# MELSEC A Series

Programmable Logic Controllers

User's Manual

# Digital-Analog Converter Modules A68DAV/A68DAI(S1)

Art. no.: 027676
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IB (NA)-66285-C

# ● 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 PLC 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.

[System Design Precautions]

**DANGER**

- Safety circuits should be installed external to the programmable controller to ensure that the system as a whole will continue to operate safely in the event of an external power supply malfunction or a programmable controller failure.
  Erroneous outputs and operation could result in an accident.
  1) The following circuitry should be installed outside the programmable controller:
     Interlock circuitry for the emergency stop circuit protective circuit, and for reciprocal operations such as forward/reverse, etc., and interlock circuitry for upper/lower positioning limits, etc., to prevent machine damage.
  2) When the programmable controller detects an abnormal condition, processing is stopped and all outputs are switched OFF. This happens in the following cases:
     - When the power supply module's over-current or over-voltage protection device is activated
     - When an error (watchdog timer error, etc.) is detected at the PLC CPU by the self-diagnosis function.

     Some errors, such as input/output control errors, cannot be detected by the PLC CPU, and there may be cases when all outputs are turned ON when such errors occur. In order to ensure that the machine operates safely in such cases, a failsafe circuit or mechanism should be provided outside the programmable controller. Refer to the CPU module user's manual for an example of such a failsafe circuit.
  3) Outputs may become stuck at ON or OFF due to an output module relay or transistor failure. An external circuit should therefore be provided to monitor output signals whose incorrect operation could cause serious accidents.

- Continuous overcurrent operation of the output module, due to operation over the rated capacity or load shorting, could result in smoke or fire. Always provide a safety circuit, such as an external fuse.

- A circuit should be installed which permits the external power supply to be switched ON only after the programmable controller power has been switched ON. Accidents caused by erroneous outputs and motion could result if the external power supply is switched ON first.

- When a data link communication error occurs, the status shown below will be established at the faulty station. In order to ensure that the system operates safely at such times, an interlock circuit should be provided in the sequence program (using the communication status information).
  Erroneous outputs and operation could result in an accident.
  1) The data link data which existed prior to the error will be held.
  2) All outputs will be switched OFF at MELSECNET (II, /B, /10) remote I/Ostations.
  3) At the MELSECNET/MINI-S3 remote I/O stations, all outputs will be switched OFF or output statuses will be held, depending on the E.C. mode setting.

  For details on procedures for checking faulty stations, and for operation statuses when such errors occur, refer to the appropriate data link manual.

[System Design Precautions ]

**⚠ CAUTION**

- Do not bundle control lines or communication wires together with main circuit or power lines, or lay them close to these lines.
  As a guide, separate the lines by a distance of at least 100 mm, otherwise malfunctions may occur due to noise.
  When file register R that are outside the range are read, e.g. by a MOV instruction, the file register data will become $FFFF_H$ and use of this data will cause malfunctions. Take care not to use file registers that are outside the range when designing programs.
  For details on instructions, refer to the Programming Manual.

[Cautions on Mounting]

**⚠ CAUTION**

- Use the PC in an environment that conforms to the general specifications in the manual.
  Using the PC in environments outside the ranges stated in the general specifications will cause electric shock, fire, malfunction, or damage to/deterioration of the product.
- Make sure that the module fixing projection on the base of the module is properly engaged in the module fixing hole in the base unit before mounting the module.
  Failure to mount the module properly will result in malfunction or failure, or in the module falling.
- Extension cables should be securely connected to base unit and module connectors. Check for loose connection after installation.
  A poor connection could result in contact problems and erroneous inputs/outputs.
- Plug the memory card firmly into the memory card mounting connector. Check for loose connection after installation. A poor connection could result in erroneous operation.
- Be sure to insert the memory securely into the memory socket.
  After mounting, make sure that it does not lift up.
  Poor contact could cause malfunctioning.

[Cautions on Wiring]

**DANGER**

- Switch off the external power supply before staring installation and wiring work.
  Failure to do so could result in electrical shocks and equipment damage.
- After installation and wiring is completed, be sure to attach the terminal cover before switching the power ON and starting operation.
  Failure to do so could result in electrical shocks.

**CAUTION**

- Be sure to ground the FG and LG terminals, carrying out at least class 3 grounding work with a ground exclusive to the PLC.
  Otherwise there will be a danger of electric shock and malfunctions.
- Carry out wiring to the PC correctly, checking the rated voltage and terminal arrangement of the product.
  Using a power supply that does not conform to the rated voltage, or carrying out wiring incorrectly, will cause fire or failure.
- Outputs from multiple power supply modules should not be connected in parallel. Failure to do so could cause the power supply module to overheat, resulting in a fire or module failure.
- Tighten the terminal screws to the stipulated torque.
  Loose screws will cause short circuits, fire, or malfunctions.
- Make sure that no foreign matter such as chips or wiring offcuts gets inside the module. It will cause fire, failure or malfunction.
- Connectors for external connections should be crimped, pressure welded, or soldered in the correct manner using the correct tools.
  For details regarding crimping and pressure welding tools, refer to the input/output module user's manual.
  A poor connection could cause shorts, fire, and erroneous operation.

[Cautions on Startup and Maintenance]

**DANGER**

- Do not touch terminals while the power is ON.
  This will cause malfunctions.
- Make sure that the battery is connected properly. Do not attempt to charge or disassemble the battery, do not heat the battery or place it in a flame, and do not short or solder the battery.
  Incorrect handling of the battery can cause battery heat generation and ruptures which could result in fire or injury.
- Switch the power off before cleaning or re-tightening terminal screws.
  Carrying out this work while the power is ON will cause failure or malfunction of the module.

**CAUTION**

- In order to ensure safe operation, read the manual carefully to acquaint yourself with procedures for program changes, forced outputs, RUN, STOP, and PAUSE operations, etc., while operation is in progress. Incorrect operation could result in machine failure and injury.
- Do not disassemble or modify any module.
  This will cause failure, malfunction, injuries, or fire.
- Switch the power OFF before mounting or removing the module.
  Mounting or removing it with the power ON can cause failure or malfunction of the module.
- When replacing fuses, be sure to use the prescribed fuse.
  A fuse of the wrong capacity could cause a fire.

[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 |
|---|---|---|
| Jul., 1991 | IB (NA) 66285-A | First edition |
| Nov., 1997 | IB (NA) 66285-B | Correction<br>Section 2.2, Section 3.6, Section 4.6.2 |
| Apr., 2001 | IB (NA) 66285-C | Adding models<br>A68DA-S1<br>Addtion<br>WARRANTY<br>Correction<br>SAFETY PRECAVTIONS,<br>Chapter 1, Section 2.2, 3.1, 3.2, 3.2.2, 3.4.1, 3.5.1, 3.6, 4.2, 4.5.2, 4.6.2, 5.2.1, 5.2.2, 5.2.3, Appendix 1 |
| | | |

Japanese Manual Version
IB-68273-C

# INTRODUCTION

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

# CONTENTS

# 1. INTRODUCTION

This manual describes specifications, handling, programming and other information on the A68DAV digital-to-analog converter module (referred to as "A68DAV"), the A68DAI digital-to-analog converter module (referred to as "A68DAI") and the A68DAI-S1 digital-to-analog converter module (referred to as "A68DAI-S1") for use with a MELSEC-A series CPU module.

(1) A68DAV

Used to convert incoming digital values (16-bit signed binary data) which are set with the PC CPU to analog values (voltage outputs ranging from -10 V to 10 V).

(2) A68DAI/A68DAI-S1

Used to convert incoming digital values (16-bit signed binary data) which are set with the PLC CPU to analog values (voltage outputs ranging from 0 mA to 20 mA).
In the following section, A68DAI is used generically for A68DAI and A68DAI-S1.

A68DAV and A68DAI are referred to as "A68DAV/DAI" or "module" in this manual.

## 1.1 Features

(1) Allows digital-to-analog conversion for 8 channels.

The A68DAV/DAI can output analog values (voltage/current) to 8 external devices.

(2) Allows setting of resolution of digital values at three stages (all channels in batch).

Resolution of digital values can be set selecting from 1/4000, 1/8000 and 1/120000 by resolution setting.

(3) Allows analog output to be enabled/disabled on a channel basis.

Analog value output can be enabled or disabled for each channel by the sequence program.

The channel disabled for analog output provides an analog output value of 0 V or 0 mA.

(4) Allows setting of analog output to be held or cleared (all channels in batch) at STOP of CPU.

Holding of analog output when the CPU is at STOP can be set with the HOLD/CLEAR terminal.

(5) Allows offset/gain adjustment to be main without using offset/gain adjusting knobs.

The offset and gain values can be specified by the UP/DOWN switch for each channel.

# 2. SYSTEM CONFIGURATION

## 2.1 Overall Configuration

### 2.1.1 Building block type CPU system

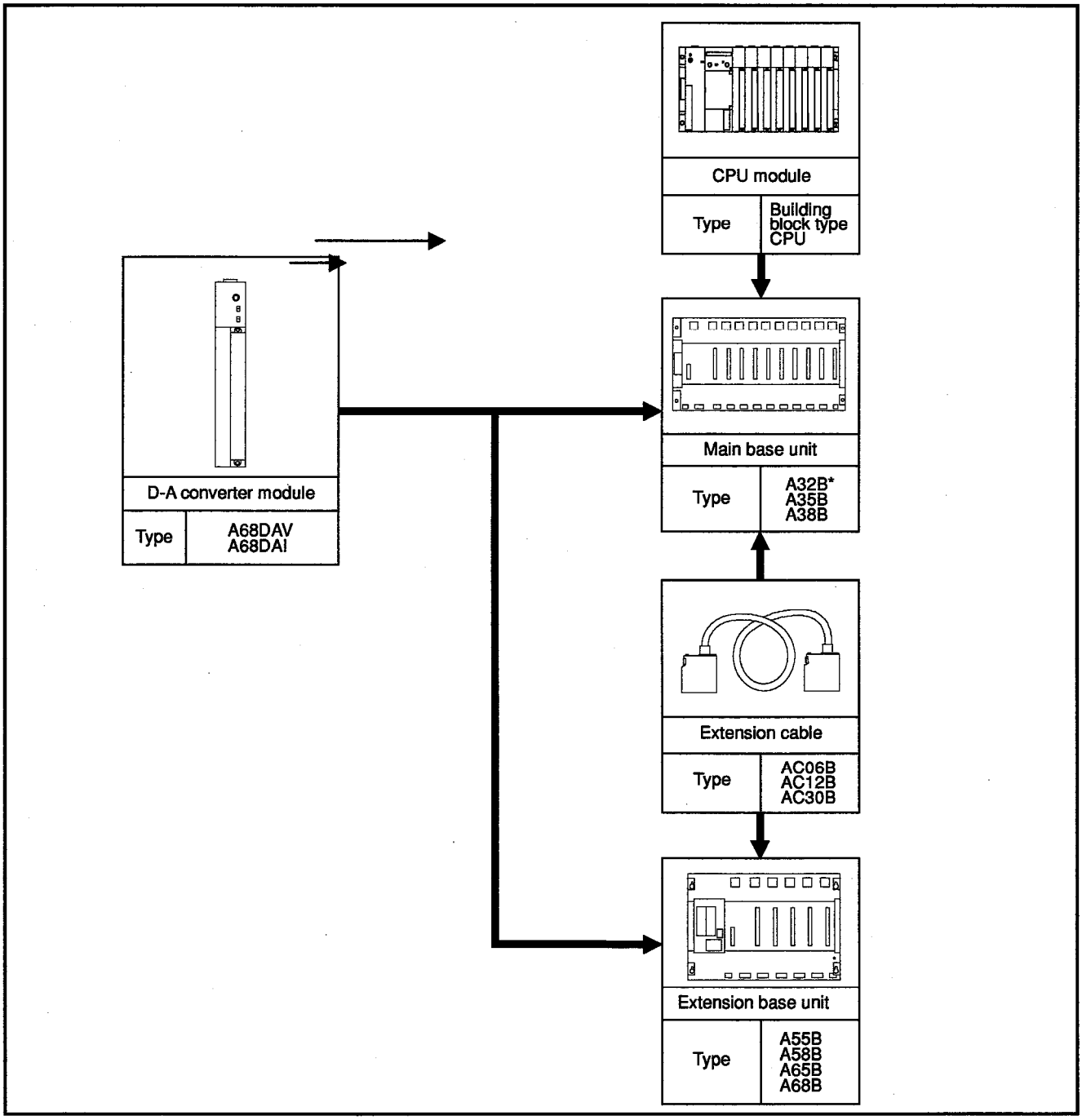



**Fig. 2.1 Building Block**

**REMARK**

1) * An extension base cannot be connected to the A32B.

### 2.1.2 Compact type CPU system

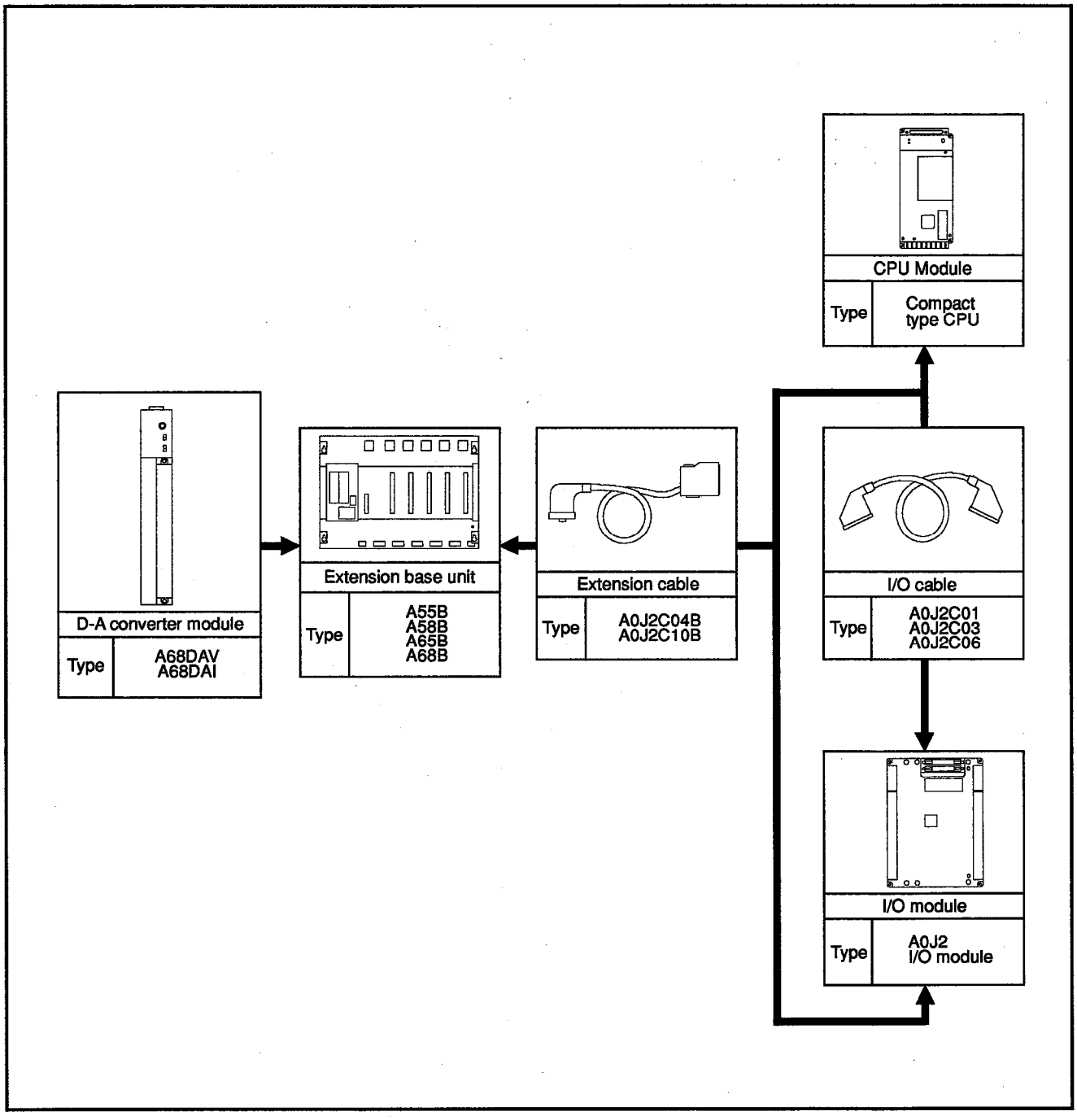



**Fig. 2.2 Compact Type CPU System Configuration**

## 2.2 Applicable A-Series Systems

The A68DAV/DAI can be used only for the following A-series systems.

(1) The following CPU modules are suitable for A68DAV/DAI.

Applicable CPU modules

| | | |
|---|---|---|
| A0J2CPU | A3UCPU | Q4ARCPU |
| A0J2HCPU | A4UCPU | A1SJCPU (S3) |
| A1NCPU | A73CPU | A1SJHCPU |
| A2NCPU | A81CPU | A1SCPU |
| A2NCPU-S1 | A1CPU | A1SCPUC24-R2 |
| A3NCPU | A2CPU | A1SHCPU |
| A3HCPU | A2CPU-S1 | A2SCPU |
| A3MCPU | A3CPU | A2SHCPU |
| A2ACPU | Q2ACPU | A2USCPU (S1) |
| A2ACPU-S1 | Q2ACPU-S1 | A2USHCPU-S1 |
| A3ACPU | Q3ACPU | Q2ASCPU (S1) |
| A2UCPU | Q4ACPU | Q2ASHCPU (S1) |
| A2UCPU-S1 | | |

**POINT**

The A68DAV/DAI cannot be used in an A0J2P25/R25(remote I/O station).

(2) A68DAV/DAI may be loaded into any slot on the base unit with the following precautions:

(a) When using the A68DAV/DAI with the A55B or A58B extension bases (i.e. those without power supplies), select the power supply for the main base unit in accordance with the relevant CPU module User's Manual.

(b) When used with the A3CPU(P21/R21), the A68DAV/DAI cannot be loaded in the slot of the 7th extension stage in a system for which I/O allocation has been made or link X, Y defined in the parameters.
(These restrictions do not apply to A3NCPU, A3HCPU, A3MCPU, A73CPU, A3ACPU).
On a data link system, the A616DA can be mounted to any of the following: master station, local station or remote I/O.
Refer to the MELSECNET and MELSECNET/B data link system reference manual for examples of programs for remote I/O stations.

## 2.3 Notes on Configuring the System

(1) When using the A68DAV/DAI, an external power supply is required to supply 24 VDC to the A68DAV/DAI.

When supplying a 24 VDC power, follow the power supply specifications mentioned in Section 3.2 Performance Specifications (external power supply). (refer to 4.6.3)

# 3. SPECIFICATIONS

This chapter describes the general specifications performance specifications, and I/O conversion characteristics of the A68DAV/DAI.

## 3.1 General Specifications

Table 3.1 shows the general specifications of the A68DAV/DAI.

