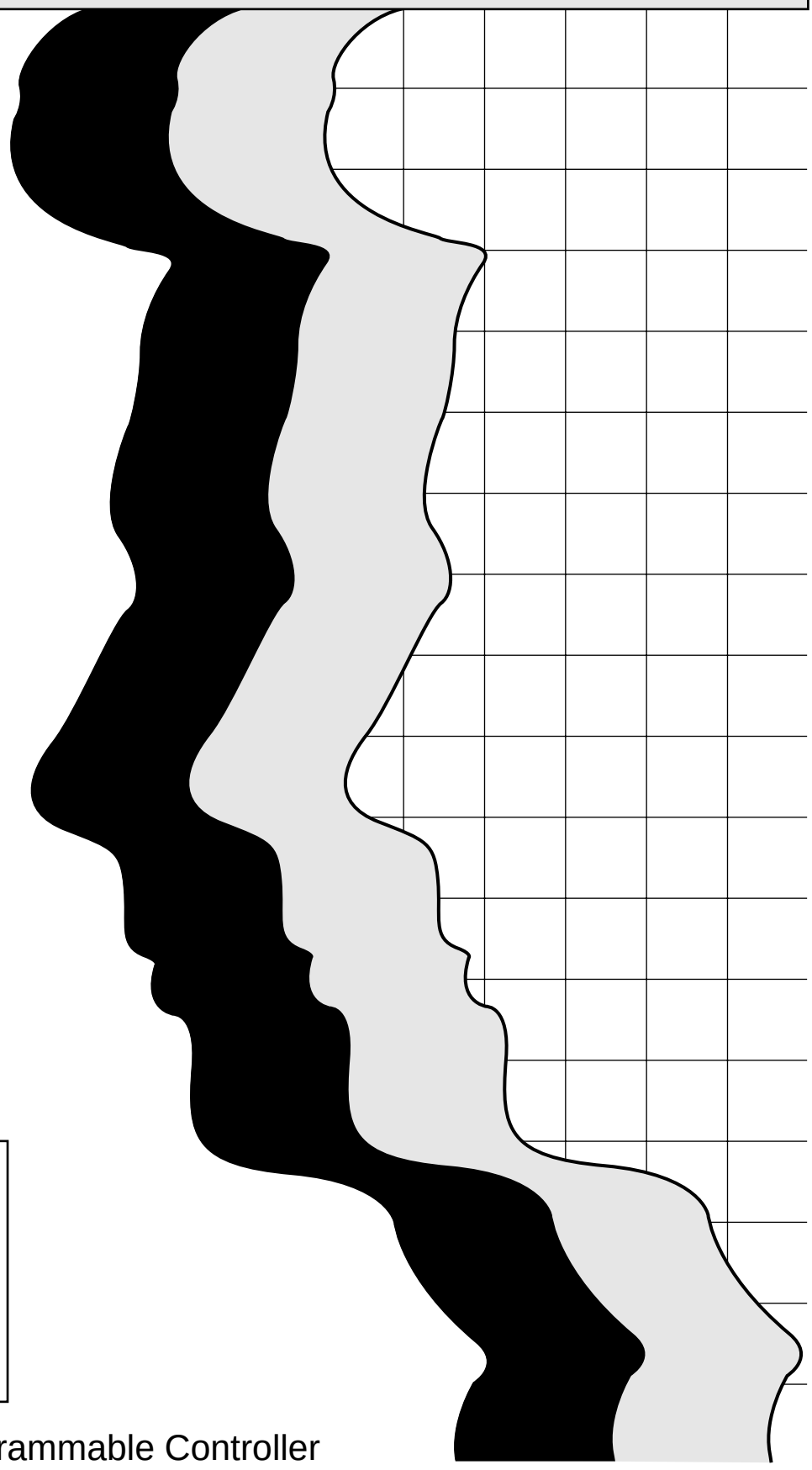
MITSUBISHI

Interruption input Module type A161

User's Manual



A

MELSEC

Mitsubishi Programmable Controller

● SAFETY PRECAUTIONS ●

(Read these precautions before using.)

When using Mitsubishi equipment, thoroughly read this manual and the associated manuals introduced in this manual.

Also pay careful attention to safety and handle the module properly. These precautions apply only to Mitsubishi equipment. Refer to the CPU module user's manual for a description of the PC system safety precautions.

These ● SAFETY PRECAUTIONS ● classify the safety precautions into two categories: "DANGER" and "CAUTION".

⚠ DANGER	**Procedures which may lead to a dangerous condition and cause death or serious injury if not carried out properly.**
⚠ CAUTION	**Procedures which may lead to a dangerous condition and cause superficial to medium injury, or physical damage only, if not carried out properly.**

Depending on circumstances, procedures indicated by ⚠ CAUTION may also be linked to serious results.

In any case, it is important to follow the directions for usage.

Store this manual in a safe place so that you can take it out and read it whenever necessary. Always forward it to the end user.

[DESIGN PRECAUTIONS]

⚠ DANGER

- Install a safety circuit external to the PC that keeps the entire system safe even when there are problems with the external power supply or the PC module. Otherwise, trouble could result from erroneous output or erroneous operation.
  (1) Outside the PC, construct mechanical damage preventing interlock circuits such as emergency stop, protective circuits, positioning upper and lower limits switches and interlocking forward /reverse operations.
  (2) When the PC detects the following problems, it will stop calculation and turn off all output.
    - The power supply module has over current protection equipment and over voltage protection equipment.
    - The PC CPUs self-diagnostic functions, such as the watchdog timer error, detect problems. In addition, all output will be turned on when there are problems that the PC CPU cannot detect, such as in the I/O controller. Build a fail safe circuit exterior to the PC that will make sure the equipment operates safely at such times. See Section 8.1 of this user's manual for example fail safe circuits.

