TOYODENKI

1unit/Arithmetic controller

DG-AMP

User's manual

TOYODENKI

Foreword

Thank you very much for your purchase of our DG-AMP 1 unit arithmetic controller.

This hardware version of user's manual contains the explanation about hardware specifications and handling of the said controller. Please read this user's manual thoroughly for proper use of this controller.

Further, we request you to read related manuals shown in the following table concurrently.

Name	Manual No.	Contents
μ GPC SX series programming manual (Command word version)	IGJ057A	This manual describes the memory, language, and details of system definition, etc. of μ GPC SX series.
μ GPC SX series programming manual (Operation version)	IGJ058A	This manual explains the menu and icons, etc. of TDsxEditor and describes all operations of TDsxEditor.

Cautions

(1) It is forbidden to reproduce any part or all of the details of this manual without our permission.

(2) Please note that the details of this manual, specifications, etc. are subject to change without notice for the improvement.

(3) We made the details of this manual doubly sure, however, if you have any questions or you notice any error, contact our sales office published at the end of this manual. At such occasion, please inform the manual number published on the front cover as well.

Important Safety Instructions

Before using this product, read "Important Safety Instructions" thoroughly for proper use.

Here, labels of Important Safety Instructions are classified into "DANGER" and "CAUTION" and their meanings are as follows:

⬦! DANGER　　　　　　: Risk of death or serious injury from improper use.

△! CAUTION　　　　　　: Risk of medium handicap, slight injury or damage to property from improper use.

FYI, even in the case of items classified into △! CAUTION, they have a probability of leading to the serious consequence as the case may be.

In either case, important details are described then always follow them.

Though we show the items requiring your special attention as follows, they are also indicated in the text of this manual.

⬦! DANGER
●While this controller is alive, do not touch the live part like terminal, etc. Electric shock may occur. ●Always perform the mounting, removal, wiring works and maintenance/inspection with power supply to this controller OFF.　　Hot work may result in electric shock, malfunction, and breakdown. ●Configure the emergency stop and interlock circuits at the outside of PC.　　Breakage and accident may occur due to breakdown in PC.

⚠ CAUTION

●Do not use the items that were found damaged or deformed during unpacking. It may cause fire, malfunction and breakdown.

●Do not apply impact to the product through drop or rollover, etc. It may cause breakage and breakdown of the product.

●Mount the product in accordance with the details published in the instruction manual and others. Defective mounting may cause drop of product, malfunction and breakdown.

●Use this product under rated voltage and current published in the instruction manual and others. Use of this product under the voltage and current other than the rated may cause fire, malfunction and breakdown. Use (Store) this product under environment published in the instruction manual and others.

●Use (Storage) of this product under the environment with high temperature, high humidity, condensation, dust, corrosive gas, oil, organic solvent and especially big vibration/impact may cause to electric shock, fire, malfunction, breakdown when the product is used.

●Select the electric wires suitable for voltage to be applied and current to be passed to tighten them at the specified torque. Defective wiring and tightening may cause fire, drop of product, malfunction and breakdown.

●Execute the wiring work so as to prevent the foreign matter, such as dust, electric wire scrap, iron powder from entering into inside of the equipment. Fire, accident, malfunction and breakdown may result.

●Always ground the grounding terminal.　Failure to perform grounding work may cause electric shock and malfunction.

●Check the terminal screws and mounting screws for secure tightening periodically. Use of this product with such screws loosen may cause fire and malfunction.

●Always fit the terminal cover to the terminal block.　Electric shock and fire may occur.

●Operations such as program change, forced output, start and stop while running shall be performed upon completion of check for the safety.
Mistake in operation may cause the machine to operate and may result in breakage and accident of the machine.

●Insert the tool connector in proper direction. Malfunction may result.

●Before you touch PC, first touch the grounded metal, etc. to make the static electricity charged in the human body, etc. discharge.　Excessive static electricity may cause malfunction and breakdown.

●Perform the wiring securely in accordance with the details published in the instruction manual and others. Wrong wiring may cause fire, accident and breakdown.

●When you pull out the plug from the receptacle, do not pull it out holding the cord.　Fire and breakdown due to break of cable may result.

●Do not make repairs of this product absolutely at the site and request its repair to us. It may cause fire, accident and breakdown.

●When you try to clean this product, turn OFF the power supply and then use the towel soaked with tepid water, etc.　Use of thinner or other organic solvent may cause melting or discoloring of the equipment surface.

●Do not modify or disassemble the product. It may cause breakdown.

●When you dispose of this product, handle this product as industrial waste.

●Product published in this manual is not the one designed or manufactured for the sake of being used in the equipment or system that affects human life.

●When you study the use of product described in this manual for the control of nuclear energy, aerospace, medical care, traffic equipment, passenger mobile unit or special application for these systems, etc. make an inquiry to our sales contact.

●When you apply the product published in this manual to the equipment that breakdown of our product affects the life or occurrence of serious loss can be expected, always install the safety equipment.

Revision history

Print date	Manual No.	Revisions
04－11－05	1st	Prepared newly
05－03－25	2nd	Addition of analog input terminal (with insulation function), (current input) and pulse-train (rate multiplier) output terminal
05－10－03	3rd	Addition of RESET button, additional writing for analog output specifications and body mounting method, etc.

Table of Contents

1-1 Overview

(1) PLC functions

The intelligible GPC language was adopted as DG-AMP. The application program which has the same function as our company's PLC μ GPCsx series can be created.

(2) External I/F

Digital input and output (DC12V/DC24V), analog input and output (-10V to +10V), and communication I/F (RS232C, RS422, RS485) are standard equipment of external I/F, to built various applications.

(3) Frequency counter function

PG input is exclusively for two-phase and can measure the input pulse frequency up to 36 kHz as frequency counter of PG.

FI input can measure the frequency of input pulse up to 36 kHz as frequency counter for single phase or two-phase that combines two channels.

(4) I/F for internal extension BUS

This controller installs internal I/F for extension BUS that can place communication option board for our inverter on board and installation of OPCN-64 to the broad makes this controller as OPCN-1 slave equipment and allows the connection with other master equipment.

(5) Simplified liquid crystal console

This controller has console LCD indicator, check of data stored in the internal resistor can be made without personal computer. In addition, data change is possible by the operation from the switch part.

2-1 System configuration
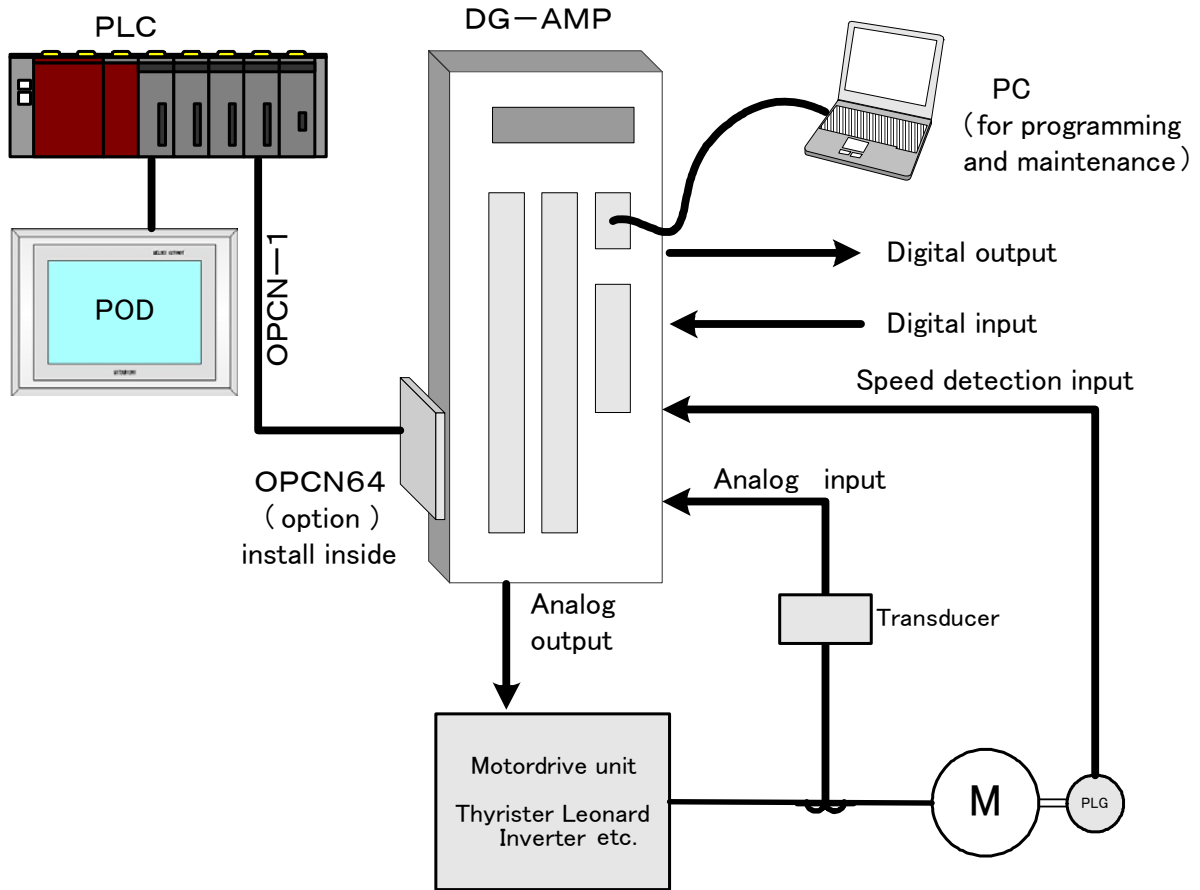
・Connect to the external communication equipment through exclusive connector.
・Connection with digital input / output and analog input is made at the terminal block.

2-2 Digital input / Input memory layout

Resistor name	Relay name	Terminal No.	Details
i00000	I00000	DI-0	Digital input signal
	I00001	DI-1	
	I00002	DI-2	
	I00003	DI-3	
	I00004	DI-4	
	I00005	DI-5	
	I00006	DI-6	
	I00007	DI-7	
	I00008	DI-8	
	I00009	DI-9	
	I0000A	DI-A	
	I0000B	DI-B	
	I0000C	DI-C	
	I0000D	DI-D	
	I0000E	DI-E	
	I0000F	DI-F	

2-3 Analog input memory / Input memory layout

Resistor name	Terminal No.	Details
i00002	AI-0	(14 bit ±10V non-insulation between channels) Read value
i00003	AI-1	(14 bit ±10V non-insulation between channels) Read value
i00004	AI-2	(14 bit ±10V non-insulation between channels) Read value
i00005	AI-3	(14 bit ±10V non-insulation between channels) Read value
i00006	AI-4	(14 bit ±10V insulation between channels) Read value
i00007	AI-5	(14 bit ±10V insulation between channels) Read value
i00008	AI-6	(10 bit 4 to 20mA current input non-insulation CH1) Read value
i00009	AI-7	(10 bit 4 to 20mA current input non-insulation CH2) Read value
i0000A		System reserved
i0000B		System reserved
i0000C		System reserved
i0000D		System reserved
i0000E		System reserved
i0000F		System reserved

2-4 Frequency measuring register

Resistor name	Details	
i00010	2-phase PG counter frequency measured value, A frequency	
i00011	2-phase PG counter frequency measured value, B frequency	
i00012	FI-1 frequency measured value	
i00013	FI-2 frequency measured value	
i00014	2-phase PG counter direction of rotation 2-phase FI counter direction of rotation	
i00015	2-phase PG counter number of detected measuring errors (sum of A and B)	
i00016	FI-1 counter number of detected measuring errors	
i00017	FI-2 counter number of detected measuring errors	
i00018	PG-A UP/DOWN count value	
i00019	PG-B UP/DOWN count value	
i0001A	FI-1 UP/DOWN count value	
i0001B	FI-2 UP/DOWN count value	

2-5 Digital output memory / Output memory layout

Resistor name	Terminal	Terminal No.	Details
o00400	O00400	DO-0	Digital output signal
	O00401	DO-1	
	O00402	DO-2	
	O00403	DO-3	

2-6 Analog output memory / Output memory layout

Resistor name	Details	
o00042	AO-0 (DAC CH1)	
o00043	AO-0 (DAC CH2)	
o00044	AO-0 (DAC CH3)	

2-7 Pulse output memory / Output memory layout

Resistor name	Details	
o00050	PO-0 (Pulse output) Set pulse width/Output level	
o00051	PO-1 (Pulse output) Set phase lag width/Output level	
o00052	PO-2 (Pulse output) Set phase lag width/Output level	
o00053	PG/FI phase mode	
o00054	PO-0 to 2 Reference frequency rate	
o00055	PO-3 (Rate multiplier) divider value after output	
o00056	PO-3 (Rate multiplier) set value	
o00057	PO-3 (Rate multiplier) control data	
o00058	System reserved	

