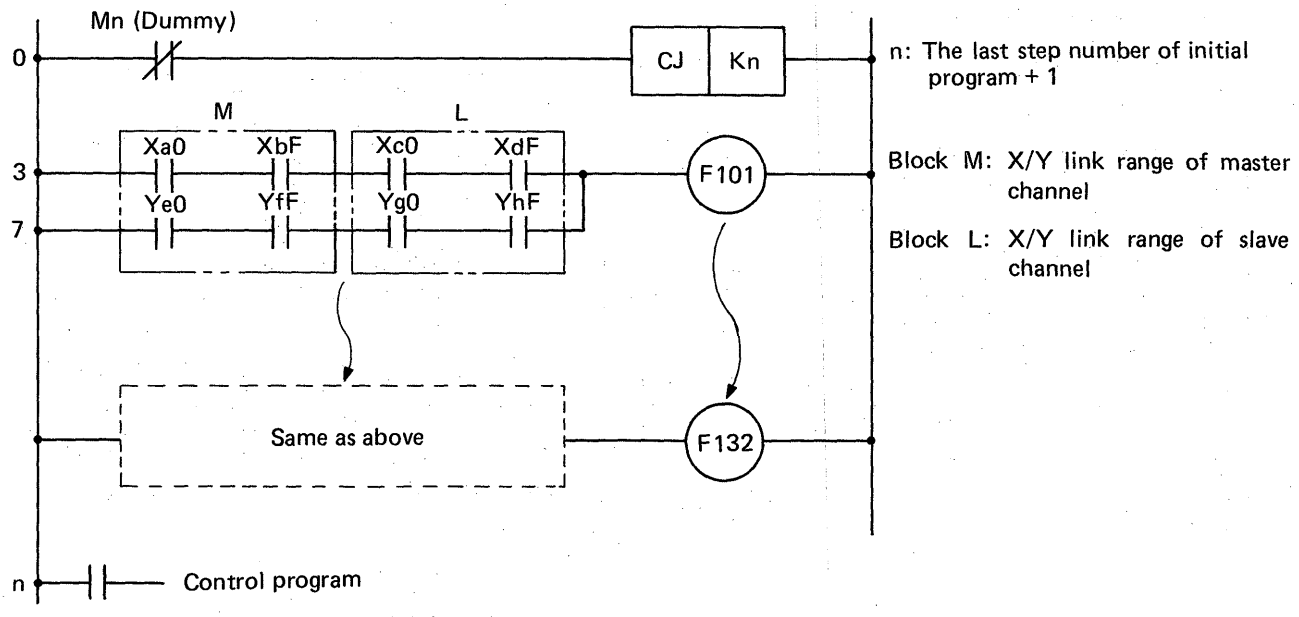


4.3 Preparing Procedure of Initial Program for Master Channel (K3NCPUP2)

4.3.1 Preparation of initial program

The master channel (K3NCPUP2) always requires an initial program at the beginning of program. Since the initial program differs between the remote I/O channel and local channel, prepare the program taking care of the following points:

Format of initial program



Restrictions on format of initial program

1) Be sure to specify the link I/O range with a multiple of 16 points.

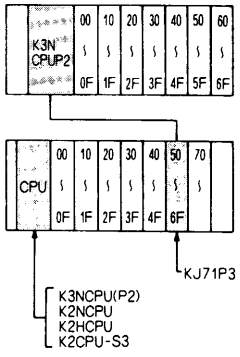
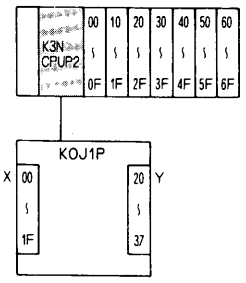
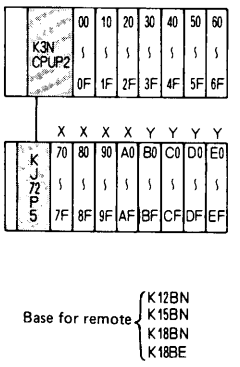
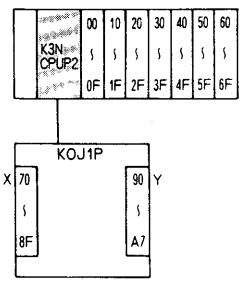
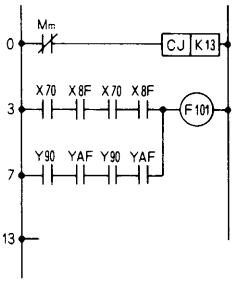
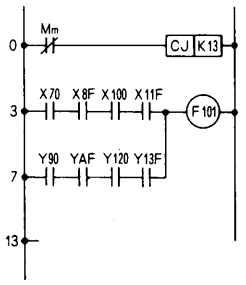
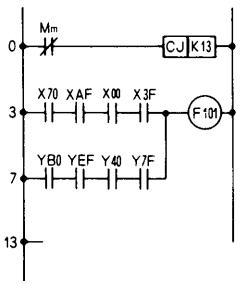
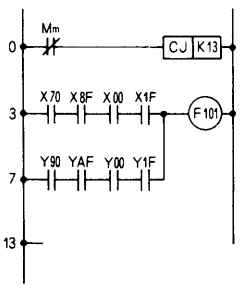
2) aO $\leqq$ eO, bF $\leqq$ fF, CO $\leqq$ gO and dF $\leqq$ gF should be satisfied.

3) The I/O addresses between M blocks (e.g. between F101 and F102) should always satisfy F101 < F102 ..... < F132.

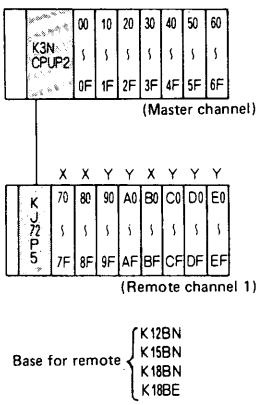
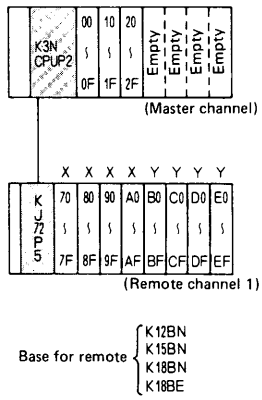
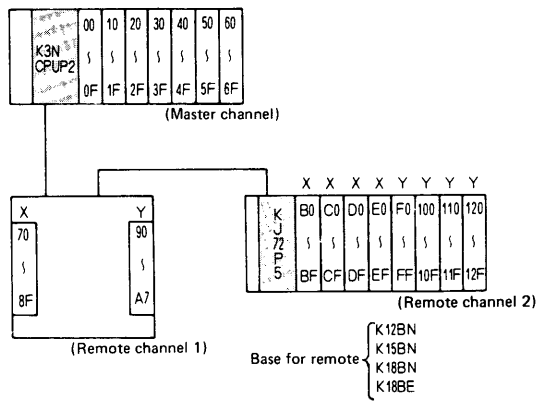
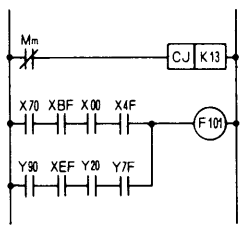
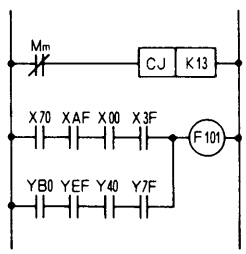
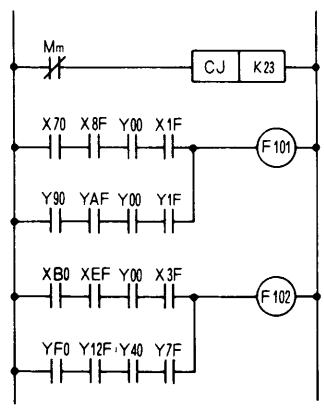
4) Be sure to specify the local and remote channels in serial numbers in order of OUT F101 to OUT F132.

4.3.2 Preparing procedures and comparison of initial programs for local and remote channels

Condition: For comparison, explanation is made on the assumption that there is one slave channel.

	For Local Channel		For Remote Channel	
System configuration				
Initial program				
Conditions	I/O used for master channel: 112 points (00 ~ 6F) Local channel CPU: K2NCPU, K2HCPU, K2NCPU-S3, K3NCPU(P2) Number of X link points: 32 points Number of Y link points: 32 points	I/O used for master channel: 112 points (00 ~ 6F) Local channel CPU: K0J1P Number of X link points: 32 points Number of Y link points: 32 points	I/O used for master channel: 112 points (00 ~ 6F) Local channel CPU: KJ72P5 Number of X link points: 64 points Number of Y link points: 64 points	I/O used for master channel: 112 points (00 ~ 6F) Local channel CPU: K0J1P Number of X link points: 32 points Number of Y link points: 32 points (24 points actually)
Explanation	Link I/O address numbers are higher than the last I/O address number used for its own channel on the master channel side. Since 00 ~ 6F are used in this example, the link I/O address of master channel begins at 70. The address numbers of local channel are higher than the address number of KJ71P3. In this example, the address begins at 70.	When the K0J1P is used for the local channel, the link address of local channel always begins at 100.	When the KJ72P5 is used for the remote channel, assign the I/O addresses of master channel side following the I/O addresses of master channel. Assign the I/O address of remote channel side to the slot next to the KJ72P5 and thereafter, beginning with 00. Load the input card first and then load the output card.	When the K0J1P is used for the remote channel, assign the I/O addresses of master channel side following the I/O addresses of master channel. Be sure to assign the I/O addresses of remote channel side, beginning with 00, for both the used I/O points.

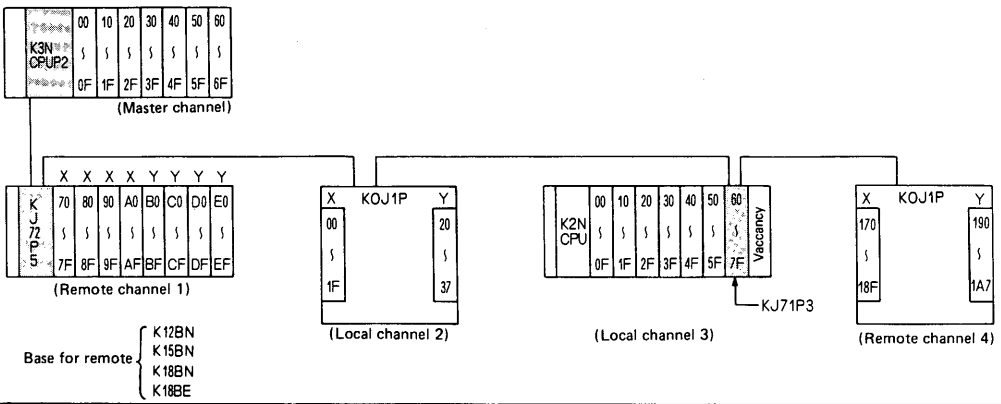
4.3.3 Initial program example for remote channel

<table>
<tr><th></th><th colspan="3">For Remote channel initical Program Example</th></tr>
<tr><td>System configuration</td><td> 
</td><td> 
</td><td> 
</td></tr>
<tr><td>Initial program</td><td> 
</td><td> 
</td><td> 
</td></tr>
<tr><td>Conditions</td><td>I/O used for master channel: 112 points (00 ~ 6F)
Remote channel CPU: KJ72P5
Number of X link points: 48 points
Number of Y link points: 80 points</td><td>I/O used for master channel: 48 points (00 ~ 2F)
Remote channel CPU: KJ72P5
Number of X link points: 64 points
Number of Y link points: 64 points</td><td>I/O used for master channel: 112 points (00 ~ 6F)
Remote channel CPU: K0J1P, KJ72P5
Number of X link points: 96 points
Number of Y link points: 96 points (88 points actually because K0J1P has 24 points)</td></tr>
<tr><td>Explanation</td><td>In regards to the loading of I/O cards into the remote channel, the input card should be loaded first and then the output card, in principle. When the input cards and output cards are mixed as shown above, however, specify the first input card address to the last input card address and then specify the the first output card address to the last output card address in the initial program. The input/output overlapping portion uses extra link I/O points.</td><td>When there are empty slots in the base of master channel, it is possible to assign the link I/O addresses, beginning with the start address (30 in the above example) of empty slots. However, it is recommended to assign the address, beginning with the address after the last address of empty slots. This allows the addition of I/O cards for the empty slots in the future without changing the initial program.</td><td>In the case of combined system which uses the K0J1P and KJ72P5 for the remote channels, the addresses of initial program of K0J1P are always assigned, beginning with X00 and Y00. Therefore, caution should be exercised.</td></tr>
</table>

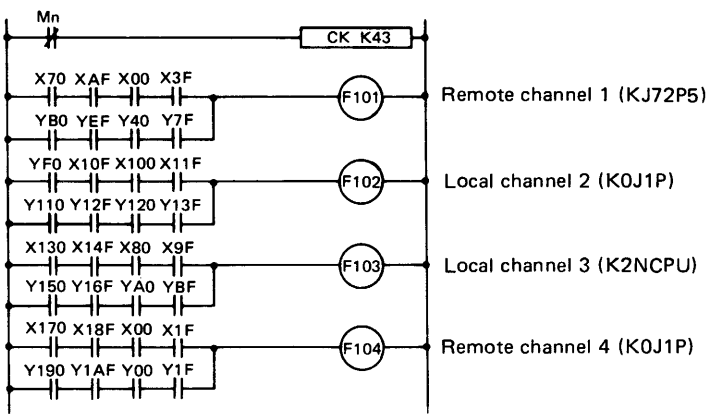
4.3.4 Example of remote I/O and local programmable controller combination

Example of Remote I/O and Local Programmable Controller Combination

System configuration



Initial program



Conditions

I/O used for master channel: 112 points (00 ~ 6F)
Remote channel 1 (KJ72P5) X = 64 points, Y = 64 points
Local channel 2 (K0J1P) X = 32 points, Y = 32 points
Local channel 3 (K2NCPU + KJ71P3) X = 32 points, Y = 32 points
Remote channel 4 (K0J1P) X = 32 points, Y = 32 points (24 points actually)

Explanation

Cautions for initial program of master channel when the link system is a combination of remote I/O system and local system.

- In regards to the assignment of link on master channel side of initial program, the link range is assigned consecutively, beginning with the address next to the I/O address used for the master channel. In the above example, the number of total link points is 320 and the I/O addresses used for the master channel are 00 ~ 6F. Therefore, link addresses are X70 ~ Y1F.
- When the KJ71P3 is used for the local channel, the link address begins with the address after the I/O address of KJ71P3. In the above example, the link address of local channel 3 begins with X/Y 80.
- When the K0J1P is used, the link address on remote channel side begins with X/Y100 and the link addresses on the local channel side are X/Y100 ~ 1FF.

4.4 Data Link Method in Local Programmable Controller System

Not only I/O data link between the master and local channels but also the link method of data registers in the local programmable controller system are described.

4.4.1 Specifications of special data registers (D), special temporary memories (M) and special functions (F) in optical data link system

Master programmable controller (K3NCPUP2)

Special Data Register Number	Function
DA06	Area for storing error channel number of data link system, Number 1 to 10 channels
DA07	Area for storing error channel number of data link system, Number 11 to 20 channels
DA08	Area for storing error channel number of data link system, Number 21 to 30 channels
DA09	Area for storing error channel number of data link system, Number 31, 32 channels
DA20	Area for storing sending/receiving destination channel number of data register link
DA21	Area for storing the head number of send/receive data register of data register link (D0 to 95)
DA22	Area for storing the quantity number of send/receive data register of data register link (D0 to 95)

Special Temporary Memory, Special Function	Function
MA18	Turned on during write (BUSY) in data register link
MA19	Turned on during read (BUSY) in data register link
F140	M channel write signal of M (master) → L (local) send data
F142	Data send request for M (master) → L (local)
F144	M channel read signal of data sent from L (local) to M (master)

Local programmable controller (K3NCPU)

Special Temporary Memory, Special Function	Function
MA20	Turned on and then off when the initial program of M (master) has been received.
MA21	Turned on when data link is normal.
F141	Signal indicating that L channel has completed receiving of M (master) → L (local) send data
F143	Signal indicating that L channel has completed sending of data to M channel at M (master) → L (local) send request.

Local programmable controller
(K2N, K2H, K2CPU-S3, K0J1P)

Special Temporary Memory, Special Function	Function
M250	Turned on and then off when the initial program of M (master) has been received.
M251	Turned on when data link is normal.
F121	Signal indicating that L channel has completed receiving of M (master) → L (local) send data
F123	Signal indicating that L channel has completed sending of data to M channel at M (master) → L (local) send request.

4.4.2 Data registers for storing error number (DA06 to DA09)

	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
DA06	0	0	0	0	0	0	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1
DA07	0	0	0	0	0	0	B20	B19	B18	B17	B16	B15	B14	B13	B12	B11
DA08	0	0	0	0	0	0	B30	B29	B28	B27	B26	B25	B24	B28	B22	B21
DA09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B32	B31

- B1 to B32 correspond to machine numbers 1 to 32. Only the bit of machine number, of which error has been detected, turns to "1". However, moving the RUN/STOP switch to the STOP position is not regarded as error. In the case of reset, reset is regarded as error.
- If the power of remote I/O channel or local channel has turned off or the optical fiber cable has been broken, all of the used channel numbers are stored in the data registers. Therefore, caution should be exercised.

EXAMPLE

For example, assume that a total of 7 units, machine numbers 1 to 7, are linked and error has occurred in all the channels. In this case, B1 to B7 of data register DA06 all turn to "1".

	64	32	16	8	4	2	1
DA06	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1

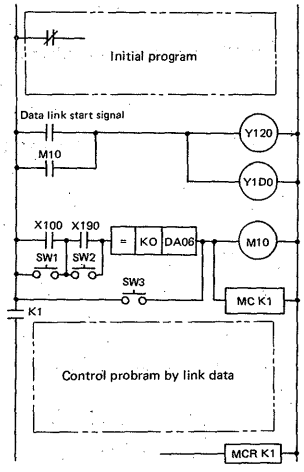
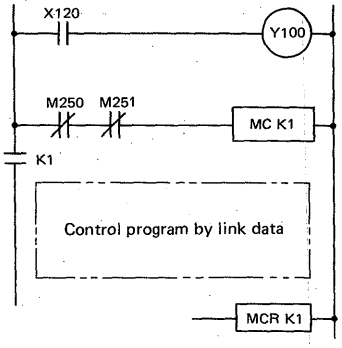
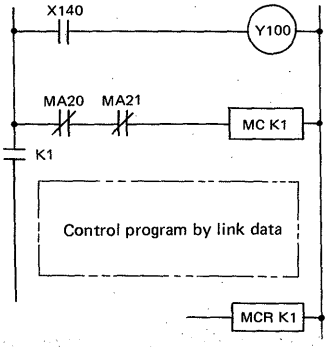
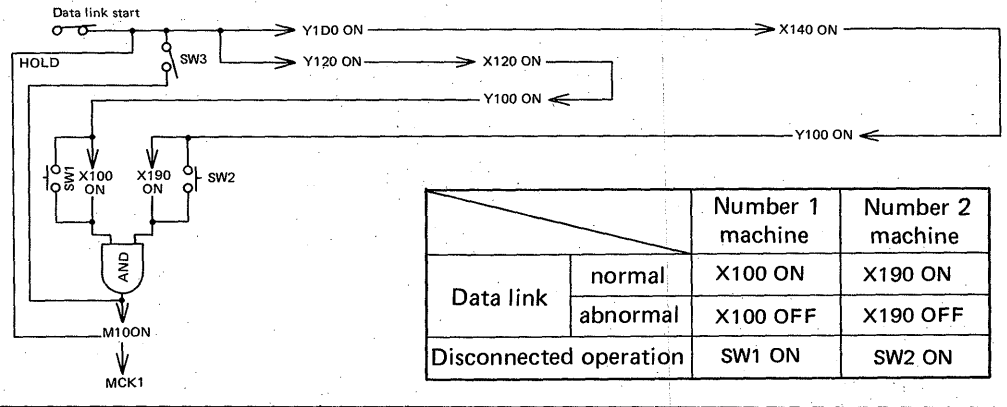
When DA06 is monitored by a peripheral unit, 64 + 32 + 16 + 8 + 4 + 2 + 1 = 127.

4.4.3 Programming instructions

If communication is interrupted in the optical data link system,

Master channel	═══ Data, which has been received last, are retained.
Remote I/O channel	═══ All outputs are turned off.
Local channel	═══ Depending on circumstances, received data are retained or cleared.

As indicated above, the results depend on channels. For the sake of fail safe, therefore, it is recommended to set an interlock condition in the program.

<table>
<tr><th></th><th>Master Channel</th><th>Local Channel Number 1 (K0J1P)</th><th>Local Channel Number 2 (K3NCPU)</th></tr>
<tr><td>Initial program</td><td> 
</td><td> 
</td><td> 
</td></tr>
<tr><td>Operation principle</td><td colspan="3"> 

<table>
<tr><th></th><th></th><th>Number 1 machine</th><th>Number 2 machine</th></tr>
<tr><td rowspan="2">Data link</td><td>normal</td><td>X100 ON</td><td>X190 ON</td></tr>
<tr><td>abnormal</td><td>X100 OFF</td><td>X190 OFF</td></tr>
<tr><td colspan="2">Disconnected operation</td><td>SW1 ON</td><td>SW2 ON</td></tr>
</table></td></tr>
<tr><td>Explanation</td><td>During data link, output is provided to Number 1 machine by Y120 and to Number 2 machine by Y1D and each local channel returns normal signal by Y100 if it receives normally. In the master channel, receipt of normal signal activates MC to allow control program processing by link data. However, when the RUN/STOP switch of local channel is moved to STOP position, the return signal from local channel is turned off, resulting in disconnected state. If disconnected operation is performed in this state, turning on SW1 and SW2 permits control program processing by link data continuously if the content of DA06 is 0 (no error in local system transmission system). To process the control program by link data of master channel although there is an error channel, turn on SW3. (See Section 4.4.2.)</td><td>When link is normal, X120 (Y120 of master channel) is turned on, which turns on Y100. When Y100 is turned on, X100 in the master channel is turned on, which allows the checking that the link system between both channels is normal.
During normal link, M250 and M251 are off. Therefore, check off of both coils and process the control program by link data. (See Section 4.4.1.)</td><td>When link is normal, X140 (Y1D0 of master channel) is turned on, which turns on Y100. When Y100 is turned on, X190 in the master channel is turned on, which allows the checking that the link system between both channels is normal.
During normal link, MA20 and MA21 are off. Therefore, check off of both coils and process the control program by link data. (See Section 4.4.1.)</td></tr>
</table>

4.4.4 Programming method of data sending from master to local side

(1) Master (M) side program

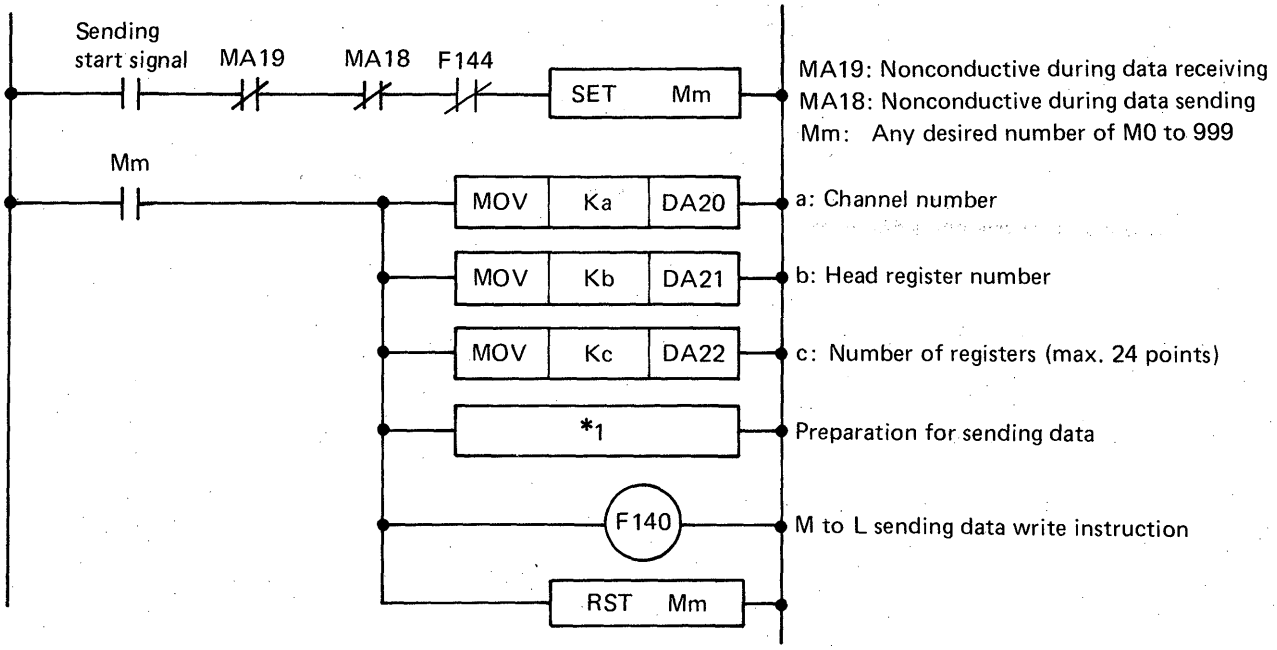


Fig. 4.1 Master Side Program

(2) Local (L) side program

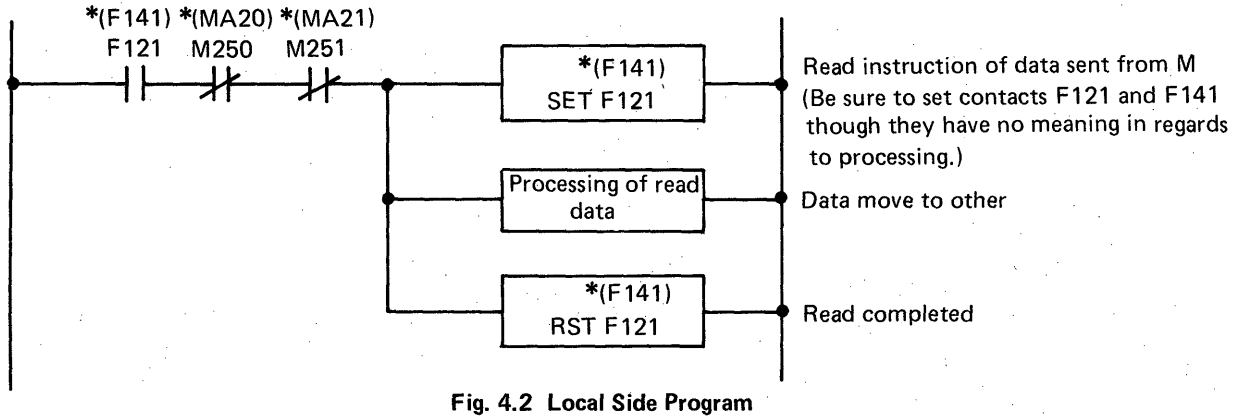


Fig. 4.2 Local Side Program

*Note 1: As a matter of course, it is required to set data, which is desired to be sent, at Db to (Db + c − 1) in advance. (*1)*

2: The maximum number of data registers for data sending is 24. Therefore, Kc should not be more than 24. Also, since the data registers are up to D95, set the range at (b + c − 1) ≦ 95. (This also applies to the case where the K3NCPU is used as a slave channel.)