    See this user's manual for example fail safe circuits.
  (3) Output could be left on or off when there is trouble in the outputs module relay or transistor. So build an external monitoring circuit that will monitor any single outputs that could cause serious trouble.
- When overcurrent which exceeds the rating or caused by short-circuited load flows in the output module for a long time, it may cause smoke or fire. To prevent this, configure an external safety circuit, such as fuse.
- Build a circuit that turns on the external power supply when the PC main module power is turned on. If the external power supply is turned on first, it could result in erroneous output or erroneous operation.
- When there are communication problems with the data link, the communication problem station will enter the following condition.
  Build an interlock circuit into the PC program that will make sure the system operates safely by using the communication state information. Not doing so could result in erroneous output or erroneous operation.
  (1) For the data link data, the data prior to the communication error will be held.
  (2) The MELSECNET (II,/B,/10) remote I/O station will turn all output off.
  (3) The MELSECNET/MINI-S3 remote I/O station will hold the output or turn all output off depending on the E.C. remote setting.

  Refer to the data link manuals regarding the method for setting the communication problem station and the operation status when there are communication problem.
- When configuring a system, do not leave any slots vacant on the base. Should there be any vacant slots, always use a blank cover (A1SG60) or dummy module (A1SG62).
  When the extension base A1S52B, A1S55B or A1S58B is used, attach the dustproof cover supplied with the product to the module installed in slot 0.
  If the cover is not attached, the module's internal parts may be dispersed when a short-circuit test is performed or overcurrent/overvoltage is accidentally applied to the external I/O area.

⚠ CAUTION

- Do not bunch the control wires or communication cables with the main circuit or power wires, or install them close to each other. They should be installed 100 mm (3.94 inch) or more from each other. Not doing so could result in noise that would cause erroneous operation.

[DESIGN PRECAUTIONS]

⚠ CAUTION

- When controlling items like lamp load, heater or solenoid valve using an output module, large current (approximately ten times greater than that present in normal circumstances) may flow when the output is turned OFF→ON. Take measures such as replacing the module with one having sufficient rated current.

[INSTALLATION PRECAUTIONS]

⚠ DANGER

- Use the PC in an environment that meets the general specifications contained in this manual. Using this PC in an environment outside the range of the general specifications could result in electric shock, fire, erroneous operation, and damage to or deterioration of the product.
- Install so that the pegs on the bottom of the module fit securely into the base unit peg holes, and use the specified torque to tighten the module's fixing screws. Not installing the module correctly could result in erroneous operation, damage, or pieces of the product falling.
- Tightening the screws too far may cause damages to the screws and/or the module, resulting in fallout, short circuits, or malfunction.
- When installing more cables, be sure that the base unit and the module connectors are installed correctly. After installation, check them for looseness. Poor connections could result in erroneous input and erroneous output.
- Correctly connect the memory cassette installation connector to the memory cassette. After installation, be sure that the connection is not loose. A poor connection could result in erroneous operation.
- Do not directly touch the module's conductive parts or electronic components. Doing so could cause erroneous operation or damage of the module.

[WIRING PRECAUTIONS]

⚠ DANGER

- Completely turn off the external power supply when installing or placing wiring. Not completely turning off all power could result in electric shock or damage to the product.
- When turning on the power supply or operating the module after installation or wiring work, be sure that the module's terminal covers are correctly attached. Not attaching the terminal cover could result in electric shock.

⚠ CAUTION

- Be sure to ground the FG terminals and LG terminals to the protective ground conductor. Not doing so could result in electric shock or erroneous operation.
- When wiring in the PC, be sure that it is done correctly by checking the product's rated voltage and the terminal layout. Connecting a power supply that is different from the rating or incorrectly wiring the product could result in fire or damage.

[WIRING PRECAUTIONS]

⚠ CAUTION

- Do not connect multiple power supply modules in parallel. Doing so could cause overheating, fire or damage to the power supply module. If the terminal screws are too tight, it may cause falling, short circuit or erroneous operation due to damage of the screws or module.
- Tighten the terminal screws with the specified torque. If the terminal screws are loose, it could result in short circuits, fire, or erroneous operation.
- Tightening the terminal screws too far may cause damages to the screws and/or the module, resulting in fallout, short circuits, or malfunction.
- Be sure there are no foreign substances such as sawdust or wiring debris inside the module. Such debris could cause fires, damage, or erroneous operation.
- External connections shall be crimped or pressure welded with the specified tools, or correctly soldered. For information regarding the crimping and pressure welding tools, see the I/O module's user's manual. Imperfect connections could result in short circuit, fires, or erroneous operation.

[STARTUP AND MAINTENANCE PRECAUTIONS]

⚠ DANGER

- Do not touch the terminals while power is on. Doing so could cause shock or erroneous operation.
- Correctly connect the battery. Also, do not charge, disassemble, heat, place in fire, short circuit, or solder the battery. Mishandling of battery can cause overheating or cracks which could result in injury and fires.
- Switch all phases of the external power supply off when cleaning the module or tightening the terminal screws. Not doing so could result in electric shock. If the screws are too tight, it may cause falling, short circuit or erroneous operation due to damage of the screws or modules.
- Tightening the screws too far may cause damages to the screws and/or the module, resulting in fallout, short circuits, or malfunction.