**Table 3.1 General Specifications**

| Item | Specifications | | | | | |
|---|---|---|---|---|---|---|
| Operating ambient temperature | 0 to 55 °C | | | | | |
| Storage ambient temperature | -20 to 75 °C | | | | | |
| Operating ambient humidity | 10 to 90 %RH, non-condensing | | | | | |
| Storage ambient humidity | 10 to 90 %RH, non-condensing | | | | | |
| Vibration resistance | Conforming to *JIS B 3501, IEC 61132-2 | — | Frequency | Acceleration | Amplitude | Sweep Count |
| | | When there is Intermittent vibration | 10 to 57 Hz | — | 0.075 mm | 10 times each in X, Y and Z axis (80 minutes) |
| | | | 57 to 150 Hz | 9.8 $m/s^2$ | — | |
| | | When there is continuous vibration | 10 to 57 Hz | — | 0.035 mm | |
| | | | 57 to 150 Hz | 4.9 $m/s^2$ | — | |
| Shock resistance | Conforming to JIS B3501, IEC 61131-2 (147 $m/s^2$, 3 times each in 3 directions) | | | | | |
| Operating environment | No corrosive gas present | | | | | |
| Operating height | 2000 m (6582 ft) or less | | | | | |
| Installation area | On the control board | | | | | |
| Over-voltage category *1 | II or less | | | | | |
| Pollution rate *2 | 2 or less | | | | | |

*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 resistance 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 environment 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.

## 3.2 Performance Specifications

Table 3.2 shows the performance specifications of the A68DAV/DAI.

**Table 3.2 Performance Specifications**

<table>
<tr><th colspan="2" rowspan="2">Item</th><th colspan="3">Specifications</th></tr>
<tr><th>A68DAV</th><th>A68DAI</th></tr>
<tr><td colspan="2">Digital input</td><td>(1) 16-bit signed binary data<br>(2) Setting range:<br><table><tr><th>Resolution Setting</th><th>Setting Range</th></tr><tr><td>1/4000</td><td>-4000 to 4000</td></tr><tr><td>1/8000</td><td>-8000 to 8000</td></tr><tr><td>1/12000</td><td>-12000 to 12000</td></tr></table></td><td>(1) 16-bit signed binary data<br>(2) Setting range:<br><table><tr><th>Resolution Setting</th><th>Setting Range</th></tr><tr><td>1/4000</td><td>0 to 4000</td></tr><tr><td>1/8000</td><td>0 to 8000</td></tr><tr><td>1/12000</td><td>0 to 12000</td></tr></table></td></tr>
<tr><td colspan="2">Analog output</td><td>-10 to 0 to 10 VDC<br>(External load resistance: 2 kΩ to 1 MΩ)</td><td>0 to 20 mADC<br>(External load resistance: 0 to 600 Ω)</td></tr>
<tr><td colspan="2">I/O characteristics</td><td><table><tr><th></th><th colspan="3">Digital Value Resolution</th><th></th></tr><tr><th></th><th>1/4000</th><th>1/8000</th><th>1/12000</th><th></th></tr><tr><td rowspan="5">Digital input value</td><td>4000</td><td>8000</td><td>12000</td><td>+10 v</td></tr><tr><td>2000</td><td>4000</td><td>6000</td><td>+5 v</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0 v</td></tr><tr><td>-2000</td><td>-4000</td><td>-6000</td><td>-5 v</td></tr><tr><td>-4000</td><td>-8000</td><td>12000</td><td>-10 v</td></tr></table>*When offset setting is 0 V and gain setting is 10 V.</td><td><table><tr><th></th><th colspan="3">Digital Value Resolution</th><th></th></tr><tr><th></th><th>1/4000</th><th>1/8000</th><th>1/12000</th><th></th></tr><tr><td rowspan="3">Digital input value</td><td>4000</td><td>8000</td><td>12000</td><td>+20 mA</td></tr><tr><td>2000</td><td>4000</td><td>6000</td><td>+12 mA</td></tr><tr><td>0</td><td>0</td><td>0</td><td>+4 mA</td></tr></table>* When offset setting is 4 mA and gain setting is 20 mA.</td></tr>
<tr><td rowspan="3">Maximum resolution of analog value *1</td><td>1/4000</td><td>2.5 mV</td><td>5.0 μA</td></tr>
<tr><td>1/8000</td><td>1.25 mV</td><td>2.5 μA</td></tr>
<tr><td>1/12000</td><td>0.83 mV</td><td>1.6 μA</td></tr>
<tr><td colspan="2">Overall accuracy (accuracy to the maximum value) *2</td><td>±1.0 % (±100 mV)</td><td>±1.0 % (±200 μA)</td></tr>
<tr><td colspan="2">Conversion time *3</td><td colspan="2">Maximum 40 ms/8 channels (same for 1 channel)<br>NOTE) Time from input of digital value till specified analog value (voltage/current) is output.</td></tr>
<tr><td colspan="2">Absolute maximum output</td><td colspan="2">Voltage: 0 to +12 V<br>Current: 0 to +28 mA<br>NOTE) A voltage or a current that exceeds these ranges is not output by an output protection ladder.</td></tr>
<tr><td colspan="2">Analog output points</td><td colspan="2">8 channels/module</td></tr>
<tr><td colspan="2">Insulation method</td><td colspan="2">Photocoupler insulation between output terminals and PLC power<br>(no insulation between channels)</td></tr>
<tr><td colspan="2">Number of I/O points</td><td colspan="2">32 points (I/O allocation: special function module)</td></tr>
<tr><td colspan="2">Connection terminal</td><td colspan="2">38 point terminal block</td></tr>
<tr><td colspan="2">Applicable wire size</td><td colspan="2">0.75 to 2 mm² (Applicable tightening torque: 39N to 59N-cm)</td></tr>
<tr><td colspan="2">Applicable solderless terminal</td><td colspan="2">V1.25-3, V1.25-YS3A, V2-S3, V2-YS3A</td></tr>
<tr><td colspan="2">Internal current consumption (5 VDC)</td><td>0.15 A</td><td>0.15 A</td></tr>
<tr><td rowspan="2">External power supply</td><td>Voltage</td><td colspan="2">21.6 to 26.4 VDC</td></tr>
<tr><td>Current consumption</td><td>0.2 A</td><td>0.4 A</td></tr>
<tr><td colspan="2">Weight kg (lb)</td><td>0.6 Kg</td><td>0.65 Kg</td></tr>
<tr><td colspan="2">External dimensions mm (in)</td><td colspan="2">250 (9.24)(H) x 37.5 (1.48)(W) x 131 (5.16)(D)</td></tr>
</table>

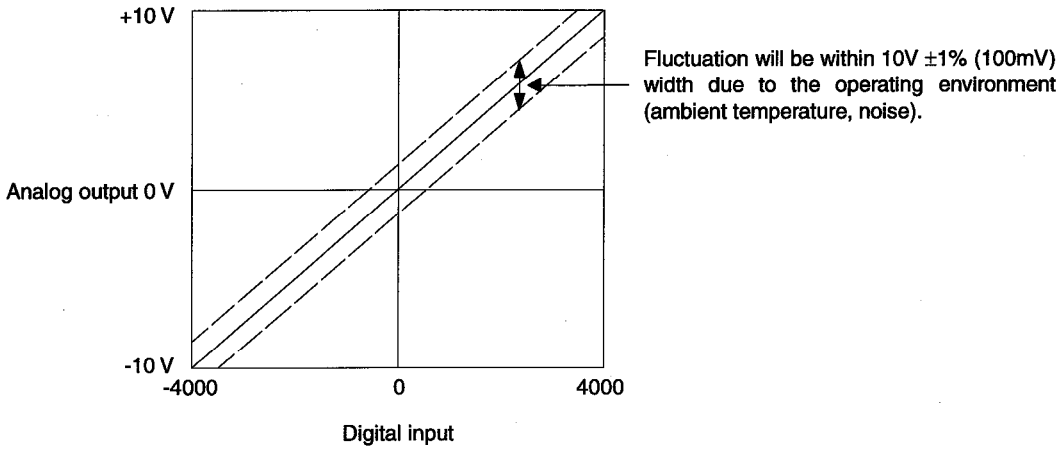
*1 Maximum resolution of analog value

The maximum resolution of analog value is the maximum variance in the analog output caused by a change in the digital value by "1".

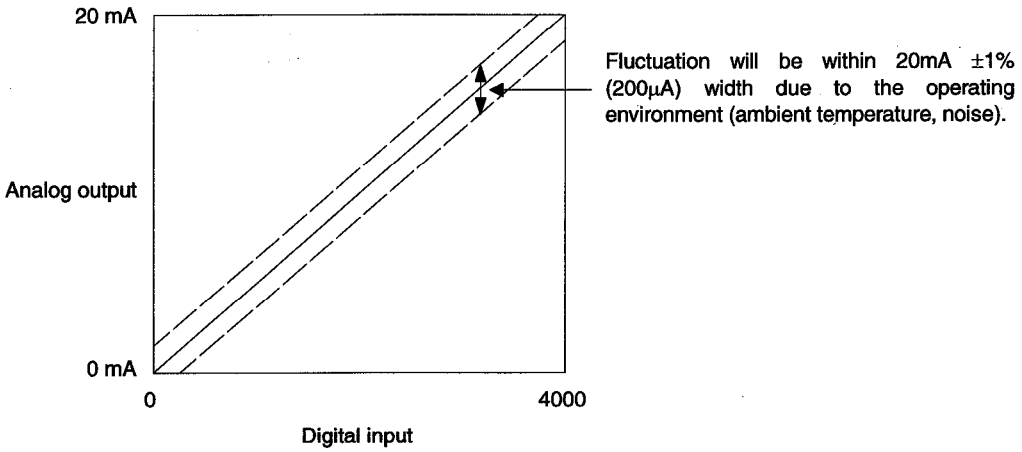
*2 Overall accuracy

Over all accuracy is the accuracy to the maximum value of analog output.

1) Overall accuracy of the A68DAV is the accuracy when the output voltage setting is 10 volts.




2) Overall accuracy of the A68DAI is the accuracy when the output voltage setting is 20 mA.




*3 Conversion speed

The conversion speed is the length of time required from the reading of a digital value written to the buffer to the output of the specified analog value after D-A conversion. The conversion speed becomes the maximum when the maximum analog value output changes to the minimum analog value output, or vice versa. The maximum speed is 40 ms.

### 3.2.1 I/O conversion characteristics of the A68DAV

(1) I/O conversion characteristics

I/O characteristics are provided to convert a digital value specified from the CPU into an analog value and are indicated by an inclination connected between an offset value and a gain value.

(2) Offset/gain values

(a) The offset and gain values are defined as follows.

1) Offset value : Voltage output from the A68DAV when the digital value specified from the PLC CPU is "0".

2) Gain value : Voltage output from the A68DAV when digital value specified from the PLC CPU is "4000" (when digital value resolution setting is 1/4000).

(b) Offset/gain values are set before delivery as shown below.

1) Offset value : 0 V

2) Gain value : 10 V

(c) Offset/gain value can be changed for each channel in the test mode.

(3) I/O conversion characteristic example

The figure below shows an example of I/O conversion characteristics.

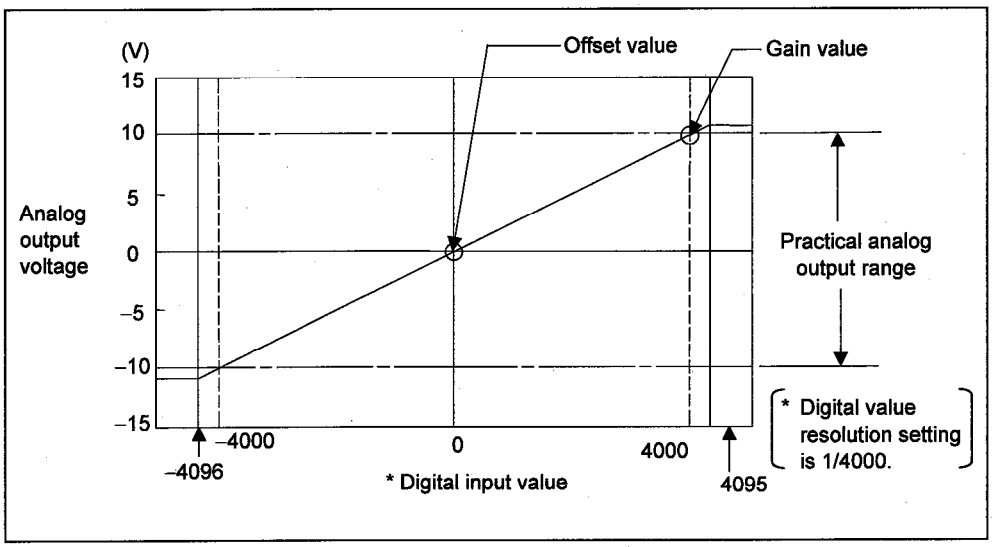



**Fig. 3.1 I/O Conversion Characteristics**

(4) Relation between offset/gain values and analog output

Resolution of the A68DAV can be changed as appropriate by offset/gain setting.

Resolution of analog value and analog output caused by digital input when offset/gain setting is changed are obtained as shown below.

$$\text{(Resolution of analog value)} = \frac{\text{(Gain value)} - \text{(Offset value)}}{\text{(Resolution of digital value)}}$$

$$\text{(Analog output)} = \frac{\text{(Gain value)} - \text{(Offset value)}}{\text{(Resolution of digital value)}} \times \text{(Digital input)} + \text{(Offset value)}$$

$$= \text{(Resolution of analog value)} \times \text{(Digital input)} + \text{(Offset value)}$$

The value of "resolution of digital value" (marked "*1") varies depending on the setting at buffer address "9" (digital value resolution multiplication). For the calculation, use the following values.

| Setting at Buffer Address "9 | Value Used for Resolution of Digital Value |
|---|---|
| 1 | 4000 |
| 2 | 8000 |
| 3 | 12000 |

Section 3.6 gives buffer details.

**POINT**

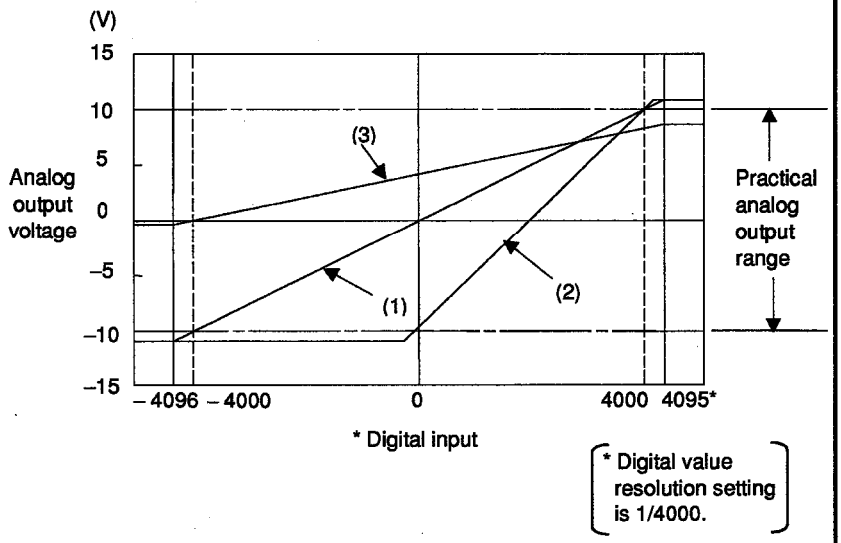
Due to the nature of the D-A converter of the A68DAV, the variance value of analog output values in response to an increment/decrement of the digital input value by "1" might differ from the calculated value.

(5) I/O conversion characteristics when offset/gain setting is changed

The figures below show the I/O conversion characteristics when offset/gain setting is changed.

The right figure shows the I/O conversion characteristics when offset/gain setting is provided as follows.

| No. | Offset Value | Gain Value |
|---|---|---|
| (1) | 0 V | +10 V |
| (2) | −10 V | +10 V |
| (3) | +4 V | +8 V |




Example

(1) The analog output voltages are as follows at the digital input value settings of 2000 and 500 for the characteristic graphs (1) to (3).

| No. | Digital Input | Analog Output |
|---|---|---|
| (1) | 2000 | +5.0 V |
| | 500 | +1.25 V |
| (2) | 2000 | 0 V |
| | 500 | −7.5 V |
| (3) | 2000 | 6.0 V |
| | 500 | 4.5 V |

**Fig. 3.2 I/O Conversion Characteristics when Offset/Gain Setting is Changed**

### 3.2.2 I/O conversion characteristics of the A68DAI

(1) I/O conversion characteristics

Since the I/O conversion characteristics are for converting the set digital values from the CPU to an analog value, they slanted by the joining of the offset value and gain value.

(2) Offset/gain values

(a) The offset and gain values are defined as follows.

1) Offset value : Voltage output from the A68DAI when the digital value specified from the PLC CPU is "0".

2) Gain value : Voltage output from the A68DAI when digital value specified from the PLC CPU is "4000" (when digital value resolution setting is 1/4000).

(b) Offset/gain values are set before delivery as shown below.

1) Offset value : 4 mA

2) Gain value : 20 mA

(c) Offset/gain value can be changed for each channel in the test mode.

(3) I/O conversion characteristic example

The figure below shows an example of I/O conversion characteristics.

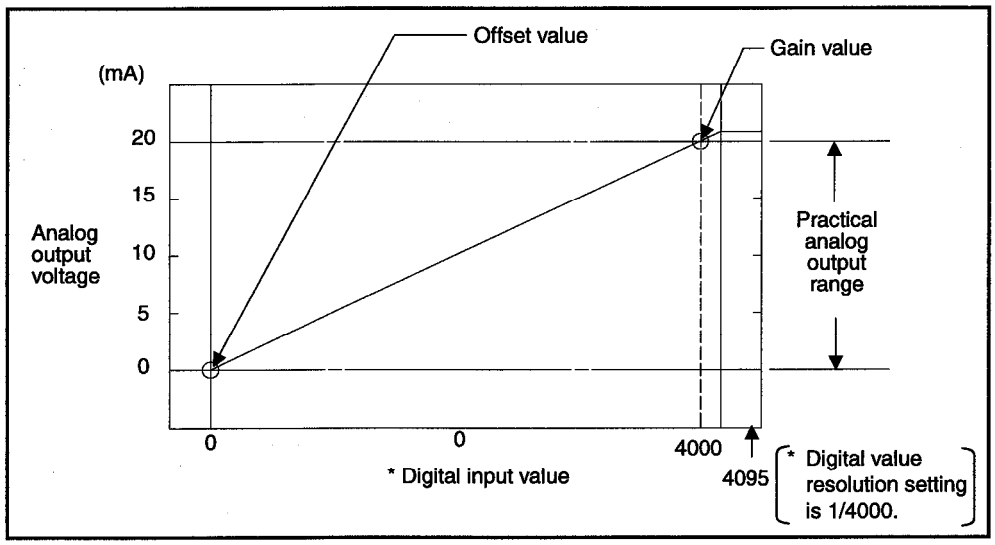



**Fig. 3.3 I/O Conversion Characteristics**

(4) Relation between offset/gain values and analog output

Resolution of the A68DAI can be changed as appropriate by offset/gain setting.