2-8 OPCN interface register

Resistor name	Details	
w00060	OPCN-1 Output register (Master > DG-AMP)	
w00061		
w00062	Number of output words	
w00063		
w00064		
w00065		
w00066		
w00067		
w00068		
w00069	OPCN-1 input register (Master <-DG-AMP)	
w0006A		
w0006B	Number of input words	
w0006C		
w0006D		
w0006E		
w0006F		
w003FC	OPCN-1 Number of input words set value	
w003FD	OPCN-1 Number of output words set value	
w003FE	OPCN-1 Baud rate set value	
w003FF	OPCN-1 Parameter setting flag	

2-9 Announce register

Resistor name	Details	Unit	Example
z00000	Running status (see note 1)		
z00001	Running status (see note 1)		
z00002	Running status (see note 1)		
z00003	(Task 1 execution time)	BCD mSEC	
z00004	(Task 2 execution time)	BCD mSEC	
z00005	(YYMM indication) Time		0501H
z00006	(DDHH indication) Time		0123H
z00007	(MMSS indication) Time		5959H
z00008			
z00009	(0.25m SEC counter)		
z0000A	(1SEC counter)		
z0000B	(System task counter)	1mSEC	
z0000C	System reserved		
z00034	System define information number of used words		
z00035	Function number of used words		
z00036	Program number of used words		
z00037	General-purpose file information number of used words		
zr002C	Task 1 scan time	Sec. (real number)	
zr002E	Task 2 scan time	Sec. (real number)	

3-1 DG-AMP general specification

Item		Specification
Physical environment	Operation ambient temperature	-0℃ to + 55℃
	Storage (Transportation) temperature	-20℃ to + 65℃
	Relative humidity	20 to 95%　 No condensation
	Level of contamination	Level of contamination 2　　 Note 1)
	Corrosion resistance	No corrosive gas. No adhesion of organic solvent
	Working altitude	2000m or less above altitude (Atmospheric pressure during transportation shall be 70kPa or more)
Mechanical operating conditions	Vibration proof	Single amplitude: 0.15mm Constant acceleration: 19.6 m/s^2 Up-and-down motion for 4 hours, transverse/longitudinal oscillation for 2 hours each, 8 hours in total
	Impact resistance	Peak acceleration: 147 m/s^2, 3 times in each direction(15G)
Electric operating conditions	Noise resistance	Noise simulator method Rise time 1ns, Pulse width 1 μ s, 1kV
	Static electricity discharge resistance	Contact discharge method: ±6kV, Aerial discharge method: ±8kV
	Radiation electromagnetic field resistance	10V/m (80MHz to 1000MHz)
Structure		Structure board–contained type
Cooling method		Natural cooling
Mass		4kg

Note 1)　Level of contamination 2: Normally, a condition that conductive contamination is absent.
　　　　However, in some cases, temporally conductivity may develop due to condensation.

3-2 Performance specification

Item		Specification
Arithmetic control mode		Stored program cyclic scan mode
I/O control mode		Direct refresh mode
Programming language		GPC language (Ladder diagram, data flow)
Program capacity		64k word (About 800 pages)
Number of inputs/outputs		512 word
Data memory	I/O memory (i0/o0)	512 word
	Global memory (g0,gr)	16384 word
	Local memory	16384 word
	File memory (fi,fr)	65536 word
	Retain memory (ri,rr)	65536 word
Self-diagnostic function		Watchdog timer
Memory backup Note 1), Note 2)		Program (including file memory), parameter ・Flash ROM Retain memory ・Built-in RAM (At the time of battery option un-equipped, memory kept one week after power off.) (At the time of battery option equipped, backup time for 10 years.) Battery option: Lithium primary battery.
Calendar		$\pm$60 seconds/month (25℃) (At the time of battery option un-equipped, memory kept one week after power off.)
Digital I/O		Sink/Source input 16 points Sink transistor output 4 points
Analog input		8CH
Analog output		3CH
Communication I/F		2CH

Note 1) When battery option equipped, exchange if out of guarantee term, even if there is battery capacity remnant.
Note 2) When battery option equipped, battery will not be consumed in the state of main power turned on.

3-3 DG-AMP Power supply specification

Item	Specification
Rated input range	AC100V/200V (AC85V to AC265V
Rated input current	AC100 - 0.6A or less AC200v - 0.35A or less
Rated input frequency (Frequency tolerance)	50 / 60[Hz] (48 to 62 [Hz])
Input rush current	20 [A] Typ. AC 100 [V]
Over-current protection	Trips when the current exceeds 105% or more of the rated current, automatic reset
Over-voltage protection	Trips when the current falls within the range from 115 to 140% of the rated voltage
Power consumption	30W or less

3-4 DC voltage input / Input specifications

Item			Specification
Input signal conditions	Rated voltage		DC12/24V
	Maximum allowable voltage		DC28V
	Allowable ripple rate		1% or less
Input circuit characteristics	Input mode		Sharing between source and sink (Bi-directional)
	Rated current		About 5mA (at 24V), about 2.5mA (at 12V)
	Input impedance		About 4.7 kΩ
	Standard operating range	OFF→ON	7.5 to 8.5V
		ON→OFF	7.5 to 8.5V
	Input type		DC type 1
	Input delay time		0.5ms
External connection			Terminal block
Insulation mode			Photo-coupler insulation
Dielectric strength			AC1500V for 1 minute between input terminal package and FG
Insulation resistance			10MΩ or more by means of insulation resistance tester of DC500V Between output terminal package and FG

3-5 Relay output / Output specifications

Item			Specification
Output power supply condition	Rated voltage		AC250V　DC30V
	Allowable voltage range		AC250V
Output circuit characteristics	Output type		Relay output
	Maximum load current		AC/DC 2A (common 5A)
	Minimum switching voltage/current		DC0.1V　0.1mA
	Output delay time	OFF->ON	10ms or less
		ON-> OFF	5ms or less
Output protection type	Built-in fuse		None
	Output type		Relay output
	Surge cutback circuit		Varistor
	Other output protection		None
Maximum switching speed			100 per sec. or less
Mechanical life			20 million times
Electric life			100,000 times or over with max load current
External connection			Terminal block
Output signal indication			None
Insulation mode			Dry contact output
Dielectric strength			AC1500V for 1 minute
Insulation resistance			160MΩ or more　With DC500V megger

3-6 Transistor output / Output specifications

Item		Specification
Output power supply condition	Rated voltage	12V
	Allowable voltage range	12V
Output circuit characteristics	Output type	Sink
	Rated current	About 500mA/1 point
	Output voltage drop	15V or less
	Output delay time OFF->ON	0.5ms or less
	Output delay time ON-> OFF	0.5ms or less
	Leakage current during OFF	Maximum 20 μ A or less (1 point)
	Output type	Transistor
Output protection		Resistor 10 Ω
External connection		Terminal block
Insulation mode		Photo-coupler insulation
Dielectric strength		AC1500V for 1 minute between input terminal package and FG
Insulation resistance		10M Ω or more by means of insulation resistance tester of DC500V Between output terminal package and FG

3-7 Analog input specifications

Item	Specification	
Number of input channels	8 channels	
Input impedance	About 1M Ω	
Maximum allowable input	$\pm$15V	
Conversion characteristics	Analog input range	Digital conversion value
	-10V to 10V	-8192 to 8191
Resolution	14 bit (Minimum resolution about 1.2mV)	
Comprehensive accuracy (Relative to full scale)	0.1%	
Type of digital conversion value	Integer	
Sampling time	500 μ s	
Input filter time	None	
Input delay time	500 μ s or less	
Other functions	None	

3-8 Analog output specifications

Item	Specification	
Output channel number	3 channels	
External load resistance	1k Ω or more	
Analog output range	-10V to 10V	
Conversion characteristics	Digital setting value	Analog setting value
	-8192 to 8191	-10V to 10V
Resolution	14bit (minimum resolution: about 1.2mV)	
Integrated accuracy (to full-scale)	0.1%	
Form of digital convert value	Whole number	
Conversion cycle	500 μ s or less	

3-9 Communication I/F specifications

Item		Specification	
		RS232C	RS422/, RS485
External interface	Port	1 channel	1 channel
	Transmission mode	Full duplex communication mode	
	Transmission rate	2400/4800/9600/19200/31250/38400 bps	
	Transmission distance	Within 15m	Within 1km (Provided that transmission rate is 19.2 kbps or less)
	Connectable units	1:1	1:1
	Connection mode	Connector	
Transmission method		Based on μ GPC language function	

3-10 TOOL I/F communication specifications

Item		Specification
External interface	Port	1 channel
	Transmission mode	Full duplex communication mode
	Transmission rate	38400 bps
	Transmission distance	Within 5m
	Connectable units	1:1
	Connection mode	D-SUB 9P (plug housing) Connection with PC is made by cross cable (receptance housing)
	Modem power supply	－
Transmission method		Use of application is not available
		PLC I/F-specific command

3-11 I/O terminal / Terminal name

	T1
	DI－0
	DI－1
	DI－2
	DI－3
	DI－4
	DI－5
	DI－6
	DI－7
	COM DI
	DI－8
	DI－9
	DI－A
	DI－B
	DI－C
	DI－D
	DI－E
	DI－F
	PG－A
	PG－B
	PG－12V
	PG－0V
	FI－1
	FI－2
	OPCN－A
	OPCN－B
	A
	B

	T2
	AI－0
	AI－1
	AI－2
	AI－3
	AI－0V
	AI－4+
	AI－4－
	AI－5+
	AI－5－
	AO－0
	AO－1
	AO－2
	AO－0V
	PO－0
	PO－1
	PO－2
	PO－3
	PO－12V
	PO－0V
	DO－0
	DO－1
	DO－2
	DO－3
	DO－0V
	G

	T3
	ＳＤ＋４２２
	ＳＤ－４２２
	GND
	ＲＤ＋４２２
	ＲＤ－４２２
	ＳＤ－２３２
	ＲＤ－２３２
	ＡＩ－６
	ＡＩ－７
	ＡＩ－０Ｖ

3-12 Digital input terminal

Terminal block   4.7K

DC input signal   DI-0   R   PC   Internal circuit
(12 to 24V)
:
:
DI-F   (Bi-directional)

COM-DI
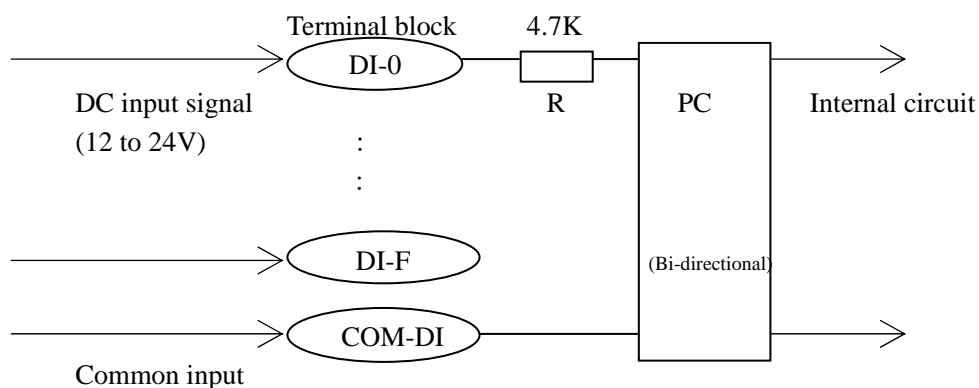
Common input

・Signal input is available at source input or sink (Common to 16 points).
・In the case of source input, ON is recognized when terminal voltage is 8V or more.