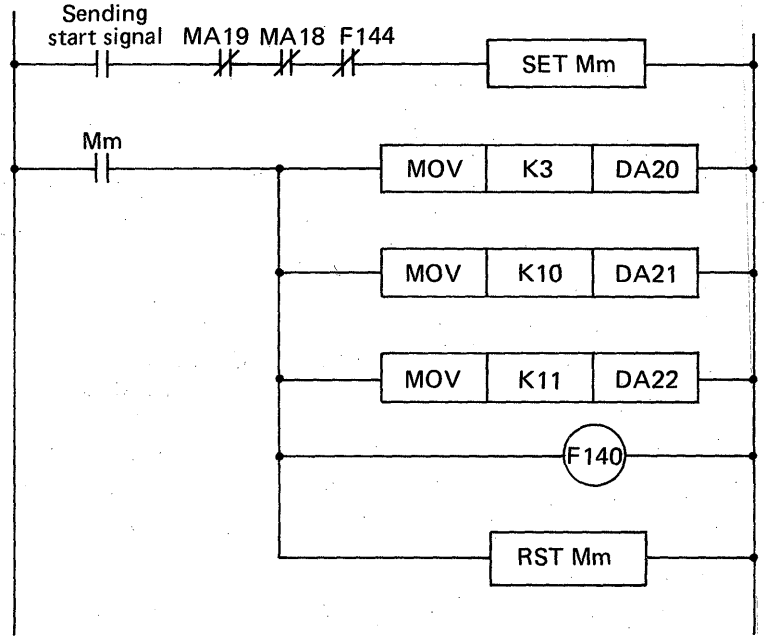
3: On both master and local sides, set the programs in Fig. 4.1 and Fig. 4.2 immediately before the END instruction which is located after the program.

4: Send the data of D96 to D999 after transferring them to D0 to D95.

Example

Program example for sending D10 to D20 from master channel to local channel (Number 3 channel)

Master channel side program



In DA20, set the channel number of destination. Specify local channel 3.

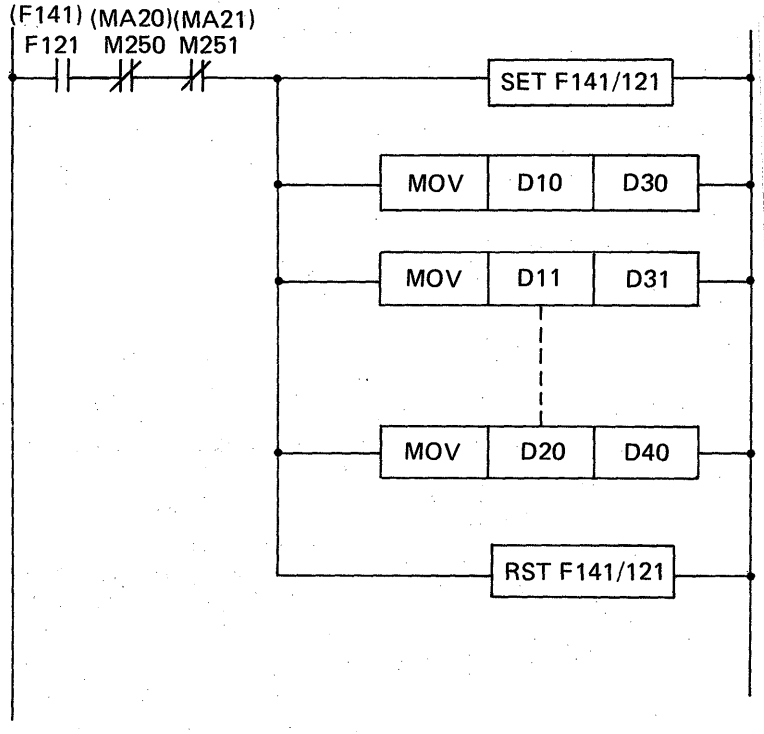
In DA21, set the head number of data register to which data are sent, D10.

In DA22, set the number of data registers to which data are sent, 11 (D10 ~ D20).

Master → local channel send data write instruction

Send data read instruction

Local channel side program



Since the contents of D10 ~ D20 of master channel are sent to D10 ~ D20, it is required to move the contents to other data registers in the local channel. In this example, the contents of D10 ~ D20 are moved to D30 ~ D40.

Read completion

4.4.5 Programming method of data sending from local to master side

Data sending from the local to the master side is executed in response to the data sending request from the master side. To freely send data from the local to the master side is not possible.

(1) Master (M) side program

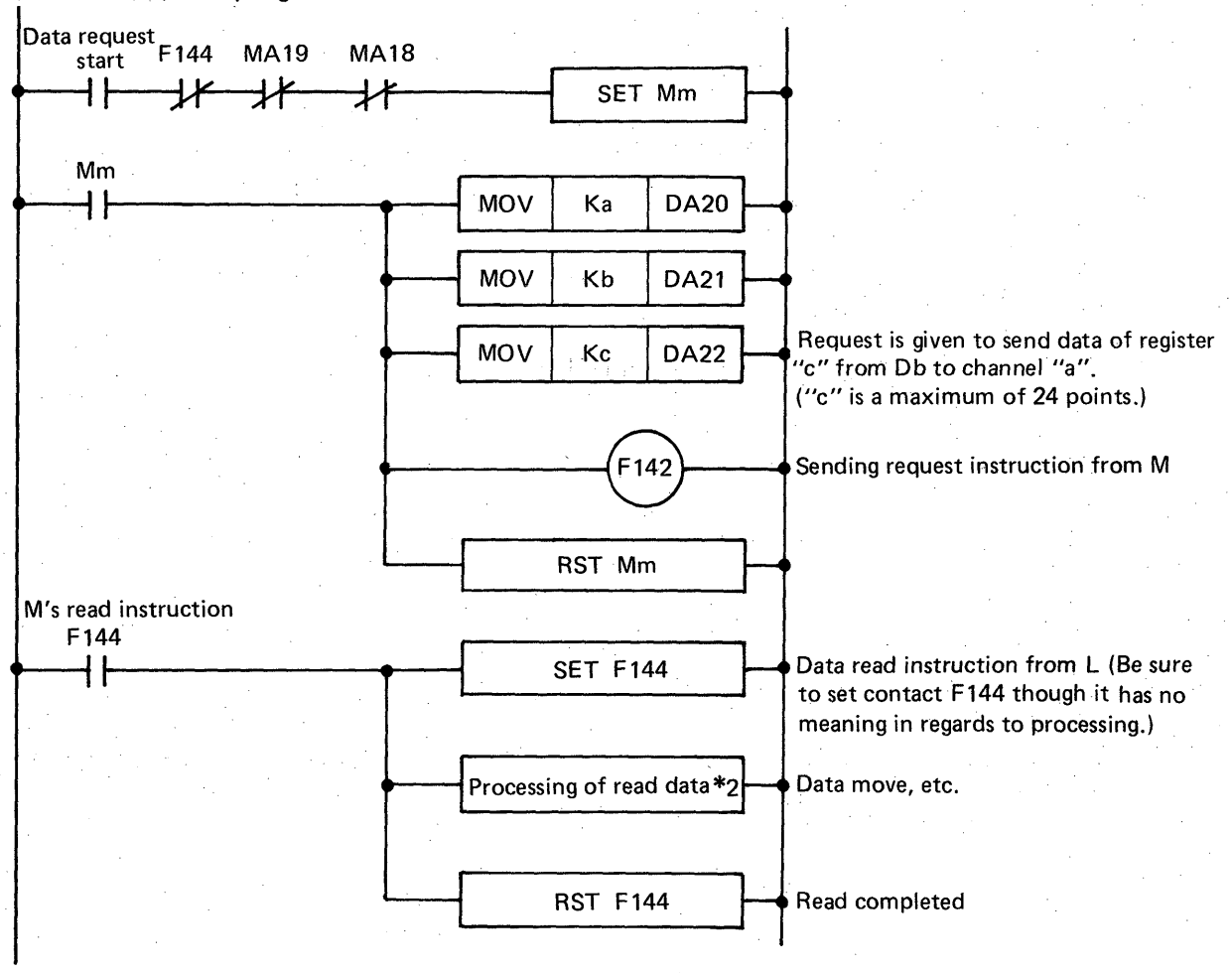


Fig. 4.3 Master Side Program

(2) Local (L) side program

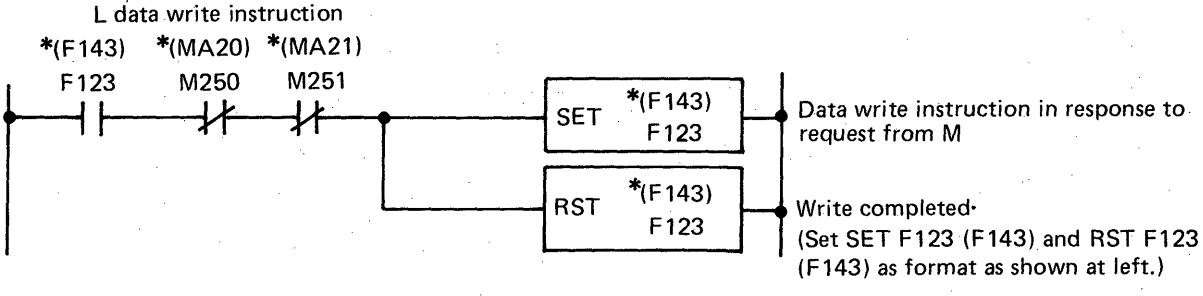


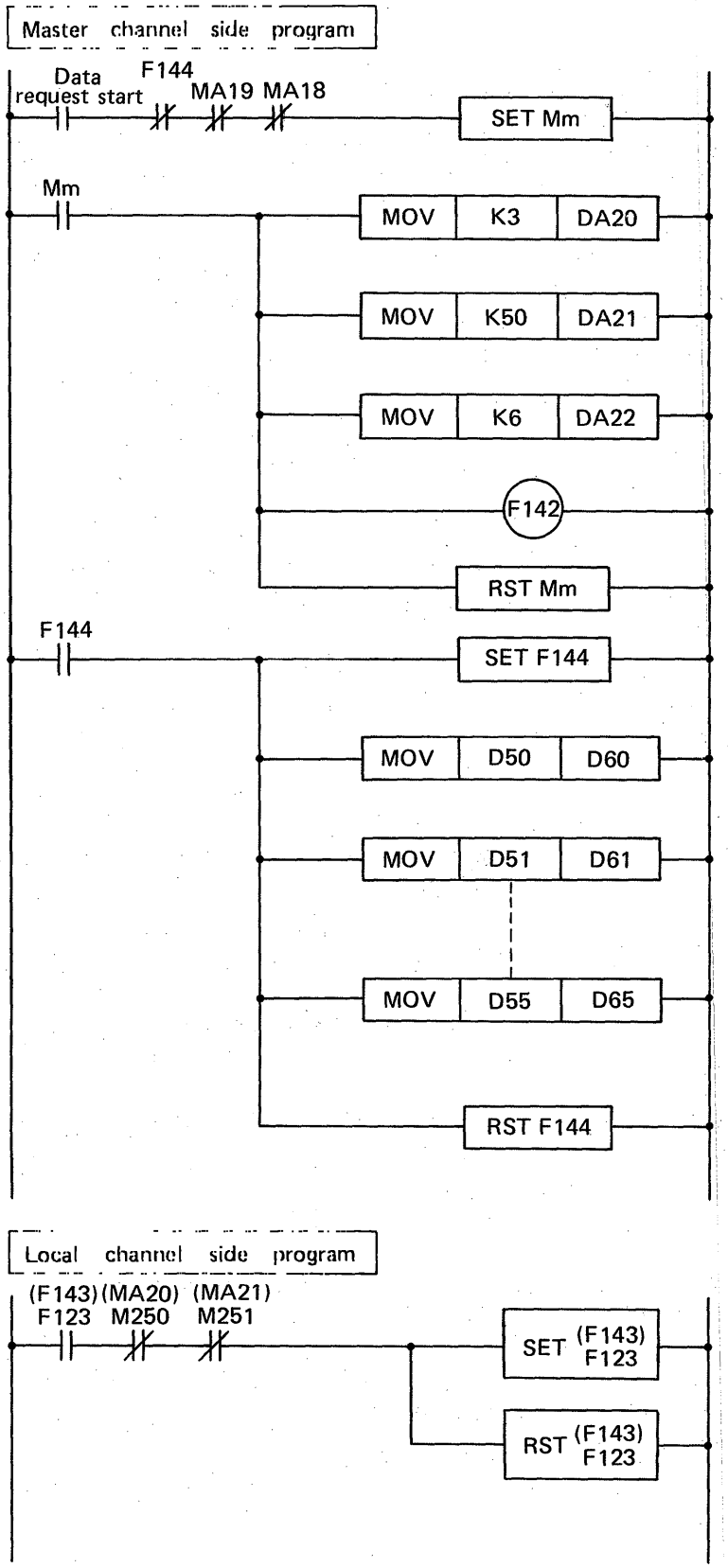
Fig. 4.4 Local Side Program

Note 1: The maximum number of data registers for data sending is 24. Therefore, Kc should not be more than 24. Also, since the data registers are up to D95, set the range at (b + c − 1) ≦ 95. (This also applies to the case where the K3NCPU is used as a slave channel.)

2: In regards to the programs shown in Fig. 4.3 and Fig. 4.4, insert the master side program in front of the OUT F100 instruction and the local side program in front of the END instruction.

Example

Program example for sending D50 to D55 from local channel (Number 3 channel) to master channel



In DA20, set the local channel number of data request destination. Specify local channel 3.

In DA21, set the head number of requested data, D50.

In DA22, set the number of requested data registers, 6 (D50 to D55).

Specified data register read instruction from local channel

Since the contents of D50 to D55 of local channel are sent to D50 to D55, it is required to move the contents to other data registers in the master channel. In this example, the contents of D50 to D55 are moved to D60 to D65.

4.4.6 Repeated continuous data sending method between master and local sides

This example shows a program which is used to alternately, repeatedly, and continuously execute the data sending (write) from the master to the local side and the data sending (read) from the master to the local side.

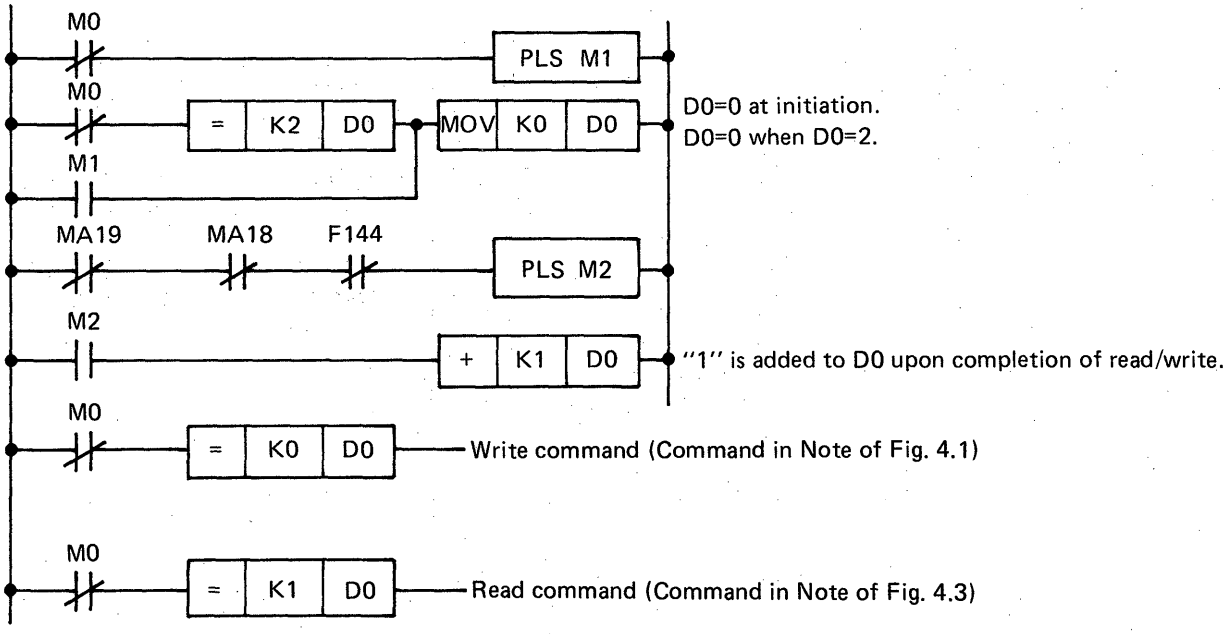


Fig. 4.5 Repeated Continuous Communication Program

M0 is a dummy contact, which sets D0 at D0 = 0 at the time of initiation and D0 = 2, adds "1" to D0 upon the completion of read and write, and gives a write request at the time of D0 = 0 and a read request at the time of D0 = 1.

Note: Be sure to insert the program shown in Fig. 4.5 in front of the program shown in Fig. 4.1 (page 38).

4.4.7 Application example of data sending between master and local sides

Data sending from the master to the local side and from the local to the master side is made by specifying the range (maximum 24 points) among 96 points of the data registers D0 to 95. (See Section 4.4.4 and Section 4.4.5.)

The master programmable controller has data registers D0 to 999 (1000 points). Therefore, when the data within the range of D96 to 999 are sent to the local side, transfer the data in blocks into the sending range of D0 to 95 by using the data block transfer instruction (OUT F158) before the sending data write instruction (OUT F140) marked with *1 in Fig. 4.6.

When data sending is made from the local to the master side, transfer the data within the receiving range of D0 to 95 in blocks into D96 to 999 by using the data block transfer instruction (OUT F158) next to the data read instruction marked with *2 in Fig. 4.9.

In case data is intended to be sent from the master channel to remote or disconnected channel, or to be received by the master channel from the aforementioned channel, by mistake, the state of sending or receiving completion is forcedly constituted (MA18 or MA19 is off), the received data all turn to "0", and continuous communication is made repeatedly.