Resolution of analog value and analog output caused by digital input when offset/gain setting is changed are obtained as shown below.

$$\text{(Resolution of analog value)*1} = \frac{\text{(Gain value)} - \text{(Offset value)}}{\text{(Resolution of digital value)}}$$

$$\text{(Analog output) *1} = \frac{\text{(Gain value)} - \text{(Offset value)}}{\text{(Resolution of digital value)}} \times \text{(Digital input)} + \text{(Offset value)}$$

$$= \text{(Resolution of analog value)} \times \text{(Digital input)} + \text{(Offset value)}$$

The value of "resolution of digital value" (marked "*1") varies depending on the setting at buffer address "9" (digital value resolution multiplication). For the calculation, use the following values.

| Setting at Buffer Address "9" | Value Used for Resolution of Digital Value |
|---|---|
| 1 | 4000 |
| 2 | 8000 |
| 3 | 12000 |

Section 3.6 gives buffer details.

**POINT**

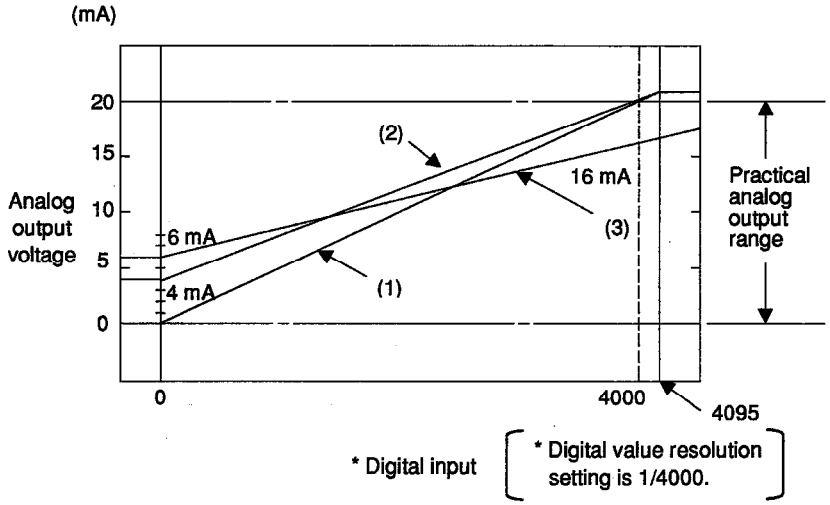
Due to the nature of the D-A converter of the A68DAV, the variance value of analog output values in response to an increment/decrement of the digital input value by "1" might differ from the calculated value.

(5) I/O conversion characteristics when offset/gain setting is changed

The figures below show the I/O conversion characteristics when offset/gain setting is changed.

The right figure shows the I/O conversion characteristics when offset/gain setting is provided as follows.

| No. | Offset Value | Gain Value |
|---|---|---|
| (1) | 0 mA | 20 mA |
| (2) | 4 mA | 20 mA |
| (3) | 6 mA | 16 mA |




Example

(1) The analog output voltages are as follows at the digital input value settings of 2000 and 1000 for the characteristic graphs (1) to (3).

| No. | Digital Input | Analog Output |
|---|---|---|
| (1) | 2000 | 10 mA |
| | 1000 | 5 mA |
| (2) | 2000 | 12 mA |
| | 1000 | 8 mA |
| (3) | 2000 | 11 mA |
| | 1000 | 8.5 mA |

**Fig. 3.4 I/O Conversion Characteristics when Offset/Gain Setting is Changed**

## 3.3 Analog Output Control Functions

### 3.3.1 Analog output HOLD/CLEAR function at STOP of CPU

When the CPU is at STOP, or when the D-A conversion is stopped by the CPU module because of the occurrence of error, holding of analog output can be selected for all channels in batch with the HOLD/CLEAR terminal.

### 3.3.2 D-A conversion execute/non-execute setting function (D-A conversion output enable flag)

This function determines if each channel outputs a D-A conversion value or an offset value by setting a D-A conversion value output enable flag for each channel in the sequence program.

The D-A conversion time (conversion speed) is fixed disregarding of setting a D-A conversion value disable flag.

ON : D-A conversion value OFF: offset value

### 3.3.3 Analog value external output enable/disable setting function (analog output enable/disable)

This function determines if an analog value output to external devices is enabled or disabled by writing 0/1 to address 0 for each channel in the sequence program.
Select one of the functions according to the state of the analog output to be set.

1 : 0 V/0 mA 0 : (D-A conversion value or offset value)

### 3.3.4 Function combination

When the CPU is at RUN or STOP, or when an error occurs in the CPU, analog values can be set as shown in Table 3.3 by combining any or all of the analog output control functions. Select the most appropriate combination.

**Table 3.3 Analog Output State Setting Combinations**

| Setting Combination / Output Status | HOLD/CLEAR Setting (Section 3.3.1) | CLEAR | | | | HOLD | |
|---|---|---|---|---|---|---|---|
| | D-A Conversion Output Enable Flag (Section 3.3.2) | Enable (ON) | | Disable (OFF) | | Enable (ON)/Disable (OFF) | |
| | Analog Output Enable/Disable Setting (Section 3.3.3) | Enable (0) | Disable (1) | Enable (0) | Disable (1) | Enable (0) | Disable (1) |
| Analog output at CPU STOP | | Analog value after D-A conversion of digital value set with the PLC CPU is output. | 0 V/0 mA | Offset value is output. | 0 V/0 mA | Analog value after D-A conversion of digital value set with the PLC CPU is output. | 0 V/0 mA |
| Analog output at CPU STOP | | Offset value is output. | 0 V/0 mA | Offset value is output. | 0 V/0 mA | Analog value before STOP is held. | 0 V/0 mA |
| Analog output at CPU error occurrence | | 0 V/0 mA | 0 V/0 mA | 0 V/0 mA | 0 V/0 mA | 0 V/0 mA | 0 V/0 mA |

## 3.4 CPU I/O Signal

### 3.4.1 Overview of I/O signals

The A68DAV/DAI uses 32 points of signals for input and output respectively.

Table 3.4 gives the allocation and description of I/O signals.

X devices refer to input signals from the A68DAV/DAI to the CPU.

Y devices refer to output signals from the CPU to the A68DAV/DAI.

The device numbers (input signals) shown in the table are used when the A68DAV/DAI is loaded into slot 0 of the main base unit.

**Table 3.4 I/O Singals**

| Signal Direction: A68DAV/DAI → CPU | | Signal Direction: CPU → A68DAV/DAI | |
|---|---|---|---|
| **Device No.** | **Signal Description** | **Device No.** | **Signal Description** |
| X0 | WDT error flag (A68DAV/DAI detection) | Y0 through YC | Unusable (used for system only) |
| X1 | D-A conversion READY | YD through YF | Interlock signal for RERP and RTOP instructions when the A68DAV/DAI is used as a remote I/O station. |
| X2 | Error flag | X10 through Y17 | D-A conversion value output enable flag |
| X3 through X1C | Unusable | Y18 | Error reset flag |
| X1D through X1F | Interlock signal for RERP and RTOP instructions when the A68DAV/DAI is used as a remote I/O station. | Y19 through Y1F | Unusable (used for system only) |

**IMPORTANT**

Because devices Y0 through YC and Y19 through Y1F are used in the system, they cannot be used in the sequence program.

If any of these devices are used (turned ON/OFF) in the sequence program, the functions of the A64DAV/DAI cannot be guaranteed.

If any of the devices Y0 through Y1F, has the same number as any of the devices X0 through X1F, that device cannot be used as an internal relay.

### 3.4.2 I/O signal functions

(1) WDT (watch dog timer) error flag (X0)

This flag is set when the self-diagnosis function of the A68DAV/DAI detects a WDT error. While the error flag is set, the D-A conversion of the A68DAV/DAI does not RUN (0 V/0 mA is output). If the error flag (X0) is set, a hardware malfunction may occur.

(2) D-A conversion READY signal (X1)

This signal is turned ON when the D-A conversion is ready after turning on or resetting the CPU in a mode other than the normal mode (test mode).

If the TEST terminals on the front of the module are connected to each other, this signal is turned OFF.

The D-A conversion READY signal (X1) can also be used as the buffer memory read/write interlock .

**REMARK**

In this manual, "D-A conversion READY" means the time when the analog output values have been output to external equipment by executing the D-A conversion with each channel.

(3) Error flag (X2)

This flag is set when an error (digital value setting error) other than the watch dog timer error occurs in the A68DAV/DAI.

This flag is reset when: (a) the error reset flag (Y18) is turned ON, or (b), "0" is written to the CH1 to CH8 set value check code storage areas (buffer 10 to 17).

(4) Interlock signals (X1D to X1F, YD to YF) for RFRP and RTOP instructions

(a) X1D and YD

One of these is set when the RFRP and RTOP instructions cannot be executed because of a module error.

When YD is turned ON, X1D is turned OFF.

(b) X1E and YE

While executing the RFRP instruction, YE is turned ON.

When the execution is completed, X1E flag is turned ON and YE remains ON.

Therefore, YE should be turned OFF by the sequence program.

(c) X1F and YF

While executing the RTOP instruction, YF is turned ON.

When the execution is completed, X1F is turned ON and YF remains ON.

Therefore, YF should be turned OFF by the sequence program.

**POINT**

Refer to the ACPU Programming Manual (Common Instructions) for the use of the interlock signals for the RFRP and RTOP instructions.

(5) D-A conversion output enable flag (Y10 to Y17)

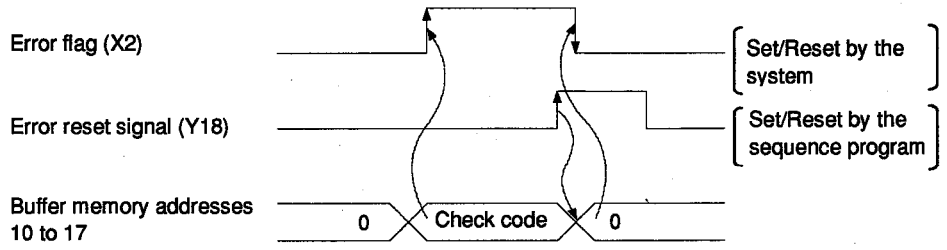
If any of the D-A conversion enable flags for channels 1 to 8 are set, the D-A conversion value output of the corresponding channels is set to "enabled".

If a D-A conversion value output needs to be set to "disable", reset the corresponding D-A conversion enable flag.

Y10 : D-A conversion value output enable flag for channel 1
Y11 : D-A conversion value output enable flag for channel 2
⋮
Y17 : D-A conversion value output enable flag for channel 8

(6) Error reset signal (Y18)

Turning ON the error reset signal (Y18) resets the error flag (X2), and clears the check code stored in the setting value check code storage area (addresses 10 to 17) of the buffer memory. It is replaced by "0".




**POINT**

The I/O allocation numbers of the A68DAV/DAI mentioned in this manual are those when the A68DAV/DAI is loaded in slot No.0 of the main base unit.

## 3.5 Buffer Memory

The A68DAV/DAI has a buffer memory (not battery backed) for data communication with the CPU.

The buffer memory assignment and data maps are indicated below.

### 3.5.1 Buffer memory assignmnt

| Address 2 (Decimal) | | Default Value | Relevant Section |
|---|---|---|---|
| 0 | Analog output enable/ disable channel | $0000_H$ (all channels enabled) | Section 3.6.2 |
| 1 | CH.1 digital value | 0 | Section 3.6.3 |
| 2 | CH.2 digital value | | |
| 3 | CH.3 digital value | | |
| 4 | CH.4 digital value | | |
| 5 | CH.5 digital value | | |
| 6 | CH.6 digital value | | |
| 7 | CH.7 digital value | | |
| 8 | CH.8 digital value | | |
| 9 | Resolution of digital value | 1(1/4000) | Section 3.6.4 |
| 10 | CH.1 set value check code | 0 | Section 3.6.5 |
| 11 | CH.2 set value check code | | |
| 12 | CH.3 set value check code | | |
| 13 | CH.4 set value check code | | |
| 14 | CH.5 set value check code | | |
| 15 | CH.6 set value check code | | |
| 16 | CH.7 set value check code | | |
| 17 | CH.8 set value check code | | |

**Fig. 3.5 Buffer Memory Assignment**

**POINT**

Addresses 10 to 17 of the buffer memory are the read-only area.
When write is executed with a sequence program, an error will occur.

### 3.5.2 Analog output enable/disable channel area (Address $0_H$)

(1) Defines output enable/disable for the converted analog value per channel.

(2) All channels are enabled for output when:

(a) Power is switched on; or

(b) CPU is reset.

(3) Output disable/enable is defined by 1/0.

(a) Disable..... 1

(b) Enable ..... 0

(4) The analog output enable/disable channel area data map is shown below:

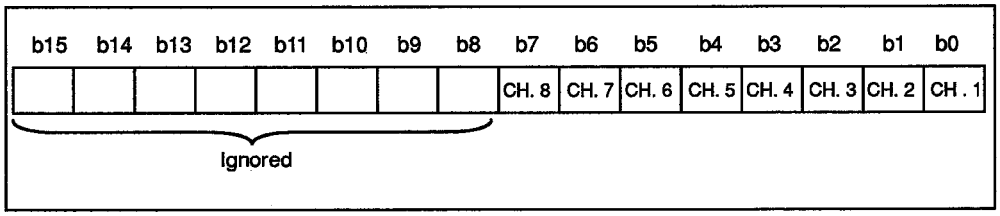



**Fig. 3.6 Analog Output Enable/Disable Channel Area Data Map**

### 3.5.3 CH.1 to CH.8 digital value area (Addresses $1_H$ to $8_H$)

(1) Write digital values to this area from the CPU for D-A conversion.

(2) Digital values of all channels are set to 0 if:

(a) D-A conversion ready (X1) is ON after power on; or

(b) D-A conversion ready (X1) is switched ON after the CPU is reset.

(3) Any digital value specified should be a 16-bit signed binary within the setting range of digital value resolution. Any digital value outside this range is changed to a value indicated below before D-A conversion, and the corresponding check code is written to the set value check code area (addresses 10 to 17).

**Table 3.5 The Setting Range of Digital Value**

| Module | Digital Value Resolution | Setting Range | Digital Value for D-A Conversion when Values Outside the Special Ranges are Set. |
|---|---|---|---|
| A68DAV | 1/4000 | –4096 to 4095<br>(–4000 to 4000 :<br>for guaranteed operation) | 4096 or above : 4095<br>–4097 or below : –4096 |
| | 1/8000 | –8192 to 8191<br>(–8000 to 8000<br>:for guaranteed operation) | 8192 or above : 8191<br>–8193 or below : –8192 |
| | 1/12000 | –12288 to 12287<br>(–12000 to 12000 :<br>for guaranteed operation) | 12288 or above : 12287<br>–12289 or below : –12288 |
| A68DAI | 1/4000 | 0 to 4095<br>(0 to 4000 :<br>for guaranteed operation) | 4096 or above : 4095<br>–1 or below : 0 |
| | 1/8000 | 0 to 8191<br>(0 to 8000 :<br>for guaranteed operation) | 8192 or above : 8191<br>–1 or below : 0 |
| | 1/12000 | 0 to 12287<br>(0 to 12000 :<br>for guaranteed operation) | 12288 or above : 12287<br>–1 or below : 0 |

### 3.5.4 Resolution setting area of digital value (Address $9_H$)

(1) The resolution set in the resolution setting area of digital value which corresponds to the range of analog output voltage is common to all channels.

(2) The resolution value of digital value is "1" (1/4000) in the following cases.

(a) At power on.

(b) At reset of the PLC CPU.

(3) The setting value should be 1, 2 or 3.

**Table 3.6 Resolution Setting Range**

| Setting Value | Resolution of Digital Value |
|---|---|
| 1 | 1/4000 |
| 2 | 1/8000 |
| 3 | 1/12000 |

**POINT**

(1) If the set value is other than 1, 2, or 3, the resolution value is not changed and is set to the last set value before set or to a default value.
(2) Set the resolution multiplication value only once before the D-A conversion value output enable flag is turned ON.
If the set value is changed while the D-A conversion enable flag is set, i.e. a machine is being controlled, the analog output will change causing machine control problems.

### 3.5.5 CH.1 to CH.8 set value check code storage area (Addresses $10_H$ to $17_H$)

(1) Used to check whether the set digital values are within or out of the setting range of digital value resolution.

(2) The corresponding check code in Table 3.7 is stored if a digital value out of the setting range of digital value resolution is set.

**Table 3.7 Check Code List**

| Check Code | Description |
|---|---|
| $000F_H$ | A digital value over the setting range of digital value resolution was set. |
| $00F0_H$ | A digital value below the setting range of digital value resolution was set. |
| $00FF_H$ | Digital values over and below the setting range of digital value resolution were set. |

(3) Any check code stored once is not reset even though the corresponding set value is corrected to a valid value (within the setting range of digital value resolution).

The check code should be reset by switching the error reset signal(Y18) ON.

**POINT**

The error flag(X2) is set ON to indicate that a check code has been stored to the set value check code area.

