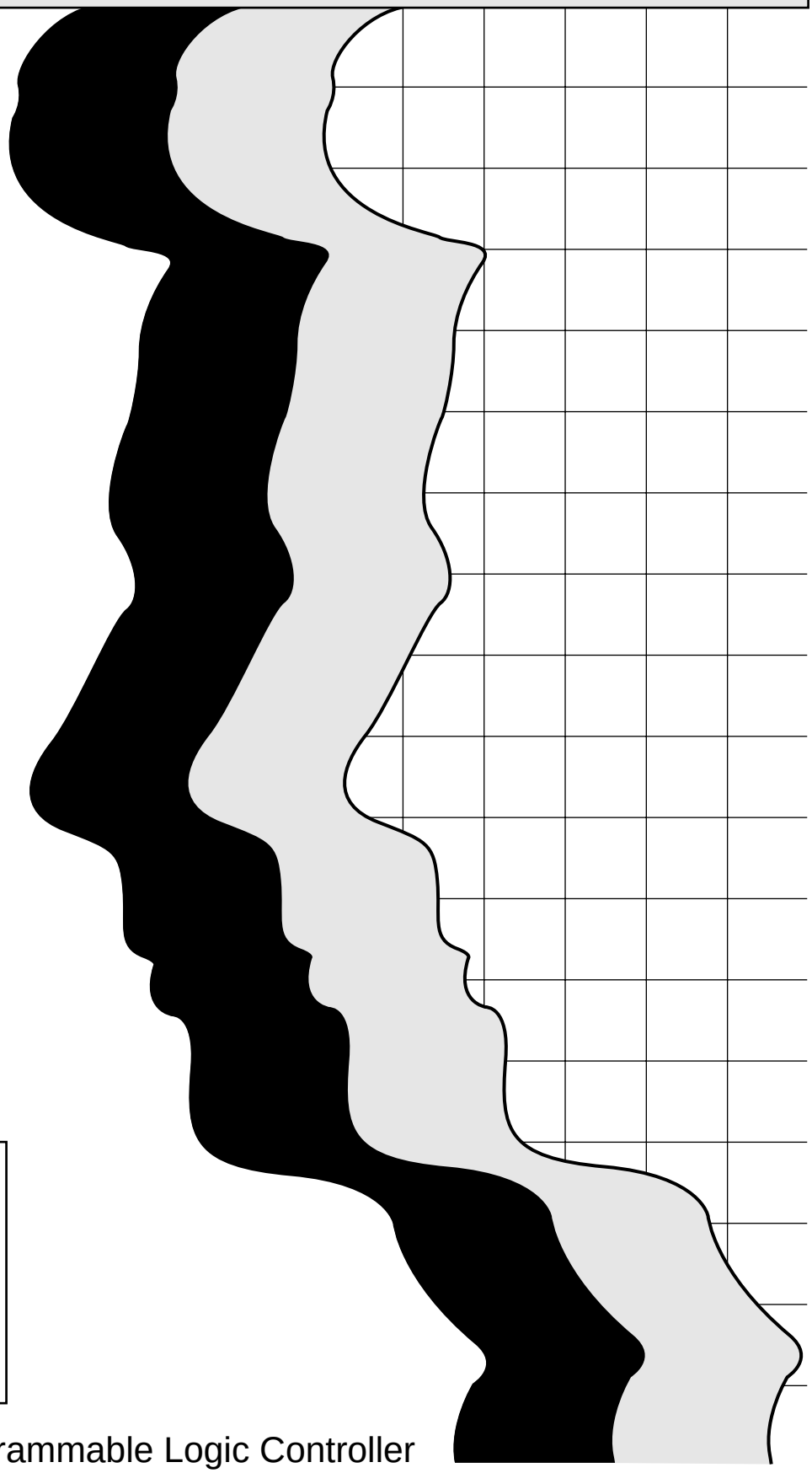
MITSUBISHI

High Speed Counter Module Type AD61-S1

User's Manual



A

MELSEC

Mitsubishi Programmable Logic Controller

• SAFETY PRECAUTIONS •

(Always read before starting use.)

Before using this product, please read this manual introduced in this manual carefully and pay full attention to safety to handle the product correctly.
The instructions given in this manual are concerned with this product. For the safety instructions of the programmable controller system, please read the User's Manual for the CPU module to use.
In this manual, the safety instructions are ranked as "DANGER" and "CAUTION".

⚠ DANGER	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 personal injury or physical damage.

Note that the ⚠CAUTION level may lead to a serious consequence according to the circumstances. Always follow the instructions of both levels because they are important to personal safety.

Please store this manual in a safe place and make it accessible when required. Always forward it to the end user.

[Cautions on Design]

DANGER

- An external output transistor failure may keep output ON or OFF. Add an external monitoring circuit for output signals whose incorrect exetution could result in serious accidents.

CAUTION

- Use the PLC in the environment indicated in the general specifications of the manual.
  Using this PLC in an environment outside the range of the general specifications may cause electric shock, fire, malfunction, and damage to or deterioration of the product.

- Do not install control lines or communication wires together with main circuit or power lines.
  Keep a distance of at least 100 mm, otherwise malfunctions may occur due to noise.

[Cautions on Mounting]

CAUTION

- Do not touch any conductive part of the module directly.
  Doing so may cause malfunction or failure in the module.

- Hold down the module loading lever at the module bottom, and securely insert the module fixing latch into the fixing hole in the base unit.
  Incorrect loading of the module can cause a malfunction, failure or drop.

[Cautions on Wiring]

⚠ CAUTION

- Ground the shield wire to the encoder (relay box).
  Otherwise, malfunctioning will result.
- Carry out wiring to the PLC correctly, checking the rated voltage and terminal arrangement of the product.
  Using a power supply that does not match the rated voltage, or carrying out wiring incorrectly, will cause fire or failure.
- Input voltage in excess of the voltage set by the setting pin will cause failures.
- Tighten the terminal screws to the specified torque.
  Loose screws will cause short circuits, fire, or malfunctions.
  Overtightening may cause a short circuit or malfunctions due to a damaged screw.
- Make sure that no foreign matter such as chips or wiring offcuts gets inside the module. It will cause fire, failure or malfunction.

[Cautions on Startup and Maintenance]

⚠ DANGER

- Do not touch terminals while the power is ON.
  Doing so may result in an electric shock or malfunction.
- Be sure to shut off all phases of the external power supply before cleaning or retightening the terminal screws.
  Failure to do so will cause failure or malfunction of the module.

⚠ CAUTION

- Do not disassemble or modify any module.
  This will cause failure, malfunction, injuries, or fire.
- Be sure to shut off all phases of the external power supply used by the system before mounting or removing the module.
  Failure to do so can cause failure or malfunction of the module.

[Cautions on Disposal]

⚠ CAUTION

- Dispose of this product as industrial waste.

REVISIONS

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

Print Date	*Manual Number	Revision
Nov., 1986	IB (NA) 66052-A	First edition
Jan., 1989	IB (NA) 66052-B	Correction CONTENTS, Page 2-1, 2-2, 3-1, 3-3, 3-4, 3-13, 4-2, 5-1, 5-2, 6-1, 6-2, 6-4, 6-6 "Instructions for Strategic Materials" added
Feb., 2004	IB (NA) 66052-C	Partial Correction SAFETY PRECAUTIONS, Chapter 1, Section 2.2, 2.3, 3.2.2, 3.5, 4.2, 5.2.2, 6.1, 6.2, Section 6.3, Chapter 8 Addition WARRANTY
Nov., 2004	IB (NA) 66052-D	Partial Correction SAFETY PRECAUTIONS, Section 3.1, 3.2, 4.1, Chapter 6, WARRANTY

Japanese Manual Version O

INTRODUCTION

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

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Conformation to the EMC Directive and Low Voltage Instruction

For details on making Mitsubishi PLC conform to the EMC directive and low voltage instruction when installing it in your product, please see Chapter 3, "EMC Directive and Low Voltage Instruction" of the User's Manual (Hardware) of the PLC CPU to use.

The CE logo is printed on the rating plate on the main body of the PLC that conforms to the EMC directive and low voltage instruction.

By making this product conform to the EMC directive and low voltage instruction, it is not necessary to make those steps individually.

MEMO

1. GENERAL DESCRIPTION

This manual describes the AD61 and AD61S1 high speed counter modules giving handling instructions and basic programming information. The AD61S1 allows counting pulses of long rise and fall times (more than 50μsec). (Unless otherwise specified, the AD61 and AD61S1 are referred to as "AD61".)
The AD61 high speed counter module is used in conjunction with MELSEC-A series programmable controllers.

POINT

In this manual, I/O signals to and from the programmable controller CPU are explained on the assumption that AD61 is loaded in No. 1 slot of the main base unless otherwise specified (except circuit example in the Appendix).

In the text of this User's Manual, the CPU model names are generically called as indicated below.

(1) PLC CPU
A1, A2, A2-S1, A3CPU(P21/R21)
A1N, A2N, A2N-S1, A3NCPU(P21/R21)
A2U, A2U-S1, A3U, A4UCPU
Q2A, Q2A-S1, Q3A, Q4ACPU
A3HCPU(P21/R21), A3MCPU(P21/R21)
A2C, A2CJCPU-S3
A1SJH, A1S(H), A2S(H)CPU
A2AS, A2ASCPU-S1
A2USH, A2USHCPU-S1
Q2AS(H), Q2AS(H)CPU-S1
A0J2(H)CPU(P23/R23)
K2ACPU

(2) Building block type CPU
A1, A2, A2-S1, A3CPU(P21/R21)
A1N, A2N, A2N-S1, A3NCPU(P21/R21)
A2U, A2U-S1, A3U, A4UCPU
Q2A, Q2A-S1, Q3A, Q4ACPU
A3HCPU(P21/R21), A3MCPU(P21/R21)
A2C, A2CJCPU-S3
A1SJH, A1S(H), A2S(H)CPU
A2AS, A2ASCPU-S1
A2USH, A2USHCPU-S1
Q2AS(H), Q2AS(H)CPU-S1
K2ACPU

(3) Compact type CPU
A0J2(H)CPU(P23/R23)

2. SYSTEM CONFIGURATION

2.1 General Description of System

A configuration example of an independent system is shown below. For the use of the AD61 in a data link system, refer to Section 2.2 "Applicable System."

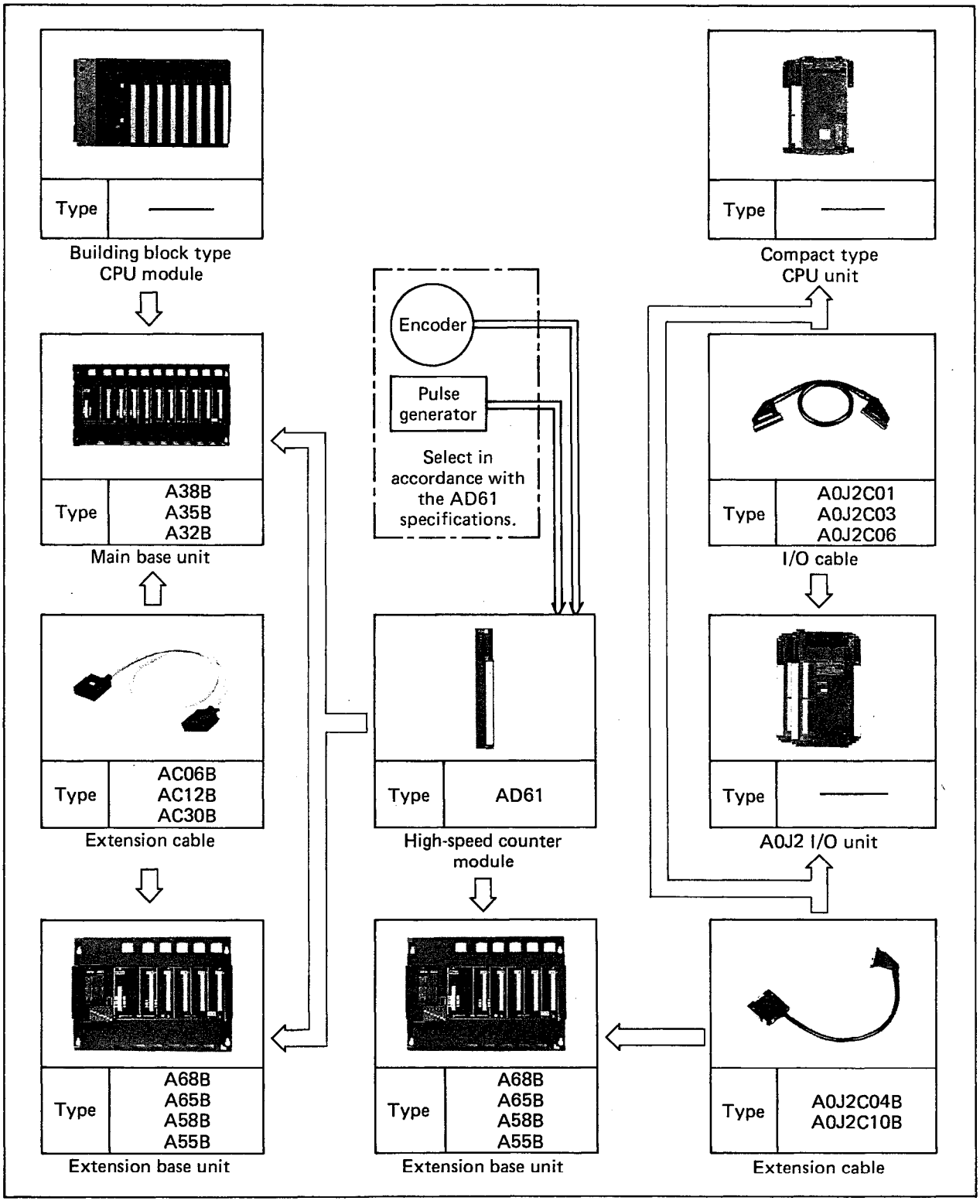


Fig. 2.1 Overall Configuration Diagram

IB (NA) 66052-B

2.2 Applicable System

(1) AD61 can be used with the following CPUs:

Applicable models	A1, A2, A2-S1, A3CPU(P21/R21) A1N, A2N, A2N-S1, A3NCPU(P21/R21) A2U, A2U-S1, A3U, A4UCPU Q2A, Q2A-S1, Q3A, Q4ACPU A3HCPU(P21/R21), A3MCPU(P21/R21) A2C, A2CJCPU-S3 A1SJH, A1S(H), A2S(H)CPU A2AS, A2ASCPU-S1 A2USH, A2USHCPU-S1 Q2AS(H), Q2AS(H)CPU-S1 A0J2(H)CPU(P23/R23) K2ACPU

(2) The AD61 can be loaded into any slot of a base unit with the exceptions given below:

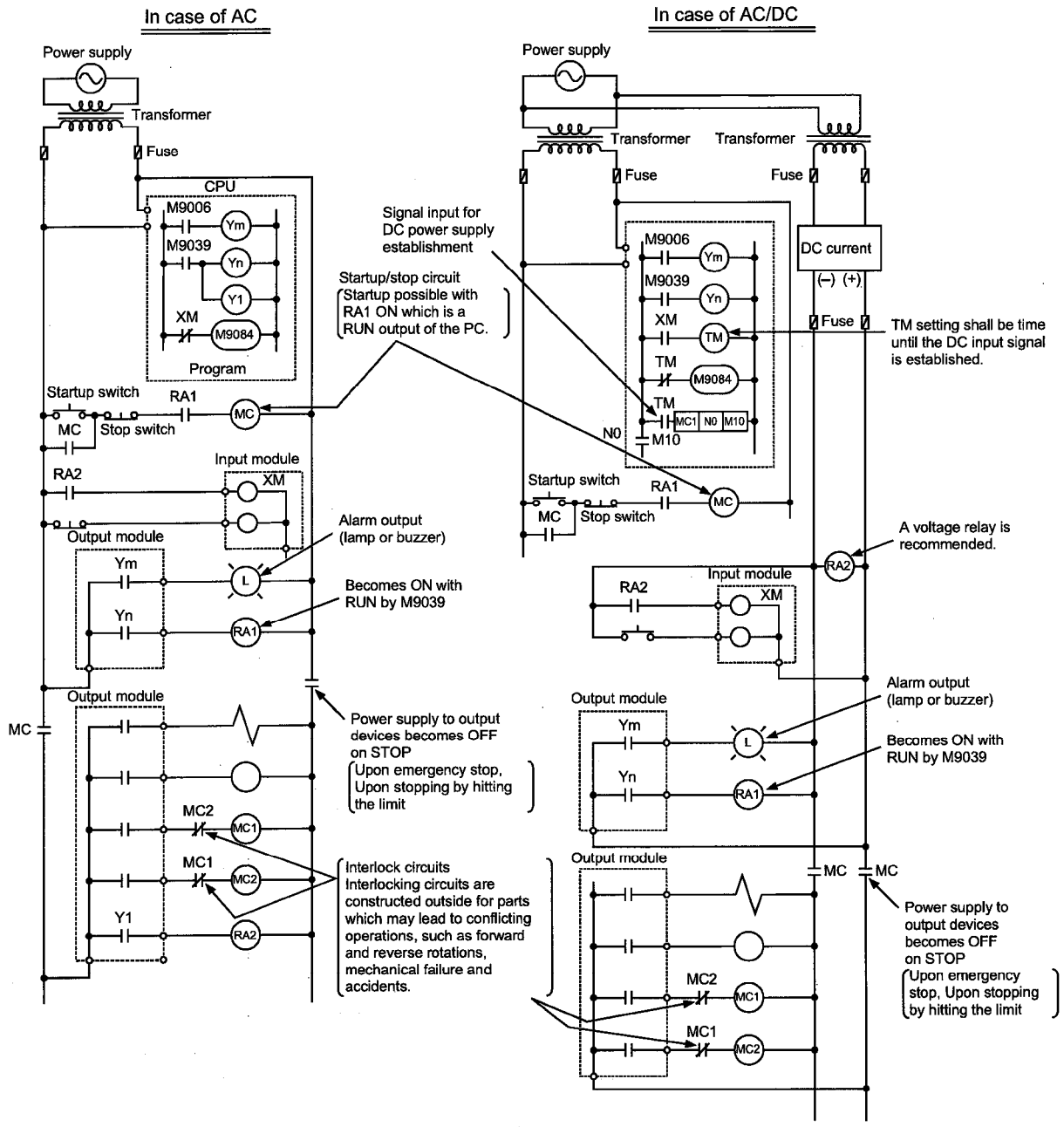
- If the AD61 is loaded into an extension base unit without a power supply module, care must be taken to ensure that the power capacity is sufficient.
  (For the selection of power supply module and extension cable, refer to Section 3.4 to 3.5 of the CPU User's Manual)
- For a data link system, the CPU must be of one of the following types.

Master station	A1, A2, A2-S1, A3CPU(P21/R21) A1N, A2N, A2N-S1, A3NCPU(P21/R21) A2U, A2U-S1, A3U, A4UCPU Q2A, Q2A-S1, Q3A, Q4ACPU A3HCPU(P21/R21), A3MCPU(P21/R21) A2C, A2CJCPU-S3 A1SJH, A1S(H), A2S(H)CPU A2AS, A2ASCPU-S1 A2USH, A2USHCPU-S1 Q2AS(H), Q2AS(H)CPU-S1 K2ACPU
Local station	A0J2(H)CPU(P23/R23)

2.3 Cautions for System Configuration

Take special care of the following points.
When the PC power is turned on or off, process output may not perform normal operation temporarily due to the difference between the delay time and rise time of the power of PC mainframe and the external power (especially DC) at the outputs. Also, in the event of external power supply failure or PC failure, the output process may perform abnormally.
In order to prevent the aforementioned abnormal operations and also from a failsafe viewpoint, program in precautions (such as an emergency stop circuit, a protection circuit, and an interlock circuit), against any abnormal operation which may lead to machine damage.
The following page shows an example of such precautions.

(1) Example of system circuit design



Startup procedure of power supply is as follows:

In case of AC

[1] Set CPU module to "RUN."
[2] Turn the power "ON."
[3] Set the start switch to "ON."
[4] Set the magnetic contactor (MC) "ON" to start driving drive output devices by a program.

In case of AC/DC

[1] Set CPU module to "RUN."
[2] Turn the power "ON."
[3] Set RA2 to "ON" when DC power supply is established.
[4] Set the timer (TM) to "ON" upon 100% establishment of DC power supply.
(Set value for TM shall be the period from RA2 turned "ON" to 100% establishment of DC power supply. Use the set value of 0.5s.)
[5] Set the start switch to "ON."
[6] Set the magnetic contactor (MC) "ON" to start driving drive output devices by a program.
(When a voltage relay is used for RA2, the timer in the program (TM) is not necessary.)

3. SPECIFICATIONS

This chapter describes the general specifications and performance specifications of the AD61.

3.1 General Specifications

The general specifications of AD61 are shown in Table 3.1.

<table>
<tr><th>Item</th><th colspan="6">Specifications</th></tr>
<tr><td>Operating ambient temperature</td><td colspan="6">0 to 55℃</td></tr>
<tr><td>Storage ambient temperature</td><td colspan="6">-20 to 75℃</td></tr>
<tr><td>Operating ambient humidity</td><td colspan="6">10 to 90%RH, non-condensing</td></tr>
<tr><td>Storage ambient humidity</td><td colspan="6">10 to 90%RH, non-condensing</td></tr>
<tr><td rowspan="5">Vibration resistance</td><td rowspan="5">Conforming to JIS B 3502, IEC 61131-2</td><td></td><td>Frequency</td><td>Acceleration</td><td>Amplitude</td><td>Sweep count</td></tr>
<tr><td rowspan="2">Under intermittent vibration</td><td>10 to 57 Hz</td><td>———</td><td>0.075 mm (0.003 in.)</td><td rowspan="4">10 times each in X, Y, Z directions (for 80 min.)</td></tr>
<tr><td>57 to 150 Hz</td><td>9.8m/s²</td><td>———</td></tr>
<tr><td rowspan="2">Under continuous vibration</td><td>10 to 57 Hz</td><td>———</td><td>0.035 mm (0.001 in.)</td></tr>
<tr><td>57 to 150 Hz</td><td>4.9m/s²</td><td>———</td></tr>
<tr><td>Shock resistance</td><td colspan="6">Conforming to JIS B 3502, IEC 61131-2 (147m/s², 3 times each in X, Y, Z directions)</td></tr>
<tr><td>Noise durability</td><td colspan="6">By noise simulator of 1500Vpp noise voltage, 1μs noise width and 25 to 60Hz noise frequency</td></tr>
<tr><td>Dielectric withstand voltage</td><td colspan="6">1500V AC for 1 minute across AC external terminals and ground</td></tr>
<tr><td>Insulation resistance</td><td colspan="6">5MΩ or larger by 500V DC insulation resistance tester across AC external terminals and ground</td></tr>
<tr><td>Operating ambiance</td><td colspan="6">No corrosive gas</td></tr>
<tr><td>Operating height *3</td><td colspan="6">2000 m (6562 ft.) max.</td></tr>
<tr><td>Installation location</td><td colspan="6">Inside the control panel</td></tr>
<tr><td>Overvoltage categry *1</td><td colspan="6">II or less</td></tr>
<tr><td>Pollution rate *2</td><td colspan="6">2 or less</td></tr>
<tr><td>Cooling method</td><td colspan="6">Self-cooling</td></tr>
</table>

Table 3.1 General Specifications

*1: Indicates the distribution area where the device is assumed to be connected, from the public power distribution network to the local machine device.
Category II is applied to the devices to which the power is supplied from a fixed equipment.
The surge resistace voltage of a rated 300 V device is 2500 V.

*2: This is an index which Indicates the occurrence rate of the conductive object in the anvironment where the device is used.
Pollution rate II indicates that only non-conductive pollution may occur with a possiblity of generating temporary conductivity due to accidental condensation.

*3: Do not use or store the PLC under pressure higher than the atmospheric pressure of altitude 0m.
Doing so can cause a malfunction.
When using the PLC under pressure, please contact your sales representative.