4.4.8 Application circuit example

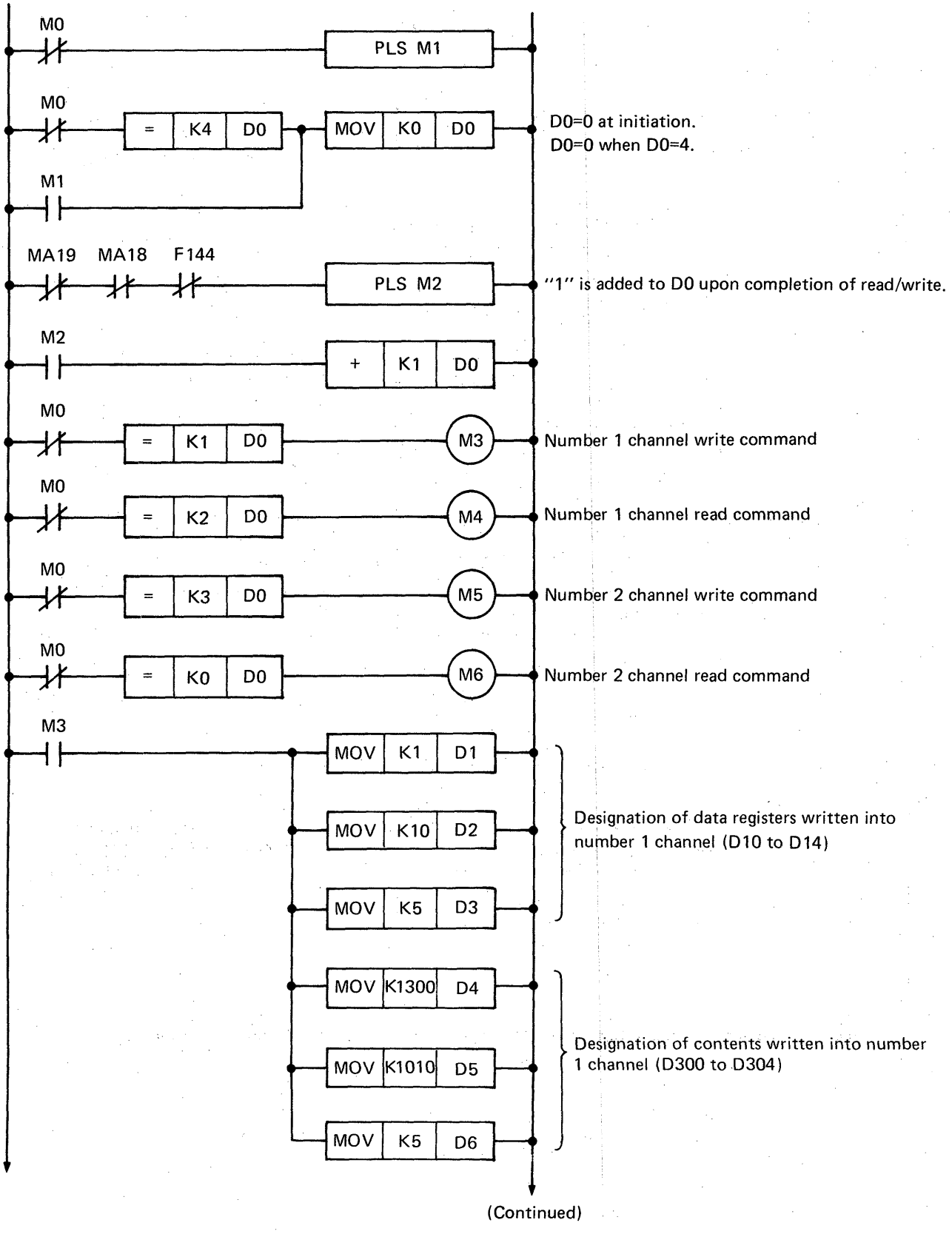


Fig. 4.6 Program Example of Continuous Data Communication with 2 Channels

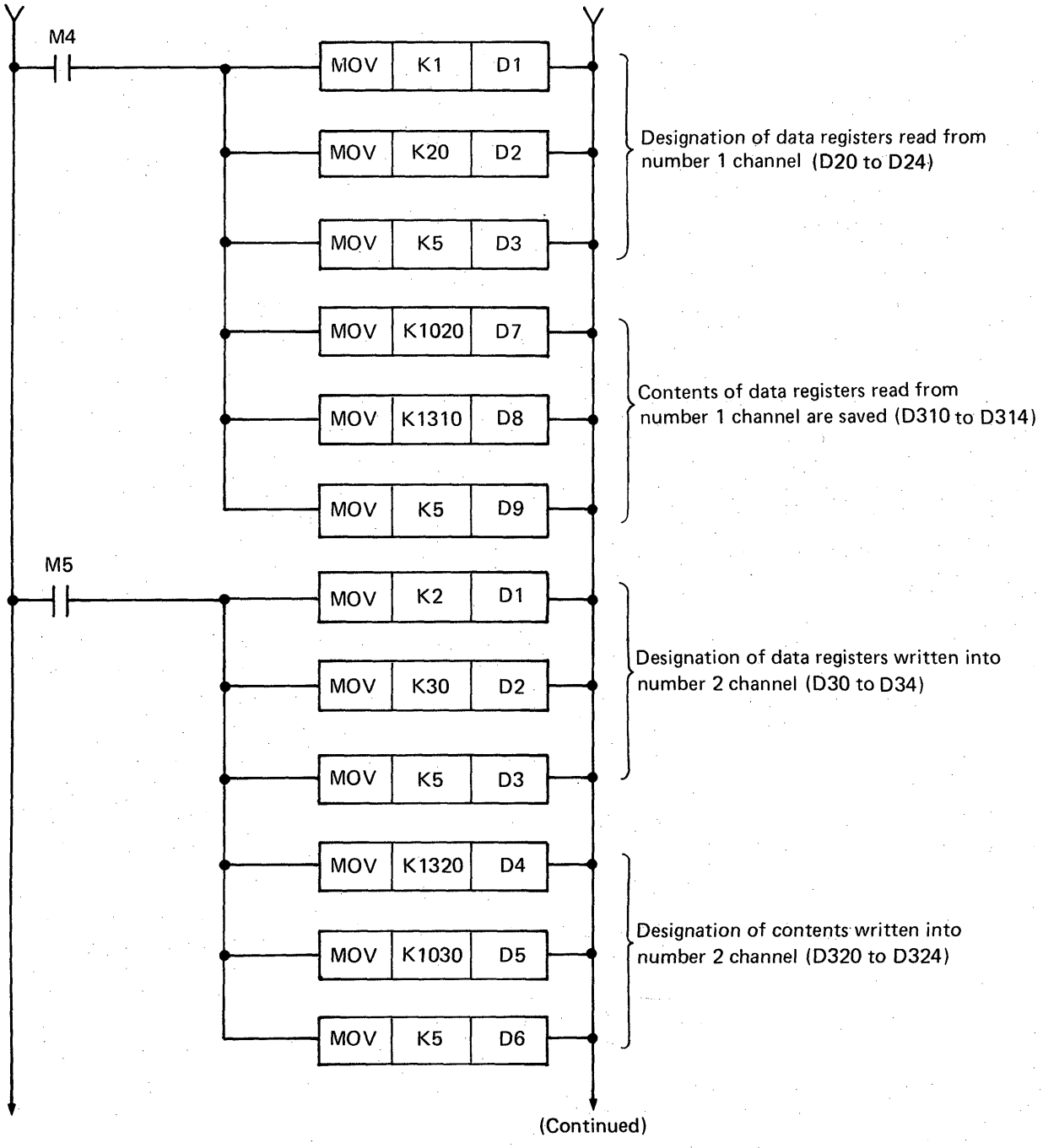


Fig. 4.6 Program Example of Continuous Data Communication with 2 Channels (Continued)

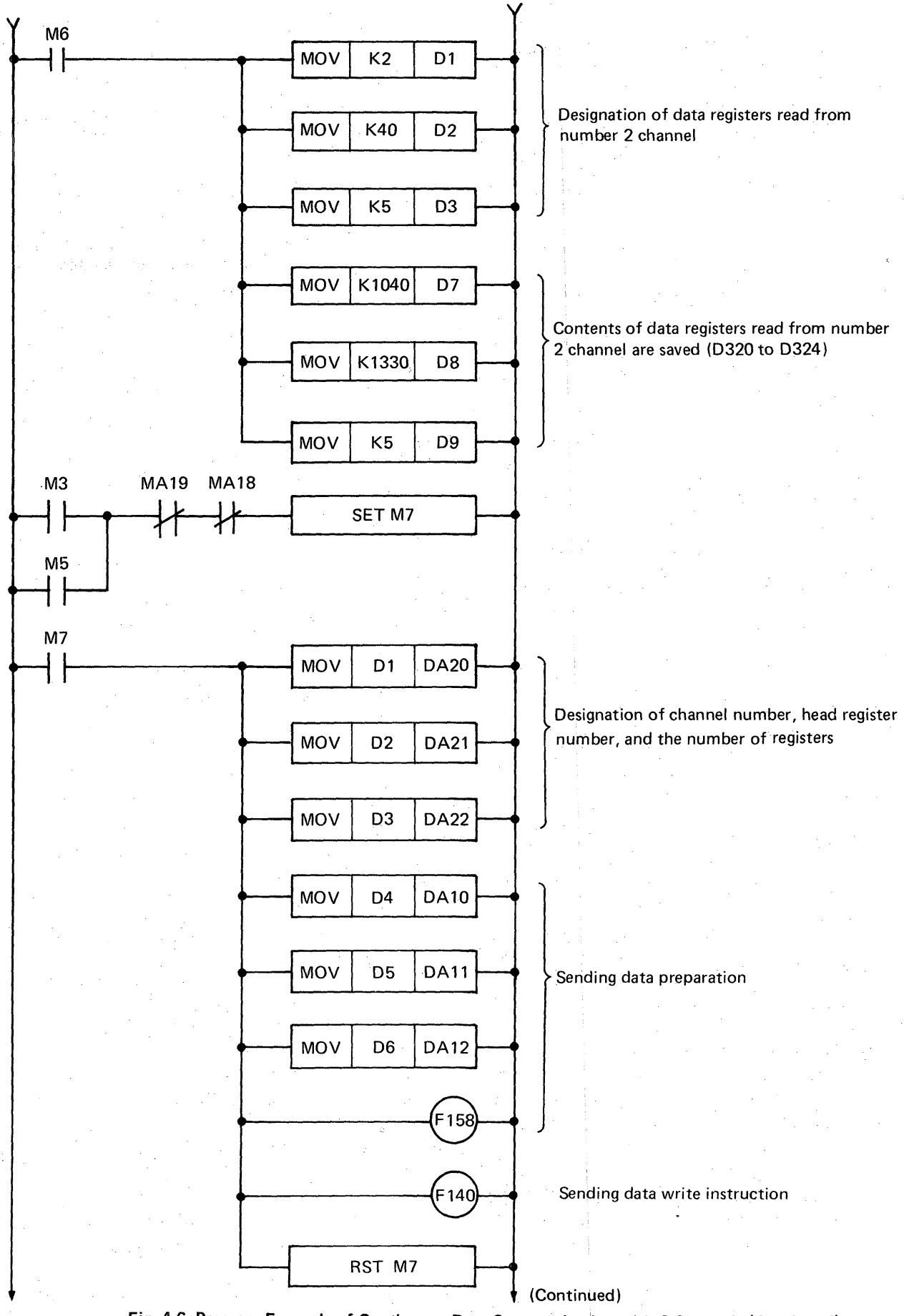


Fig. 4.6 Program Example of Continuous Data Communication with 2 Channels (Continued)

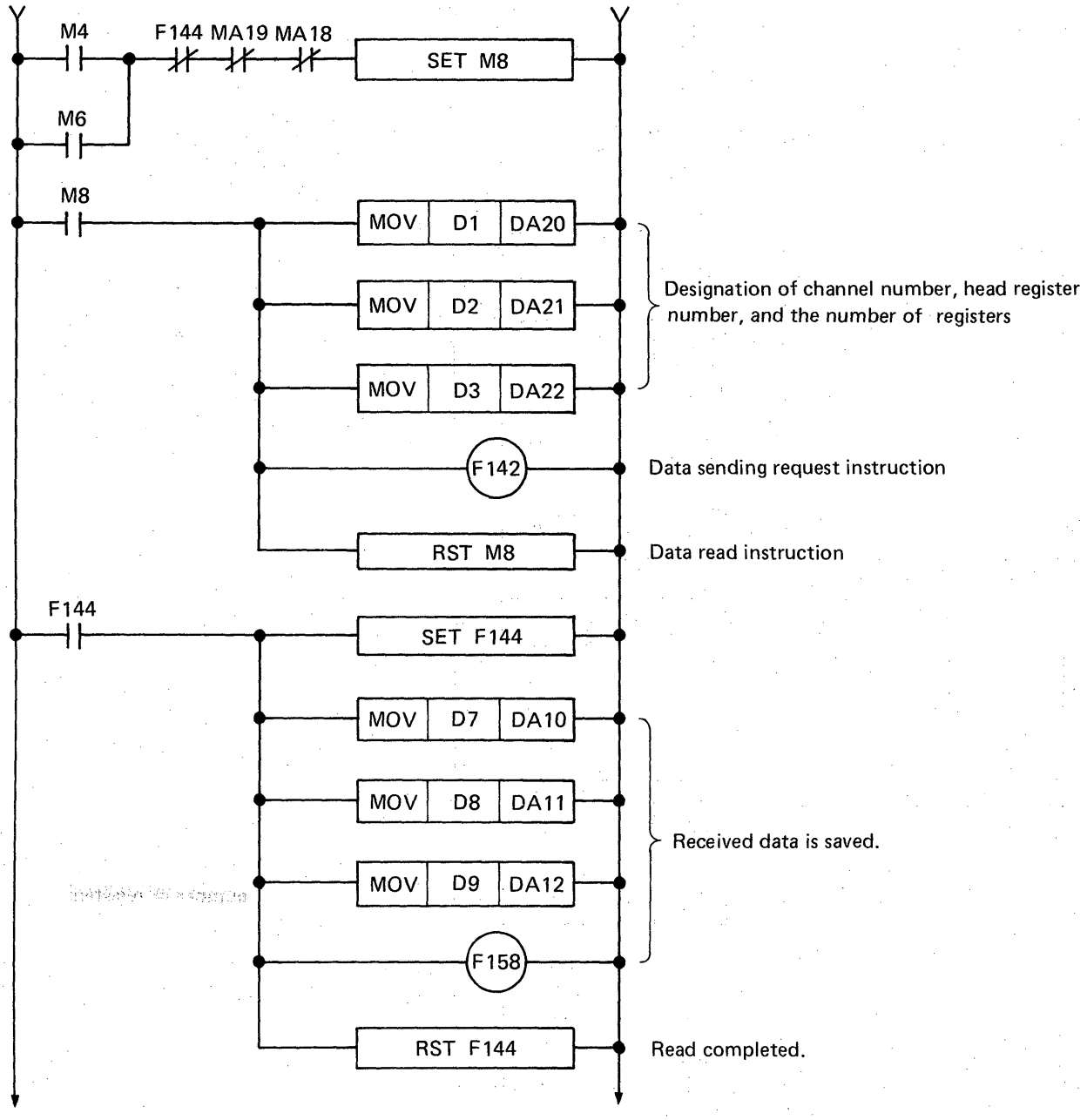


Fig. 4.6 Program Example of Continuous Data Communication with 2 Channels (Continued)

(1) M0 is a dummy contact, which sets D0 at D = 0 at the time of initiation and D0 = 4.
(2) "1" is added to D0 upon the completion of read and write.
(3) When D0 is "0", M3 turns on. The contents of D300 to D304 are stored into D10 to D14 by the data block transfer instruction (OUT F158). The contents of D10 to D15 are sent to channel number 1.
(4) When D0 is "1", M4 turns on. This gives request to send the contents of D20 to D24 to channel number 1. The received contents of D20 to D25 are stored into D310 to D314 by the data block transfer instruction (OUT F158).
(5) When D0 is "2", M5 turns on. The contents of D320 to D324 are stored into D30 to D34 by the data block transfer instruction (OUT F158). The contents of D30 to D34 are sent to channel number 2.
(6) When D0 is "3", M6 turns on. This gives request to send the contents of D40 to D44 to channel number 2. The received contents of D20 to D25 are stored into D330 to D334 by the data block transfer instruction (OUT F158).

4.5 Process Time

4.5.1 Transmission delay time

The maximum transmission delay time in each sending and receiving is as shown in Table 4.1.

	Type of Sending/Receiving	Transmission Delay Time
Remote channel	Y data from master channel	1 cycle of K3NCPUP2 + transmission process time
	X data to master channel	3 cycles of K3NCPUP2
Local channel	Y data from master channel	1 cycles of K3NCPUP2 + 1 cycle of KCPU
	X data to master channel	3 cycles of K3NCPUP2 + 1 cycle of KCPU
	D data from master channel	2 cycles of K3NCPUP2 + 2 cycles of KCPU
	D data to master channel	3 cycles of K3NCPUP2 + 2 cycles of KCPU

Table 4.1 Maximum Transmission Delay Time

NOTE

1. 1 cycle in Table 4.1 means 1 scan time (from step 0 to step 0 of the next cycle).
2. Transmission process time means the time required until the sending and receiving of X/Y data to and from all channels are completed, and is obtained by the following expression:

$$\text{Transmission process time} = \frac{\text{total of link points}}{500} + (0.8 \times n)\ [\text{ms}]$$

n: channel No.

3. Transmission delay time does not include the delay time of input/output unit.

4.5.2 X/Y data flow in remote channels

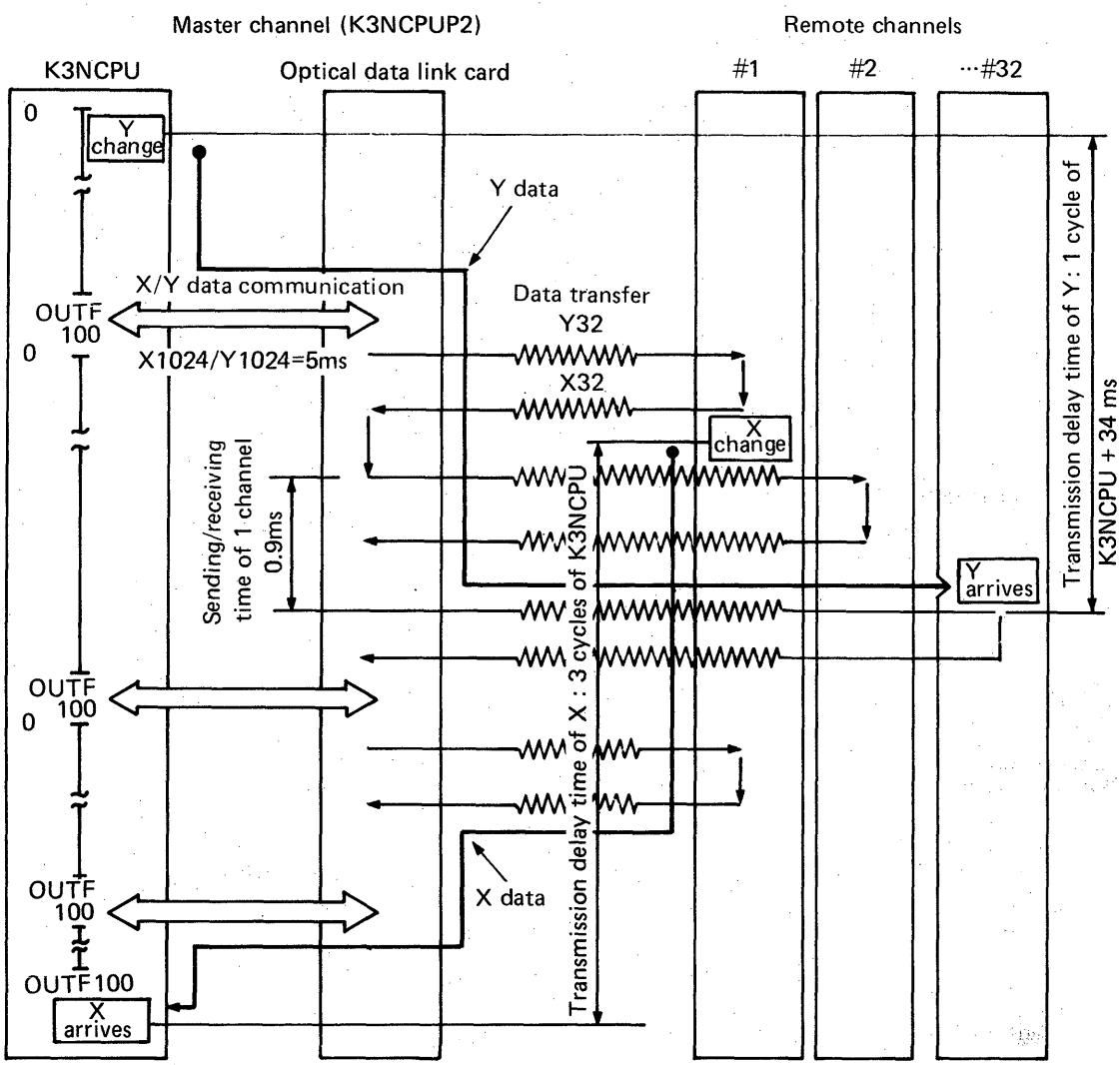


Fig. 4.7 X/Y Data Flow in Remote Channels
(In case of a total of 32 channels linked with 32 X points and 32 Y points)

X/Y data flow as shown by the thick lines in Fig. 4.7.

(1) Process time

The operation of 0 step to OUT F100 is repeated. After this OUT F100, the K3NCPUP2 makes data communication with the optical data link card 2, and thereafter, gives the optical data link card a sending/receiving command to/from the remote channels, and at the same time, executes the operation of 0 step to OUT F100 again. Therefore, the process time is longer by the data communication time with the optical data link card (approximately 5 ms when X/Y points are 2048).

(2) Transmission delay time

The output of K3NCPUP2 is sent to the remote channels after the next OUT F100. If this output changes in the vicinity of step number 0, the sending delay time to channel number 32 is (1 cycle of K3NCPUP2 + 34 ms).
This 34 ms is the value obtained by the addition of the data communication time between K3NCPUP2 and optical data link card and the sending time to channels number 1 to 32 when the number of X/Y link points is 2048. Reversely, if the output changes after the sending/receiving of input signal of remote channel (channel number 1), the transmission delay time is 3 cycles of K3NCPUP2.

4.5.3 X/Y data flow in local channel

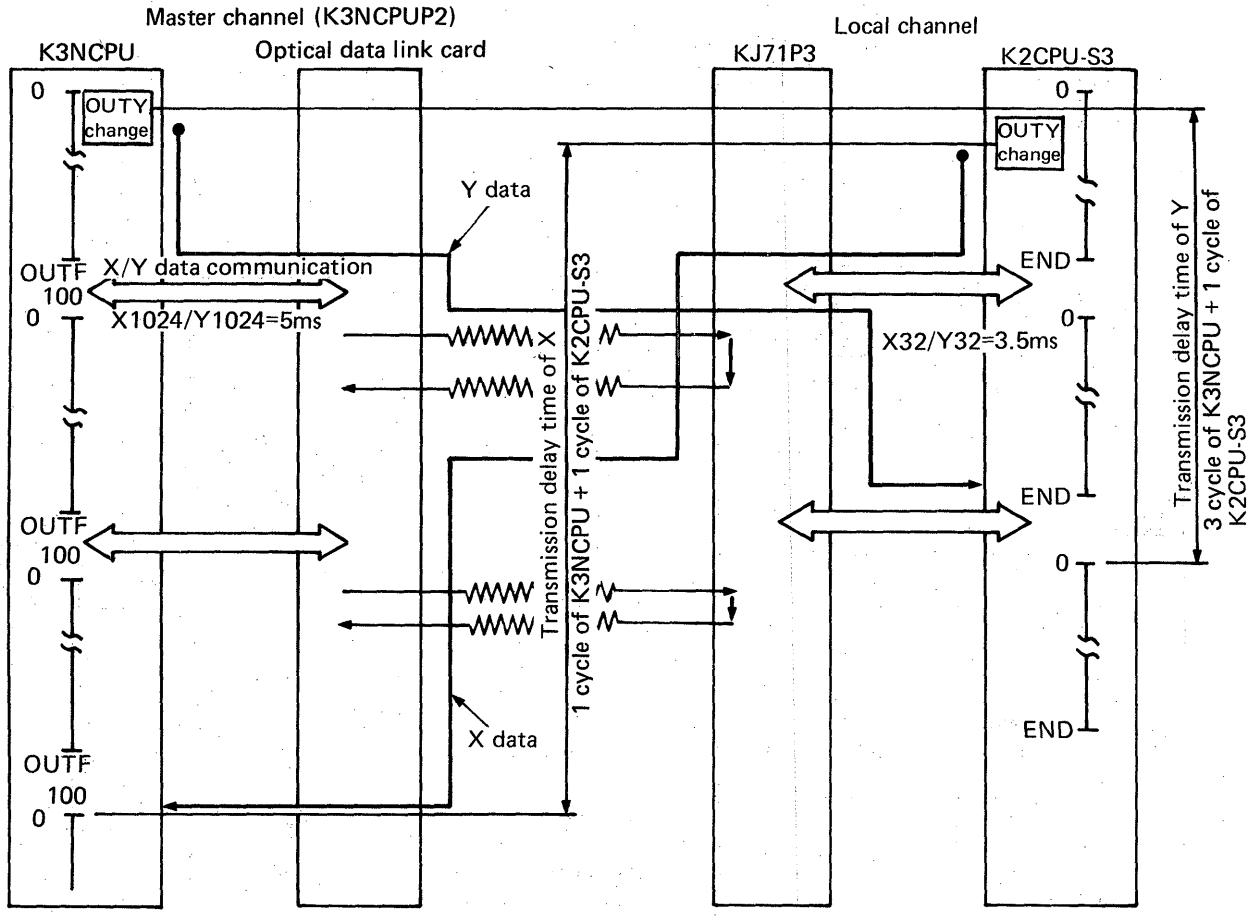


Fig. 4.8 X/Y Data Flow in Local Channel

X/Y data flow as shown by the thick lines in Fig. 4.8.

(1) Process time

The operation of 0 step to OUT F100 is repeated in the master channel. After this OUT F100, the K3NCPUP2 makes data transfer with the optical data link card, and thereafter, gives the optical data link card a sending/receiving command to/from the local channel, and at the same time, executes the operation of 0 step to OUT F100 again. (Sending/receiving and sequence operation are made parallelly.) Therefore, the process time is longer by the data communication time with the optical data link card (approximately 5 ms when X/Y points are 2048).
The operation of 0 step to END is also repeated in the local channel. After this END instruction, the K2CPU-S3 executes data communication with the KJ71P3. The required data communication time is approximately 3.5 ms when X/Y points are 64. Therefore, the process time is longer by 3.5 ms.

(2) Transmission delay time

The output of master channel is sent to local channel after the next OUT F100. After END, the local channel is replaced by the image memory which is used by the programmable controller. Therefore, if the output of master channel changes in the vicinity of program step number 0, the transmission delay time is (1 cycle of K3NCPUP2 + 1 cycle of K2CPU-S3). Reversely, if the output of local channel changes in the vicinity of program step number 0, the transmission delay time is (3 cycles of K3NCPUP2 + 1 cycle of K2CPU-S3).