Terminal No.	Internal relay No.	Terminal No.	Internal relay No.
DI-0	I00000	DI-8	I00008
DI-1	I00001	DI-9	I00009
DI-2	I00002	DI-A	I0000A
DI-3	I00003	DI-B	I0000B
DI-4	I00004	DI-C	I0000C
DI-5	I00005	DI-D	I0000D
DI-6	I00006	DI-E	I0000E
DI-7	I00007	DI-F	I0000F

3-13 PG input terminals
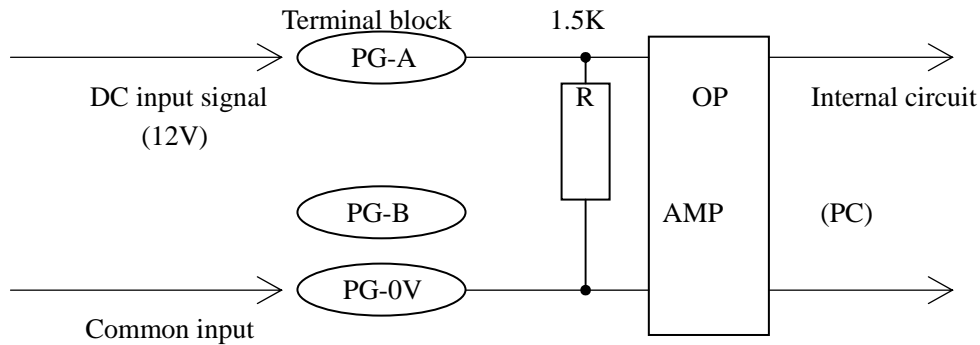
Terminal No.	Details
PG-A	Phase A (90° lead) signal
PG-B	Phase A (90° delay) signal
PG-0V	PG common line
PG-12V	External power supply output for PG

Register No.	Details
i00010	PG frequency –A (0Hz to 36000Hz)
i00011	PG frequency –B (0Hz to 36000Hz)
i00015	PG – A+B error counter (change detection of 10Hz or over)
i00018	PG-A UP/DOWN count value (-32768 to 32767)
i00019	PG-B UP/DOWN count value (-32768 to 32767)

Relay No.	Details
I00140	PG's direction of rotation: (Setting to 1 leads to reverse rotation, 0 normal rotation) (Toyo's standard direction of rotation) Direction of rotation: (Setting to 1 leads to lead of phase A) (Setting to 0 leads to lead of phase B)
O00530	PG frequency 1/2 display (1 to 1/2, 0 to 1/1)
O00531	2-phase PG selection (1 to 2-phase, 0 to single phase/2 channels)

(Supplement explanation)   To return to single phase after selection of 2-phase PG, reset the power. Also, when
2-phase PG is selected, i00011, i00019 and I00140 are invalid. (Single phase to see I00140)
In PG direction of rotational, PG-A is normal rotation by phase delay of 90° in selection of
single-phase mode. (Toyo's standard mode)
   Also, when 2-phase mode is selected, i0010 will be +value at 90° phase delay of PG-A,
and –value at 90° phase lead of PG-A.

3-14 FI Input terminal

Normally this terminal is used in single-phase 2 channels, however, use as 2-phase 1 channel is also available.
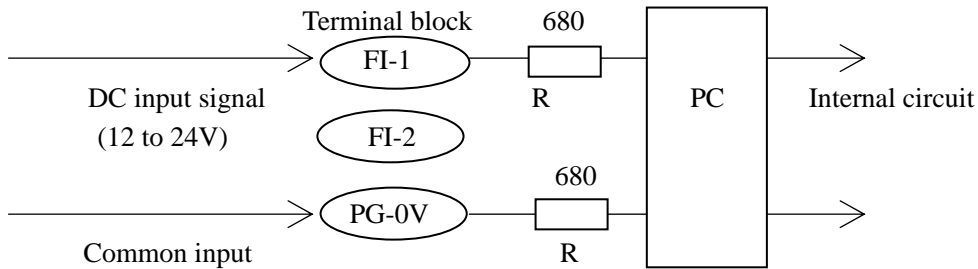
Terminal No.	Details
FI-1	FI-1CH (Phase A signal)
FI-2	FI-2CH (Phase B signal)
PG-0V	FI/PG common line
PG-12V	External power supply output for PG

Register No.	Details
i00012	FI-1 frequency (0Hz to 30000Hz)
i00013	FI-2 frequency (0Hz to 30000Hz)
i00016	FI-1 error counter (change detection of 10Hz or over)
i00017	FI-2 error counter (change detection of 10Hz or over)
i0001A	FI-1 UP/DOWN count value (-32768 to 32767)
i0001B	FI-2 UP/DOWN count value (-32768 to 32767)

Relay No.	Details
100141	PG's direction of rotation: (Setting to 1 leads to reverse rotation, 0 normal rotation) (Toyo's standard direction of rotation) Direction of rotation: (Setting to 1 leads to lead of phase A) (Setting to 0 leads to lead of phase B)
O00532	PG frequency 1/2 display (1 to 1/2, 0 to 1/1)
O00533	2-phase PG selection (1 to 2-phase, 0 to single phase/2 channels)

(Supplement explanation)   To return to single phase after selection of 2-phase PG, reset the power. Also, when
2-phase PG is selected, i00013, i0001B and I00141 are invalid. (Single phase to see I00141)
In PG direction of rotational, FI-1 is normal rotation by phase delay of 90° in selection of
single-phase mode. (Toyo's standard mode)
   Also, when 2-phase mode is selected, i0012 will be +value at   90° phase delay of FI-1,
and –value at 90° phase lead of FI-1.

[About PG and FI input/maximum input frequency]

There are 4 channels including both, but maximum frequency has limits.

<Formula>
   When channel 1 to 4 is f1 to f4 of maximum frequency, it is possible to use in the
following condition: $f1+f2+f3+f4 < 36$ kHz

  1) Up to 36 kHz is usable in case of 1 channel.
    Each will be limited to 18 kHz (36 kHz/2) in case of 2 channels.
    Each will be limited to 9 kHz (36 kHz/4) in case of 4 channels.

  2) Both PG mode and FI input can select 2-phase mode
    In this case, 2-phase 1 channel (A/B phase input) can also select 36 kHz.

  3) Selecting of PG frequency 1/2 display (1/2Hz display mode)
    Because the display becomes minus value for the frequency of 32767Hz, mode to display 18000 at
    36 kHz is selectable.

3-15 OPCN-1 Input terminal
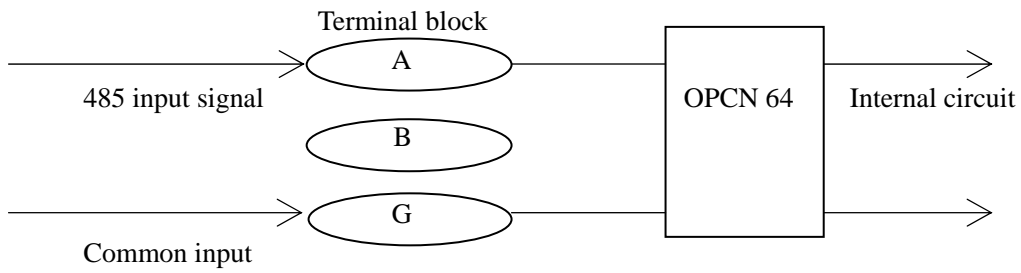
Terminal No.	Details
OCPN-A	OPCN-1 Cable A line signal
OCPN-B	OPCN-1 Cable B line signal
OCPN-G	OPCN-1 Cable SG line
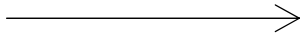
Register No.	Details
w00060	OPCN-1 Output register (Set value from master)
to	(Portion set for w003FD)
w000xx	(Use as I00xxx is also available)
w000xx+1	OPCN-1 Input register (Monitor to master)
to	(Portion set for w003FC)
w000yy	(Use as O00xxx is also available)
w003FC	OPCN-1 Number of input words set value (7 to 19)
w003FD	OPCN-1 Number of output words set value (6 to 12)
w003FE	OPCN-1 Baud rate set value (0 to 3, 3:1M)
w003FF	OPCN-1 Parameter setting flag (3FCh)

3-16 Analog input terminal
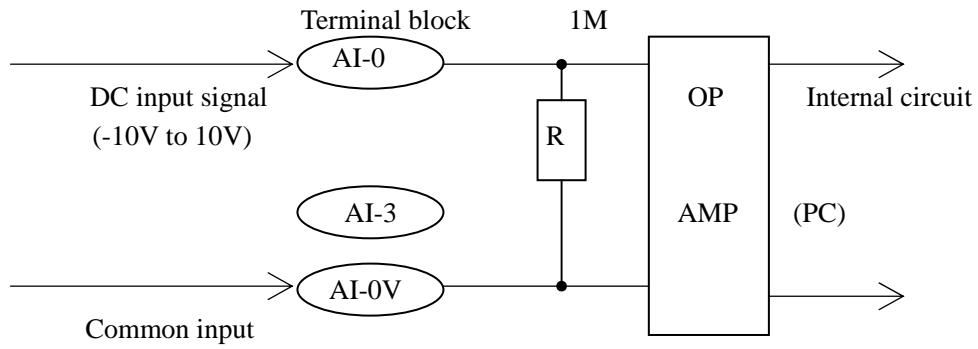
Terminal No.	Details
AI-0	0Ch Input signal
AI-1	1Ch Input signal
AI-2	2Ch Input signal
AI-3	3Ch Input signal
AI-0V	AI Common line

Register No.	Details
i00002	AI-0 Input data (-8192 to 8191)
i00003	AI-1 Input data (-8192 to 8191)
i00004	AI-2 Input data (-8192 to 8191)
i00005	AI-3 Input data (-8192 to 8191)

Terminal block
AI-4+

DC input signal
(-10 to 10V)

AI-4-

ISO
AMP

Internal circuit
(PC)

Terminal block
AI-5+

DC input signal
(-10V to 10V)

AI-5-

ISO
AMP

Internal circuit
(PC)
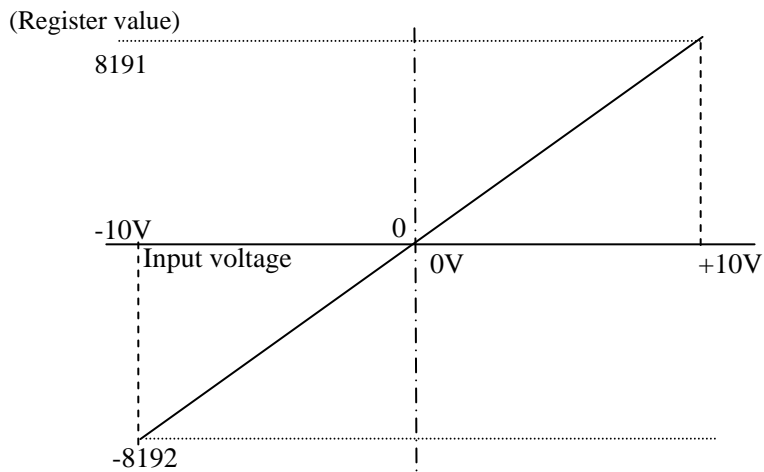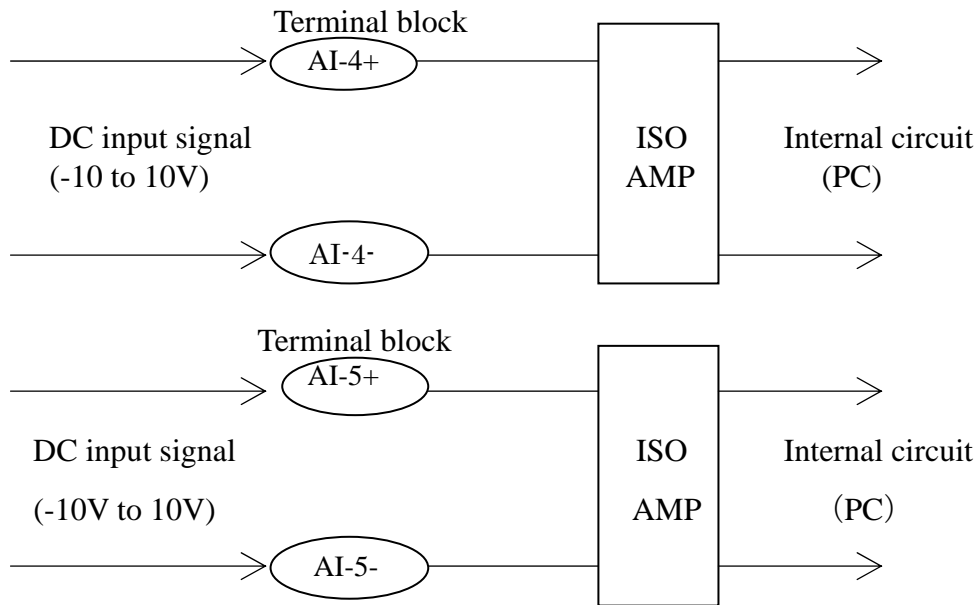
Terminal No.	Details
AI-4+	4Ch+ input signal
AI-4-	4Ch- input signal
AI-5+	5Ch+ input signal
AI-5-	5Ch- input signal

Register No.	Details
i00006	AI-4 input data (-8192 to 8191)
i00007	AI-5 input data (-8192 to 8191)

(Register value)
8191

-10V   0

Input voltage   0V   +10V

-8192
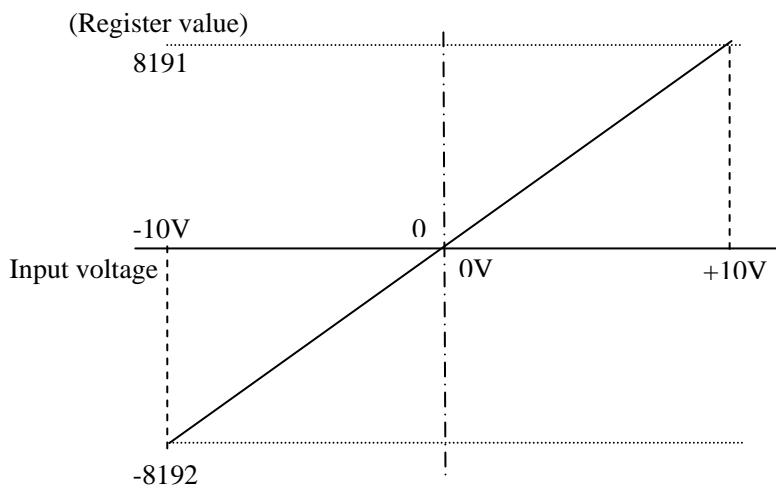
Put the resistor in series and can be used for current input.
In case of direct current input, range of 0 to 3 V will be the range of condition.