3.2 Performance Specifications

The AD61 is used to count pulses which are occuring at a frequency too high for the CPU counters to use. The AD61 counts independently of the CPU.

3.2.1 Performance list

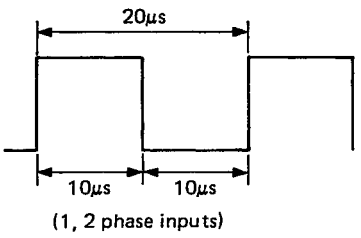
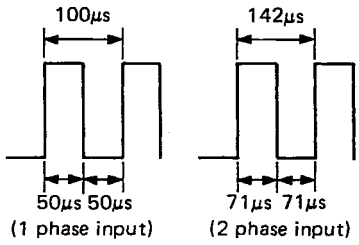
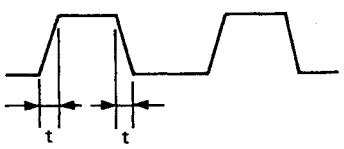
Item			Specifications	
			AD61	AD61S1
I/O points			32 points	
Number of channels			2 channels	
Performance specifications of 1 channel	Count input signal	Phase	1 phase input, 2 phase input	
		Signal level (Phase A, Phase B)	5V DC 12V DC 24V DC } 2 to 5mA	
	Counter	Counting speed *(Maximum)	1 phase input: 50KPPS 2 phase input: 50KPPS	1 phase input: 10KPPS 2 phase input: 7KPPS
		Counting range	24 bits binary 0 to 16,777,215 (decimal)	
		Form	Up/down preset counter plus ring counter function	
		Minimum count pulse width Set input rise and fall times to 5μs. or less. Duty ratio: 50%	 (1, 2 phase inputs)	 (1 phase input) (2 phase input)
	Magnitude comparison between CPU and AD61	Comparison range	24 bits, binary	
		Comparison result	Set value < count value Set value = count value Set value > count value	
	External input	Preset	12/24V DC, 3/6mA 5V DC, 5mA	
		Count disable	12/24V DC, 3/6mA 5V DC, 5mA	
	External output	Coincidence output	Transistor (open collector) output 12/24V DC, 0.5A	
Current consumption			5V DC, 0.3A	
Weight			0.5kg	

Table 3.2 Performance List

*: Counting speed is influenced by pulse rise time and fall time. Countable speeds are as follows. (If a pulse greater than 50μs is counted by the AD61, miscounting may occur. In this case, use the AD61S1.)

(1) AD61 (for both 1 and 2 phase inputs)
t = 5μs. 50KPPS
t = 50μs. . . .5KPPS



(2) AD61S1

Rise/Fall Time	1 Phase Input	2 Phase Input
t = 5μs	10KPPS	7KPPS
t = 500μs	500PPS	250PPS

3.2.2 Functions

(1) General description

The AD61 module counts high-speed pulse input which cannot be used directly of programmable controller CPU. Its size is the same as that of programmable controller I/O module.
AD61 incorporates a BIN (binary) 24-bit preset counter function which is capable of up/down count, a ring counter function, an internal preset function, an external disable function, a comparison function with BIN 24-bit set value, and a coincidence signal external output function, applicable to two channels.

(2) Block diagram

General operation

CH1 counter counts the pulse train entering its phase A input up or down as appropriate. In order to read a count value from the CPU module, it is necessary to rear the value via the buffer memory. I/O signals to and from the programmable controller CPU are used to control the operation of the counter. The buffer memory is used to store set data, etc. which controls the counter.

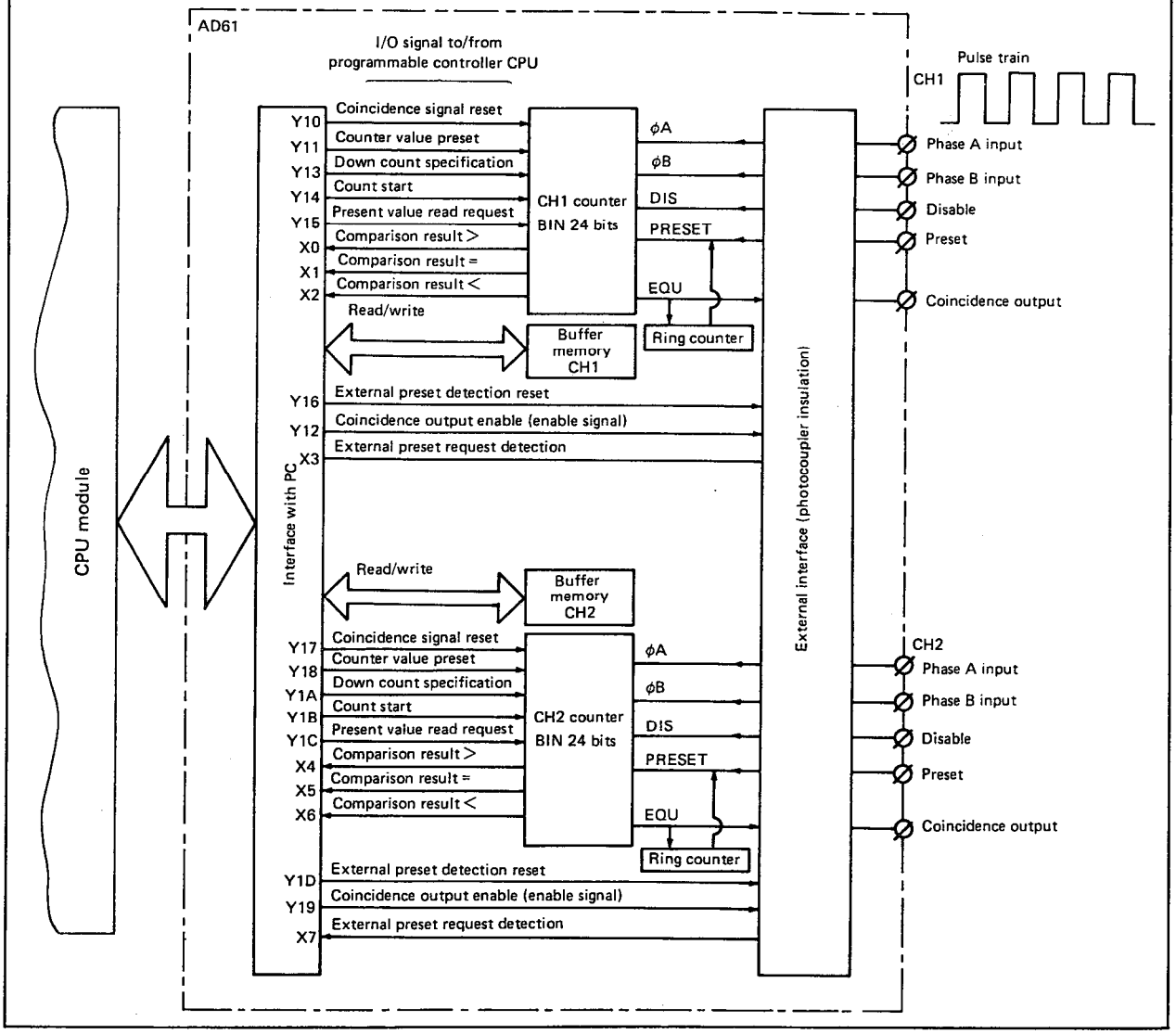
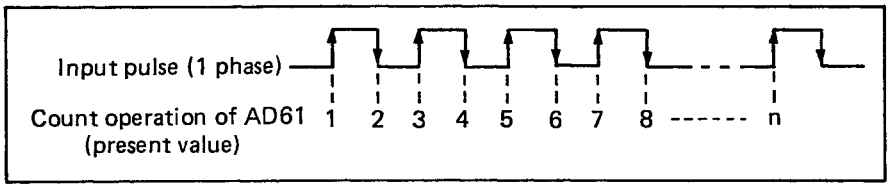


Fig. 3.1 Block Deagram

(3) General description

The AD61 counts the number of input pulses. In the following figure, for example, each time a pulse is input, the AD61 counts pulses in order of 1 to 2 to 3 to 4 to n. The allowable counting range is 0 to 16,777,215. The AD61 module always executes the comparison function (>, = <) with a set value (a target value optionally set by user).



(4) Pulse input

Pulse inputs may be 1-phase or 2-phase. For 1-phase pulse input, up count (down count specification is also possible from the main program) is made each time a pulse is input. For 2-phase pulse input, the up/down direction of the counter is automatically judged depending on the relation between phase A and phase B. In the following figure, the voltages at the AD61 count input terminal are shown for 1-phase and 2-phase inputs. In this manual, explanation will be given in reference to source load.

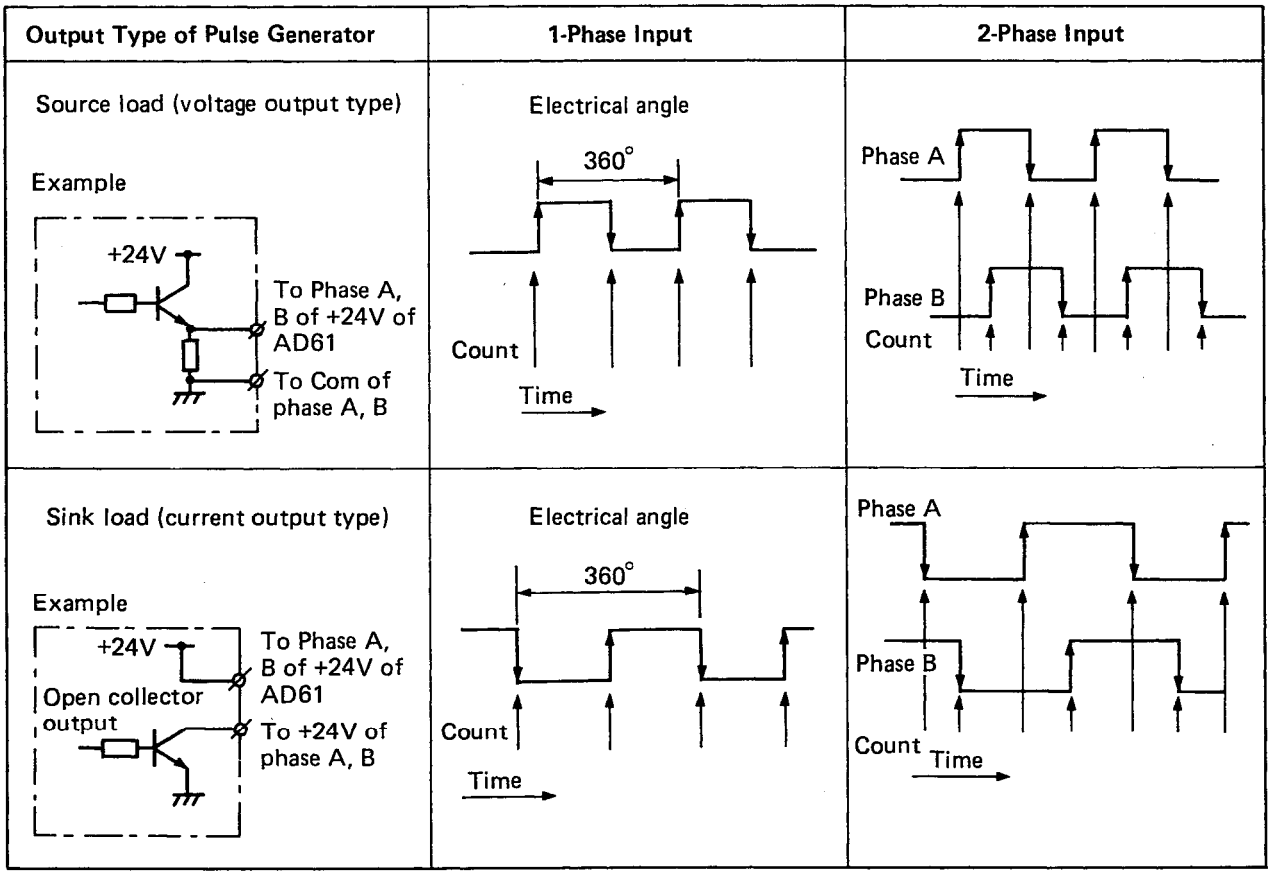


Fig. 3.2 1-Phase and 2-Phase Inputs

(5) Count timing

The timing (for 1 phase input) of the comparison result between a present value and a set value is as indicated below. (Indicated by the assignment numbers of CH1 and 2.)

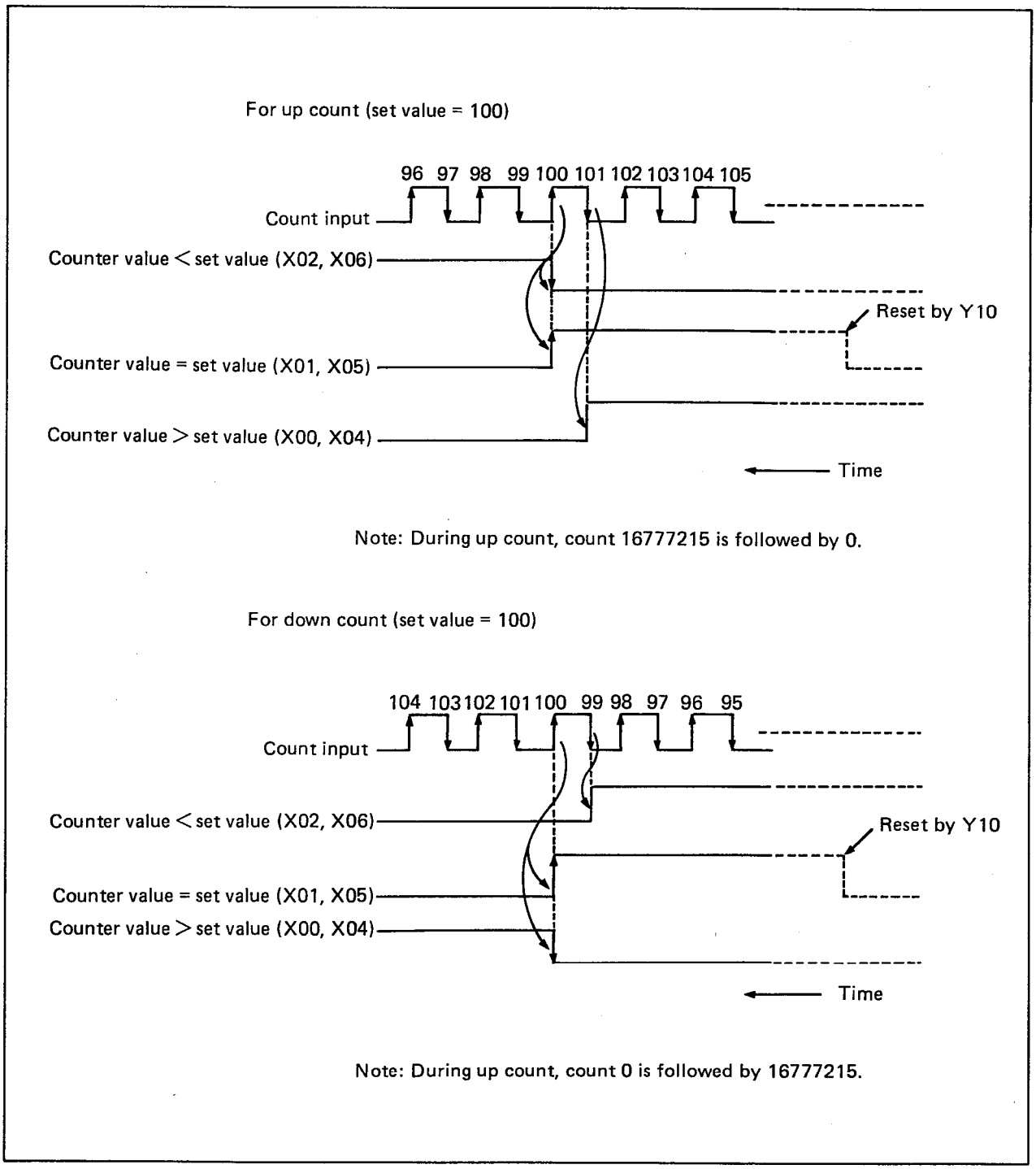


Fig. 3.3 Count Timing

(6) Count mode

On AD61, the count ratios of input pulses are as described below:

1) Twice for 1-phase input (2 counts are made for 1 pulse input).
2) Four times for 2-phase input (4 counts are made for 1 pulse input).

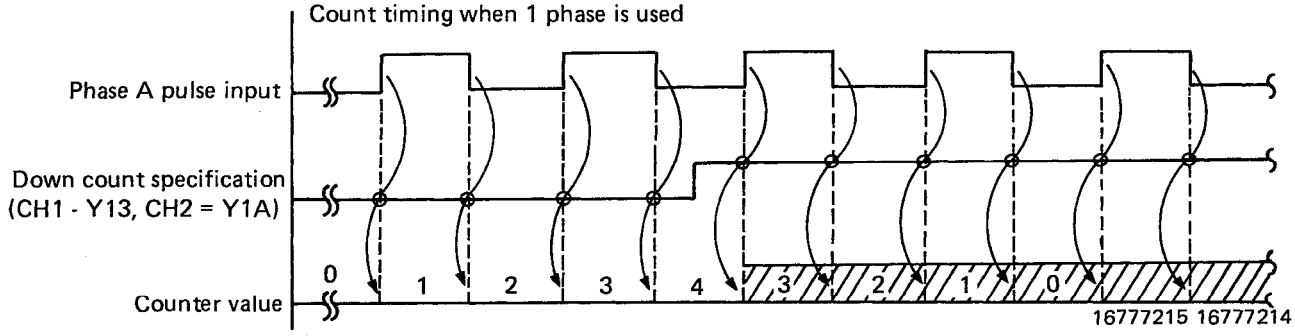
POINT

1. **Each input pulse registers two counts for 1-phase input and four counts for 2-phase input. If the counting range is large, select the pulse generator so that a value twice (for 1 phase) or four times (for 2 phases) greater than the number of generated pulses is within the counting range (0 to 16,777,215).**

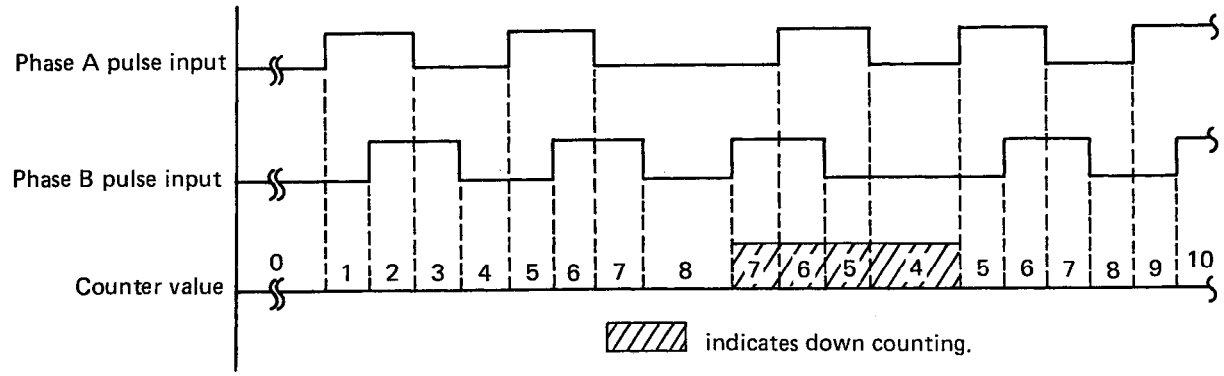
2. **For 1-phase input, specify any set value as twice the actual number of input pulses or halve the present value (by using D/instruction). For 2-phase input, specify any set value as four times the actual number of input pulses or divide the present value by four (by using D/instruction).**

Counting methods for 1-phase input and 2-phase input are shown below. When 1 phase is used, down counting is made if down count specification is on. When 2 phases are used, down count is made if phase B input pulse leads phase A input pulse.

Count timing when 1 phase is used



Count timing when 2 phases are used



(7) Preset function

When the power to the AD61 is turned off, or the CPU reset, the AD61 memory contents are lost (i.e. present values, set values etc.). If these values need to be retained for subsequent use, they must be stored in a suitable data register in the Programmable controller CPU.

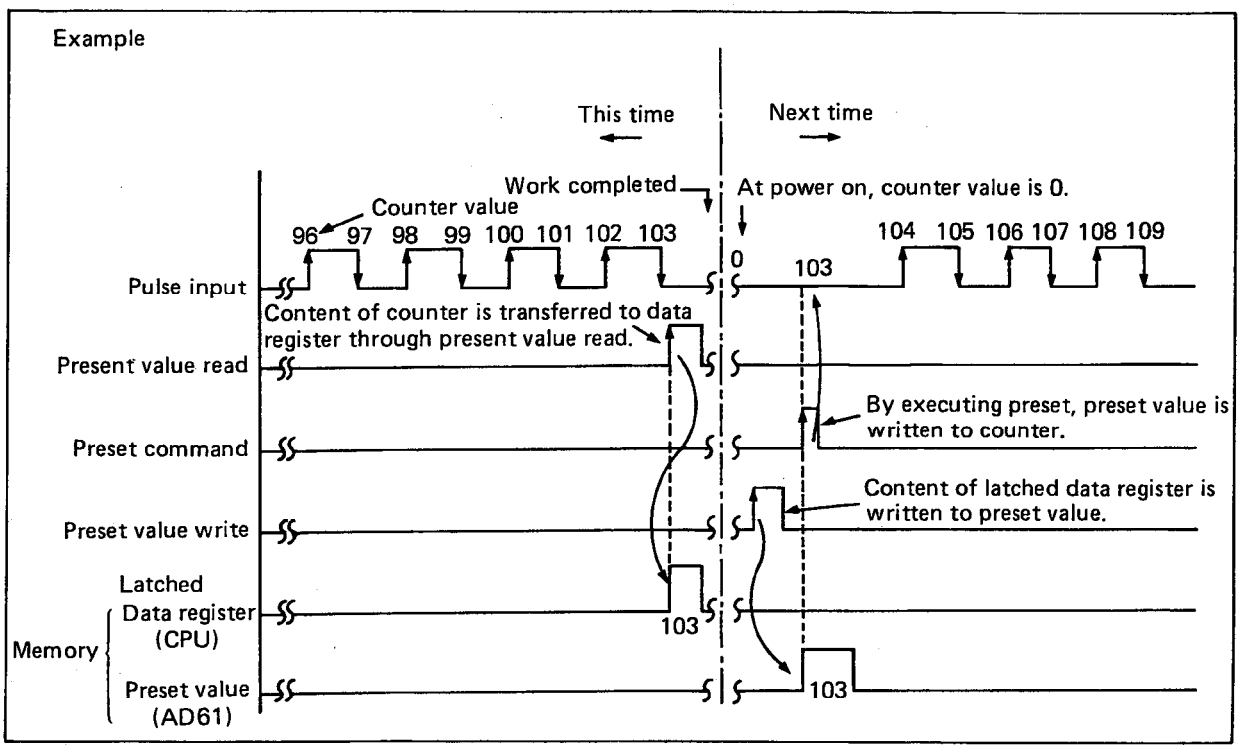


Fig. 3.4 Preset Operation

- The preset value is written to the appropriate buffer memory address (address 1 for CH1, address 33 for CH2) as a 24 bit binary number.
  To load the preset value into the counter current value turn on the preset command (Y 11 for CH1, Y18 for CH2) from the programmable controller CPU.