4.5.4 D data flow at the time of data register write

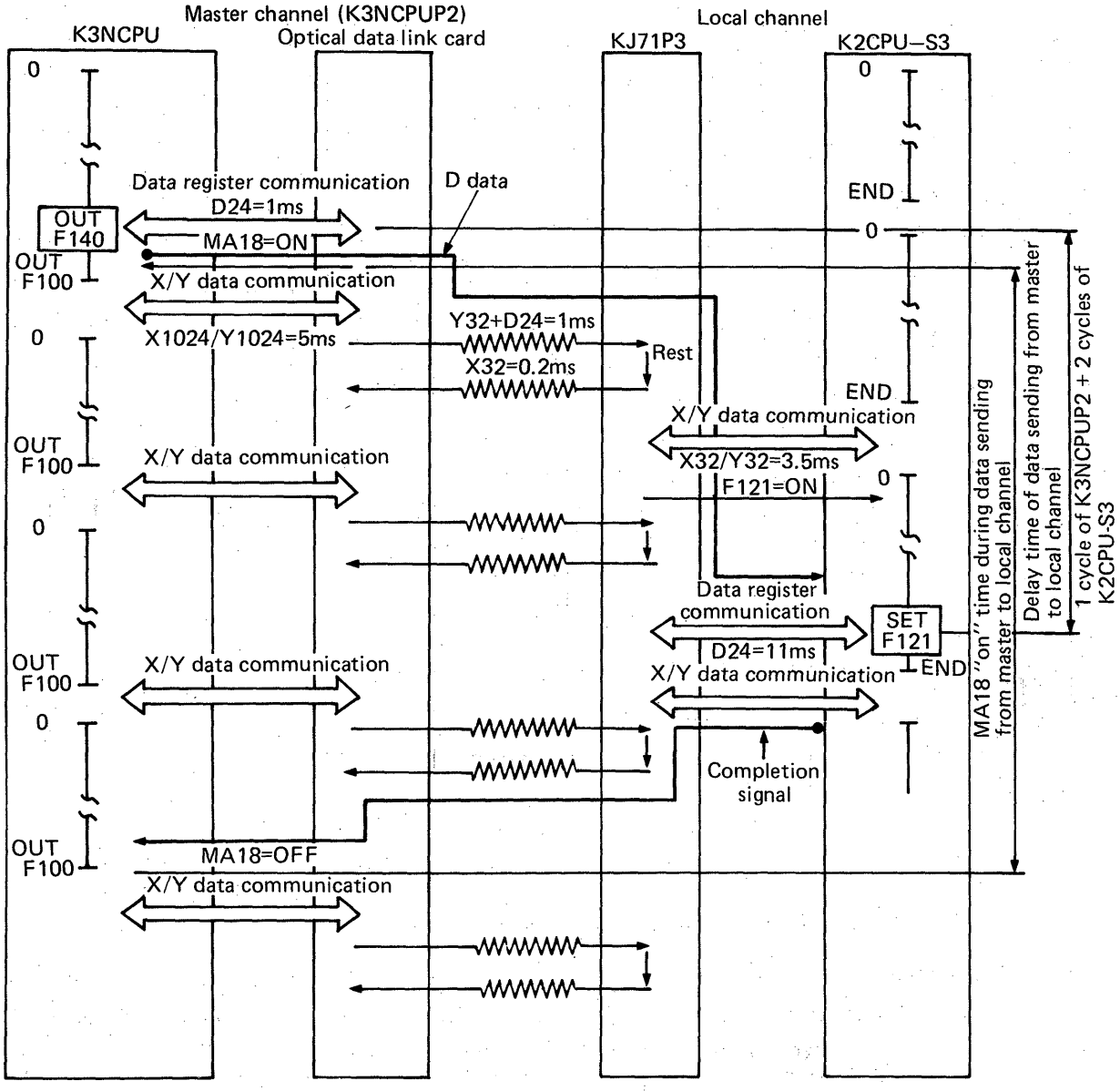


Fig. 4.9 D Data Flow at the Time of Data Register Write

D data flows as shown by the thick line in Fig. 4.9.

Process time is longer by approximately 1 ms in the master channel when the data registers are the maximum simultaneous 24 points (DA22 = 24). In the local channel, the process time is longer by approximately 11 ms. The transmission delay time in response to the write request from the master channel to the local channel is (1 cycle of K3NCPUP2 + 2 cycles of K2CPU-S3). The MA18 "on" time during sending is (2 cycles of K3NCPUP2 + 2 cycles of K2CPU-S3).

4.5.5 D data flow at the time of data register read

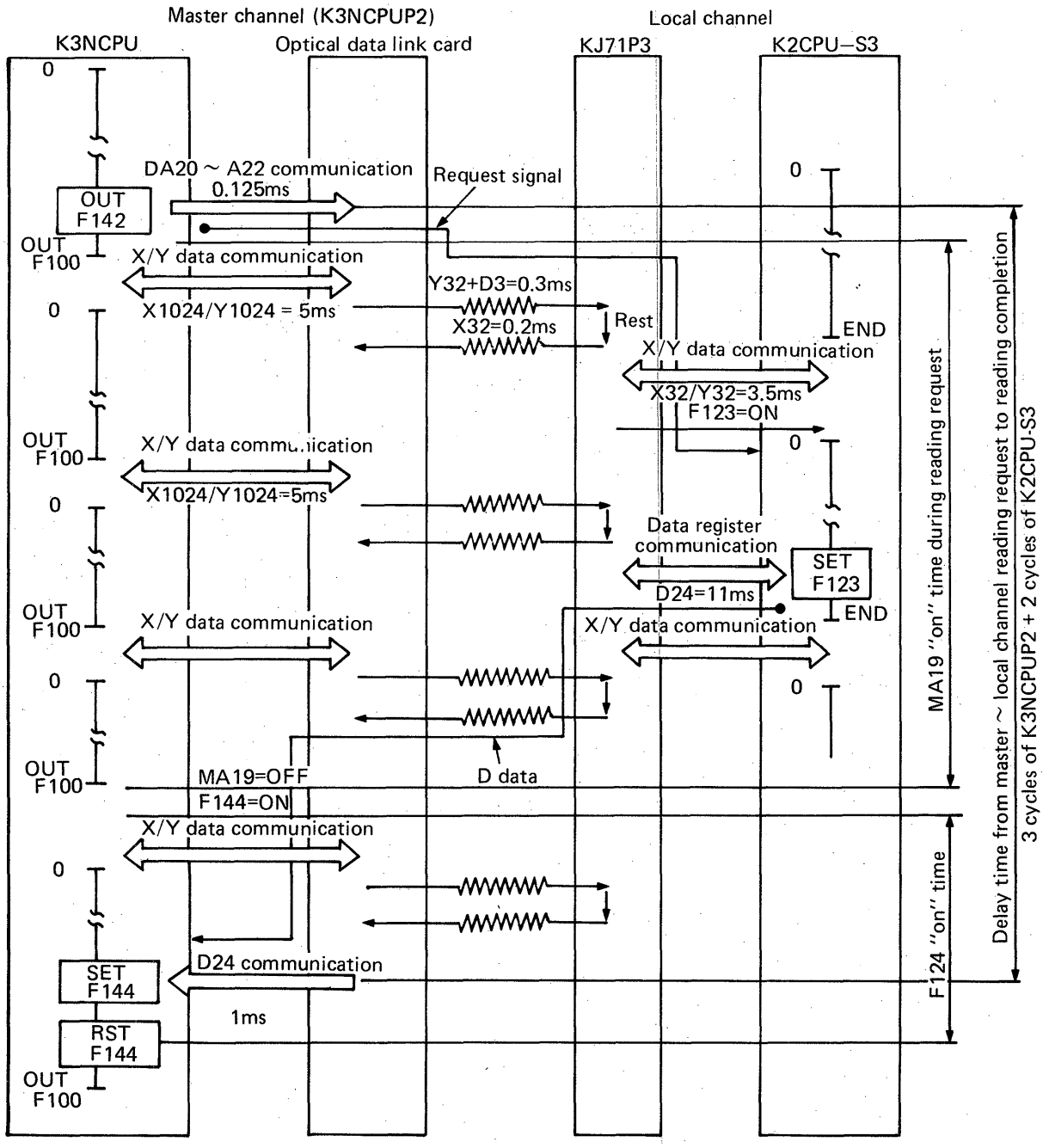


Fig. 4.10 D Data Flow at the Time of Data Register Read

D data flows as shown in Fig. 4.10.

Process time is longer by approximately 1 ms in the master channel when the data registers are the maximum simultaneous 24 points (DA22 = 24). In the local channel, the process time is longer by approximately 11 ms. The transmission delay time in response to the read request from the master channel to the local channel is (3 cycles of K3NCPUP2 + 2 cycles of K2CPU-S3). The time required until read is completed is the total of MA19 "on" time during receiving, i.e. (2 cycles of K3NCPUP2 + 2 cycles of K2CPU-S3, and F144 "on" time upon completion of read, i.e. (1 cycle of K3NCPUP2).

4.6 Utilization of Special Units in Optical Data Link Remote I/O System

This section explains how to use special units in the remote I/O system.
Special units for remote I/O channel are available as shown in Table 4.2. Note that some are not applicable to the K3CPUP2.

Unit Name	Type	Application
A/D, D/A converter unit	KA62, KA63	No
A/D, D/A converter unit	KA62A, KA63A	Yes
Insulation amplifier unit	KA64	Yes
High-speed counter unit	KD61	Yes
Analog timer unit	KT61	No
Intelligent communication unit	KD51E	No
PID unit	KD81	Yes
Computer link unit	KJ71L7/KJ71L4	No
Data link unit for coaxial cable (for master channel)	KJ71L2	No
Data link unit for coaxial cable (for local channel)	KJ71L3	No
Optical data link unit (for local channel)	KJ71P3	No
Positioning unit	KD71N	Yes

Table 4.2 Special Units and Applicability

4.6.1 Initial program when special units are used in optical data link system

The initial program is used to specify the correspondence of I/O numbers between the master side and the remote side in the data link system.
The initial program for the system configuration example shown in Fig. 4.11 is as shown in Fig. 4.12. Set the initial program at the head of sequence program of K3NCPUP2 (from step number 0).

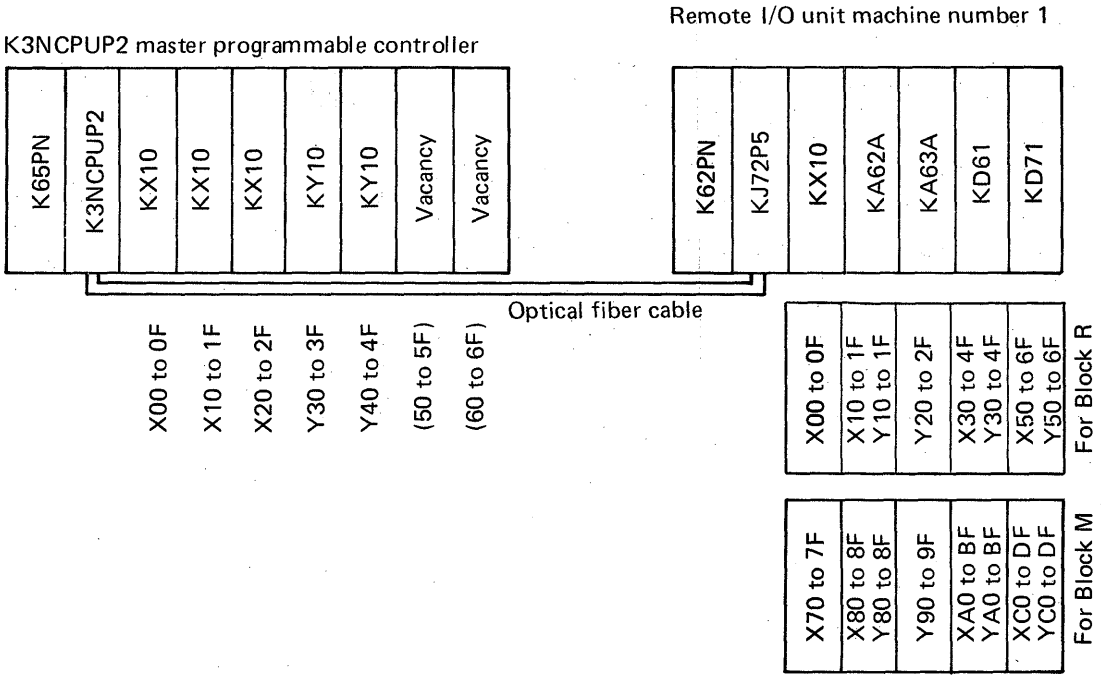


Fig. 4.11 System Configuration Example

NOTE

1. The output numbers inside [ ] are the allotted numbers in relation to the master programmable controller.
2. KJ72P5: Serial data link unit (K2 remote set)
   K62PA, K65PN: Power supply units (115V AC input)

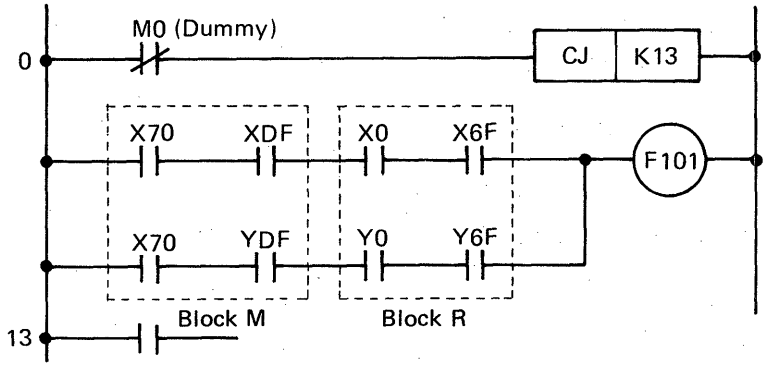


Fig. 4.12 Initial Program Example (Master programmable controller)

4.6.2 Program example for KA62A (A/D converter unit) in remote I/O system

The input signals of KA62A in the system configuration example shown in Fig. 4.11 correspond to X80 to X8F and the output signals correspond to Y80 to Y8F in the master programmable controller.
For reading the channel select signal of KA62A and the digital value, which has been converted from analog signal after the selection of channel, the special timing pulses (F190 and F191) are used.

(1) The program for reading data in channel "0" of KA62A and for storing the data into the data register D0 is as shown in Fig. 4.13.

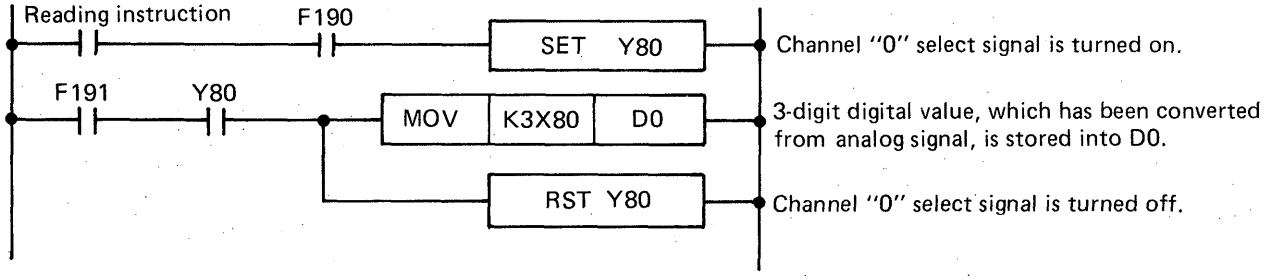


Fig. 4.13 Program Example for Reading Data in Channel "0" of A/D Converter Unit

(2) The special timing pulses F190 and F191 turn on during only 1 scan per 4 cycles of operation as shown in Fig. 4.14.
The pulse F191 turns on 3 cycles after F190. Utilize these special timing pulses only as contacts in the sequence program.

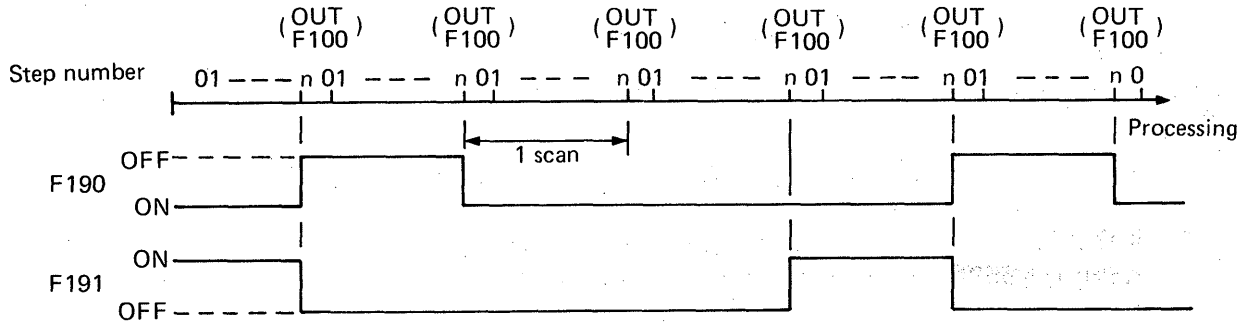


Fig. 4.14 Special Timing Pulses F190, F191

(3) The program for consecutively reading data in 4 channels, channels "0" to "3", of KA62A and for storing the data into the data registers, D0 to D3, is as shown in Fig. 4.15.

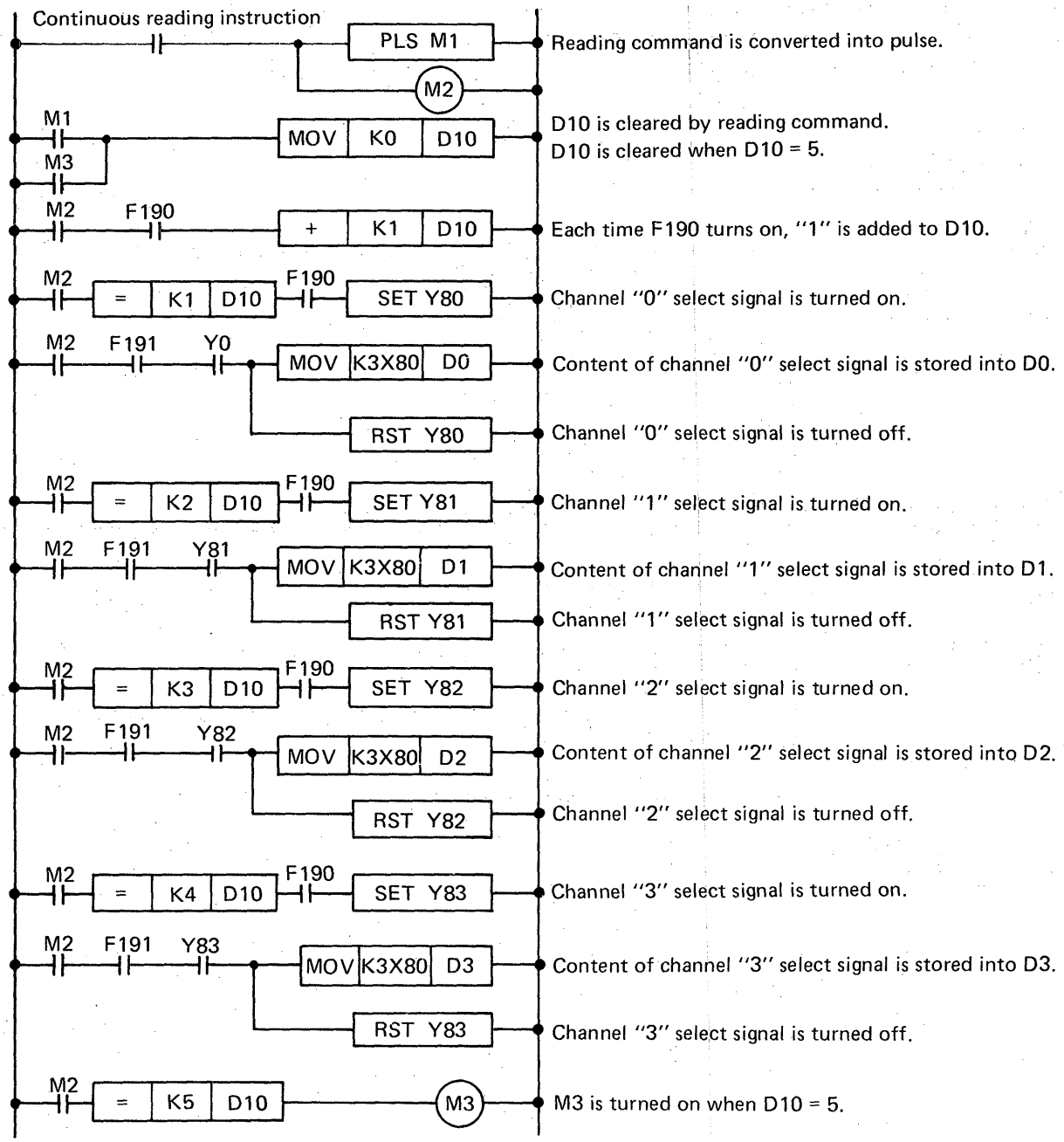


Fig. 4.15 Program Example for Continuous Reading of Channels "0" to "3" of A/D Converter Unit

4.6.3 Program example for KA63A (D/A converter unit) in remote I/O system

The output signals of KA63A in the system configuration example shown in Fig. 4.11 correspond to Y90 to Y9F in the master programmable controller.
The program for outputting the content of K0 to channel "0" of KA63A and the content of D1 to channel "1" is as shown in Fig. 4.16.

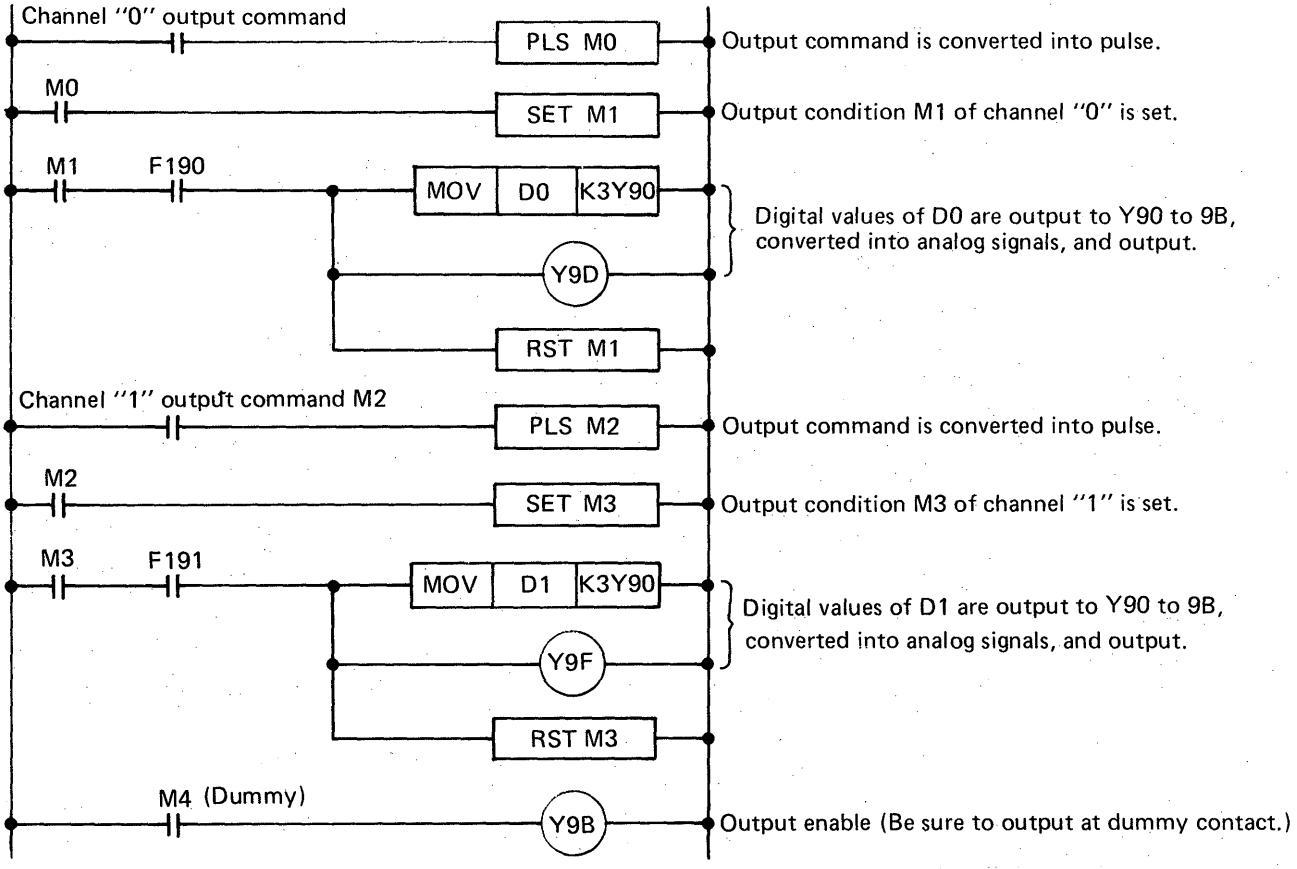


Fig. 4.16 Program Example for Outputting to Channels "0" and "1" of D/A Converter Unit

4.6.4 Program example for KD61 (high-speed counter unit) in remote I/O system

The input signals of KD61 in the system configuration example shown in Fig. 4.11 correspond to XA0 to XBF and the output signals correspond to YA0 to YBF in the master programmable controller.
For presetting (changing temporary value), setting set value, and reading counter value of KD61, the special timing pulses (F190 and F191) are utilized, and the program used for this purpose is as shown in Fig. 4.17.