## 3.6 Function Block Diagram

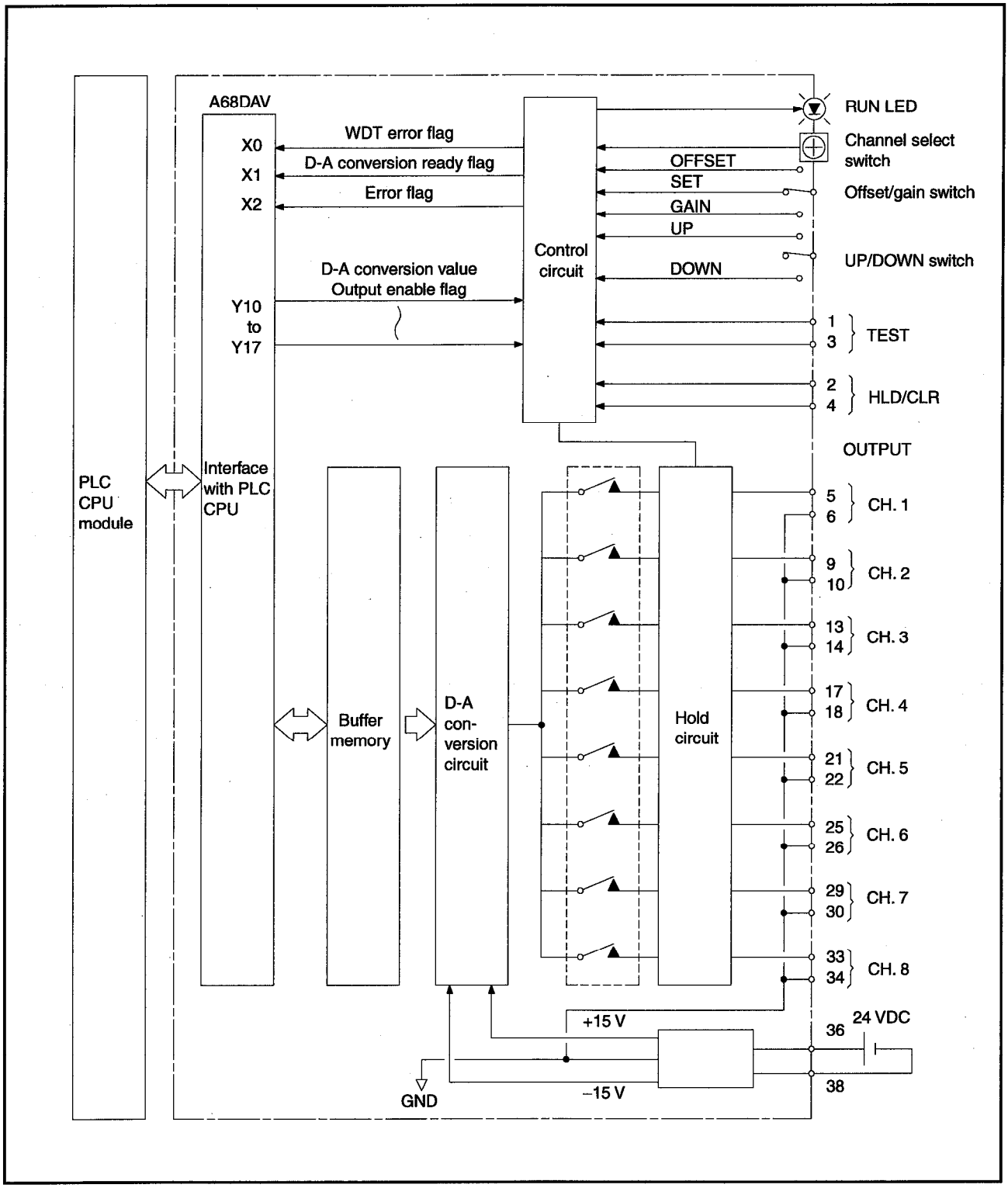



**Fig. 3.7 A68DAV Function Block Diagram**

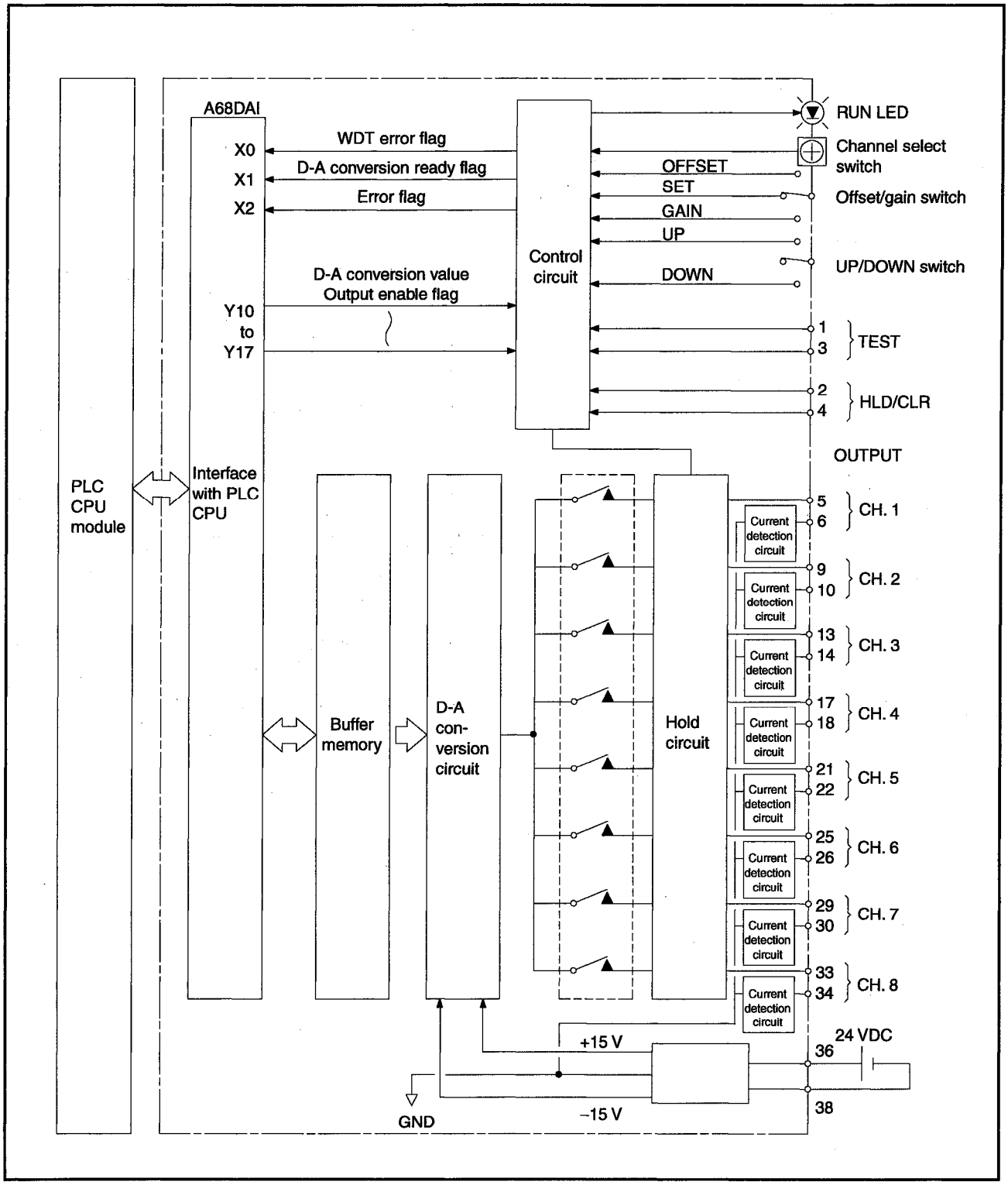



**Fig. 3.8 A68DAI Function Block Diagram**

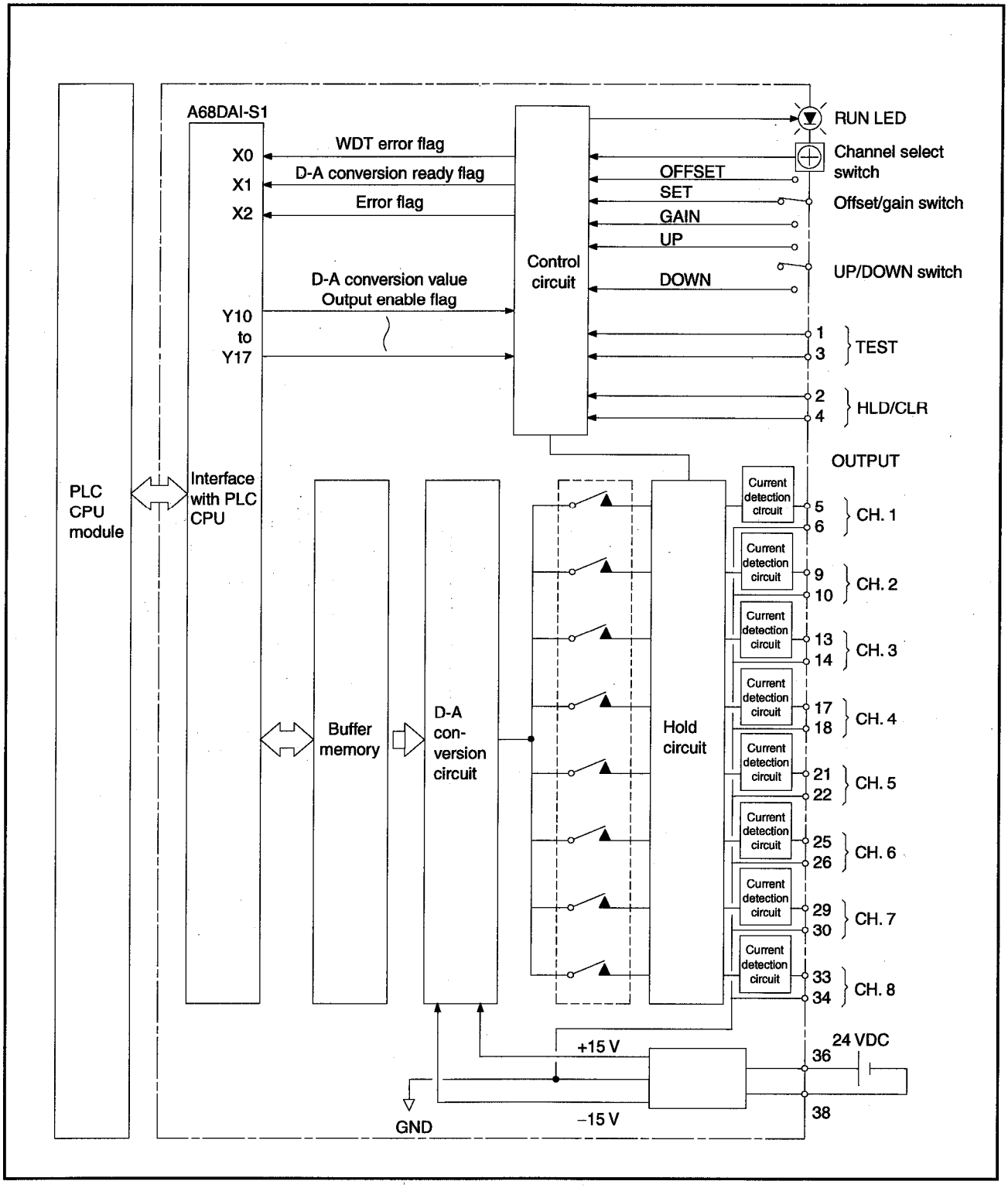



**Fig. 3.9 A68DAI-S1 Function Block Diagram**

# MEMO

# 4. PRE-OPERATION SETTINGS AND PROCEDURES

## 4.1 Pre-operation Procedure

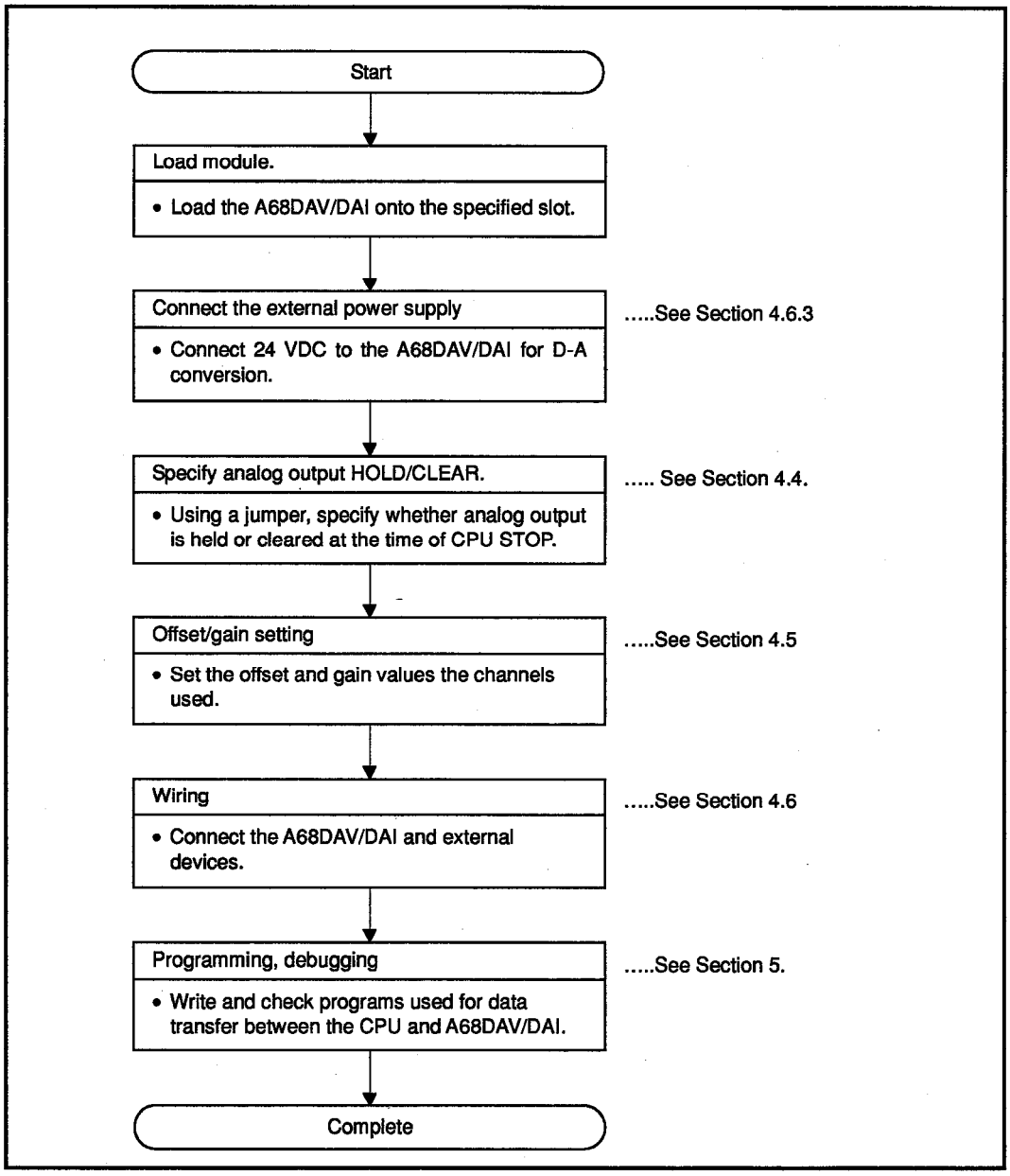



**Fig. 4.1 Pre-operation Procedure**

## 4.2 Handling Instructions

(1) Protect the A68DAV/DAI and its terminal block from impact loads.

(2) Do not remove the printed circuit boards from the housing. There are no user-serviceable parts on the boards.

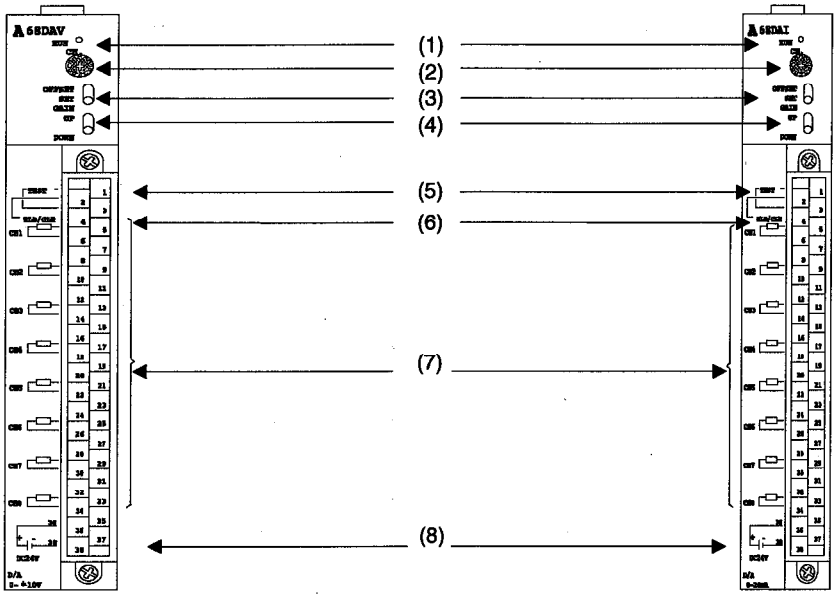
(3) Ensure that no conductive debris can enter the module. If it does, make sure that it is removed. Guard particularly against wire offcuts.

(4) Tighten the screws as specified below:

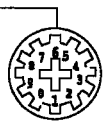
| Screw | Tightening Torque Range N·cm |
|---|---|
| I/O terminal screw (M3 screw) | 39 to 59 |
| I/O terminal block installation screw (M4 screw) | 78 to 118 |

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

## 4.3 Nomenclature




| No. | Description | Application |
|---|---|---|
| 1 | "RUN" LED | Indicates the operating status of the A68DAV/DAI.<br>(Normal mode)<br>On ..... • Indicates that the A68DAV/DAI is operating without fault.<br>Off ..... • 5 VDC is not supplied to the A68DAV/DAI.<br>• A68DAV/DAI is in WDT error.<br>• A68DAV/DAI hardware fault has occurred.<br>• PLC CPU has detected an error and stopped operation.<br>Flash ..... • A write data error has occurred.<br>(Test mode)<br>Flash { 0.5 s interval ..... • OFFSET/GAIN select switch is in "OFFSET" or "GAIN" position.<br>0.1 s interval ..... • The high or low limit of the allowed range has been exceeded during offset/gain value setting using the UP/DOWN switch.<br>• Offset value setting is greater than gain value setting using the UP/DOWN switch.<br>Off ..... • OFFSET/GAIN select switch is in "SET" position. |

<table>
<tr><th>No.</th><th>Description</th><th>Application</th></tr>
<tr><td>2</td><td>Channel select switch<br>CH.<br>  </td><td>Used to specify the channel (CH.1 to CH.8) for offset/gain adjustment.<br>Channels should be switched when the OFFSET/GAIN select switch is in "SET" position.<br>Only valid in test mode. (Positions "0" and "9" are ineffective.)</td></tr>
<tr><td>3</td><td>OFFSET/GAIN select switch</td><td>Used to select any of the following modes:<br>• OFFSET position : Offset value calibration mode.<br>• GAIN position : Gain value calibration mode.<br>• SET position : Offset/gain value storage mode.<br>(The offset/gain value is stored to the A68DAV/DAI internal memory when the switch is moved from "OFFSET"/"GAIN" to "SET".</td></tr>
<tr><td>4</td><td>UP/DOWN switch</td><td>Used to define the offset/gain value for the specified channel.<br>Increases or decreases the offset or gain value at the following rate:<br>• UP/DOWN position for less than 1.5 seconds : Increase or decrease spell of 0.54 mV,1.15 μA at one time.<br>• UP/DOWN position for 1.5 seconds or more : Increase or decrease of 0.54 mV, 1.15 μA per 0.02 s.</td></tr>
<tr><td>5</td><td>TEST mode terminals (terminal Nos. 1 and 3)</td><td>Used to select normal or test mode.<br>• Disconnected : Normal mode (to output analog values to external devices)<br>• Connected : Test mode (to set offset/gain values)</td></tr>
<tr><td>6</td><td>Analog output HOLD/CLEAR setting terminals (terminal Nos. 2 and 4)</td><td>Used to hold or clear analog output at the time of CPU stop. (See Section 4.4.)<br>• Disconnected : CLEAR<br>• Connected : HOLD</td></tr>
<tr><td>7</td><td>Analog output terminals (CH.1 to CH.8)</td><td>Used to output an analog value after D-A conversion.
<table>
<tr><th>Channel</th><th>Terminal No.</th><th>Channel</th><th>Terminal No.</th></tr>
<tr><td>1</td><td>5, 6</td><td>5</td><td>21, 22</td></tr>
<tr><td>2</td><td>9, 10</td><td>6</td><td>25, 26</td></tr>
<tr><td>3</td><td>13, 14</td><td>7</td><td>29, 30</td></tr>
<tr><td>4</td><td>17, 18</td><td>8</td><td>33, 34</td></tr>
</table></td></tr>
<tr><td>8</td><td>Power terminals (terminal Nos. 36 and 38)</td><td>Input terminals for analog value output power supply (24 VDC).</td></tr>
</table>

## 4.4 HOLD/CLEAR Setting of Analog Output

This section explains how to define a HOLD/CLEAR setting of analog output when the CPU is in the STOP mode.