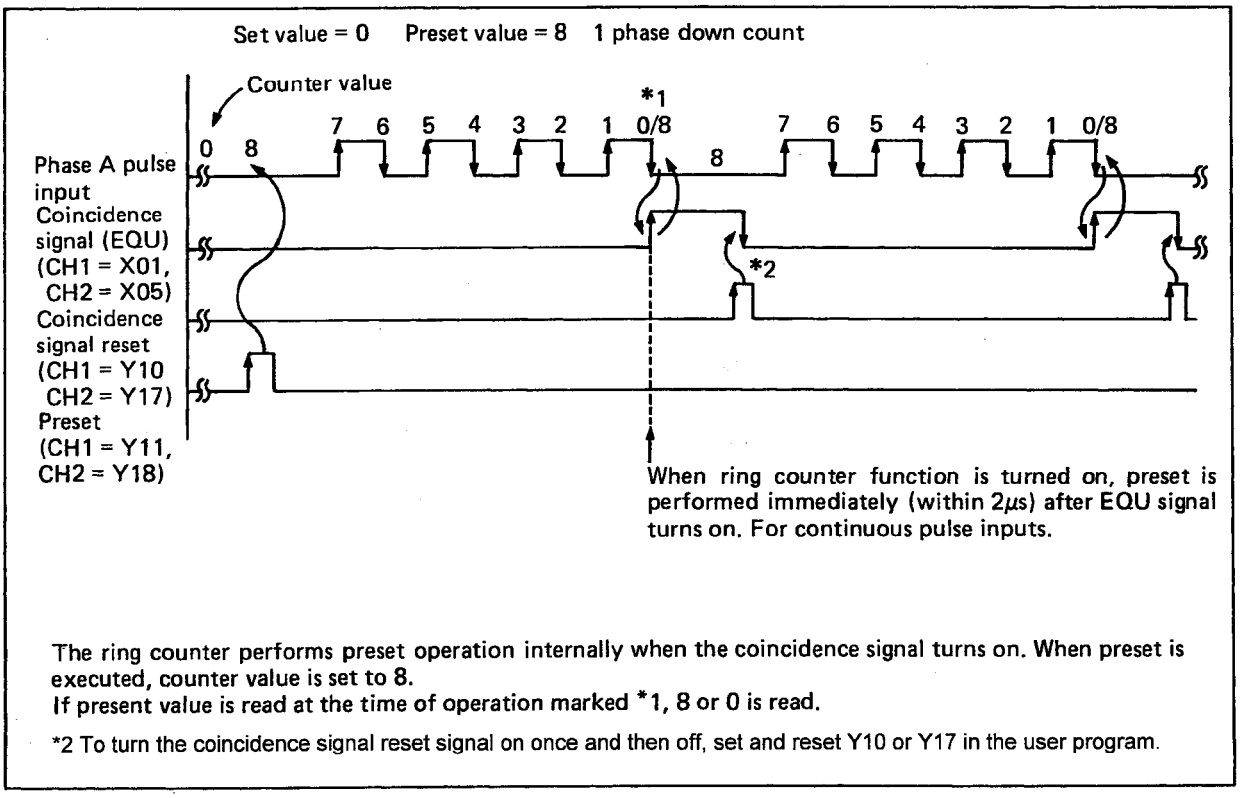
- The preset command may either be loaded from the program or input by applying a voltage to the PRST terminal on the external terminal block (external preset).
  When the external preset signal is given, a flip flop (F/F) is set. If the external preset input turns on again while the F/F is set, the presetting function is stopped. Reset the F/F from the program. (Y16 for CH1, Y1D for CH2) Even if the external preset input remains on, the F/F can be reset. (The F/F is set on the leading edge of the external preset pulse.)

(8) Disable function

By turning on the count enable signal (i.e. a programmable controller I/O signal), AD61 starts counting. (Y14 for CH1, Y1B for CH2)
When a voltage is applied to the DIS (disable) terminal on the external input terminal block, the AD61 stops counting. By utilizing this, counting may be started and stopped by the external input, irrespective of scan time.

(9) Ring counter function

By moving the ring counter setting pin on the AD61 circuit board to the ON position, automatic preset is performed if the counter value becomes equal to the set value. Use this function for cyclic control such as sizing feed. The timing for the ring counter is shown below.



The ring counter performs preset operation internally when the coincidence signal turns on. When preset is executed, counter value is set to 8.
If present value is read at the time of operation marked *1, 8 or 0 is read.

*2 To turn the coincidence signal reset signal on once and then off, set and reset Y10 or Y17 in the user program.

Fig. 3.5 Ring Counter Operation

(10) External output

AD61 is capable of giving a counter value coincidence signal (open collector output) (which turns on if the counter value is equal to the set value). In order to use the counter coincidence signal, it is necessary to turn on the coincidence signal output enable (Y12 for CH1, Y19 for CH2) which is assigned to the programmable controller I/O.

3.3 I/O Signals To and From Programmable Controller CPU

This section describes I/O signals to and from programmable controller CPU when AD61 has been assigned to slot 0.

	CH1	CH2	Signal	Description
Input signal	X00	X04	Counter value greater	Turned on if counter value is greater than set value.
	X01	X05	Counter value coincidence	Latched on if counter value is equal to set value. Turned off by coincidence signal reset command.
	X02	X06	Counter value less	Turned on if counter value is less than set value.
	X03	X07	External preset request detection	Latched on when preset request is given from external input. Turned off when external preset detection signal is reset.

Table 3.3 Input Signals

- Do not use X08 to X0F signals.
- Counter value coincidence signal is turned on when the power is turned on or reset is executed because both the counter value and set value are 0. Therefore, always reset the counter coincidence signal first by turning the coincidence signal reset command on and then off. (If both the counter and set values are 0 after executing the coincidence signal reset command, the counter value coincidence signal is enabled again.)

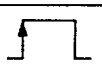
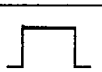
	Channel		Signal	Operation Timing	Description
	CH1	CH2			
Output signal	Y10	Y17	Coincidence signal reset command		Reset signal for counter value coincidence signal (latch) and coincidence output (EQU) signal
	Y11	Y18	Preset command		Preset value write execution signal
	Y12	Y19	Coincidence signal output enable		By turning on this signal, counter value coincidence signal is output to outside.
	Y13	Y1A	Down count command		If this signal is on in 1 phase mode, down count is performed.
	Y14	Y1B	Count enable		By turning on this signal, count operation is enabled.
	Y15	Y1C	Present value read request		At the rise of this signal, count value is read as present value.
	Y16	Y1D	External preset detection reset command		Reset signal of external preset request detection signal (latch)

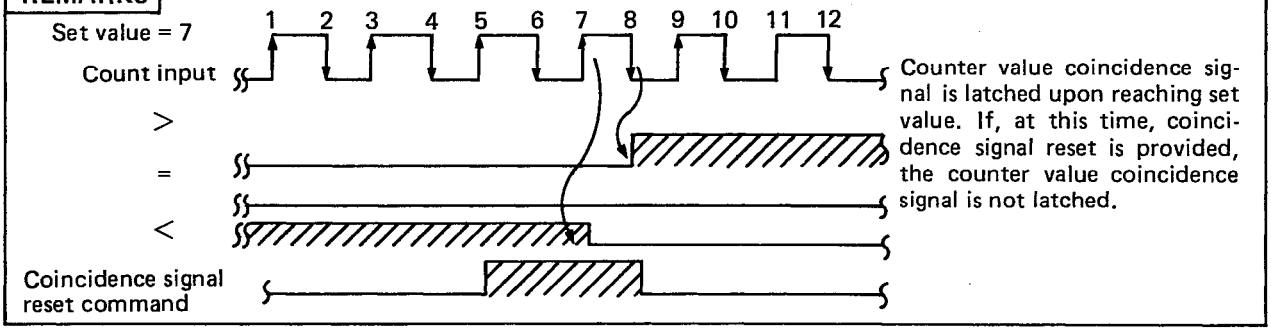
Table 3.4 Output Signals

IMPORTANT

Y00 to 0F and Y1E to 1F may not be used as they are reserved. If one of the above signals is used (turned on/off) in a sequence program, the functions of the AD61 cannot be guaranteed. However, when the AD61 is used for remote I/O, Y0E and Y0F may be reset from the program. (For details, refer to Section 6.3.)

- In Table 3.4 the symbol ⌐↑⌐ indicates that the function is executed on the rise of the signal.
- The coincidence signal latches itself on and must be reset from the sequence program.

REMARKS

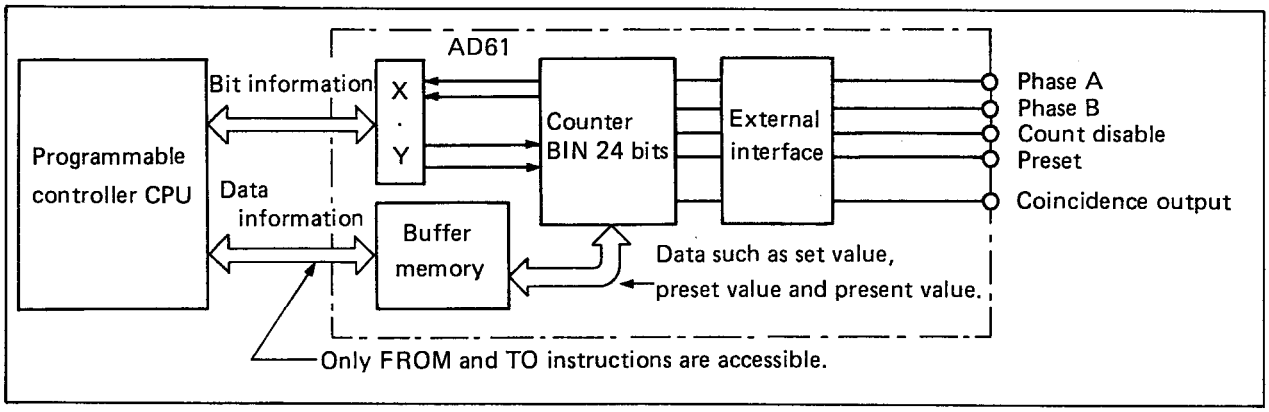


- The external preset detection reset command must be executed at high speed so that the scan time of the program has minunal effect on the AD61 operation.
  For this reason do not use the PLS Y16 instruction. Use a SET Y16 instruction followed by RST Y16, this is fully explained later in this manual.

3.4 Buffer Memory

(1) General description

By using FROM and TO instructions, the AD61 is capable of making data communication with the programmable controller CPU through the buffer memory. (The address consists of 16 bits.)



(2) Memory map

The memory map inside the buffer memory is shown below. When the power is turned on or the CPU is reset, the contents of the buffer memory are initialized to 0. Preset value, present value, and set value and handled as 24 bit binary. (The address is expressed in decimal.)

CH1 address	CH2 address		
1	33	Preset value write (lower and middle)	Write only
(2)	(34)	Preset value write (upper)	
3	35	Mode register	Read/write
4	36	Present value read (lower and middle)	Read only
(5)	(37)	Present value write (upper)	
6	38	Set value read/write (lower and middle)	Read/write
(7)	(39)	Set value read/write (upper)	

Addresses in parentheses in the above table indicate those of the upper 8 bits of 24-bit data.

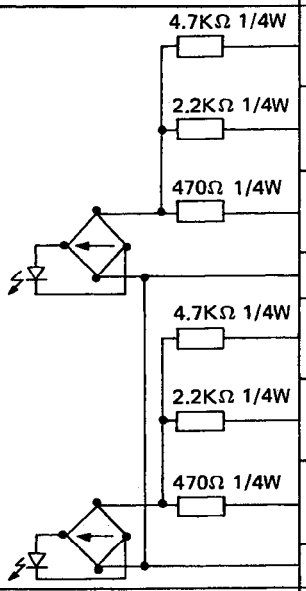
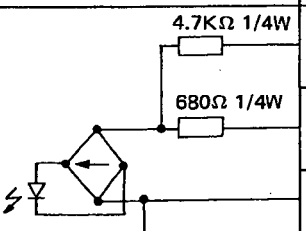
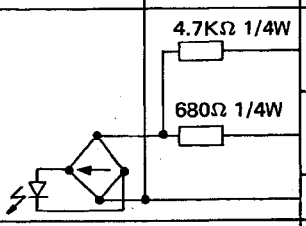
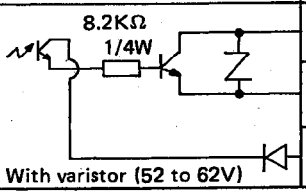
(3) Setting of mode register

Set the value of the mode register as indicated in the following table. The value is indicated in decimal.
When the power is turned on, the value is 0.

Division of Phase	Data to Be Written
1 phase	8
2 phases	18

3.5 Interface with External Equipment

The external equipment interface list of AD61 is indicated below.

I/O Division	Internal Circuit	Terminal Number CH1	Terminal Number CH2	Signal	Operation	Input Voltage (Guaranteed value)	Operation Current (Guaranteed value)
*Input		1	19	Phase A pulse input 24V	At ON	21.6 to 26.4V	2 to 5mA
					At OFF	5V or less	0.1mA or less
		2	20	Phase A pulse input 12V	At ON	10.8 to 13.2V	2 to 5mA
					At OFF	4V or less	0.1mA or less
		3	21	Phase A pulse input 5V	At ON	4.5 to 5.5V	2 to 5mA
					At OFF	2V or less	0.1mA or less
		4	22	COM			
		5	23	Phase B pulse input 24V	At ON	21.6 to 26.4V	2 to 5mA
					At OFF	5V or less	0.1mA
		6	24	Phase B pulse input 12V	At ON	10.8 to 13.2V	2 to 5mA
					At OFF	4V or less	0.1mA or less
		7	25	Phase B pulse input 5V	At ON	4.5 to 5.5V	2 to 5mA
					At OFF	2V or less	0.1mA or less
		8	26	COM			
Input		9	27	Disable input 12/24V	At ON	10.2 to 26.4V	2 to 6mA
					At OFF	2V or less	0.1mA or less
		10	28	Disable input 5V	At ON	4.5 to 5.5V	3.5 to 5.5mA
					At OFF	1.5V or less	0.1mA or less
		11	29	COM	Response time	OFF → ON 0.5ms	ON → OFF 3ms or less
Input		12	30	Preset input 12/24V	At ON	10.2 to 26.4V	2 to 6mA
					At OFF	2V or less	0.1mA or less
		13	31	Preset input 5V	At ON	4.5 to 5.5V	3.5 to 5.5mA
					At OFF	1.5V or less	0.1mA or less
		14	32	COM	Response	OFF → ON 0.5ms or less	ON → OFF 3ms or less
Output		15	33	Open collector output OUT	Operating voltage: 10.2 to 30V Rated voltage: 0.5A Maximum rush current: 4A, 10msec Maximum voltage drop at ON: 1.5V at 0.5A Response time: OFF → ON 0.1msec or less (Resistor load) ON → OFF 0.1msec or less		
		16	34	0V			
		17	35	External power input 12/24V	Input voltage: 10.2 to 30V Current consumption: 2 to 5mA		

REMARKS

The encoder that can be connected to the AD61 is an open collector output type or CMOS output type encoder. A TTL output type or line drive output type encoder cannot be used.
For the CMOS output type encoder, check whether its output voltage meets the AD61 specifications.

4. HANDLING

This chapter describes the handling instructions, nomenclature, maintenance, and inspection of the AD61.

4.1 Handling Instructions

(1) Protect the AD61 and its terminal block from impact.

(2) Do not touch or remove the printed circuit board from the case.

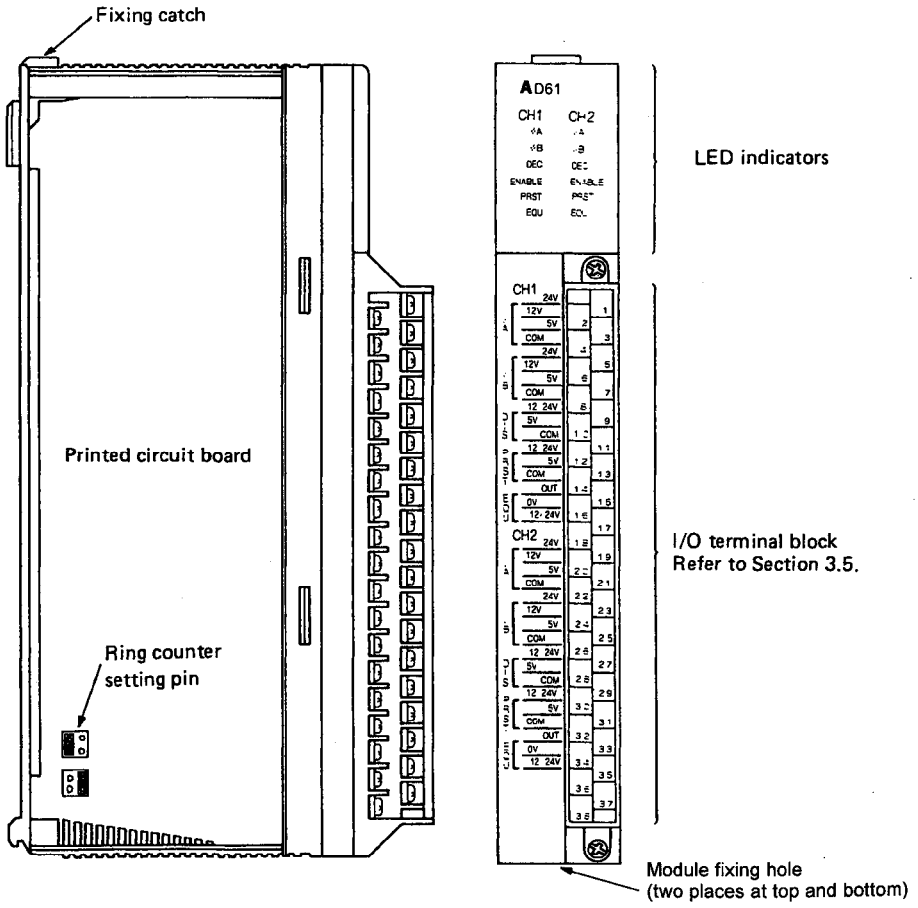
(3) When wiring, ensure that no wire offcuts enter the unit and remove any that do enter.

(4) Tighten terminal screws as specified below.

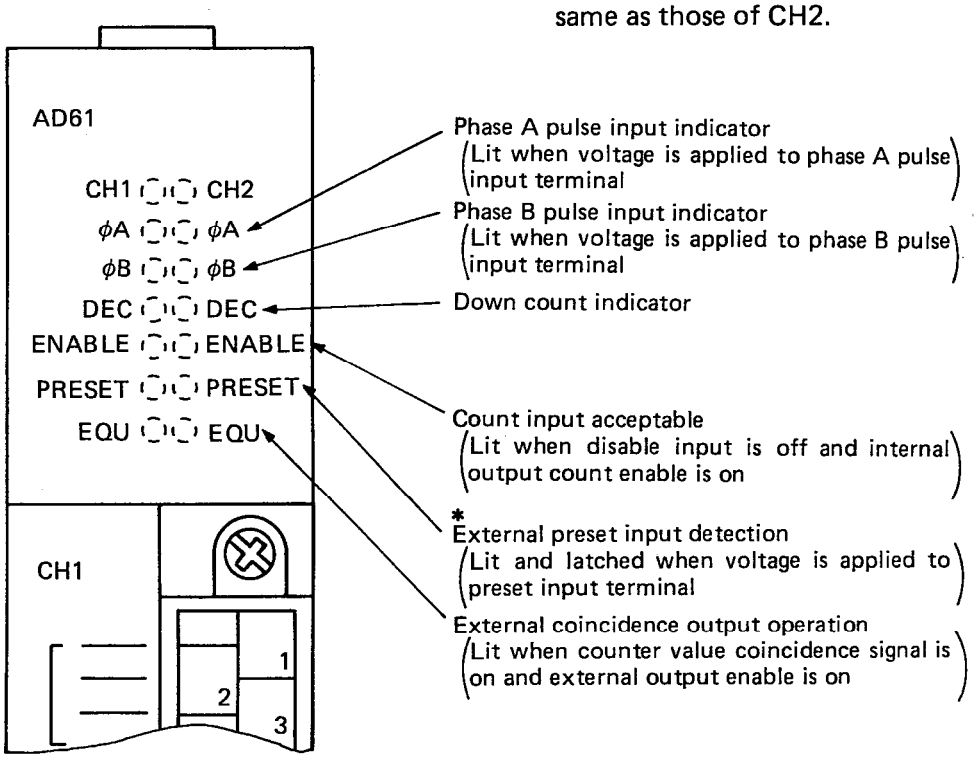
Screw	Tightening Torque Range
I/O terminal block terminal screw (M3 screw)	49 to 78 N·cm
I/O terminal block mounting screw (M4 screw)	78 to 137 N·cm

(5) To load the unit onto the base, press the unit against the base so that the hook is securely locked. To unload the unit, push the catch on the top of the unit, and after the hook is disengaged from the base, pull the unit toward you.

4.2 Nomenclature and Explanation



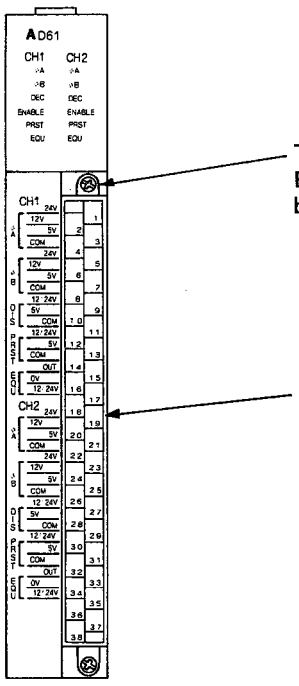
(1) LED indicators: LED "on" conditions are explained below. LED operations of CH1 are the same as those of CH2.



REMARKS

*If external preset detection reset signal (Y16 for CH1, Y1D for CH2) is turned on when this LED is on, it will turn off.

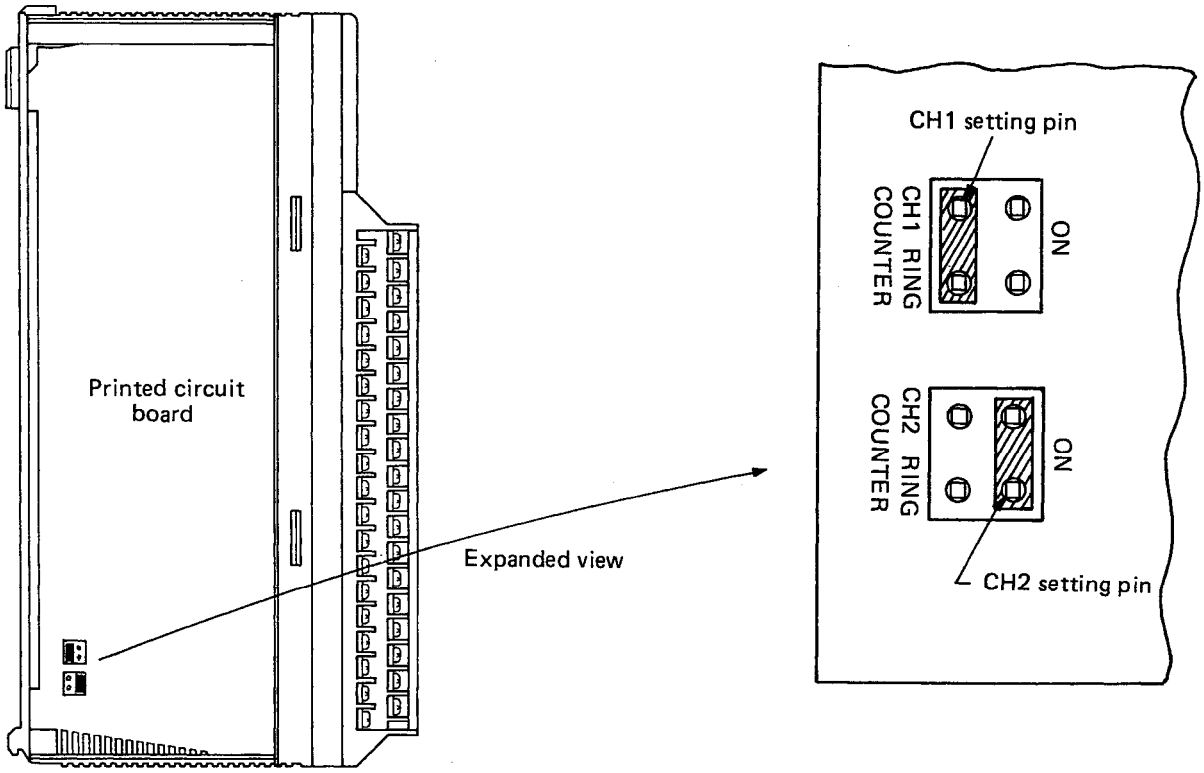
(2) I/O terminal block: I/O terminal block is explained below. For the arrangement of terminal block, refer to Section 3.5.