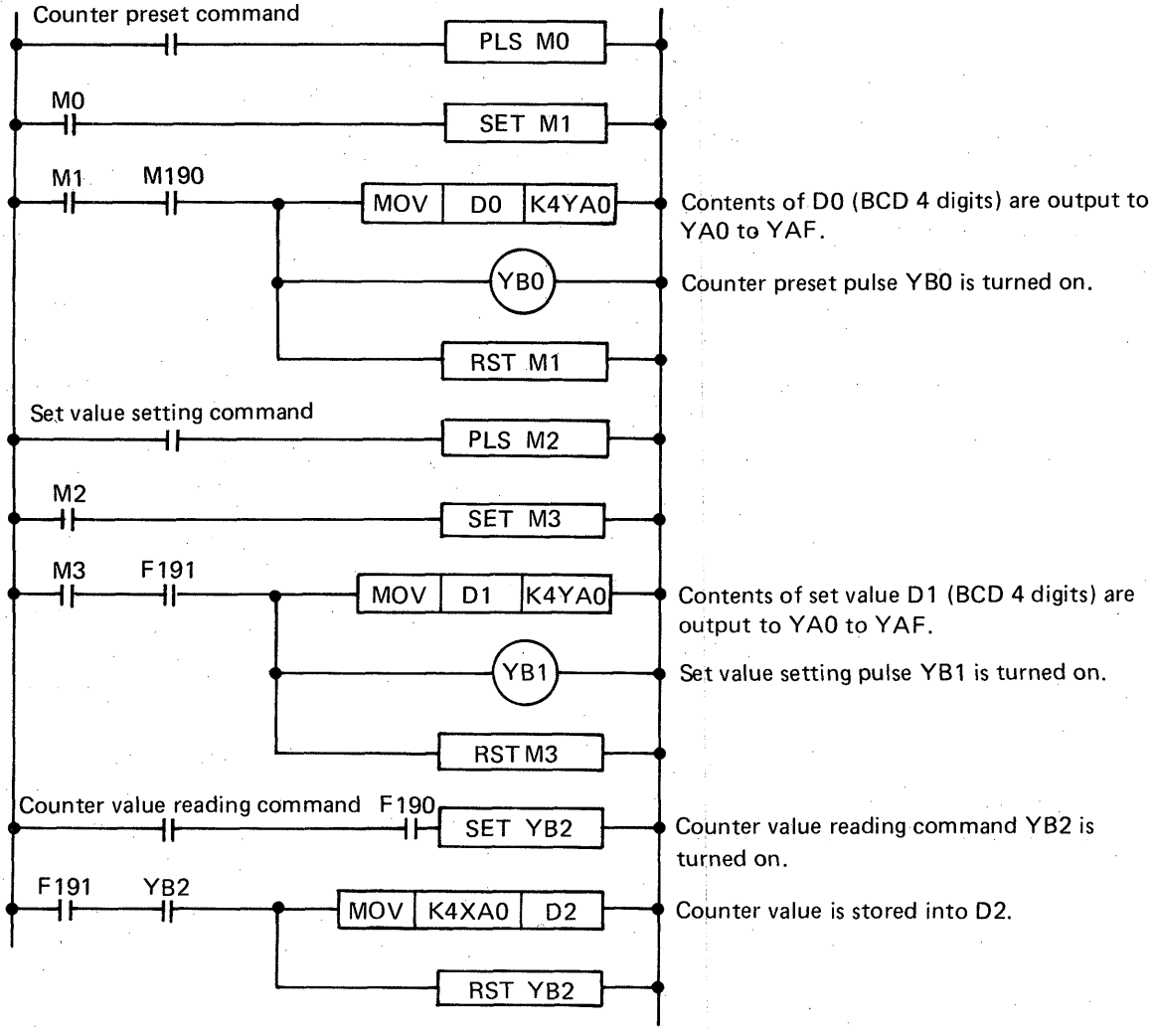


Fig. 4.17 Program Example for KD61

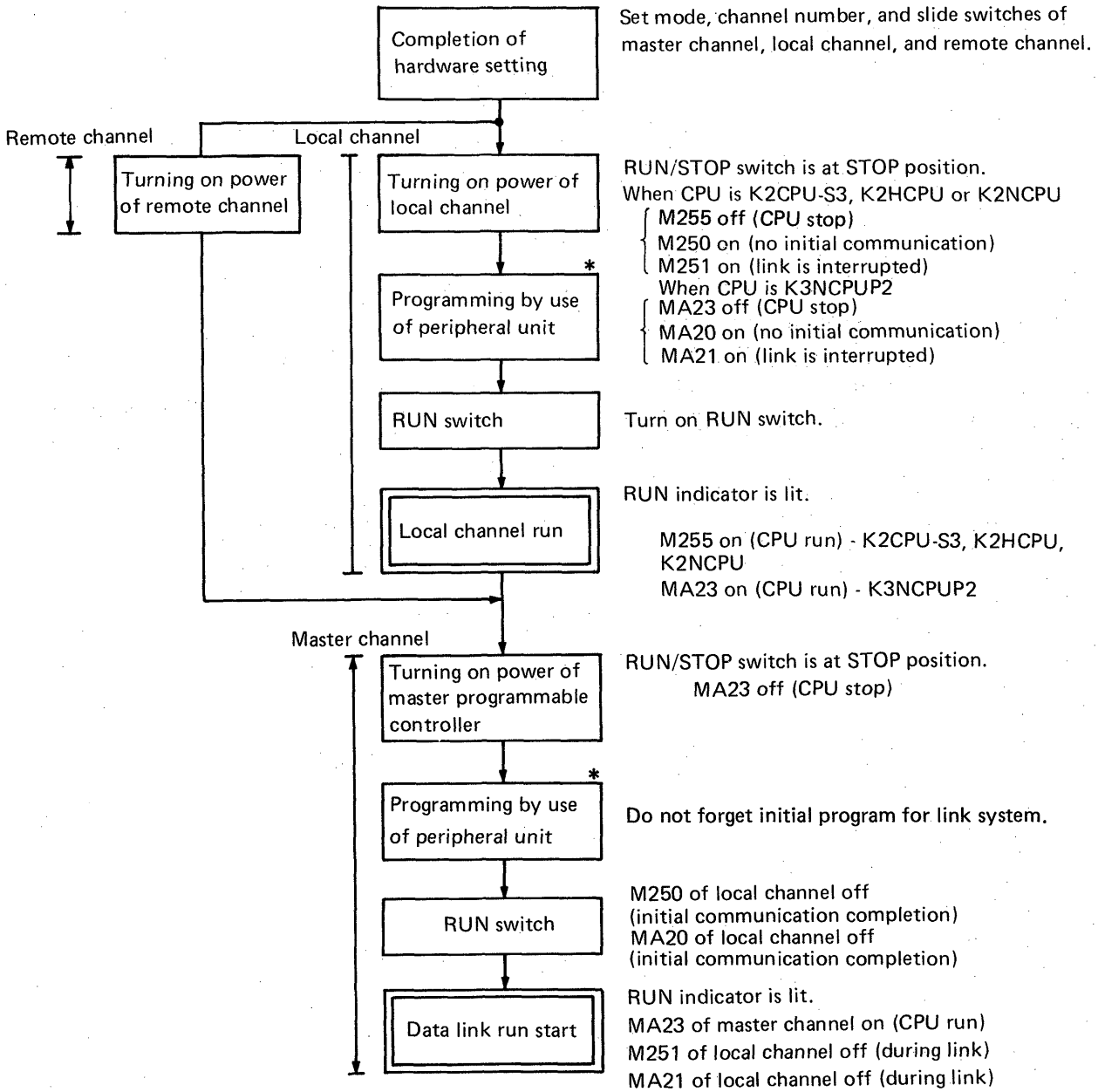
MEMO

5. OPERATING PROCEDURE

5. OPERATING PROCEDURE

5.1 Operation Start

Initiate operation according to the following procedure:



NOTE

1. Perform the steps indicated by * marks only at the time of the first start of system. In principle, turn on the power in order of local channels and remote channels, and then the master channel. After the program has been completed, the channels may be turned on at the same time. When the automatic reconnection function has been set at the time of hardware setting, the system may be started by first turning on the power of master channel and then turning on the power of slave channels.
2. When the system is independently run without making data link at the time of program debugging, the initial program is also required for the master channel. (Refer to page 30)

5.2 Operation Stop

Determine the order of stopping the operation considering the whole system. When the RUN/STOP switch on the master programmable controller is controlled, the system functions as shown in Table 5.1.

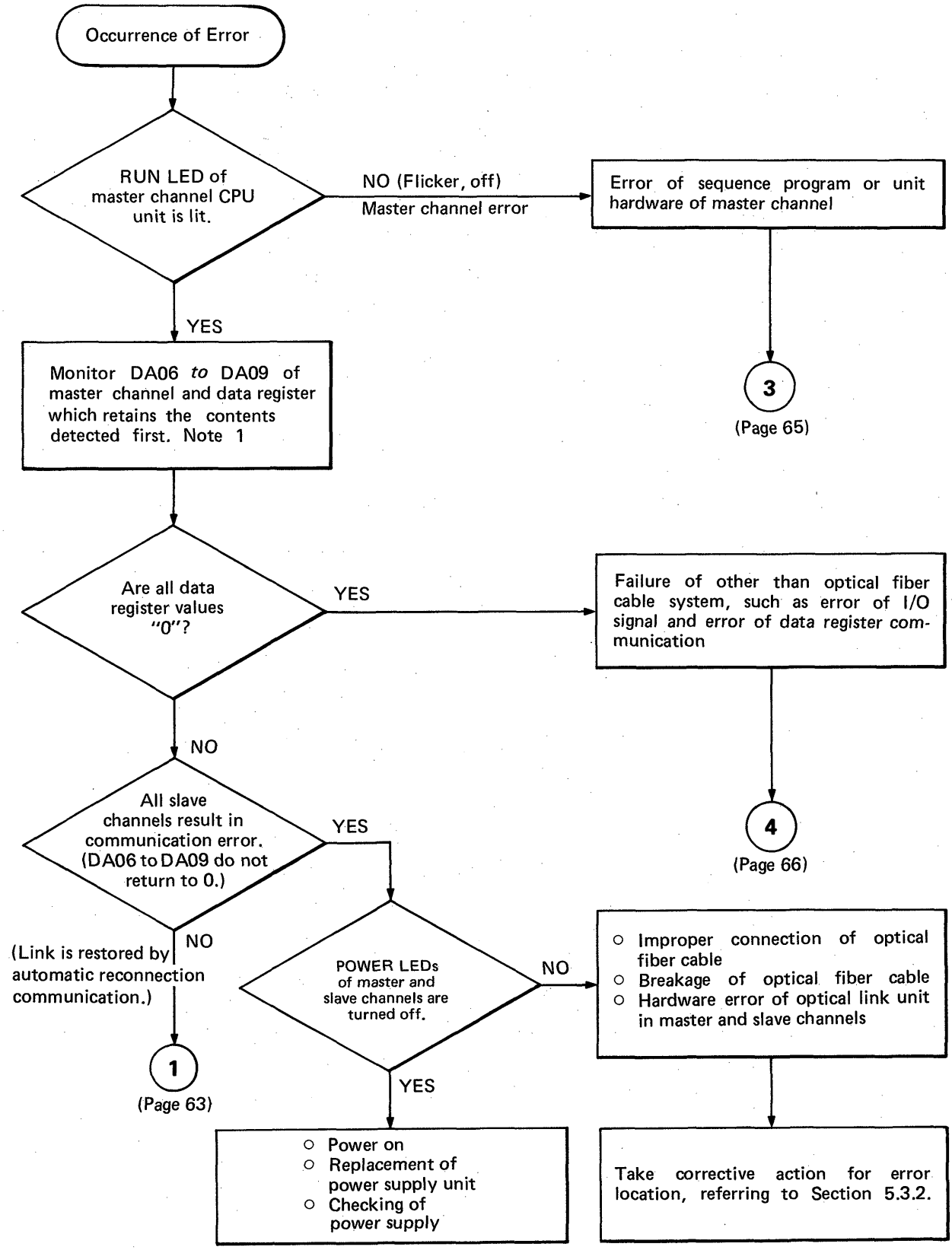
Control	Master Programmable Controller	Local Programmable Controller	Remote I/O Unit
RUN → STOP	Sequence processing is stopped.	M251 and MA21 are turned on when link is interrupted.	Outputs of all points are turned off.
RUN	Operation is restarted.	Operation is restarted.*	Operation is restarted.*

**When the automatic reconnection has not been set, operation cannot be restarted.*

Table 5.1 RUN/STOP Switch Control of Master Programmable Controller

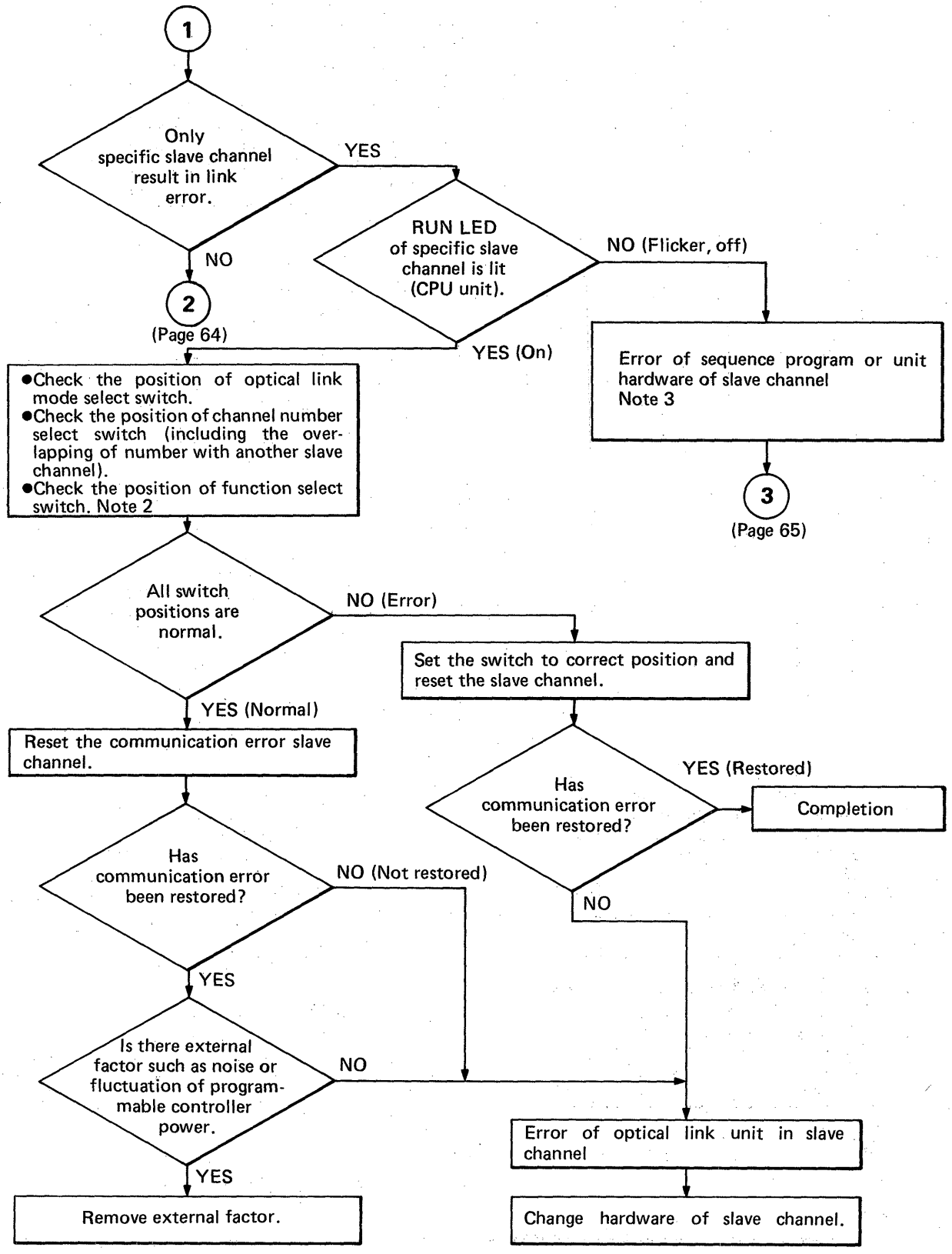
5.3 Troubleshooting

5.3.1 Troubleshooting chart



Note 1

Retain the value when DA06 to DA09 (data registers for indicating communication error slave channel numbers) first turn to other than "0" in the sequence program of master channel.

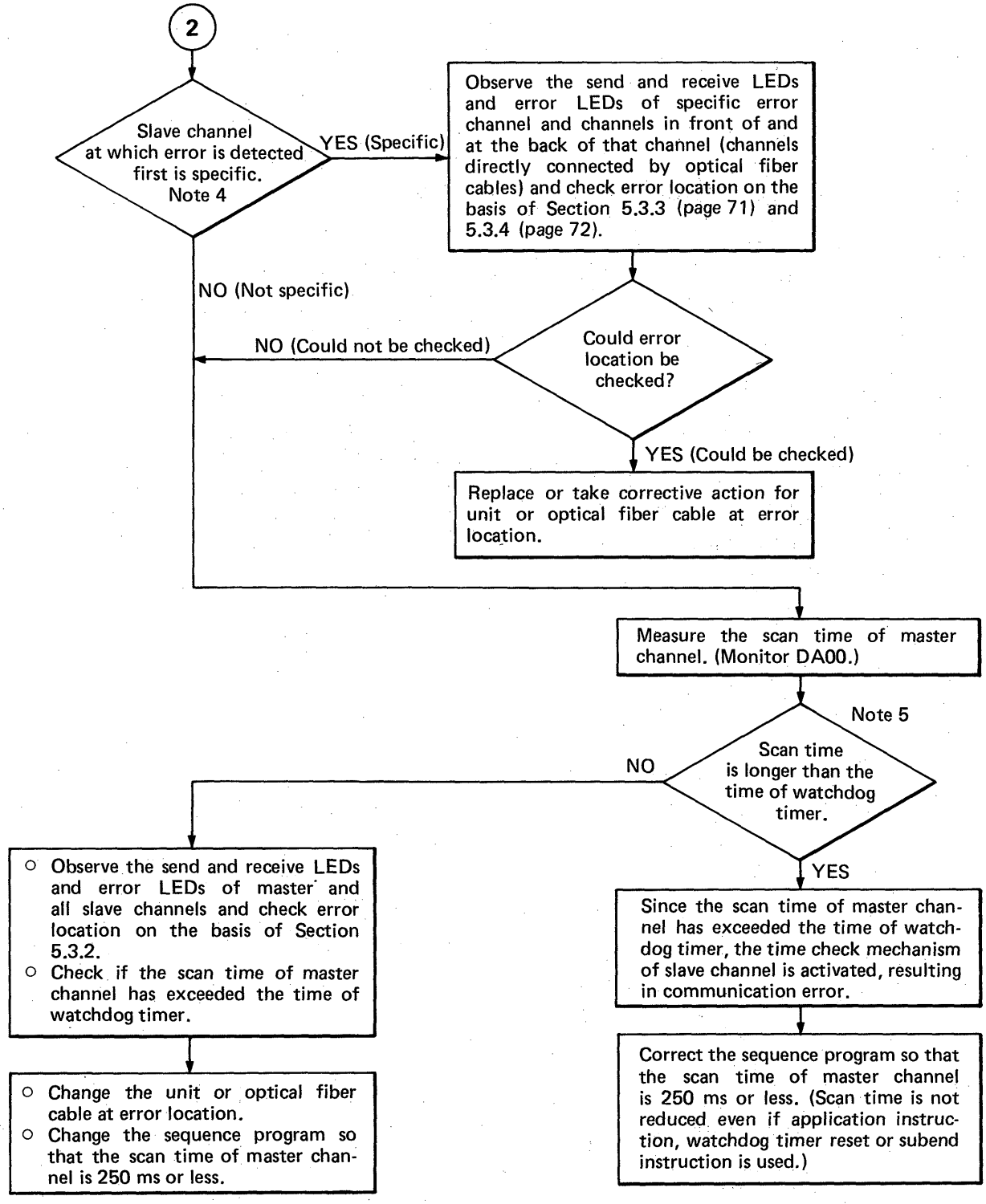


Note 2

Refer to switch setting in Section 3.3 to 3.5

Note 3

When there is an instruction which provides output to I/O number of link unit in the sequence program, error may result.

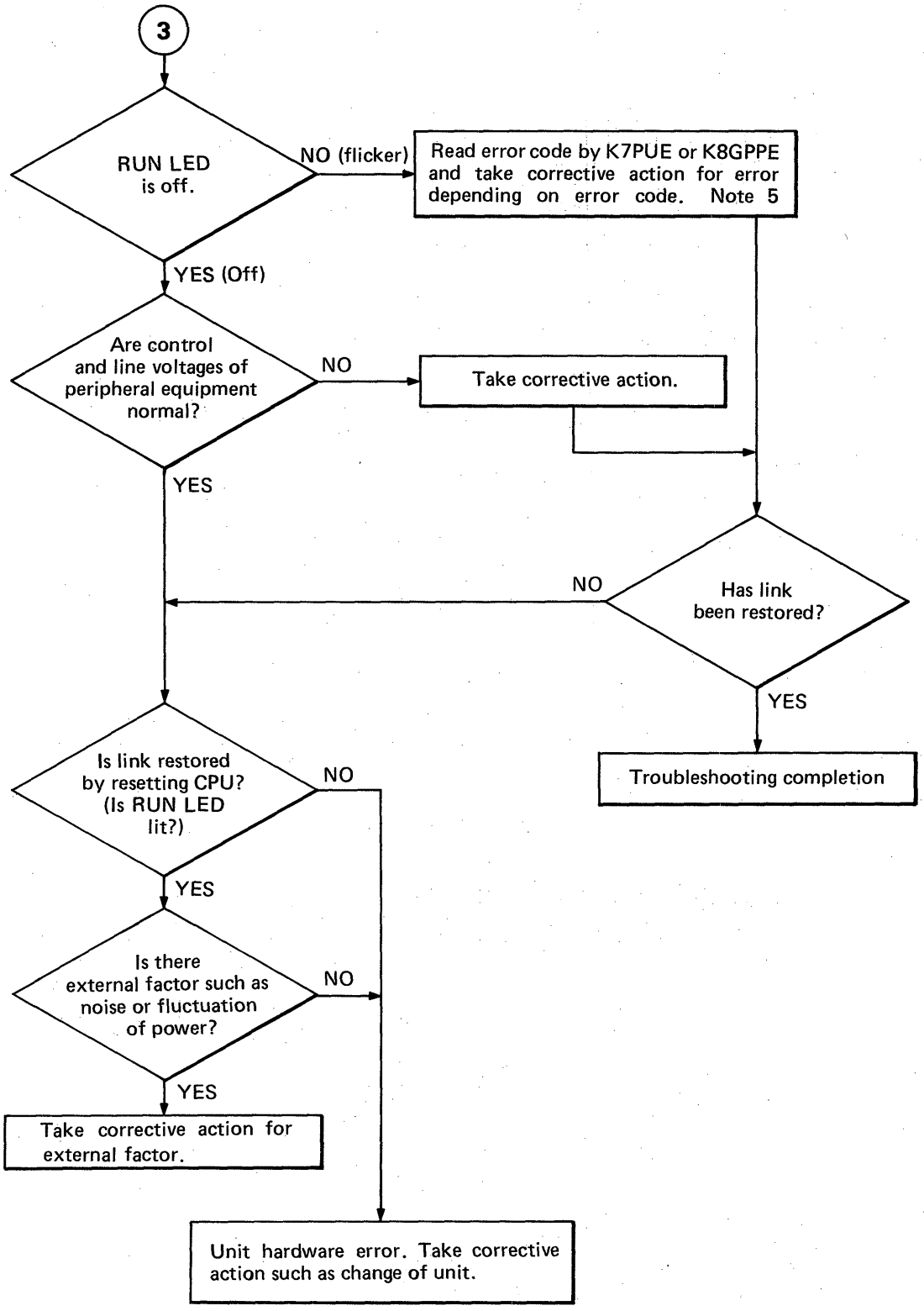


Note 4

Retain the value when DA06 to DA09 (data registers for indicating communication error slave channel numbers) first turn to other than "0" first in the sequence program of master channel.