⚠ CAUTION

- The online operations conducted for the CPU module being operated, connecting the peripheral device (especially, when changing data or operation status), shall be conducted after the manual has been carefully read and a sufficient check of safety has been conducted. Operation mistakes could cause damage or trouble of the module.
- Do not disassemble or modify the modules. Doing so could cause trouble, erroneous operation, injury, or fire.
- Switch all phases of the external power supply off before mounting or removing the module. If you do not switch off the external power supply, it will cause failure or malfunction of the module.

[DISPOSAL PRECAUTIONS]

⚠ CAUTION

- When disposing of this product, treat it 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) 66102-A	First edition
Sep., 1989	IB (NA) 66102-B	Correction CONTENTS, Page 1-1, 2-1, 4-7 "Instructions for Strategic Materials" added

INTRODUCTION

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

CONTENTS

1. GENERAL DESCRIPTION

This User's Manual describes the specifications, handling, etc. of the AI61 interruption unit (hereinafter referred to as "AI61") which is used in combination with the MELSEC-A series CPU unit. A general description of each chapter is as follows:

Chapter 2 Specifications

Describes the general and performance specifications of the AI61.

Chapter 3 Handling

Describes nomenclature, maintenance, and inspection of the AI61.

Chapter 4 Interruption Processing Procedure

Describes interruption execution, restrictions on the use of the AI61, setting of interruption conditions, writing interruption programs, timing of interruption processing, etc.

Appendix

Gives dimension of the AI61.

In relation to the use of AI61, the following manuals are available in addition to this User's Manual.

A1NCPU/A2NCPU/A3NCPU User's Manual
A3HCPU User's Manual
ACPU Programming Manual
A1, A2, A3CPU User's Manual
A1, A2, A3CPU Programming Manual
Data Link System User's Manual

REMARKS

In this manual, the A7PU, A6GPPE, A6PHPE, A6HGPE are generically referred to as a peripheral.

POINT

For notes on system configuration, installation, maintenance and inspection for the AI61, see the relevant CPU module User's Manual.

2. SPECIFICATIONS

2.1 General Specifications

The general specifications of A161 are indicated in Table 2.1.

<table>
<tr><th>Item</th><th colspan="5">Specifications</th></tr>
<tr><td>Operating ambient temperature</td><td colspan="5">0 to 55°C</td></tr>
<tr><td>Storage ambient temperature</td><td colspan="5">−20 to 75°C</td></tr>
<tr><td>Operating ambient humidity</td><td colspan="5">10 to 90%RH, no condensation</td></tr>
<tr><td>Storage ambient humidity</td><td colspan="5">10 to 90%RH, no condensation</td></tr>
<tr><td rowspan="3">Vibration resistance</td><td rowspan="3">Conforms to JIS C 0911</td><td>Frequency</td><td>Acceleration</td><td>Amplitude</td><td>Sweep Count</td></tr>
<tr><td>10 to 55Hz</td><td>−</td><td>0.075mm</td><td rowspan="2">10 times
*(1 octave/minute)</td></tr>
<tr><td>55 to 150Hz</td><td>1G</td><td>−</td></tr>
<tr><td>Shock resistance</td><td colspan="5">Conforms to JIS C 0912 (10g x 3 times in 3 directions)</td></tr>
<tr><td>Noise durability</td><td colspan="5">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="5">500V AC for 1 minute across batch of
DC external terminals and ground</td></tr>
<tr><td>Insulation resistance</td><td colspan="5">5MΩ or larger by 500V DC insulation resistance tester across
batch of AC external terminals and ground</td></tr>
<tr><td>Operating ambience</td><td colspan="5">To be free from corrosive gases. Dust should be minimal.</td></tr>
<tr><td>Cooling method</td><td colspan="5">Self-cooling</td></tr>
</table>

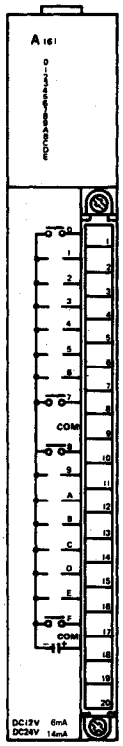
Table 2.1 General Specifications

REMARKS

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

2.2 Performance Specifications

Specification \ Type		Interruption unit (DC Input) AI61		Front view
Number of interruption input points		16 points		
Number of I/O occupying points		32 points		
Insulation system		Photocoupler		
Rated input voltage		12V DC	24V DC	
Rated input current		6mA	14mA	
Operating voltage range		10.2 to 26.4V DC		
Max. simultaneous ON points		100% (8 points/common) simultaneous ON		
ON voltage/ON current		9V or higher/4.5mA or higher		
OFF voltage/OFF voltage		6V or lower		
Input resistance		Approx. 2.4kΩ		
Response time	OFF → ON	0.2ms or shorter		
	ON → OFF	0.2ms or shorter		
Internal current consumption (5V DC)		140mA (TYP. all points ON)		
Common wiring system		16 points/common (common terminal: TB9, TB18)		
Operation indicator		ON display (LED)		
External connection system		20-point terminal block connector (M3 x 6mm screws)		
Applicable wire size		0.75 to 2mm² (applicable tightening torque: 7kg·cm)		
Applicable solder-less terminal		1.25–3.1, 1.25–YS3A, 2–S3, 2–YS3A V1.25–3, V1.25–YS3A, V2–S3, V2–YS3A		
Weight		0.4kg		



Terminal No.	Signal No.
TB1	X00
TB2	X01
TB3	X02
TB4	X03
TB5	X04
TB6	X05
TB7	X06
TB8	X07
TB9	Power supply common
TB10	X08
TB11	X09
TB12	X0A
TB13	X0B
TB14	X0C
TB15	X0D
TB16	X0E
TB17	X0F
TB18	24V DC
TB19	Not used
TB20	Not used