4.3 Setting of Ring Counters

To select the ring counter function, change the setting of the pin on the circuit board. As shown below, ring counter setting pins are located AD61 at the bottom left of the circuit board.

Set the ring counters individually for CH1 and CH2. The pins are factory-set at the OFF position. (If the pin is removed, setting is placed into OFF state.) The figure shows CH1 ring counter OFF and CH2 ring counter ON.



4.4 Maintenance

For general maintenance and inspection items, to the A CPU User's Manual.
Since the AD61 uses an external power supply, check that the external power voltage is within ±10% of the rated voltage every three to six months.

5. WIRING AND INSTALLATION

5.1 Module Arrangement Precautions

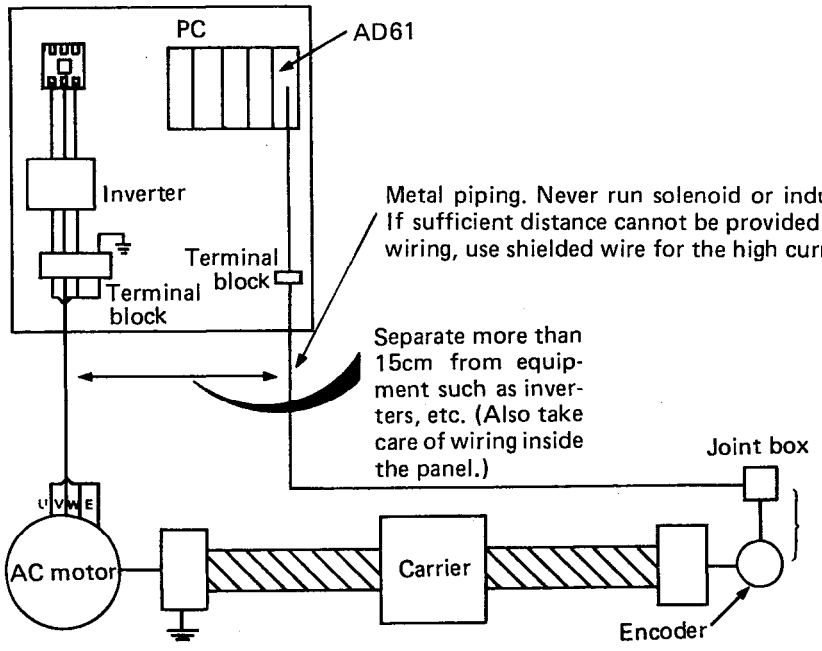
Only use the AD61 on an extension base which has a power supply module installed. Do not use the AD61 on an extension base which does not have a power supply module because power capacity may become insufficient.

5.2.1 Wiring instructions

When using high speed pulse inputs take precautions against noise in all wiring.

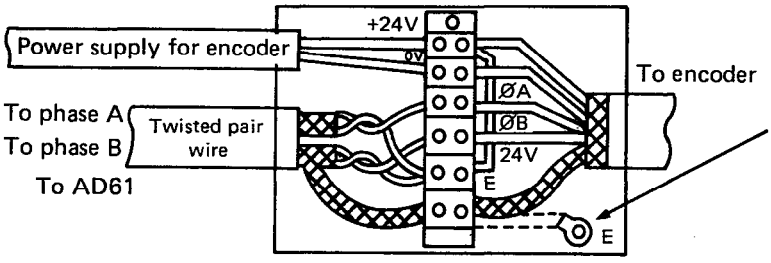
1) Be sure to use shielded twisted pair wires. Also provide Class 3 grounding.
2) Do not run a twisted pair wire in parallel with any power line, I/O line, etc. which may generate noise. It is necessary to run the twisted pair wire separately from the above described lines and over the shortest possible distance.
3) A stabilized power supply is necessary for the pulse generated. For 1-phase input, connect count input signal only to phase A. For 2-phase input, connect count input signal to phase A and phase B.

Special care must be taken to prevent the input wiring from picking up noise. The diagram below indicates the type of precautions required.



Distance between encoder and joint box should be as short as possible. If the distance from the AD61 to the encoder is too long an excessive voltage drop occurs. Therefore, measure the voltage during operation and check that the voltages are within the rated voltage of the encoder. If the voltage drop is large, increase the size of wiring or use an encoder of 24V DC with less current consumption.

- Ground twisted shield wire on the encoder side (joint box). (This is a connection example for 24V sink load.)



Connect the encoder shield wire to the twisted pair shield wire inside the joint box. If the shield wire of the encoder is not grounded in the encoder, ground it inside the joint box as indicated by dotted line.

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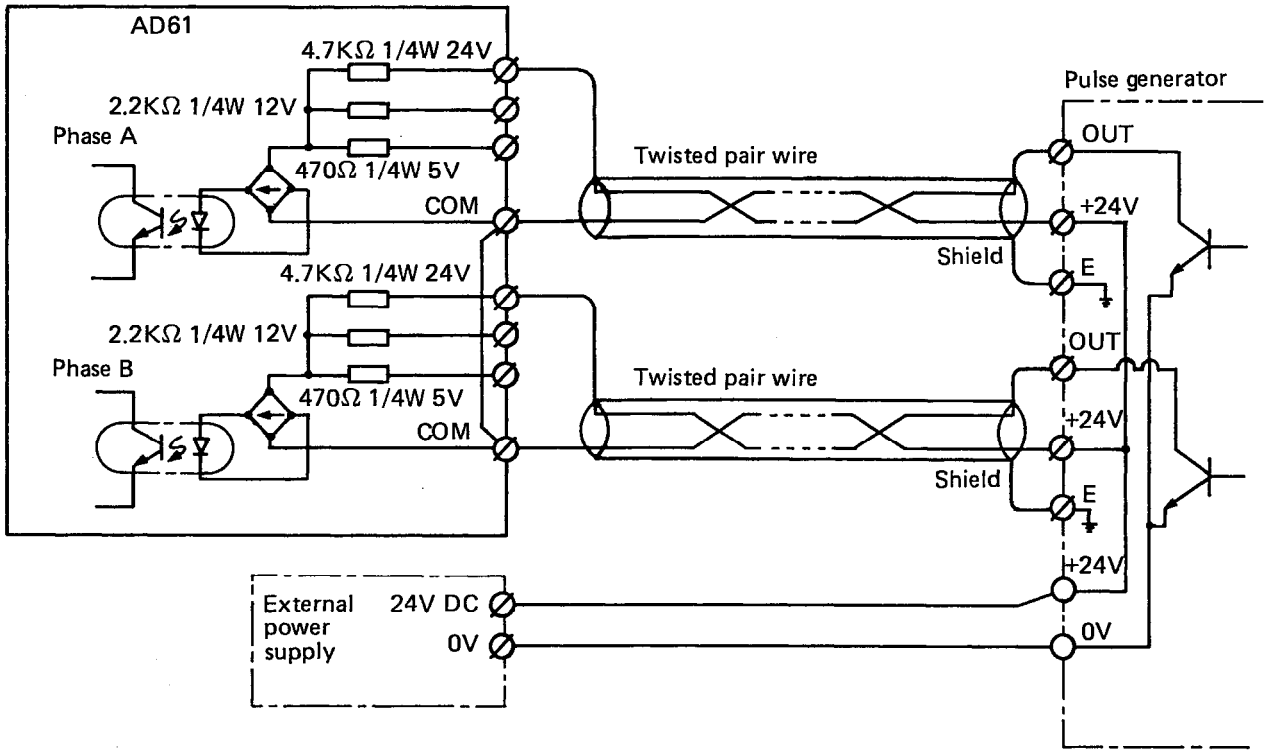
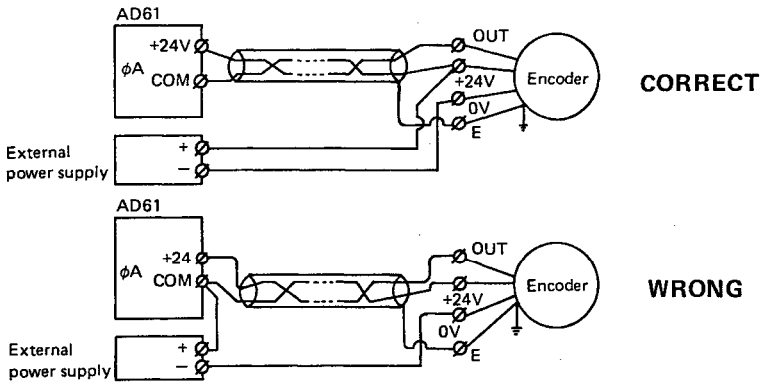
5.2.2 Module wiring examples

(1) Pulse generator is open collector output (24V DC)



POINT

In order to minimize any interference from noise on the encoder power supply, the encoder signal and supply lines should be wired as follows:



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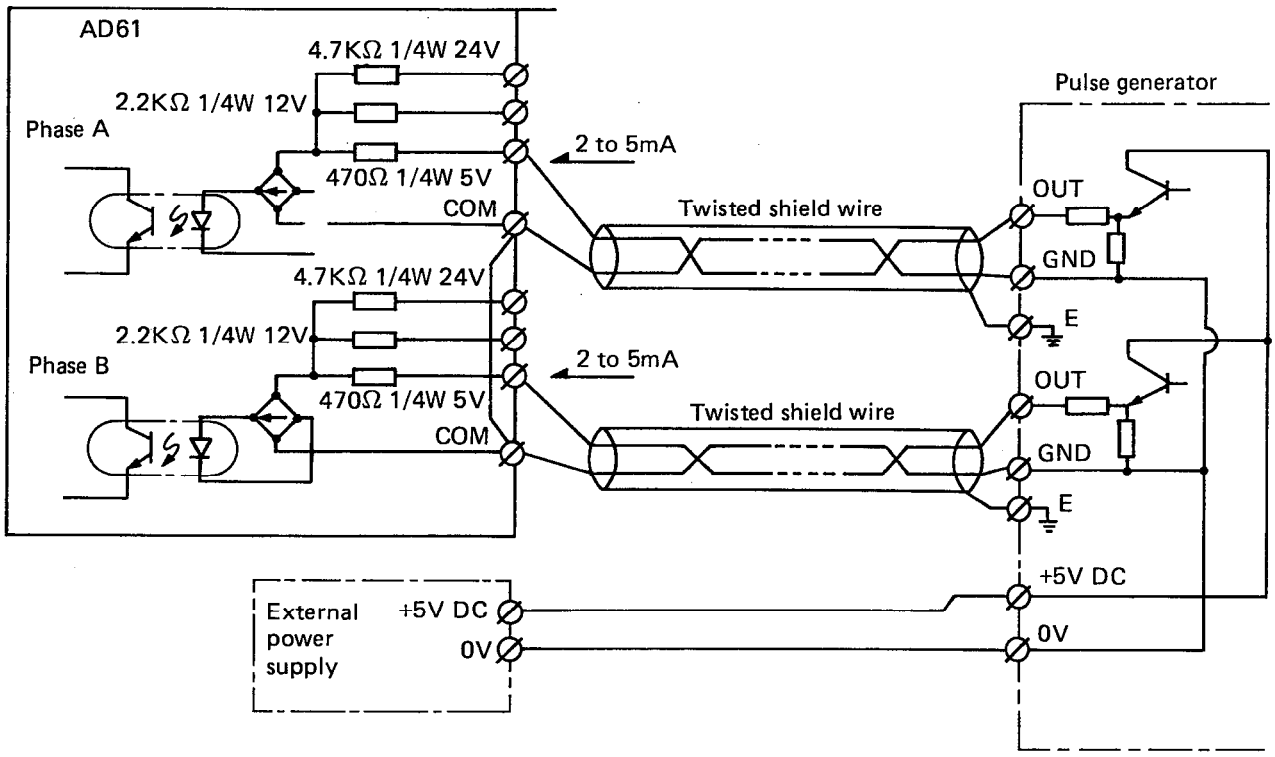
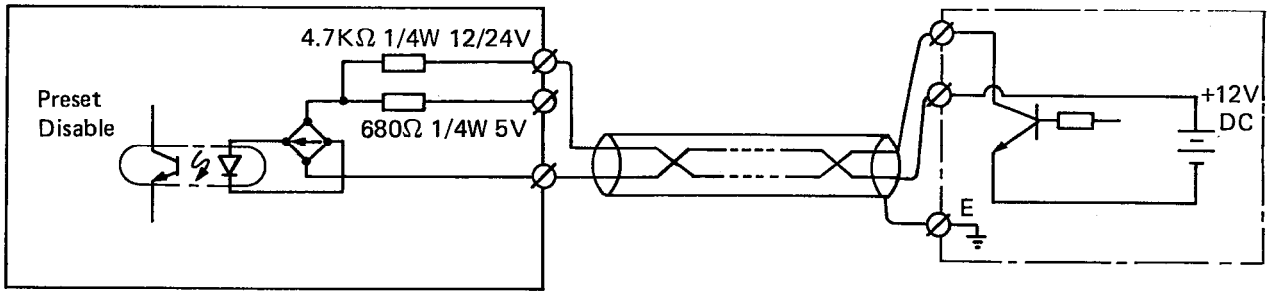
(2) Pulse generator is voltage output type (5V DC)



(3) Connection with input (the same interface for preset and disable)



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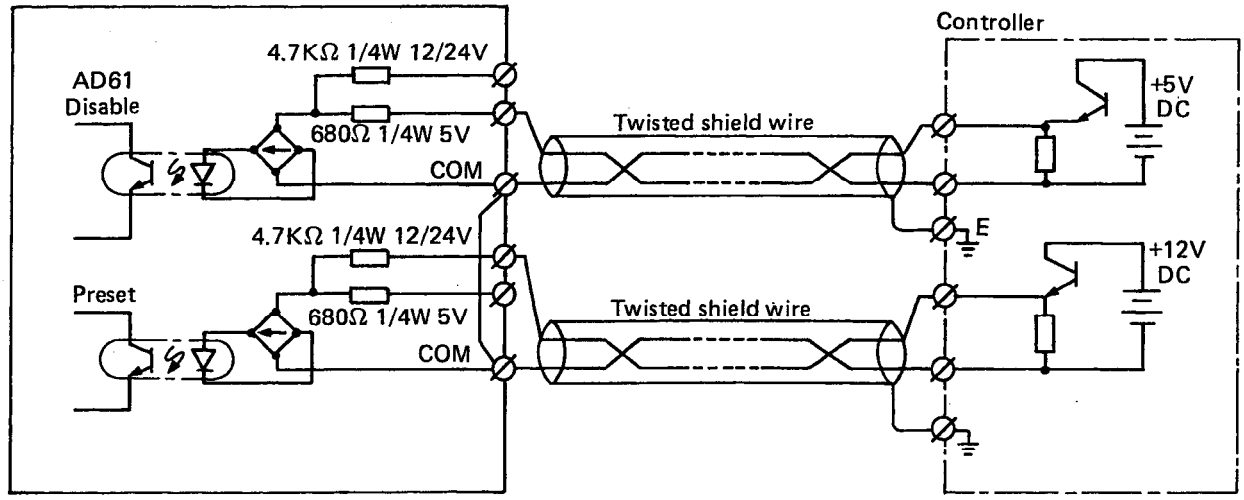
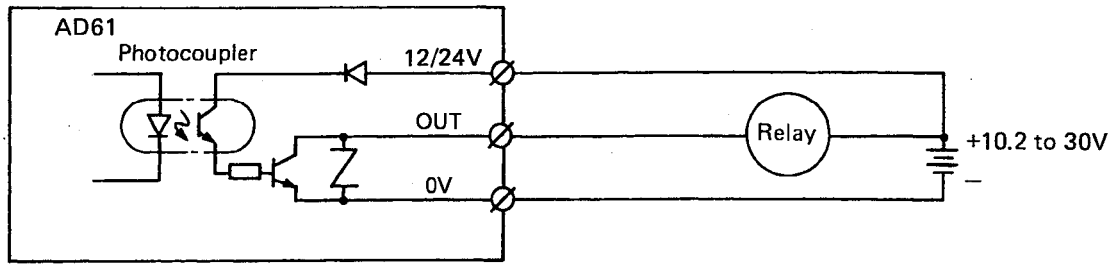
(4) Source load (voltage output type)



(5) Connection with EQU terminal

To use the EQU terminal, the internal photocoupler should be activated. For this purpose, 10.2 to 30V external power is necessary. Connection methods are as follows:



6. PROGRAMMING

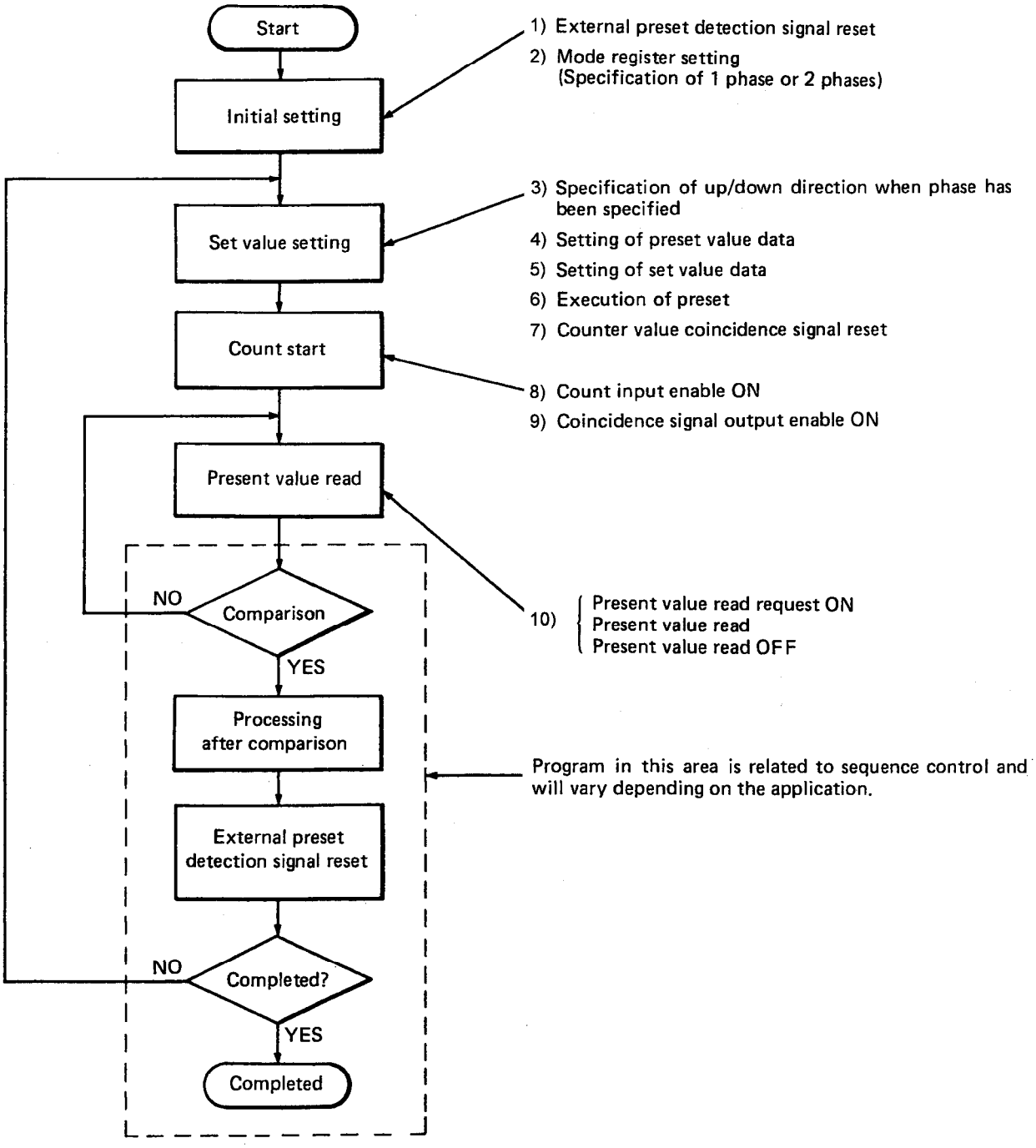
This section explains the programming procedure for use of the AD61. When applying any of the program examples introduced in this chapter to the actual system, verify the applicability and confirm that no problems will occur in the system control.

6.1 General Description of Programming

Program flow for the control of AD61 is as shown below. (Common to All CPU)

(1) Flow chart and programming procedure when ring counter function is not used (Set the ringcounters for OFF position).

1) Flow chart



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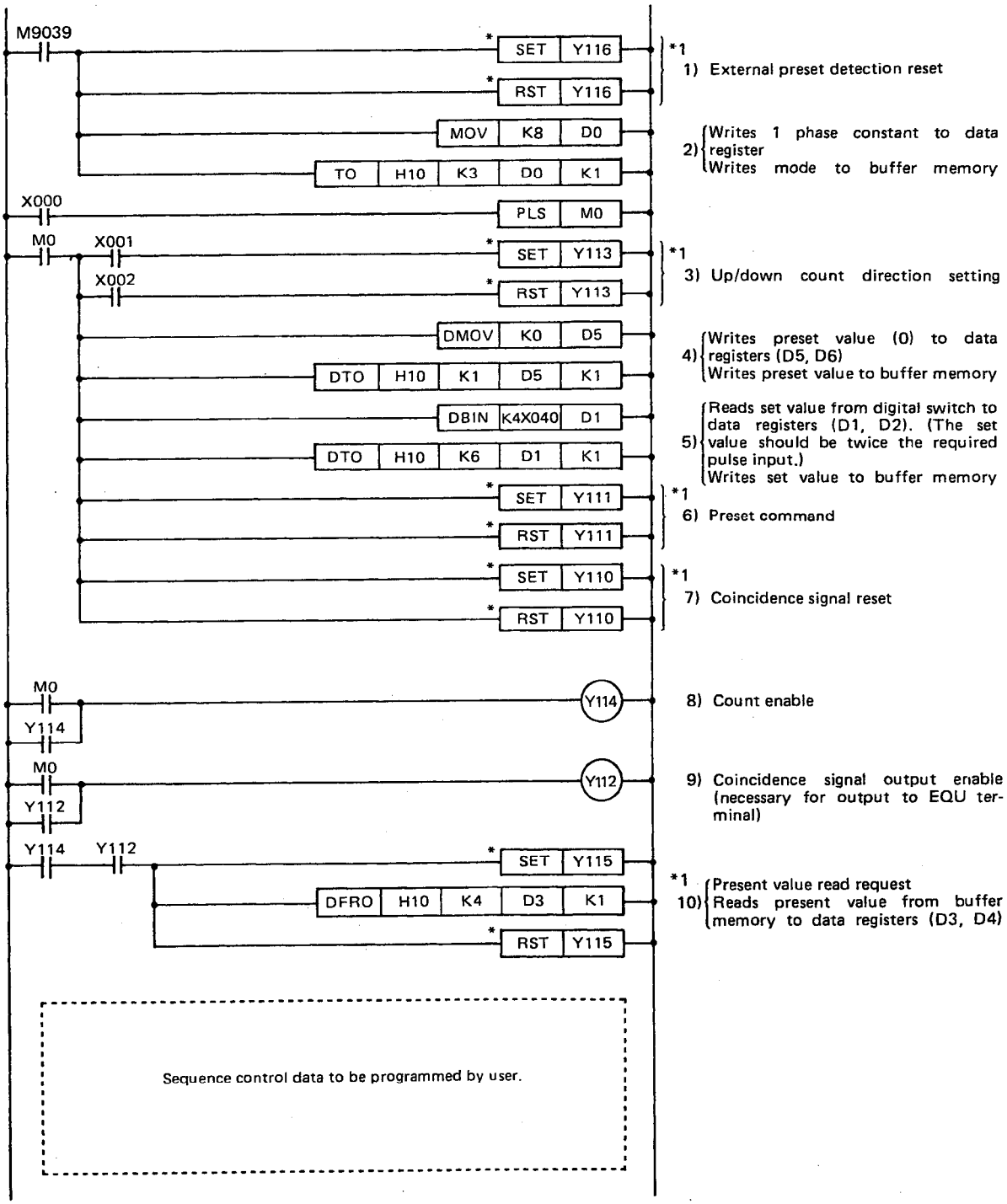
2) Programming procedure

The following example shows the programming procedure for the A1, A2, and A3CPUs according to the flow chart in 1). The AD61 I/O numbers are assigned to 100 to 11F.