Note 5

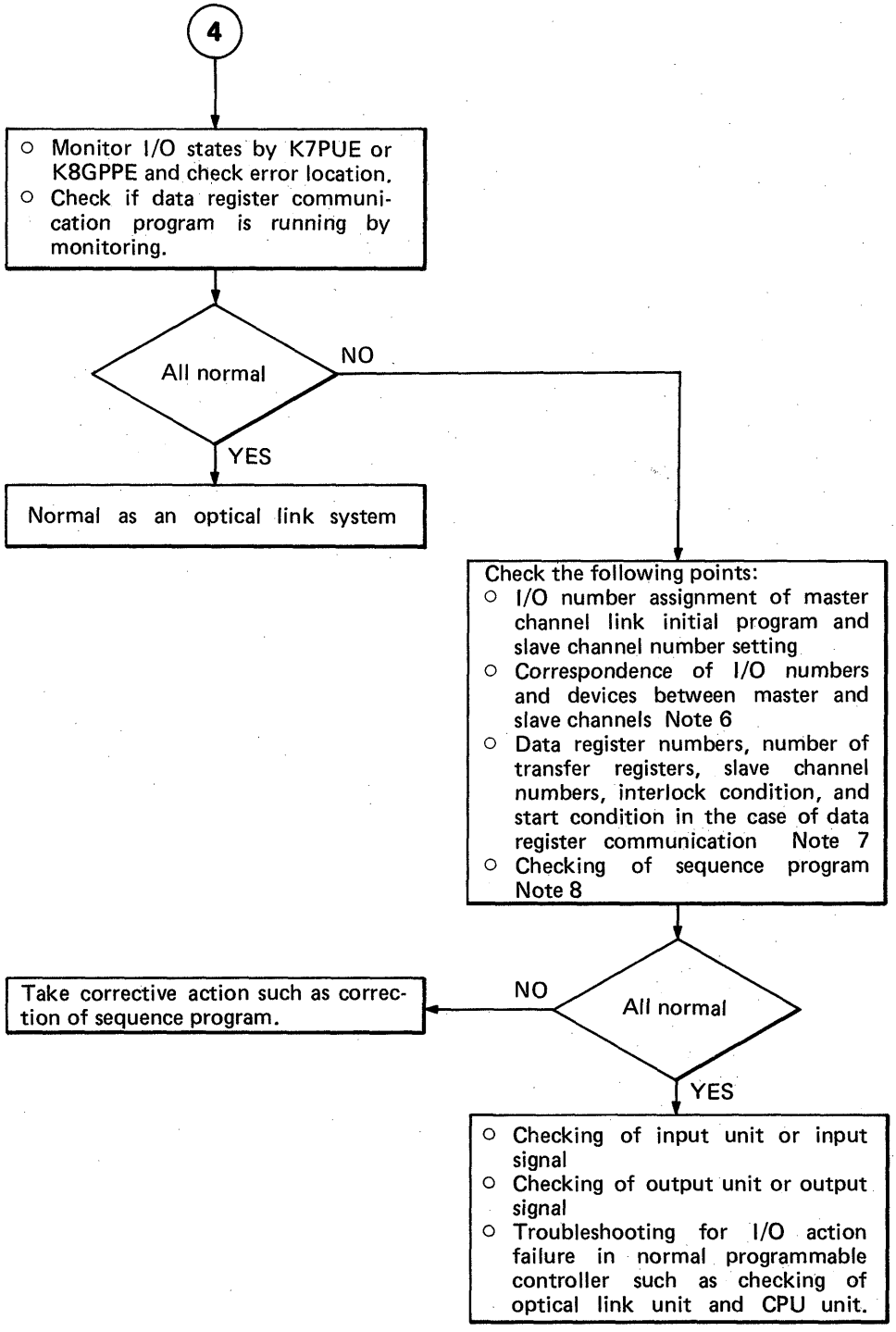
The standard watch dog timer time of K3NCPUP2 is 200ms. In this case, even if the time is prolonged by use of watch dog timer reset, etc., the time check mechanism is actuated in the slave channel when 250ms is exceeded.



Note 5

For reading method of error code, see the instruction manual for peripheral equipment. For the error code and corrective action, see the instruction manual and programming manual for corresponding unit.

- *Error which has error code may occur due to instantaneous power faulure or voltage drop of programmable controller power.*
- *When the mode setting or channel number setting of master channel link unit is not correct, error having error code may also occur. It is required to check it at the same time.*



Note 6

For the initial program and I/O number assignment, see instruction manual and programming manual of master channel unit. For devices of local link, special care is required because X and Y are reversed between the master channel and slave channel.

Note 7

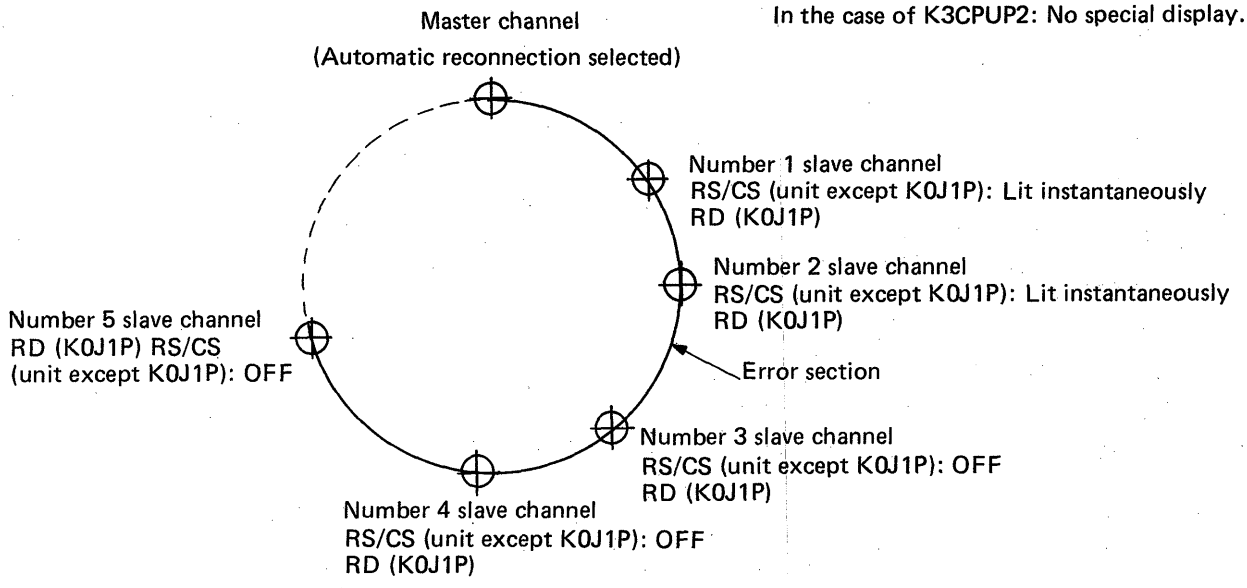
2 or more types of data register communication cannot be made at the same time.
(Receiving from Number 2 slave channel cannot be performed during sending from master channel to Number 1 slave channel.)

Note 8

In the link system, the period until I/O signals reach the CPU unit or output unit is linger than that of independent system. Special care is required for pulse signals.
(In this case, signal may not be received properly or output may not be provided even after predetermined period of time.)

5.3.2 How to find error location in the loop

(1) Link system has shut down due to error of all channels



Note: Make check in order of optical fiber cable connection.

Fig. 5.1

As shown in Fig. 5.1, carefully looking at the LED display "RD" (K0J1P) or "RS/CS" (unit except K0J1P) of each channel in the loop allows judgement where the error exists in the loop. Carefully look at the LED "RD" (K0J1P) or "RS/CS" (unit except K0J1P) in due order, beginning with that of the master channel (this method is valid only when the automatic reconnection function is selected). If there is a channel of which LED is lit instantaneously, channels upstream of that channel are normal. When the LEDs of channels are always off, the error is due to one of the following factors. (Between Number 2 and 3 channels in Fig. 5.1)

1) The optical fiber cable is broken. (Between Number 2 and 3 channels in Fig. 5.1)

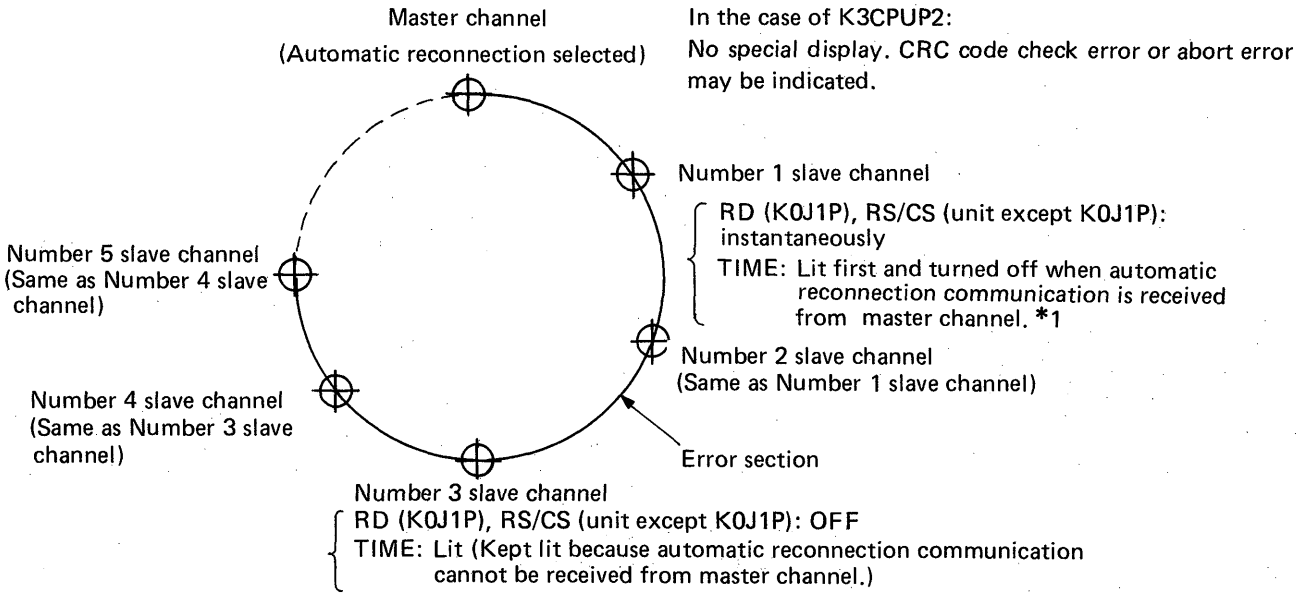
2) Failure of optical transmitter located upstream by 1 channel (Number 2 channel in Fig. 5.1)

3) Failure of optical receiver of its own channel (Number 3 channel in Fig. 5.1)

4) Cables are wired from RD to RD and from SD to SD between channels. (Between Number 2 and 3 channels in Fig. 5.1)

5) Hardware error of link channel (Number 2 or 3 channel in Fig. 5.1)

(2) Link system has shut down due to error of all channels during communication



Note: Make check in order of optical fiber cable connection. (In this case, there is no relation to channel number.)

Fig. 5.2

As shown in Fig. 5.2, carefully looking at the LED display "TIME" of each channel in the loop allows judgement where the error exists in the loop. Carefully look at the LED "TIME" in due order, beginning with that of the master channel (this method is valid only when the automatic reconnection function is selected). When the LED of channel is off, channels upstream of that channel are normal. If there is a channel of which LED is on, the error is due to one of the following factors. (Between Number 2 and 3 channels in Fig. 5.2)

1) The optical fiber cable is broken. (Between Number 2 and 3 channels in Fig. 5.2)

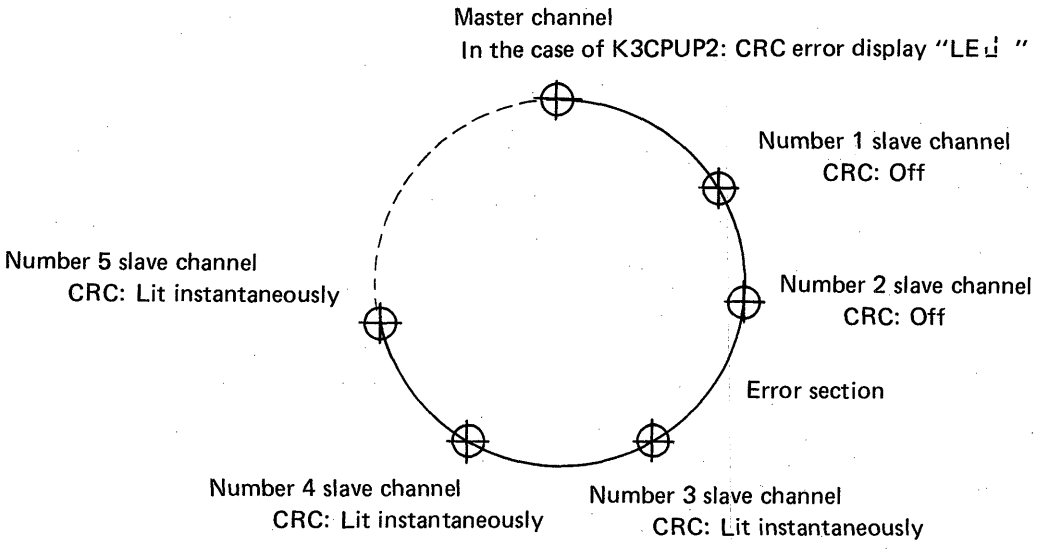
2) Failure of optical transmitter located upstream by 1 channel (Number 2 channel in Fig. 5.2)

3) Failure of optical receiver of its own channel (Number 3 channel in Fig. 5.2)

4) Hardware error of link channel (Number 2 or 3 channel in Fig. 5.2)

*1: When automatic reconnection is selected for the master channel and there is a channel which has resulted in communication error, the automatic reconnection communication from the master channel is made per "scan time of master channel (ms) x 256". Check the LEDs after the automatic reconnection communication from the master channel is made.

(3) Sometimes communication error occurs, resulting in disconnected channel



Note: Make check in order of optical fiber cable connection. (In this case, there is no relation to channel number.)

Fig. 5.3

As shown in Fig. 5.3, carefully looking at the LED display "CRC" of each channel in the loop allows judgement where the error exists in the loop. Carefully look at the LED "CRC" in due order, beginning with that of the master channel. When the LED of channel is always off, channels upstream of that channel are normal. If there is a channel of which LED has been lit instantaneously, the error is due to one of the following factors. (Between Number 2 and 3 channels in Fig. 5.3)

1) The optical fiber cable is connected improperly. (Between Number 2 and 3 channels in Fig. 5.3)

2) Failure of optical transmitter located upstream by 1 channel (Number 2 channel in Fig. 5.3)

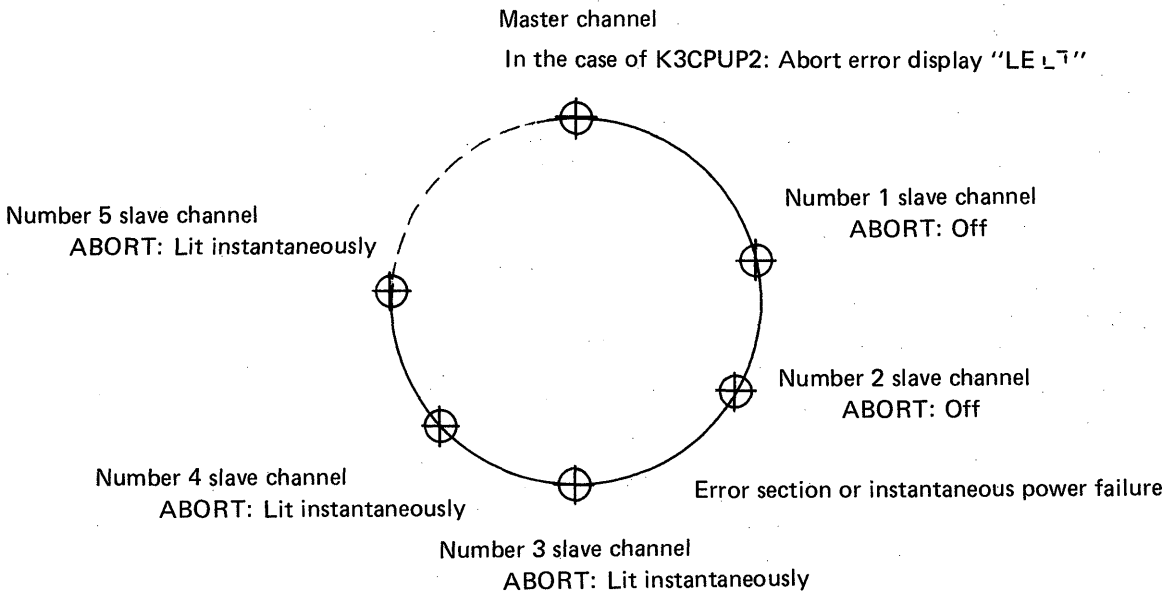
3) Failure of optical receiver of its own channel (Number 3 channel in Fig. 5.3)

4) Hardware error of link channel (Number 2 or 3 channel in Fig. 5.3)

(4) Sometimes communication error occurs, resulting in disconnected channel

Carefully looking at the LED display "RC" may indicate the failure of optical receiver. Normally, the LED "RC" is lit lightly. However, if the optical receiver has error, the LED may become dim instantaneously. In this case, it can be judged that the receiver of that channel is defective.

(5) Sometimes communication data is interrupted and communication error occurs, resulting in disconnected channel



Note: Make check in order of optical fiber cable connection. (In this case, there is no relation to channel number.)

Fig. 5.4

As shown in Fig. 5.4, carefully looking at the LED display "ABORT" of each channel in the loop allows judgement where the error exists in the loop. Carefully look at the LED "ABORT" in due order, beginning with that of the master channel. When ABORT of a channel is always off, channels upstream of that channel are normal. If there is a channel of which ABORT has been lit instantaneously, the error is due to one of the following factors. (Between Number 2 and 3 channels in Fig. 5.4)

1) The optical fiber cable is connected improperly. (Between Number 2 and 3 channels in Fig. 5.4)

2) Failure of optical transmitter located upstream by 1 channel (Number 2 channel in Fig. 5.4)

3) Failure of optical receiver of its own channel (Number 3 channel in Fig. 5.4)

4) Instantaneous power failure (The power of Number 2 channel is unstable in Fig. 5.4)

The above described methods (1) to (5) serves to find the error location of optical link system. Many of these errors are due to the failure of optical transmitter or receiver. Therefore, when the error location is detected, change the portion with spare and make checks. When the optical fiber cable is broken, make checks by the master test described later.
Other possible causes are as follows:

1) The power of programmable controller in the loop has been turned off carelessly.

2) The mode setting switch or channel number setting switch has been moved during operation.

3) The optical fiber cable has been twisted or the connector portion has been moved.

4) Instantaneous power failure has occurred.

5.3.3 Instantaneous power failure of programmable controller power in optical link system

When the power of programmable controller has become unstable in the optical link system due to instantaneous power failure, etc., link communication troubles indicated in the following table may occur. Therefore, connect the power of programmable controller to a high-quality power supply. Also, if instantaneous power failure occurs, the scan time of CPU unit is elongated even when the unit is not linked. In some cases, the CPU unit may be shut down due to watchdog timer error.

Unit which is influenced / Unit to which instantaneous power failure is applied	K3NCPUP2	KCPU + KJ71P3 (Slave channel: Local channel)	KJ72P5 (Slave channel: Remote channel)
K3NCPUP2 (Master channel)	No error	• Communication error CRC code check error Abort error	• Communication error CRC code check error Abort error
KCPU + KJ71P (Slave channel: Local channel)	No error	• KCPU shuts down due to link unit communication error. • Communication error CRC code check error Abort error	• Communication error CRC code check error Abort error
KJ72P5 (Slave channel: Remote channel)	No error	• Communication error CRC code check error Abort error	• Communication error CRC code check error Abort error

Note: Instantaneous power failure includes so-called voltage drop by which voltage reduces to 85VAC or less.

5.3.4 Master test and slave test

The KJ71P3, KJ72P5 and K0J1P have a built-in master test and slave test functions of which specifications are as follows:

(1) Master test

Unit Type Name	Mode	Description	Normal	Error
KJ71P3, KJ72P5	Master test I	Used to judge whether or not the sending and receiving functions of its own channel are normal. By connecting the optical fiber cable as shown in Fig. 5.5 and operating the RESET switch, the built-in test program is started.	8 LEDs at right row on the front flicker.	LED of corresponding error is lit.
K0J1P			ERROR LED flickers.	Check the content of error by monitoring D126.
KJ71P3, KJ72P5	Master test II	Used to judge whether or not the optical fiber cables between channels are normal after making sure that the sending and receiving function of its own channel are normal by master test I. By connecting the optical fiber cables as shown in Fig. 5.6, set the mating channel to offline mode and operating the RESET switch, the built-in test program is started.	8 LEDs at right row on the front flicker.	LED of corresponding error is lit.
K0J1P			ERROR LED flickers.	Check the content of error by monitoring D126.

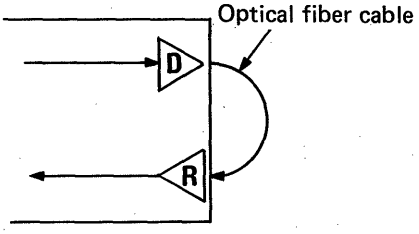


Fig. 5.5 Master Test I

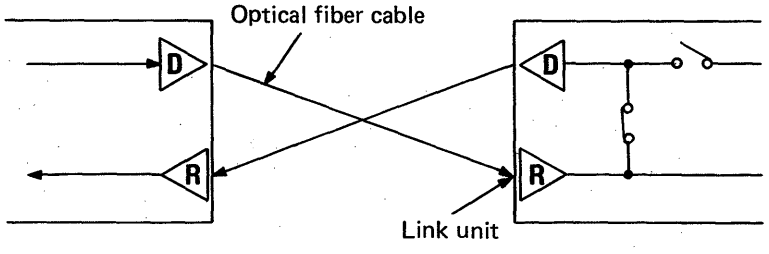


Fig. 5.6 Master Test II

(2) Slave test

Unit Type Name	Mode	Description	Normal	Error
KJ71P3, KJ72P5	Slave test	Used to allow the sending and receiving functions of its own channel to be tested by the mating channel. By setting the mating channel to master test mode and operating the RESET switch on slave test side and then the RESET switch on the master test side, the built-in test program is started.	8 LEDs at right row on the front flicker.	LED of corresponding error is lit.
K0J1P			ERROR LED flickers.	Check the content of error by monitoring D126.

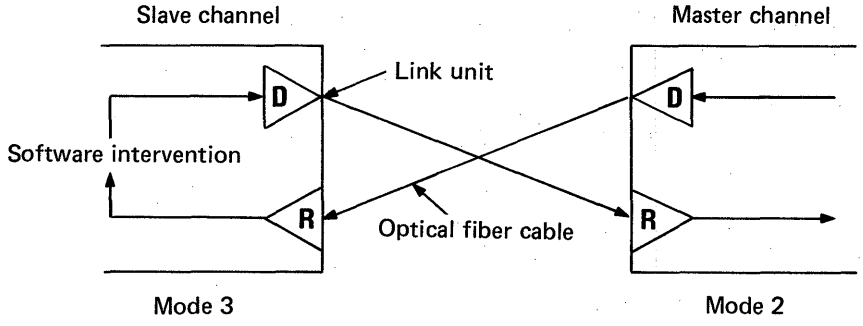


Fig. 5.7 Slave Test

Cautions for master and slave tests

1) Before making the tests, move the RUN switch of programmable controller to the STOP position.

2) When the KJ71P3 is used, perform reset operation by use of the RESET switch of CPU in its own channel.

3) When the system to be tested consists of 3 or more channels, be sure to set the channels, which are not put to the master and slave tests, to the offline mode.

5.3.5 Errors of KJ71P3 and KJ72P5

Display	Description	Contents	Condition	
RUN	CPU RUN	Optical link CPU is running normally.	Turns on when hardware is normal.	
SD	Send Data	Send data		
SC	Send Clock	Send clock		
RD	Receive Data	Receive data		
RC	Receive clock	Receive clock		
RS	Request to Send	Request to send	Dimly lit when sending and receiving are normal.	
CS	Clear to Send	Sending is possible		
CD	Carrier Detect	Carrier detect		
CRC	CRC Error	Code check error	Turns on when error is detected.	Automatically turned off when normal state is restored.
OVER	Overrun Error	Data receiving delay error		
ABORT. INVAL	Aborted or Invalid Frame Error	Data are all "1".		
TIME	Time Over	Time over error *1		
DATA	Data Error	Receive data error		
UNDER	–	(Not used)	Off	
IDLE				
CARR				

*1: Time check error of communication interval from master channel

The display of this time over error is turned off when the initial communication and automatic reconnection communication (which is made per "scan time of master channel (ms) x 256" when the automatic reconnection is selected and if there is a communication failure channel) from the master channel are received.