Terminal block　　150Ω
AI-6

DC current input signal　　　　　R　　OP　　Internal circuit
(0V to 3V)　　　　　　　　　　　　　AMP　　(PC)

AI-0V

Terminal block　　150Ω
AI-7

DC current input signal　　　　　R　　OP　　Internal circuit
(0V to 3V)　　　　　　　　　　　　　AMP　　(PC)
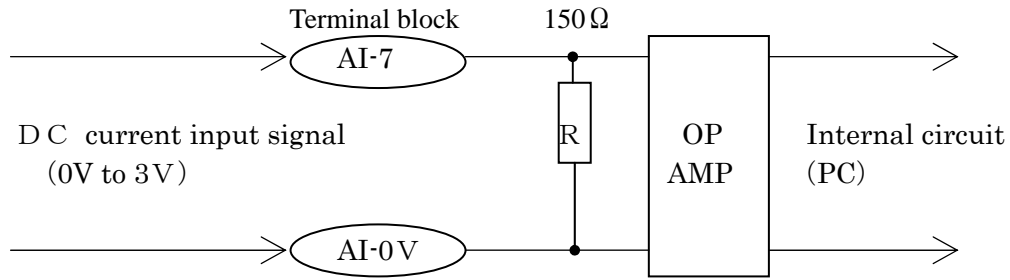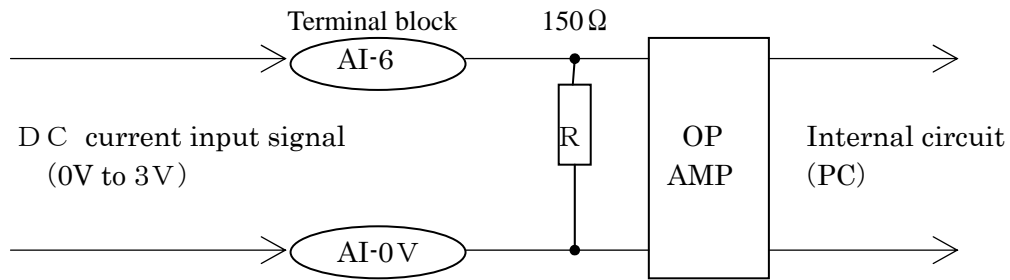
AI-0V

Terminal No.	Details
AI-6	6Ch+ Input signal
AI-0V	6Ch- Input signal
AI-7	7Ch+ Input signal
AI-0V	7Ch- Input signal

Register no.	Details
i00008	AI-6 input data (0 to 1023)
i00009	AI-7 input data (0 to 1023)

(Register value)

1023

943

188

Input current

0mA　4mA　　　　　　20mA　21.7mA
　　　(0.6V)　　　　　(3.0V)　(3.257V)
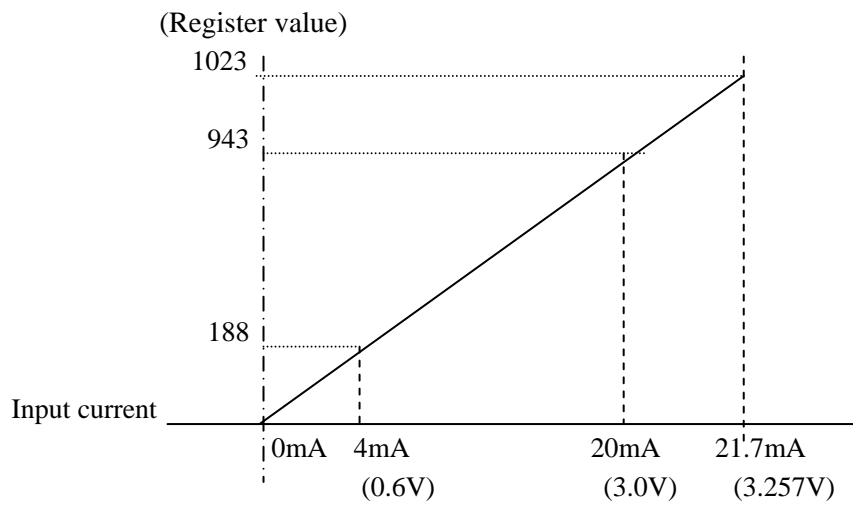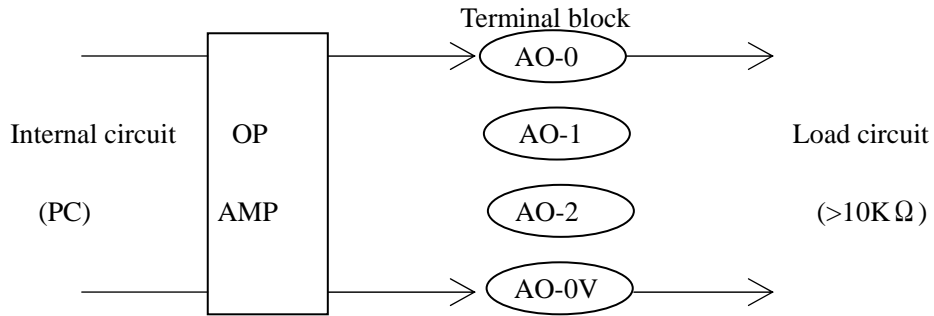
Terminal No.	Details
AO-0	0Ch Output signal
AO-1	1Ch Output signal
AO-2	2Ch Output signal
AO-0V	AO Common line

Register No.	Details
o00042	AO-0 Output data (-8192 to 8191)
o00043	AO-1 Output data (-8192 to 8191)
o00044	AO-2 Output data (-8192 to 8191)
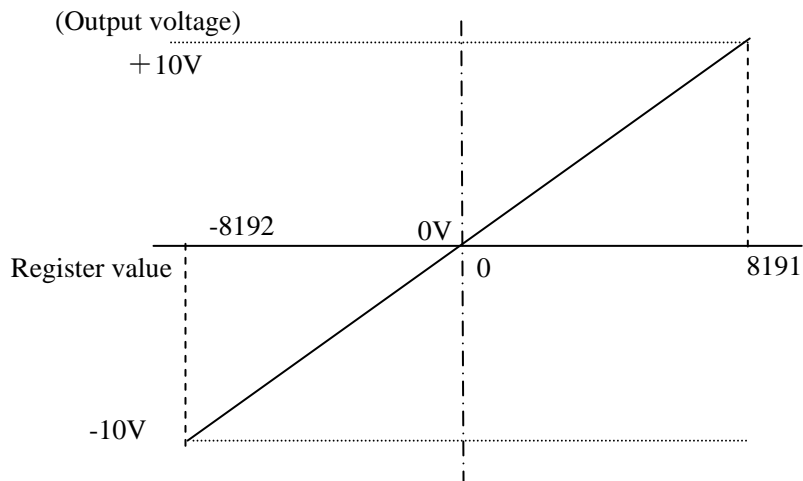
In addition to use as pulse output, this terminal can be used also as digital (transistor) output.

```
                          Terminal block
                    ┌─────────┐
         TR   ARY   │  PO-0   │──────────►
                    └─────────┘
Internal circuit  ±12 V         :         Load circuit
                                :
(PC)                    ┌─────────┐
                        │  PO-3   │        (>1KΩ)
                        └─────────┘
                    ┌─────────┐
                    │  PO-0V  │──────────►
                    └─────────┘
```
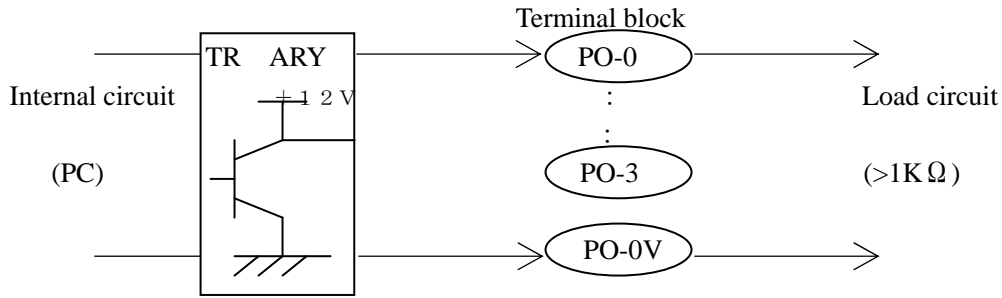
Terminal No.	Details
PO-0	0Ch Output signal (Master pulse signal)
PO-1	1Ch Output signal (Master synchronization signal-1)
PO-2	2Ch Output signal (Master synchronization signal-2)
PO-3	3Ch Output signal (Master synchronization signal-3)
PO-0V	PO Common line

Set each relay to 1 to use digital (transistor) output.

Terminal No.	Relay name	Details
PO-0	O00500	1 (turn off O00501 to O0050F)
PO-1	O00510	1 (turn off O00511 to O0051F)
PO-2	O00520	1 (turn off O00521 to O0052F)

Register No.	Details
o00050	Setting to PO-0 (Pulse output) set pulse width/output level 2 or more causes all 3 channels to be pulse output.
o00051	PO-1 (Pulse output) set pulse width/Output level
o00052	PO-2 (Pulse output) set pulse width/Output level
o00053	PO-3 (Pulse output) set pulse width/Output level
o00054	PO-0 to 3 Reference frequency rate (Reference clock 12MHz) 0:1/1, 1:1/4, 2:1/16, 3:1/64 4:1/256, 5:1/1024

Master pulse signal

o 00050   o 00050
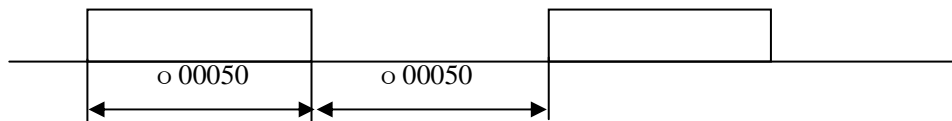
Master synchronous signal 1
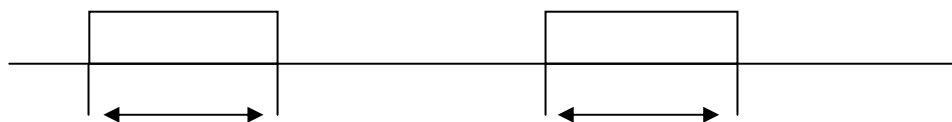
o 00051

Master synchronous signal 2
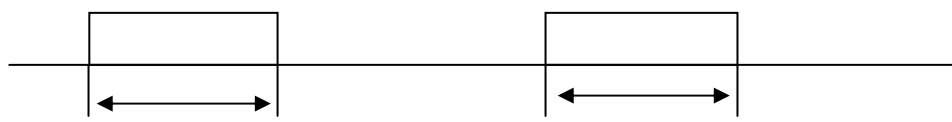
o 00052

Only for pulse train output use.