POINT

***1: When using the A1E, A2E, or A3ECPU, use the partial refresh instructions.**

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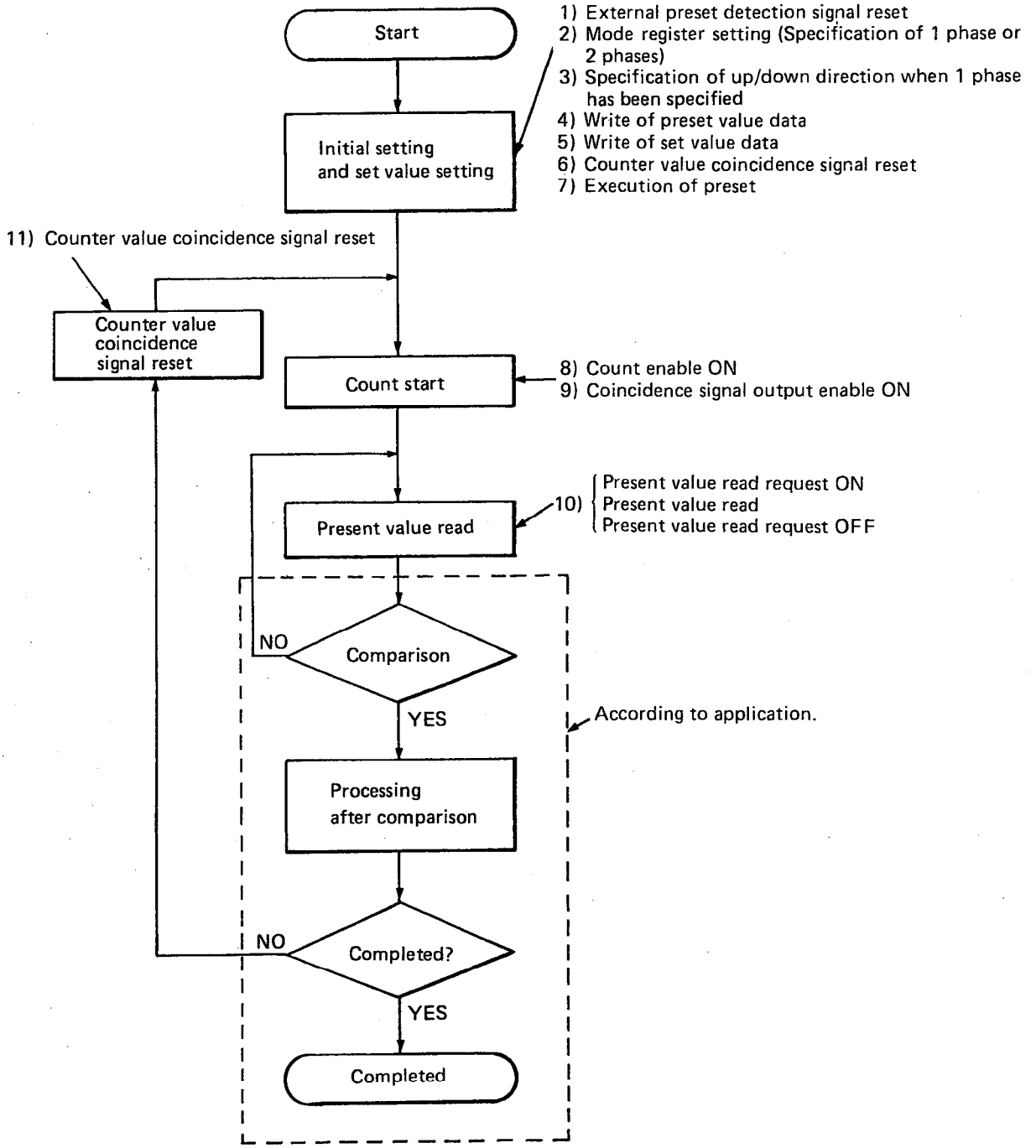
POINT

When the used I/O control system of the ACPU is the refresh system, the SET/RST instruction cannot be used within the same scan as shown in the above ladders marked * to output pulses to the AD61. Use the partial refresh (SEG) instruction to output pulses to the AD61. Refer to the ACPU Programming Manual for the partial refresh (SEG) instruction.

(2) Flow chart and programming procedure when ring counter function is used

1) Flow chart

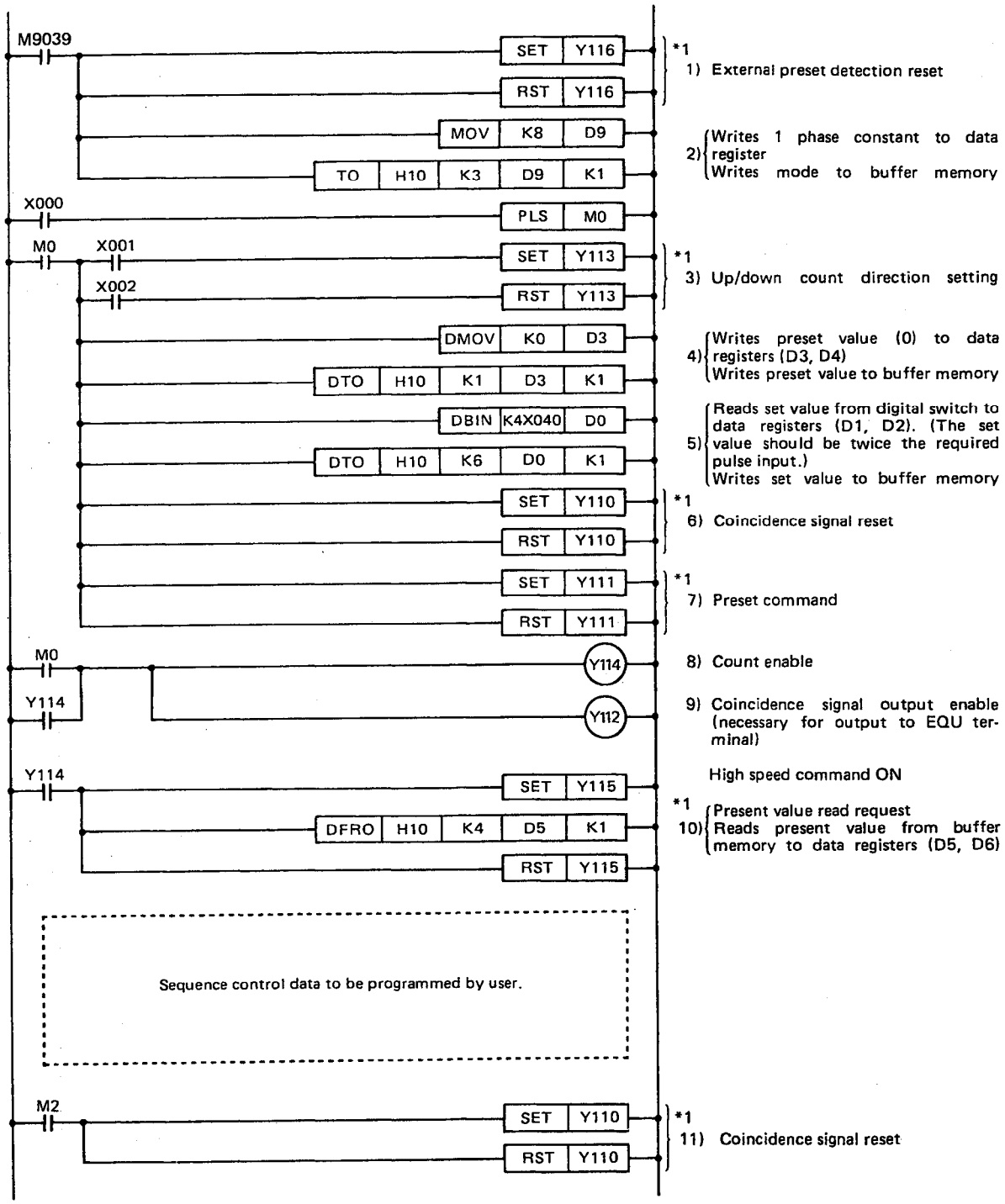


POINT

When the ring counter function is used, the next preset cannot be performed if the counter coincidence signal (X01 for CH1, X05 for CH2) remains on. Be sure to reset the counter coincidence signal.

2) Programming procedure

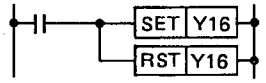
The following example shows the programming procedure for the A1, A2, and A3CPUs according to the flow chart in 1). The AD61 I/O numbers are assigned to 100 to 11F.



POINT

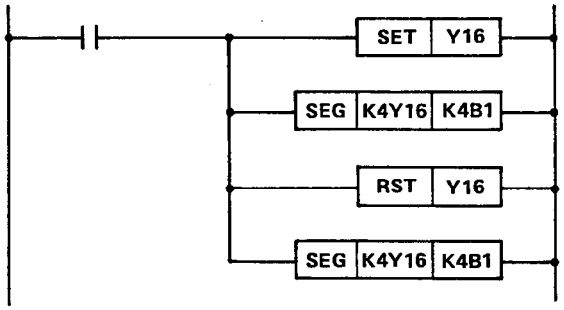
***1: When using the A1E, A2E, or A3ECPU, use the partial refresh instructions.**

(3) Differences of programming depending on system configurations

System Configuration Using AD61	Instruction or Programming Method Necessary for Use of AD61	
	Accessing method to buffer memory	AD61 F/F reset pulse generating method
A CPU data link system. Remote I/O station	RFRP instruction (equivalent to FROM instruction) RTOP instruction (equivalent to TO instruction) Only one instruction may be executed for 1 special unit within 1 scan.	Since Y output to actual remote I/O station is executed after END of sequence program, pulse is not output by the above method. To output pulse to remote I/O station, create the following program; SET Y16 → END (link refresh) → RST Y16 → END (link refresh).
A CPU in dependent system. A CPU data link system. Master station and local station.	FROM and TO instructions are used.	SET and RST are used. Example:  Use of PLS Y16 turns on Y16 for 1 scan. This is undesirable because AD61 may not operate for that period.

POINT

When using the I/O refresh type CPU (A1E, A2E, A3ECPU), always use the partial refresh instructions and convert them into pulses using the SET and RST instructions.



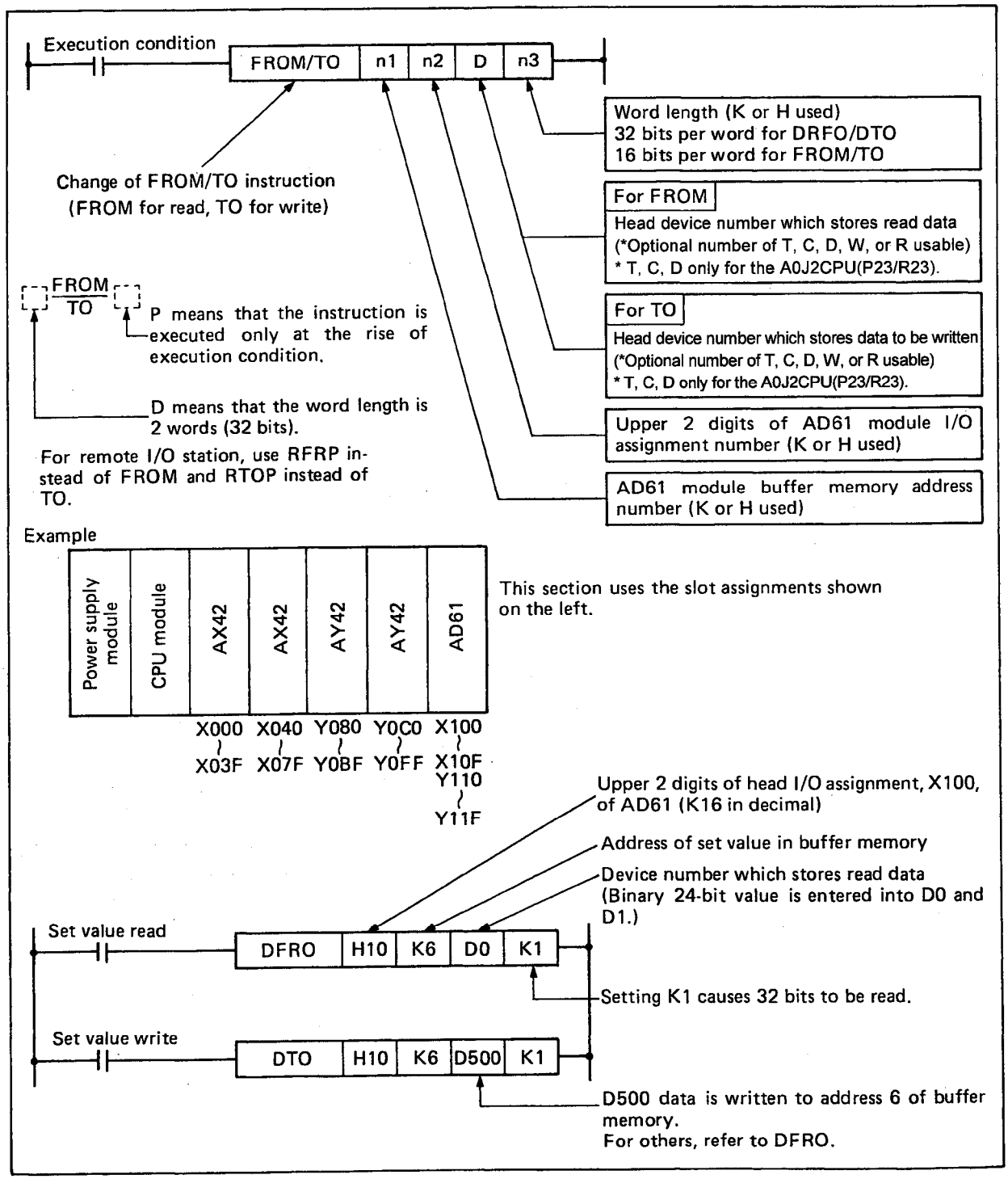
REMARKS

The A2A(S1) and A3ACPU have the dedicated instructions for the AD61: preset data write (PVWR1, PVWR2), set value data write (SVWR1, SVWR2), and present value read (PVRD1, PVRD2). For details, refer to the A2(S1), A3ACPU Programming Manual (Dedicated Instructions).

6.2 Programming for A1(E), A2(E) and A3(E)CPU

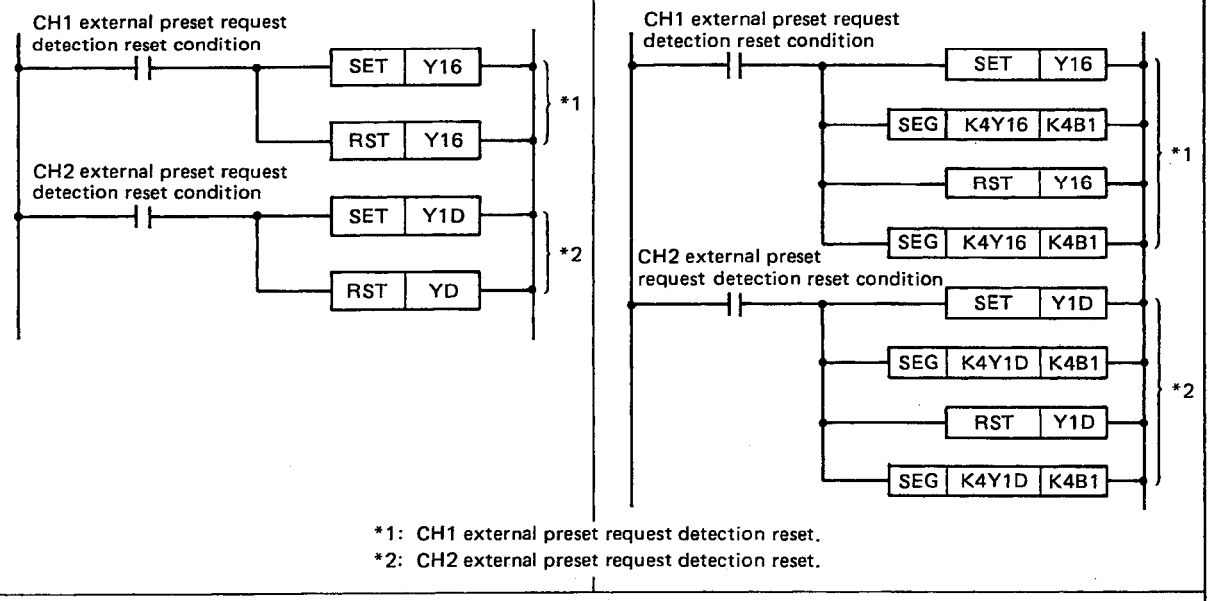
This section describes the programming procedure for A1(E), A2(E), and A3(E)CPU. Explanation will be given in order of programming flow chart in Section 6.1.

To use any special function unit, utilize FROM and TO instructions. These instructions will be described below. For details, refer to A1, A2, A3 Programming Manual.



IB (NA) 66052-B

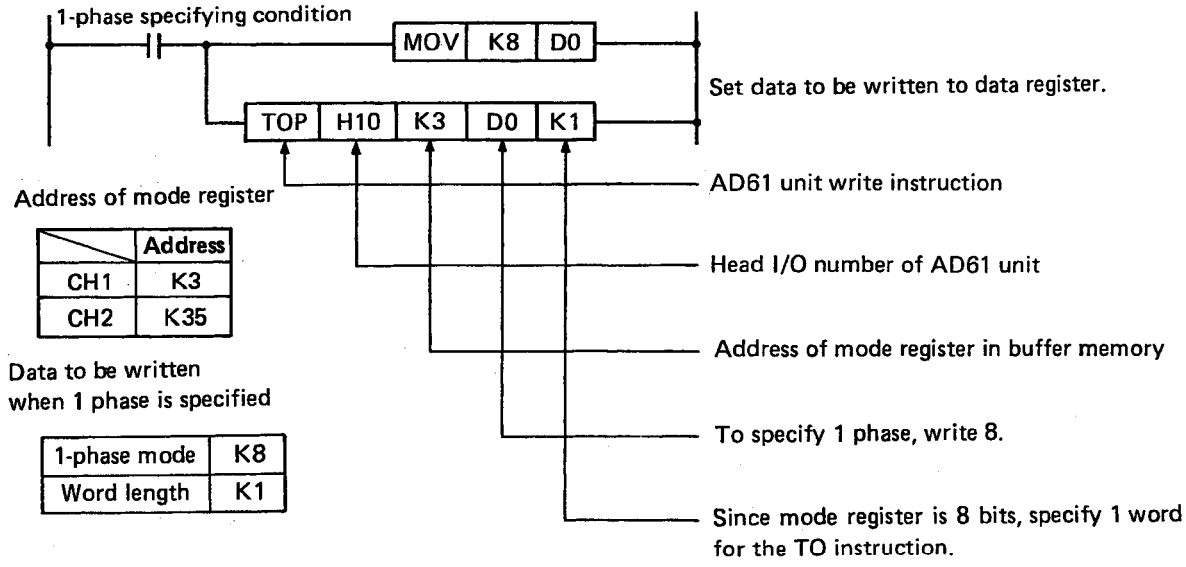
(1) External preset detection reset



*1: CH1 external preset request detection reset.
*2: CH2 external preset request detection reset.

- To perform preset from outside, it is necessary to perform reset of external preset each time.
- Since the preset operation occurs on the pulse leading edge, further, preset by external input or preset by sequence program cannot be performed until the external preset flip flop has been reset.
- The external preset flip flop can be reset while the external preset input is on.
- It is not necessary to execute this signal if the external preset terminal is not used.

(2) Setting of mode register (1-phase specification)



Address of mode register

	Address
CH1	K3
CH2	K35

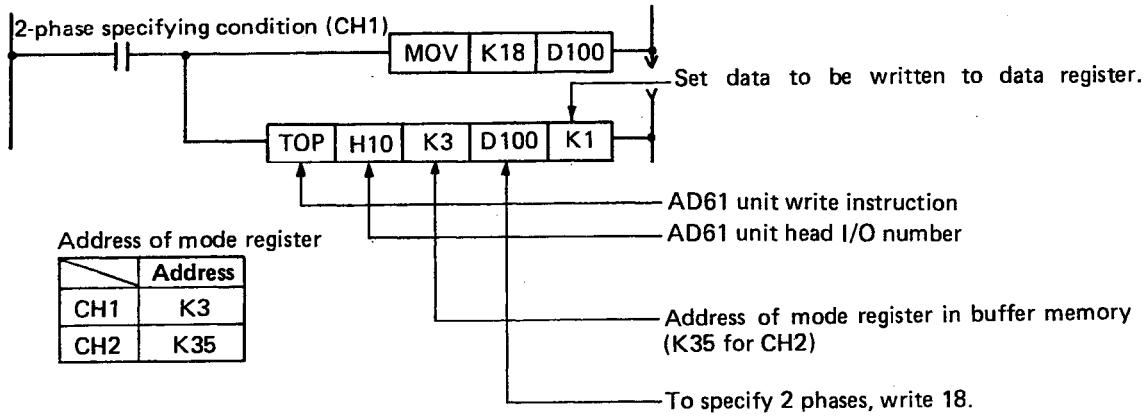
Data to be written when 1 phase is specified

1-phase mode	K8
Word length	K1

- When the power is turned on or the CPU is reset, the value of the mode register is 0.
- For the specification of up or down count, refer to Section (4).

IB (NA) 66052-A

(3) Setting of mode register (2-phase specification)



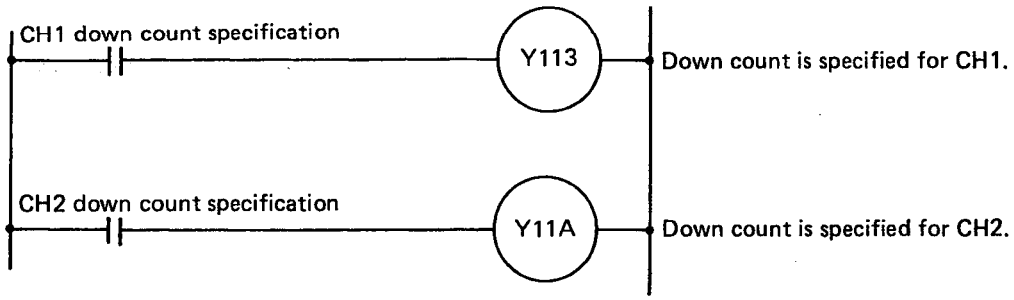
Address of mode register

	Address
CH1	K3
CH2	K35

Data to be written when 2 phases have been specified (in decimal)

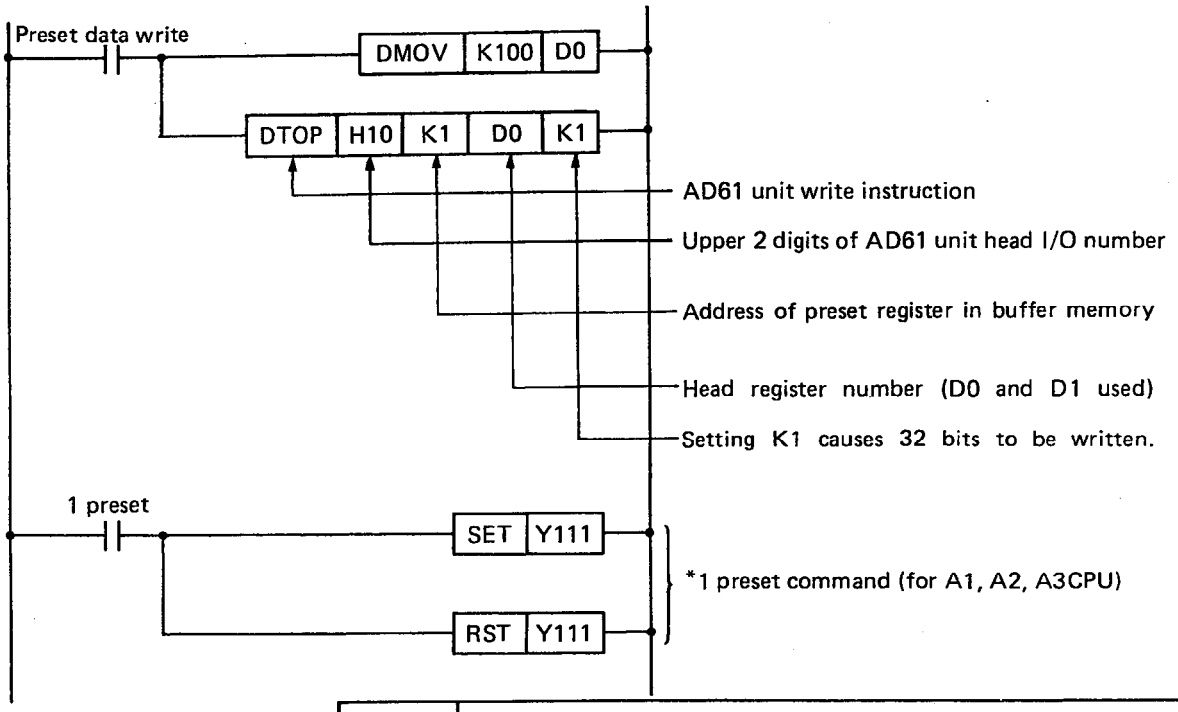
2-phase mode	K18
Word length	K1

(4) Setting of up/down count when 1-phase has been specified.



