MITSUBISHI

General-Purpose AC Servo

MELSERVO-J2-A

Absolute Position Detection System Installation Guide

MITSUBISHI ELECTRIC

C

Thank you for choosing this Mitsubishi AC servo. This installation guide gives handling information and precautions for using the servo amplifier and motor. Incorrect handling may cause an unexpected fault. Before using the servo amplifier and servo motor, please read this installation guide carefully to use the equipment to its optimum.
Please forward this installation guide to the end user.

Safety Instructions

Do not attempt to install, operate, maintain or inspect the servo amplifier and servo motor until you have read through this installation guide and appended documents carefully and can use the equipment correctly. Do not use the servo amplifier and servo motor until you have a full knowledge of the equipment, safety information and instructions.
In this Installation guide, the safety instruction levels are classified into "WARNING" and "CAUTION".

⚠WARNING	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠CAUTION	Indicates that incorrect handling may cause hazardous conditions, resulting in medium or slight injury to personnel or may cause physical damage.

Note that the CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.

What must not be done and what must be done are indicated by the following diagrammatic symbols:

⃠ : Indicates what must not be done. For example, "No Fire" is indicated by ⃠ .

● : Indicates what must be done. For example, grounding is indicated by ⏚ .

After reading this Installation guide, always keep it accessible to the operator.

In this Installation guide, instructions at a lower level than the above, instructions for other functions, and so on are classified into "NOTICE", "INFORMATION" and "MEMORANDUM".

NOTICE	Indicates that incorrect handling may cause the servo amplifier to be faulty and may not lead to physical damage.
INFOR-MATION	Indicates that parameter setting change, etc. will provide another function or there are other usages.
MEMO-RANDUM	Indicates information needed for use of this equipment.

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INTRODUCTION

This installation guide describes how to handle the MELSERVO-J2-A servo when using it as an absolute position detection system. For specifications and detailed design other than those of the absolute position detection system, refer to the MR-J2-A Specifications and Installation Guide IB(NA)67286.

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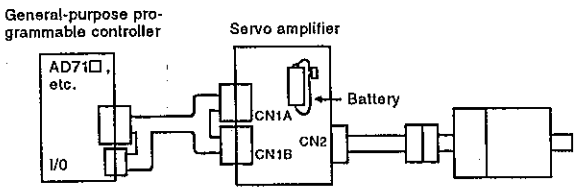
1. SPECIFICATIONS OF ABSOLUTE POSITION DETECTION SYSTEM (ABS)

An absolute position detection system is configured by using a general purpose programmable controller in conjunction with the MELSERVO-J2 series AC servo. The absolute position detection system eliminates the need for the home position return operation usually required after the power goes off - for example as a result of an instantaneous power failure or emergency stop - and this simplifies the processing for restarting operation.

1.1 Configuration of absolute position detection system and preparation

(1) Configuration



(2) Preparation

Take the following items into consideration when configuring the absolute position detection system.

Component	Description
Servo amplifier	Use the standard models.
Servo motor	
Battery	MR-BAT or A6BAT
Encoder cable	Use the standard model. When fabricating the cable, refer to (2), Section 6-1-2 in the MR-J2-A Specifications and Installation Guide.
General-purpose programmable controller	An I/O module (3 input and 2 output points) is used for sending and receiving the detected absolute position data. The programmable controller must have the following functions: 1) 32-bit data register function 2) Masking (AND and WAND instructions) capability for data registers 3) 2-bit data shift capability for data registers 4) Function that allows changing of the current position data

1.2 Absolute position encoder specifications

(1) Specifications

Item	Description
Type	Electronic type, battery-backed
Battery	Lithium battery (primary battery, nominal +3.6V) x 1 pc. Model: MR-BAT or A6BAT
Encoder resolution	HC-MF/HA-FF: 8192 pulses/rev HC-SF/RF: 16384 pulses/rev.
Max. number of revolutions	± 32767 revolutions from zero point
Max. speed at power failure (Note 1)	500r/min
Battery back-up time (Note 2)	About 10,000 hours (battery life when no power is supplied)
Accumulative revolution counter data retention time (Note 3)	2 hours when delivered 1 hour when 5 years have passed after delivery
Battery storage period	For 5 years from date of manufacture

Note: 1. Indicates the maximum speed at which the shaft is rotated by external force when power failure or the like occurs.
2. Indicates the length of time when data can be retained by the battery with the power off.
3. Indicates the length of time when data can be retained by the super capacitor built in the encoder, after power is switched off with the battery voltage low or the battery removed. Change the battery within this period.

(2) Cautions on configuring the absolute position detection system

The absolute position detection system cannot be configured under the following conditions.

1) If operation is performed in the speed control mode or torque control mode.
2) If the control loop is switched (position control ↔ speed control, position control ↔ torque control).
3) If the system uses a coordinate system with an infinite stroke length, such as a rotary axis, or system for positioning over infinite distances.
4) If alarm code output is used.

Note: When performing test operation (jog, positioning) using the Set-Up Software, set "0000 (absolute position detection system invalid)" in parameter No. 1.

(3) Adaptable modules

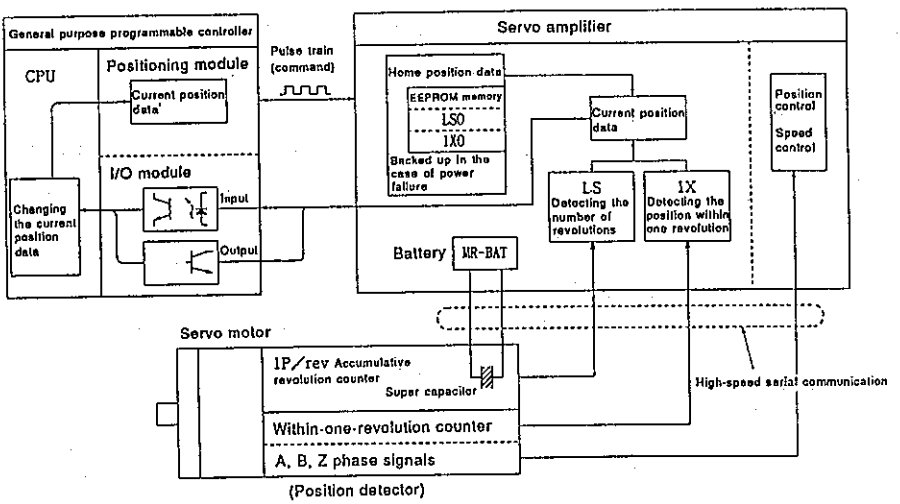
Positioning module	I/O module (transistor output type)
• AD71, AD71S2, SD71S7 • A1SD71S2, A1SD71S7 • AD75□ • A1SD75□	• AX40, 41 • AY40, 41
• FX-1PG, E20	• FX_2-32MT

Note: A0J2CPU cannot be used.

1.3 Outline of absolute position data communications

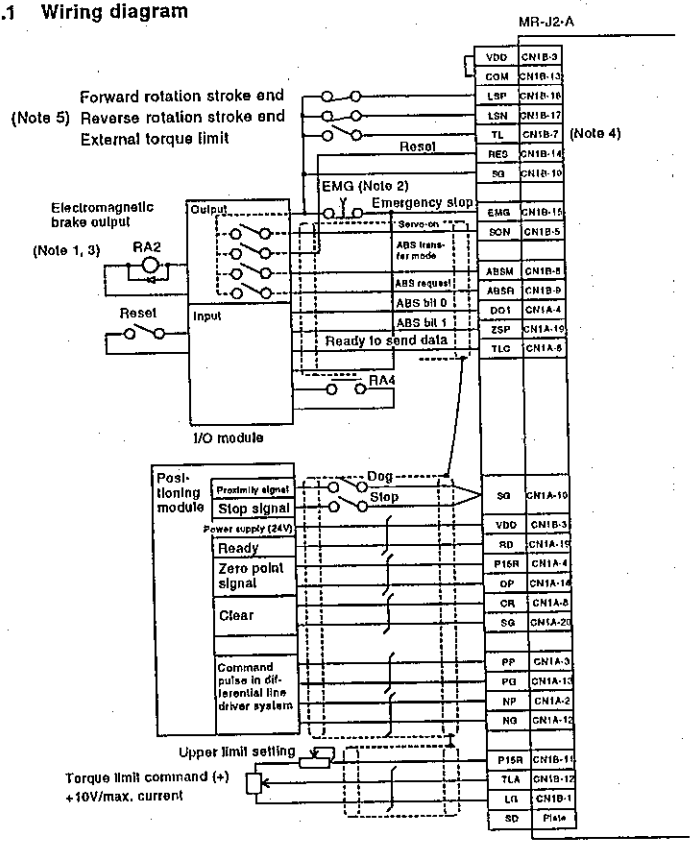
(1) System block diagram

As illustrated in the block diagram below, the position detector consists of an encoder which detects the position within one revolution and the A, B, and Z phase signals (for position control during normal operation), and an accumulative revolution counter which detects the number of revolutions.
The absolute position detection system detects the absolute position of the machine and by means of a back-up battery retains the absolute position data even if the power supply to the general purpose programmable controller is switched off. Thanks to this feature, the zero point (home position) only needs to be set once, during installation of the machine; the home position return operation is not necessary each time power is switched on. It is also easy to restart operation after it has been interrupted by a power failure or machine malfunction.
The absolute position data is retained by the super capacitor in the position detector for the period stated in the specification table (accumulative revolution counter data retention time) if the cable is disconnected or broken.



2. WIRING AND TERMINALS

2.1 Wiring diagram



⚠ CAUTION	Note:1. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits. 2. The emergency stop switch must be installed.
NOTICE	Note:3. The sum of currents that flow in the external relays should be 80mA max. If it exceeds 80mA, supply interface power from external.
INFORMATION	Note:4. When using the torque limit signal (TL), set □□□4 in parameter No. 46 to assign TL to pin CN1B-7.
MEMORANDUM	Note:5. When starting operation, always connect the external emergency stop signal (EMG) and forward/reverse rotation stroke end signal (LSN/LSP) with SG. (Normally closed contacts) 6. The pins with the same signal name are connected in the servo amplifier.

2.2 Terminals

(1) Connector pins

The following table describes the functions of the pins in the "absolute position detection system" setting. For the functions when the ABS transfer mode is off or for the functions of the other pins not listed below, refer to Chapter 3 of the MR-J2-A Specifications and Installation Guide.

Signal name	Symbol	Connector pin No.	Function and application	I/O (Note 1)	Control mode
ABS transfer mode	ABSM	CN1B 8	ABS transfer mode terminal. When this pin is connected with SG, the servo amplifier goes into the ABS transfer mode, in which ZSP, TLC and DO1 have the functions described in this table.	DI-1	P (Position control)
ABS request	ABSR	CN1B 9	To be shorted to request the ABS data in the ABS transfer mode.	DI-1	
ABS bit 0	DO1	CN1B 4	Indicates the lower bit of the ABS data (2 bits) which is sent from the servo to the programmable controller in the ABS transfer mode. If there is a signal, the circuit between PF and SG is closed.	DO-1	
ABS bit 1	ZSP	CN1B 19	Indicates the upper bit of the ABS data (2 bits) which is sent from the servo to the programmable controller in the ABS transfer mode. If there is a signal, the circuit between ZSP and SG is closed.	DO-1	
Send data ready	TLC	CN1B 6	Indicates that the data to be sent is being prepared in the ABS transfer mode. At the completion for the ready state, the circuit between TLC and SG is closed.	DO-1	
Clear (zero point set)	CR	CN1A 8	If this is shorted with SG, the position control counter is cleared and the zero point data is stored in the nonvolatile memory (backed up by battery).	DI-1	

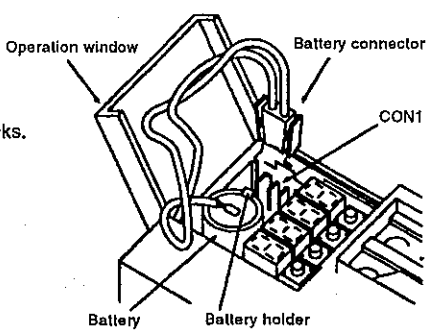
Note: For the I/O interface, refer to Chapter 3 of MR-J2-A SPECIFICATION AND INSTRUCTION MANUAL.

(2) Fitting the battery for retaining absolute position data

> ⚠ **WARNING** Before starting maintenance and inspection, make sure that the charge lamp is off more than 10 minutes after power-off, then confirm the voltage with a tester or the like. Otherwise, you may get an electric shock.

> **NOTICE** The internal circuits of the servo amplifier may be damaged by static electricity. Always take the following precautions:
> 1. Ground human body and work bench.
> 2. Do not touch the conductive areas, such as connector pins and electrical parts, directly by hand.

1) Oen the operation window.
2) Install the battery in the battery holder.
3) Insert the battery connector into CON1 until it clicks.

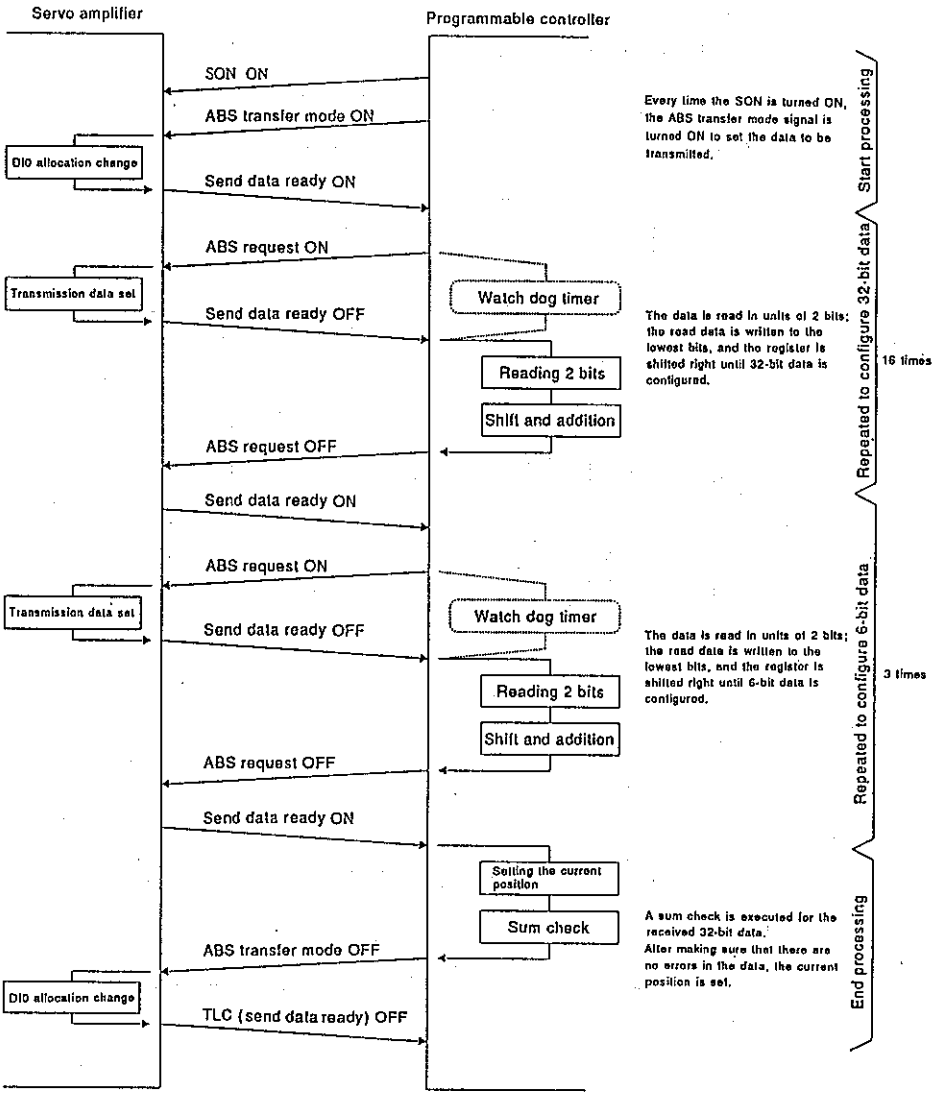


3. ABSOLUTE POSITION DATA TRANSMISSION SEQUENCE

3.1 Absolute position data transmission sequence

Each time the SON signal is turned ON (when the power is switched ON for example), the programmable controller reads the position data (present position) of the servo amplifier.

- Write the sequence program to execute the data transmission diagrammed below, referring to the program examples in Chapter 6.



Note: Time-out monitoring is performed by the programmable controller.

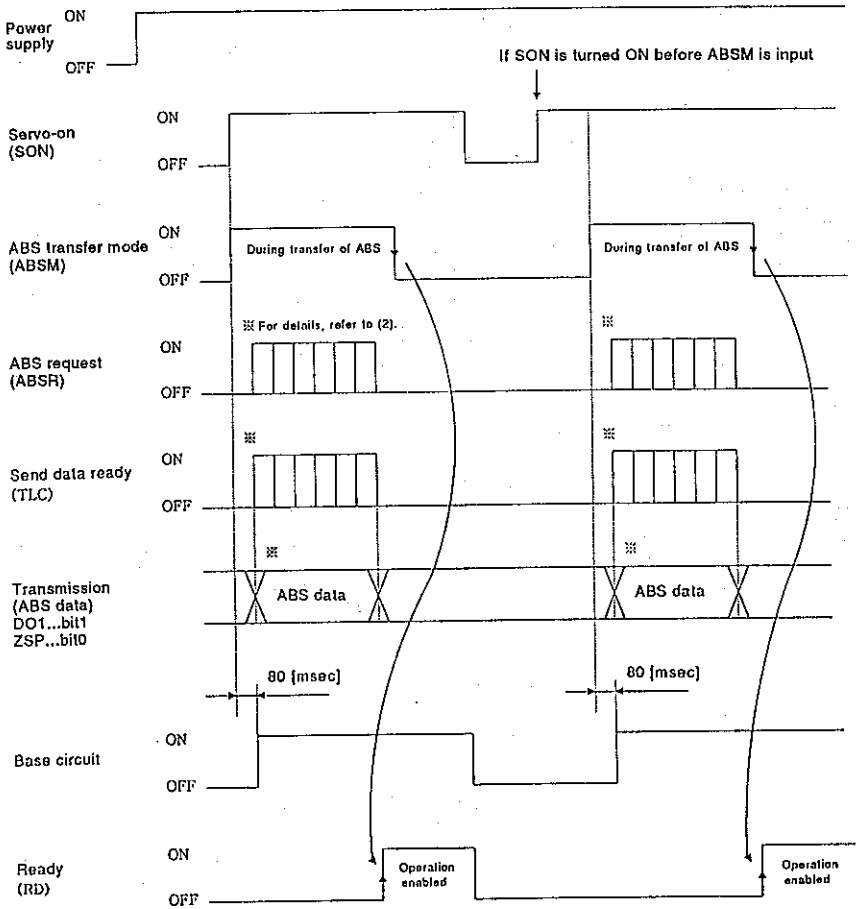
3. ABSOLUTE POSITION DATA TRANSMISSION SEQUENCE

3.2 Data transmission method

The sequence in which the base circuit is turned ON (servo ON) when it is in the OFF state due to the servo ON (SON) signal going OFF, an emergency stop, or alarm, is explained below.
To turn ON the base circuit, the ABS transfer mode signal (ABSM) must be turned ON. Unless the ABS transfer mode signal (ABSM) is turned ON, the base circuit cannot be turned ON.

3.2.1 Absolute position data transmission sequence at power ON

(1) Timing chart - power ON



Explanation of the timing chart

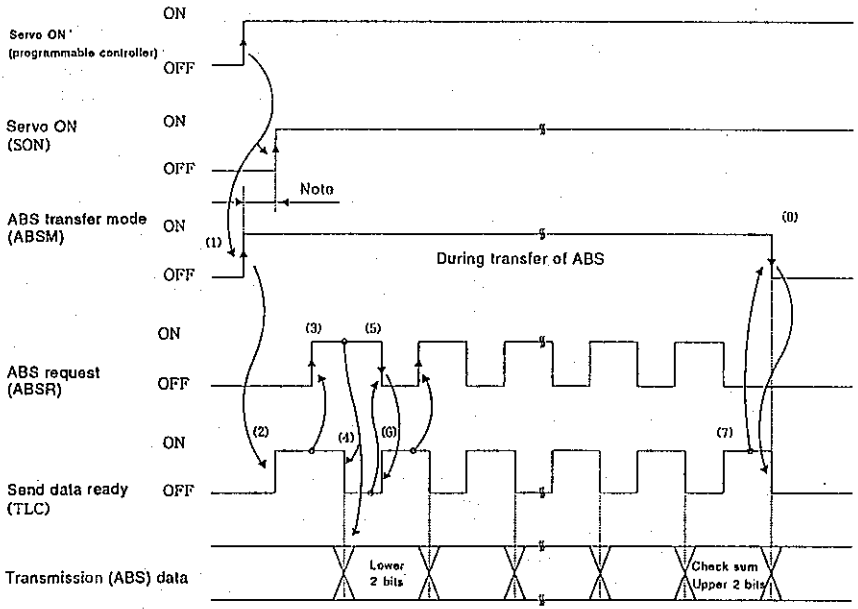
1) The ready signal (RD) is turned ON when the ABS transfer mode signal (ABSM) is turned OFF after transmission of the ABS data.
2) Even if the servo ON (SON) signal is turned ON before the ABS transfer mode signal (ABSM) is turned ON, the base circuit is not turned ON until the ABS transfer mode signal (ABSM) is turned ON.
3) If a servo alarm has occurred, the ABS transfer mode signal (ABSM) is not received.
4) The ABS transfer mode signal (ABSM) can be transmitted while a servo warning, such as an over-regeneration warning, is effective.
5) If the ABS transfer mode signal (ABSM) is turned OFF during the ABS transfer mode, the ABS transfer mode is interrupted and the time-out error (A.E5) occurs.
6) The functions of output signals such as ZSP, TLC, and PF change depending on the ON/OFF state of the ABS transfer mode signal (ABSM).