5.3.6 Errors of K0J1P

(1) Error codes of K0J1P

5008: Link card (K0J83) loading failure
When the K0J1P is used as remote I/O or local programmable controller, the link card has not been loaded correctly.

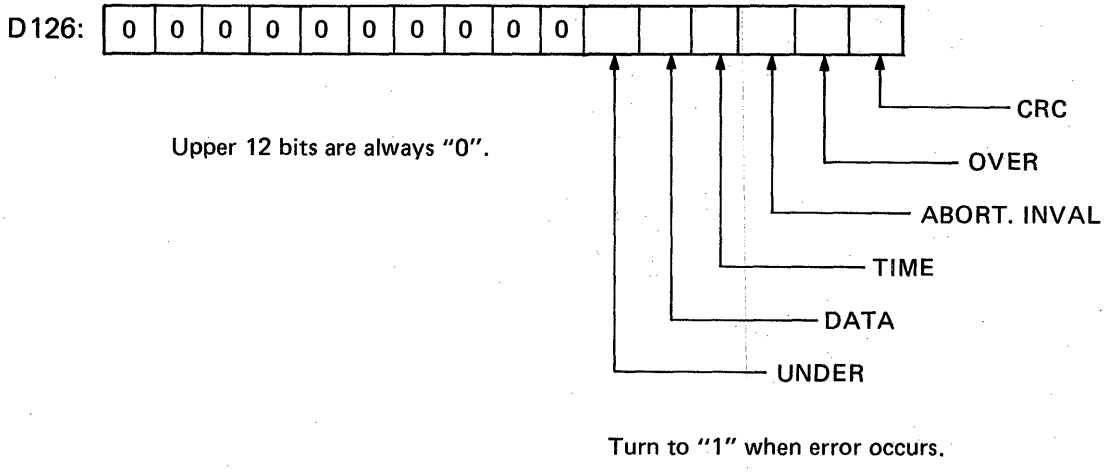
5021: Watchdog timer (200ms) error

(2) Special registers for error indication

M250: Turned off when initial data is received.

M251: Turned off when link communication is normal. Turned on when link communication is interrupted.

M253: Turned on when link system error is detected.
When M253 turns on, the error LED on the front panel is lit, and at the same time, the content of error is stored in D126 as shown below.
However, the contents of M253 and D126 are rewritten to new contents at each communication.



5.4 Corrective Actions for Master Programmable Controller (K3NCPUP2) during Transmission Designation Error

Table 5.2 shows the error numbers and corrective actions of transmission designation errors during data link.

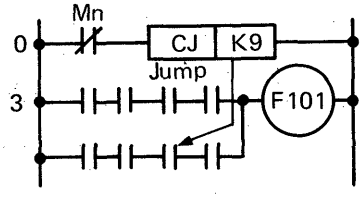
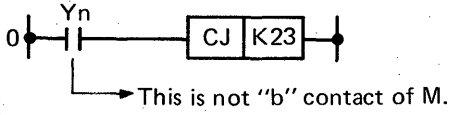
Error Number	Error Code	CPU State	Content and Cause of Error	Corrective Action
A06	FA06	Stop	Communication error with optical data link card built in K3NCPUP2 Communication between K3NCPUP2 and optical data link card cannot be made properly. (1) The mode setting digital switch of K3NCPUP2 does not indicate 0 or 1. ○0.....for execution of optical data link ○1.....for non-execution of optical data link (2) The channel number setting digital switch does not indicate 00.	(1) Move the RUN key switch to "STOP" position. (2) Check and reset the mode setting digital switch and channel number setting digital switch. (3) Perform reset by the RESET key switch. (4) Move the RUN key switch to "RUN" position.
A07	FA07	Stop	Initial program error The initial program of data link has error. (1) The jump destination of CJ instruction is not a step next to the initial program.  (2) Step 0 does not have a dummy temporary memory M.  **CAUTION** The reverse number and empty slot memories. However, they cannot be can be used only for the temporary memory M.	(1) Move the RUN key switch to "STOP" position. (2) Perform reset by the RESET key switch. (3) Correct the initial program. (4) Move the RUN key switch to "RUN" position.

Table 5.2 Transmission Designation Error List

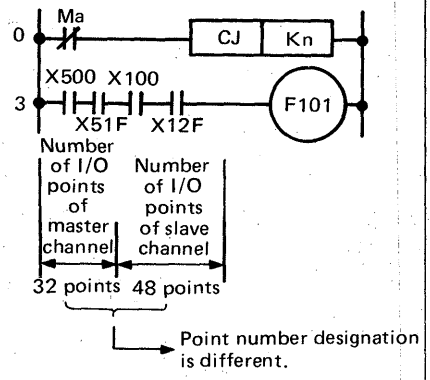
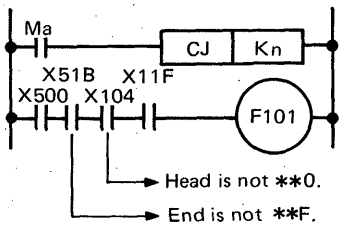
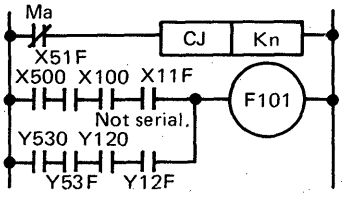
Error Number	Error Code	CPU State	Content and Cause of Error	Corrective Action
			(3) The specified number of I/O points is different between the master channel and slave channel.  (4) The head of I/O point range designation is not **0 and its end is not **F.  (5) The input point range and output point range of 1 channel are not serial.  (6) NOP is provided in the initial program. 0 LDI M000 1 CJ 2 K 10 3 LD X300 4 AND X34F 5 NOP..... NOP is 6 AND X100 provided 7 AND X14F 8 ORB ..... NOP is 9 OUT F101 provided 10 LD X000 11 OUT Y050 Initial program	

Table 5.2 Transmission Designation Error List (Continued)

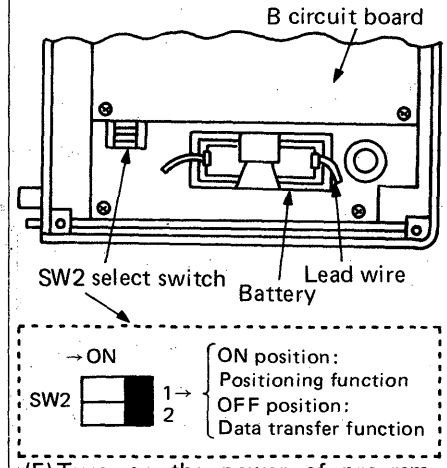
Error Number	Error Code	CPU State	Content and Cause of Error	Corrective Action
A14	FA14	Stop	4 or more KJ71 loading (1) 4 or more units of KJ71L2, L3 and L7 data link units are loaded. (2) 4 or more units of KD71N are loaded and the function of KD71N is set to "data transfer". (3) A total of 4 or more units of data link unit and KD71N are loaded and the function of KD71N is set to "data transfer". **CAUTION** If the function of KD71N is set to "data transfer", K3NCPU(P2) regards KD71N as a data link unit.	(1) Move the RUN key switch to "STOP" position. (2) Turn off the power of programmable controller. (3) Check the following points: ○When 4 or more units of KJ71L2, L3 and L7 are loaded, reduce the units to 3 or less. However, 2 units of the same type name cannot be loaded. ○When KD71N is loaded, unload it from the base unit and check if SW2-1 (for function setting) is at ON position. (4) Load KD71N into the base unit.  (5) Turn on the power of programmable controller. (6) Move the RUN key switch to "RUN" position.
A15	FA15	Stop	L2ROM loading error (1) 2 or more units of KJ71L2 are loaded. (2) There are 2 or more data link units which are loaded with ROM "L2ROM" for OS of KJ71L2.	(1) Move the RUN key switch to "STOP" position. (2) Turn off the power of programmable controller. (3) Check the following points: ○When 2 or more units of KJ71L2 are loaded, reduce the units to 1 or less. However, 2 units of the same type name cannot be loaded. ○When 1 unit of KD71N is loaded unload KJ71L3 and L7 from the base unit and check if the ROM for OS is "L2ROM". (When L2ROM is used, it is required to ROM for OS.) (4) Load KJ71L2, L3 and L7 into the base unit. (5) Turn on the power of programmable controller. (6) Move the RUN key switch to "RUN" position.

Table 5.2 Transmission Designation Error List (Continued)

Error Number	Error Code	CPU State	Content and Cause of Error	Corrective Action
A16	FA16	Stop	Communication error with KJ71L2 Communication between K3NCPU and KJ71L2 cannot be made normally. (1) The channel number setting of KJ71L2 has not been performed for master. (2) The ROM inside KJ71L2 is not "L2ROM".	(1) Move the RUN key switch to "STOP" position. (2) Turn off the power of programmable controller. (3) Unload KJ71L2 from the base unit. (4) Check the following points: ○ Check the setting of channel number of KJ71L2. ○ Check if the ROM for OS of KJ71L2 is "L2ROM". (When "L2ROM" is not used, it is required to change the ROM for OS to "L2ROM".) (5) Load KJ71L2 into the base unit. (6) Turn on the power of programmable controller. (7) Move the RUN key switch to "RUN" position.
			Communication error with KJ71L3 Communication between K3NCPU(P2) and KJ71L3 cannot be made normally. (1) The channel number setting of KJ71L3 has not been performed channels 1 to 7. (2) The ROM inside KJ71L3 is not "L3ROM".	(1) Move the RUN key switch to "STOP" position. (2) Turn off the power of programmable controller. (3) Unload KJ71L3 from the base unit. (4) Check the following points: ○ Check the setting of channel number of KJ71L3. ○ Check if the ROM for OS of KJ71L3 is "L3ROM". (When not used, it is required to change the ROM to "L3ROM".) (5) Load KJ71L3 into the base unit. (6) Turn on the power of programmable controller. (7) Move the RUN key switch to "RUN" position.
			Communication error with KJ71P3 Communication between K3NCPU(P2) and KJ71P3 cannot be made normally. (1) The channel number setting of KJ71P3 is not 1 to 32. (2) The ROM inside KJ71P3 is not "P3ROM".	(1) Move the RUN key switch to "STOP" position. (2) Turn off the power of programmable controller. (3) Check the following points: ○ Check the setting of channel number setting digital switch of KJ71P3. ○ Unload KJ71P3 from the base unit and check if the ROM for OS is "P3ROM". (When "P3ROM" is not used, it is required to change the ROM to "P3ROM".) (4) Load KJ71P3 into the base unit. (5) Turn on the power of programmable controller. (6) Move the RUN key switch to "RUN" position.

Table 5.2 Transmission Designation Error List (Continued)

Error Number	Error Code	CPU State	Content and Cause of Error	Corrective Action
A19	FA19	Stop	Communication error with KJ71L7 Communication between K3NCPU and KJ71L7 cannot be made normally. (1) The setting of DIP switch of KJ71L7 has not been performed for computer link. (2) The ROM inside KJ71L7 is not "L7ROM".	(1) Move the RUN key switch to "STOP" position. (2) Turn off the power of programmable controller. (3) Unload KJ71L7 from the base unit. ○ Check the setting of DIP switch of KJ71L7. ○ Check if the ROM for OS inside KJ71L7 is "L7ROM". (When "L7ROM" is not used, it is required to change the ROM for OS to "L7ROM".) (4) Load KJ71L7 into the base unit. (5) Turn on the power of programmable controller. (6) Move the RUN key switch to "RUN" position.

Table 7.4 Transmission Designation Error List (Continued)

5.5 Errors during Optical Data Link of Master Programmable Controller (K3NCPUP2)

The optical data link card for K3CPUP2 is not provided with the error indicator LED. Therefore, the transmission software error detected by the optical data link card is displayed by the error number indicator LED of K3CPUP2.
Once the error occurs, the K3CPUP2 retains the content of error and keeps displaying it. Therefore, turn off the display as required by the INDICATOR LED RESET switch.

Error Display		Type of Error	Cause	Corrective Action
LE	d	Code check error	●Non-coincidence of sending and receiving codes due to power-off, instantaneous power failure during sending and receiving ●Failure of hardware	1. Prevention of power-off, etc. 2. Prevention of vibration and shock to units, cables, etc. 3. Change defective unit and cable.
	E	Overrun error	●Failure in takeout of received data ●Failure of hardware	Change defective unit and cable.
	F	Abort invalid frame error	●Sending failure of sent data For example, kept at high level. ●Failure of hardware	Change unit.

Table 5.3 Error List during Optical Data Link

NOTE

The failure of unit includes that of light amount adjustment.
The failure of cable includes that of cable work (such as less than 20mm bending radius).

5.6 External Failure Numbers

Table 5.4 shows the error numbers and corrective actions of external failure numbers.

Error Number	Error Code	CPU State	Content and Cause of Error	Corrective Action
F0 to 99	—	—	External failure number Failure detection program, which has been preset by external failure memories OUT F0 to 99, has been executed.	(1) Remove the cause of failure depending on displayed failure number. (2) Turn on the F171 reset switch. (3) Clear the display by the error number indicator LED reset switch.

Table 5.4 External Failure Number List

5.7 Errors of K3NCPU(P2)

Table 5.5 shows the error numbers and corrective actions of CPU errors.

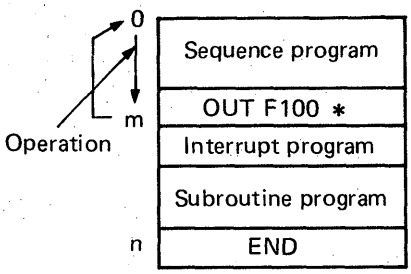
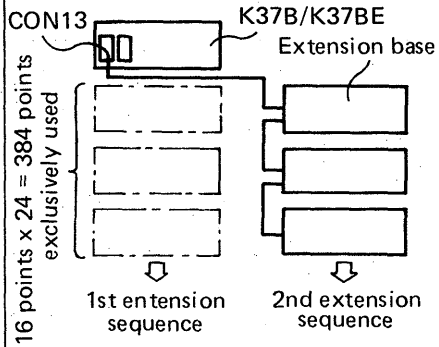
Error Number	Error Code	CPU State	Content and Cause of Error	Corrective Action
C00	FA00	Stop	Without OUT F100 Sequence program end OUT F100 is not written at the end of sequence program.  *The operation of K3NCPU(P2) is performed in the range of 0 to OUT F100. Therefore, OUT F100 is always required also when there are no interrupt program and subroutine program.	(1) Move the RUN key switch to "STOP" position. (2) Perform reset by the RESET key switch. (3) Write OUT F100 at the end of sequence program. (4) Move the RUN key switch to "RUN" position.
C02	FA02	Stop	I/O points exceeded (1) I/O units exceeding 2048 I/O points have been loaded within the range of 55 slots of base units (1 basic × 6 extension base units). (2) When there are 3 or less stages of extension bases, extension cable is connected to CON13 of basic base, resulting in the setting of 2nd extension sequence.  I/O points = (number of points of K37B) + (384 points) + (number of points of 2nd extension sequence)	(1) Move the RUN key switch to "STOP" position. (2) Check the following points: ○ When the number of I/O points has exceeded 2048 points, make reselection so that I/O points are 2048 points or less. ○ Check the connecting position of connector for extension cable of basic base (K37B/K37BE). ● 1st extension sequence ..... CON12 ● 2nd extension sequence ..... CON13 (3) Reduce the number of points of I/O units to 2048 points or less, or change the position of connector for extension cable to CON12.

Table 5.5 CPU Error List

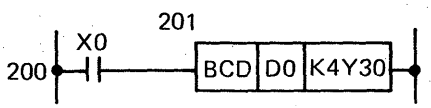
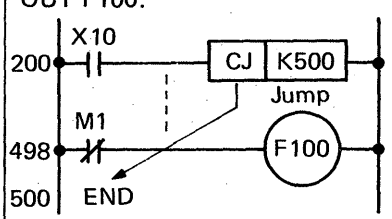
Error Number	Error Code	CPU State	Content and Cause of Error	Corrective Action
C10	–	Run continued	BCD conversion error (1) Result of BCD conversion has exceeded "9999". (2) S (source) intended to be converted into binary is not decimal.	(1) Move the RUN key switch to "STOP" position. (2) Monitor DA05 by K7PUE, K8GPPE, etc. to check the error step number. (The error step number indicates the head step of instruction which has resulted in error.)  *In the above figure, the error step is the head step 201 of BCD instruction. (3) Read and correct the program with error step number. When S (source) is data register (D), correct the program which is stored in the data register. (4) Perform reset by the RESET key switch. (5) Move the RUN key switch to "RUN" position.
C11	0 to F999 (Error step number)	Stop	Instruction code error The instruction codes of program during operation processing include a code which cannot be decoded by CPU. Example: 2-step and 3-step instructions are not complete. 10 LD X0 11 OUT T0 ← There is no set value. 12 LDI M0 13 PLS M1 14 MOV] ← This is MOV instruction but does not have 3 steps. 15 D0] 16 OUT F100 17 END	(1) Move the RUN key switch to "STOP" position. (2) Check the error step number in "TEST" mode of K7PUE, K8GPPE, etc. (3) Perform reset by the RESET key switch. (4) Read and correct the program with error step number. When the error step number is 0, the error may be due to the jump destination of CJ instruction. Therefore, when step 0 is normal, retrieve the CJ instruction and correct the jump destination. (5) Move the RUN key switch to "RUN" position.
	0	Stop	Sequence end cannot be executed because jump by CJ instruction has been made to the destination which is located below sequence program end OUT F100. 	

Table 5.5 CPU Error List (Continued)

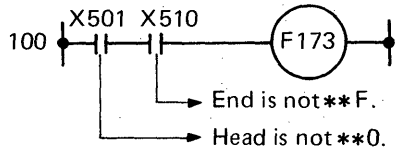
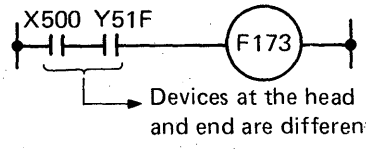
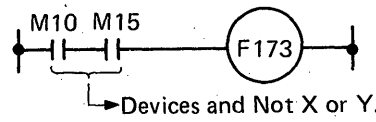
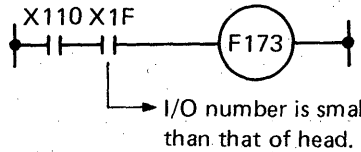
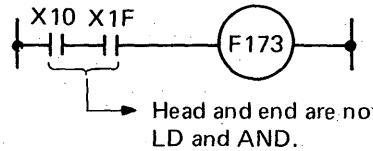
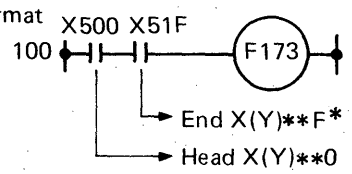
Error Number	Error Code	CPU State	Content and Cause of Error	Corrective Action
C20	FA20	Stop	Partial refresh program format error (1) The head of range designation of partial refresh OUT F173 is not **0 and its end is not **F.  (2) "NOP" instructions are provided in the format of partial refresh. 15 LD X010 16 OUT Y051 17 LD Y050 18 NOP ← NOP is provided 19 NOP ← NOP is provided 20 AND Y05F 21 NOP 22 OUT F173 Designation of partial refresh ≀ (3) The devices at the head and end of partial refresh are different.  (4) The specified devices of partial refresh are not X and Y.  (5) The end of partial refresh is specified smaller than the head.  (6) The head and end of partial refresh are not LD and AND. 	(1) Move the RUN key switch to "STOP" position. (2) Perform reset by the RESET key switch. (3) Retrieve partial refresh OUT F173 and correct. Format  Coding ≀ 100 LD X500 101 AND X51F 102 OUT F173 ≀ NOP is not provided. *Head step < end step (4) Move the RUN key switch to "RUN" position.

Table 5.5 CPU Error List (Continued)

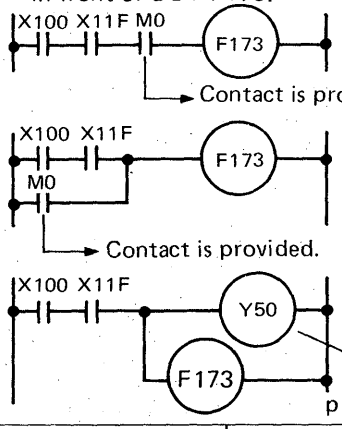
Error Number	Error Code	CPU State	Content and Cause of Error	Corrective Action
			(7) Extra contact, coil, etc. is provided in front of OUT F173. 	
C22	–	Run continued	Battery voltage error (1) K6BAT is not loaded in K3NCPU-(P2). (2) The connectors of lead wires of K6BAT are not inserted in the pin connectors on printed circuit board. (3) The voltage of K6BAT has reduced due to discharge.	**CAUTION** C22 battery voltage error does not pose a problem when K3NCPU-(P2) is run with ROM and power failure latch is not performed. If CPU stop error has occurred, the error number is displayed. (1) Move the RUN key switch to "STOP" position. (2) Turn off the power of programmable controller. (3) Unload K3NCPU(P2) from the base unit. (4) Check the loading state of K6BAT and the inserting state of lead wire connectors. (5) Perform the following actions: ○ K6BAT is not loaded ..... Load K6BAT and positively insert the connectors of lead wires to the pin connectors of printed circuit board. ○ Connectors are not inserted positively ..... Positively insert the connectors of lead wires to the pin connectors of printed circuit board. ○ Connectors are inserted positively ..... Change K6BAT. (See page 149.) (6) Load K3NCPU(P2) into the base unit. (7) Turn on the power of programmable controller. (8) Move the RUN key switch to "RUN" position.

Table 5.5 CPU Error List (Continued)

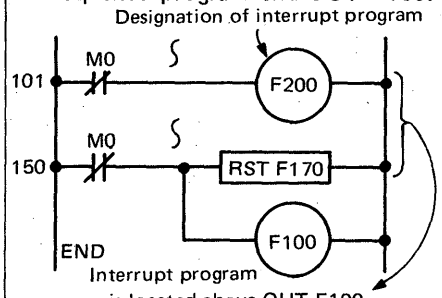
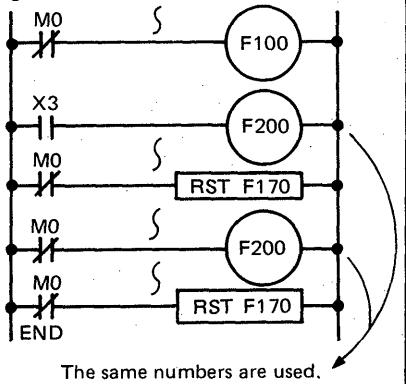
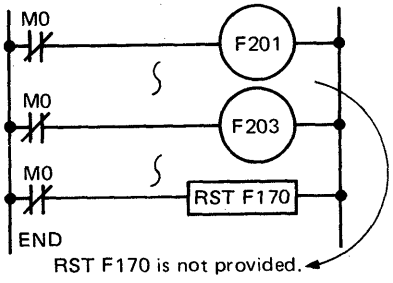
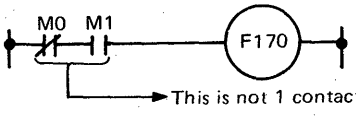
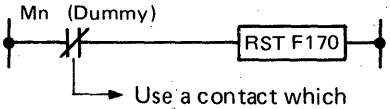
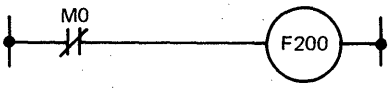
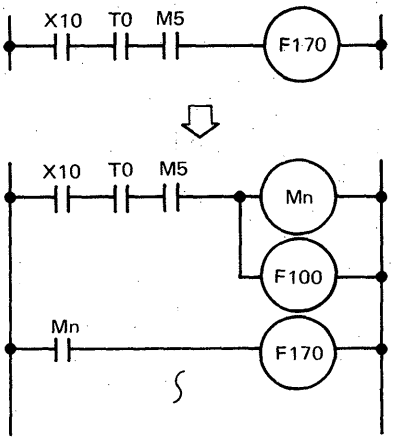
Error Number	Error Code	CPU State	Content and Cause of Error	Corrective Action
C23	FA23	Stop	Interrupt program format error (1) Subroutine program and interrupt program are not written below sequence program end OUT F100.  (2) OUT F170 and OUT F200 to 215 are written below sequence program end two or more times.  (3) The end of one of OUT F170 and OUT F200 to 215 programs is not RST F170.  (4) The serial contact in front of OUT F170 or OUT F200 to 215 is not only 1 contact. 	(1) Move the RUN key switch to "STOP" position. (2) Perform reset by the RESET key switch. (3) Retrieve OUT F170 and OUT F200 to 215 and correct. ○There are OUT F170 and OUT F200 to 215 above OUT F100. .... Provide OUT F100 above OUT F170 and OUT F200 to 215. ○OUT F170 and OUT F200 to 215 are provided two or more times. .... Do not use OUT F170 and OUT F200 to 215 two or more times. ○There is no RST F170. .... Write RST F170.  Use a contact which always allows the exectuion of RST F170. ○There are 2 or more contacts in front of OUT F170 or OUT F200 to 215. .... Use only necessary contact (1 contact).  *When there are plural execution conditions of OUT F170 or OUT F200 to 215, change them into one in sequence program.  (4) Move the RUN key switch to "RUN" position.