- When Y113 or Y11A is off, up count is made.
- When the power is turned on or the CPU is reset, both Y113 and Y11A are off.

(5) Setting of preset value data (to set preset value to 100)



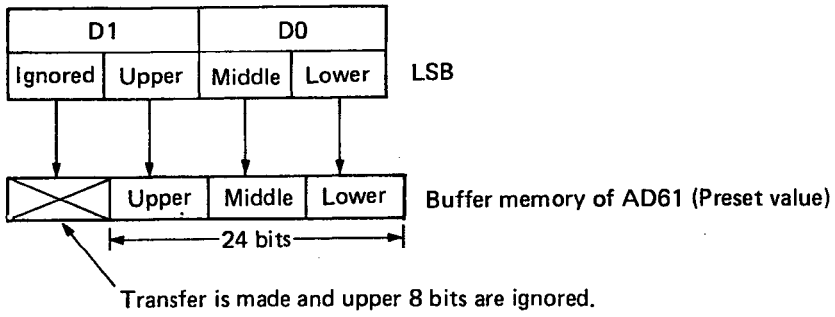
POINT

***1: When using the A1E, A2E, or A3ECPU, use the partial refresh instructions.**

1. Address of preset value

	Address
CH1	K1
CH2	K33
Word length	K1

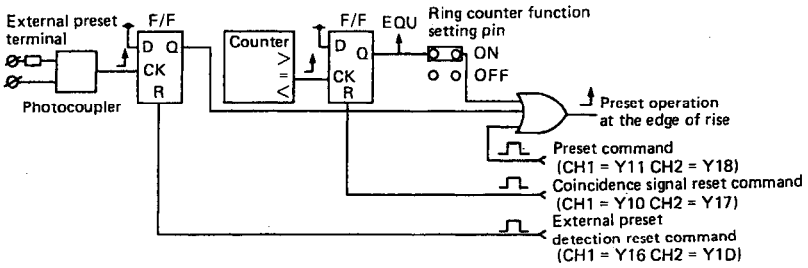
2. Write operation



3. When preset command signal turns on, preset value is set as the initial value of counter at the edge of rise.
   - o If external preset request detection signal remains on, preset operation is not performed even when the above instructions are executed. Before turning on preset, it is necessary to execute external preset detection signal reset.
   - o After preset value write has been executed, preset can be made at any position.

POINT

A block diagram related to the preset operation of the AD61 is shown below.

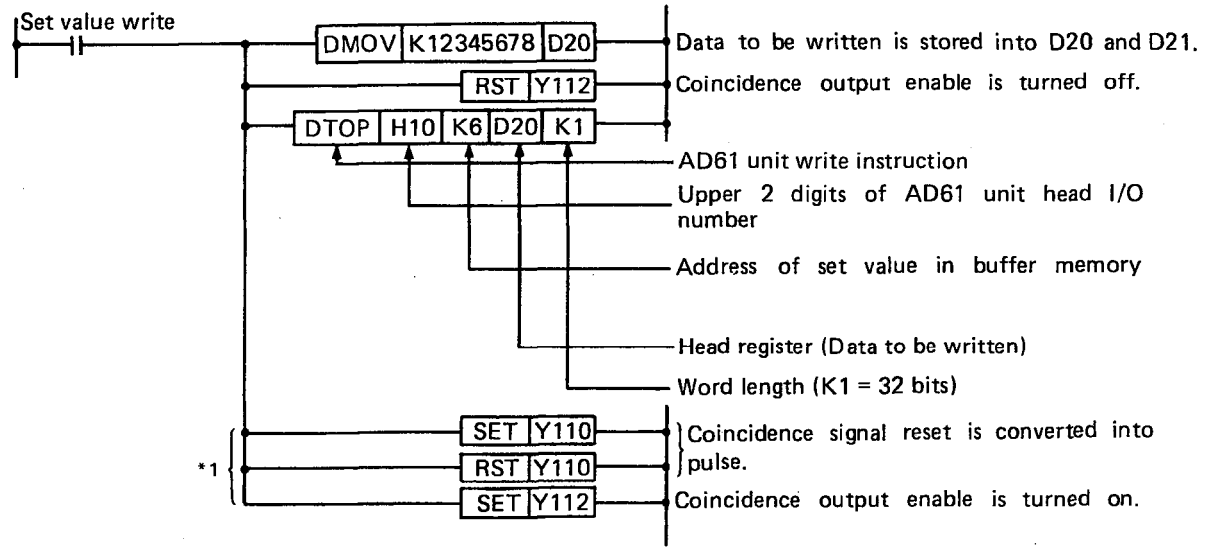


Three signals are available for preset operation.

1. Preset by program
2. Input from external preset terminal
3. Counter coincidence when ring counter is on

Preset operation uses logical add (OR) of these three signals. Upon rise of this signal from off to on, preset operation is performed. If one of the signals remains on, preset operation is not performed because, if another preset signal is turned from off to on, the output of logical add remains on. When ring counter function has been selected, counter value coincidence signal (preset signal) and external preset signal are latched by flip flop. Therefore, it is necessary to provide a reset signal to each of them.

(6) Setting of set value data



POINT

***1: When using the A1E, A2E, or A3ECPU, use the partial refresh instructions.**

Set value address and signal

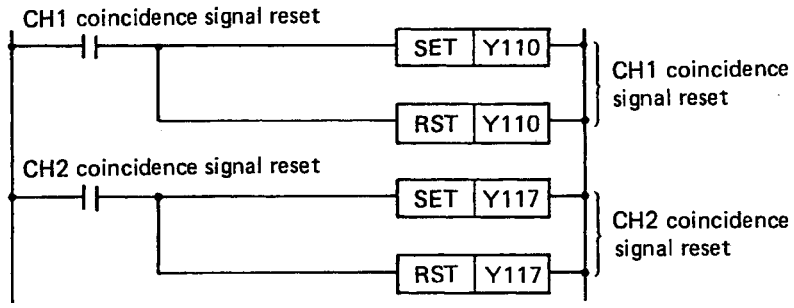
	Address	Coincidence output enable	Coincidence signal reset
CH1	K6	Y112	Y110
CH2	K38	Y119	Y117
Word length	K1		

○When external EQU terminal is not used, RST Y112 and SET Y112 are not required.

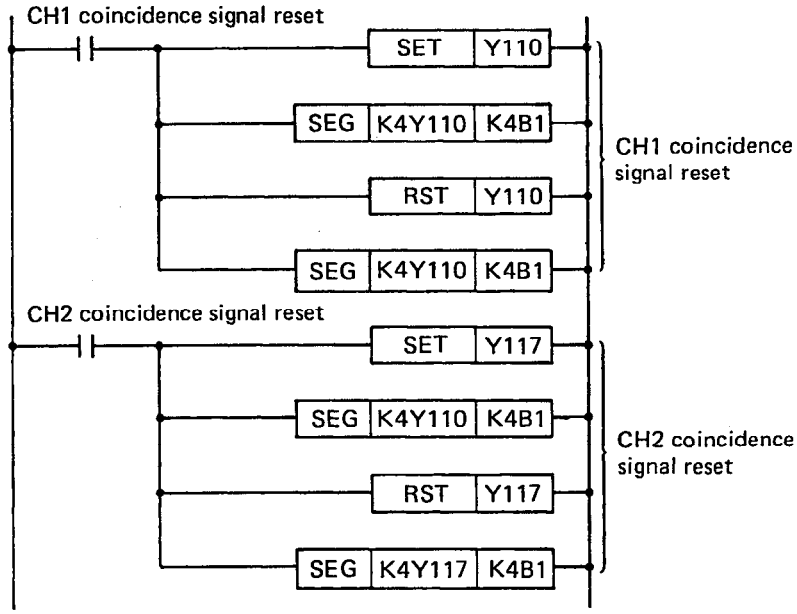
○ When the set value data is written to the buffer memory, the counter value coincidence signal may turn on. For this reason, turn off the coincidence output enable before the set value is written, reset the coincidence signal and finally re-enable the coincidence output.

(7) To reset coincidence signal

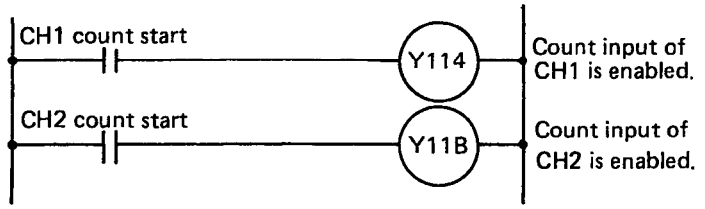
For A1, A2, A3CPU



For A1E, A2E, A3ECPU

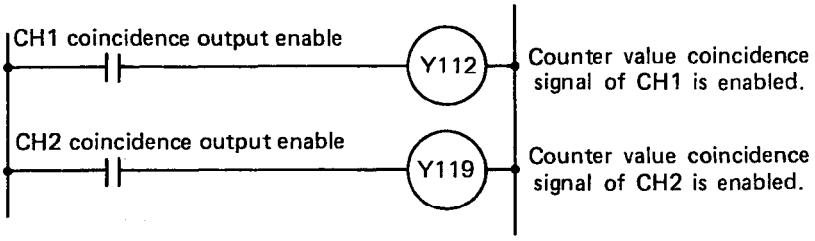


(8) To enable count input



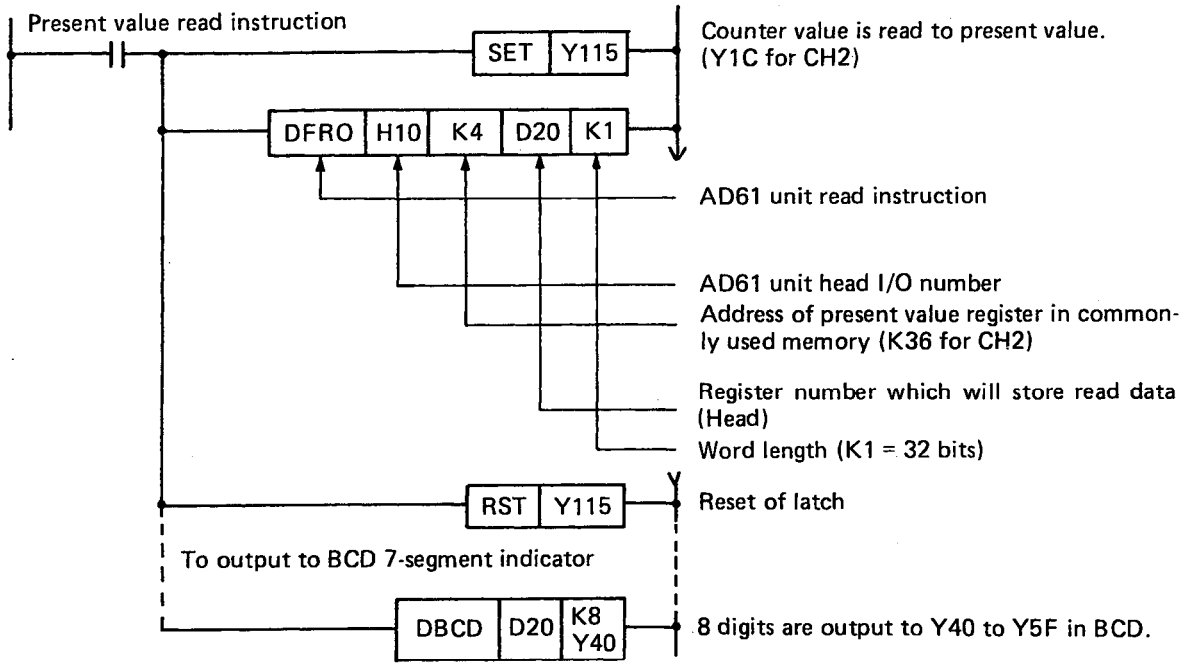
To count signals from the count input terminal block, this signal should be on and the disable input of external terminal block should be off.

(9) To enable coincidence signal output



If a counter value is equal to a set value after this signal is turned on, the counter value coincidence signal is output to the EQU terminal. At the same time, "EQU" LED on the indicator at the top of AD61 is lit.

(10) Present value read

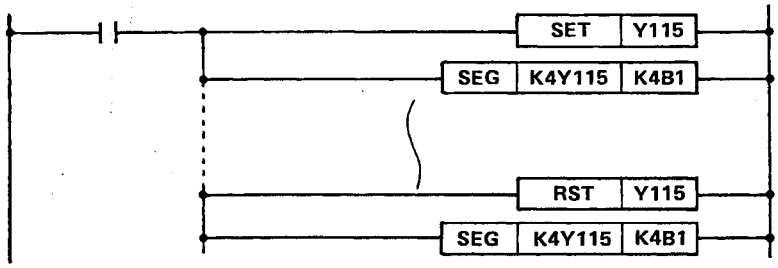


Present value read (decimal)

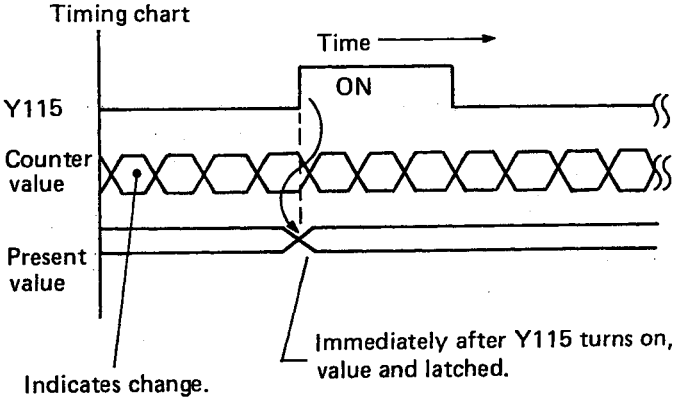
	Address
CH1	K4
CH2	K36
Word length	K1

POINT

When using the A1E, A2E, or A3ECPU, use the partial refresh instructions.



Timing chart

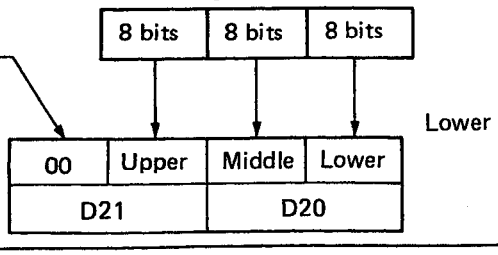


The current value is continuously changing, so to ensure that a correct value is read the above interlock must be used.

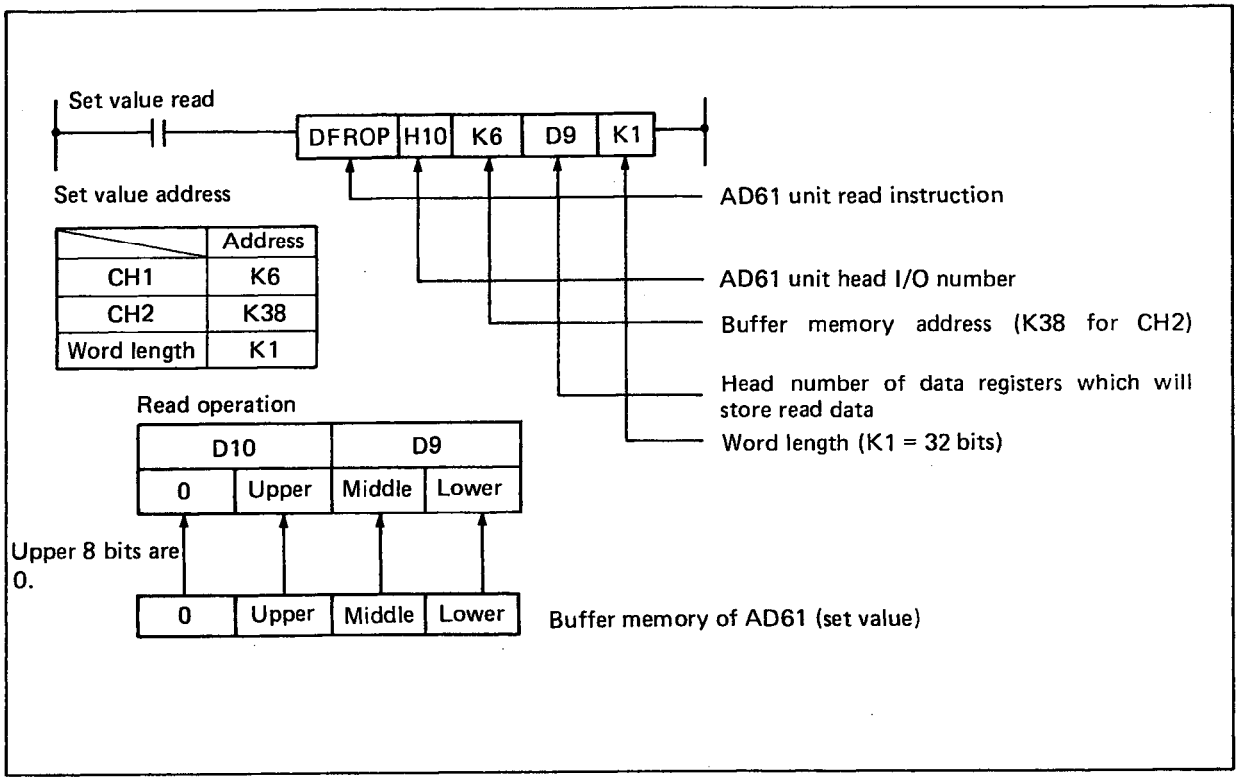
Immediately after Y115 turns on, the count value is treated as present value and latched.

At read time, 00 is set into upper 8 bits.

Present value register (BIN 24 bits)

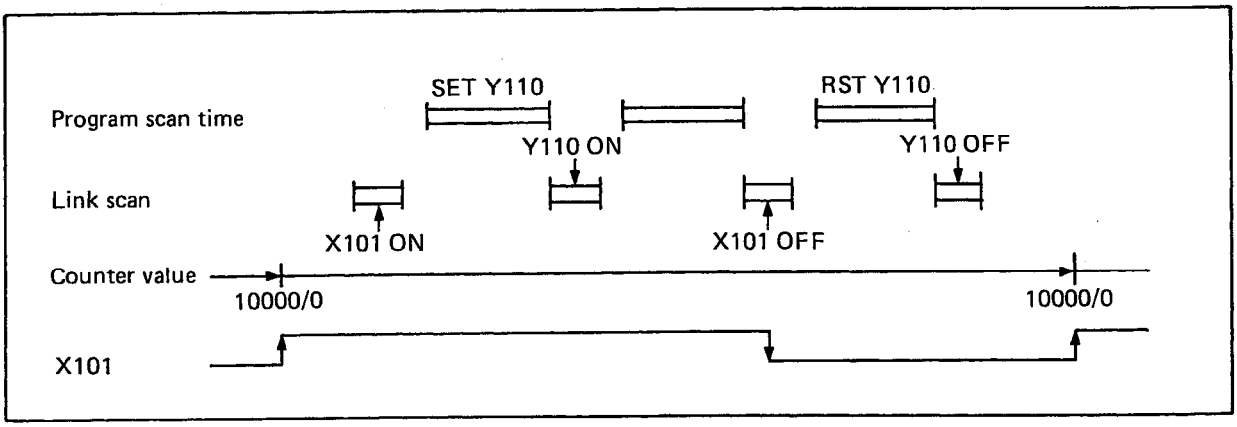


(11) Set value read



6.3 Programming for AD61 in Remote I/O Station

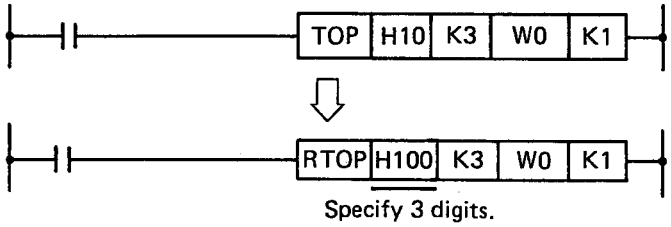
(1) When using the AD61 in a remote I/O station all data and I/O signals must be passed via the link memory. This memory is only accessed after the END command in the main program has been executed so all handshake signals between the AD61 and the CPU will take several scans to be completed.
For example, consider the resetting of the coincidence signals (X01) using the coincidence signal reset command (Y10) (Assume that the AD61 is loaded into the slot corresponding to head number X/Y 100 and the coincidence occurs when the counter current value reaches 10000)



The above example operates correctly because the time taken for the counter to count from 0 to its set value (10000) is greater than the time taken for the handshake signals to operate. If this count time was reduced (i.e. the pulse frequency increased) so that it became less than the time taken to complete the full handshake operation, the AD61 would mis-operate and continue counting above 10000.
It is very important to be aware of this potential problem when using the high speed counter in a remote I/O station. Careful consideration of the main program scan time, the link scan time and the pulse frequency will avoid mis-operation, however it is recommended that the AD61 is used only in stations with their own CPU. If the AD61 is used in a remote I/O station, the handshake sequences described in this section should be used with caution.

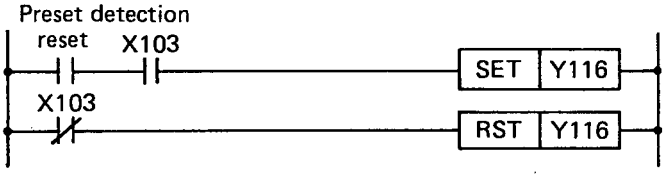
(2) For the communication program to and from the remote I/O station, use RTOP to write to the AD61 and RFRP to read from the AD61.
The RTOP and RFRP instructions differ from TO and FROM in the following point: To set the AD61 head I/O numbers, specify upper 2 digits for TO and FROM. Specify all digits for RTOP and RFRP. (Refer to the Data Link Unit User's Manual.)

Example: AD61 head I/O numbers assigned to X/Y100 to X/Y11F.

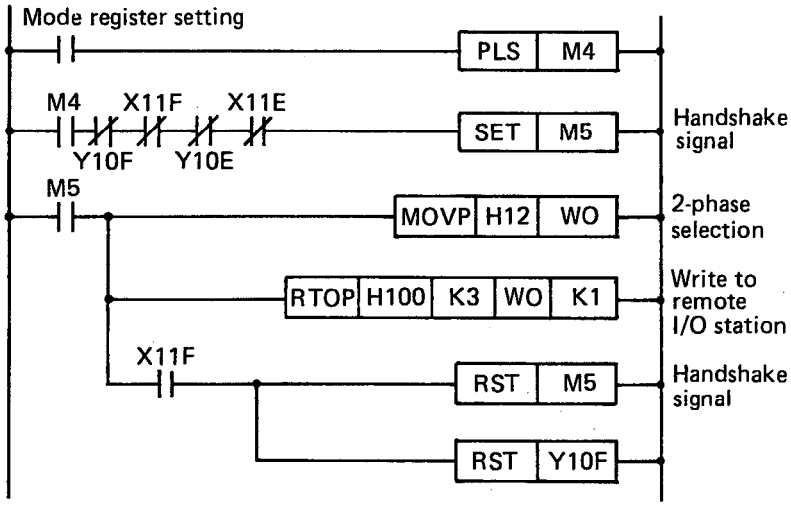


All data is communicated via the link registers. The link registers W should be set in the programmable controller CPU parameters. In the following example, the AD61 is assigned to X/Y100 to X/Y11F.