(1) Use the HOLD/CLEAR terminal (on the front of the A68DAV/DAI module) to define the HOLD/CLEAR setting of analog output.

Table 4.1 describes the settings and their states.

**Table 4.1 HOLD/CLEAR Setting**

| Analog Output Setting | State of HLD/CLR Terminal (Between Terminal Nos. 2 and 4) |
|---|---|
| HOLD | Connected |
| CLEAR | Not connected |

The original(factory-set) analog output state is CLEAR(disconnected).

(2) The analog output state by HOLD/CLEAR setting varies with settings of the D-A conversion value output enable flag (see Section 3.4.2) and the analog output enable/disable state (see Section 3.5.2).

Table 3.3 shows the analog output states for settings of the D-A conversion value output enable flag and the analog output enable/disable state. It also shows the analog output state when the CPU is in the RUN mode.

## 4.5 Offset/Gain Setting

(1) The offset and gain values are factory-set to output the voltages indicated in Table 4.2.

**Table 4.2 Factory-set Offset/Gain Values**

| | A68DAV | A68DAI |
|---|---|---|
| Gain value | 10 V | 20 mA |
| Offset value (V) | 0 V | 4 mA |

(2) The offset and gain values may be changed and fine-adjusted by offset/gain setting in test mode.

### 4.5.1 Notes on offset/gain setting

(1) Do not select test mode during execution of D-A conversion. Selecting test mode stops D-A conversion of all channels and affects control of external devices. Returning from test mode to normal resumes D-A conversion with new offset/gain values.

(2) Offset/gain setting is allowed within the following ranges:

(a) A68DAV : –10 V to 0 V to + 10 V

(b) A68DAI : –0 mA to 20 mA

If any value set is outside the above range, overall accuracy may not be within the range of performance specifications (see Section 3.2).

(3) The defined value is stored when the OFFSET/GAIN select switch is set to the "SET" position.

The offset and gain value remain unchanged if test mode is terminated with the OFFSET/GAIN select switch in the "OFFSET" or "GAIN" position.

(4) Before switching from one channel to another in test mode, the OFFSET/GAIN select switch should be set to the "SET" position.

If the channel remains unchanged and the set value is stored to the new channel when the switch is set to "OFFSET" or "GAIN".

(5) The "RUN" LED flickers fast at intervals of 0.1 seconds to indicates that the offset/gain specified has exceeded the allowed range.

When the "RUN" LED is flickering fast, the offset/gain value remains unchanged if the OFFSET/GAIN select switch is set to "SET".

### 4.5.2 Offset/gain setting procedure

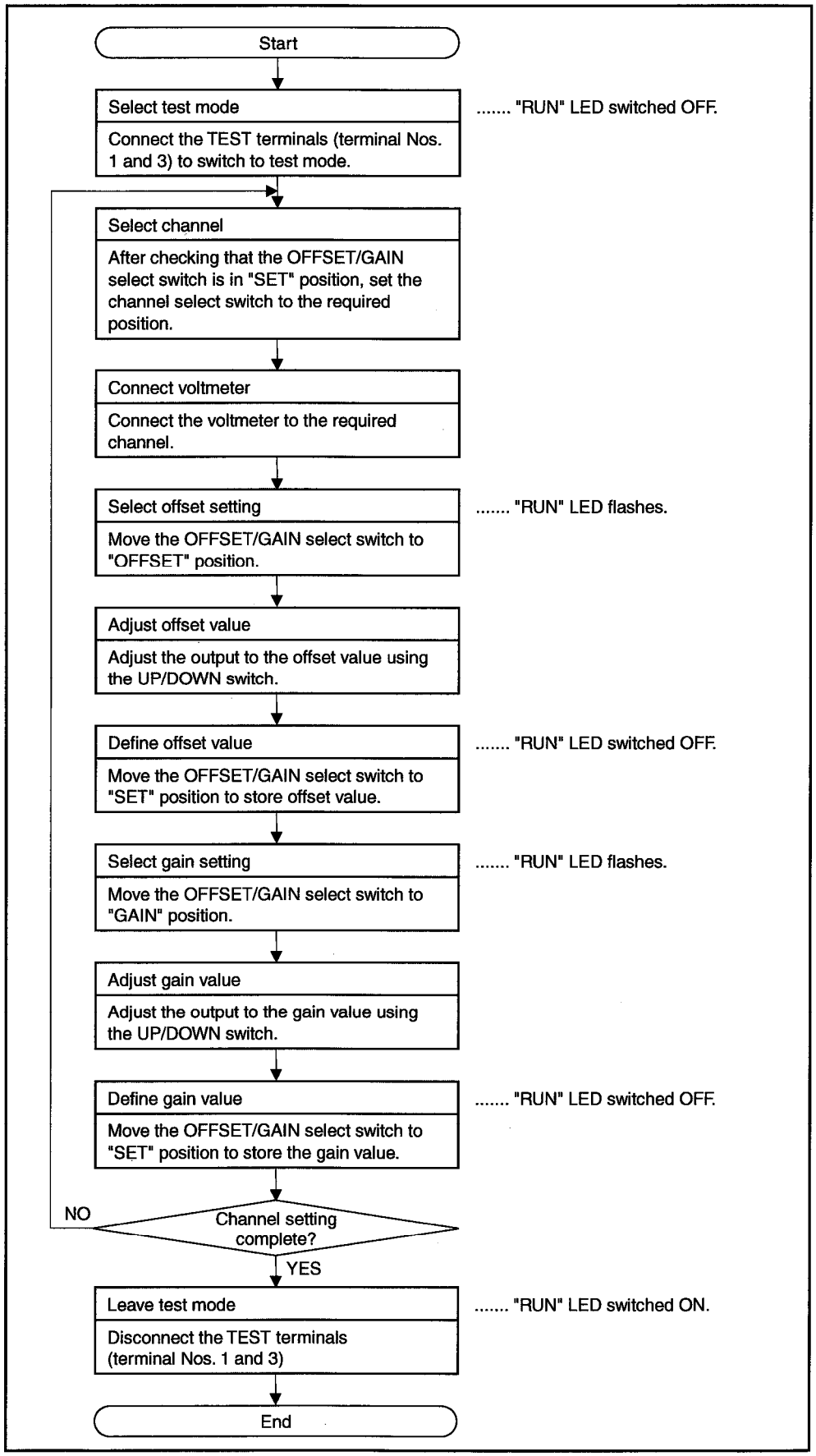



**Fig.4.2 Offset/Gain Setting Procedure**

## 4.6 Wiring

### 4.6.1 Wiring instructions

Protect external wiring against noise with the following precautions:

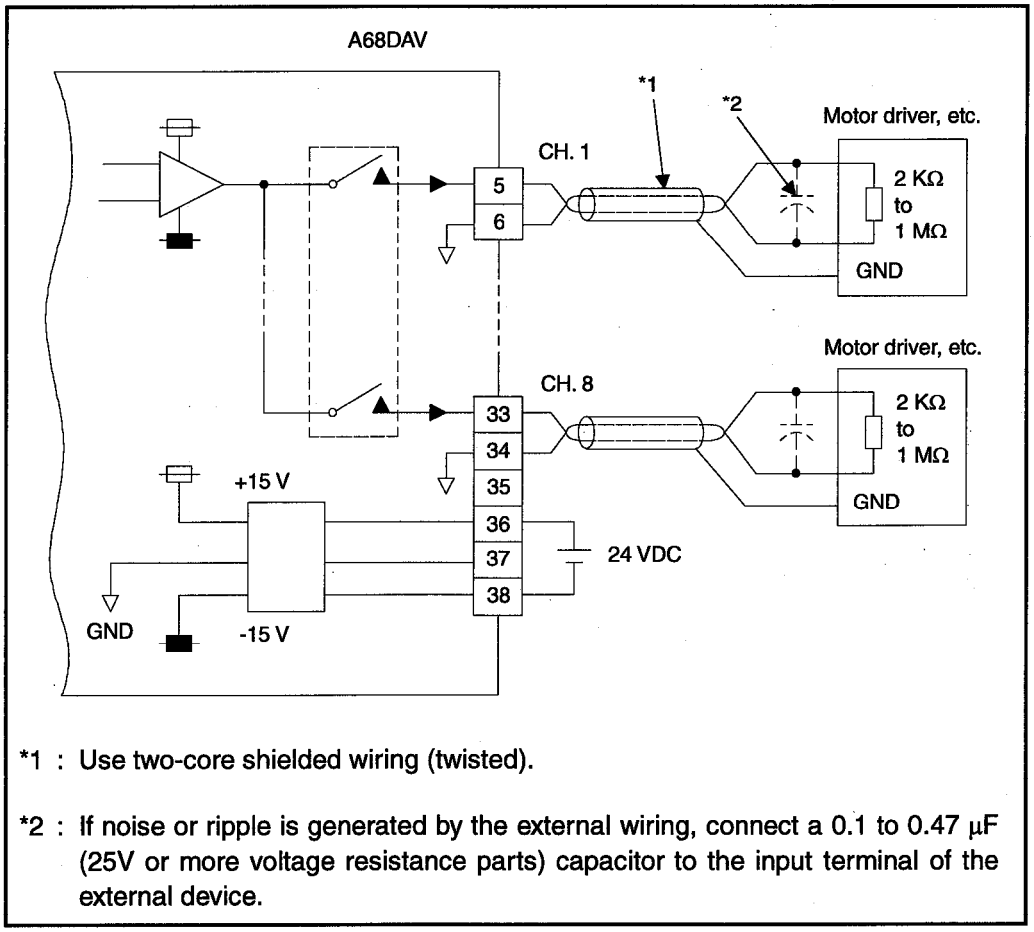
(1) Separate AC and DC wiring.

(2) Separate main circuit and/or high voltage wiring from control and signal wiring.

(3) Where applicable, ground the shielding of all wires to a common ground point.

### 4.6.2 Connection of A68DAV/DAI/DAI-S1 and external devices

(1) Connection Example of A68DAV and External Devices

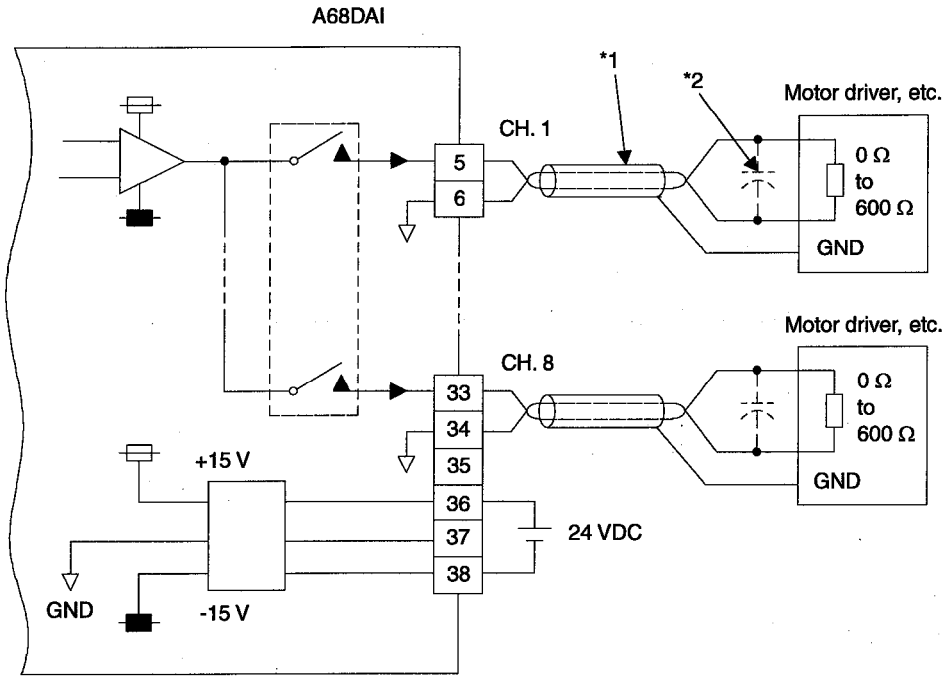



*1 : Use two-core shielded wiring (twisted).

*2 : If noise or ripple is generated by the external wiring, connect a 0.1 to 0.47 μF (25V or more voltage resistance parts) capacitor to the input terminal of the external device.

**Fig. 4.3 Connection Example of A68DAV and External Devices**

(2) Connection Example of A68DAI/A68DAI-S1 and External Devices




*1 : Use two-core shielded wiring (twisted).

*2 : If noise or ripple is generated by the external wiring, connect a 0.1 to 0.47 μF (25V or more voltage resistance parts) capacitor to the input terminal of the external device.

**Fig. 4.4 Connection Example of A68DAI /A68DAI-S1 and External Devices**

**IMPORTANT**

(1) When using the A68DAI, never route a common jumper on the side with the external device.
If wiring is not routed independently for each channel to the module as shown above, proper amperage output will not be attained.
When using the A68DAI-S1, a common jumper on the side with the external device can be routed.

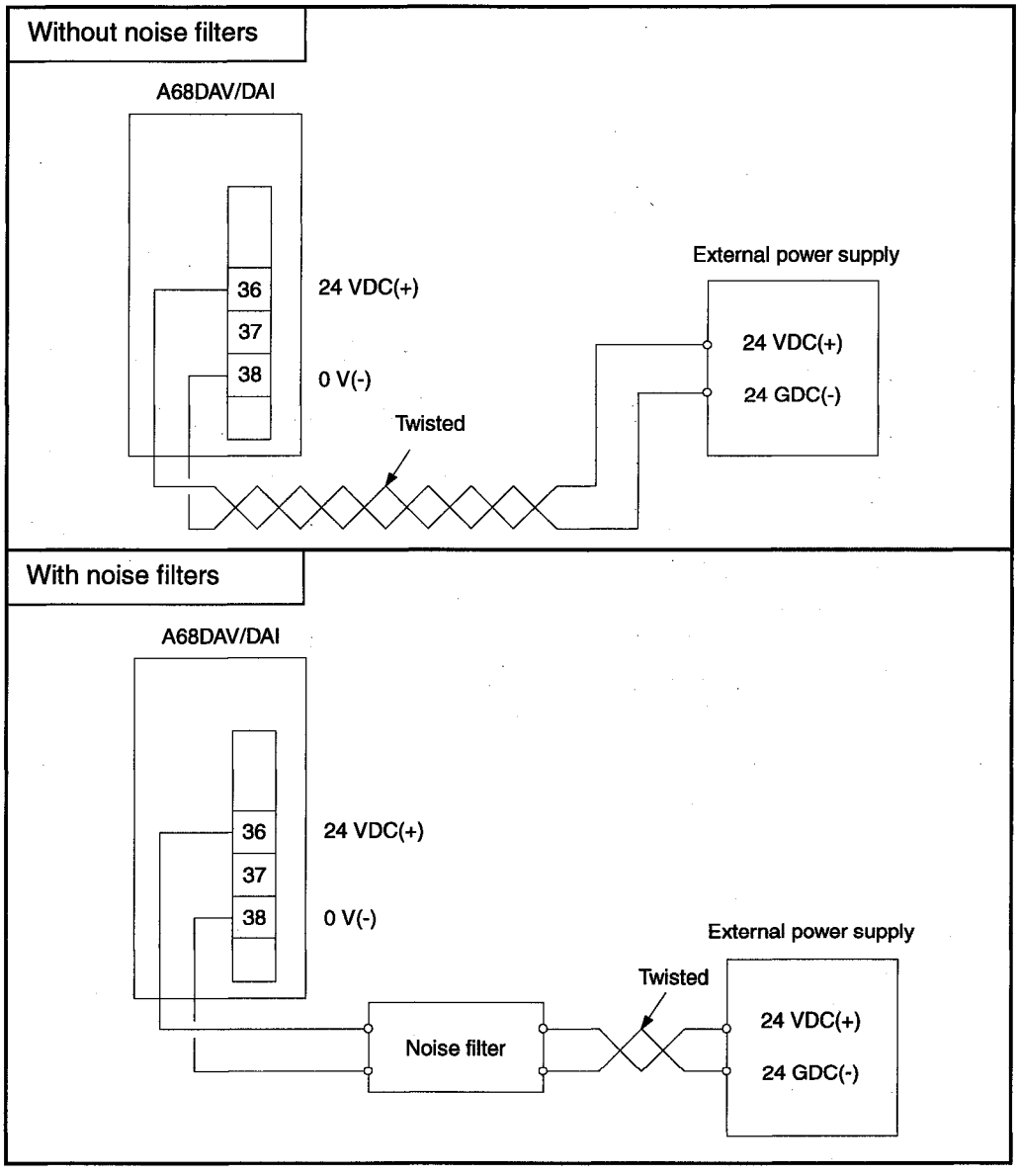
(2) If a A68DAI-S1 inductor component load is continued, normal output may not be attained.

### 4.6.3 Connection of 24 VDC to the A68DAV/DAI

The following describes the method of supplying +24 VDC to the A68DAV/DAI.

(1) To connect the external power supply, twisted-wire pair cable should be used to avoid electromagnetic inductive noise.

(2) When the external power supply is used, it is recommended to use noise filters with the A68DAV/DAI.




**POINT**

(1) The cables between the noise filters and A68DAV/DAI must not be bundled with any other cable.
(2) The cables between the noise filters and A68DAV/DAI must be as short as possible.

# 5. PROGRAMMING

## 5.1 Programming Procedure

Program data transfer between the CPU and A68DAV/DAI as indicated in Fig. 5.1.