Symbol	Pin No.	Output Signal	
		ABS transfer mode (ABSM): OFF	ABS transfer mode (ABSM): ON
DO1 (Note)	CN1B-4	Positioning completion	ABS data bit 0
ZSP	CN1B-19	Zero speed	ABS data bit 1
TLC	CN1B-6	Limiting torque	Ready to send data
INP (Note)	CN1A-18	Positioning completion	ABS data bit 0

Note: CN1B-4 and CN1A-18 output the same signals. (To enter the positioning completion signal into INPS of the AD75, connect CN1A-18.)

7) If the ABS transfer mode signal (ABSM) is turned ON for a purpose other than transmission of the ABS data, the output signals will nevertheless be assigned the functions for ABS data transmission. Therefore, do not turn the ABS transfer mode signal (ABSM) ON unless ABS data transmission is required.
8) ABS transfer mode signal (ABSM) input is not accepted while the ready signal (RD) is ON.

(2) Timing chart - absolute position data transmission



Note: If the servo ON (SON) signal is not turned ON within 1 second after the ABS transfer mode signal (ABSM) is turned ON, an SON time-out warning (A.EA) occurs. This warning, however, does not interrupt data transmission. It is automatically cleared when the servo ON (SON) signal is turned ON.

(Explanation)

1) The programmable controller turns ON the ABS transfer mode signal (ABSM) and servo ON (SON) signals at the leading edge of the internal servo ON signal. (1)
2) On receiving the ABS transfer mode signal, the servo detects and calculates the absolute position and turns ON the ready to send (TLC) signal as the response, which notifies the programmable controller that the servo is ready for transmission of the ABS data. (2)
3) After acknowledging that the ready to send (TLC) signal has been turned ON, the programmable controller turns ABS request (ABSR) ON. (3)
4) In response to ABS request (ABSR), the servo outputs the lower 2 bits of the ABS data and the ready to send (TLC) signal in the OFF state. (4)

5) After acknowledging that the ready to send (TLC) signal has been turned OFF, which implies that 2 bits of the ABS data have been transmitted, the programmable controller reads the lower 2 bits of the ABS data and then turns OFF the ABS request (ABSR). (5)

6) The servo turns ON the ready to send (TLC) so that it can respond to the next request. (6)
Steps 3) to 6) are repeated until 32-bit data and the 6-bit check sum have been transmitted.

7) After receiving of the check sum, the programmable controller turns the ABS transfer mode signal (ABSM) OFF. (8)

8) If the ABS transfer mode signal (ABSM) is turned OFF during data transmission, the ABS transfer mode is interrupted.

(3) Calculating the check sum

The check sum is the code which is used by the programmable controller to check for errors in the received ABS data. The 6-bit check sum is transmitted following the 32-bit ABS data.
At the programmable controller, calculate the sum of the received ABS data using the ladder program and compare it with the check sum code sent from the servo.

□Calculating the check sum
Every time the programmable controller receives 2 bits of ABS data, it adds the data to obtain the sum of the received data. The check sum is 6-bit data.

Example: ABS data: -10 (FFFFFFF6H)

10^{b}
01^{b}
11^{b}
11^{b}
11^{b}
11^{b}
11^{b}
11^{b}
11^{b}
11^{b}
11^{b}
11^{b}
11^{b}
11^{b}
11^{b}
11^{b}
+)
101101^{b}

< Appendix>

Decimal −10

Hexadecimal FFFF FFF6

Binary 1111 1111 1111.....0110

When the binary data of each 2 bits of the ABS data is added up, "10 1101^{bn}" is obtained.

Therefore, the check sum of "-10" (ABS data) is "$2D^{hn}$".

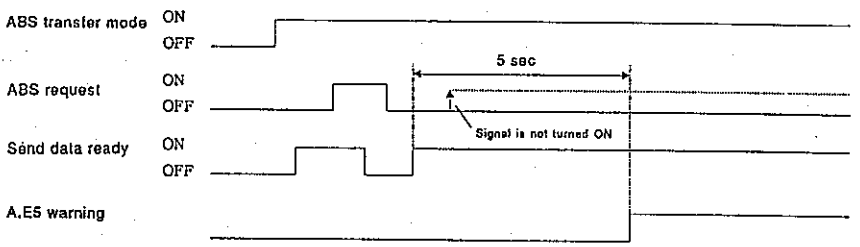
(4) Transmission error

(4-1)Time-out warning (A.E5)

In the ABS transfer mode, the time-out processing shown below is executed at the servo. If a time-out error occurs, an ABS time-out warning (A.E5) is output.

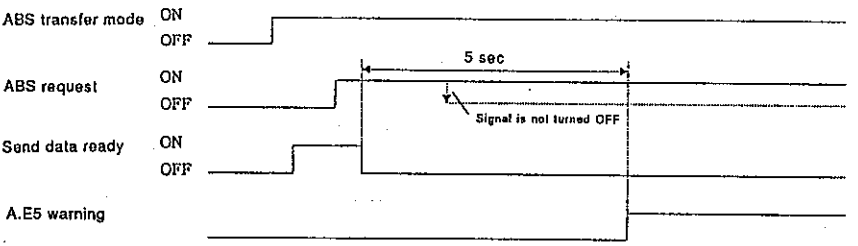
1) ABS request OFF-time time-out check (applied to 32-bit ABS data in 2-bit units + check sum)

If the ABS request signal is not turned ON by the programmable controller within 5 seconds after the send data ready signal is turned ON, this is regarded as a transmission error and the ABS time-out warning (A.E5) is output.



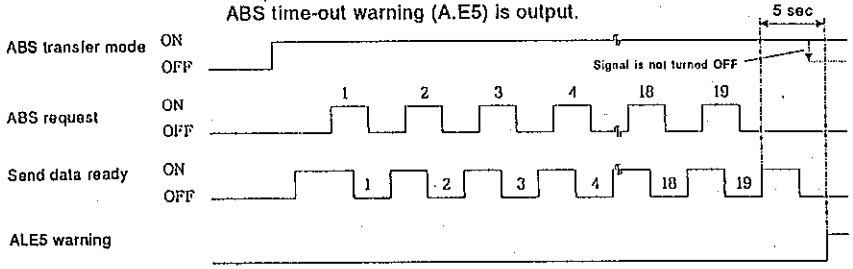
2) ABS request ON-time time-out check (applied to 32-bit ABS data in 2-bit units + check sum)

If the ABS request signal is not turned OFF by the programmable controller within 5 seconds after the send data ready signal is turned OFF, this is regarded as the transmission error and the ABS time-out warning (A.E5) is output.



3) ABS transfer mode finish-time time-out check

If the ABS transfer mode signal is not turned OFF within 5 seconds after the last ready to send signal (19th signal for ABS data transmission) is turned ON, it is regarded as the transmission error and the ABS time-out warning (A.E5) is output.



Note 1: The ABS time-out warning (A.E5) is cleared when the ABSM transfer mode signal (ABSM) changes from OFF to ON.

2: For the processing after the output of the ABS time-out warning (A.E5), refer to Section 8.1.

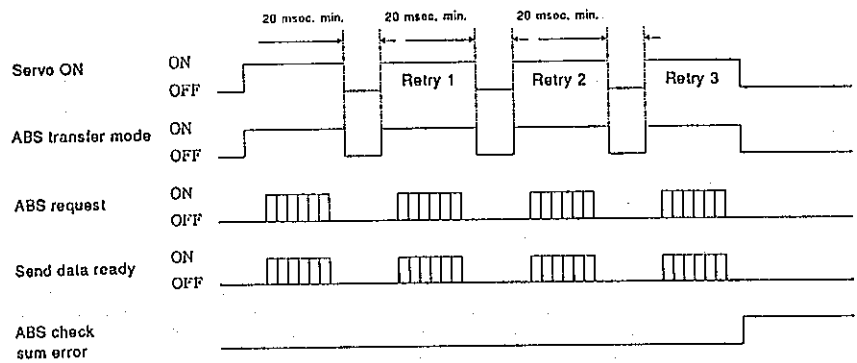
4) When test operation is performed with "absolute position detection system" valid

An error will occur if operation is performed with "1□□□" (absolute position detection system valid) set in parameter No. 3. When performing test operation, always set "0□□□" in parameter No. 3 to make the absolute position detection system invalid.

(4-2) Check sum error

If the check sum error occurs, the programmable controller should retry transmission of the ABS data.
Using the ladder check program, turn OFF the ABS transfer mode (ABSM) and servo ON (SON) signals once. Turn them ON again after an OFF time of longer than 20 milliseconds.
If the ABS data transmission fails to end normally even after retry, regard this situation as an ABS check sum error and execute error processing.

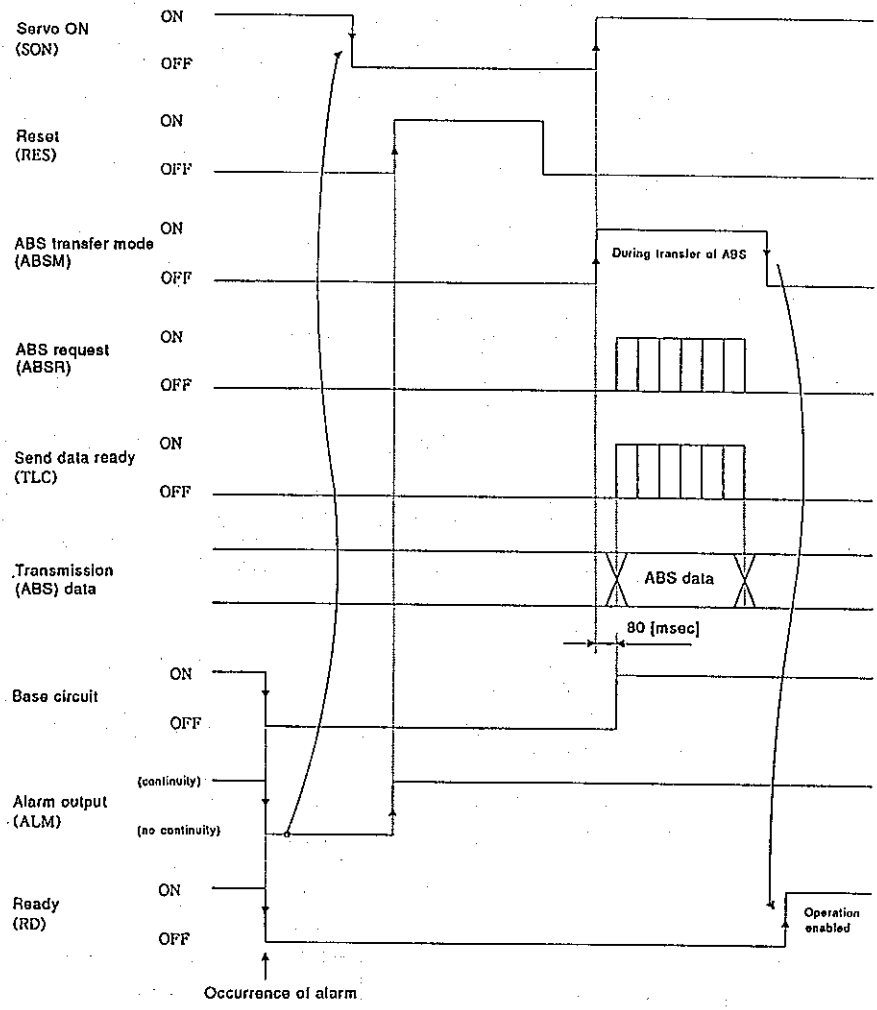
Example:To retry ABS data transmission 3 times



Note: The start command for positioning, which cannot be executed when an ABS check sum error has occurred, must be interlocked with the ABS data ready signal.

3. ABSOLUTE POSITION DATA TRANSMISSION SEQUENCE

3.2.2 Absolute position data transmission sequence when the alarm is reset



Note 1: If an alarm occurs, turn OFF the servo ON (SON) signal by detecting the alarm output (ALM).

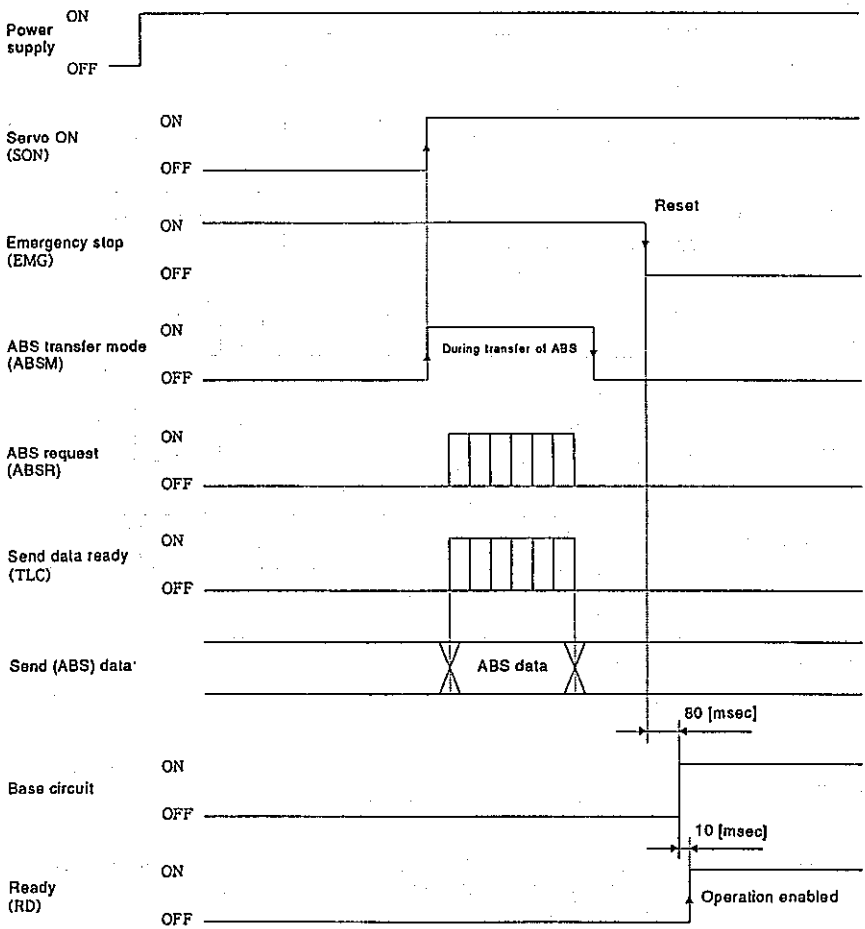
2: If an alarm has occurred, the ABS transfer mode signal (ABSM) cannot be accepted. After eliminating the cause of the alarm, clear the alarm output with the reset (RES) signal.

3: In the reset state, the ABS transfer mode signal (ABSM) can be input.

4: The present position data is updated during the alarm state, so that the machine motion during the alarm state causes droop. If the alarm state is reset and the base circuit is turned ON in this condition, the motor will operate to return the machine by the distance that it moved during the alarm state at high speed. To avoid this problem, read the ABS data again as indicated in the chart above

3.2.3 Absolute position data transmission sequence when the emergency stop state is reset

(1) If the power is switched ON in the emergency stop state



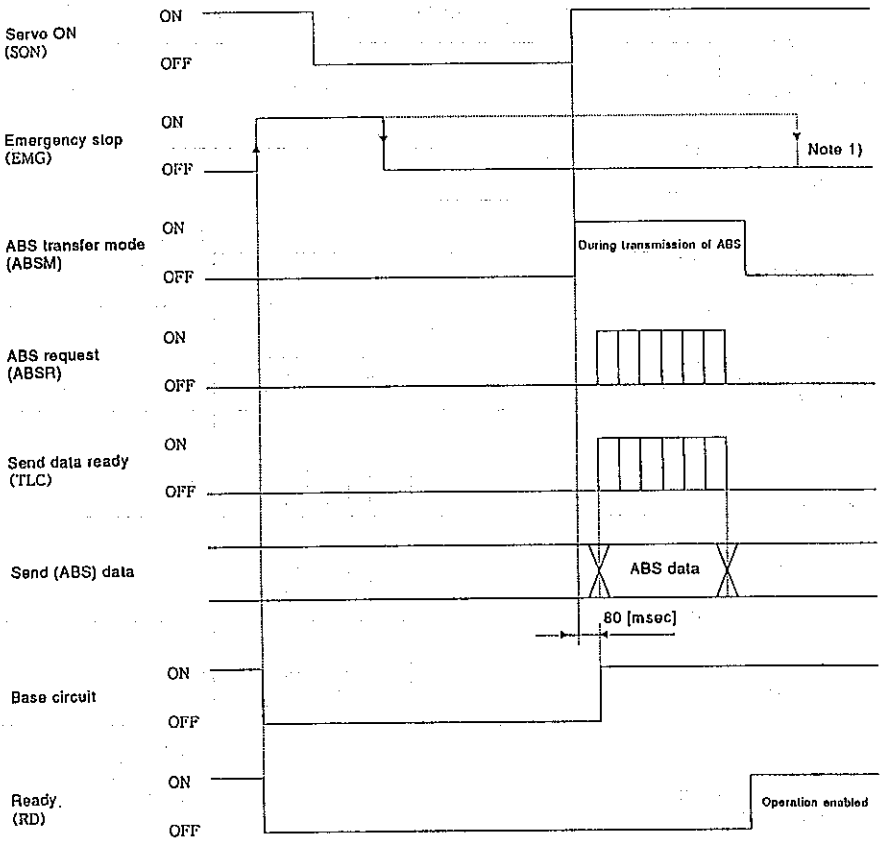
Note 1: The emergency stop state can be reset while the ABS data is being transferred
If the emergency stop state is reset while the ABS data is transmitted, the base circuit is turned ON 80 [msec] after resetting. If the ABS transfer mode signal (ABSM) is OFF when the base circuit is turned ON, the ready signal (RD) is turned ON 10 [msec] after the turning ON of the base circuit. If the ABS transfer mode signal (ABSM) is ON when the base circuit is turned ON, it is turned OFF and then the ready signal (RD) is turned ON.

2: The ABS data can be transmitted after the emergency stop state is reset. Turn ON the ABS transfer signal (ABSM) after resetting the emergency stop state.

3: The present position data is updated during the emergency stop state, so that the machine motion during the emergency stop state causes droop. If the emergency stop state is reset and the base circuit is turned ON in this condition, the motor will operate to return the machine by the distance that it moved during the emergency stop state at high speed. To avoid this problem, read the ABS data again as indicated in the chart above.

3. ABSOLUTE POSITION DATA TRANSMISSION SEQUENCE

(2) If emergency stop is activated during servo ON

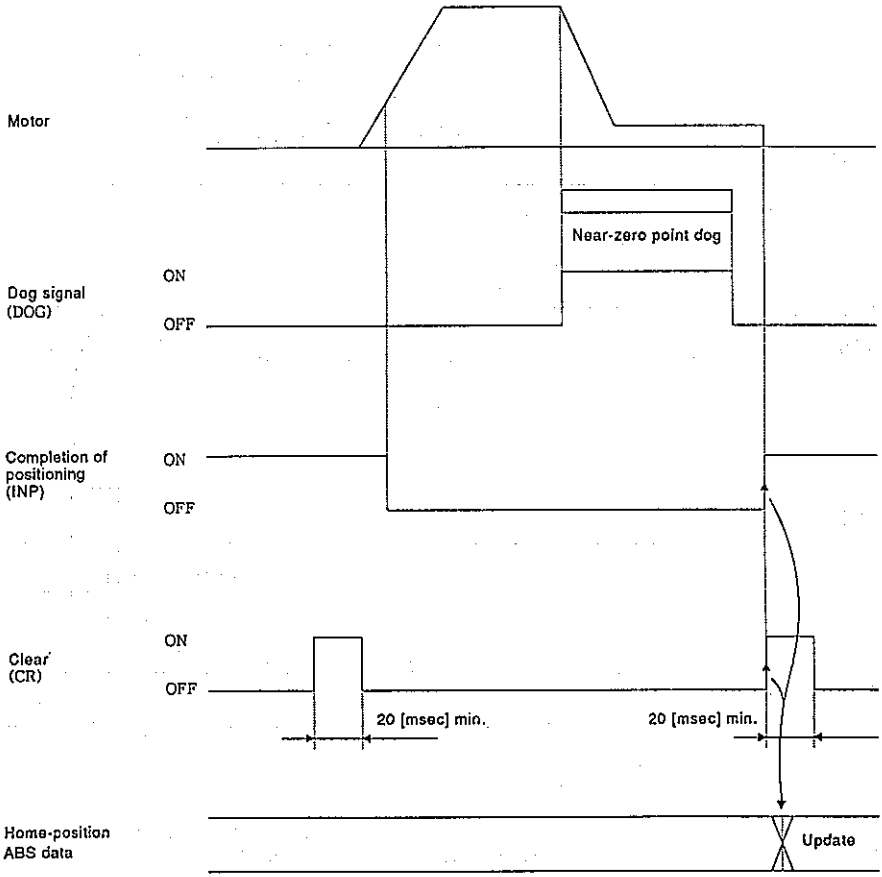


Note 1: The ABS transfer mode signal (ABSM) is permissible while in the emergency stop state. In this case, the base circuit and the ready signal (RD) are turned ON after the emergency stop state is reset.

2: The present position data is updated during the emergency stop state, so that the machine motion during the emergency stop state causes droop. If the emergency stop state is reset and the base circuit is turned ON in this condition, the motor will operate to return the machine by the distance that it moved during the emergency stop state at high speed. To avoid this problem, read the ABS data again as indicated in the chart above.

4. HOME POSITION SETTING

4.1 Dog type home position setting



Note 1: The programmable controller sets an appropriate creep speed so as not to impart a shock to the machine when it is stopped. When the programmable controller detects the zero-pulse, it outputs the clear (CR) signal to update the present position data.

2: The servo amplifier clears droop from OFF to ON of the clear signal and stops immediately.
It backs up the home position ABS data in the nonvolatile memory when the following conditions are satisfied.