Table 5.5 CPU Error List (Continued)

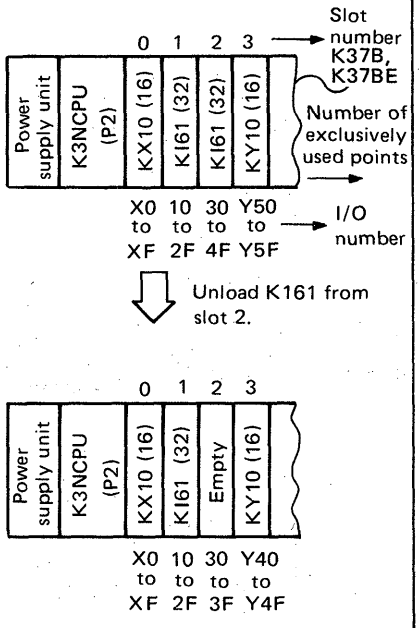
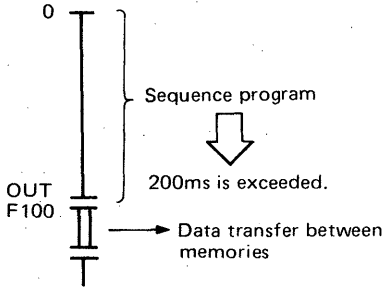
Error Number	Error Code	CPU State	Content and Cause of Error	Corrective Action
C24	FA24	Stop	2 or more interrupt unit loading 2 or more interrupt units KI61 are loaded in the basic base K37B.	(1) Move the RUN key switch to "STOP" position. (2) Turn off the power of programmable controller. (3) Reduce KI61 loaded in K37B (K37BE) to 1 unit. **CAUTION** K161 exclusively uses 32 points. However, since the empty slot uses 16 points, I/O numbers change. Therefore, caution should be exercised.  (4) Turn on the power of programmable controller. (5) Move the RUN key switch to "RUN" position.
C27	FA27	Stop	Watch dog error The processing time of sequence program (0 to OUT F100) has exceeded 200 ms. 	(1) Move the RUN key switch to "STOP" position. (2) If DA00 is monitored by K7PUE, the operation processing time is obtained. K8GPPE, GP-80A displays the operation processing time at right bottom in "MONITOR" mode. (3) Perform reset by the RESET key switch. (4) Reduce operation processing time to 200 ms or less by use of CJ instruction, or execute watchdog timer reset OUT F159 in sequence program. (5) Move the RUN key switch to "RUN" position.

Table 5.5 CPU Error List (Continued)

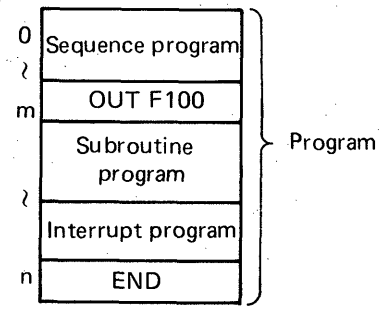
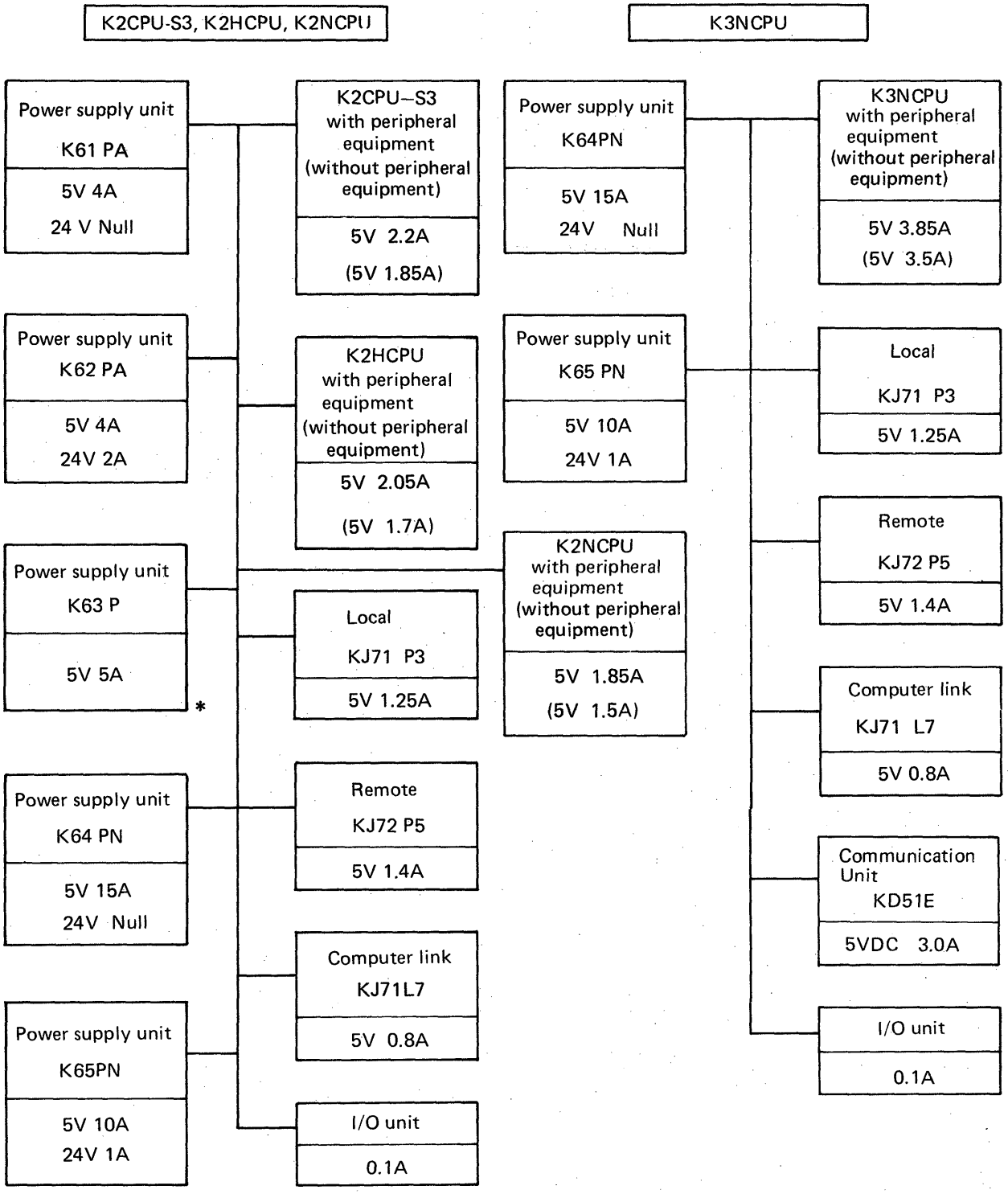
Error Number	Error Code	CPU State	Content and Cause of Error	Corrective Action
C80	–	Run continued	Without END instruction END instruction is not written at the end step of program.	**CAUTION** 1. If sequence program end OUT F100 is written, K3NCPU(P2) operates normally without END instruction. 2. If there is no END instruction, read operation in the ladder mode of K8GPPE, etc. cannot be performed. (1) Move the RUN key switch to "STOP" position. (2) Write END instruction at the end step of program.  (3) Move the RUN key switch to "RUN" position. (4) Turn off the error number by the error number indicator LED reset switch.

Table 5.5 CPU Error List (Continued)

6. POWER SUPPLY CAPACITY

6. POWER SUPPLY CAPACITY

To select the power supply unit for local channel and remote channel, calculate the total current consumption of the following units.



*Power supply unit for 24 V DC input

7. CAUTIONS FOR HANDLING OPTICAL FIBER CABLE

7. CAUTIONS FOR HANDLING OPTICAL FIBER CABLE

7.1 Cabling Between Link Units

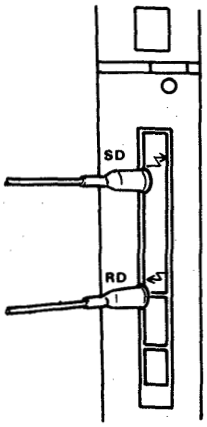


Fig. 7.1 Installed Optical Fiber Cable

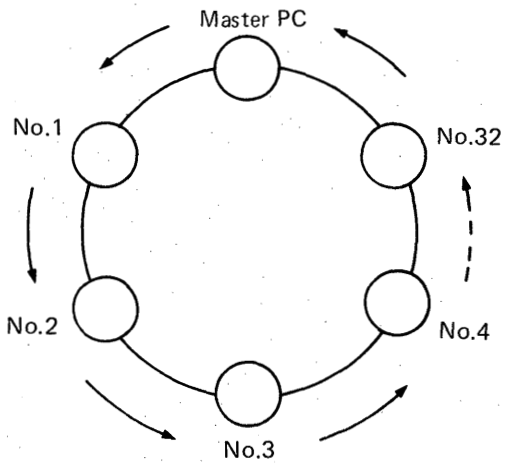


Fig. 7.2 Cabling Method

Install optical fiber cables after removing the white caps of connectors on both the front panel of the unit and the optical fiber cable. Be careful not to touch the connecting parts of optical fiber cables and connectors with bare fingers.

The optical fiber cables shall be installed starting from the transmitting connector of the master PC and proceeding to the receiving connector through slave PCs as shown in Fig. 7.2. In this case, slave PCs may not always be in the order of small to large numbers such as 1 → 2 → 3. Be careful not to connect transmitting or receiving connectors to each other; otherwise the entire system will fail to operate.

7.2 Optical Fiber Cable Construction and Standards

The construction and standards for optical fiber cables are shown in Table 7.1.

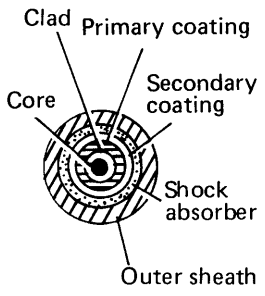
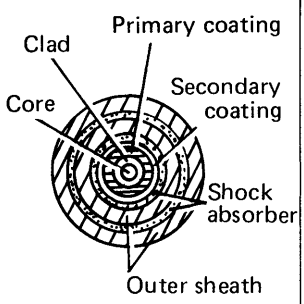
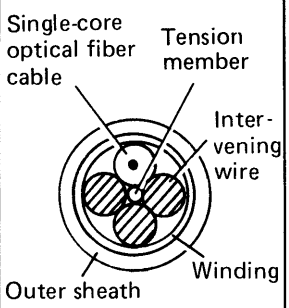
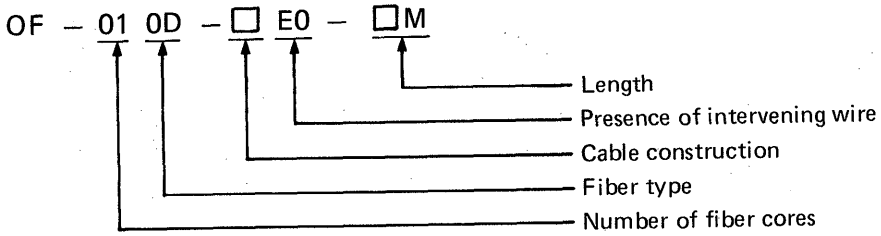
Item	Single-core optical fiber cable (3 mm ϕ)	Reinforced single-core optical cable (5 mm ϕ)	Plural-cores optical fiber cable
Construction			
Finished outside diameter	Approximately 3 mm	Approximately 5 mm	Approximately 11 mm
Allowable bending radius	20 mm	30 mm	110 mm
Allowable tensile force	30 kg	50 kg	60 kg
Weight	Approximately 10 g/m	Approximately 25 g/m	Approximately 100 g/m
Number of cores	1 core	1 core	1 core
Transmission loss	3.5 dB/km or less (λ = 0.85μm)		
Transmission band	200 MHz/km or less (λ = 0.85μm band LD)		
Core	Quartz glass, diameter: 50 ± 3μm		
Clad	Quartz glass, diameter: 125 ± 3μm		
Core eccentricity and elliptic ratio	Each 6% or less		
Primary coating	Silicone resin, approximately 0.4 mm ϕ		
Secondary coating	Nylon, 0.9 ± 0.1 mm ϕ		
Shock absorber	Nylon fiber		
Tension member	PE-sheathed steel wire, approximately 2 mm ϕ		
Intervening wire	Polyethylene wire, approximately 3 mm ϕ		
Winding	Plastic tape		
Outer sheath	Black PVC		
Profile	GI		
Cable construction	A	B	D

Table 7.1 Specifications of Optical Fiber Cables

7.3 How to Specify Optical Fiber Cable

7.3.1 How to specify optical fiber cable only



(1) Number of fiber cores
01: Indicates one-core cable.

(2) Fiber type
0D: Indicates G1 fiber of EG-5/3502.

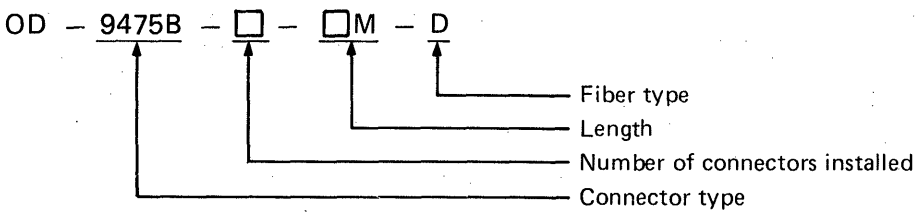
(3) Cable construction
A: Single-core optical fiber cable (3 ϕ).

(4) Presence of intervening wire
E0: No intervening wire given.

(5) Length
Specifies the length of optical fiber cable in units of meters (0.5 to 100 m).
100M: 100 m

Example of specification: 50 m of reinforced single-core optical cable only.
OF-010D-BE0-50M

7.3.2 How to specify optical fiber cable with connector



(1) Connector type
9475B: Indicates D4M-type connector.

(2) Number of connectors installed (*)
1: Indicates that a connector is installed only on one end of the cable.
2: Indicates that a connector is installed on each end of the cable.

(3) Length
Specifies the length of optical fiber cable in units of meters (0.5 to 1000 m).
50M: 50 m

(4) Fiber type
D: Indicates GI fiber of EG-5/3502.

Example of specification: 50 m of reinforced single-core optical cable with connectors installed on both ends.
OF-010D-BE0-50M
0D-9475B-2-50M-D

Note: A cable and connectors shall be connected at the single-core cable portions as shown in the figure below.

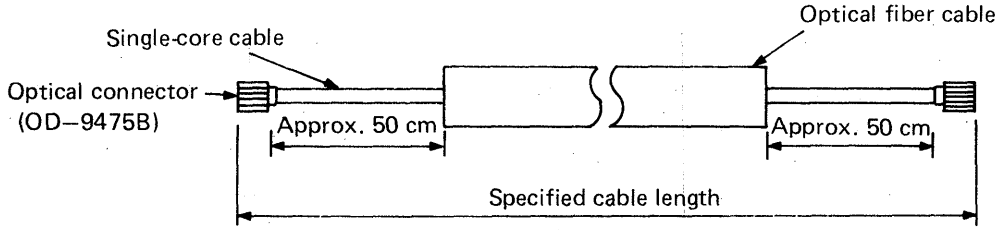


Fig. 7.3

7.4 Cautions for Handling Optical Fiber Cable

Optical fibers are glass of approximately 125 μm diameter, coated with plastic resin. Various reinforcements provided to make cables from them allow you to handle the cables in almost same manner as ordinary cables. Do not, however, handle them in the following extremely rough ways; otherwise they may be damaged.

(1) Do not bend a cable sharply and strongly. (Refer to Table 7.1.)
(2) Do not compress a cable with a sharp, rigid article.
(3) Do not twist a cable strongly.
(4) Do not pull a cable by holding the optical connector or cable.
(5) Do not pull a cable very strongly.
(6) Do not step on a cable.
(7) Do not place an article on a cable.

7.5 Standards for Optical Fiber Cable Application (Refer to Table 7.1.)

(1) Cable construction type A (cord, 3 mm ϕ) . . . . . .for cabling between equipment
Use this cable only inside the board. The cable can be used for indoor cabling between equipment if no special route (rack, pit, or duct) for optical fiber cable is used and the cabling length is 10 m or less.

(2) Cable construction type B (cord, 5 mm ϕ) . . . . . .for indoor cabling between equipment
- Only for indoor use as a rule.
- This cable can be placed on a rack (pit or duct), but do so last.
- Protect cable cross points, such as bend portions, with Flexible Metal Conduit tubes or the like.
- Do not place a cable of 15 m or more in a duct.

(3) Cable construction type D (cable, 11 mm ϕ) .....for outdoor cabling between equipment

- This cable can also be used for outdoor cabling.
- This cable can be placed on a rack (pit or duct), but do so last.
- Protect cable cross points, such as bend portions, with Flexible Metal Conduit tubes or the like.
- For cabling in a duct, do not provide more than one bend point. If two or more bend points are needed, provide a pulling box.

7.6 Cabling plan

There are various methods of optical fiber cable laying. The proper cabling process should be designed upon inspection of the site to minimize the cabling cost. The decision standards and process flow are shown in Table 7.2 and Fig. 7.4.

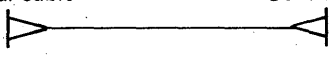
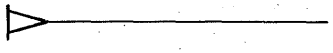
Number	Site Conditions	Cabling Process	Cost Ratio
1	Distances and installation sites of terminals are certain.	Prepare optional fiber cables with connectors on both ends and perform only cabling at the site. Optical fiber cable with connectors on both ends. Optical cable Connector 	1 (Reference)
2	Distances and installation sites of terminals are uncertain.	Prepare optical fiber cables with connector on one end and install a connector on the other end at the site after cabling. Optical fiber cable with connector on one end. 	1.5
3	Distances and installation sites of terminals are uncertain because the shop is new or for other reasons.	Carry out both installation of connectors on cables and optical fiber cable laying at the site. Cable without connector.	2.0

Table 7.2 Process Decision Standards

Process Number 1 is recommended because very precise work is required for assembling optical connectors.

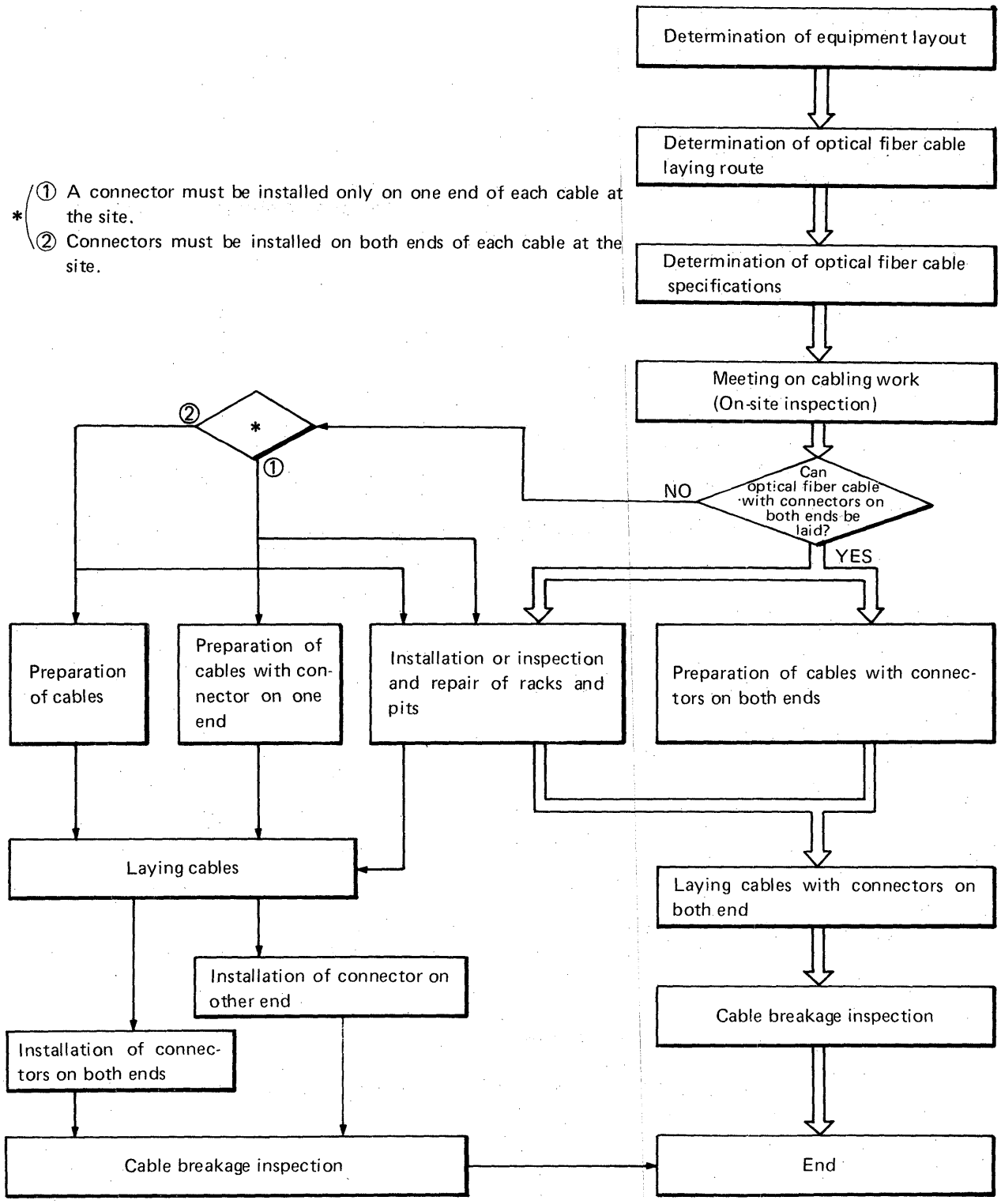


Fig. 7.4 Flow Chart of Cabling and Optical-Connector Installation

7.7 Cabling

7.7.1 Laying optical fiber cables without connector

- Lay cables of construction types A and B (shown in Table 7.1) on racks by rolling them (they are wound on polystyrene foam).
- If ducts are used, lay the cable along extended ropes.
- Lay a cable of construction type D (shown in Fig. 7.1) by pulling the cable and rope after covering the cable top with a cable net. Locate a worker every 20 to 30 meters in this case.
- Optical fiber cable shall be laid at a pulling speed of 10 m/minute or less.
- Avoid twisting cables; twist 5 m or more/turn at the worst.

7.7.2 Laying optical fiber cables with connector

- Protect the optical connectors with PVC hoses or spiral tubes.
- Do not extend cables by holding the optical connectors because the connectors are very sensitive to impact and tensile force.
- Do not bend or twist cables at the roots of the optical connectors.
- Optical fiber cables shall be laid separately from other electrical cables. If they have to be placed in the same rack, they shall be laid last. If both are laid in the same duct, optical fiber cables must not be given a big tensile force.
- Be sure to provide a pull box if a duct has more than one bend.
- Other conditions are the same as in paragraph 7.7.1.

7.7.3 Installation of connectors

Let expert contractors install connectors on optical fiber cables because special skills and tools are required for installation.

IMPORTANT

(1) Design the system so that the protection and safety circuits for troubles of programmable controller are located in the exterior of the system.

(2) Since the printed circuit boards are mounted with electric parts, which will be adversely affected by static electricity, handle them as described below when they are directly handled.

1) Ground human body and work bench.

2) Do not directly touch the conductive areas and electrical parts of product..

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