Terminal block

TR　ARY

＋１２V

Internal circuit

(PC)

PO-3

PO-0V

Load circuit

(>10 KΩ)
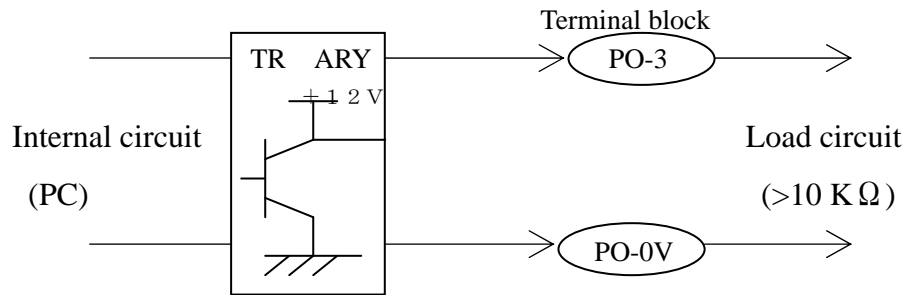
Terminal No.	Details
PO－3	Pulse train (rate multiplier) output
PO－0V	PO common line

Register No.	Details
o00055	Divider value after rate multiplier output （2 to 1022）：M of example below
o00056	Rate multiplier set value （0 to 65535）:N of example below
o00057	Rate multiplier control data （normally, set 512）

[Block diagram]　　　　　o00056　　　　　　　o00055

N　　　　　　　　　　M

Oscillator 60 MHz	16bit Rate multiplier	10 bit Divider
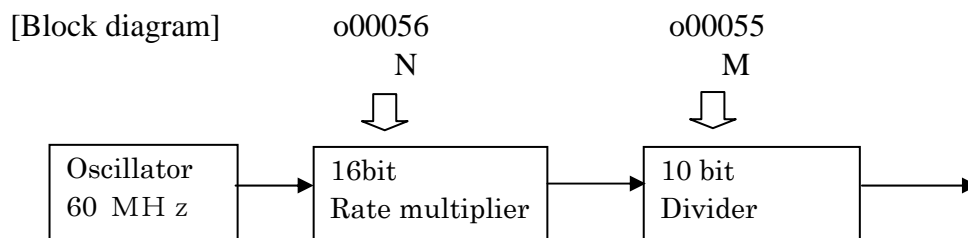
Output frequency f = 60*1000000*N/ (M*2*65536)

[Notice]

N is selectable between 0 to 65535 (-1)

M is selectable between 2 to 1022 (smaller value will make inaccuracy larger, we recommend 100 or over)

(Setting example)

At N = 4096,　　M = 100

f = 60*1000000*4096/ (100*2*65536)

=18750 (Hz)
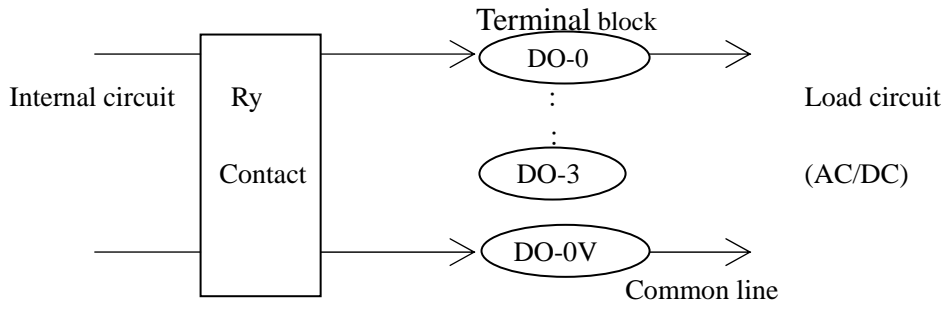
Terminal No.	Details
DO-0	0Ch Output signal (Relay 0 contact output signal)
DO-1	1Ch Output signal (Relay 1 contact output signal)
DO-2	2Ch Output signal (Relay 2 contact output signal)
DO-3	3Ch Output signal (Relay 3 contact output signal)
DO-0V	Relay contact common line

Register No.	Details
o00040	Really 4 points lump writing data

Register No.	Details
O000400	DO-0 (Relay output) ON/OFF data
O000401	DO-1 (Relay output) ON/OFF data
O000402	DO-2 (Relay output) ON/OFF data
O000403	DO-3 (Relay output) ON/OFF data

⑦Mounting hole

⑥Console LCD indicator

⑤Console LED indicator

④Console switch section

③Programming tool connecting connector

②Connectors for communication I/F

①Power supply terminal

⑧Terminal block for digital I/O
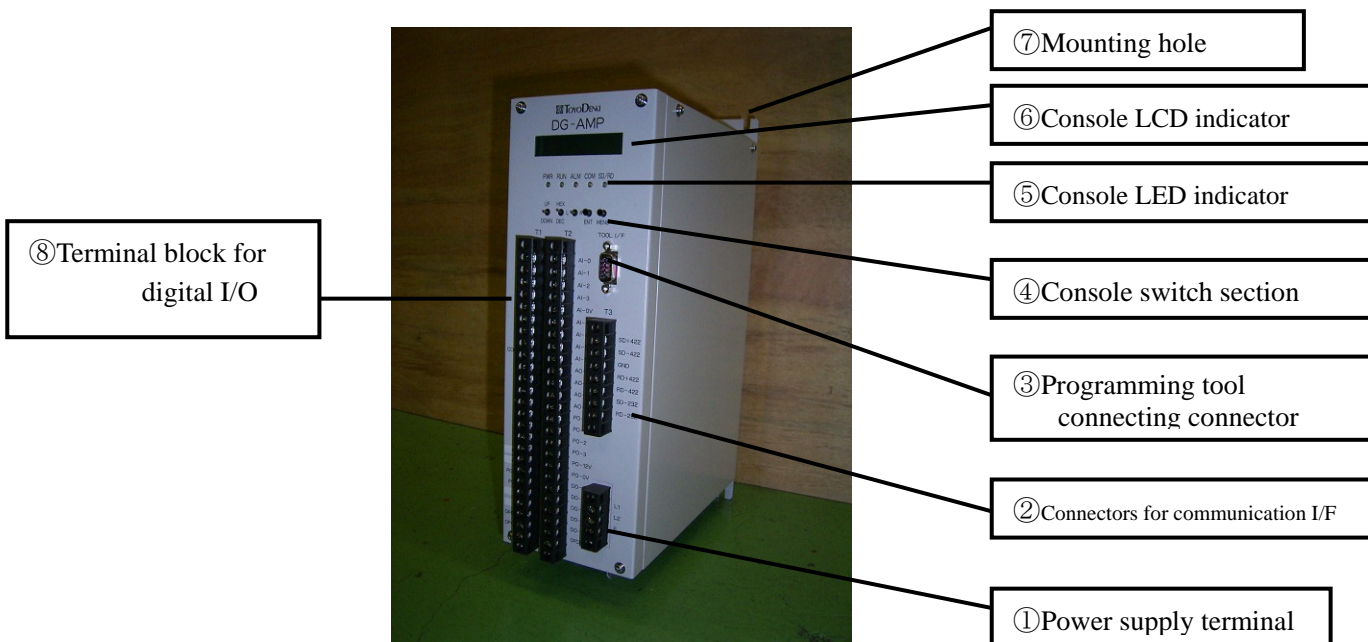
① Power supply terminal

　This terminal is used for supplying the power from outside.

　Ground E terminal to independent and stable C type or D type terminals.

Polarity
AC (L1)
AC (L2)
E

② RESET button

　Use only when resetting the DG-AMP alone.

　(Note) Do not push the reset button while operating.

③ Connectors for communication I/F

　These connectors are used when communicating by RS422/RS485/RS232C.

　Use exclusive connector.

④ Programming tool connecting connector

　This is the connector for connecting with programming tool (TDsxEditor).

　Use D-SUB 9-pin cross cable.

⑤ Console switch section

　These are switches for data indication and writing operation. See Chapter 5.

⑥ Console LCD indicator

　This is LED to indicate the control status of DG-AMP.

Symbols	Name	Lighting condition
PWR(G)	POWER indication	Turns on when power is turned ON (Internal power supply normal).
RUN(G)	RUN indication	Turns on while CPU is running. Blinks while CPU stops (including major breakdown stop).
ALM(R)	ALARM indication	Turns on when error occurs.
COM(Y)	COMMUNICATION indication	Turns on when communication is established on communication board.
SD/RD(G)	SEND/RECEIVE indication	Blinks when data is sent / received.

⑦ Console LCD indicator

　This section indicates the data in the internal register.

31

⑧ Mounting hole
    Use M3 mounting screws.

⑨ Terminal block for digital I/O
    This terminal block is used when connection with external digital I/O signal is made.
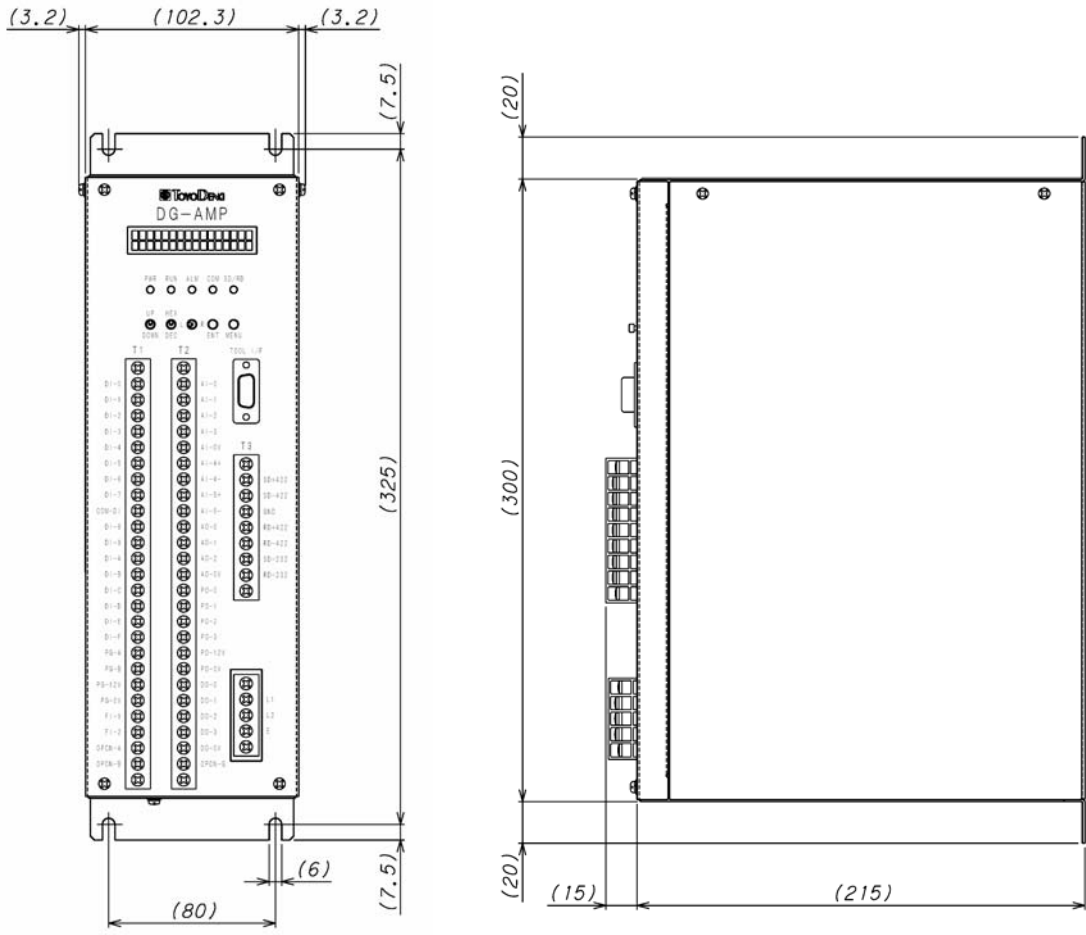   Use M3 fork terminal.

The attachment position of a battery option.
    The inside of DG-AMP is equipped with a battery option.
   The cover on the left side of DG-AMP can be removed and exchanged.

①The battery for backup

②Battery connection connector
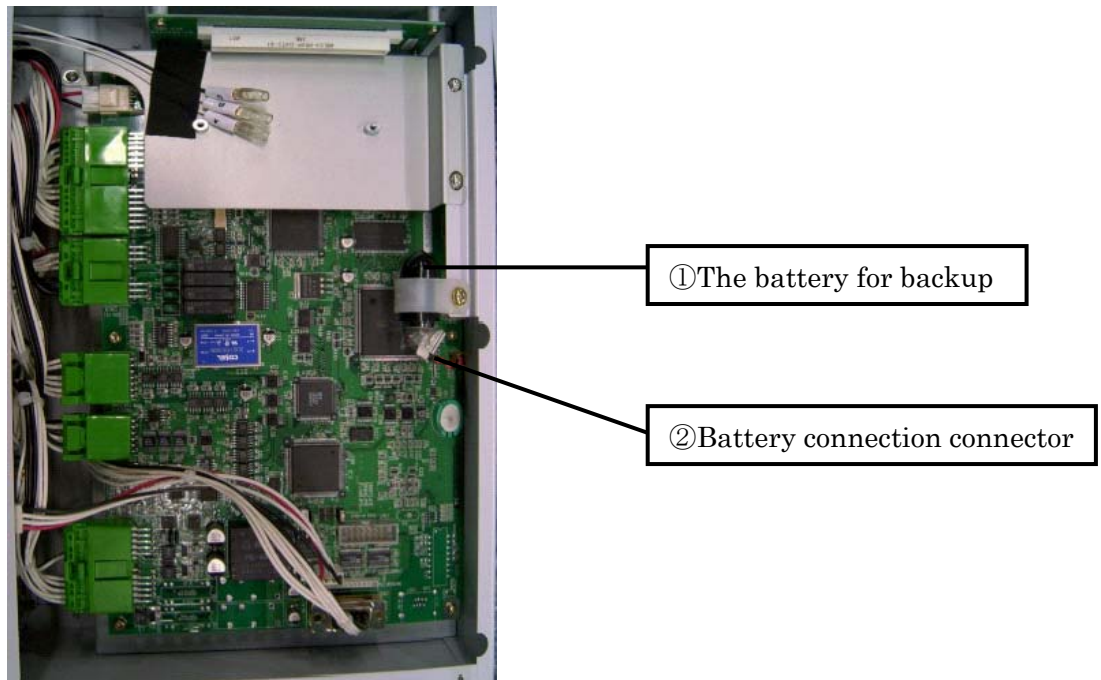
① In case of mounting DG-AMP to the control panel, be sure to insulate from the frame of the control panel and perform independent grounding (C type or D type grounding) for FG terminal.