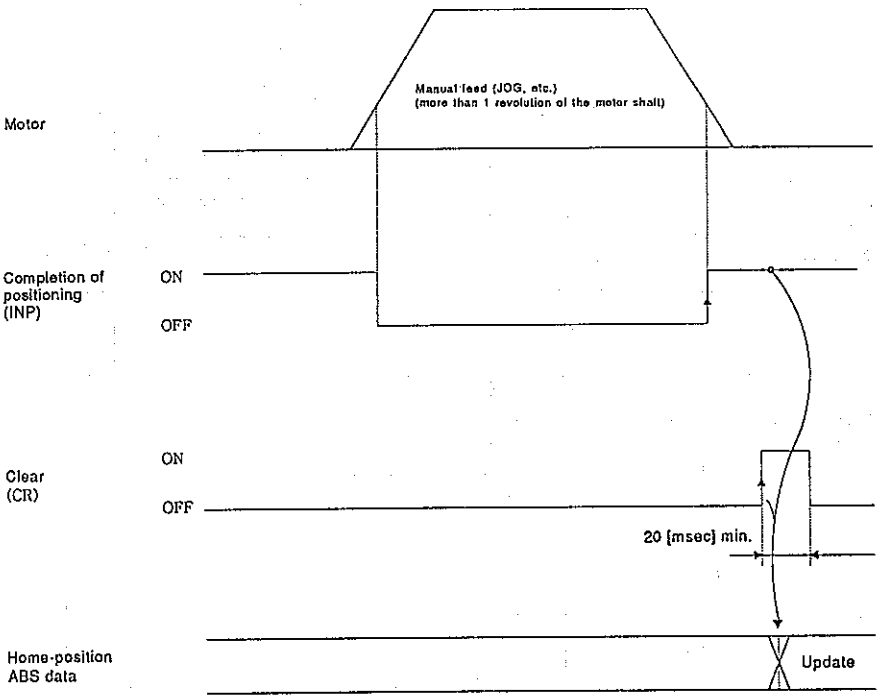
[Home position ABS data update conditions - servo amplifier]
1) The clear (CR) signal changes from OFF to ON.
2) The completion of positioning (INP) signal is ON.

If the conditions indicated above are not satisfied, the home position set error warning (A.96) occurs. This warning is, however, automatically cleared when the conditions indicated above are satisfied by repeating the home position setting.

3: The number of home position setting is limited to 100,000 times.

4.2 Data set type home position setting

The home position can be set at any required position if the data set type home position setting method is used.



Note 1: Move the machine to the position where the home position is to be set by manually operating the machine; in this positioning, the motor shaft must turn through more than one revolution.

2: At the position where the home position is to be set, the programmable controller outputs the clear signal (CR) for more than 20 [msec] and, at the same time, it updates the present position data.

3: The servo amplifier clears the droop pulses in response to the clear signal (CR) ON and stops the motor. It backs up the home position ABS data in the nonvolatile memory when the following conditions are satisfied.

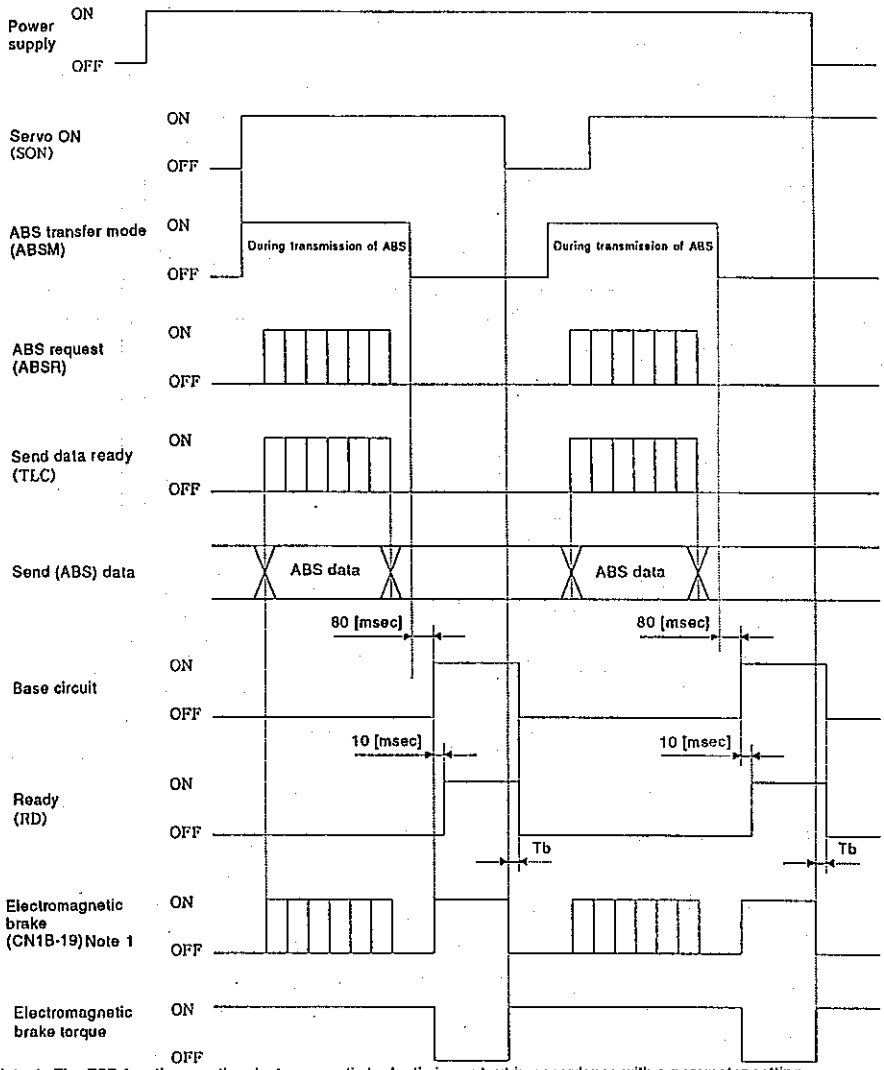
[Home position ABS data update conditions - servo amplifier]
1) The clear (CR) signal changes from OFF to ON.
2) The completion of positioning (INP) signal is ON.

If the conditions indicated above are not satisfied, the home position set error warning (A.96) occurs. This warning is, however, automatically cleared when the conditions indicated above are satisfied by repeating the home position setting.

4: The number of home position setting is limited to 100,000 times.

5. TRANSMISSION OF ABSOLUTE POSITION DATA WHEN THE MOTOR WITH ELECTROMAGNETIC BRAKE IS USED

• Power ON/OFF and Servo ON/OFF Timing Chart



Note 1: The ZSP functions as the electromagnetic brake timing output in accordance with a parameter setting.

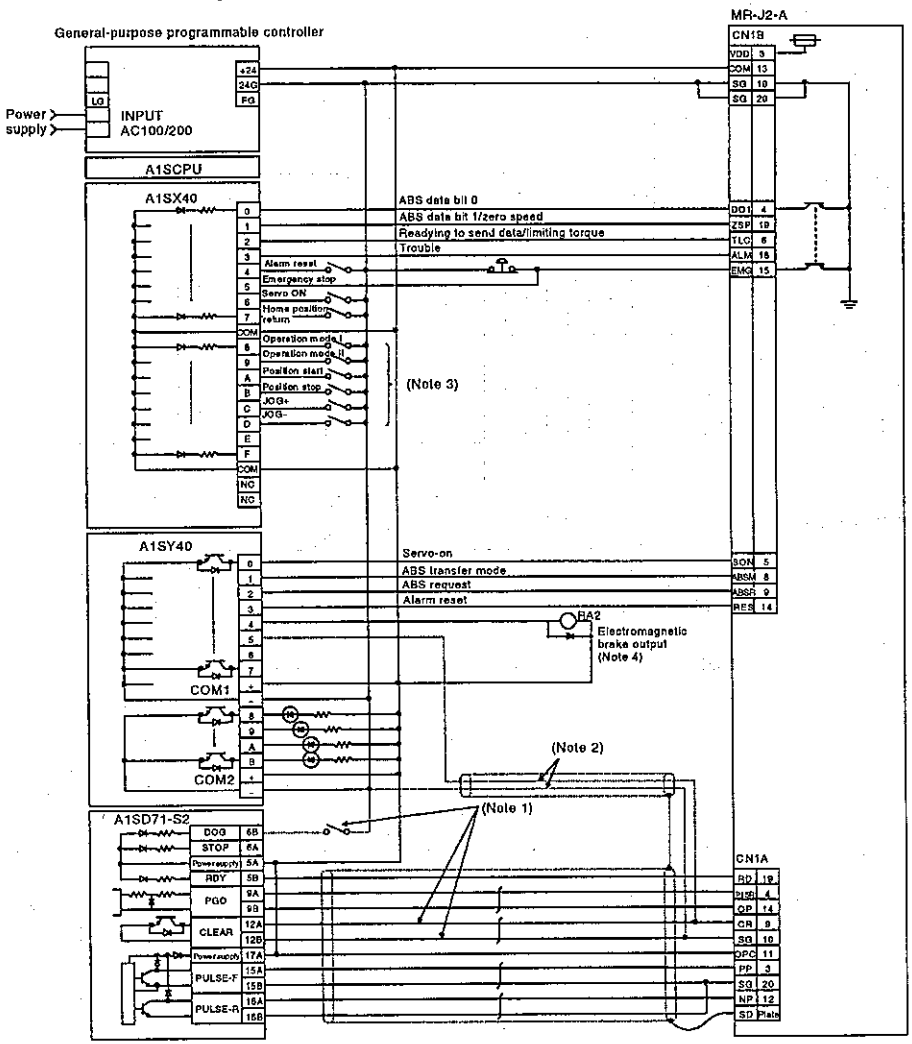
2: The timer (Tb) for the electromagnetic brake is set in the servo parameters.

3: When the ABS transfer mode is on, the electromagnetic brake output (CN1B-19) serves as ABS data bit 1. Therefore, configure the sequence externally using the ABS mode (ABSM) and electromagnetic brake output (CN1B-19) so that the electromagnetic brake torque can be generated as indicated above.

6. CONNECTION OF ABSOLUTE POSITION DETECTION SYSTEM AND TYPICAL SEQUENCE PROGRAMS

6.1 Connection example - MR-J2-A servo amplifier and MELSEC-A1S (A1SD71)

6.1.1 Connection diagram



Note 1: For dog type home position setting.

2: For data set type home position return. Connection in Note 1 should not be made.

3: This circuit is for your reference.

4: The electromagnetic brake output should be controlled via a relay connected to the programmable controller output.

6.1.2 Cautions on handling the absolute position detection system

Take the following factors into consideration when performing absolute position detection with an A1SD71 (AD71).

IMPORTANT

The absolute coordinate system (programmable controller coordinate system) of the A1SD71 (AD71) only covers the range in which the address increases (positive coordinate values) on moving away from the machine home position (the position reached in the home position return operation). Therefore, if the motor enters the range where the coordinate value is negative due to the load torque or a fall on a vertical axis when the power is turned ON/OFF at a point near the machine home position, the system fails to detect the absolute position. To prevent this problem, it is necessary to set the home position (operation origin) for positioning in addition to the machine home position.

1) The home position should be set in the direction in which the position address of the programmable controller coordinate system increases on moving away from machine home position, as illustrated in Fig. 6-1. Note that the home position for positioning must be more than one revolution of the servo motor shaft from the machine home position.
If the address of the machine home position is changed to any value other than "0", the home position should be set in the direction in which the position address increases on moving away from the machine home position (machine home position after changing the home position address) and at a point removed from the machine home position by more than one revolution of the motor shaft.

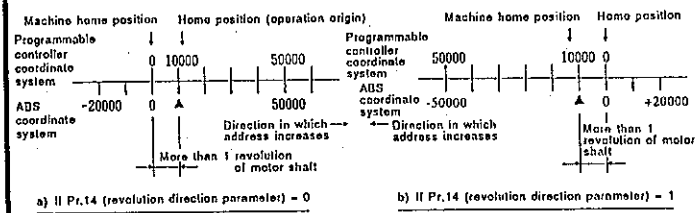


Fig. 6-1 Machine Home Position and Home Position

2) In the address decreasing range which starts at the machine home position, do not turn on or off power to the programmable controller or servo amplifier, the servo ON pushbutton switch or the PC-RESET switch. (See Fig. 6-2.) If any of these operations is performed, the absolute position cannot be detected, resulting in the output of the ABS coordinate error (Y4B).
If the home position address is changed to other than 0, the programmable controller coordinate system will be as illustrated in Fig.6-3.
Power should be switched on/off in the address increasing range which starts at the positioning home position.

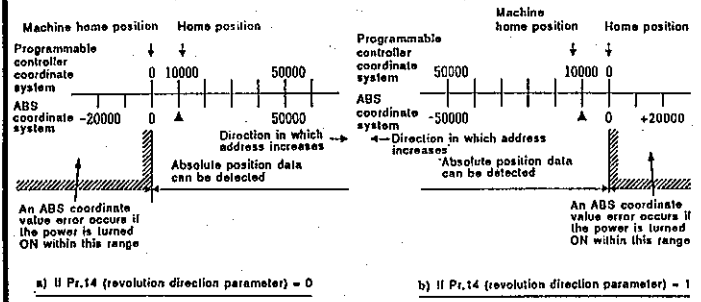


Fig. 6-2 Detection Range for Absolute Position Data

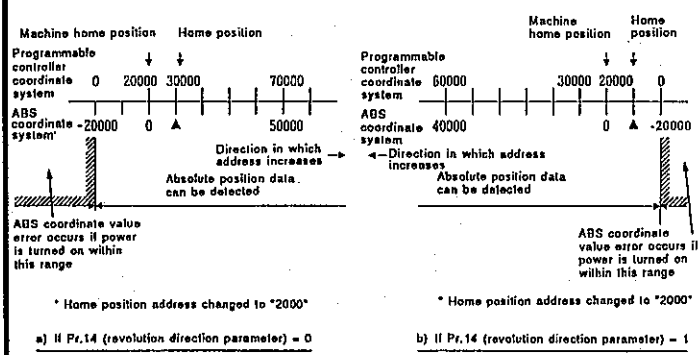


Fig. 6-3 Detection Range for Absolute Position Data after Changing the Home Position Address

3) In a positioning program, the address of the positioning point should be determined by adding the home position address to the target position address.

Example) To execute positioning at (1), (2), and (3).

(1) Positioning at position address 80000.

(2) Positioning at position address 130000.

(3) Positioning at position address 0.

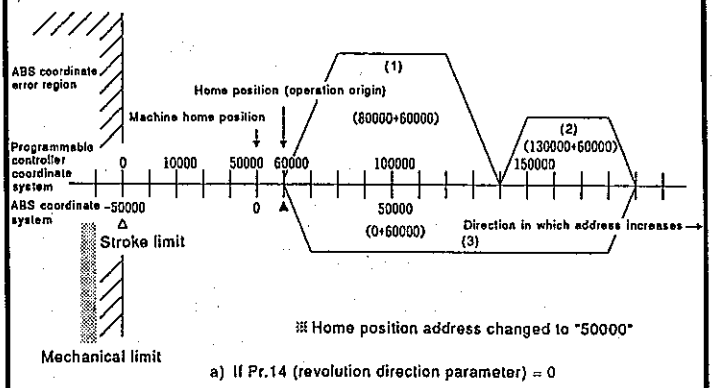
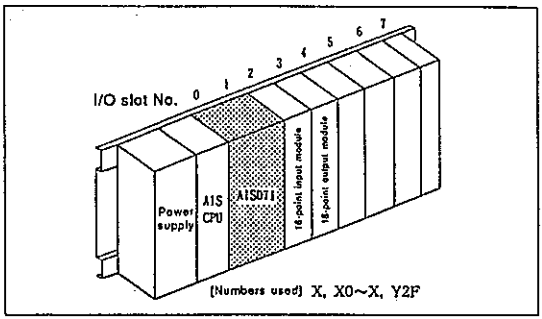


Fig. 6-4 Determining the Address for Positioning

The sequence programs presented in this chapter show I/O numbers (X, Y) assuming the arrangement of modules on the main base unit is as illustrated below. A1SD71 is mounted at I/O slots 0 and 1, a 16-point input module at slot 2, and 16-point output module at slot 3. If the actual arrangement of the modules differs from this arrangement, change the X and Y numbers accordingly.



Example arrangement of modules

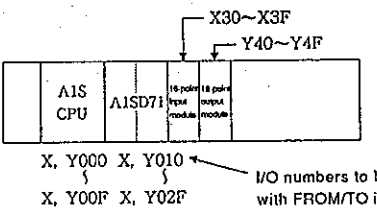
The numbers of the devices (M, D, T, etc.) used in the program can be changed as required.

POINTS

(1) The A1SD71 has 48 I/O points and occupies 2 slots. For I/O allocation using the GPP function, follow the instructions given below.

First slot: Vacant slot 16 points
Second slot: Special function module 32 points

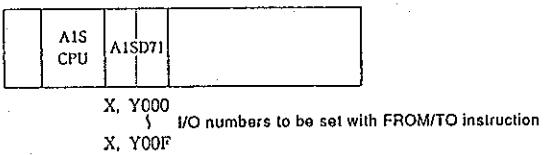
(2) To execute the FROM/TO instruction for the A1SD71, use the head I/O number of the second slot.



(Note) The program example given in Section 6-1-3 is for use with 1-axis control and assumes the slot allocation shown on the left.
For use as a 2-axis ABS system, increase the number of I/O points..

Therefore, the I/O number to be set with the FROM/TO instruction is "head I/O number allocated to the A1SD71 + 010H".

(3) By setting "0 point of vacant slot" for the first slot of the A1SD71 in the "I/O allocation" of the GPP function, the 16 points in the first slot can be saved.
In this case, the I/O number to be set with the FROM/TO instruction is the same number as the head I/O number allocated to the A1SD71.



6.1.3 ABS sequence program example

[Example]
To transmit the ABS data using the OFF-to-ON change of the servo ON signal as the trigger

[Conditions]

(1) When the servo ON signal and the GND of the power supply are shorted, the ABS data is transmitted when the power to the servo amplifier power is turned ON, or at the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset, or when the emergency stop state is reset.

(2) If a check sum discrepancy is detected in the transmitted data, ABS data transmission is retried up to three times. If the check sum discrepancy is still detected after retrying, the ABS check sum error is generated (Y4A ON).

(3) The following time periods are measured and if the ON/OFF state does not change within the specified time, the ABS communication error is generated (Y4A ON).
ON period of ABS transfer mode (Y41)
ON period of ABS request (Y42)
OFF period of ready to send ABS data (X32).

(4) If the relationship between the polarity (±) of the received ABS data and the setting value for parameter No. 14 (rotating direction) of A1SD71 (AD71) involves negative coordinate values, which cannot be handled by the A1SD71 (AD71), the ABS coordinate error is generated (Y4B ON).

■ List of devices used in X-axis ABS sequence program

X input contact	
X30	ABS bit 0 / completion of positioning
X31	ABS bit 1 / zero speed
X32	Send ABS data ready / torque limit control
X33	Servo alarm
X34	Error reset
X35	Servo emergency stop
X36	Servo ON
X37	Home position return start
X38	Operation mode I
X39	Operation mode II

Y output contact	
Y40	Servo ON
Y41	ABS transfer mode
Y42	ABS request
Y43	Alarm reset
Y44 Note2	Electromagnetic brake output
Y45 Note1	Clear
Y48	Servo alarm
Y49	ABS communication error
Y4A	ABS check sum error
Y4B	ABS coordinate error

D register	
D0	ABS data transmission counter
D1	Check sum transmission counter
D2	Check sum addition counter
D3	ABS data: Lower 16 bits
D4	ABS data: Upper 16 bits
D5	ABS data 2-bit receiving buffer
D6	Check data in case of check sum error
D7	Retry frequency
D8	Forward rotation direction
D9	Home position address:Lower 16 bits
D10	Home position address:Upper 16 bits
D100	Received shift data:Lower 16 bits
D101	Received shift data:Upper 16 bits

T timer	
T0	ABS transfer mode timer
T1	ABS request response timer
T2	Retry wait timer
T3	Ready to send response timer
T10 Note1	Clear signal ON timer
T200	Transmitted data read 10ms delay timer

M contact	
M0	ABS data transmission start
M1	Sum check completion
M2	Sum check discrepancy
M3	ABS data ready
M4	Transmission data read enabled
M5	Check sum 2 bits read completion
M6	ABS 2 bits read completion
M7	ABS 2 bits request
M8	Servo ON request
M9	Servo alarm
M10	ABS data transmission retry start pulse
M11	Retry flag setting
M12	Retry flag reset
M13	ABS coordinate (-)
M14	ABS coordinate (+)
M20 Note1	Clear signal ON timer request
M21 Note2	Data set type home position return request

C counter	
C0	ABS data receive frequency counter
C1	Check sum receive frequency counter
C2	Retry counter

Note 1: Necessary when data set type home position return is executed.
2: Necessary in the event of electromagnetic brake output.

[ABS sequence program example]

This sequence program example assumes the following conditions:

- Parameters of the A1SD71-S2 (AD71) positioning module
  1) Unit setting : 3=pulse (PLS)
  2) Travel per pulse : 1=1 pulse

To select the unit other than the pulse, conversion into the unit of the feed command value per pulse is required. Hence, add the following program to the area marked Note 1 in the sequence program.