○ External preset detection reset



○ Mode register setting



POINT

When executing the RFRP/RTOP instruction, the system uses the M→R area of the link registers assigned to the remote I/O station as many as the special function modules mounted on the remote I/O station, starting from the beginning.
The link registers used in the RTOP instruction should be the ones that are not used by the system.
(Refer to the MELSECNET, MELSECNET/B Data Link System Reference Manual.)

7. TEST OPERATION

7.1 Pre-test Checks

IMPORTANT

Before switching on the encoder power supply, check that the correct terminals have been used. Application of 24V to 5V terminals will damage the unit.

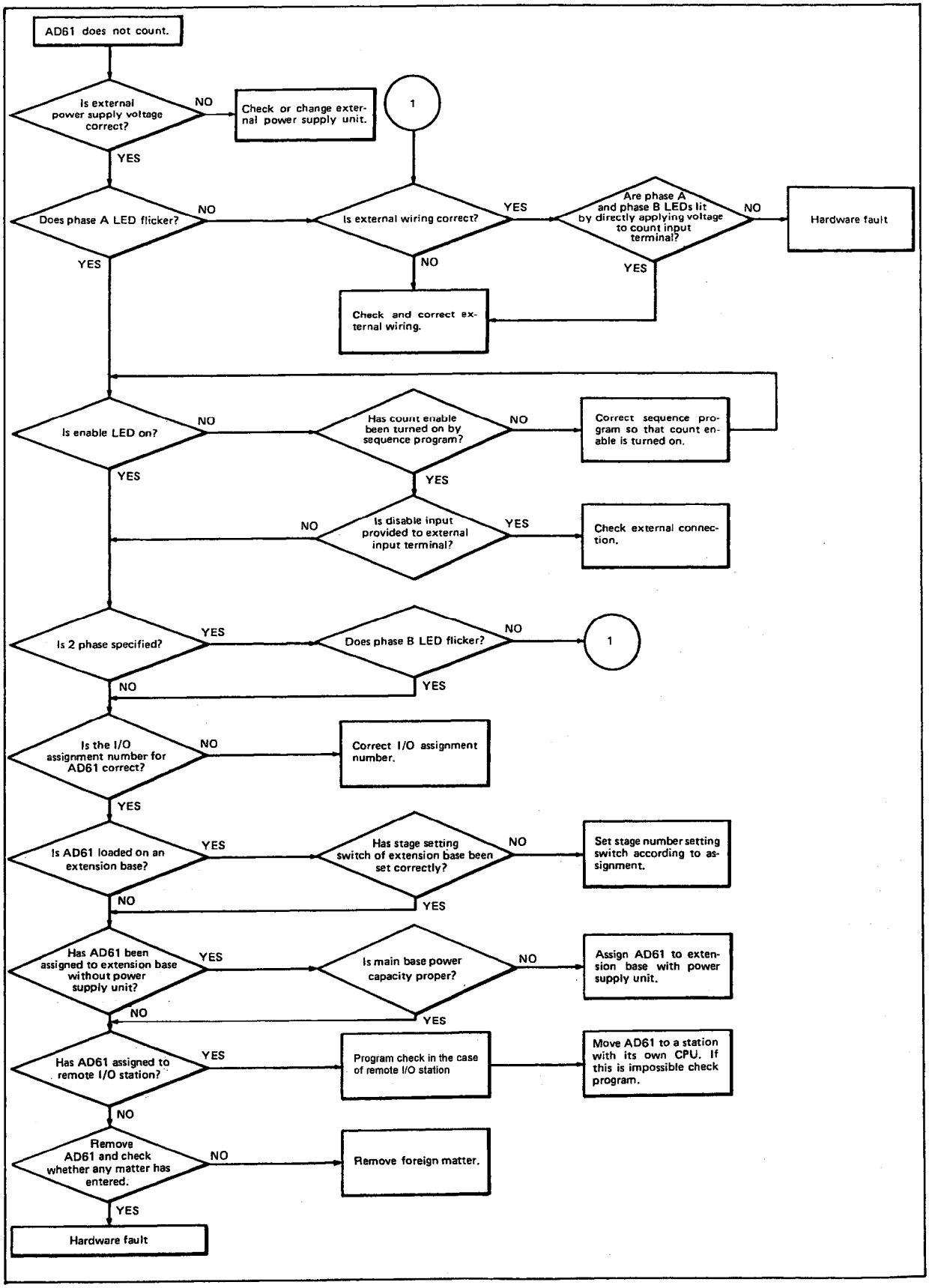
Before turning on the power, check the following:

1. Ring counter setting pin.
2. Check that the AD61 is properly loaded onto the base unit.
3. Check terminal wiring.
4. Check the voltage of the external power supply.

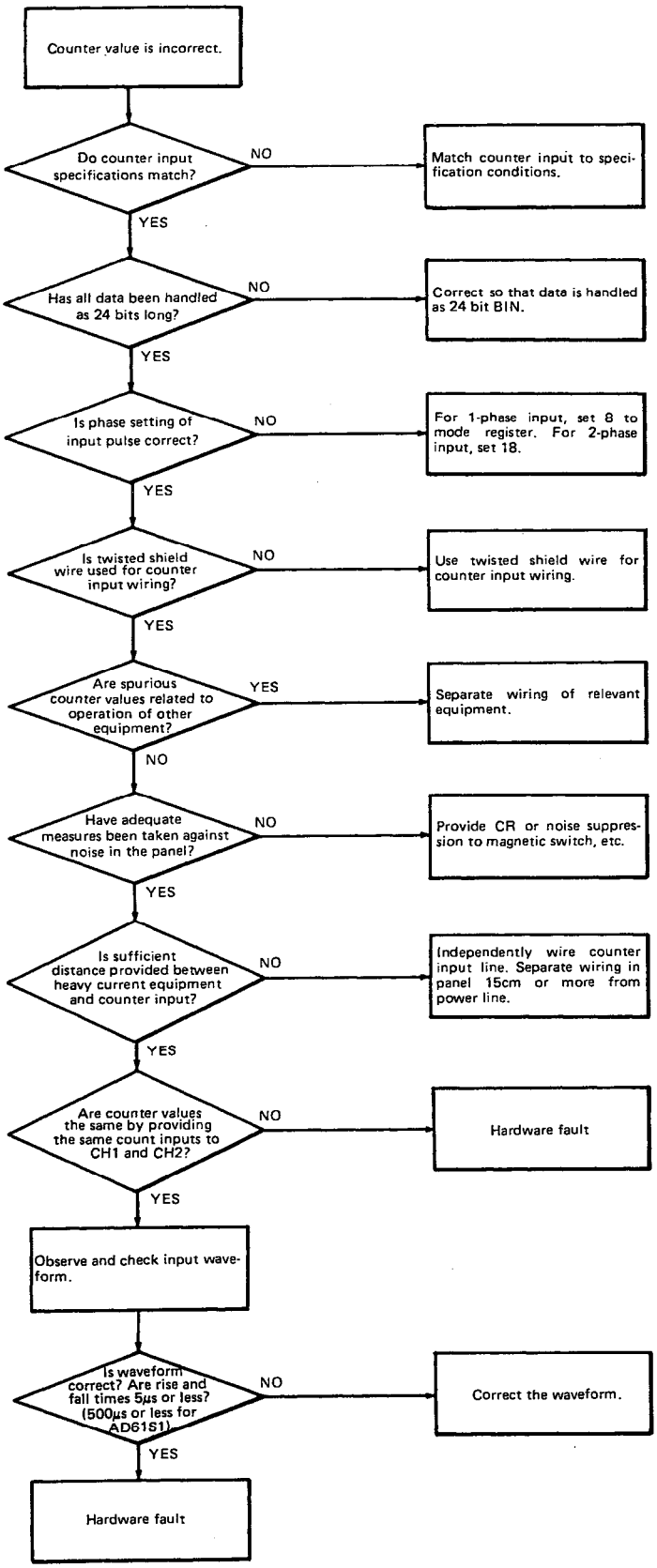
After the above checks, turn on the power and operate the pulse generator. Check the relevant phase indicator LED.

8. TROUBLESHOOTING

AD61 does not count.



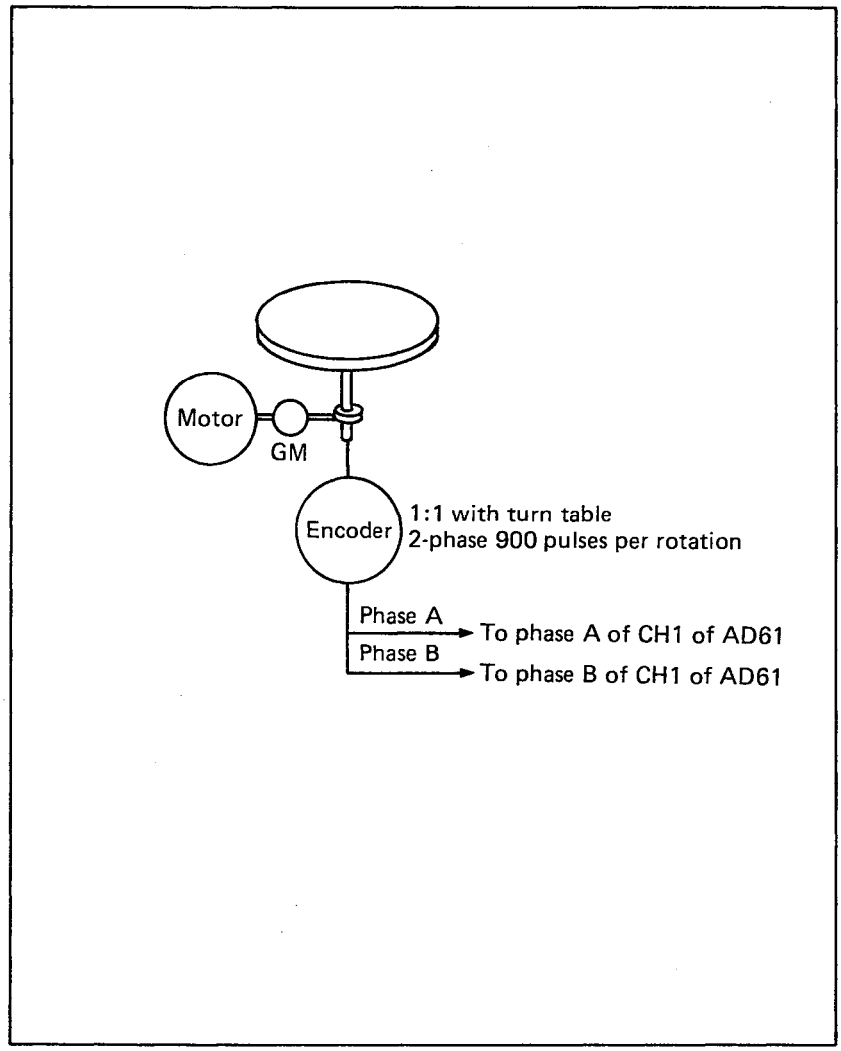
Counter value is incorrect.



APPENDICES

APPENDIX 1 Application Circuit Examples

(1) Example of turn table indexing



Operation

The indexing table is positioned at a corresponding to the digital switch setting (0 to 3599). The encoder is directly connected to the turn table rotating shaft. The encoder gives 900 pulses per rotation, 2-phase.

I/O assignment

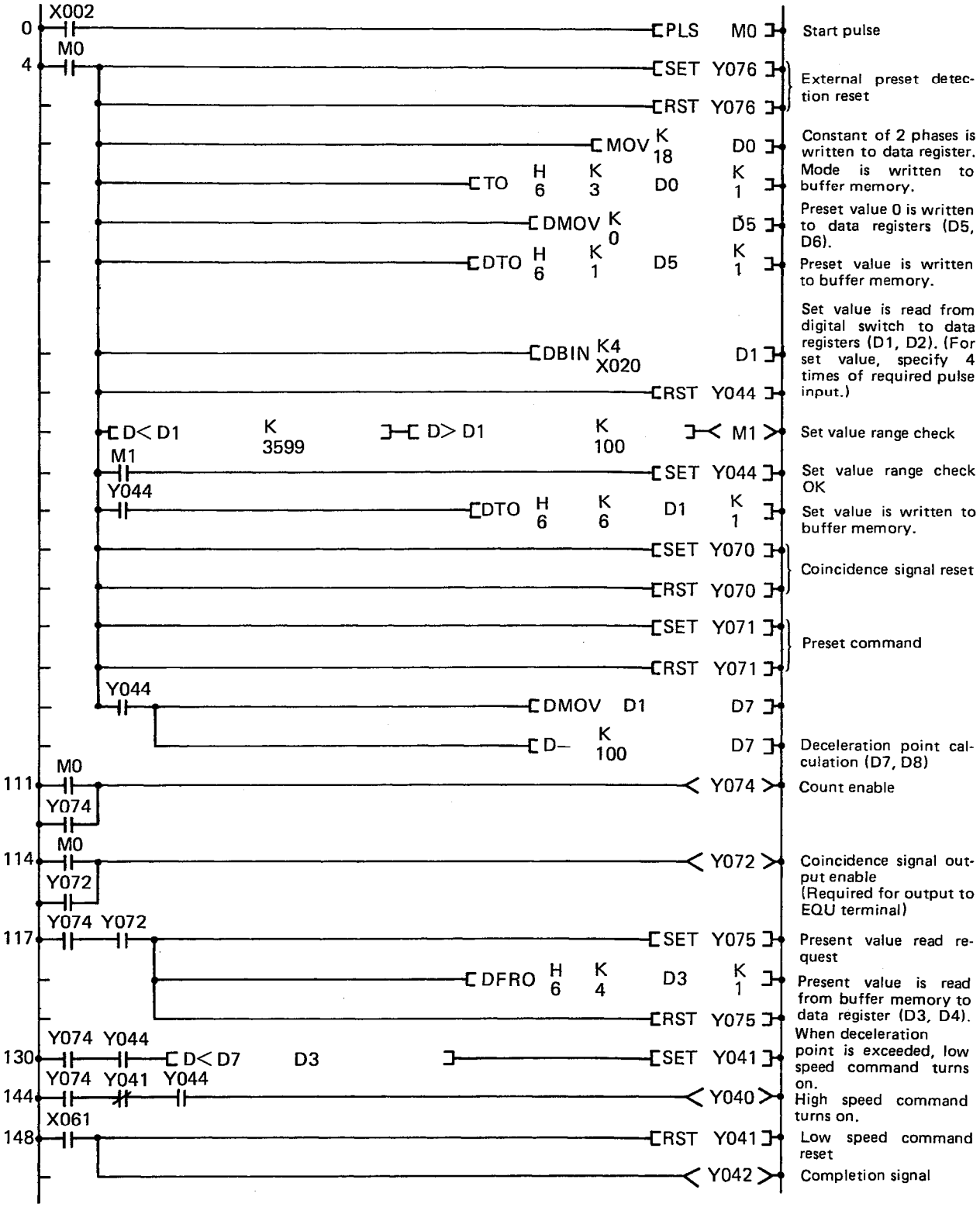
X60 to X6F Y70 to Y7F	AD61
X20 to X2F	4 digits of digital switch
X02	Start switch
Y40	Motor high speed
Y41	Motor low speed
Y42	Completion signal
Y44	Set value range OK

Data register assignment

D0	Mode
D1, D2	Set value
D3, D4	Present value
D5, D6	Preset value
D7, D8	Deceleration point value

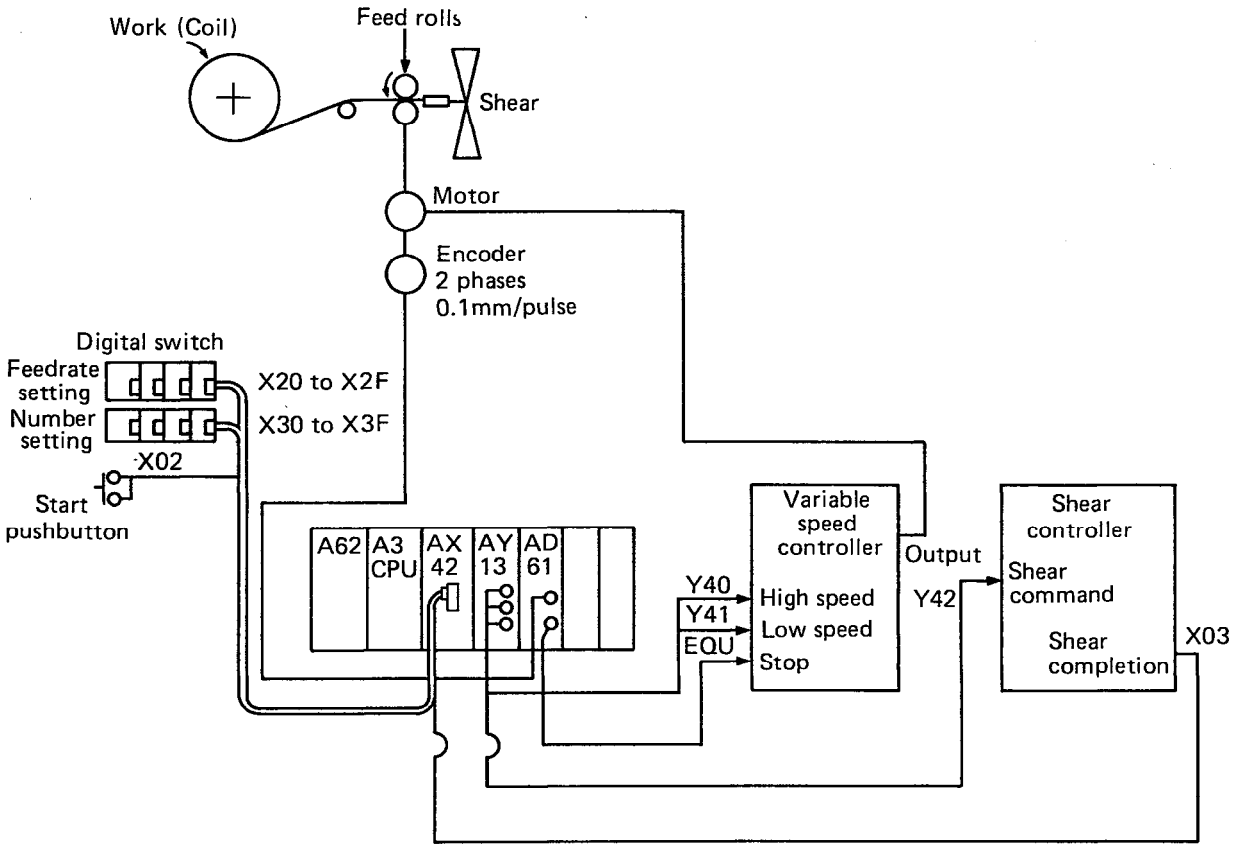
When the start pushbutton is pressed, the motor rotates at high speed and present the value is read. 10 degrees ahead of the indexing point, the speed is reduced. When the counter value coincidence signal turns on, the turn table is brought to a stop. (If the set value is 10 degrees (100 counts) or less, the program does not operate.)

Example of turn table indexing



(2) Example using ring counter function

Shearing control application using the ring counter function.

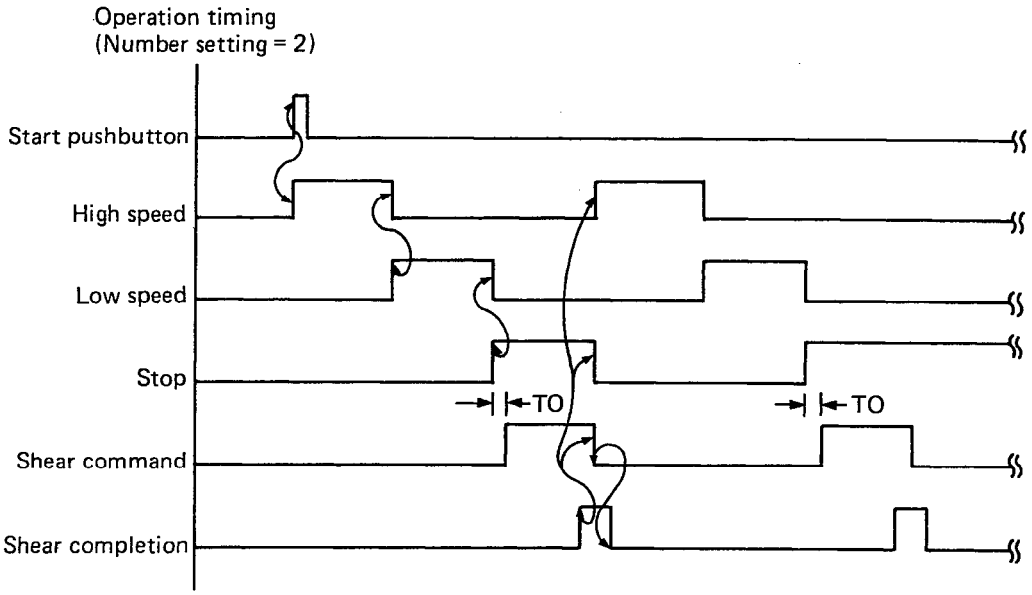


Operation

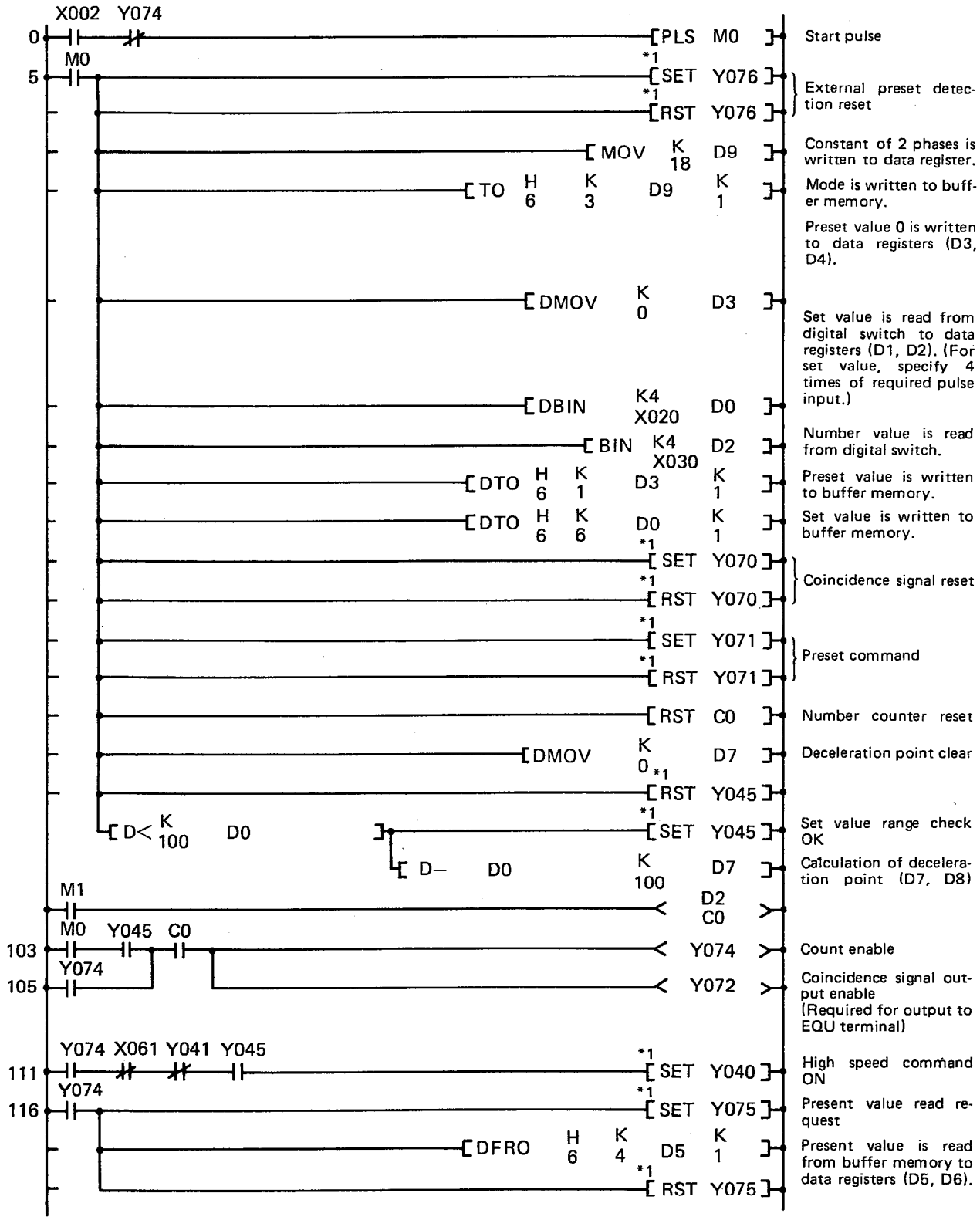
When the start pushbutton is pressed, the amount set by the feedrate digital switch is advanced. When positioning is completed, a shear command is sent to the shear controller. When shearing is complete, the positioning operation is repeated. (Deceleration point is 100 counts ahead of the set value. If the set value is 100 counts or less, the program does not operate.)