② Put noise-cut trance or noise filter to AC power supply.

③ Use clipping terminal for the wiring to the terminal block. Be careful to the inclination of the clipping terminal and secure insulation distance (more than 3.2mm) from the adjacent. Also use insulation cover for the clipping terminal.

④ Arrange more than 50mm from the ambient equipment for ventilation.

⑤ Separate from high voltage devise and power devise as possible. Do not parallel wiring with those devise.

⑥ Mount vertically from the panel floor and do not mount horizontally.

The heat inside the unit cannot escape

The heat inside the unit cannot escape

Panel floor
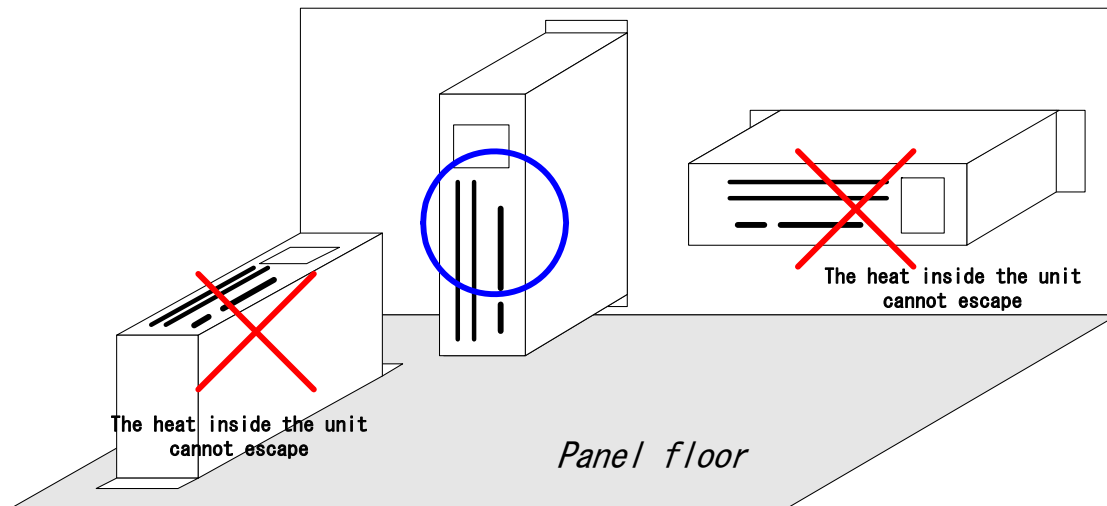
4-1 Programming

Programming of DG-AMP is performed by TDsxEditor.
When you start TDsxEditor, following screen will appear.
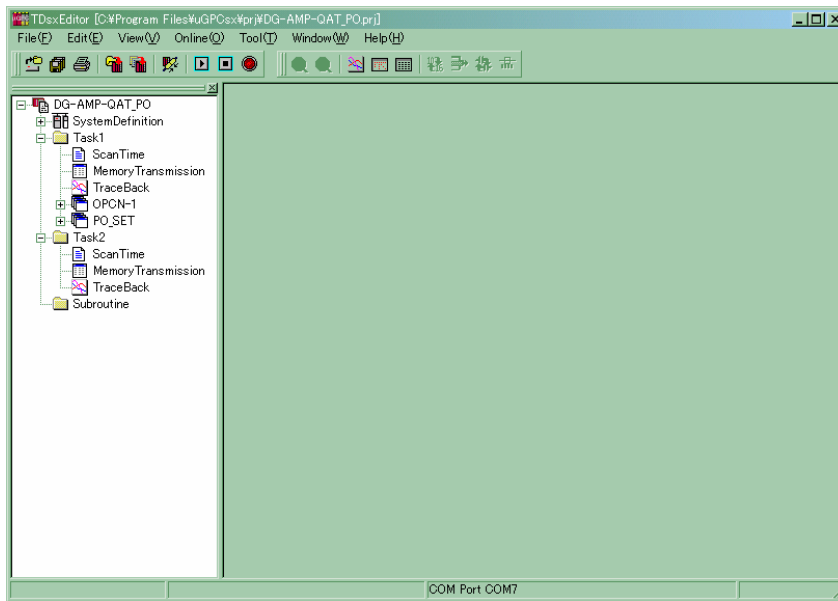
First, prepare the project through "File" and "New Project", then prepare the program through "Edit" and "Program new preparation". Details of control are described in the program.

Select the task to which you want to add the program. Priority in computation becomes the relationship as Task 1 > Task 2. Normally, relationship is scan time of Task 1 > Task 2.

Scan time designates the execution period of the task. Designation in 1msec is available. (As the settings for the value of 1msec or less, designation of 2 settings, 0.25msec and 0.5msec is available)
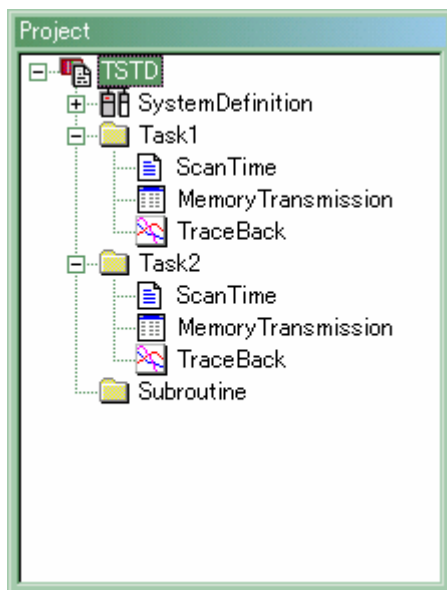
4-2 Editing of the circuit

Edition of the control details can be performed by double-click on "Circuit" in the program.
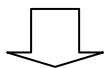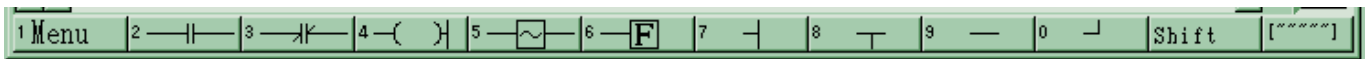Edition of "Circuit" gets available after "Program new preparation" has been performed.
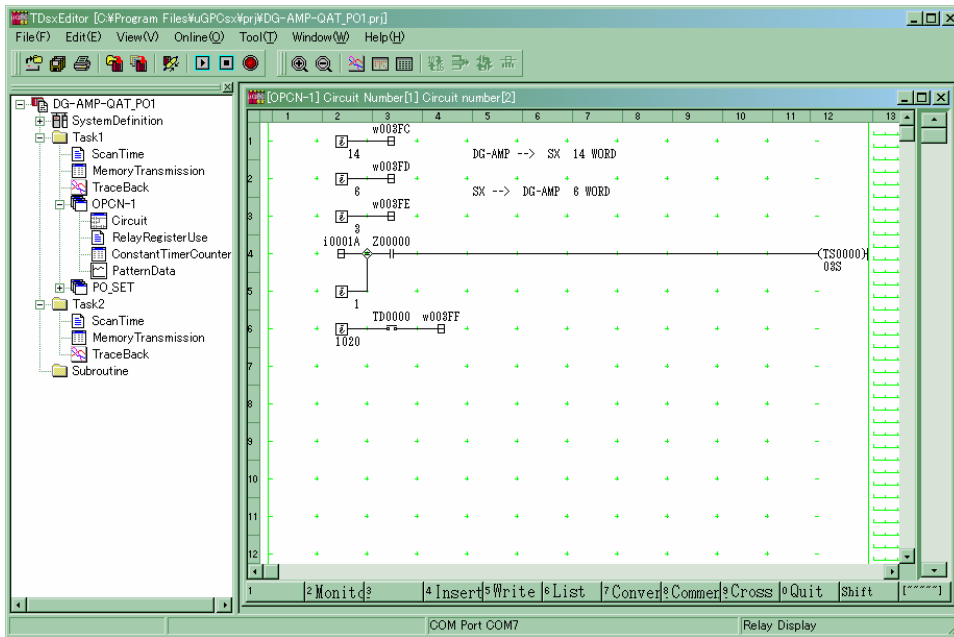
While editing new program, opening of the circuit results in "Writing mode". While editing existing program, select "Writing mode".
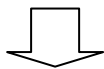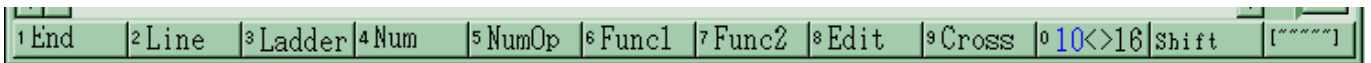
Circuit symbol can be placed by switching following menus
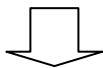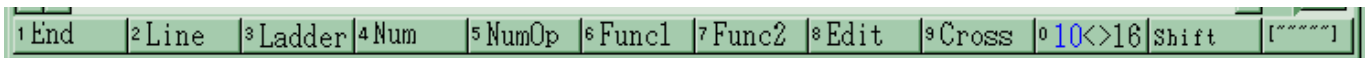
Select "Ladder"

Select "Main menu".

When you want to shift the mode to the reading mode, select "Writing exit".
Mode shifts to reading mode.

4-3 Circuit symbol types

There are following types of symbol.

Ladder diagram language

Symbol	Operation	Data type
I00000 SI ─┤├─ SO	Contact"A" SO=I00000&SI	bit
I00000 SI ─┤/├─ SO	Contact"B" SO=$\overline{I00000}$&SI	bit
SI ─[~]─ SO	Logic inversion SO=$\overline{SI}$	bit
─(000000)─ SO	Coil 000000=SO	bit

Symbol	Operation	Data type
SI ─① ①─ SO	Connector load store	bit real int BCD8 word BCD4
[L]─	Label Use as a jump destination label	──
─( )─	Control command JPXXXX:Page or label jump RETURN:Return from subroutine	──

Data flow language

Symbol	Operation	Data type
mi0000 ─□─ N0	Load N0=mi0000	int BCD8 word BCD4 real
N1 ─mi0000─□─ N0	Load and store mi0000=N1 N0=mi0000	int BCD8 word BCD4 real
N1 ─mi0000─□	Store mi0000=N1	int BCD8 word BCD4 real
I00000 N1 ─▱─ N0	Contact"a" N0=N1 When I00000=1 N0=0 When I00000=0	int real
I00000 N1 ─▱─ N0	Contact"b" N0=0 When I00000=1 N0=N1 When I00000=0	int real
I00000 N1 ─▱─ N0 N2	Contact"c" N0=N1 When I00000=1 N0=N2 When I00000=0	int real
I00000 N1 ─▱─ N0 N2	Contact"c" N0=N2 When I00000=1 N0=N1 When I00000=0	int real
N1 ─◇─ S0 N2	Conpare high S0=1 When N1>N2 S0=0 When N1≦N2	int real
N1 ─◇─ S0 N2	Conpare low S0=0 When N1≧N2 S0=1 When N1<N2	int real
N1 ─◇─ S0 N2	Conpare equal S0=1 When N1=N2 S0=0 When N1≠N2	int real

Symbol	Operation	Data type
N1 ─▷─ N0 N2	High-lebel priority N0=N1 When N1≧N2 N0=N2 When N1<N2	int real
N1 ─▷─ N0 N2	Low-lebel priority N0=N2 When N1>N2 N0=N1 When N1≦N2	int real
N1 ─⊐─ N0 N2	Logical and N0=N1 AND N2	int
N1 ─⊐─ N0 N2	Logical or N0=N1 OR N2	int
N1 ─⊐─ N0 N2	Logical exclusive or N0=N1 EXOR N2	int
N1 ─⊕─ N0 N2	Addition N0=N1+N2	int real
N1 ─⊖─ N0 N2	Substraction N0=N1−N2	int real
N1 ─⊗─ N0 N2	Multiplication N0=N1×N2	int real
N1 ─▷─ N0 N2	Division N0=N1／N2	int real
N1 ─▷─ N0 N2	Remainder N0=MOD(N1／N2)	int
[i]─ N0 XXXX	Local constant:integer N0=XXXX	int
[r]─ N0 YYYY	Local constant:real number N0=YYYY	real