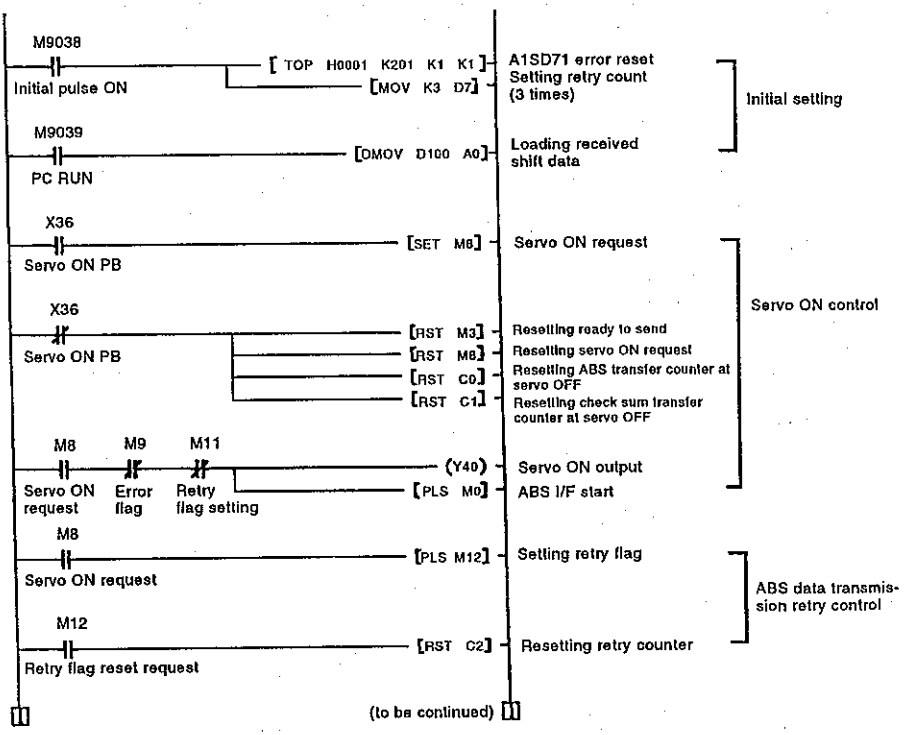
<Additional program>

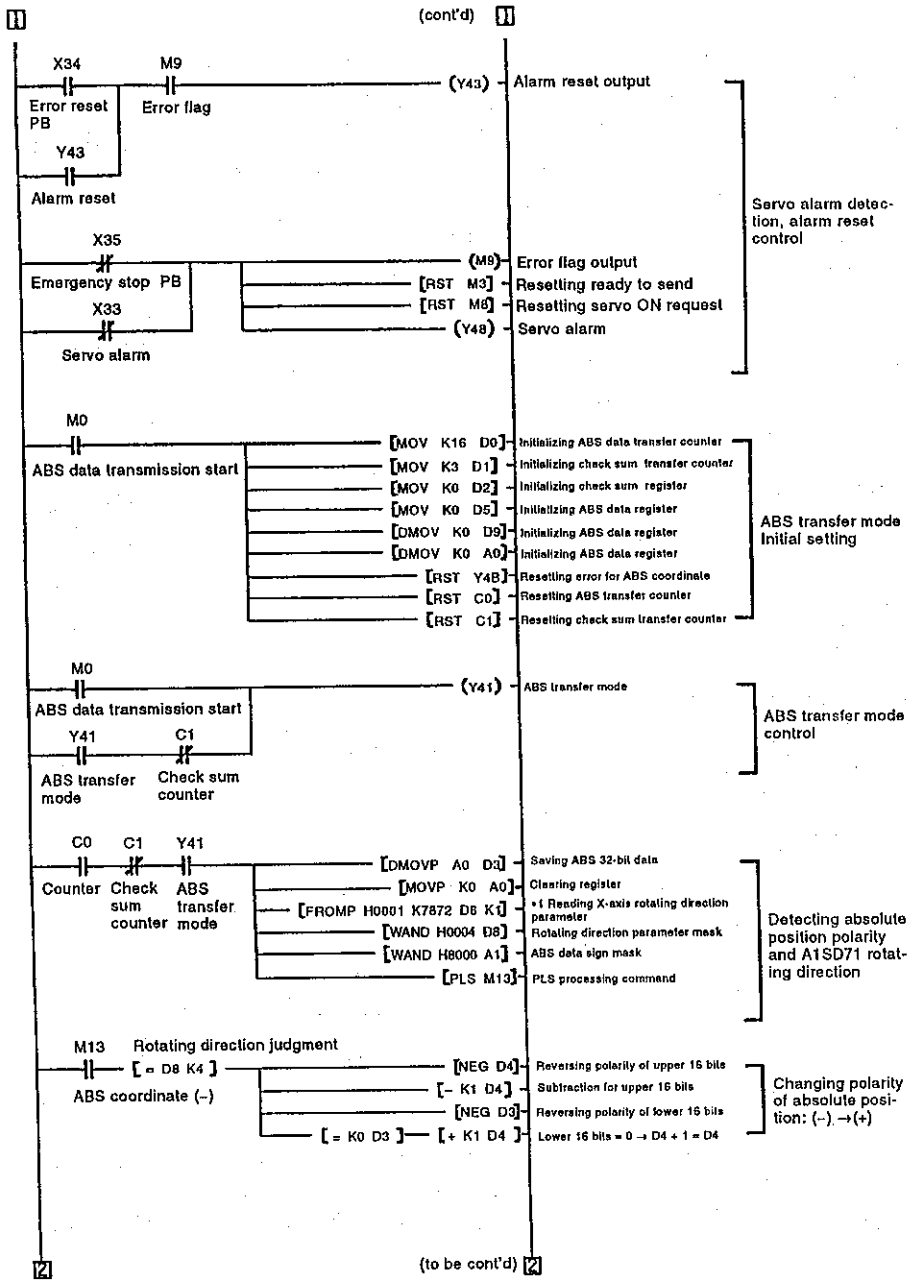
—[D*P K□□ D3 D3]—

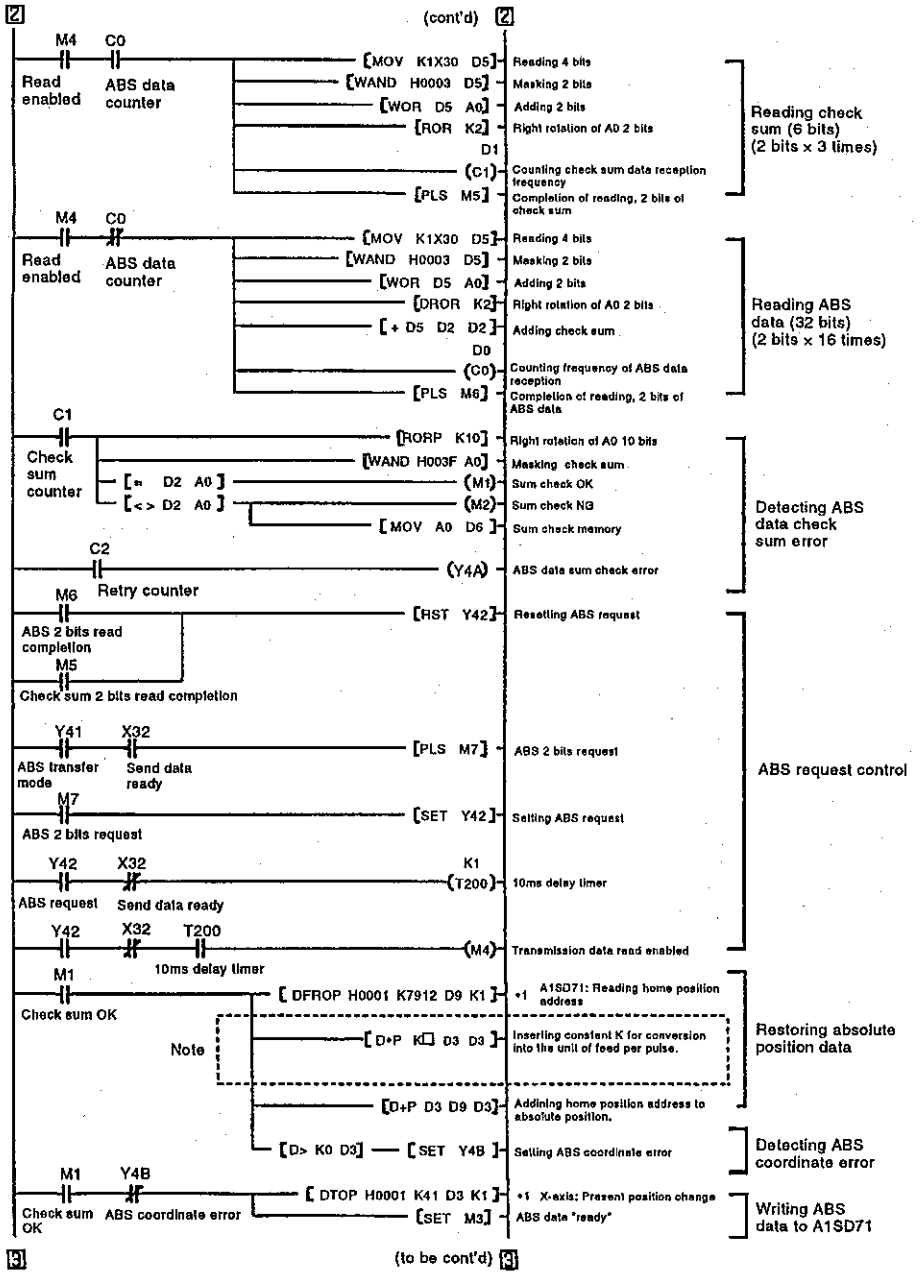
Item	mm			Inch			degree	PULS
Unit setting	0			1			2	3
Travel per pulse	0.1	1.0	10.0	0.00001	0.0001	0.001	—	—
Unit of travel	μm/PLS			inch/PLS or degree/PLS				PLS
Constant K for conversion into unit of travel	1	10	100	1	10	100		None

Reference

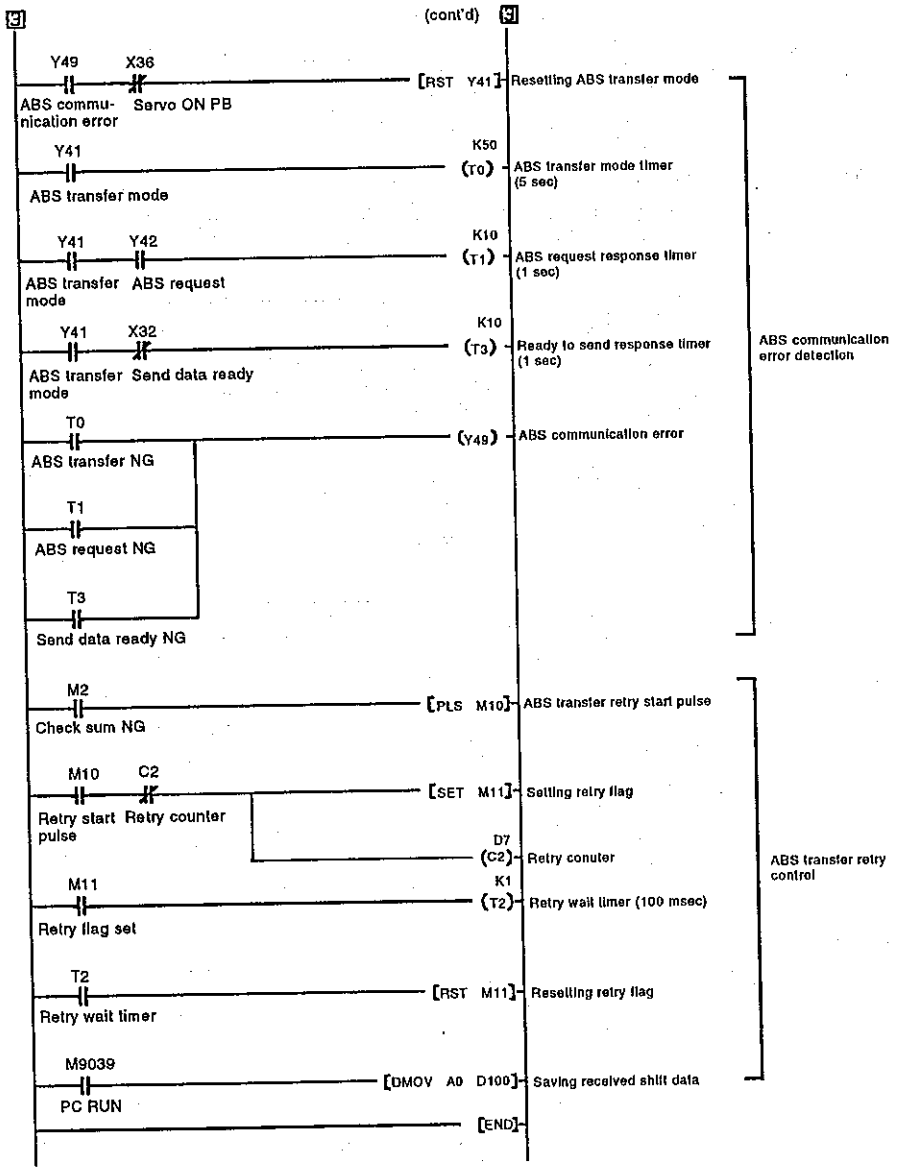
- For 1μm/PLS, set constant K to 10
- For 5μm/PLS, set constant K to 50
- When the unit setting is PULS, the additional program is not required.




(cont'd)
X34
Error reset PB
M9
Error flag
Y43
Alarm reset
(Y43)
Alarm reset output
X35
Emergency stop PB
X33
Servo alarm
(M9)
Error flag output
[RST M3]
Resetting ready to send
[RST M6]
Resetting servo ON request
(Y48)
Servo alarm
Servo alarm detection, alarm reset control
M0
ABS data transmission start
[MOV K16 D0]
Initializing ABS data transfer counter
[MOV K3 D1]
Initializing check sum transfer counter
[MOV K0 D2]
Initializing check sum register
[MOV K0 D5]
Initializing ABS data register
[DMOV K0 D9]
Initializing ABS data register
[DMOV K0 A0]
Initializing ABS data register
[RST Y4B]
Resetting error for ABS coordinate
[RST C0]
Resetting ABS transfer counter
[RST C1]
Resetting check sum transfer counter
ABS transfer mode Initial setting
M0
ABS data transmission start
Y41
ABS transfer mode
C1
Check sum counter
(Y41)
ABS transfer mode
ABS transfer mode control
C0
Counter
C1
Check sum counter
Y41
ABS transfer mode
[DMOVP A0 D3]
Saving ABS 32-bit data
[MOVP K0 A0]
Clearing register
[FROMP H0001 K7872 D8 K1]
• 1 Reading X-axis rotating direction parameter
[WAND H0004 D8]
Rotating direction parameter mask
[WAND H8000 A1]
ABS data sign mask
[PLS M13]
PLS processing command
Detecting absolute position polarity and A1SD71 rotating direction
M13
Rotating direction judgment
[= D8 K4]
ABS coordinate (–)
[NEG D4]
Reversing polarity of upper 16 bits
[– K1 D4]
Subtraction for upper 16 bits
[NEG D3]
Reversing polarity of lower 16 bits
[= K0 D3]
[+ K1 D4]
Lower 16 bits = 0 → D4 + 1 = D4
Changing polarity of absolute position: (–) → (+)
(to be cont'd)

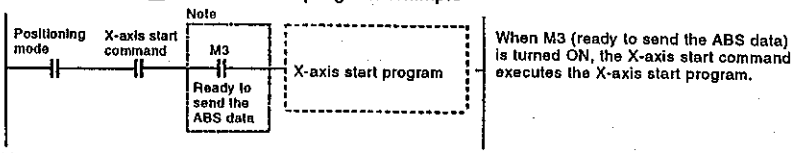


Note : When the unit setting parameter value of the A1SD71 positioning module is changed from 3 (PULS) to 0 (mm), the unit is 0.1μm. To set the unit to 1μm, for example, add the program enclosed in the broken line above to multiple the feed command value by 10.



Note : When absolute position data is received at power ON, for example, if a negative coordinate position which cannot be handled by the A1SD71 is detected, the ABS coordinate error (Y4B ON) is generated. If this error is generated, move the axis into the positive coordinate zone in JOG operation. Then, turn OFF the servo ON pushbutton switch and turn it ON again.

■ X-axis control program example



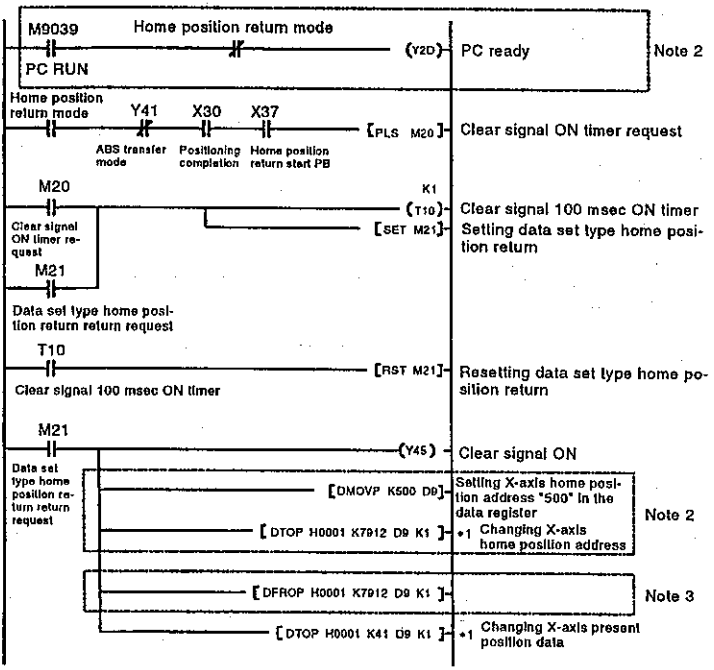
Note: This precludes execution of the X-axis start program while M3 (ready to send the ABS data) is OFF.

■ For an example of a program for the dog type home position return operation, refer to the home position return program presented in the User's Manual for A1SD71.

■ Program for data set type home position return operation

[Example]
After jogging the machine to the position where the home position is to be set, select the home position return mode and press the home position return start pushbutton switch to set the home position. The home position address should be "500".

[Conditions]
After turning ON the power, the motor must rotate more than one revolution before executing home position return.



Note 1: Do not turn ON the clear signal (Y45) for an operation other than home position return. Turning it ON in other circumstances will cause position shift.

2: If data of the home position address parameter is not written by using an A6GPP programming tool, etc. before starting a program for data set type home position return, the circuit indicated in Note 2 is necessary and the circuit indicated in Note 3 is not necessary.

3: Contrary to Note 2 above, if the home position address is written in the home position address parameter, the circuit indicated in Note 2 is not necessary and the circuit indicated in Note 3 is necessary.

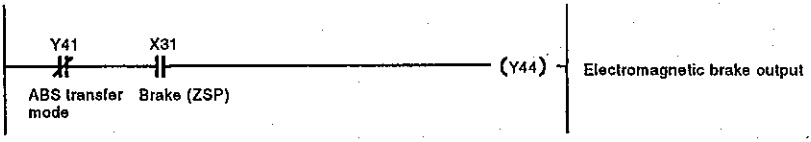
■ Electromagnetic brake output program

[Example]
To create the electromagnetic brake signal

[Conditions]

(1) While the ABS data is being transmitted (for several seconds after the servo ON signal has changed from OFF to ON), the motor is assumed to be stopped.

(2) "1 □ 1 □" (electromagnetic brake output selection) is set for servo amplifier parameter No. 03.

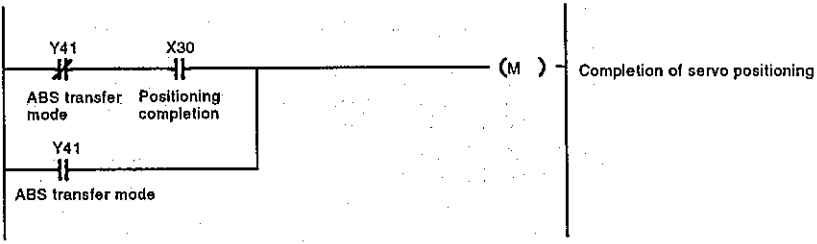


■ Positioning completion program

[Example]
To create the status information for servo positioning completion

[Conditions]

While the ABS data is being transmitted (for several seconds after the servo ON signal has changed from OFF to ON), the motor is assumed to be stopped.

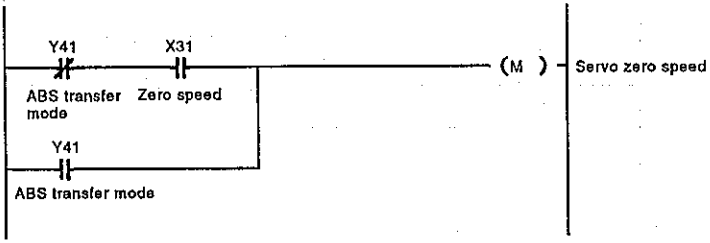


■ Zero speed program

[Example]
To create the status information for servo zero speed

[Conditions]

While the ABS data is being transmitted (for several seconds after the servo ON signal has changed from OFF to ON), the motor is assumed to be stopped.



6

■ Torque limiting mode program

[Example]
To create the status information for the servo torque limiting mode

[Conditions]

While the ABS data is being transmitted (for several seconds after the servo ON signal has changed from OFF to ON), the torque limiting mode is assumed to be OFF.

6.1.4 ABS sequence program example - 2-axis control

The example programs presented in the previous section are for 1-axis control (X-axis).
The ABS sequence program for the second axis (Y-axis) when one A1SD71 unit is used for X and Y axes is described below. The program can be written in the same manner for the third and later axes.

■ ABS sequence program for Y-axis

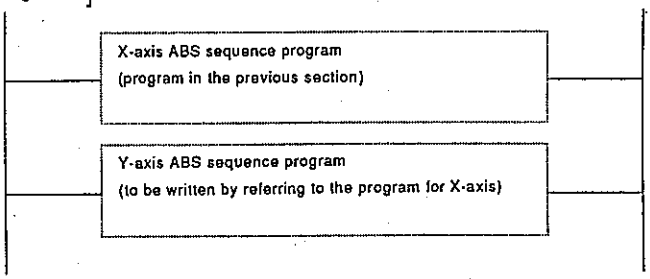
[Procedure]
It is advisable to write the Y-axis program by referring to the program for X-axis.

(1) Allocate the X inputs, Y outputs, D registers, M contacts, T timers, and C counters for the Y-axis so that they will not overlap the allocations for the X-axis.

(2) The A1SD71 has different buffer memory addresses for the X-axis and Y-axis. Change the program for X-axis as indicated below to write the program for Y-axis.

```
[FROMP  H0001  K7872  D8  K1]  →  [FROMP  H0001  K7892  D8  K1]
[DFROP  H0001  K7912  D9  K1]  →  [DFROP  H0001  K7922  D9  K1]
[DTOP   H0001  K41    D3  K1]  →  [DTOP   H0001  K341   D3  K1]
```

[Program configuration]



■ Data set type home position return program for Y-axis

[Example]
Arrange the data set type home position return program written for the X-axis in series to control two axes.