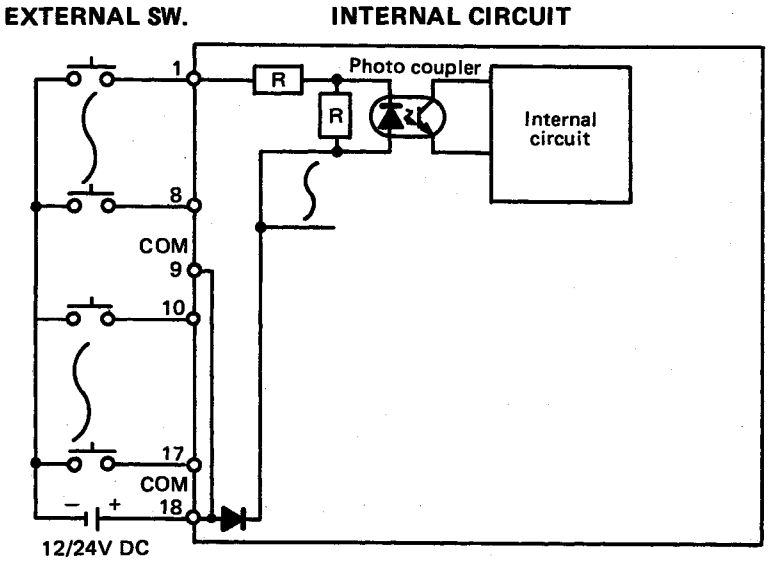


Table 2.2 Type AI61 Interruption Unit Specifications

3. HANDLING

3.1 Handling Instructions

(1) Do not subject the unit to impact or shock.

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

(3) When wiring, prevent wire offcuts from entering the unit.

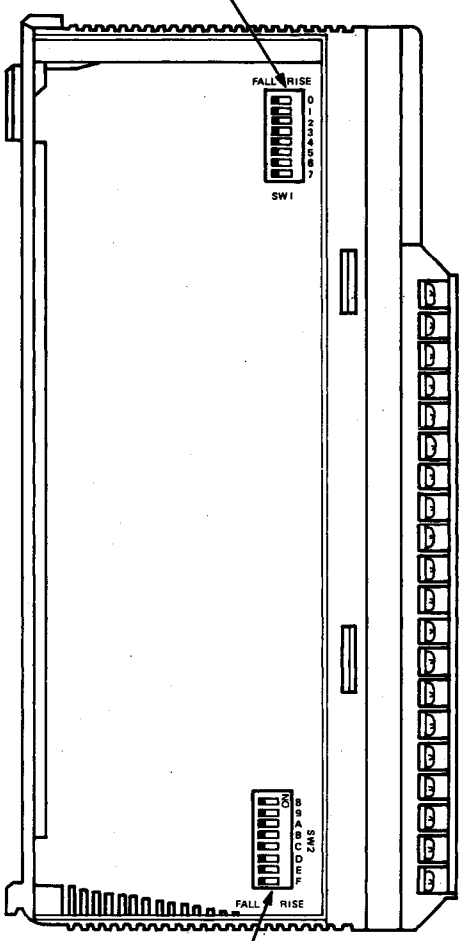
(4) Tighten screws, such as unit mounting screws and terminal screws, in the range specified below.

Screw	Tightening Torque Range (kg·cm)
I/O unit terminal block terminal screw (M3 screw)	5 to 8
I/O unit terminal block mounting screw (M4 screw)	8 to 14
Unit mounting screw (optional) (M4 screw)	8 to 12

(5) When loading the unit to the base, push the unit so that the catch is securely locked to the base. When unloading the unit, push the catch and then pull toward you after the hook is completely disengaged from the base.

For details, refer to the A1, A2, A3CPU User's Manual.

3.2 Nomenclature



Interruption processing condition setting switch (SW1)

Setting for interruption execution on input signal rise or fall for first 8 points (0 to 7)

Unit fixing hook

Hook for fixing the unit to the base.

Unit fixing screw mounting hole

In addition to the unit fixing hook, the unit can be fixed to the base unit with screws. This hole is used as a fixing screw mounting hole (mounting hole for M4 screw).

Input display LED

A light emitting diode which displays the ON and OFF statuses of input. Lit when input turns on.

Terminal block fixing screw (M4 screw)

Screw for mounting and fixing the terminal block to the unit.

Terminal block

Terminal block for connecting the power and I/O signal cables.

Terminal screw

M3 x 0.5 x 6

Interruption processing condition setting switch (SW2)

Setting for interruption execution on input signal rise or fall for second 8 points (8 to F)

Unit fixing screw mounting hole

In addition to the unit fixing hook, the unit can be fixed to the base unit with screws. This hole is used as a fixing screw mounting hole (mounting hole for M4 screw).

3.3 Wiring Instructions

The response time of the AI61 to an interruption input signal is 0.2 ms or less. Therefore, any noise induced in the input signal wires may cause misoperation. For this reason, special care should be exercised to prevent noise from being induced. For example, wires must be run as far away as possible from power lines, main circuit lines, etc. or a twisted shield wire should be used.