Data flow language(Function)

| Symbol	Operation	Data type
N1 ▷ N0	Conversion to Sign N0＝－N1	int real
N1 N0	Complement of 1 N0＝$\overline{N1}$	int
N1 N0	Conversion to absolute value N0＝｜N1｜	int real
N1 ++ N0	increment N0＝N1＋1	int real
N1 -- N0	Decrement N0＝N1－1	int real
N1 1/2 N0	One half N0＝N1×1／2	int
N1 ×2 N0	Double N0＝N1×2	int
N1 ↑2 N0	Square N0＝N1²	int real
N1 ↑N N0	Exponential N0＝N^{N1}	real
N1 √ N0	Square root N0＝√N1	int real
N1 B.C N0	Bit count Number of bits that → set 1 in N1	int
N1 G.B N0	Gray code binary N1 converted to gray code	int
N1 N0	Dead zone N0＝N1－ki0000 when N1＞ki0000 N0＝N1＋ki0000 when N1＜－ki0000	int real
N1 N0	Pattern N0＝pi0000(N1)	int real
N1 N0	Differential compensation	real
N1 θ N0	Phase compensation	real
N1 N0	PI compensation	real
N1 N0	ARC	real
N1 N0	S－ARC	real
N1 $\bar{x}$ N0	Arithmetic mean N0＝SUM(mr0000)／N1	real
N1 N0	Filter	real
N1 N0	PID compensation	real
N1 N0	Transient delay	real
N1 N0	Delay	real
N1 N0	Fixed cycle pulse	real
N1 N0	Variable setting pattern N0＝mr0000(N1)	real
N1 N0	Upper/lower limiter N0＝upper limit when N1＞upper limit N0＝lower limit when N1＜lower limit	real
N1 N0	Hysteresis	real
N1 Sb N0	Subroutine Subroutine running N1 argument N0 return value	int real bit
SI SB	Condicional subroutine Subroutine running when SI＝1	bit
N1 f N0	System function N0＝f(N1) f() SIN：SIN(N1) COS：COS(N1) TAN：TAN(N1) ASIN：SIN（N1) TSTD：ON timer TRTC：OFF timer USUC：ON defferentiation DSDC：OFF defferentiation BKLC：Back lash BKLS：Back lash compensation	int real bit
SI F	System function When SI＝1 execution F() SET： RESET： MOVW：Data transfer UPDOWN：Counter,etc.	bit

4-4 Download/Upload

When Edit is completed, download the project to DG-AMP.
Project is stored in the flash memory.
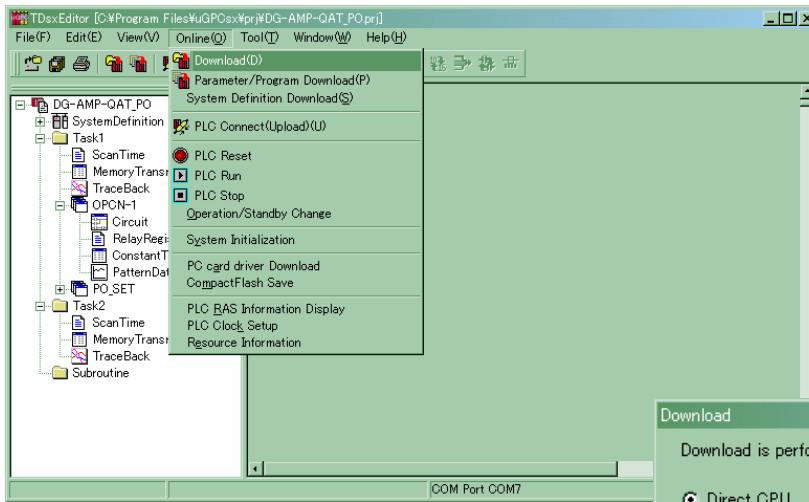
In the case of DG-AMP, connection target is valid only for "Online CPU".
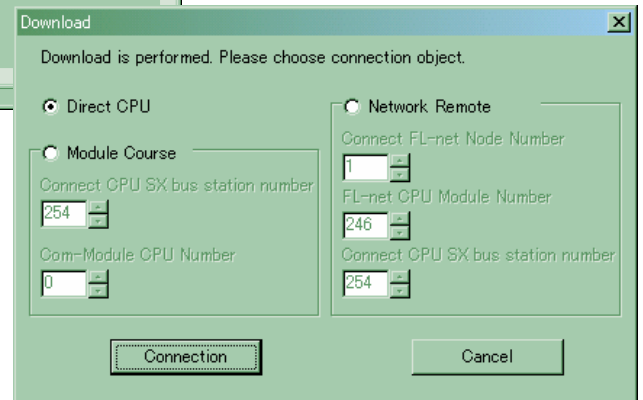
When you want to monitor/debug the program, perform "PLC connection (Upload)" to read the details of project from DG-AMP then perform said operation. (Immediately after downloading, TDsxEditor becomes the condition that monitor and debug are allowed".)
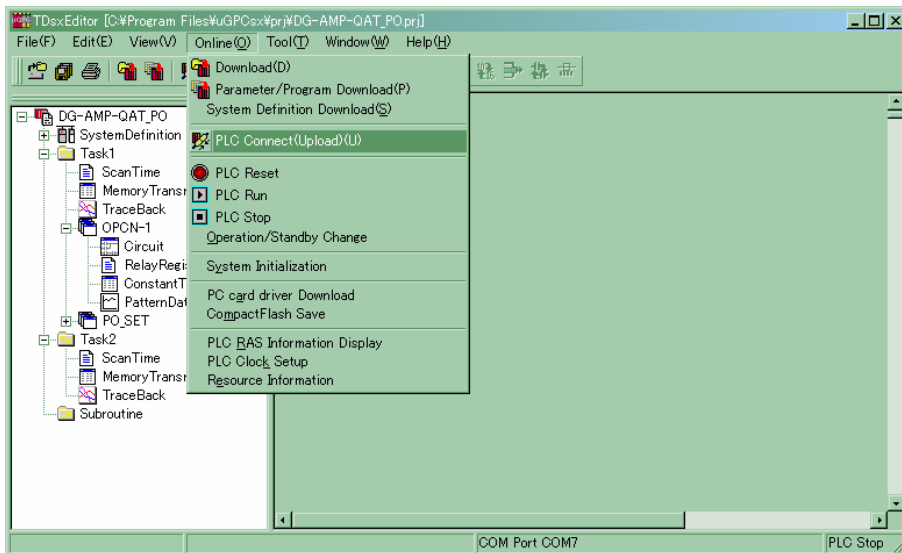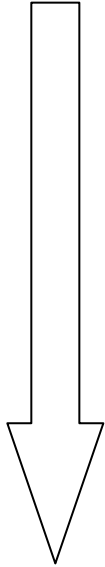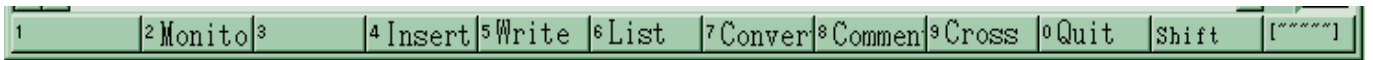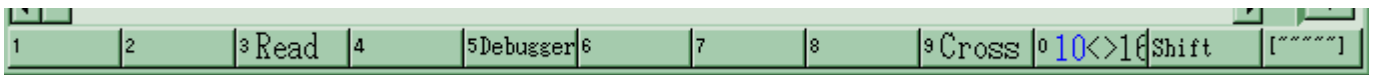

In the case of DG-AMP, connection target is valid only for "Online CPU".
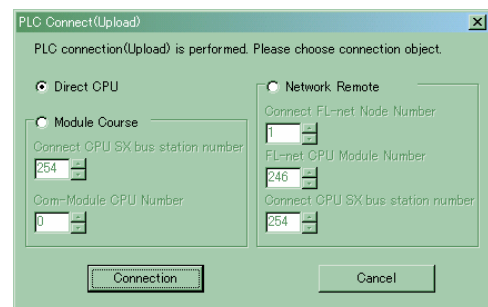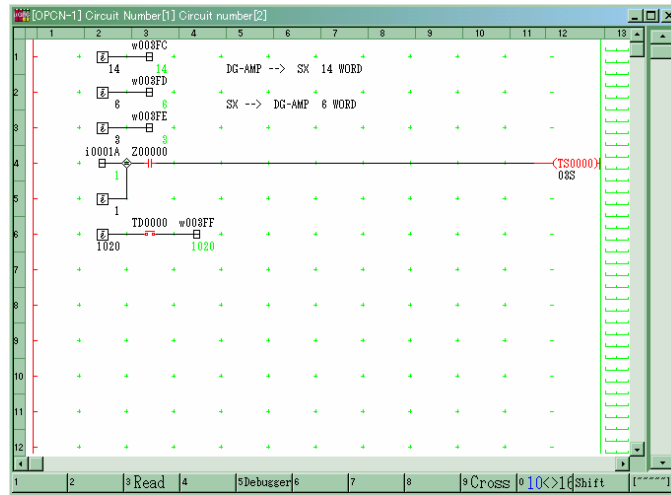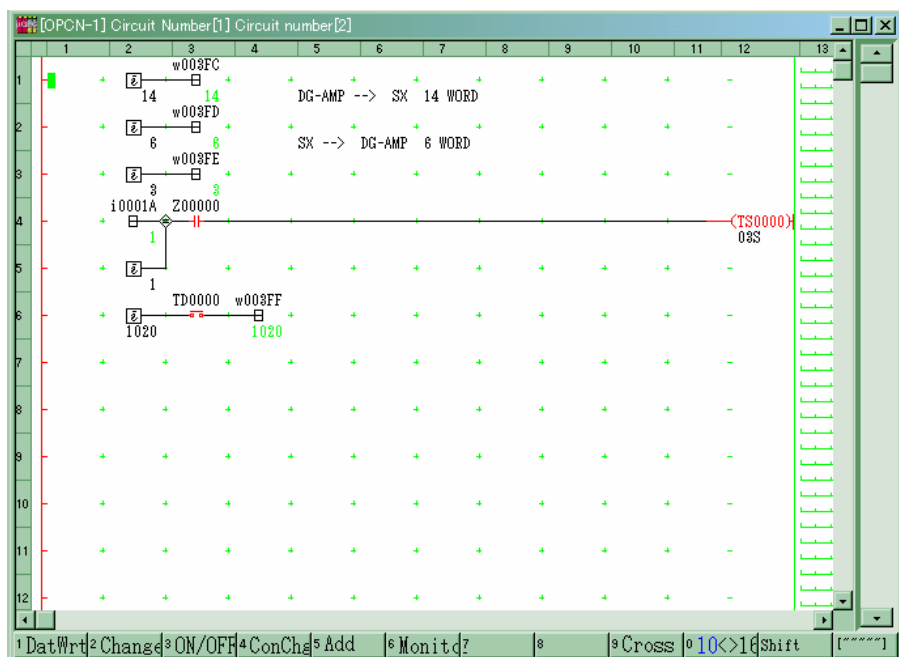
4-5 Monitor/Debug

As is the case with editing, select the program that you want to monitor/debug to make the circuit appear.