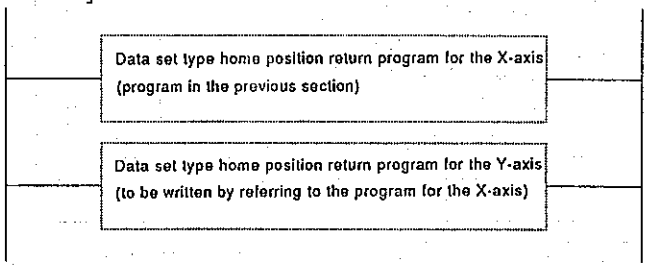
[Procedure]
It is advisable to write the data set type home position return program for the Y-axis by referring to the program for X-axis.

(1) Allocate the X inputs, Y outputs, D registers, M contacts, and T timers for the Y-axis so that they will not overlap the allocations for the X-axis.

(2) The A1SD71 has different buffer memory addresses for the X-axis and Y-axis. Change the program for the X-axis as indicated below to write the program for the Y-axis.

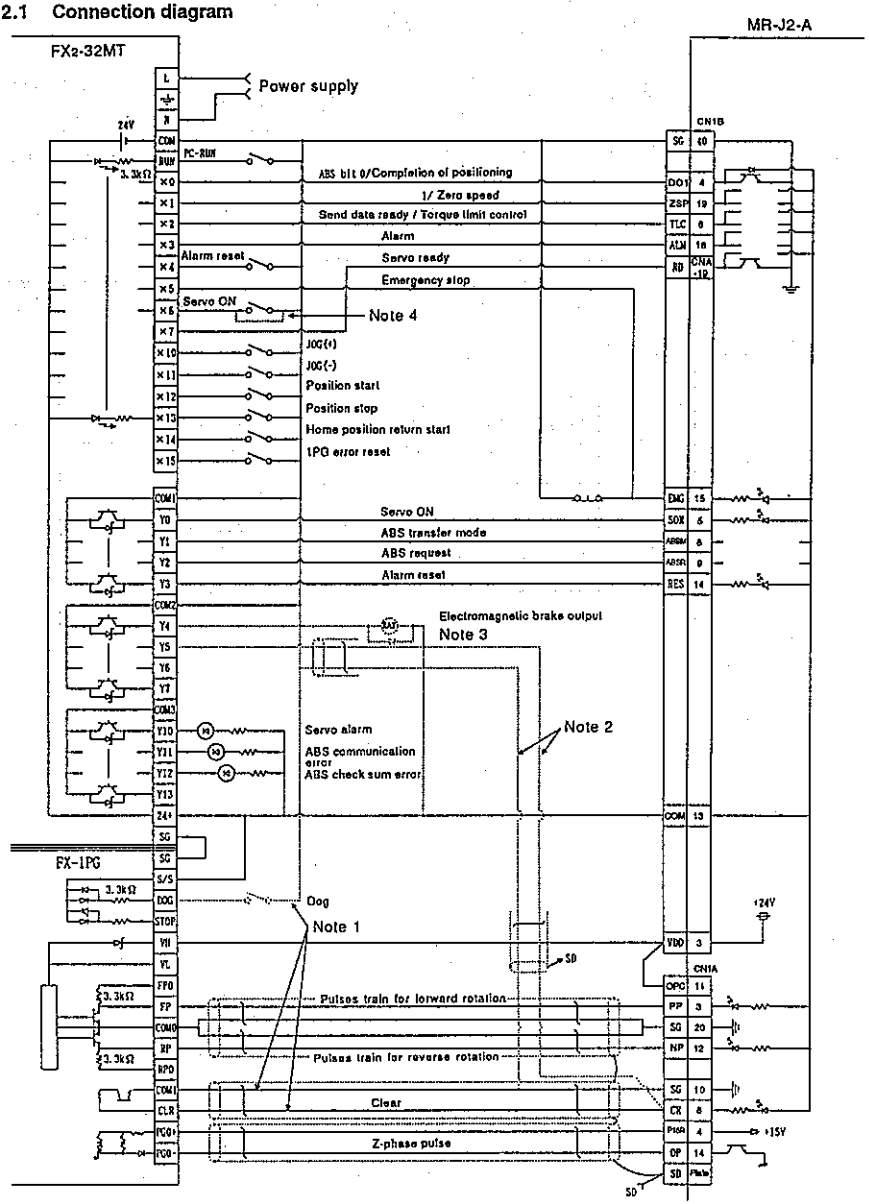
```
[DTOP  H0001  K7912  D9  K1]   →   [DTOP  H0001  K7922  D9  K1]
[DTOP  H0001  K41    D9  K1]   →   [DTOP  H0001  K341   D9  K1]
```

[Program configuration]



6.2 Connection example - MR-J2-A servo amplifier and MELSEC FX2-32MT (FX-1PG)

6.2.1 Connection diagram

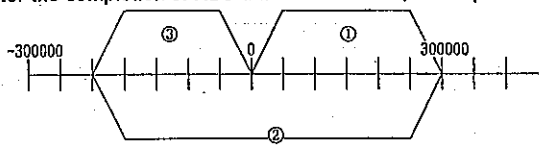


Note 1: To be connected for dog type home position setting.
2: To be connected for data set type home position setting.
3: The electromagnetic brake output should be controlled by connecting the programmable controller output to a relay.
4: To be shorted if a servo ON switch is not used.

6.2.2 ABS sequence program example

[Example]

- To transmit the ABS data using the OFF-to-ON change of the servo ON signal as the trigger
- After the completion of ABS data transmission, positioning is possible in the following operation patterns
  1) Positioning from the position where the absolute position is detected to address 300000
  2) Positioning from address 300000 to address –250000
  3) Positioning from address –250000 to address 0
- After the completion of ABS data transmission, JOG operation is possible



using the JOG+ or JOG– pushbutton switch.

- After the completion of ABS data transmission, dog type home position return is possible using the home position return pushbutton switch.

Note: The FX-1PG buffer memory allocations are indicated below.

BMF No.		Name and symbol		Set value	Remark
Upper 16 bits	Lower 16 bits				
–	#0	Pulse rate	A	2000	
#2	#1	Feed rate	B	1000	
–	#3	Parameter		H0000	Command unit: Pulses
#5	#4	Max. speed	Vmax	100000PPS	
–	#6	Bias speed	Vbia	0PPS	
#8	#7	JOG operation	Vjog	10000PPS	
#10	#9	Home position return speed (high speed)	VRT	50000PPS	
–	#11	Home position return speed (creep)	VCL	1000PPS	
–	#12	Home position return zero-point signal count	N	2 pulses	Initial value: 10
#14	#13	Home position address	HP	0	
–	#15	Acceleration/deceleration time	Ta	200msec	Initial value: 100
–	#16	Not usable			
#18	#17	Target address (I)	P(I)	0	
#20	#19	Operation speed (I)	V(I)	100000	Initial value: 10
#22	#21	Target address (II)	P(II)	0	
#24	#23	Operation speed (II)	V(II)	10	
–	#25	Operation command		H0000	

Note : BMF No.:For BFM numbers after #26, refer to the User's Manual for the FX-1PG.

[Conditions]

(1) When the servo ON pushbutton switch and the GND of the power supply are shorted, the ABS data is transmitted when the servo amplifier power is turned ON, or at the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset, or when the emergency stop state is reset.

(2) If check sum discrepancy is detected in the transmitted data, the ABS data transmission is retried up to three times. If the check sum discrepancy is still detected after retrying, the ABS check sum error is generated (Y12 ON).

(3) The following time periods are measured and if the ON/OFF state does not change within the specified time, the ABS communication error is generated (Y11 ON).
ON period of ABS transfer mode (Y1)
ON period of ABS request (Y2)
OFF period of ready to send the ABS data (X2).

■ List of devices used in X-axis ABS sequence program

X input contact	
X0	ABS bit 0 / completion of positioning
X1	ABS bit 1 / zero speed
X2	Send ABS data ready/ torque limit control
X3	Servo alarm
X4	Alarm reset PB
X5	Servo emergency stop
X6	Servo ON PB
X7	Servo ready
X10	JOG (+) PB
X11	JOG (-) PB
X12	Position start PB
X13	Position stop PB
X14	Home position return start PB
X15	1PG error reset

Y output contact	
Y0	Servo ON
Y1	ABS transfer mode
Y2	ABS request
Y3	Alarm reset
Y4 Note2	Electromagnetic brake output
Y5 Note1	Clear
Y10	Servo alarm
Y11	ABS communication error
Y12	ABS check sum error

D register	
D0	ABS data: Lower 16 bits
D1	ABS data: Upper 16 bits
D2	Check sum addition counter
D3	Check data in case of check sum error
D4	Transmission retry count in check sum discrepancy
D24	Home position address:Lower 16 bits
D25	Home position address:Upper 16 bits
D106	1PG present position address:Lower 16 bits
D107	1PG present position address:Upper 16 bits

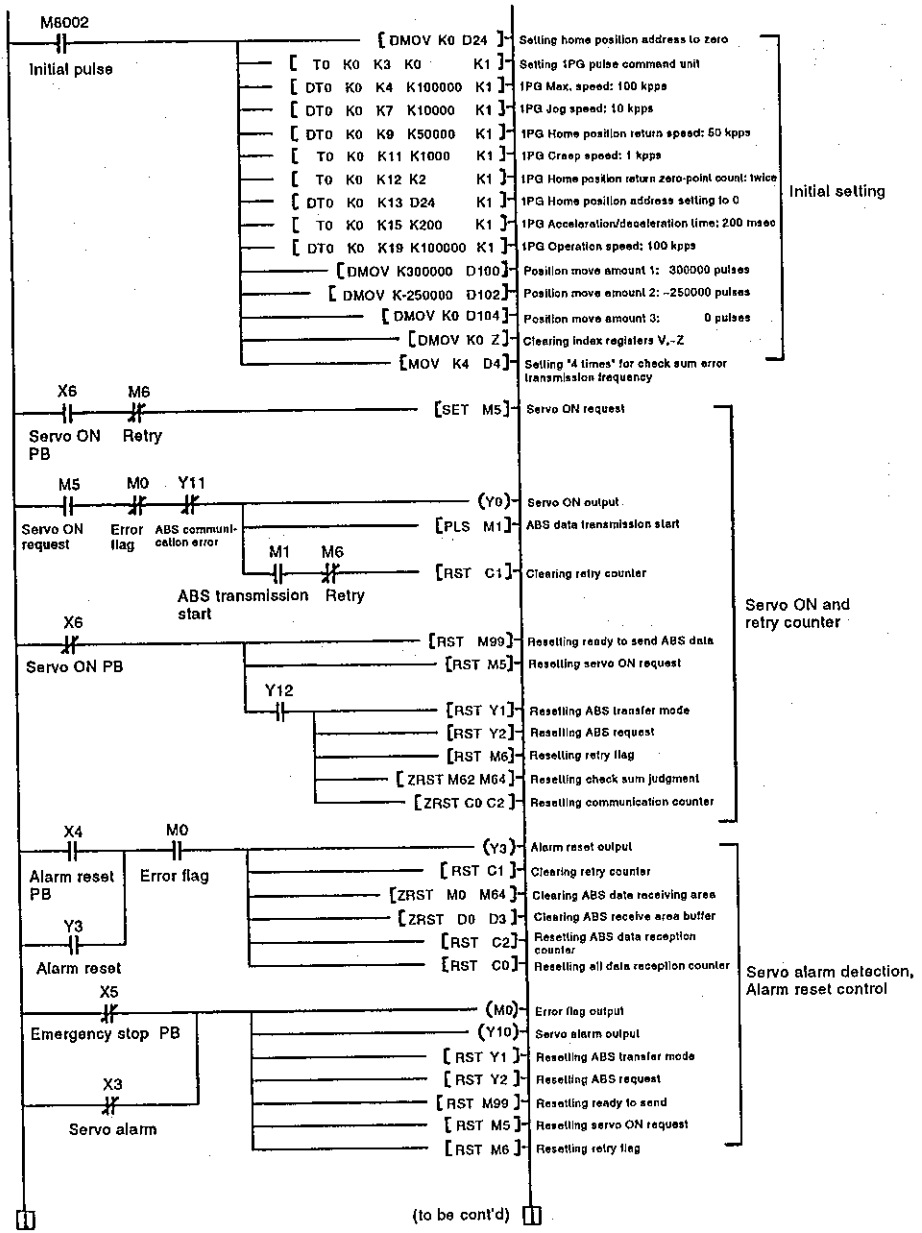
T timer	
T200	Retry wait timer
T201	ABS transfer mode timer
T202	ABS request response timer
T203	Ready to send response timer
T210 Note1	Clear signal ON timer

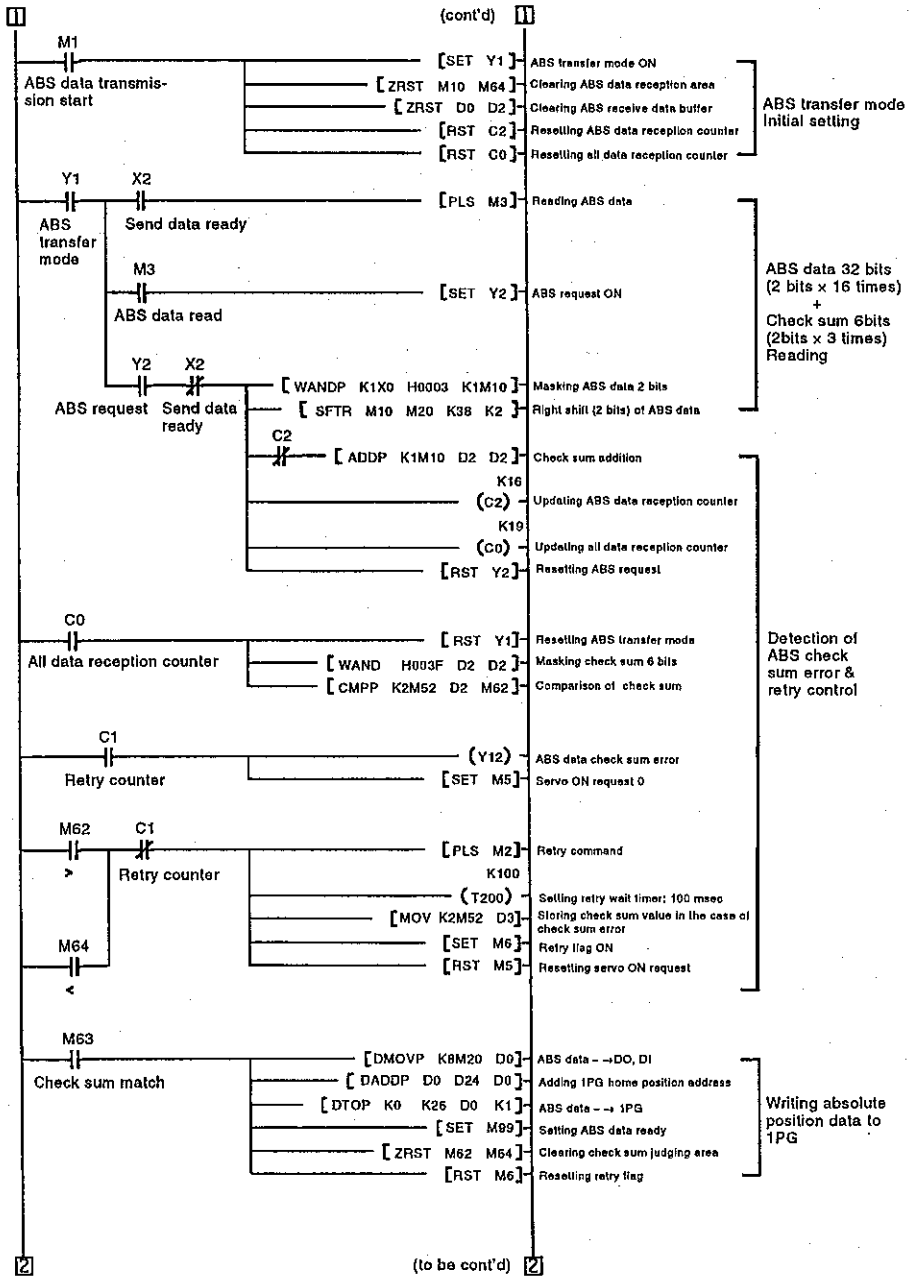
M contact	
M0	Error flag
M1	ABS data transmission start
M2	Retry command
M3	ABS data read
M4	Spare
M5	Servo ON request
M6	Retry flag
M10	ABS data 2 bit receiving buffer
M11	
M12	
M13	
M20 ↓ M51	ABS data 32 bit buffer
M52 ↓ M57	Check sum 6 bit buffer
M62	Sum check discrepancy (greater) >
M63	Sum check discrepancy =
M64	Sum check discrepancy (less) >
M70 Note1	Clear signal ON timer request
M71 Note1	Data set type home position return request
M99	ABS data ready

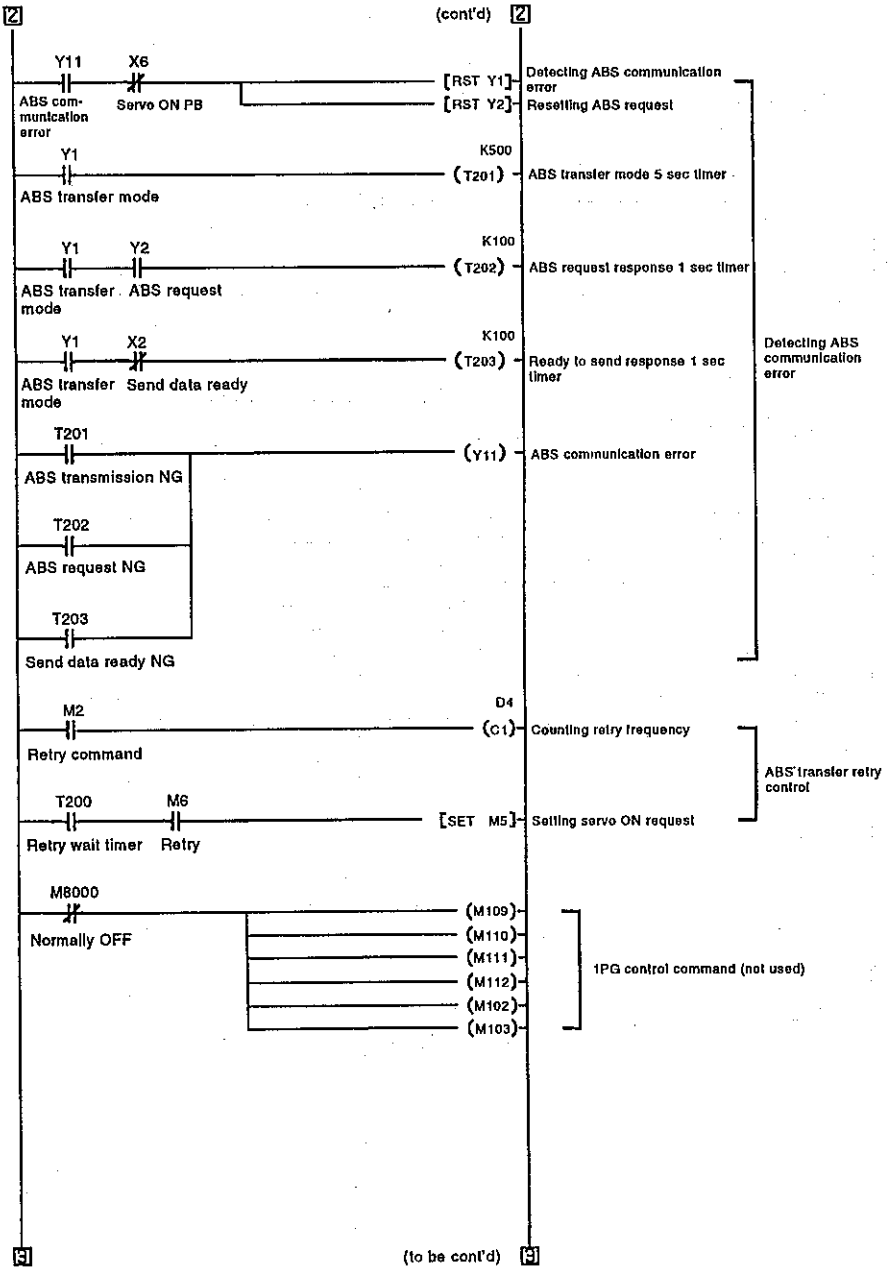
C counter	
C0	All data reception frequency counter (19 times)
C1	Check sum reception frequency counter
C2	ABS data reception frequency counter (16 times)

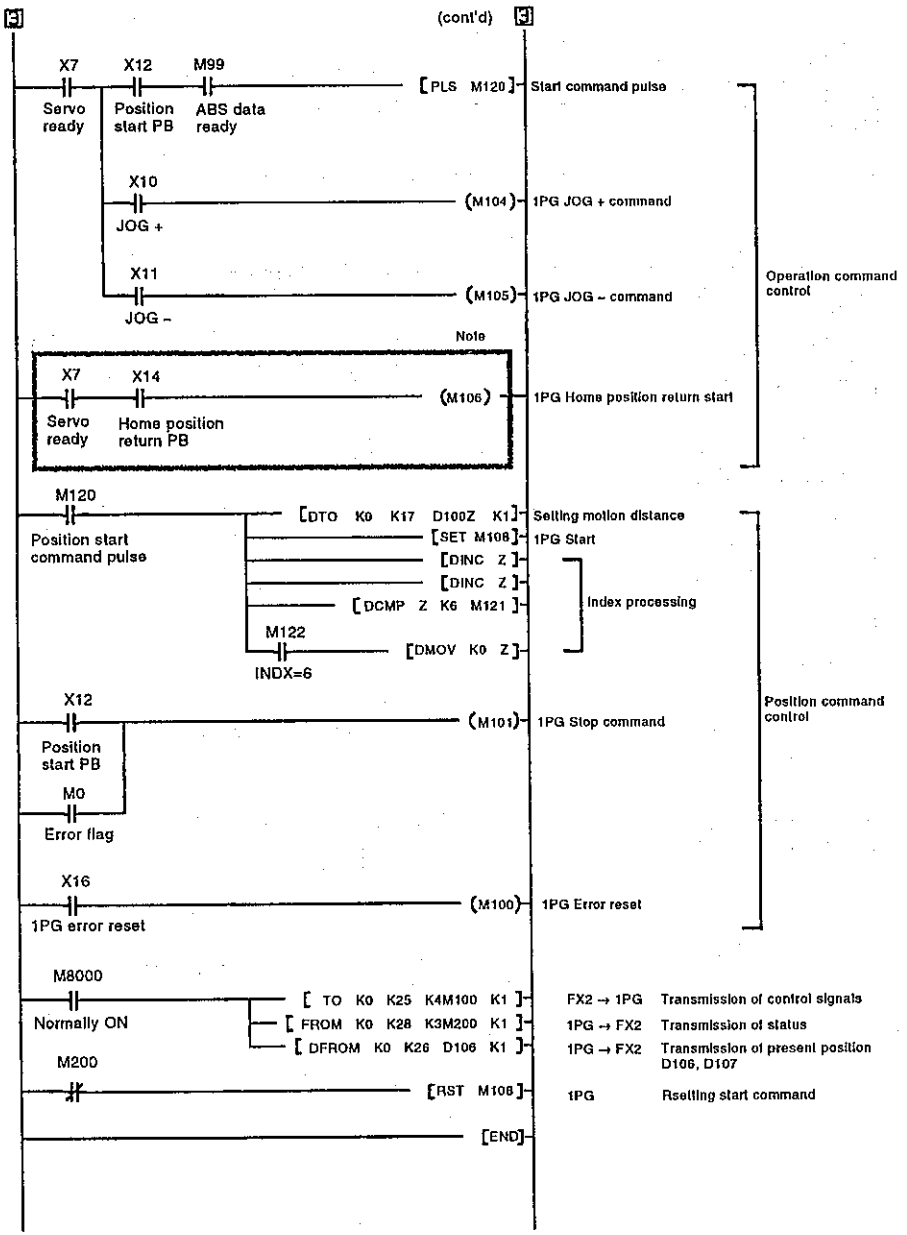
Note 1: Necessary when data set type home position return is executed.
2: Necessary in the event of electromagnetic brake output.