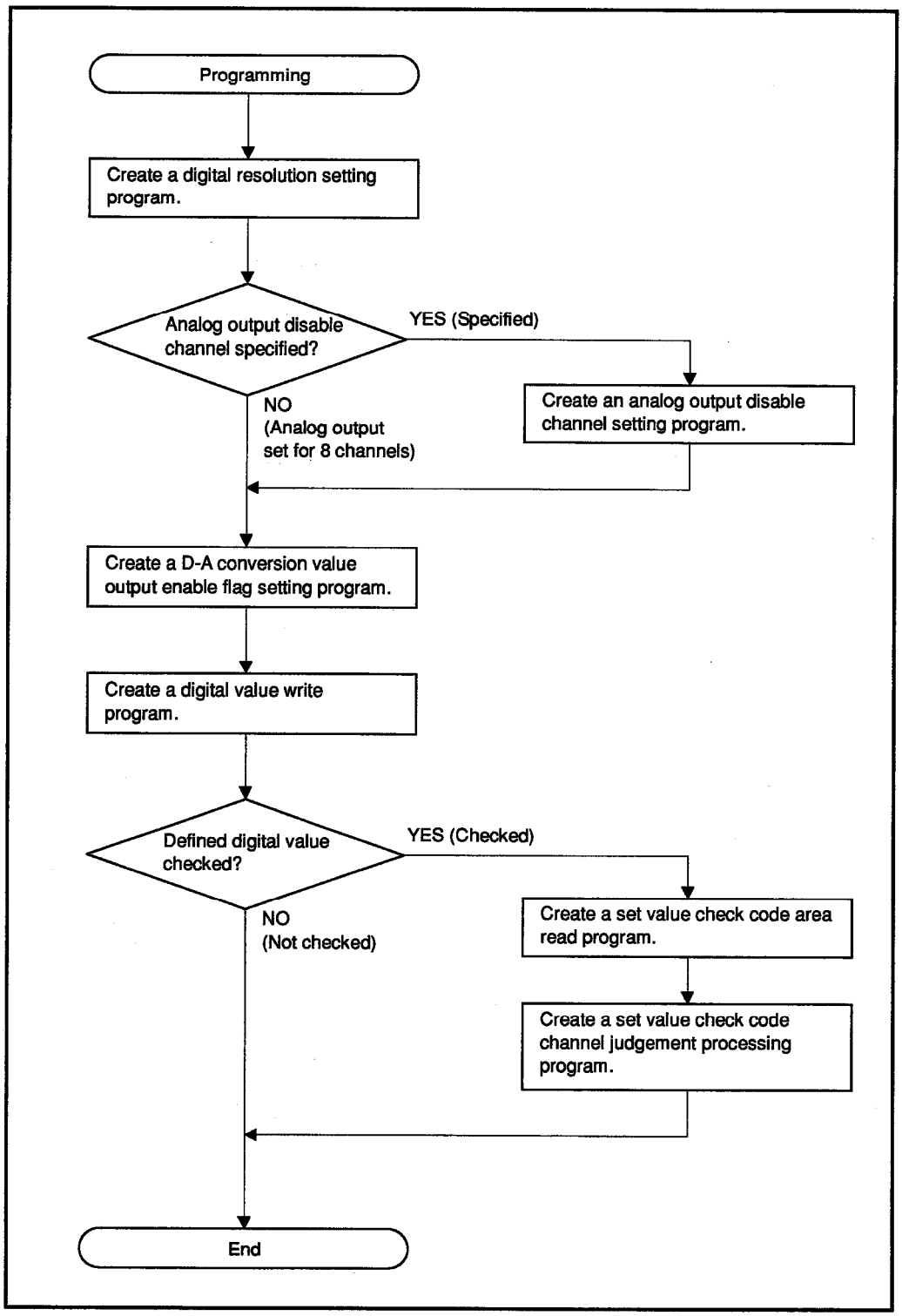



**Fig.5.1 Programming Procedure**

## 5.2 Sample Program

This section explains the programming used with the A68DAV/DAI.

**IMPORTANT**

A FROM/TO instruction cannot be executed in the test mode. Use the D-A conversion ready signal as an interlock for any program that contains a FROM/TO instruction.

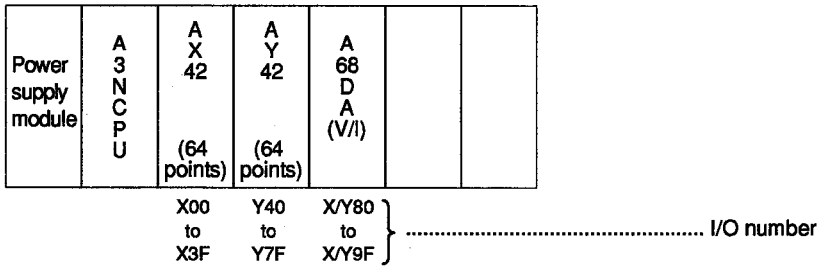
If a FROM/TO instruction is executed in the test mode, the set offset and/or gain values might be lost, or a CPU error occurs.

### 5.2.1 Digital value setting program

The following describes a program used to write a value (0 to 8000) to the digital value setting area (addresses 1 to 4 of the buffer memory) for channels 1 to 4 of the A68DAV/DAI. The value is set with a BCD digital switch.

**Programming conditions**

(1) System configuration




(2) Initial settings

(a) Digital value resolution ..... "2" (1/8000)

(b) Analog output disable channel ..... CH.5, 6, 7, 8

(3) Device for user

(a) Digital value write command input signal

1) Channel No.1 ..... X1

2) Channel No.2 ..... X2

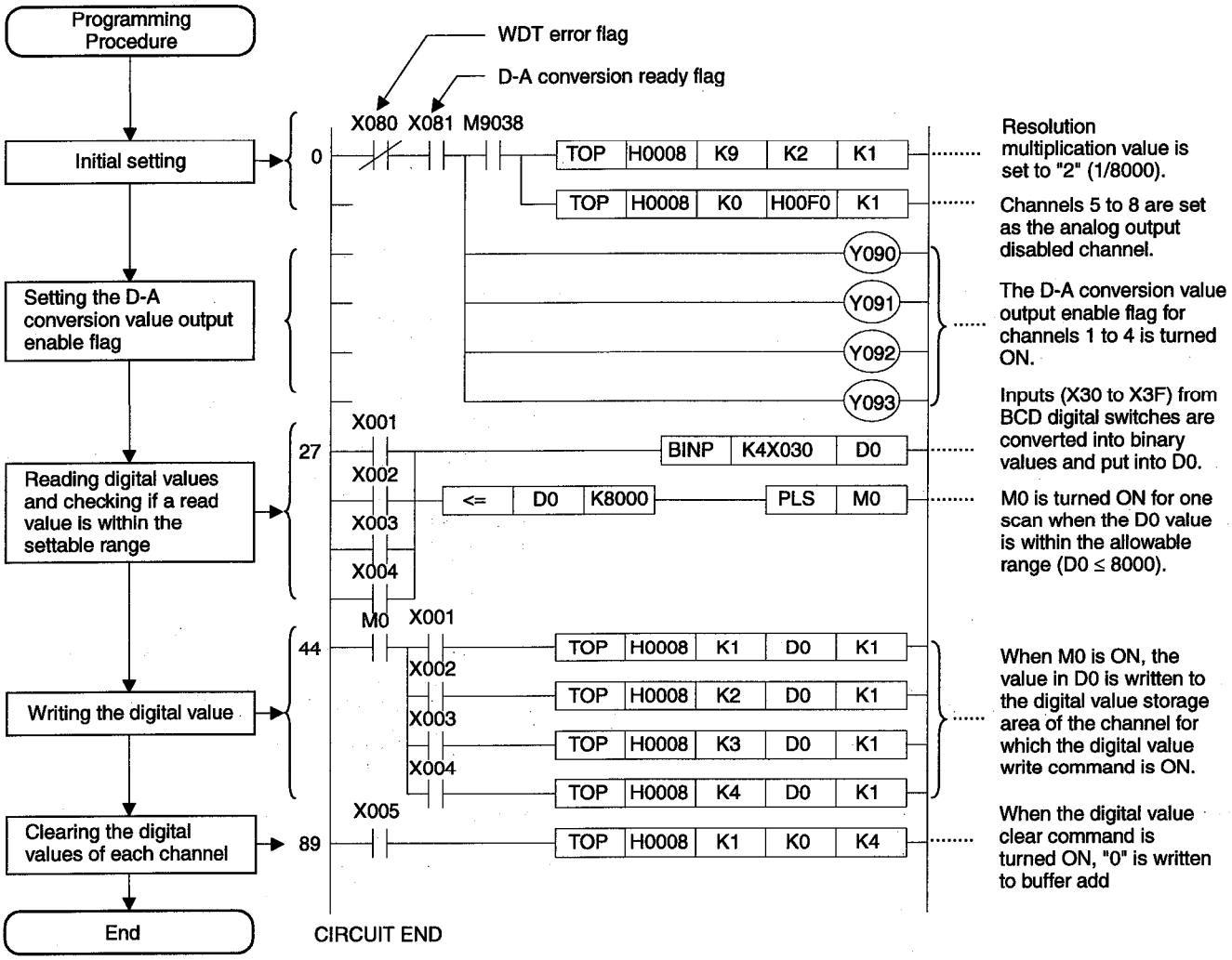
3) Channel No.3 ..... X3

4) Channel No.4 ..... X4

(b) Setting of digital value (4 digits in the BCD code) ..... X30 to X3F

(c) Digital value clear command ..... X5

(d) Digital value storage register ..... D0




**POINT**

During each of the processes of the special function module, access from the PLC CPU will have priority.
Accordingly, if frequent access to the buffer memory of the special function module made from the PLC CPU, it will not only extend the scan time of the PLC CPU, delays in each of the processes of the special function module will occur.
Only use the FROM/TO and other such commands to access the buffer memory from the PLC CPU when necessary.

### 5.2.2 Program for the A68DAV/DAI loaded in remote I/O station

The following program is used to write a value (0 to 8000) defined by the BCD digital switch to channels 1 to 4 (addresses 1 to 4 of buffer memory) of the A68DAV/DAI in a remote I/O station.

**Cautions on programming**

(1) Data transfer method

The CPU has direct and refresh I/O control modes. Data transfer between the CPU and remote I/O station is made in batch refresh mode after execution of the END (FEND) instruction.

(2) Response delay

A time difference (response delay) occurs because control data transferred between the master station CPU and remote I/O station A68DAV/DAI is controlled through the link module. Control timing must therefore be noted.

(3) Instructions used

The following instructions are used for data transfer between the master station CPU and remote I/O station A68DAV/DAI.

(a) Data write (master station to A68DAV/DAI) : RTOP instruction

(b) Data read (A68DAV/DAI to master station) : RFRP instruction

(4) Device for data transfer

Link registers (W) are used for data transfer between the master station CPU and remote I/O station A68DAV/DAI. Write either of both of the following programs to the master station as appropriate:

(a) Data write : Program which transfers data (to be transferred to the remote I/O station A68DAV/DAI) to the specified link registers before execution of the RTOP instruction.

(b) Data read : Program which transfers data from the link registers to the other device after execution of the RFRP instruction.

(5) Disable simultaneous execution of RTOP and RFRP instructions

The RTOP ad RFRP instructions cannot be executed at the same time to one A68DAV/DAI. To enable simultaneous execution, data link I/O signals must be written in the program as interlock conditions.

(When two A68DAV/DAI are loaded in the remote I/O station, the RTOP instruction may be executed to one A68DAV/DAI and the RFRP instruction to the other at the same time.)

(6) Control signals to the A68DAV/DAI

Because of the relation between the master station scan time and link scan time, the PLS Y[ ][ ] signal output to the remote I/O station may not be provided to the A68DAV/DAI.

The pulse output which executes the RST instruction after the SET instruction cannot be used because data is transferred between the master station and remote I/O station in batch refresh mode after execution of the END (FEND) instruction.

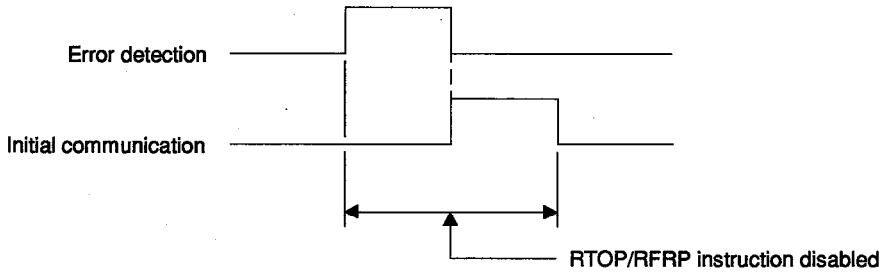
(7) Detection of remote I/O station error or parameter communication

(a) Provide interlock using the following devices so that the RTOP/RFRP instruction is not executed when the remote I/O station is faulty or during initial communication with the remote I/O station.

1) Remote I/O station error detection : D9228 to D9231

2) Initial communication detection : D9224 to D9227

The remote I/O station error and initial communication detection timings are as shown below:




(b) The error detection program must be written before the initial communication detection program.

If these programs are written in reverse order, neither error nor initial communication may be detected depending on the link refresh timing.

(8) A68DAV/DAI error detection

(a) X1D is switched ON to indicate that the A68DAV/DAI is faulty and the RFRP/RTOP instruction cannot be executed. In this case, check the A68DAV/DAI for A68DAV/DAI fault, module loading error, etc.

(b) Switch ON YD to switch OFF X1D

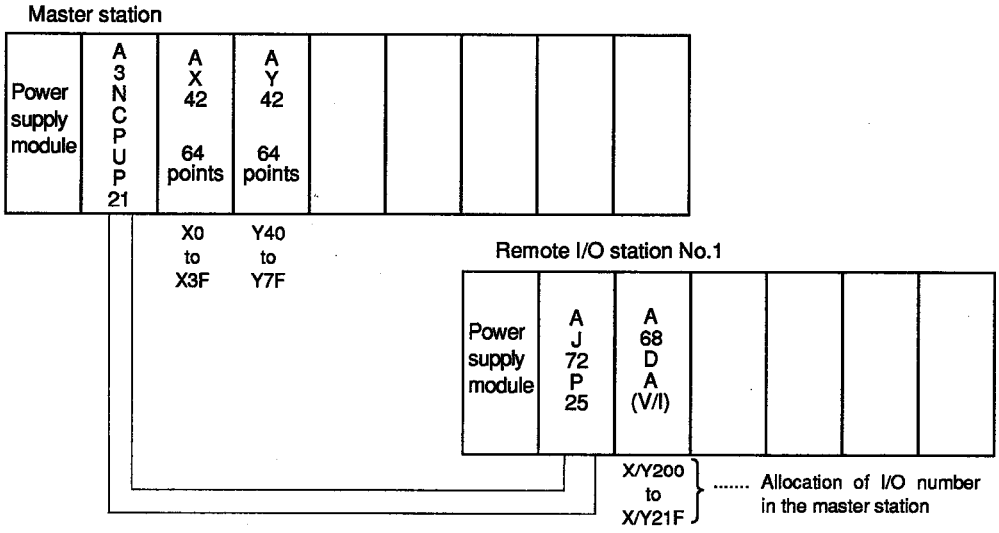
YD must only be switched ON/OFF as described below by using the SET/RST instruction:

1) Switched ON when X1D is switched ON.

2) Switched OFF only once when X1D is switched OFF.

**Programming condition**

(1) System configuration




(2) Initial settings

(a) Digital value resolution ..... "2" (1/8000)