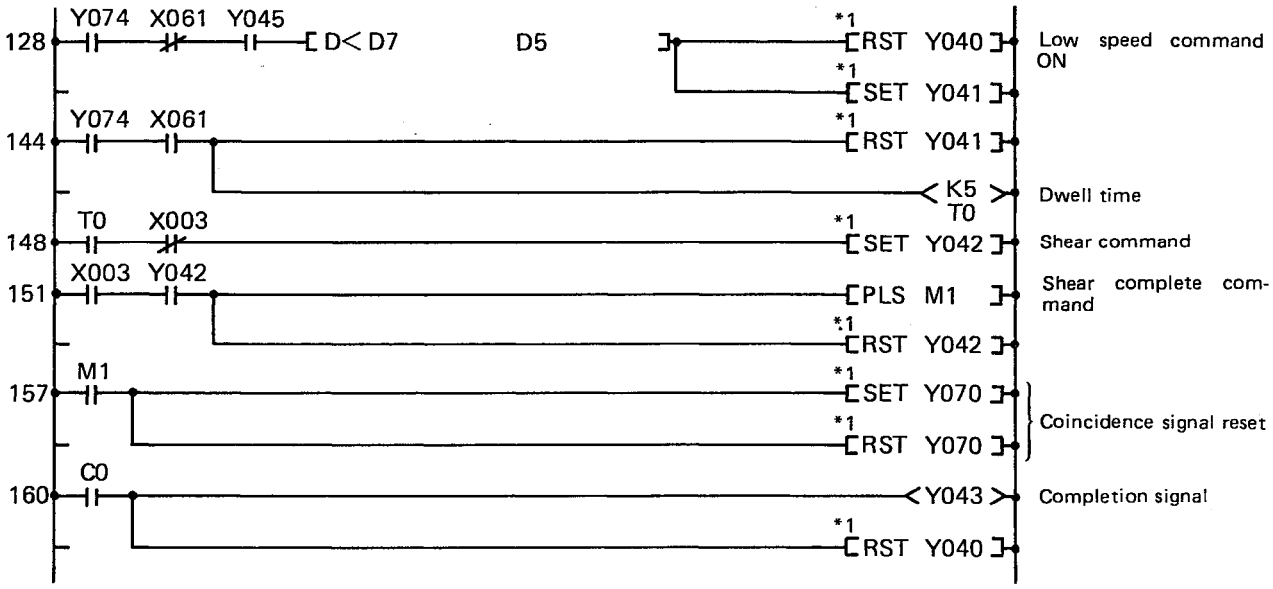
Data register assignment

D0, D1	Set value
D2	Number value
D3, D4	Preset value
D5, D6	Present value


Operation timing
(Number setting = 2)
Start pushbutton
High speed
Low speed
Stop
TO
TO
Shear command
Shear completion

Application circuit using ring counter function (for A1, A2, A3CPU)



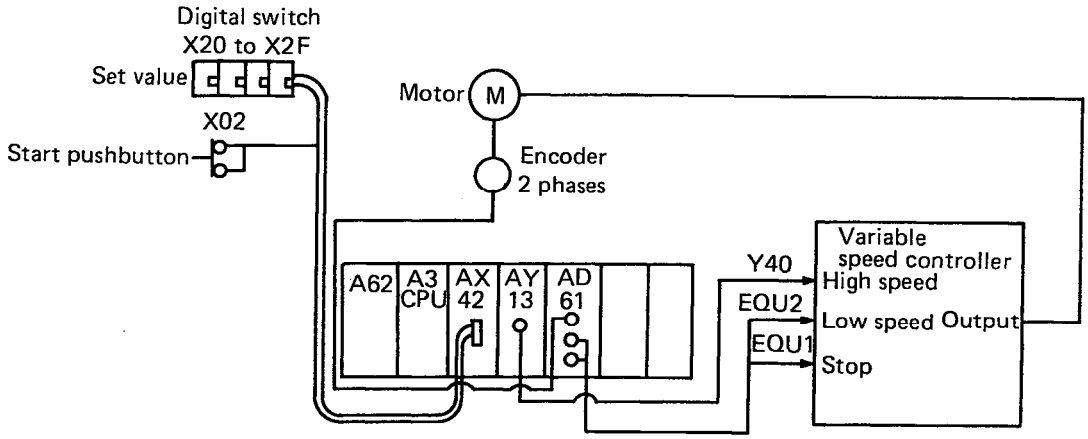


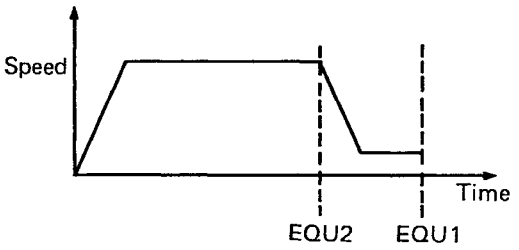
POINT

When using the A1E, A2E, or A3ECPU, use the partial refresh instructions at places marked * in the program.

(3) Example using CH1 and CH2 coincidence signal output

This section shows a high-speed response positioning circuit example which uses the coincidence signal outputs of CH1 and CH2 (EQU1 and EQU2) and has no relation to the scan time of the sequence program.



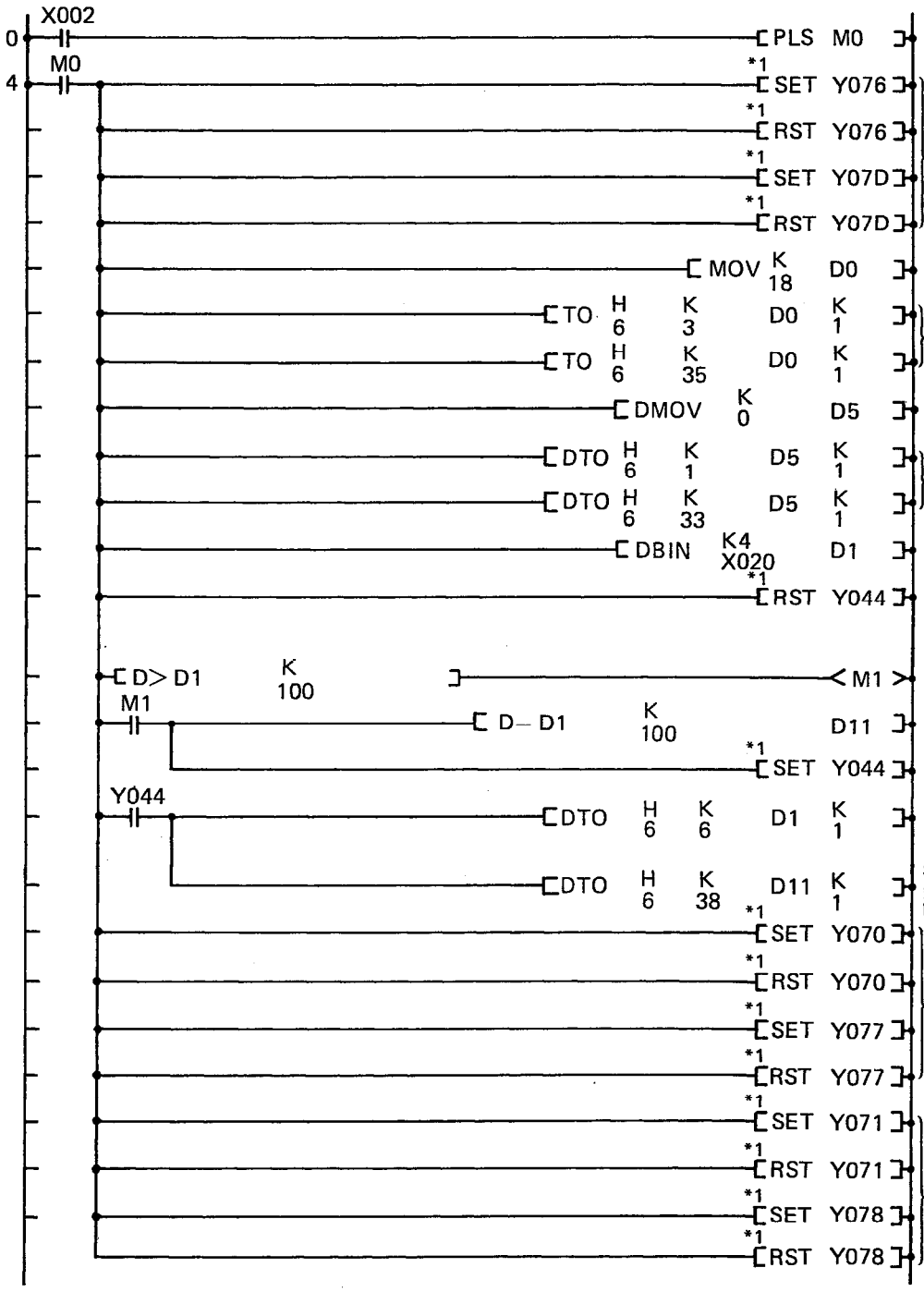


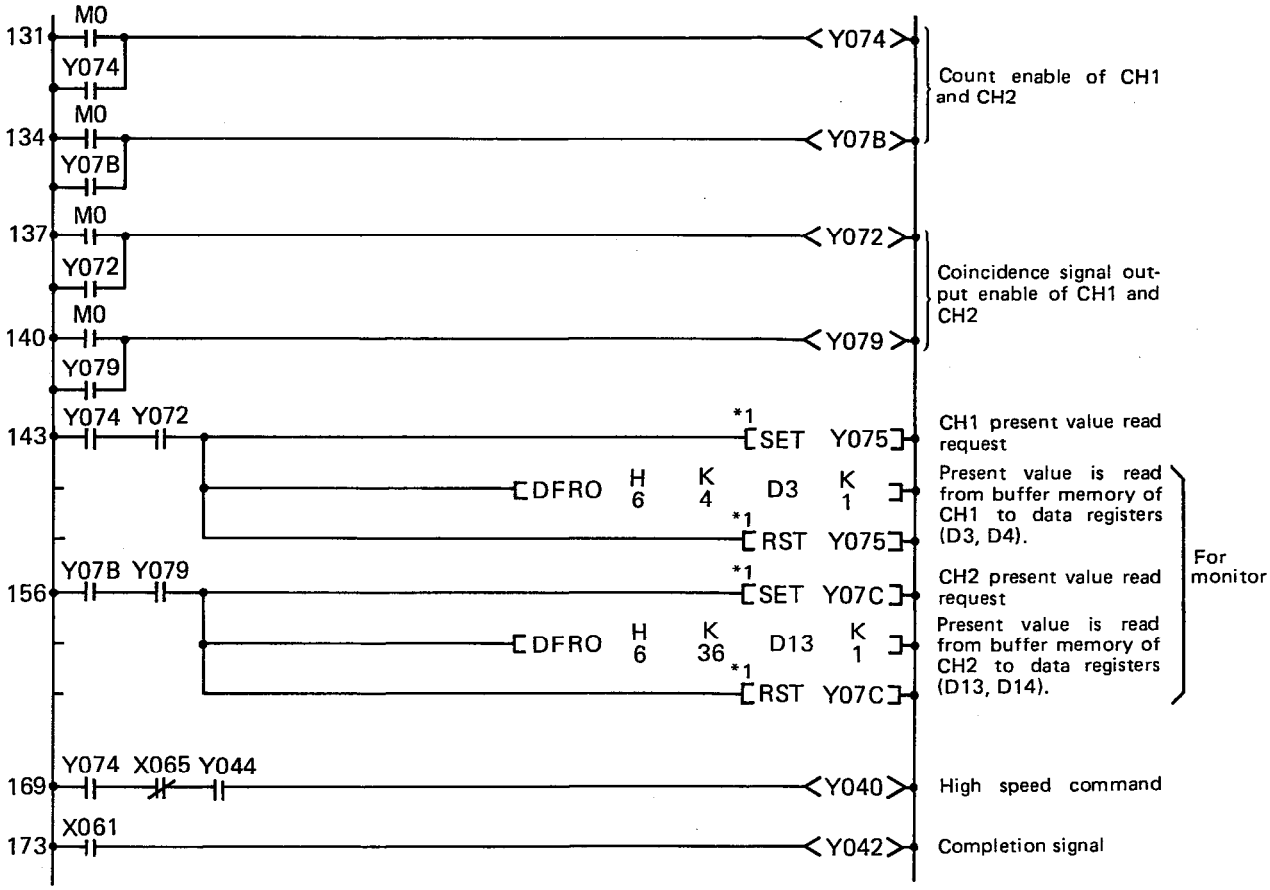
Operation

When the start pushbutton is pressed, the set value is read from the digital switch, output Y is provided, and positions the job at high-speed, using the output signals EQU1 and EQU2.
(Deceleration point is 100 counts ahead of set value. If the set value is 100 counts or less, program does not operate.)

Data register assignment

D0	Modes of CH1 and CH2
D1, D2	Set value of CH1
D3, D4	Present value of CH1
D5, D6	Preset values of CH1 and CH2
D11, D12	Set value of CH2
D13, D14	Present value of CH2

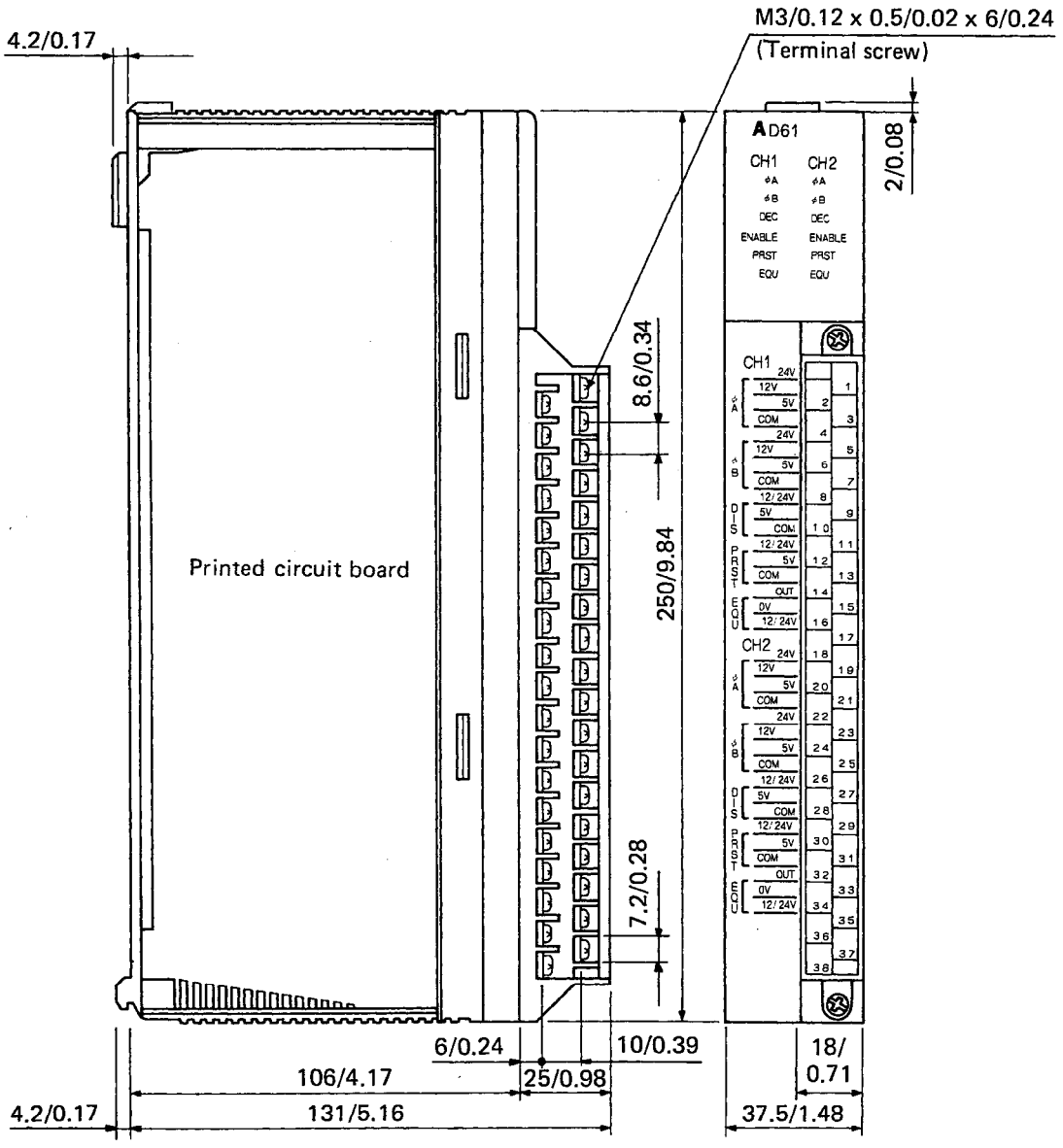

X002
0
PLS M0
Start pulse
M0
4
*1 SET Y076
*1 RST Y076
*1 SET Y07D
*1 RST Y07D
External preset of CH1 and CH2
MOV K 18 D0
Constant of 2 phases is written to data register.
TO H 6 K 3 D0 K 1
TO H 6 K 35 D0 K 1
Mode is written to buffer memories of CH1 and CH2.
DMOV K 0 D5
Preset value is written to data registers (D5, D6).
DTO H 6 K 1 D5 K 1
DTO H 6 K 33 D5 K 1
Preset value is written to buffer memories of CH1 and CH2 (D5, D6).
DBIN K4 X020 D1
*1 RST Y044
Set value is read from digital switch to data registers (D0, D1). (For set value, specify 4 times of required pulse input.)
D> D1 K 100
M1
Set value range check OK
M1
D- D1 K 100 D11
*1 SET Y044
Caiculation of deceleration point (D11, D12)
Y044
DTO H 6 K 6 D1 K 1
Set value (stop point) is written to buffer memory of CH1.
DTO H 6 K 38 D11 K 1
Set value (deceleration point) is written to buffer memory of CH2.
*1 SET Y070
*1 RST Y070
*1 SET Y077
*1 RST Y077
Coincidence signals of CH1 and CH2 are reset.
*1 SET Y071
*1 RST Y071
*1 SET Y078
*1 RST Y078
Preset commands of CH1 and CH2



POINT

When using the A1E, A2E, or A3ECPU, use the partial refresh instructions at places marked * in the program.

APPENDIX 2 External View



Unit: mm/inch

IMPORTANT

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

(1) Ground human body and work bench.

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

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

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

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

WARRANTY

Please confirm the following product warranty details before using this product.

1. Gratis Warranty Term and Gratis Warranty Range

If any faults or defects (hereinafter "Failure") found to be the responsibility of Mitsubishi occurs during use of the product within the gratis warranty term, the product shall be repaired at no cost via the sales representative or Mitsubishi Service Company.

However, if repairs are required onsite at domestic or overseas location, expenses to send an engineer will be solely at the customer's discretion. Mitsubishi shall not be held responsible for any re-commissioning, maintenance, or testing on-site that involves replacement of the failed module.

[Gratis Warranty Term]

The gratis warranty term of the product shall be for one year after the date of purchase or delivery to a designated place.

Note that after manufacture and shipment from Mitsubishi, the maximum distribution period shall be six (6) months, and the longest gratis warranty term after manufacturing shall be eighteen (18) months. The gratis warranty term of repair parts shall not exceed the gratis warranty term before repairs.

[Gratis Warranty Range]

(1) The range shall be limited to normal use within the usage state, usage methods and usage environment, etc., which follow the conditions and precautions, etc., given in the instruction manual, user's manual and caution labels on the product.

(2) Even within the gratis warranty term, repairs shall be charged for in the following cases.

1. Failure occurring from inappropriate storage or handling, carelessness or negligence by the user. Failure caused by the user's hardware or software design.
2. Failure caused by unapproved modifications, etc., to the product by the user.
3. When the Mitsubishi product is assembled into a user's device, Failure that could have been avoided if functions or structures, judged as necessary in the legal safety measures the user's device is subject to or as necessary by industry standards, had been provided.
4. Failure that could have been avoided if consumable parts (battery, backlight, fuse, etc.) designated in the instruction manual had been correctly serviced or replaced.
5. Failure caused by external irresistible forces such as fires or abnormal voltages, and Failure caused by force majeure such as earthquakes, lightning, wind and water damage.
6. Failure caused by reasons unpredictable by scientific technology standards at time of shipment from Mitsubishi.
7. Any other failure found not to be the responsibility of Mitsubishi or that admitted not to be so by the user.

2. Onerous repair term after discontinuation of production

(1) Mitsubishi shall accept onerous product repairs for seven (7) years after production of the product is discontinued. Discontinuation of production shall be notified with Mitsubishi Technical Bulletins, etc.

(2) Product supply (including repair parts) is not available after production is discontinued.

3. Overseas service

Overseas, repairs shall be accepted by Mitsubishi's local overseas FA Center. Note that the repair conditions at each FA Center may differ.

4. Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation of damages caused by any cause found not to be the responsibility of Mitsubishi, loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products, special damages and secondary damages whether foreseeable or not , compensation for accidents, and compensation for damages to products other than Mitsubishi products, replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

5. Changes in product specifications

The specifications given in the catalogs, manuals or technical documents are subject to change without prior notice.

6. Product application

(1) In using the Mitsubishi MELSEC programmable logic controller, the usage conditions shall be that the application will not lead to a major accident even if any problem or fault should occur in the programmable logic controller device, and that backup and fail-safe functions are systematically provided outside of the device for any problem or fault.

(2) The Mitsubishi programmable logic controller has been designed and manufactured for applications in general industries, etc. Thus, applications in which the public could be affected such as in nuclear power plants and other power plants operated by respective power companies, and applications in which a special quality assurance system is required, such as for Railway companies or Public service purposes shall be excluded from the programmable logic controller applications.

In addition, applications in which human life or property that could be greatly affected, such as in aircraft, medical applications, incineration and fuel devices, manned transportation, equipment for recreation and amusement, and safety devices, shall also be excluded from the programmable logic controller range of applications.

However, in certain cases, some applications may be possible, providing the user consults their local Mitsubishi representative outlining the special requirements of the project, and providing that all parties concerned agree to the special circumstances, solely at the users discretion.

High Speed Counter Module Type AD61-S1

User's Manual

MODEL	AD61S1-USERS-E
MODEL CODE	13J610
IB(NA)-66052-D(0411)MEE	

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When exported from Japan, this manual does not require application to the Ministry of Economy, Trade and Industry for service transaction permission.

Specifications subject to change without notice.