[Program]


M8002
Initial pulse
[DMOV K0 D24] Setting home position address to zero
[TO K0 K3 K0 K1] Setting 1PG pulse command unit
[DTO K0 K4 K100000 K1] 1PG Max. speed: 100 kpps
[DTO K0 K7 K10000 K1] 1PG Jog speed: 10 kpps
[DTO K0 K9 K50000 K1] 1PG Home position return speed: 50 kpps
[TO K0 K11 K1000 K1] 1PG Creep speed: 1 kpps
[TO K0 K12 K2 K1] 1PG Home position return zero-point count: twice
[DTO K0 K13 D24 K1] 1PG Home position address setting to 0
[TO K0 K15 K200 K1] 1PG Acceleration/deceleration time: 200 msec
[DTO K0 K19 K100000 K1] 1PG Operation speed: 100 kpps
[DMOV K300000 D100] Position move amount 1: 300000 pulses
[DMOV K-250000 D102] Position move amount 2: -250000 pulses
[DMOV K0 D104] Position move amount 3: 0 pulses
[DMOV K0 Z] Clearing index registers V, Z
[MOV K4 D4] Setting "4 times" for check sum error transmission frequency
Initial setting
X6
Servo ON PB
M6
Retry
[SET M5] Servo ON request
M5
Servo ON request
M0
Error flag
Y11
ABS communication error
(Y0) Servo ON output
[PLS M1] ABS data transmission start
M1
ABS transmission start
M6
Retry
[RST C1] Clearing retry counter
Servo ON and retry counter
X6
Servo ON PB
[RST M99] Resetting ready to send ABS data
[RST M5] Resetting servo ON request
Y12
[RST Y1] Resetting ABS transfer mode
[RST Y2] Resetting ABS request
[RST M6] Resetting retry flag
[ZRST M62 M64] Resetting check sum judgment
[ZRST C0 C2] Resetting communication counter
X4
Alarm reset PB
M0
Error flag
(Y3) Alarm reset output
[RST C1] Clearing retry counter
[ZRST M0 M64] Clearing ABS data receiving area
[ZRST D0 D3] Clearing ABS receive area buffer
[RST C2] Resetting ABS data reception counter
[RST C0] Resetting all data reception counter
Y3
Alarm reset
X5
Emergency stop PB
(M0) Error flag output
(Y10) Servo alarm output
[RST Y1] Resetting ABS transfer mode
[RST Y2] Resetting ABS request
[RST M99] Resetting ready to send
[RST M5] Resetting servo ON request
[RST M6] Resetting retry flag
X3
Servo alarm
Servo alarm detection, Alarm reset control
(to be cont'd)


1
(cont'd)
1
M1
ABS data transmission start
[SET Y1] ABS transfer mode ON
[ZRST M10 M64] Clearing ABS data reception area
[ZRST D0 D2] Clearing ABS receive data buffer
[RST C2] Resetting ABS data reception counter
[RST C0] Resetting all data reception counter
ABS transfer mode Initial setting
Y1
ABS transfer mode
X2
Send data ready
[PLS M3] Reading ABS data
M3
ABS data read
[SET Y2] ABS request ON
ABS data 32 bits (2 bits x 16 times) + Check sum 6bits (2bits x 3 times) Reading
Y2
ABS request
X2
Send data ready
[WANDP K1X0 H0003 K1M10] Masking ABS data 2 bits
[SFTR M10 M20 K38 K2] Right shift (2 bits) of ABS data
C2
[ADDP K1M10 D2 D2] Check sum addition
K16
(C2) Updating ABS data reception counter
K19
(C0) Updating all data reception counter
[RST Y2] Resetting ABS request
C0
All data reception counter
[RST Y1] Resetting ABS transfer mode
[WAND H003F D2 D2] Masking check sum 6 bits
[CMPP K2M52 D2 M62] Comparison of check sum
Detection of ABS check sum error & retry control
C1
Retry counter
(Y12) ABS data check sum error
[SET M5] Servo ON request 0
M62
>
C1
Retry counter
[PLS M2] Retry command
K100
(T200) Setting retry wait timer: 100 msec
[MOV K2M52 D3] Storing check sum value in the case of check sum error
[SET M6] Retry flag ON
[RST M5] Resetting servo ON request
M64
<
M63
Check sum match
[DMOVP K8M20 D0] ABS data → D0, D1
[DADDP D0 D24 D0] Adding 1PG home position address
[DTOP K0 K26 D0 K1] ABS data → 1PG
[SET M99] Setting ABS data ready
[ZRST M62 M64] Clearing check sum judging area
[RST M6] Resetting retry flag
Writing absolute position data to 1PG
2
(to be cont'd)
2


2
(cont'd)
2
Y11
X6
ABS communication error
Servo ON PB
[RST Y1]
[RST Y2]
Detecting ABS communication error
Resetting ABS request
Y1
K500
(T201)
ABS transfer mode
ABS transfer mode 5 sec timer
Y1
Y2
K100
(T202)
ABS transfer mode
ABS request
ABS request response 1 sec timer
Y1
X2
K100
(T203)
ABS transfer mode
Send data ready
Ready to send response 1 sec timer
Detecting ABS communication error
T201
(Y11)
ABS transmission NG
ABS communication error
T202
ABS request NG
T203
Send data ready NG
M2
D4
(C1)
Retry command
Counting retry frequency
ABS transfer retry control
T200
M6
[SET M5]
Retry wait timer
Retry
Setting servo ON request
M8000
(M109)
(M110)
(M111)
(M112)
(M102)
(M103)
Normally OFF
1PG control command (not used)
3
(to be cont'd)
3

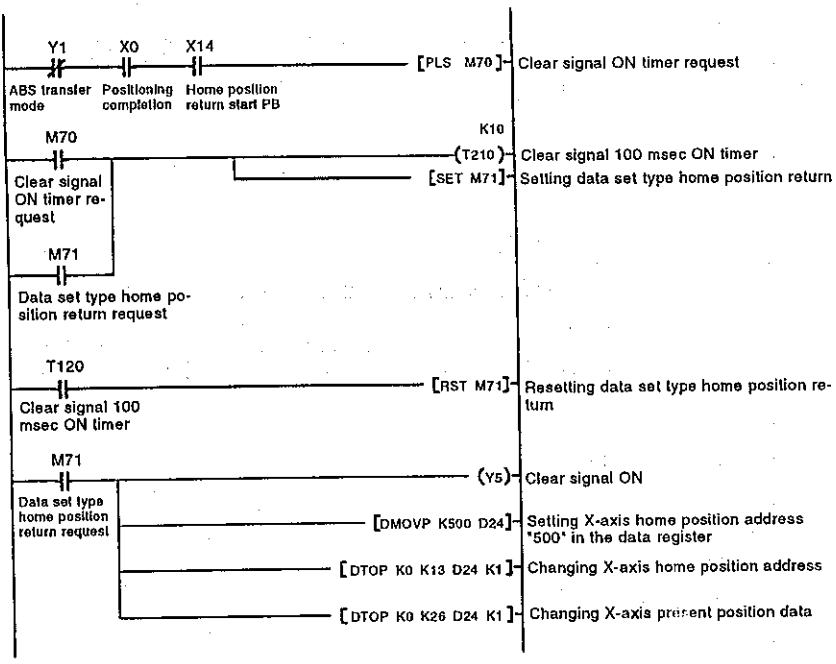


Note: The program example above is for dog type home position return operation. For a program for a data set type home position return operation, refer to the following program example.

■ Program for data set type home position return operation

[Example]
After jogging the machine to the position where the home position is to be set, select the home position return mode and press the home position return start pushbutton switch to set the home position. The home position address should be "500".

[Conditions]
After turning ON the power, the motor must rotate more than one revolution.



Note : Do not turn ON the clear signal (Y45) for an operation other than home position return. Turning it ON in other circumstances will cause position shift.

■ Electromagnetic brake output program

[Example]
To create the electromagnetic brake signal

[Conditions]

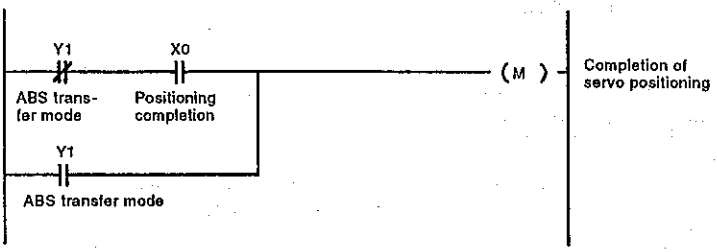
(1) While the ABS data is being transmitted (for several seconds after the servo ON signal has changed from OFF to ON), the motor is assumed to be stopped.

(2) "1□1□" (electromagnetic brake output selection) is set for servo amplifier parameter No. 01.

■ Positioning completion program

[Example]
To create the status information for servo positioning completion

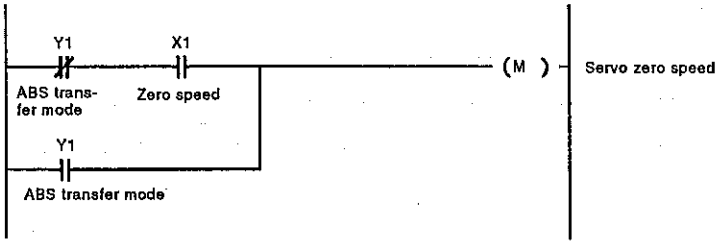
[Conditions]
While the ABS data is being transmitted (for several seconds after the servo ON signal has changed from OFF to ON), the motor is assumed to be stopped.



■ Zero speed program

[Example]
To create the status information for servo zero speed

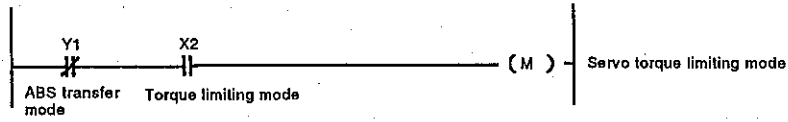
[Conditions]
While the ABS data is being transmitted (for several seconds after the servo ON signal has changed from OFF to ON), the motor is assumed to be stopped.



■ Torque limiting mode program

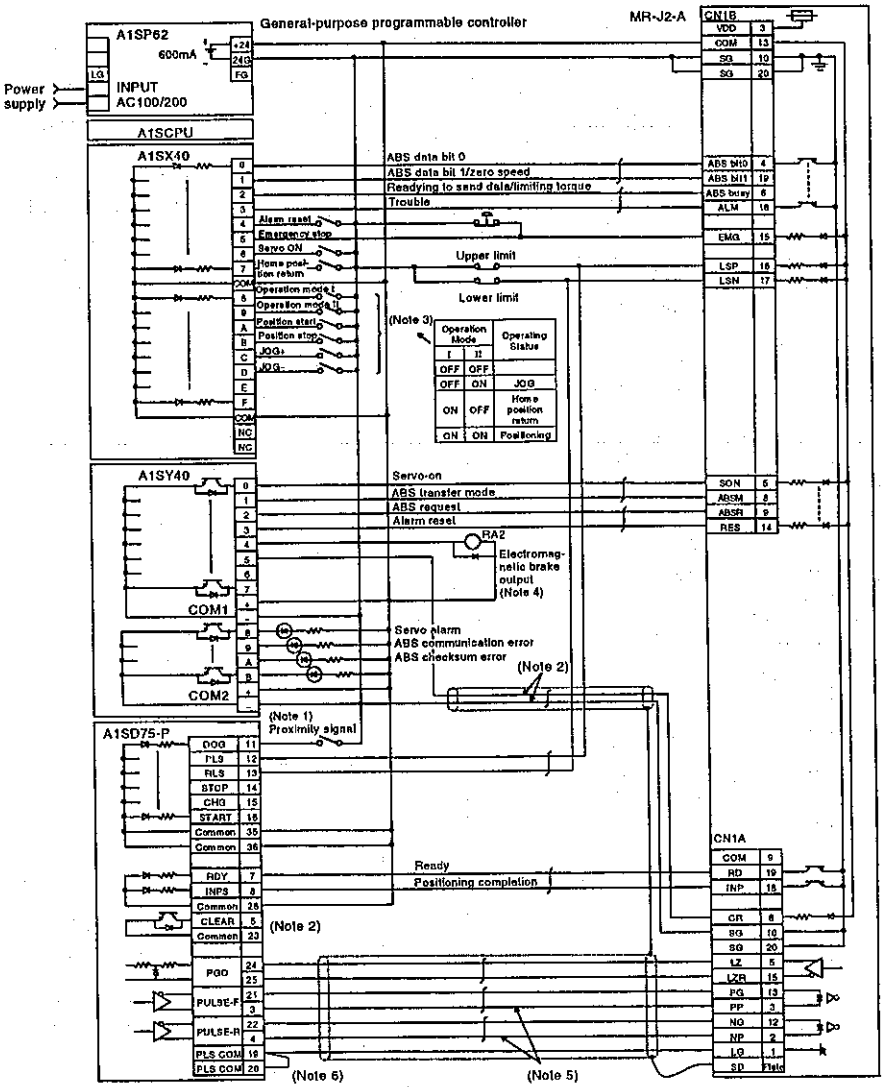
[Example]
To create the status information for the servo torque limiting mode

[Conditions]
While the ABS data is being transmitted (for several seconds after the servo ON signal has changed from OFF to ON), the torque limiting mode is assumed to be off.



6.3 Connection example - MR-J2-A servo amplifier and MELSEC-A1SD75 (AD75)

6.3.1 Connection diagram



Note 1: For dog type home position return. Do not connect when home position return is of the data set type.
2: If the servo motor provided with the zero point signal is started, the A1SD75 (AD75) will output the deviation counter clear signal. Therefore, do not connect the clear signal of the MR-J2-A to the A1SD75 (AD75) but connect it to the output module of the programmable controller.
3: This circuit is for your reference.
4: The electromagnetic brake output should be controlled via a relay connected to the programmable controller output.
5: Use the differential line driver system for pulse input. Do not use the open collector system.
6: To reinforce noise suppression, connect LG and pulse output COM.

6.3.2 ABS sequence program example

[Example]
To transmit the ABS data on the leading edge of the servo ON signal.

[Conditions]
(1) When the servo ON signal and GND of the power supply are shorted, the ABS data is transmitted at power-on of the servo amplifier or on the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset or when the emergency stop state is reset.

(2) If a checksum mismatch is detected in the transmitted data, ABS data transmission is retried up to three times. If the checksum mismatch still persists after the retries, the ABS checksum error occurs (Y3A ON).

(3) The following time periods are measured and if the ON/OFF state does not change within the specified time, the ABS communication error occurs (Y3A ON): ON period of ABS transfer mode (Y31)
ON period of ABS request (Y32)
OFF period of readying to send ABS data (X22)

■ List of devices used in X-axis ABS sequence program

X input contact		Y output contact	
X20	ABS bit 0/positioning completion	Y30	Servo ON
X21	ABS bit 1/zero speed	Y31	ABS transfer mode
X22	Readying to send ABS data/limiting torque	Y32	ABS request
X23	Servo alarm	Y33	Alarm reset
X24	Alarm reset	Y34 Note2	Electromagnetic brake output
X25	Servo emergency stop	Y35 Note2	Clear
X26	Servo ON	Y38	Servo alarm
X27	Home position return start	Y39	ABS communication error
X28	Operation mode I	Y3A	ABS checksum error
X29	Operation mode II		
D register		M contact	
D0	ABS data transmission counter	M5	ABS data transmission start
D1	Checksum transmission counter	M6	Sum check completion
D2	Checksum addition register	M7	Sum check mismatch
D3	ABS data: Lower 16 bits	M8	ABS data ready
D4	ABS data: Upper 16 bits	M9	Transmission data read enabled
D5	ABS data 2-bit receiving buffer	M10	Checksum 2 bits read completion
D6	Check data in case of checksum error	M11	ABS 2 bits read completion
D7	Number of retries	M12	ABS 2 bits request
D8	Forward rotation direction	M13	Servo ON request
D9	Home position address: Lower 16 bits	M14	Servo alarm
D10	Home position address: Upper 16 bits	M15	ABS data transmission retry start pulse
D11	Drive unit ready data	M16	Retry flag set
D12	Home position return completion data	M17	Retry flag reset
D110	Received shift data: Lower 16 bits	M18	PLS processing command
D111	Received shift data: Upper 16 bits	M20 Note1	Clear signal ON timer request
T timer		M21 Note1	Data set type home position return request
T0	ABS transmission mode timer	M22	Home position return processing instruction
T1	ABS request response timer	M23	Current position change processing instruction
T2	Retry wait timer	M24	Current position change flag
T3	ABS data send readying response timer	C counter	
T10	Clear signal ON timer	C0	ABS data receive times counter
T200	Transmitted data read 10ms delay timer	C1	Checksum receive times counter
		C2	Retry counter

Note 1: Required for data set type home position return.
2: Required for electromagnetic brake output.

[ABS sequence program example]

This sequence program example assumes the following conditions:

- Parameters of the A1SD75-P1 (AD75-P1) positioning module
  1) Unit setting : 3=pulse (PLS)
  2) Travel per pulse : 1=1 pulse

To select the unit other than the pulse, conversion into the unit of the feed value per pulse is required. Hence, add the following program to the area marked (Note 1) in the sequence program:

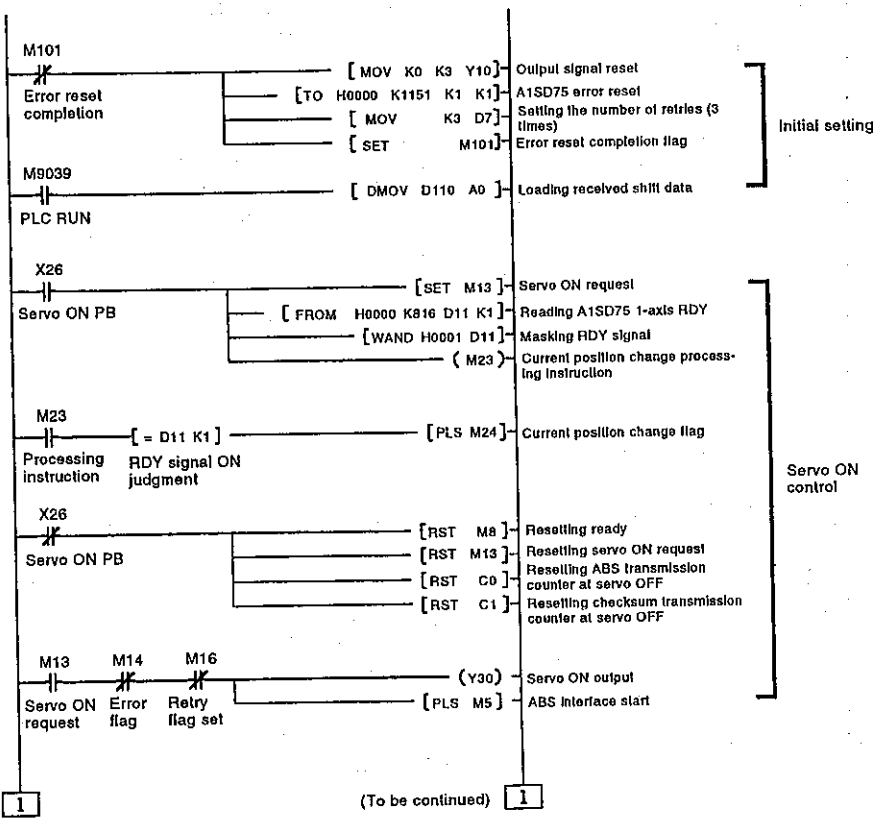
<Additional program>

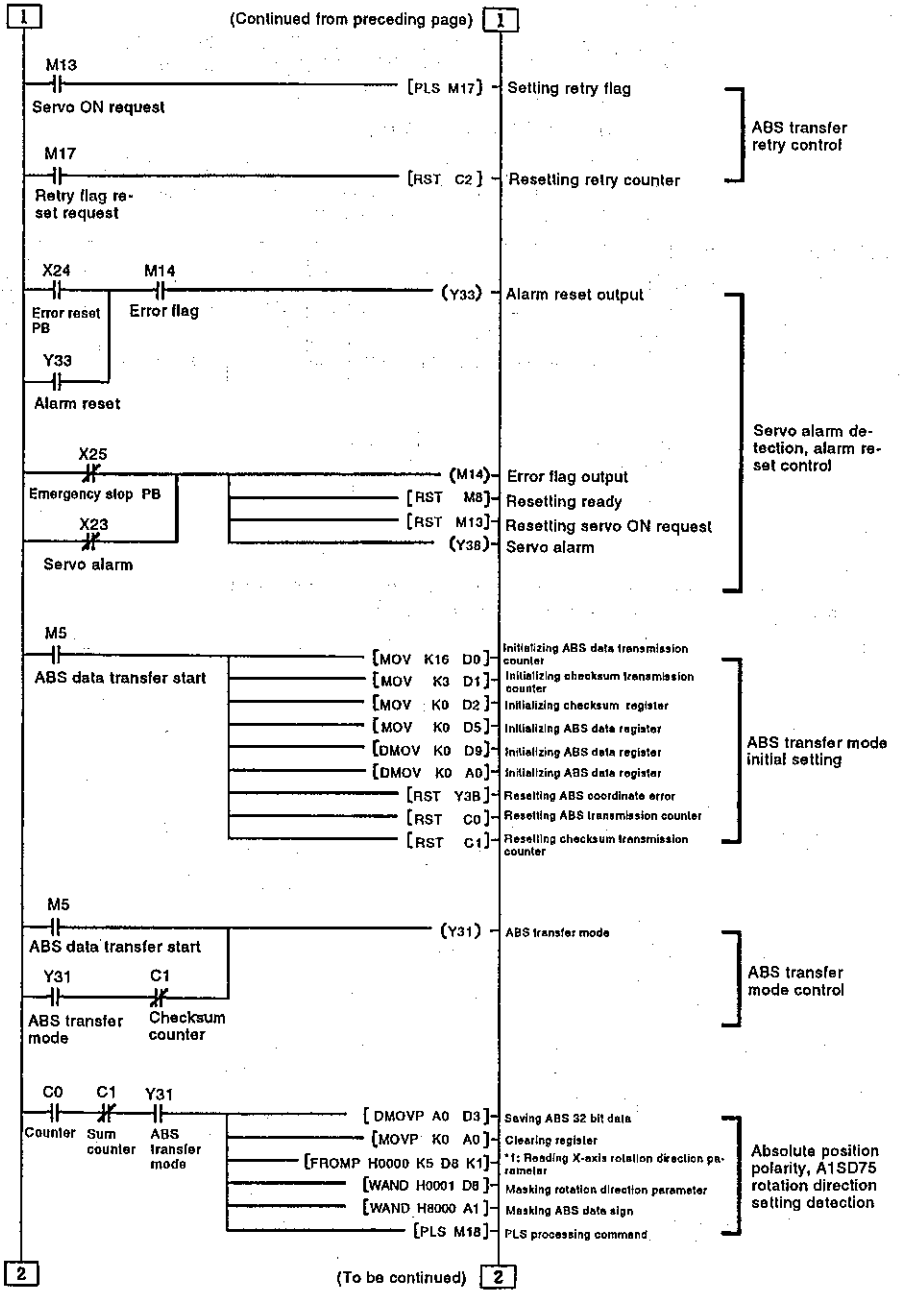
[D•P K□□ D3 D3]

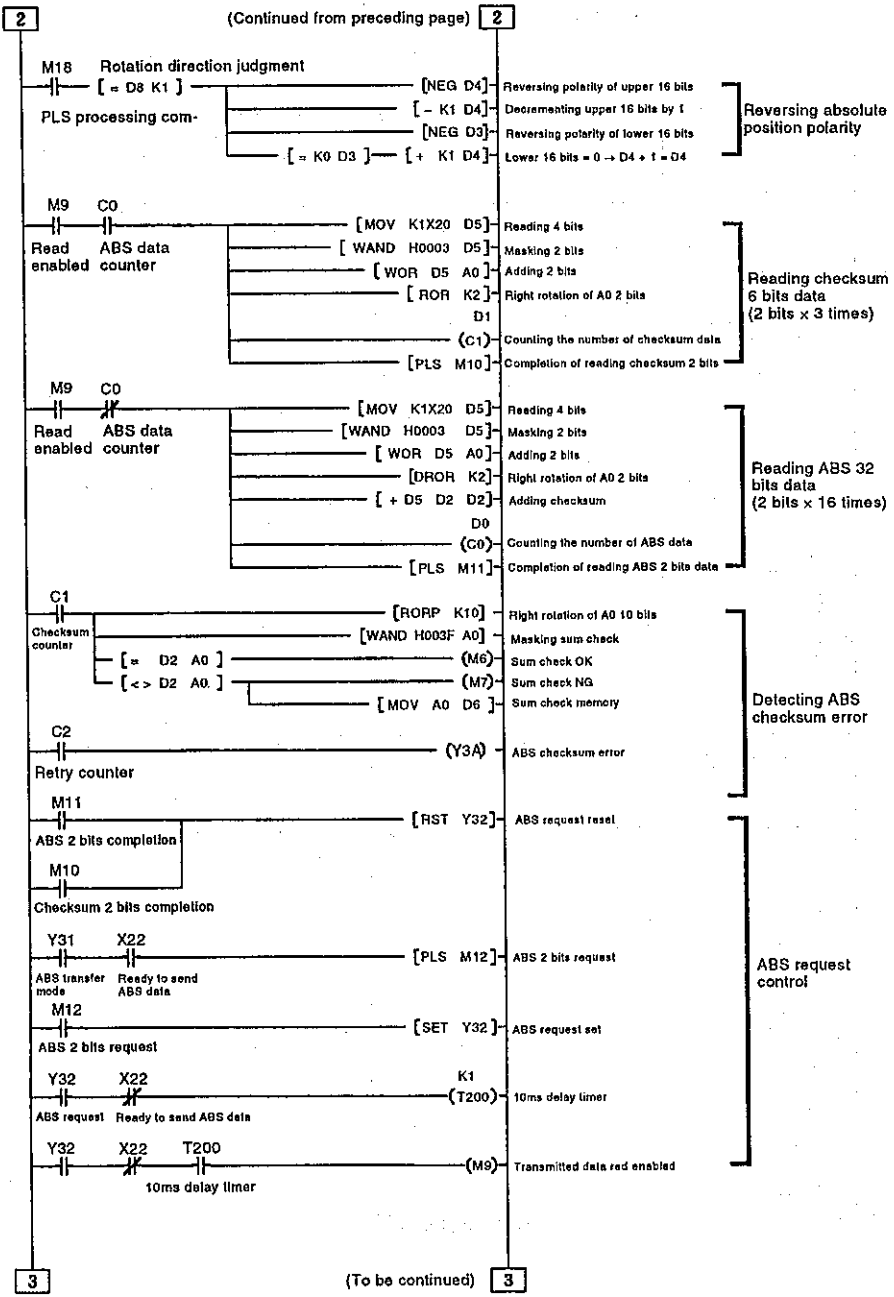
Item	mm				inch				degree				PULS
Unit setting	0				1				2				3
Travel per pulse	0.1	1	10	100	0.00001	0.0001	0.001	0.01	---				---
Unit of travel	μm/PLS				inch/PLS or degree/PLS								PLS
Constant K for conversion into unit of travel	1	10	100	1000	1	10	100	1000	None				

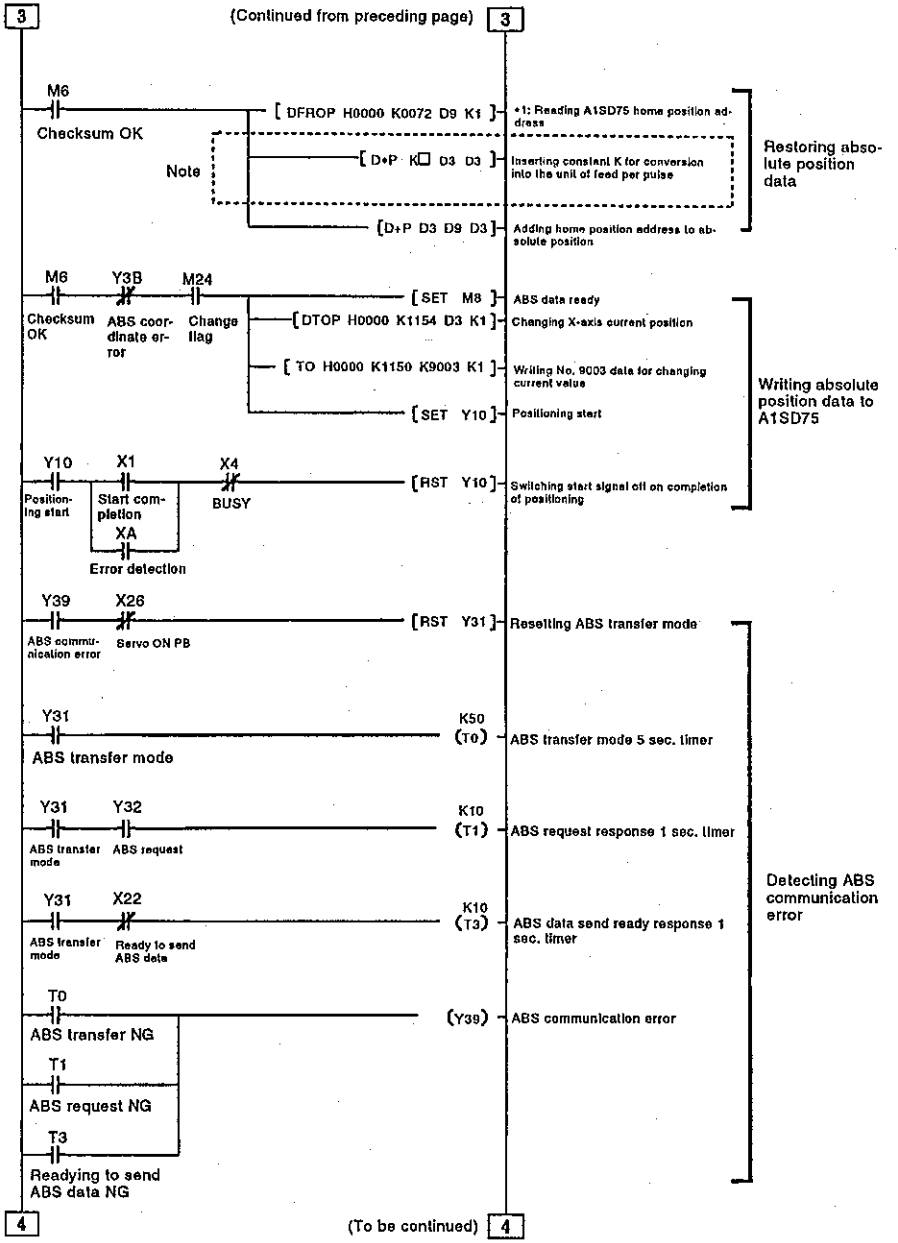
Reference

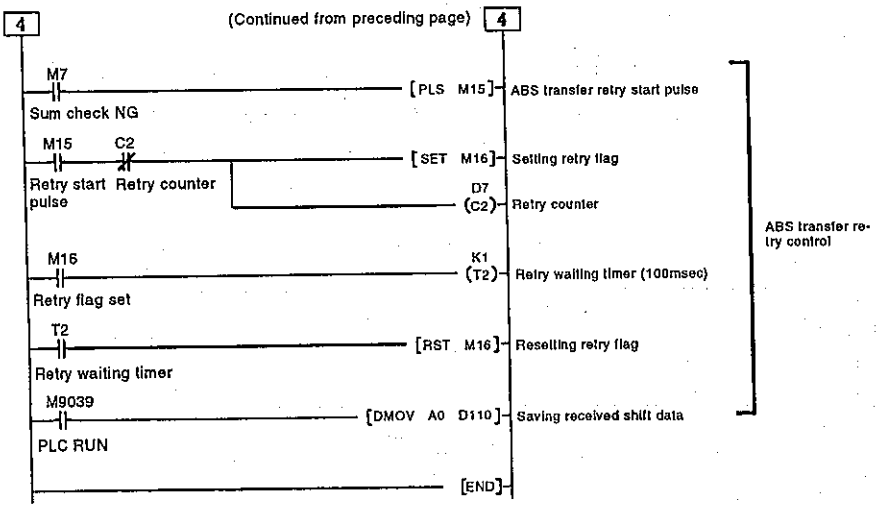
- For 1μm/PLS, set constant K to 10.
- For 5μm/PLS, set constant K to 50.
- The additional program is not required for the unit setting of PLS.




1
(Continued from preceding page)
1
M13
Servo ON request
[PLS M17]
Setting retry flag
ABS transfer retry control
M17
Retry flag reset request
[RST C2]
Resetting retry counter
X24
Error reset PB
M14
Error flag
(Y33)
Alarm reset output
Y33
Alarm reset
X25
Emergency stop PB
X23
Servo alarm
(M14)
Error flag output
[RST M8]
Resetting ready
[RST M13]
Resetting servo ON request
(Y38)
Servo alarm
Servo alarm detection, alarm reset control
M5
ABS data transfer start
[MOV K16 D0]
Initializing ABS data transmission counter
[MOV K3 D1]
Initializing checksum transmission counter
[MOV K0 D2]
Initializing checksum register
[MOV K0 D5]
Initializing ABS data register
[DMOV K0 D9]
Initializing ABS data register
[DMOV K0 A0]
Initializing ABS data register
[RST Y3B]
Resetting ABS coordinate error
[RST C0]
Resetting ABS transmission counter
[RST C1]
Resetting checksum transmission counter
ABS transfer mode initial setting
M5
ABS data transfer start
(Y31)
ABS transfer mode
Y31
ABS transfer mode
C1
Checksum counter
ABS transfer mode control
C0
Counter
C1
Sum counter
Y31
ABS transfer mode
[DMOVP A0 D3]
Saving ABS 32 bit data
[MOVP K0 A0]
Clearing register
[FROMP H0000 K5 D8 K1]
*1: Reading X-axis rotation direction parameter
[WAND H0001 D8]
Masking rotation direction parameter
[WAND H8000 A1]
Masking ABS data sign
[PLS M18]
PLS processing command
Absolute position polarity, A1SD75 rotation direction setting detection
2
(To be continued)
2

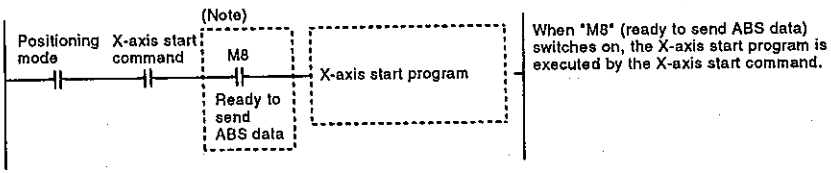

2
(Continued from preceding page)
2
M18
Rotation direction judgment
[= D8 K1]
PLS processing com-
[NEG D4]
Reversing polarity of upper 16 bits
[- K1 D4]
Decrementing upper 16 bits by 1
[NEG D3]
Reversing polarity of lower 16 bits
[= K0 D3]
[+ K1 D4]
Lower 16 bits = 0 → D4 + 1 = D4
Reversing absolute position polarity
M9
C0
Read enabled
ABS data counter
[MOV K1X20 D5]
Reading 4 bits
[WAND H0003 D5]
Masking 2 bits
[WOR D5 A0]
Adding 2 bits
[ROR K2]
Right rotation of A0 2 bits
D1
(C1)
Counting the number of checksum data
[PLS M10]
Completion of reading checksum 2 bits
Reading checksum 6 bits data (2 bits x 3 times)
M9
C0
Read enabled
ABS data counter
[MOV K1X20 D5]
Reading 4 bits
[WAND H0003 D5]
Masking 2 bits
[WOR D5 A0]
Adding 2 bits
[DROR K2]
Right rotation of A0 2 bits
[+ D5 D2 D2]
Adding checksum
D0
(C0)
Counting the number of ABS data
[PLS M11]
Completion of reading ABS 2 bits data
Reading ABS 32 bits data (2 bits x 16 times)
C1
Checksum counter
[RORP K10]
Right rotation of A0 10 bits
[WAND H003F A0]
Masking sum check
[= D2 A0]
(M6)
Sum check OK
[<> D2 A0]
(M7)
Sum check NG
[MOV A0 D6]
Sum check memory
C2
(Y3A)
ABS checksum error
Retry counter
Detecting ABS checksum error
M11
ABS 2 bits completion
M10
Checksum 2 bits completion
[RST Y32]
ABS request reset
Y31
ABS transfer mode
X22
Ready to send ABS data
[PLS M12]
ABS 2 bits request
M12
ABS 2 bits request
[SET Y32]
ABS request set
Y32
ABS request
X22
Ready to send ABS data
K1
(T200)
10ms delay timer
Y32
X22
T200
10ms delay timer
(M9)
Transmitted data red enabled
ABS request control
3
(To be continued)
3


3
(Continued from preceding page)
3
M6
Checksum OK
[DFROP H0000 K0072 D9 K1]
*1: Reading A1SD75 home position address
Note
[D*P K□ D3 D3]
Inserting constant K for conversion into the unit of feed per pulse
[D+P D3 D9 D3]
Adding home position address to absolute position
Restoring absolute position data
M6
Checksum OK
Y3B
ABS coordinate error
M24
Change flag
[SET M8]
ABS data ready
[DTOP H0000 K1154 D3 K1]
Changing X-axis current position
[TO H0000 K1150 K9003 K1]
Writing No. 9003 data for changing current value
[SET Y10]
Positioning start
Writing absolute position data to A1SD75
Y10
Positioning start
X1
Start completion
XA
Error detection
X4
BUSY
[RST Y10]
Switching start signal off on completion of positioning
Y39
ABS communication error
X26
Servo ON PB
[RST Y31]
Resetting ABS transfer mode
Y31
ABS transfer mode
K50
(T0)
ABS transfer mode 5 sec. timer
Y31
ABS transfer mode
Y32
ABS request
K10
(T1)
ABS request response 1 sec. timer
Y31
ABS transfer mode
X22
Ready to send ABS data
K10
(T3)
ABS data send ready response 1 sec. timer
Detecting ABS communication error
T0
ABS transfer NG
T1
ABS request NG
T3
Readying to send ABS data NG
(Y39)
ABS communication error
4
(To be continued)
4



Note: When the unit setting parameter value of the AD75 positioning module is changed from 3 (PULS) to 0 (mm), the unit is 0.1μm. To set the unit to 1μm, for example, add the program enclosed in the broken line (Note) above to multiple the feed command value by 10.

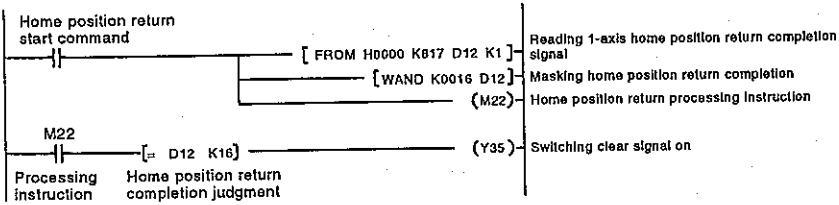
■ X-axis start program example



Note: Do not execute the X-axis start program while "M8" (ready to send ABS data) is off.

■ Dog type home position return program

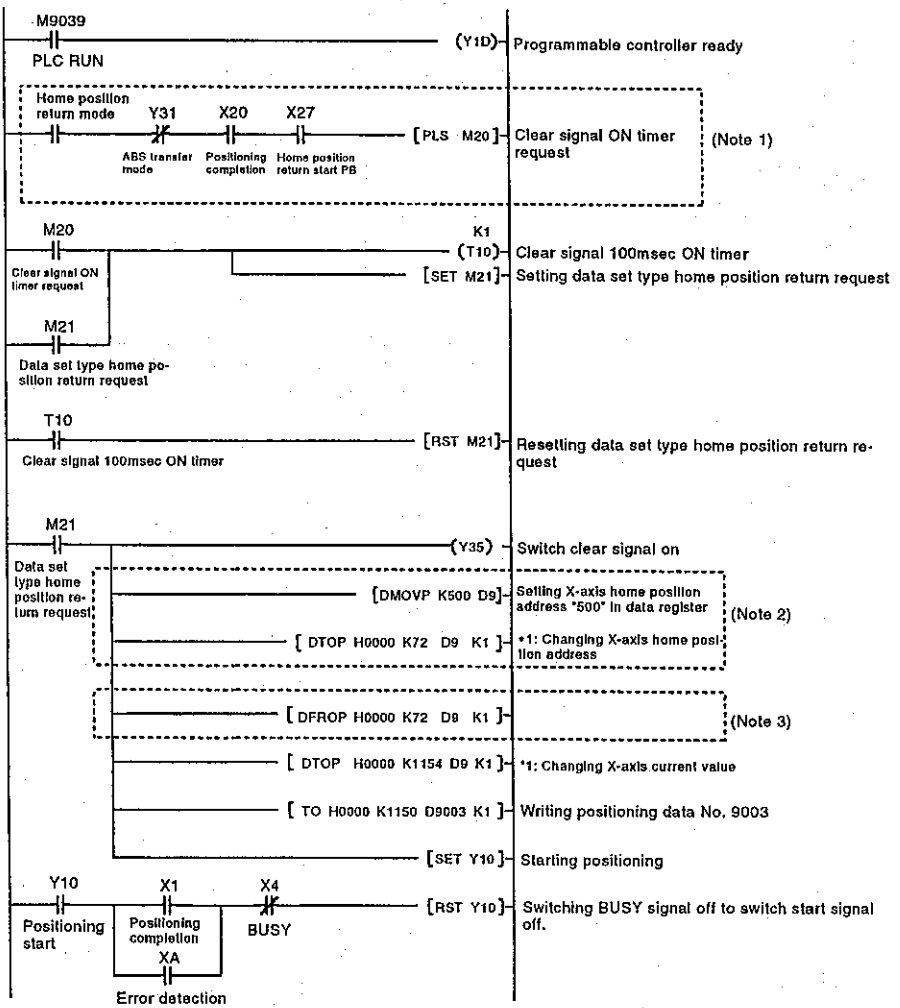
Refer to the home position return program in the A1SD75 User's Manual. This program requires a program which outputs the clear signal (Y35) after completion of home position return. Add the following program:



■ Data set type home position return program for X axis

[Example]
After jogging the machine to the position where the home position is to be set, select the home position return mode and press the home position return start pushbutton switch to set the home position. The home position address should be "500".