3.4 Maintenance and Inspection

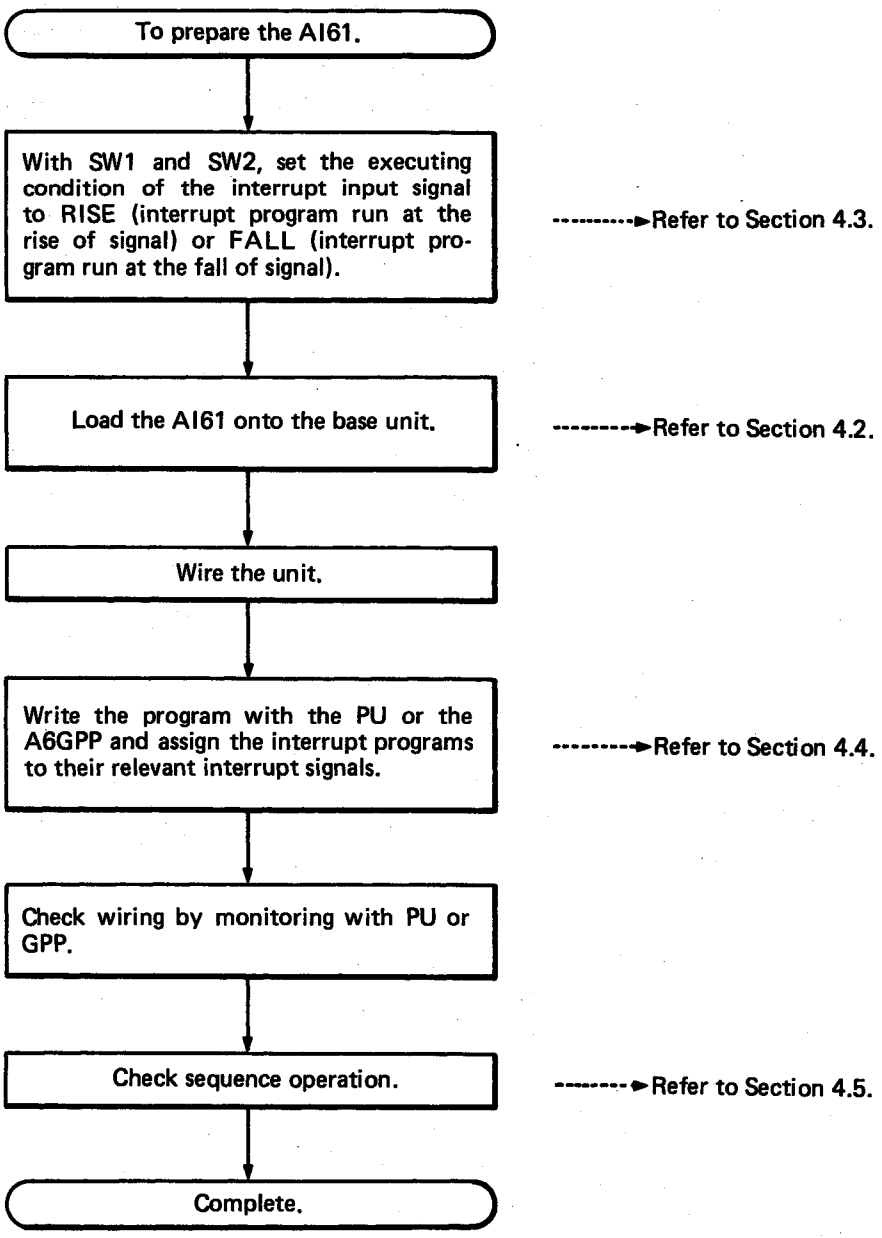
The AI61 needs no special maintenance or checks. For general information, refer to the A1, A2, A3CPU User's Manual.

4. INTERRUPTION PROCESSING PROCEDURE

The AI61 unit temporarily stops the normal sequence program from running when an interruption input signal, which requires high-speed response, has occurred and executes an interruption program according to the interruption factor.

4.1 Operation Procedure

Preparation of the AI61:



4.2 Loading Position and Usable Number of Units

This section describes the loading position and restrictions on the number of AI61s.

(1) The AI61 can be loaded into any slot on the main base (A3□B) or extension base (A6□B, A5□B).

(2) The AI61 cannot be used for a remote I/O station.

(3) Only one AI61 per CPU system. (Therefore, the number of interruption input points is a maximum of 16.)
If two or more AI61 units are loaded, an error will occur. (In the case of A3CPU, "SP. UNIT LAY. ERR." will be displayed at the LED indicator on the front of the CPU.)

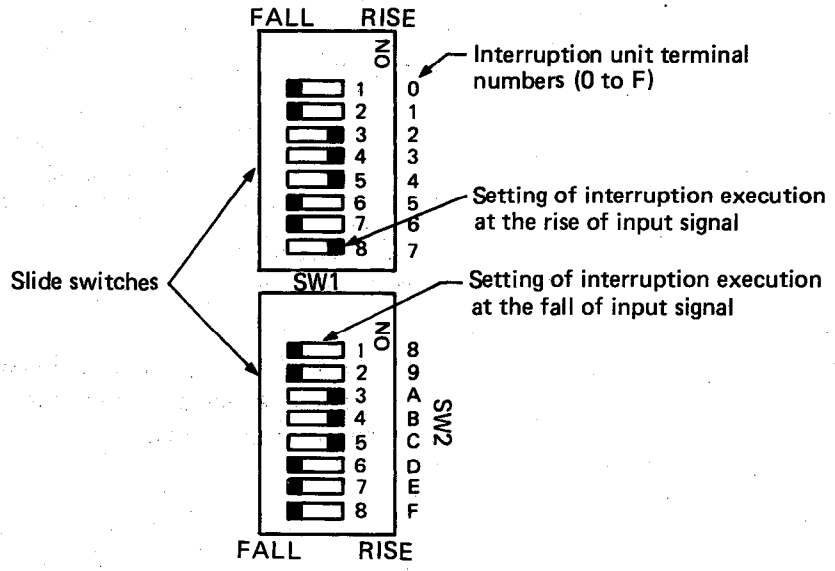
4.3 Setting of Interrupt Processing Condition

There are two types of interrupt start conditions; RISE (execution at rise) and FALL (execution at fall). This section describes the setting of these conditions.