(b) Analog output disable channel ..... CH.5, 6, 7, 8

(3) Device for user

(a) Initial setting command input signal ..... X0

(b) Digital value write command input signal

1) Channel No.1 ..... X1

2) Channel No.2 ..... X2

3) Channel No.3 ..... X3

4) Channel No.4 ..... X4

(c) Setting of digital value (4 digits in the BCD code ) ..... X30 to X3F

(d) Digital value clear command ..... X5

(e) Start/completion signal of each processing ..... M0 to M16

(f) Data storage register at an error detection ..... D0, D1

(g) Initial setting data register

1) Resolution value register ..... W101

2) Analog output enable/disable channel setting data register ..... W102

(h) Digital value register

1) Channel No.1 ..... W111

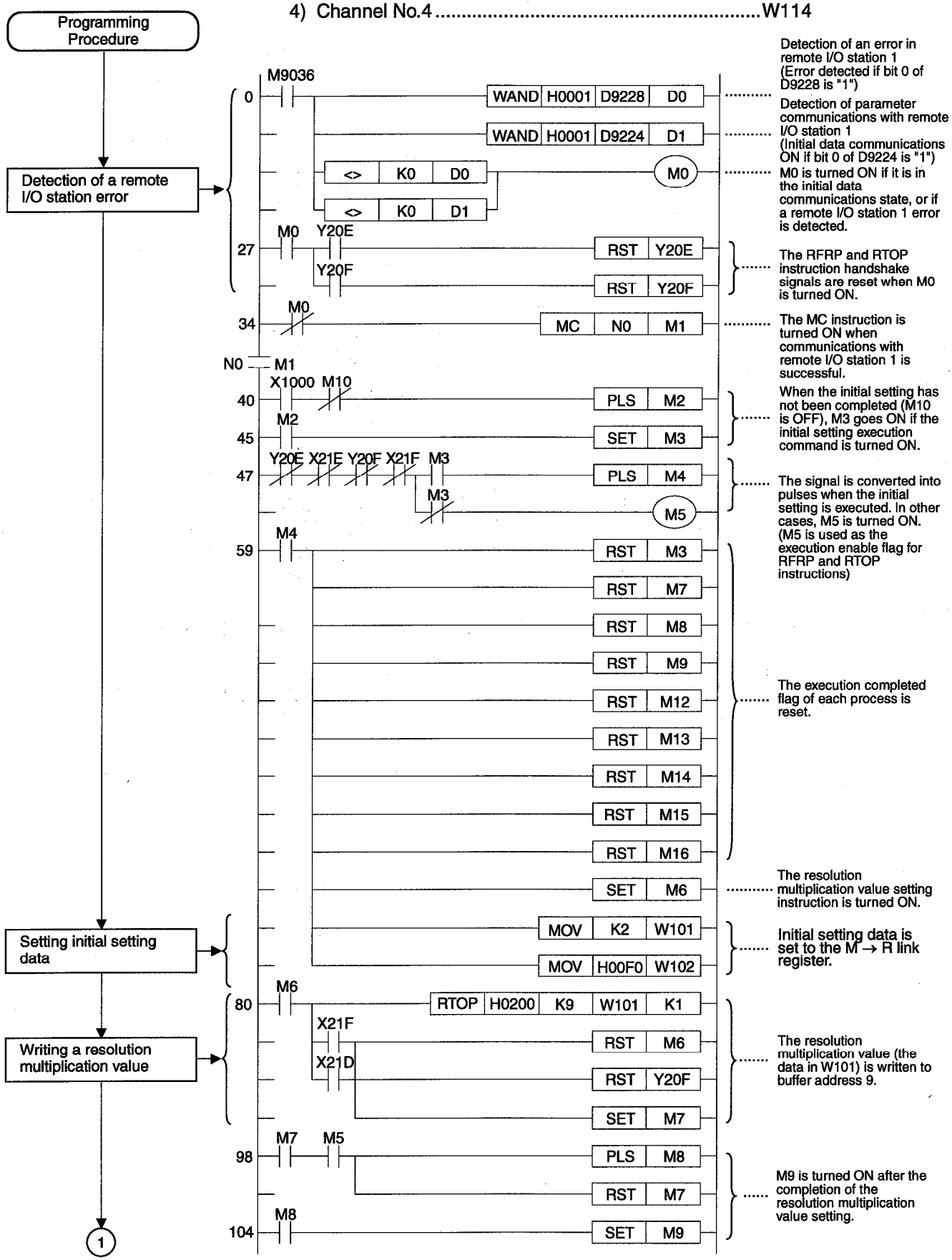
2) Channel No.2 ..... W112

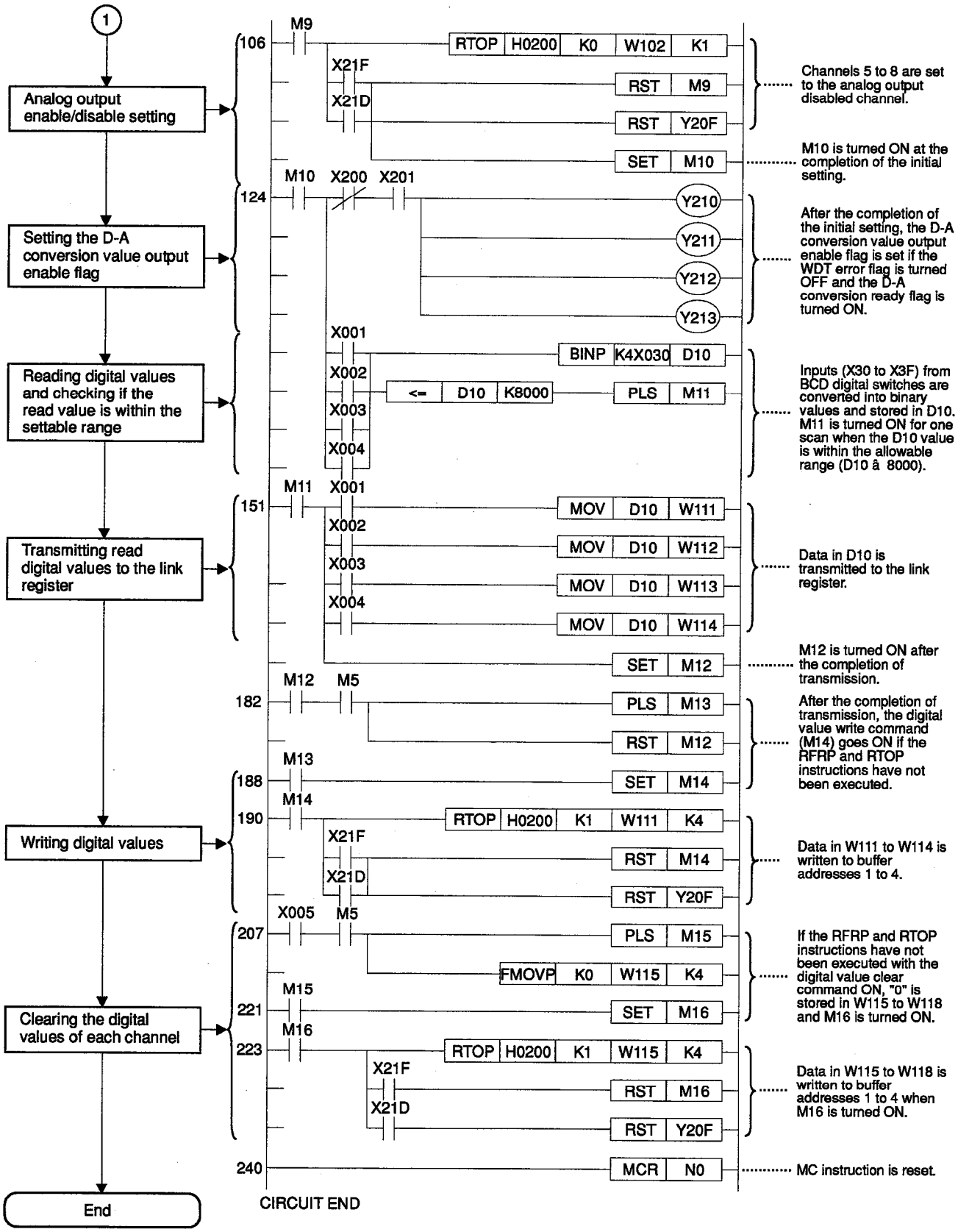
3) Channel No.3 ..... W113

4) Channel No.4 ..... W114

3) Channel No.3 ..... W113

4) Channel No.4 ..... W114



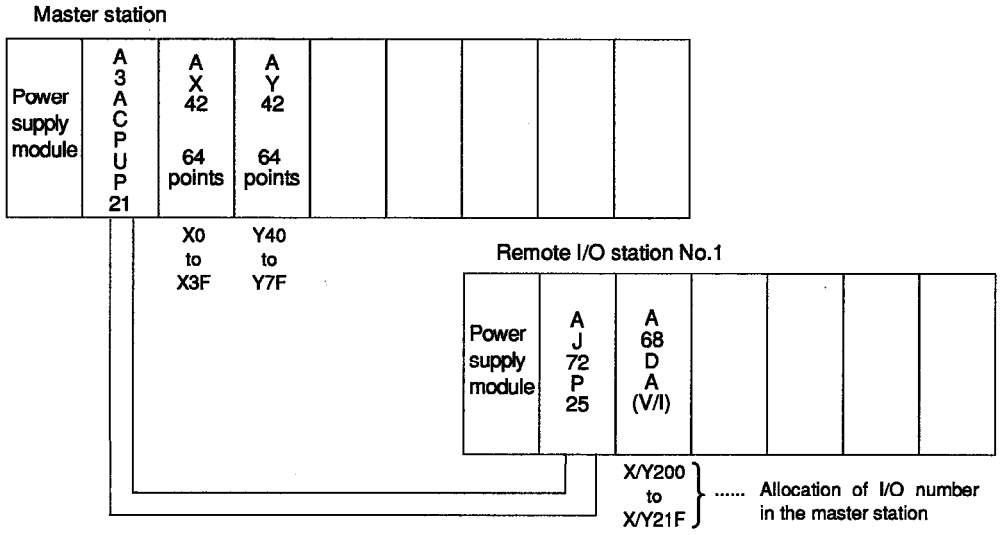

1
Analog output enable/disable setting
Setting the D-A conversion value output enable flag
Reading digital values and checking if the read value is within the settable range
Transmitting read digital values to the link register
Writing digital values
Clearing the digital values of each channel
End
106
M9
RTOP H0200 K0 W102 K1
X21F
RST M9
X21D
RST Y20F
SET M10
Channels 5 to 8 are set to the analog output disabled channel.
M10 is turned ON at the completion of the initial setting.
124
M10 X200 X201
Y210
Y211
Y212
Y213
After the completion of the initial setting, the D-A conversion value output enable flag is set if the WDT error flag is turned OFF and the D-A conversion ready flag is turned ON.
X001
BINP K4X030 D10
X002
<= D10 K8000
PLS M11
X003
X004
Inputs (X30 to X3F) from BCD digital switches are converted into binary values and stored in D10. M11 is turned ON for one scan when the D10 value is within the allowable range (D10 â 8000).
151
M11 X001
MOV D10 W111
X002
MOV D10 W112
X003
MOV D10 W113
X004
MOV D10 W114
Data in D10 is transmitted to the link register.
SET M12
M12 is turned ON after the completion of transmission.
182
M12 M5
PLS M13
RST M12
After the completion of transmission, the digital value write command (M14) goes ON if the RFRP and RTOP instructions have not been executed.
188
M13
SET M14
190
M14
RTOP H0200 K1 W111 K4
X21F
RST M14
X21D
RST Y20F
Data in W111 to W114 is written to buffer addresses 1 to 4.
207
X005 M5
PLS M15
FMOVP K0 W115 K4
221
M15
SET M16
If the RFRP and RTOP instructions have not been executed with the digital value clear command ON, "0" is stored in W115 to W118 and M16 is turned ON.
223
M16
RTOP H0200 K1 W115 K4
X21F
RST M16
X21D
RST Y20F
Data in W115 to W118 is written to buffer addresses 1 to 4 when M16 is turned ON.
240
MCR N0
MC instruction is reset.
CIRCUIT END

### 5.2.3 Program for the A68DAV/DAI loaded in remote I/O station (Use of the AnACPU dedicated instruction)

The following program is used to write a value (0 to 8000) defined by the BCD digital switch to channels 1 to 4 (addresses 1 to 4 of buffer memory) of the A68DAV/DAI in a remote I/O station when AnACPU dedicated instructions are used.

**Programming condition**

(1) System configuration




(2) Initial settings

(a) Digital value resolution ..... "2" (1/8000)

(b) Analog output disable channel ..... CH.5, 6, 7, 8

(3) Device for user

(a) Initial setting command input signal ..... X0

(b) Digital value write command input signal

1) Channel No.1 ..... X1

2) Channel No.2 ..... X2

3) Channel No.3 ..... X3

4) Channel No.4 ..... X4

(c) Setting of digital value (4-digit in the BCD code ) ..... X30 to X3F

(d) Digital value clear command ..... X5

(e) Start/completion signal of each program ..... M0 to M9

(f) Initial setting data storage link register

1) Resolution value register ..... W101

2) Analog output enable/disable channel setting data register ..... W102

(g) Digital value read data register ..... D0

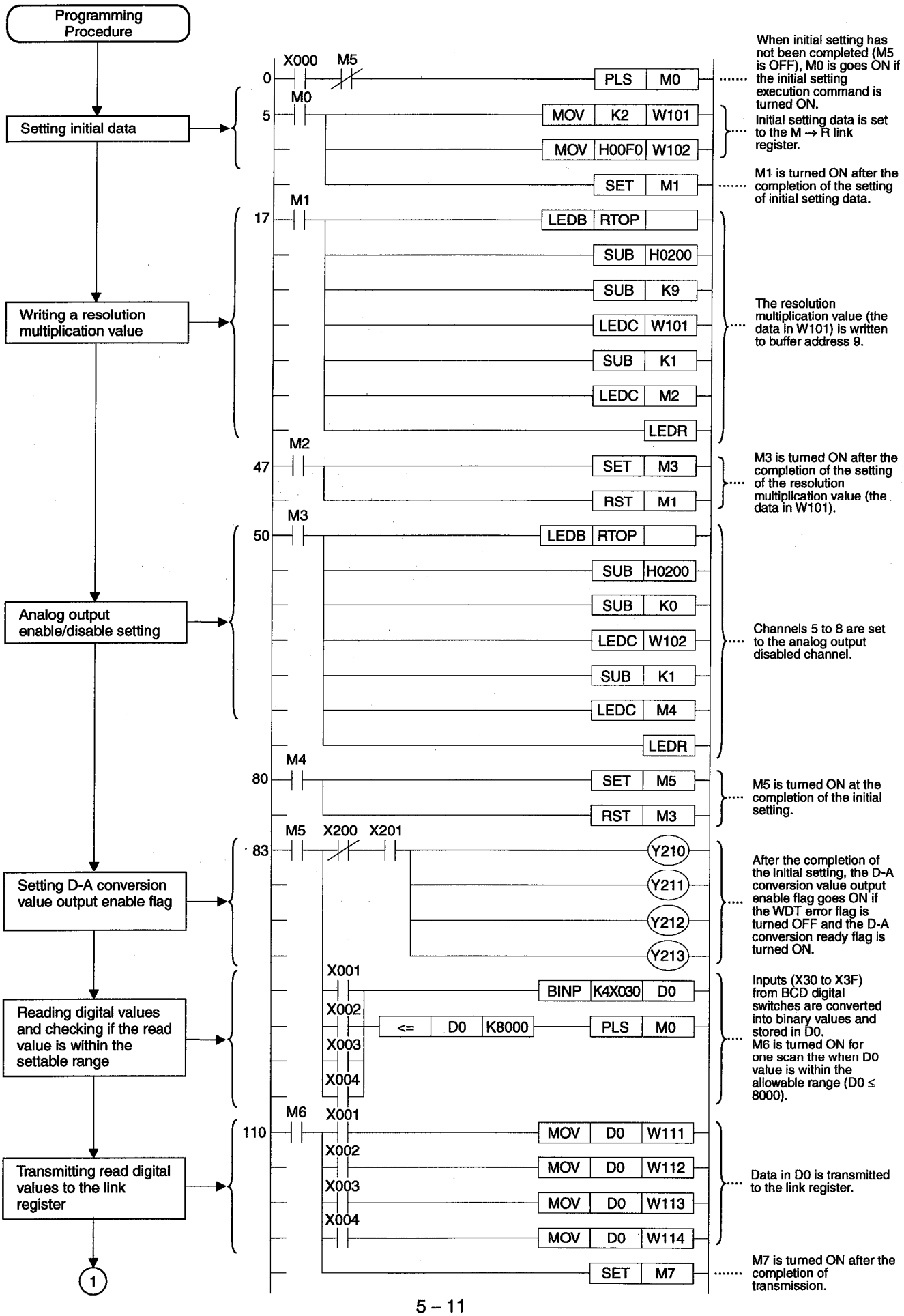
(h) Digital value storage link register

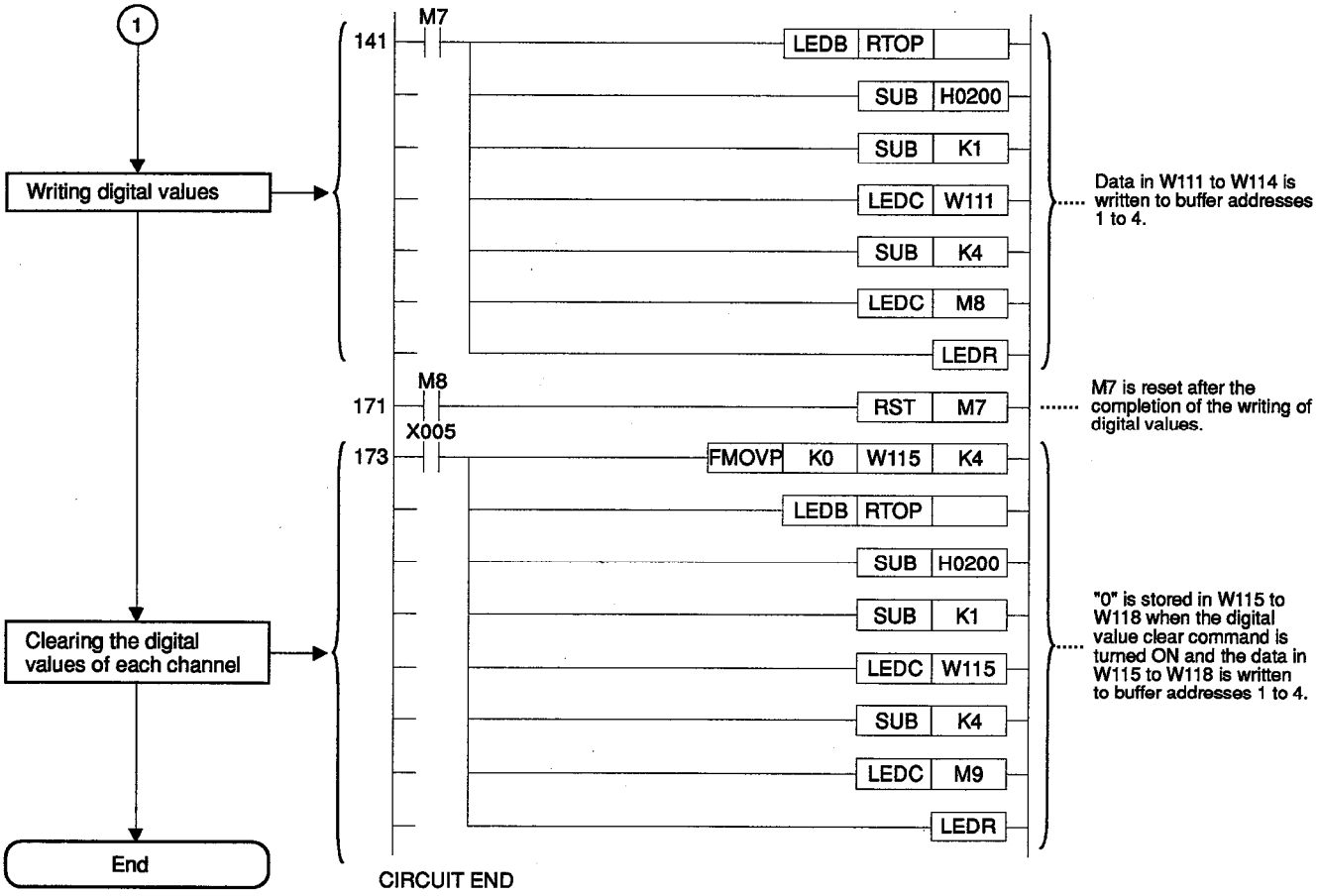
1) Channel No.1 ..... W111

2) Channel No.2 ..... W112

3) Channel No.3 ..... W113

4) Channel No.4 ..... W114


Programming Procedure
Setting initial data
Writing a resolution multiplication value
Analog output enable/disable setting
Setting D-A conversion value output enable flag
Reading digital values and checking if the read value is within the settable range
Transmitting read digital values to the link register
1
0 X000 M5 PLS M0
When initial setting has not been completed (M5 is OFF), M0 is goes ON if the initial setting execution command is turned ON.
5 M0 MOV K2 W101
MOV H00F0 W102
Initial setting data is set to the M → R link register.
SET M1
M1 is turned ON after the completion of the setting of initial setting data.
17 M1 LEDB RTOP
SUB H0200
SUB K9
LEDC W101
SUB K1
LEDC M2
LEDR
The resolution multiplication value (the data in W101) is written to buffer address 9.
47 M2 SET M3
RST M1
M3 is turned ON after the completion of the setting of the resolution multiplication value (the data in W101).
50 M3 LEDB RTOP
SUB H0200
SUB K0
LEDC W102
SUB K1
LEDC M4
LEDR
Channels 5 to 8 are set to the analog output disabled channel.
80 M4 SET M5
RST M3
M5 is turned ON at the completion of the initial setting.
83 M5 X200 X201 Y210 Y211 Y212 Y213
After the completion of the initial setting, the D-A conversion value output enable flag goes ON if the WDT error flag is turned OFF and the D-A conversion ready flag is turned ON.
X001 BINP K4X030 D0
X002 <= D0 K8000 PLS M0
X003
X004
Inputs (X30 to X3F) from BCD digital switches are converted into binary values and stored in D0.
M6 is turned ON for one scan the when D0 value is within the allowable range (D0 ≤ 8000).
110 M6 X001 MOV D0 W111
X002 MOV D0 W112
X003 MOV D0 W113
X004 MOV D0 W114
Data in D0 is transmitted to the link register.
SET M7
M7 is turned ON after the completion of transmission.


1
Writing digital values
Clearing the digital values of each channel
End
141
M7
LEDB RTOP
SUB H0200
SUB K1
LEDC W111
SUB K4
LEDC M8
LEDR
Data in W111 to W114 is written to buffer addresses 1 to 4.
171
M8
RST M7
M7 is reset after the completion of the writing of digital values.
173
X005
FMOVP K0 W115 K4
LEDB RTOP
SUB H0200
SUB K1
LEDC W115
SUB K4
LEDC M9
LEDR
"0" is stored in W115 to W118 when the digital value clear command is turned ON and the data in W115 to W118 is written to buffer addresses 1 to 4.
CIRCUIT END

# 6. TROUBLESHOOTING

Problem conditions and troubleshooting diagnoses for the A68DAV/DAI are given below. For information on the CPU module, see the corresponding CPU User's Manual.