- Switch power on, then perform jog operation or the like to run the motor more than one revolution before starting home position return.



Note 1: Do not switch on the clear signal (Y35) for any other operation than home position return. To do so will cause a position shift.
2: If the data of the home position address parameter is not written from the A7PHP programming tool or the like before starting the data set type home position return program, the ladder (Note 2) is required and the ladder (Note 3) is not required.
3: Contrary to above 2, if the home position address is written in the home position address parameter, the ladder (Note 2) is not required but the ladder (Note 3) is required.

■ Electromagnetic brake output program

[Example]
To create the electromagnetic brake control signal

[Conditions]

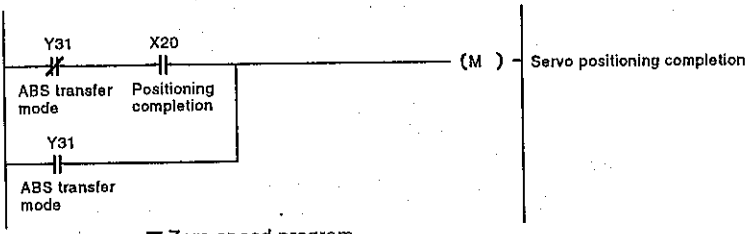
(1) While the ABS data is being transmitted (for several seconds after the servo-on signal has changed from OFF to ON), the motor should be at a stop.

(2) "1□1□" (electromagnetic brake output selection) should be set in parameter No. 1 of the servo amplifier.

■ Positioning completion program

[Example]
To create the status information for servo positioning completion.

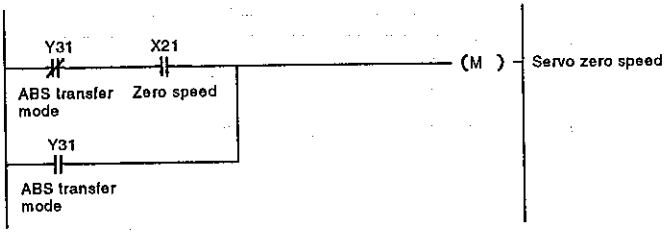
[Condition]
While the ABS data is being transmitted (for several seconds after the servo-on signal has changed from OFF to ON), the motor should be at a stop.



■ Zero speed program

[Example]
To create the status information for servo zero speed.

[Condition]
While the ABS data is being transmitted (for several seconds after the servo-on signal has changed from OFF to ON), the motor should be at a stop.

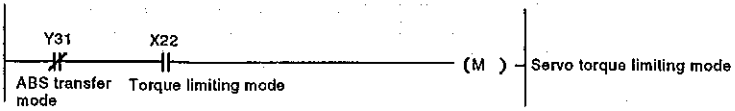


6

■ Torque limiting mode program

[Example]
To create the status information for the servo torque limiting mode.

[Condition]
While the ABS data is being transmitted (for several seconds after the servo-on signal has changed from OFF to ON), the torque limiting mode should be off.



6.3.3 ABS sequence program example - 2-axis control

■ ABS sequence program for Y axis

[Example]
Correct the X-axis ABS sequence program given in the preceding section, and arrange the X- and Y-axis programs in series for use as a program for 2-axis control.

[Procedure]
Make corrections to the X-axis ABS sequence program to create a Y-axis program.

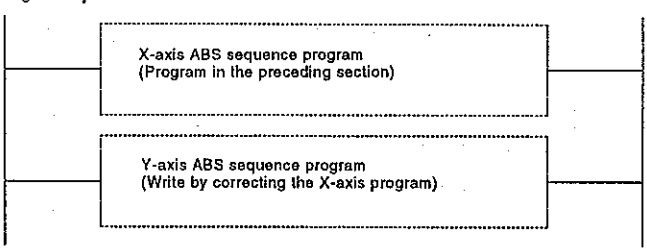
(1) Reallocate the X input contacts and Y output coils to match the Y axis.

(2) Allocate the D registers, M contacts, T timers and C counters so that those of the X axis are not repeated.

(3) Change the instructions marked *1 (A1SD75P2 buffer memory addresses) in the program of the preceding section (X-axis program) as indicated below to use the program for the Y axis.

[FROMP	H0000	K5	D8	K1] →	[FROMP	H0000	K155	D8	K1]
[DFROP	H0000	K72	D9	K1] →	[DFROP	H0000	K222	D9	K1]
[DTOP	H0000	K1154	D3	K1] →	[DTOP	H0000	K1204	D3	K1]
[TO	H0000	K1150	K9003	K1] →	[TO	H0000	K1200	K9003	K1]

[Program configuration]



■ Data set type home position return program for Y axis

[Example]
Correct the X-axis data set type home position return program given in the preceding section, and arrange the X- and Y-axis programs in series for use as a program for 2-axis control.

[Procedure]
Make corrections to the X-axis data set type home position return program to create a Y-axis program.

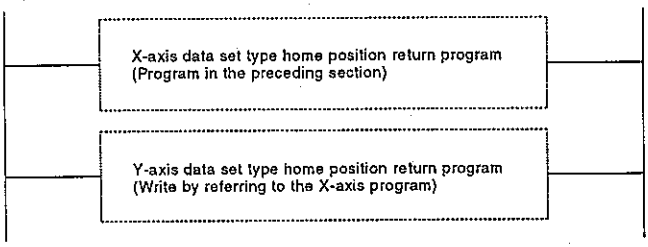
(1) Reallocate the X input contacts and Y output coils to match the Y axis.

(2) Allocate the D registers, M contacts and T timers so that those of the X axis are not repeated.

(3) Change the instructions marked *1 (A1SD71 buffer memory addresses) in the program of the preceding section (X-axis data set type home position return program) as indicated below to use the program for the Y axis.

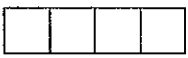
[DTOP	H0000	K72	D9	K1]→	[DTOP	H0000	K222	D9	K1]
[DTOP	H0000	K1154	D9	K1]→	[DTOP	H0000	K1204	D9	K1]
[TO	H0000	K1150	K9003	K1]→	[TO	H0000	K1200	K9003	K1]

[Program configuration]



7. START-UP/MAINTENANCE

7.1 Parameter setting for the absolute position detection system

Category	No.	Symbol	Name and function	Control Mode	Initial value	Unit	Setting range
Basic parameter	1	*OP1	Function selection 1: Select the servo type option.  Absolute position selection 0: Invalid 1: Valid		0000		0000 to 1012

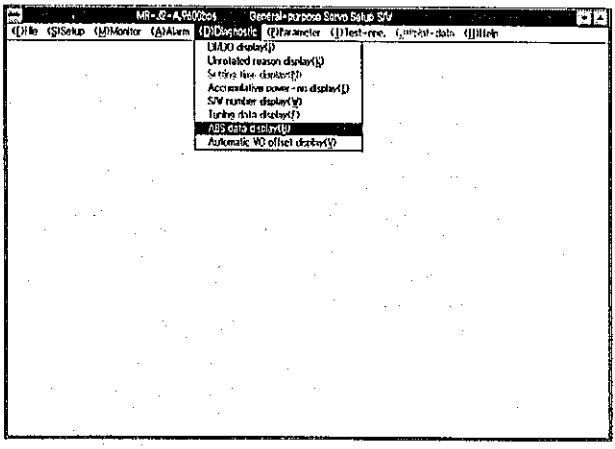
For the setting of the other parameters, refer to the MR-J2-A Specifications and Installation Guide IB(NA)67286.

7.2 Checking the absolute position data

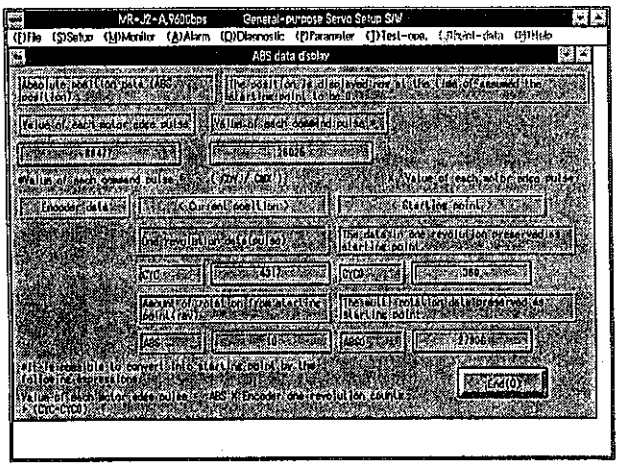
The absolute position data can be checked by using the Set-Up Software (MRZJW3-SETUP31E or later) in the following procedure:

Operation procedure

(1) Select "(D) Diagnostic" to display the sub menu.



(2) Select "ABS data display (B)" in the sub menu to call the ABS data display window.



(3) Press the END (Q) button to terminate the ABS data display window.

7.3 Start-up procedure for absolute position detection system

(1) Installing the battery
Refer to Section 2.2, item (2) Battery for retaining absolute position data.

(2) Setting the parameters
Set "1" at the leftmost digit of servo amplifier parameter No. 1 (1□□□: absolute position detection valid). After that turn OFF the power and then turn it back ON.

(3) Clearing the absolute position lost alarm (A.25)
When the power is first turned ON after connecting the encoder cable, the absolute position lost alarm (A.25) is generated. Leave the system in this state for several minutes and then turn OFF the power. Turn ON the power again; the alarm state will be cleared.

(4) Checking the transmission of absolute position data
When the servo ON pushbutton switch is pressed, the absolute position data is transmitted to the programmable controller. Use the following procedure to check whether the absolute position data has been transmitted correctly or not.
If the ABS data is transmitted correctly,

1) The ready signal (RD) comes ON,
2) At the programmable controller, the "ready to send" contact (M3 of A1SD71, M99 for 1PG) is turned ON,
3) The value shown on the ABS data display window of the Set-Up Software (refer to Section 7.2) matches the value in the ABS data registers (D3 and D4 for the A1SD71, D106 and D107 for the 1PG) of the programmable controller. (When the home position address is 0.)

If the ABS time-out warning (A.E5) or other data transfer error is generated in the programmable controller, take appropriate corrective action by referring to Section 8.2.

(5) Setting the home position
With the absolute position detection system, the coordinate system used for determining the position data is established when the home position is set in the system set-up operation. If positioning is executed before the home position has been set the motor will run uncontrollably and this will be dangerous. Always set the home position before starting operation. Home position setting is necessary in the following cases as well as when setting up the system.

Cases in which home position setting is necessary

- Setting up the system
- When the control PCB in the servo amplifier is replaced or the servo amplifier is replaced.
- When the motor or the ABS encoder is replaced.
- When the absolute position lost alarm (AL25) is occurred.

For details of the methods for setting the home position, refer to Chapter 4.

7.4 Maintenance and inspection

(1) Battery maintenance
The service life of the battery is 5 years or longer. However, it is advisable to replace the battery every 3 or 4 years. If the battery alarm (A.9F) is occurs, replace the battery immediately.

(2) Replacing the battery

1) Turn OFF the power supply to the amplifier.
2) Remove the battery. Follow the procedure described in Section 2.2, item (2) Battery for retaining absolute position data, in reverse order.
3) Install a new battery. Install the new battery within 1 hour after removal of the old one.
4) Turn ON the power to the servo amplifier and check if the absolute position lost alarm (A.25) has occurred. If the alarm has occurred, clear it and set the home position.

8. TROUBLESHOOTING

When the absolute position detection function is used, the following alarm and warning codes are added to those provided for the standard functions.

8.1 ABS error

Display	Alarm code screen			Name	Definition	Cause	Corrective action
	Pin CN1B19	Pin CN1A18	Pin CN1A19				
A.25	1	1	0	Absolute position lost	Absolute position data in error	1. Voltage of super capacitor in encoder is low (Set-Up start-up).	Leave the system in the alarm state for a few minutes with power on. After that, switch power off once, then on again. Make home position return again.
						2. Battery voltage is low.	Change battery. Make home position return again.
						3. Battery cable or battery is faulty.	
A.92				Battery cable breakage warning	Voltage of absolute position detection system battery dropped.	1. Battery cable is broken.	Repair cable or change battery.
						2. Battery voltage dropped to 2.8V or less.	Change battery.
A.96				Home position setting error warning	Home position return could not be made.	1. Command pulses were entered after droop pulse clearance.	1. Make provisions so that command pulses are not entered after clearance.
						2. Reduce creep speed for home position return operation.	2. The number of remaining droop pulses is larger than the in-position range set value.
A.9F				Battery warning	Voltage of absolute position detection system battery dropped.	Battery voltage dropped to 3.2V or less.	Change battery.
A.E3				Absolute position counter warning	Pulses of absolute position encoder are faulty	1. Noise entered encoder.	Take action against noise.
						2. Encoder is faulty.	Change servo motor.
A.E5				ABS time-out warning	Absolute position data transfer fault	1. PLC ladder program error	Correct program.
						2. Mis-wiring of pin CN1B-9/CN1B-6	Connect correctly.
A.EA				ABS servo ON warning	Servo ON (SON) signal was switched on within 1 sec. after system had gone into absolute position data transfer mode.	1. PLC ladder program error	Correct program.
						2. SON signal mis-wiring	Connect correctly.

8.2 ABS data transfer error

The error check of the PC ladder program operates in the following conditions. If an error is detected, check the nature of the error, locate the cause and take appropriate action.

■ Cause of ABS data transfer error and corrective action

Error item	Output coil		Cause of actuation	Cause of error	Inspection	Corrective action
	AD71	1PG				
ABS communication error	Y49	Y11	• The ABS data transfer mode signal (Y41) is not completed within 5 seconds. • The ready to send signal (X32) is not turned OFF within 1 second after the ABS data request signal (Y42) is turned ON. • The ready to send signal (X32) remains OFF for longer than 1 second	1) Wiring for the control signal (ABS transfer mode signal, ABS data request signal, or ready to send signal) is disconnected or connected to the SG terminal. 2) PC ladder program error 3) Defective input or output module 4) Defective PCB in the servo amplifier 5) Power supply to the servo amplifier is OFF.	• Check the wiring for continuity. • Check the PC ladder program. • Replace the input or output module. • Replace the servo amplifier. • Turn on the power to the servo amplifier.	• Correct the wiring. • Corrent the program • Replace the input or output module. • Replace the amplifier. • Turn ON the power to the servo amplifier.
ABS data check sum error	Y4A	Y12	• Discrepancy in sum check occurred four times consecutively.	1) Wiring for the ABS data signal (ABS bit 0 (DO1), bit 1 (ZSP)) is disconnected or connected to the SG terminal. 2) PC ladder program error 3) Defective input module 4) Defective PCB in the servo amplifier	• Check the wiring for continuity. • Check the PC ladder program. • Replace the input module. • Replace the servo amplifier.	• Correct the wiring. • Correct the program. • Replace the input or output module. • Replace the amplifier.
ABS coordinate error	Y4B	-	• The motor position is in the negative coordinate value range when the servo is turned ON or when power supply is turned ON.	1) The servo is turned ON or the power supply is turned ON near the machine home position or in the zone in which addresses decrease. 2) The machine falls on a vertical axis when the servo signal is turned ON/OFF.	• Turn ON the servo at a point more than one motor shaft revolution away from the machine home position in the range in which addresses increase. • Change the electromagnetic brake operation sequence (brake ON/OFF time).	• Reconsider the position where the servo is turned ON. • Set the home position for positioning apart from the machine home position. • Change the electromagnetic brake operation sequence.
Servo alarm	Y48	Y10	Alarm relating to the servo amplifier, or emergency stop, is turned ON.	Refer to: ABS error in Section 8.1 and the Specifications and Installation Guide supplied to the amplifier Alarms and warnings in Section 8.2		

Note: The output coil numbers and input contact numbers indicated in ( ) above correspond to the numbers for A1SD71 (AD71).

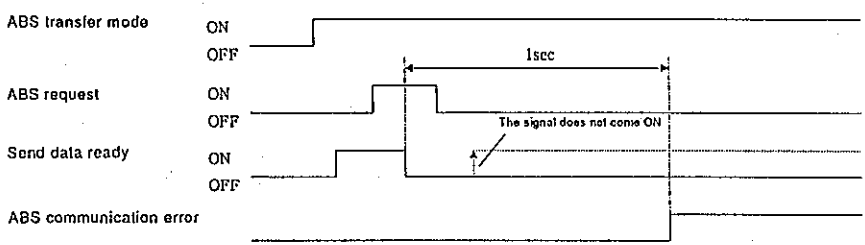
■ Error clearing conditions

Error	Output coil		Cause of actuation	Error clearing conditions	Servo operating conditions
	A1SD71	1PG			
ABS communication error	Y49	Y11	• The ABS data transfer mode signal (Y41) is not completed within 5 seconds. • The send data ready signal (X32) is not turned OFF within 1 second after the ABS data request signal (Y42) is turned ON. • The ready to send signal (X32) remains OFF for longer than 1 second.	Turn OFF the servo ON PB signal (X36).	Ready signal (RD) is OFF. Note 1
ABS check sum error	Y4A	Y12	• Discrepancy in sum check occurred four times consecutively.	AD71: The error state is cleared when the servo ON PB signal (X36) change from OFF to ON. 1PG: The error status is cleared when the servo ON PB signal is turned OFF.	Ready signal (RD) is ON.
ABS coordinate error	Y4B	–	• The motor position is in the negative coordinate value range when the servo is turned ON or when the power supply is turned ON.	After moving the machine to positive coordinate value position in the JOG operation, turn OFF the servo ON signal and then turn it ON again.	Ready signal (RD) is ON.
Servo alarm	Y48	Y10	Alarm relating to the servo amplifier	The error status is cleared when the alarm reset pushbutton switch is pressed or the power supply is turned OFF and then back ON.	Ready signal (RD) is OFF.

Note 1: To move the machine to a safe position before recovering machine operation, change the parameter setting for the absolute position detection mode (servo parameter No. 1) from "1□□□" (valid) to → 0□□□". In this setting, move the machine in the JOG mode.

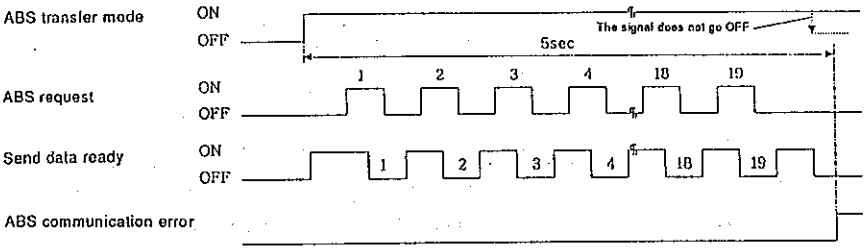
2: Details of the ABS communication alarm are given below.

1) The OFF period of the send data ready signal output from the servo amplifier is checked. If the OFF period is 1 second or longer, this is regarded as a transfer fault and the ABS communication error is generated.
This error is generated if the ABS time-out warning (A.E5) is generated at the servo amplifier due to an ABS request time time-out.

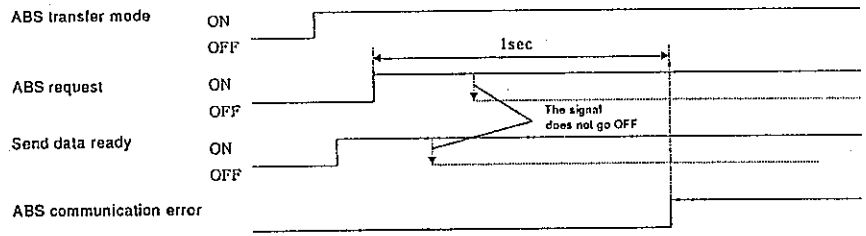


■ Error clearing conditions

2) The time required for the ABS transfer mode signal to go OFF after it has been turned ON (ABS transfer time) is checked. If the ABS transfer time is longer than 5 seconds, this is regarded as a transfer fault and the ABS communication error is generated. This error is generated if the ABS time-out warning (A.E5) is generated at the servo amplifier due to an ABS transfer mode completion time time-out.



3) To detect the ABS time-out warning (A.E5) at the servo amplifier, the time required for the ABS request signal to go OFF after it has been turned ON (ABS request time) is checked. If the ABS request remains ON for longer than 1 second, it is regarded that an fault relating to the ABS request signal or the send data ready signal has occurred, and the ABS communication error is generated.
This error is generated if the ABS time-out warning (A.E5) is generated at the servo amplifier due to an ABS request OFF time time-out.



8.3 Processing of absolute position data at detection of forward/reverse rotation stroke end

When a stroke end (LSP or LSN) is detected, the MR-J2 amplifier used with the A1SD71 (AD71) positioning module stops accepting the command pulse, and at the same time, clears the deviation counter value (droop) to zero to bring the servo motor shaft to an immediate stop. At this time, the programmable controller keeps outputting the command pulse.Since this causes a discrepancy between the absolute position data of the servo amplifier and the programmbale controller, a difference will occur between the position data of the servo amplifier and that of the programmable controller. To prevent this difference in position data from occurring, do as described below. When the servo amplifier has detected the stroke end, perform jog operation or the like to clear the stroke end. After that, switch the servo ON signal off once, then on again, or switch the power off once, then on again. This causes the absolute position data of the servo amplifier to be transferred to the programmable controller, restoring the normal data.

REVISIONS

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

Print Date	*Manual Number	Revision
Sep., 1996	IB (NA) 67309-A	First edition Translated from IB-67308-A
Sep., 1997	IB (NA) 67309-B	Section 4-1: Note 3 changed. Section 4-2: Note 4 changed. Section 6-1-1: Connection diagram changed. "COM1" and "COM2" of A1SY40 connected to "+24V". Section 6-3-3: Y-axis data setting type home position return program changed. Revised to conform to IB-67308-B.
Nov., 1997	IB (NA) 67309-C	Section 6-2-2: MR-J2-A clear signal (CR) pin number corrected. Section 6-3-2: Dog type home position return program corrected. Translated from IB-67308-D

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE:MITSUBISHI DENKI BLDG MARUNOUCHI TOKYO 100-8310

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