(1) For the setting of interrupt start condition, use the switches (SW1 and SW2) provided on the printed circuit board.

(2) The interrupt start conditions can be individually set for each input.

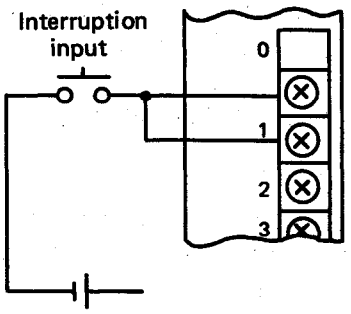
(3) When the slide switch is set to the RISE position, interruption is executed at the rise of the input signal. When it is set to the FALL position, interruption is executed at the fall of input signal.



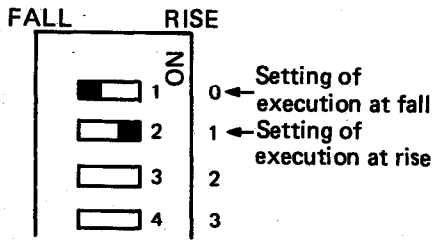
Interrupt condition setting switches

(5) Only one of the interrupt start conditions, RISE or FALL, can be set to each terminal. If it is necessary to perform interruption at both conditions, use the following procedure:

1) Perform wiring and setting as shown in the figure below.



AI61 terminal block



Interruption processing condition setting

2) Write the interrupt program in list mode.

```
I0
I1
LD .....
:
IRET
```

Interrupt program

When the program shown on the left is displayed in ladder mode, I0 is not displayed on the screen. However, I0 is processed properly.

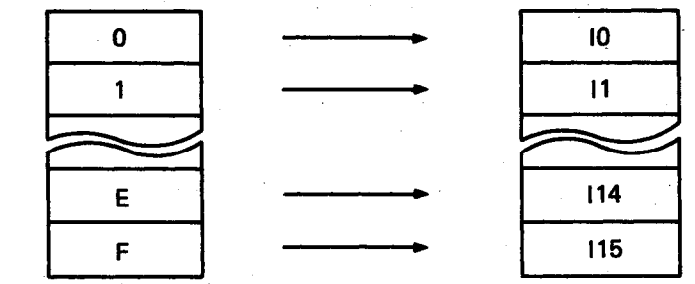
3) By performing the above steps 1) and 2), the interrupt program is executed when the interrupt input signal turns off to on or on to off.

4.4 Writing Interrupt Programs

This section describes the requirements and cautions for writing an interrupt program.

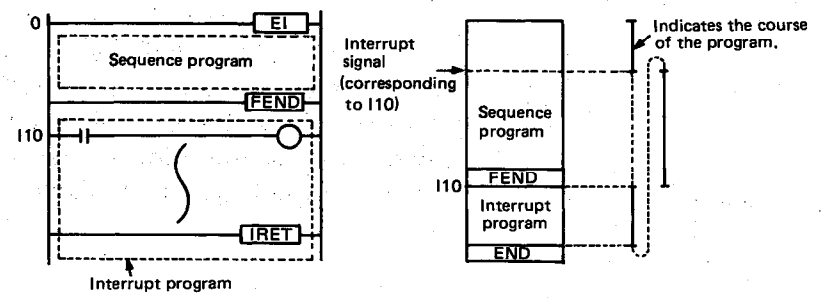
4.4.1 Specification of interrupt programs (I0 to I15)

The AI61 interrupt unit is capable of executing 16 interrupt programs (I0 to I15) according to interruption factors, 0 to F.
When an interrupt input signal enters terminal number 0 of AI61 with the slide switch set to the RISE position, execution jumps to interrupt pointer I0 and the interrupt program is executed.
The numbers of interrupt pointers (I) corresponding to the terminal numbers of the AI61 are as follows.



4.4.2 Writing the interrupt program

Write the interrupt program after the FEND instruction, enter a pointer I□□ at the head of the interrupt program, and enter the IRET instruction at the end of the interrupt program. An example is given below:



Circuit example of interruption program　　Program flow

POINT

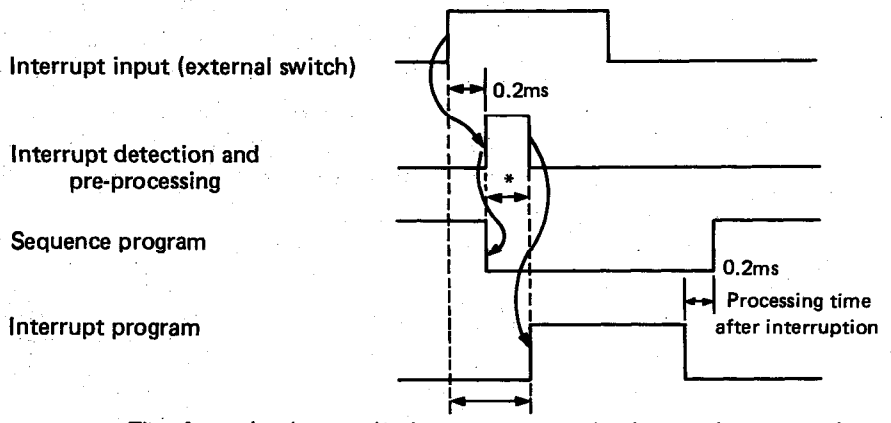
(1) The ACPU is set to interrupt disable (DI) status each time the CPU is reset. Therefore, before executing an interruption, it is always required to set the ACPU to interrupt enable status by executing the EI instruction as shown in the above example.