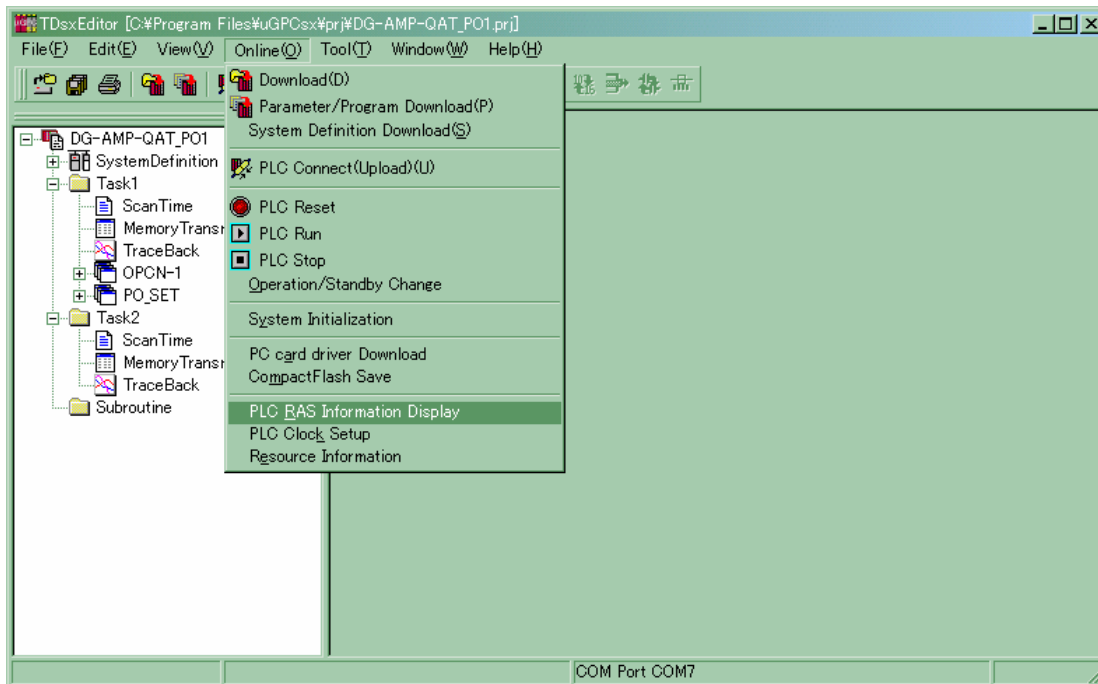"Monitor" allow you to monitor the current value of the register in the circuit.
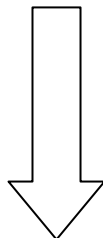
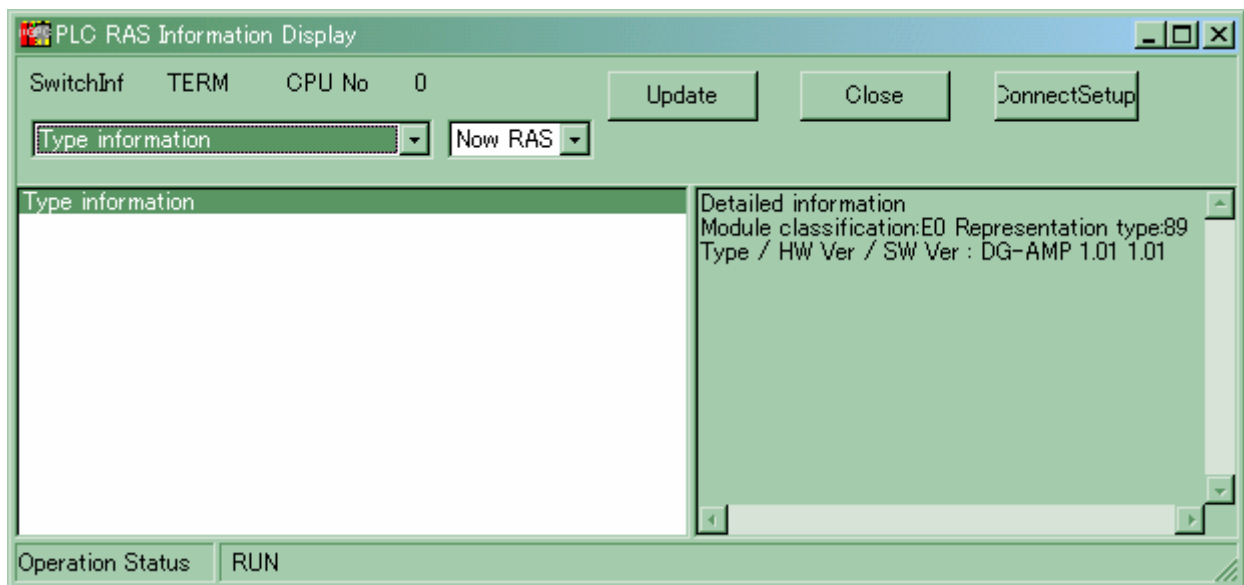"Debug" enables you to modify the circuit locally.

4-6 How to check the firmware version

For checking the firmware version of DG-AMP,
  select "Online", "PLC RAS information indication", then
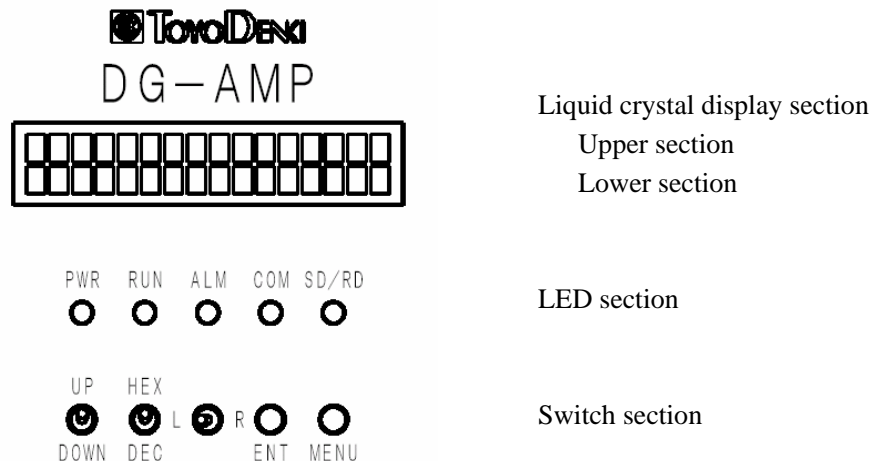

Select "Model information".

Version information of DG-AMP displays in the right-side window.

5-1 Console

Console section at the front of DG-AMP body is as followed:

Liquid crystal display section
   Upper section
   Lower section

LED section

Switch section

1) Liquid crystal indicator

Upper section displays the normal time. In addition, when error occurs, this section displays the details of error.

Lower section displays the data in the internal register. In addition, setting of writing data is available.

* 11 / 03   15 : 25 : 00 *
i00000 /   12345

Upper section   Month / Day   Hour: Minute: Second
Lower section   Register address   /   Data display

2) LED section

(1) PWR LED (G)

Normally stays ON in green while the power stays ON.

(2) RUN LED (G)

Normally stays ON in green while the power stays ON.

(3) ALM LED (R)

Turn on red when error occurs.

(4) COM LED (Y)

While communication board (OPCN-1, etc) is connected, this LED turns on green after connection with high-level PLC has made and communication has been established.

(5) SD/RD LED (G)

While communication board (OPCN-1, etc.) is connected, this LED blinks in green when data is sent/ received.

3) Switch section

(1) UP/DOWN switch

Switch to make the data value (numeric value) at cursor position to be counted up/down by 1/-1.

(2) HEX/DEC switch

Switch to make the data indicated value to appear in hexadecimal/decimal.

(3) L/R switch

Switch to make the cursor position to shift to the left or right.

(4) ENT switch

Turning ON this switch confirms the data value or cursor zone. (Shift to the right is performed)
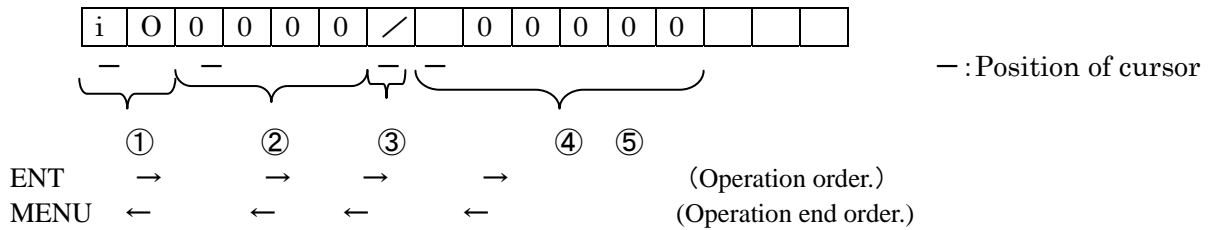
(5) MENU switch

Turning ON this switch cancels the confirmation of cursor zone. (Shift to the left is performed)

5-2 Indication of the data

Normally, cursor position is present at register group set position ((1)) at the lower section of LCD.

Actuation of UP/DOWN, L/R and ENT switches under this condition allows the data value of the respective registers to be indicated.

Data display (Lower section side)

| i | O | 0 | 0 | 0 | 0 | / | | 0 | 0 | 0 | 0 | 0 | | | |

─ : Position of cursor

① ② ③ ④ ⑤

ENT →   →   →   →   (Operation order.)
MENU ←   ←   ←   ←   (Operation end order.)

① (Selecting the register at) register group set position

Change 2-digit portion of the register number by actuating UP/DOWN switch to select the register which you want to indicate.

iO → oO → gO → zO → ri → iO → Repeat

After you have selected the register that you want to indicate, push ENT switch to move the cursor to the register number set position.

(Note) ki register can display and write only the ki register at the top of subprogram in the project made with TDsx Editor.

② (Setting the register number at) register number set position

Select the digit position that you want to change by actuating L/R switch to change the register number by actuating UP/DOWN switch.

1 → 2 → 3 → · · · → A → · · · → F   Repeat (when HEX/DEC switch is put to HEX),

After you have set the register number that you want to indicate by repeating, push ENT switch to move the cursor to the data indication position. Then, data value of the register that you have set appears at data indication section.

③ (Confirming the data indication at) data indication section

After above operation ②, cursor moves to the data indication position and present data value appears in the data indication section.

You can confirm I/O data, etc. at this position.

If needed, change of cardinal number is available from HEX/DEC switch.

5-3 Writing of the data

After you made the register number that you want to write through actuation in above 5-2 to appear, push ENT switch to move the cursor to the data writing position.

④ (Setting the writing data at) data writing position

Push of ENT switch under the condition ③ to make data indicator to hold, cursor moves to the data writing position and then set the writing data by actuating L/R and UP/DOWN switches.

After you have set the writing data, push of ENT switch to make the data to be written.

(Note) About 2 seconds are needed for writing process of ki register. Conform the renewal of the time (sec.) of upper section after ENT switch is pressed, and then do the next actuation (ex: actuation of MENU key.)

When you want to hold the indication state even without performance of writing, you can confirm the data at this cursor position.

In such a case, after indication confirmation, return the cursor to the register group set position ① by MENU switch.

⑤ Writing of the data

After completing the actuation ④, data indicated is written (cursor position does not change).

After data writing operation (Turning ON ENT switch), push the MENU switch to move cursor to the data indication position and written data appears in the data indicator.

5-4 Setting of the time

You can set the time of day (Year, month, hour, and minute) without using PC.
Normally indication state is as following:

[Normal time indicator (Upper section side)]

＊ ０ ０ ／ ０ ０　　 XX ： XX ： XX ＊
　　Month　　　Day　Hour　Min.　Sec.

(1) Holding down MENU pushbutton for 5 seconds or more to make the indicator to change as following:

[Indicator for time setting (Upper section side)]

％　０ ０ ／ ０ ０ ／ ００　 XX ： XX　 ％
　　Year　　Month　　Day　Hour　Min.

(2) Change the indication from Year →Month→Day→Hour→Minute by actuating R switch, and UP/DOWN
for each value.
(Push of L switch allows the indication to be changed as Minute→Hour→Day→Month→Year).
Actuating the ENT switch finally causes the indication to be changed.

5-5 Version indication of firmware

To confirm the version of the firmware of DG-AMP; press MENU button and actuate L or R switch at same
time to indicate

Remarks 1: Running status

Register name	Relay name	Details	Unit
z00000	Z00000	Application program running (RUN LED)	
	Z00001	Major breakdown	
	Z00002	Minor breakdown	
z00001	Z00010	COM ERROR	
	Z00011		
	Z00012		
	Z00013		
	Z00014		
	Z00015		
	Z00016		
	Z00017		
	Z00018		
	Z00019	ALM lamp on	
	Z0001A	COM lamp on	
	Z0001B	SD/RD lamp on	
	Z0001C		
	Z0001D		
	Z0001E		
	Z0001F		
z00002	Z00020		
z00003	—	CPU execution time register	B.C.D (mSec)
z00004	—	CPU scan time register	B.C.D (mSec)
z00005	—	Calendar (Year/month)indication register	B.C.D (YYMM)
z00006	—	Calendar (Day/hour)indication register	B.C.D (DDHH)
z00007	—	Calendar (Min./sec.)indication register	B.C.D (MMSS)
z00008	—	Calendar (Day of the week) indication and	B.C.D (FFWW)
z00009	—	0.25ms counter register (While application is running)	
z0000A	—	1s counter register	
z0000B	—	System program scan counter register	
z0000C	—	0.25ms counter register	
z0000D	—	System reserved	
z0000E	Z000E0	DOWN　toggle switch	
	Z000E1	UP　　toggle switch	
	Z000E2	L　　toggle switch	
	Z000E3	R　　toggle switch	
	Z000E4	HEX　　toggle switch	
	Z000E5	ENT　　push button switch	
	Z000E6	MENU　push button switch　(ON at each switch actuating)	
zr002C		Task 1 scan time (Unit: second　Real number)	
zr002E		Task 2 scan time (Unit: second　Real number)	

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