## 6.1 When the RUN LED Flashes or Goes OFF

(1) When the RUN LED goes OFF:

| Items to Check | Corrective Actions |
|---|---|
| Are the TEST terminals shorted? (Test mode) | Cancel the test mode by opening the TEST terminals. |
| Has an error occurred in the CPU module? | Refer to the appropriate User's Manual for error information, and correct the error |
| Is the power supply module (5 VDC) installed to the base unit not getting enough current? | Recalculate the total amperage for the CPU, I/O module, and special function module installed to the base unit, and replace the power supply module based on that calculation. |
| Is the A68DAV/DAI WDT error flag set? | Reset the CPU module. |

(2) When the RUN LED flashes:

| Items to Check | Corrective Actions |
|---|---|
| Has a digital value outside the set range been written? | Clear the set value check code storage area using the error reset flag. |
| Are the TEST terminals closed (test mode) with the offset/gain switch placed in either "OFFSET" or "GAIN"? | After setting the offset or gain value, open the TEST terminals. |
| Does the LED flash at 0.1 s intervals when in the test mode? | Make offset/gain setting within an allowable range. |

## 6.2 When the Analog Value is 0 V/0 mA

(1) When the values of all channels are 0 V/0 mA:

| Items to Check | Corrective Actions |
|---|---|
| Is the RUN LED of the A68DAV/DAI turned OFF? | Follow procedures in Section 6.1. |
| Is the WDT error flag set? | Follow procedures in Section 6.7. |
| Is the D-A conversion ready flag set? | Follow procedures in Section 6.8. |
| Is the channel set as the analog output enabled/disabled channel? | Set the channel to be used as the analog output enabled/disabled channel. |
| Is a digital value written to the digital value setting area (addresses 1 to 8) in the buffer? | Write the digital value to the channel used for D-A conversion (see Sections 3.5.3 and 5.2.). |

(2) When the value of a given channel is 0 V/0 mA:

| Items to Check | Corrective Actions |
|---|---|
| Is the analog output enable/disable channel with its "0 V/0 mA" analog value set to disable? | Confirm the data set in the analog output enable/disable channel setting area of the buffer memory. (Refer to Section 3.5.2.) |
| Is the digital value of the channel with its "0 V/0 mA" analog value written in the digital value setting area of the buffer memory? | Write the digital value. (Refer to Section 3.5.3.) |
| Is the external wiring done correctly? | Make sure the external wiring is correct. |

## 6.3 When Analog Values are Offset Values

(1) When the analog values of all channels are offset values:

| Items to Check | Corrective Actions |
|---|---|
| Are the TEST terminals shorted? (Test mode) | Cancel the test mode by opening the TEST terminals. |
| Is the RUN key switch of the CPU module set to a position other than "RUN"? | Set the switch to the RUN position |
| Is the D-A conversion output enable flag of each channel OFF? | Turn ON the D-A conversion output enable flag of the channel to be used. |
| Is the digital value setting area (addresses 1 to 8) of the buffer memory? | Write the digital values of the channel to be converted from digital to analog.<br>(Refer to Sections 3.5.3 and 5.2 ) |

(2) When the analog value of a given channel is an offset value:

| Items to Check | Corrective Actions |
|---|---|
| Is the D-A conversion output enable flag OFF for the channel when the analog value is an offset value? | Turn ON the D-A conversion output enable flag. |
| Is the digital value of the channel whose analog value is an offset value written to the digital value setting area of the buffer memory? | Write the digital value. (Refer to Section 3.5.3.) |

## 6.4 Analog Values are Output though the CPU Module is set to STOP

(1) When the analog output does not change after setting to STOP:

| Items to Check | Corrective Actions |
|---|---|
| Are the HOLD/CLEAR setting terminals shorted(held)? | Open the HOLD/CLEAR setting terminals. |

(2) When the analog output changes after setting to STOP:

| Items to Check | Corrective Actions |
|---|---|
| Is the analog output set to offset value? | After checking the offset value setting, set the offset value again if 0 V/0 mA output is required. |

## 6.5 When Digital and Analog Values do not Match

(1) When both digital values and analog values change:

| Items to Check | Corrective Actions |
|---|---|
| Does the digital value match the analog value? | Correct the offset/gain values. |
| Are the A68DAV/A68DAI and external devices properly wired? | Make sure the wiring between the A68DAV/A68DAI and the external devices is correct. |
| Is the 24 VDC external power supply getting enough current? | Recalculate the total amperage for the module installed to the base unit, and replace the power supply module based on that calculation. |

(2) When the digital value changes and the analog value is fixed:

| Items to Check | Corrective Actions |
|---|---|
| Is 24 VDC power being supplied? | Check the external power supply. |
| Is the RUN key switch of the CPU module set to a position other than "RUN"? | Set the switch to the RUN position. |

## 6.6 WDT Error Flag is Set

| Item to Check | Corrective Actions |
|---|---|
| Is the WDT setting time shorter than the sequence program scan time? | Change the WDT setting time to conform to the sequence program scan time. |
| Is the sequence program correct? | Check if the sequence program contains an infinite loop. |

## 6.7 D-A Conversion READY Flag is Reset

| Items to Check | Corrective Actions |
|---|---|
| Are the TEST terminals closed (test mode)? | Cancel test mode by opening the TEST terminals. |
| Is there an error in the CPU module? | See the corresponding User's Manual for respective CPU module for error information. Correct the error. |
| Is there an I/O number error? | Confirm and correct the I/O number. |

## 6.8 Error Flag is Set

| Item to Check | Corrective Action |
|---|---|
| Is a value that is not "0" set in the setting value check code storage area (addresses 10 to 17) of the buffer memory? | Find out why a digital value outside the set range is written to the digital value setting area of the channel that corresponds to the non-zero set value check code storage area. Then, take corrective action and use the error reset flag to clear the set value check code storage area. |

**POINT**

If all of the troubleshooting checks do not show problems, or if the prescriped corrective measures do not solve the problem, the A68DAV/DAI hardware might be faulty.

Consult a Mitsubishi representative.

# APPENDICES

## APPENDIX 1 Comparison with Other D-A Converter Modules

Table 1.1 shows the comparison of A68DAV/DAI and other D-A converter modules.

**Table 1.1 Comparison List**

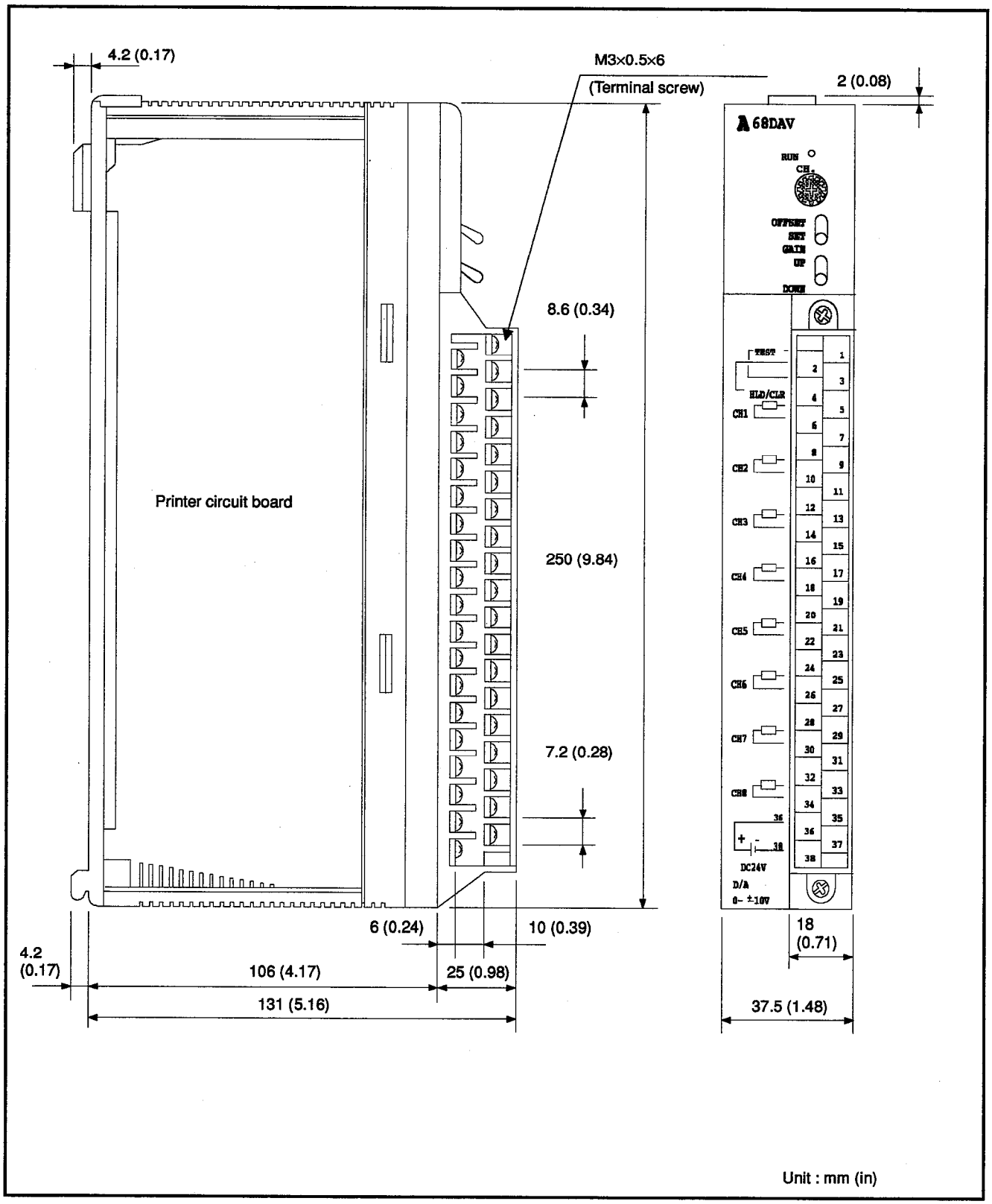
| Item | | Specifications | | | |
|---|---|---|---|---|---|
| | | A62DA | A62DA-S1 | *1 A616DAV/A616DAI | *1 A68DAV/A68DAI |
| Digital input *2 | Voltage | ±2000 | 0 to +4000 | −4000 to 4000 | Maximum -12000 to 12000 (Varies according to resolution setting) |
| | Current | ±1000 | | 0 to 4000 | Maximum 0 to 12000 (Varies according to resolution setting) |
| Analog output | Voltage | −10 to 0 to +10 VDC (External load resistance : 500 Ω to 1 MΩ) | | −10 to 0 to 10 VDC/ −5 to 0 to 5 VDC (External load resistance: 2 KΩ to 1 MΩ) | −10 to 0 to 10 VDC (External load resistance: 2 KΩ to 1 MΩ) |
| | Current | −20 to 0 to 20 mADC (External load resistance: 0 Ω to 600 Ω) | 0 to 20 mADC (External load resistance: 0 Ω to 600 Ω) | 0 to 20 mADC (External load resistance: 0 Ω to 600 Ω) | |
| Maximum resolution | Voltage | 5 mV (1/2000) | 1 to 5 V :1 mV (1/4000)<br>0 to 5 V :1.25 mV (1/4000)<br>0 to 10 V :2.5 mV (1/4000) | −10 to 0 to 10 V : 1.30 mV (1/4000)<br>−5 to 0 to 5 V : 0.65 mV (1/4000) | 2.5 mV (1/4000)<br>1.25 mV (1/8000)<br>0.83 mV (1/12000) } Selectable |
| | Current | 20 μA (1/1000) | 4 to 20 mA : 4 μA (1/4000)<br>0 to 20 mA : 5 μA (1/4000) | 2.64 μA (1/4000) | 5 μA (1/4000)<br>2.5 μA (1/8000)<br>1.6 μA (1/12000) } Selectable |
| Overall accuracy (Precision related to the maximum value) | | Within ±1.0% | | Within ±0.6% | Within ±1.0% |
| Number of channels of analog output | | 2 channels/module | | 16 channels/module | 8 channels/module |
| Conversion time | | Within 15 ms/2 channels (same with 1 channel) | | 0.5 ms/channel | Within 40 ms/8channels (same with 1 channel) |
| Absolute maximum output | Voltage | ±12 V | 0 to 12 V | ±12 V | ±12 V |
| | Current | ±28 mA | 0 to 28 mA | 0 to 28 mA | 0 to 28 mA |
| Conversion method | | 2-channel simultaneous scanning | | Scanning by each channel | 8 channels simultaneous scan method |
| Offset/Gain adjustment | | Adjustable without using offset/gain adjusting knobs | | | |
| Insulation method | Between input terminal and PLC | Photocoupler insulation | | | |
| | Between channels | Not insulated | | | |
| Output HOLD/CLEAR setting at STOP of PLC | | Disabled | Enabled | | |
| Channel designation of D-A conversion | | Batch designation of all channels with output enable flag | | Designation by each channel by setting of analog output enable/disable channel | |
| Designation of D-A conversion enable/disable with output enable flag | | Batch designation of all channels | | | Designation by each channel |
| External power supply | Voltage | 24 VDC | | ±15 VDC | 24 VDC |
| | Current | 0.35 A | | +15 V:0.2 A, −15 V:0.17 A (DAV) | 0.2 A (DAV) |
| | | | | +15 V:0.53 A, −15 V: 0.125 A (DAI) | 0.4 A (DAI) |

*1 ——— In the columns of the A616DAV/A616DAI and A68DAV/A68DAI where the voltage and current areas are shown, values in the voltage area indicate specification of the voltage converter module (A[ ]DAV), and those in the current area indicate specification of the current converter module (A[ ]DAI).

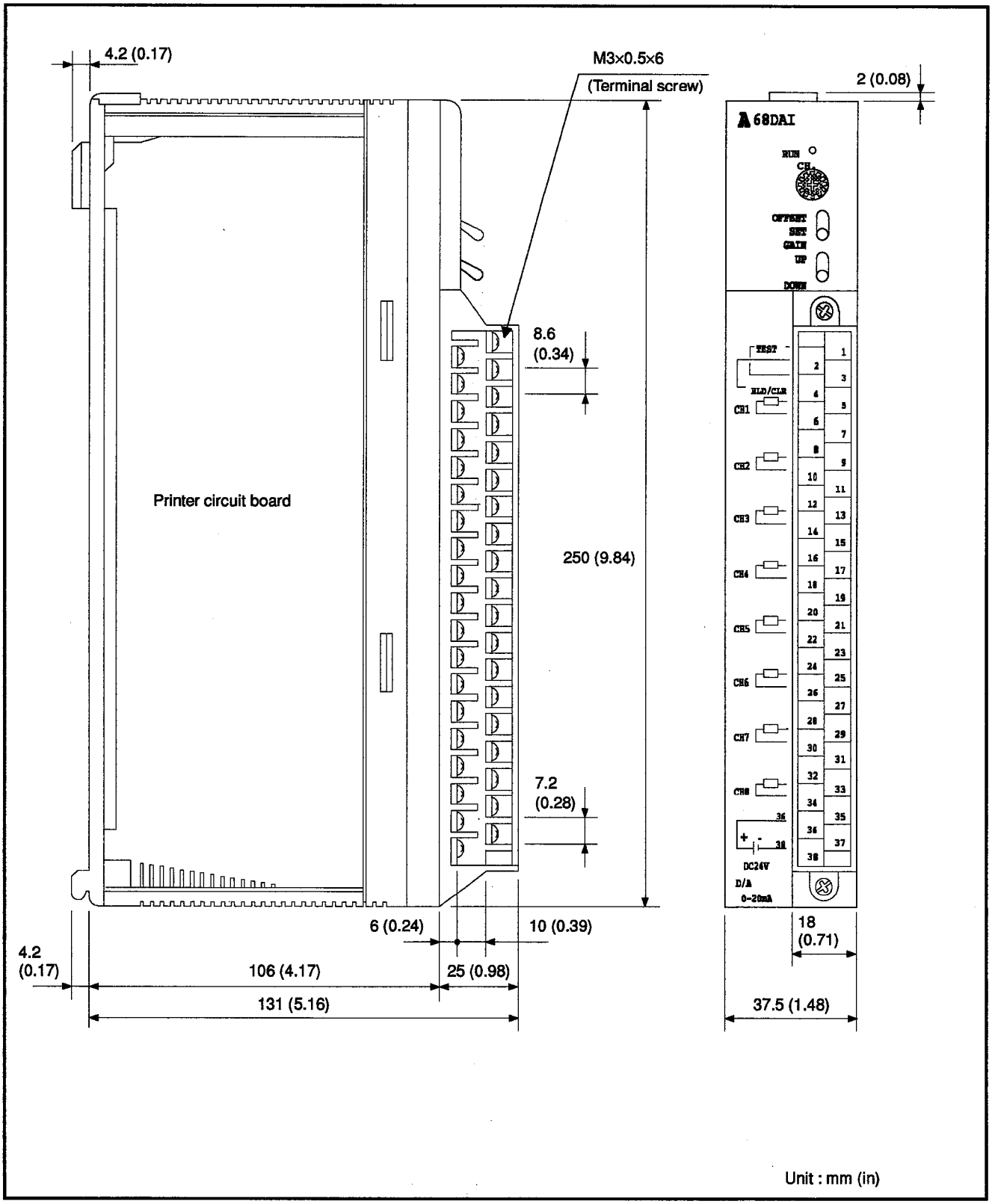
*2 ——— Digital input values that allow the analog output value of a practicable range to be obtained are specified.

## APPENDIX 2 Dimensions

### 2.1 A68DAV



## 2.2 A68DAI


4.2 (0.17)
M3×0.5×6
(Terminal screw)
2 (0.08)
A68DAI
RUN
CH
OFFSET
SET
GAIN
UP
DOWN
TEST
HLD/CLR
CH1
CH2
CH3
CH4
CH5
CH6
CH7
CH8
DC24V
D/A
0-20mA
Printer circuit board
8.6
(0.34)
250 (9.84)
7.2
(0.28)
6 (0.24)
10 (0.39)
4.2
(0.17)
106 (4.17)
25 (0.98)
131 (5.16)
18
(0.71)
37.5 (1.48)
Unit : mm (in)

# WARRANTY

Please confirm the following product warranty details before starting use.

## 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 dealer or Mitsubishi Service Company. Note that if repairs are required at a site overseas, on a detached island or remote place, expenses to dispatch an engineer shall be charged for.

### [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 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 possible 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 chance loss and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to damages caused by any cause found not to be the responsibility of Mitsubishi, chance losses, lost profits incurred to the user by Failures of Mitsubishi products, damages and secondary damages caused from special reasons regardless of Mitsubishi's expectations, compensation for accidents, and compensation for damages to products other than Mitsubishi products and other duties.

## 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 general-purpose 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 National Defense purposes shall be excluded from the programmable logic controller applications.

Note that even with these applications, if the user approves that the application is to be limited and a special quality is not required, application shall be possible.

When considering use in aircraft, medical applications, railways, incineration and fuel devices, manned transport devices, equipment for recreation and amusement, and safety devices, in which human life or assets could be greatly affected and for which a particularly high reliability is required in terms of safety and control system, please consult with Mitsubishi and discuss the required specifications.

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