(2) Even if the EI instruction is executed after an interruption has occurred, the interrupt program will be run after the EI instruction is executed. Also, when the ACPU is set to the RUN status and the EI instruction is executed after an interruption has occurred during STOP status, that interrupt program will be run.

4.5 Timing of Interrupt Processing

When an interrupt signal is input, the relevant interrupt program is executed, however, there is a delay until the interrupt program is actually executed. There will also be a delay in the execution of the program when an interruption occurs during the execution of another interruption. Such delays will be described below.

4.5.1 Normal interrupt delay



Time from when interruption input turns on to when interruption program is run

Time marked * changes as indicated below (max. value) if the CPU is performing any of the following processings, because the interrupt program is delayed:

Item	Normal Sequence Execution	Any of I29 to I31 Interrupt Programs Running	General Data Processing (Communication with AJ71C24(S3), AD51E(S3)	Data Link Interrupt Processing	Monitoring Interrupt Processing (Interrupt from peripheral)
Value marked*	0.2ms	1ms + corresponding interrupt program run time	1.5ms	12ms	0.65ms (Devices of 128 bytes monitored)

If two or more of the above processings are performed simultaneously, time marked * is the sum of the corresponding values.

Example:

1) Interrupt from AI61 during general data processing

   Value * = 0.2 + 1.5ms

2) Data link interrupt and interrupt from AI61 during general data processing

   Value * = 0.2 + 1.5 + 12ms

3) Interrupt from AI61 during I31 interrupt program run

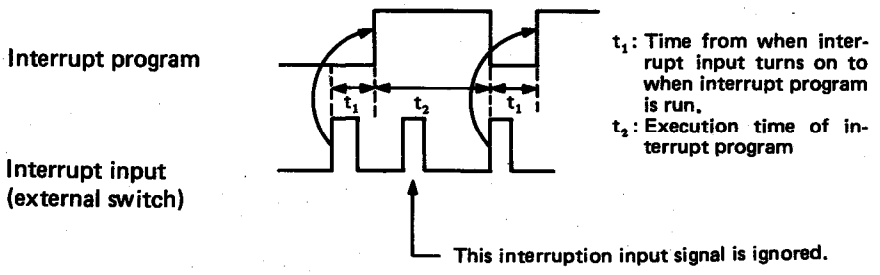
   Value * = 0.2 + 1 + I31 program run time, ms

POINT

An interrupt signal will cause interruption during the execution of any instruction.

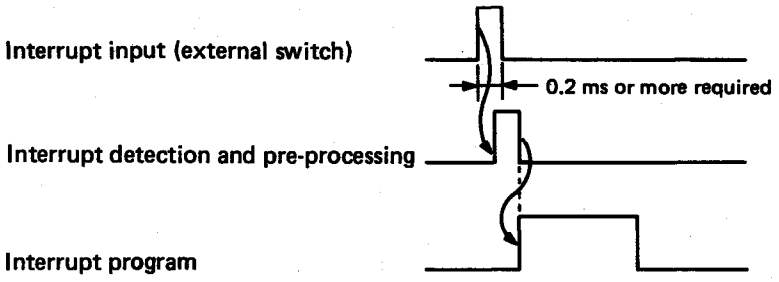
4.5.2 Minimum consecutive interval of the same interruption

If the same interrupt is executed consecutively, set the interval between input signals to more than the time for the interrupt signal to be processed and the interrupt program to be executed. If the time is less than this, the interrupt is executed after the completion of program run because the unit stores the interrupt input signal. In this case, however, even if the interruption input signal is provided several times, only one interruption is executed.



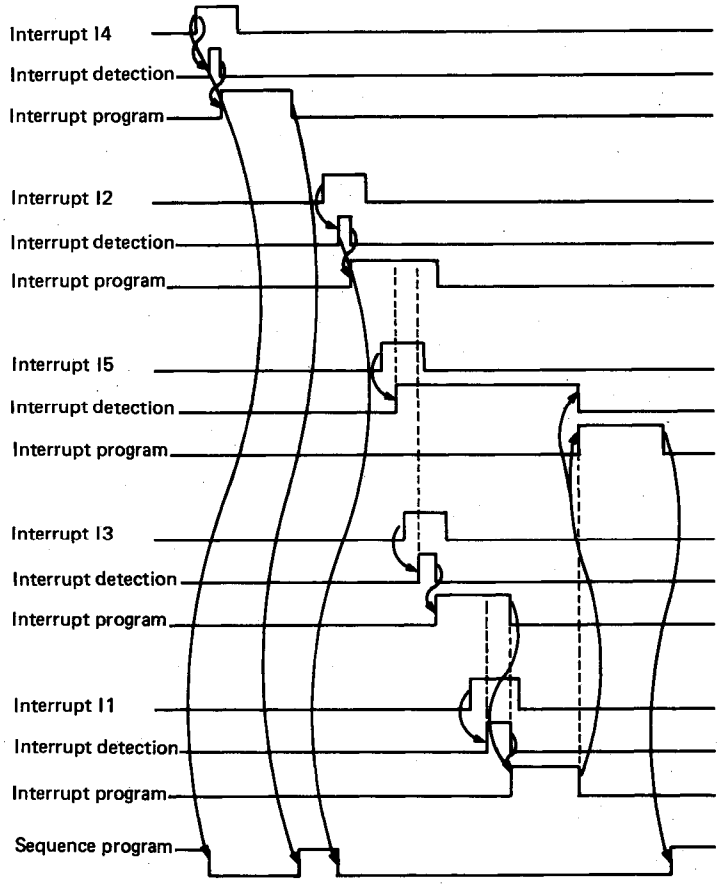
4.5.3 Interrupt input signal pulse width

The response time of the AI61 is 0.2 ms from when a signal turns on to when it turns off. Therefore, set the pulse width of interruption input signal to 0.2 ms or more.
If the pulse width is less than 0.2 ms, the interruption may sometimes not be accepted.



4.5.4 Priority of interrupt processing

Interrupt processing priority is highest for the lowest interrupt input number, i.e. priority is highest for input 0 and lowest for input F. The following gives an example of priority of operation.



In the above example, actual execution is in order of I4, I2, I3, I1, and I5.
Even if interrupt factors I5 and I3 are supplied during the interrupt processing of I2, the interrupt program with the lower interrupt number (pointer) I3 has a higher priority than I5 and is executed after the processing of I2.
Since the interrupt factor, I1, has been generated during the run of interrupt program, I3, the interrupt program, I1, is run earlier than I5 after the processing of I3 and I5 is executed last.

POINT

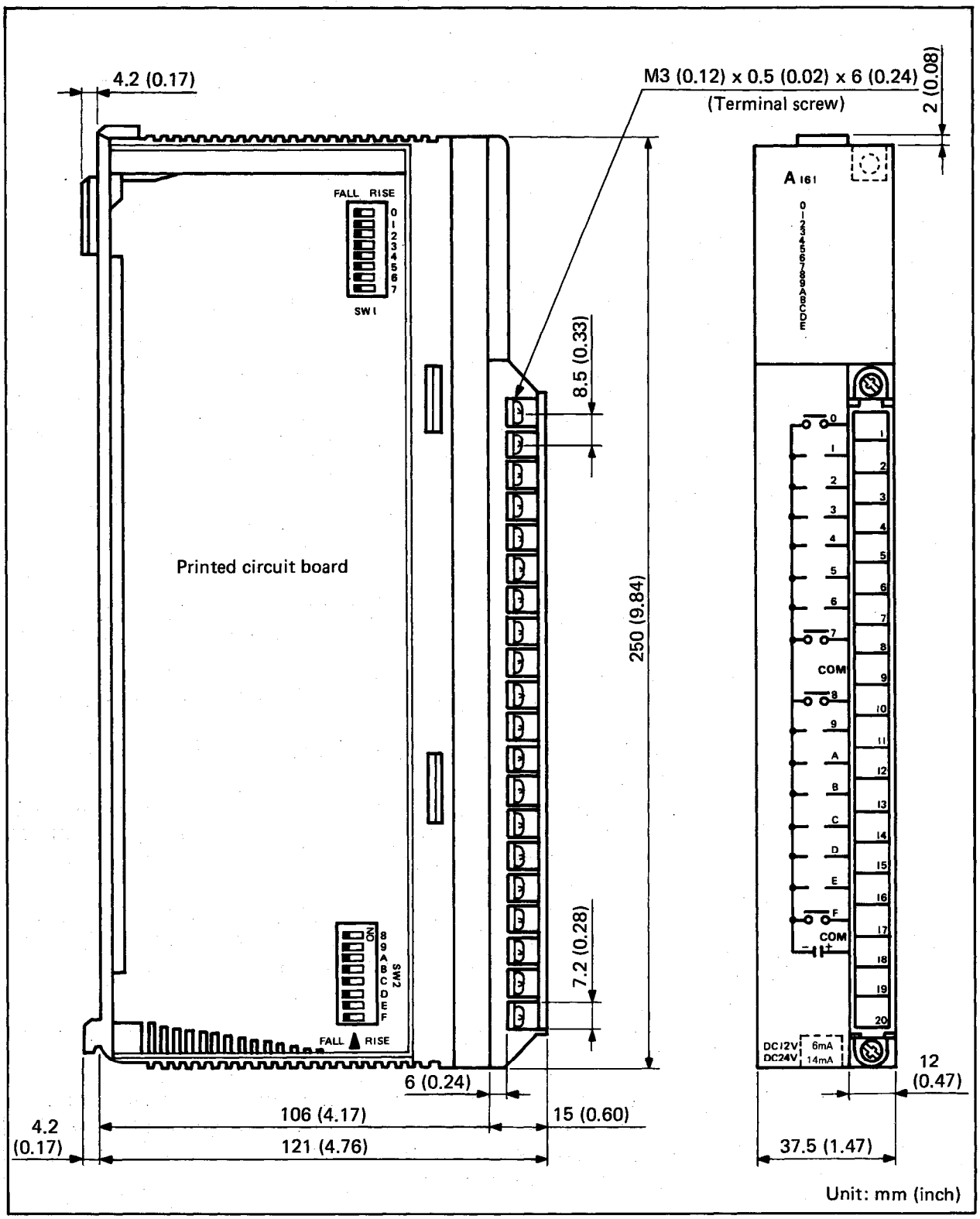
Other interrupt programs corresponding to interrupt factors are also available and there are other interrupt pointers I16 to I23 and I29 to I31. The priority of interruption including these is as indicated below.

I16 to I23 → I0 to I15 → I31 to I29

← Higher priority

APPENDIX

1. EXTERNAL DIMENSION DIAGRAM



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.

Interruption input Module type A161

User's Manual

MODEL	AI61-U-E
MODEL CODE	13J611
IB(NA)66102-B(8909)MEE	

MITSUBISHI ELECTRIC CORPORATION

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