

DG21E4J

✔ KC certification

R-R-Diu-DGE4J

Company name: Ilpum Corporation

Model name: DG21E4J



✔ Operating environment

Normal operating temperature range = $-25 \sim 70$ [°C]

No dew, no dust.

✔ Power

Rated voltage = DC 24 [V] (operable range 19 ~ 27 [V])

Maximum current consumption = 600 [mA]

✔ Communication

Physical standard: TIA/EIA-485A (RS485)

Maximum number of devices on the track = 64 nodes

ESD protection = up to 15 [kV]

Data protocol: MODBUS RTU protocol



✔ Rating of DI terminal

Points can be connected without any external power

Have direct connection with external DO (includes power for DI detection inside the device)

✔ DI detection indication

LED lights up when ON is detected

✔ Rating of DO terminal

Transistor output: Sink type

Current: 0~0.5 [A], Voltage: 0~50 [V]

✔ DO operation indication

Setting OFF: LED OFF, contact open

Setting ON: LED ON, contact short circuit

✔ Rating of AI terminal

Voltage: 0 ~ 10 [V], Current: 0 ~ 20 [mA], Internal resistance: 500 [Ω]

✔ **AI detection indication**

LED lights up when AI voltage is above AI threshold

✔ **Rating of AO terminal**

Voltage: 0 ~ 10 [V], maximum current: 20 [mA]

✔ **AO operation indication**

LED lights up when AO voltage is above AO threshold

✔ **Rating of UI terminal**

PT1000, resistance (0 ~ 4 [kΩ]), contacts (short circuit/open) can be connected without external power source

✔ **UI detection indication**

LED lights up when RTD is below RTD threshold

✔ **Isolation**

Isolation between RS485 and power (power terminal and all input/output terminals)

Maximum isolation voltage = 1.5 [kV rms] (50~60 [Hz], 1 [min])

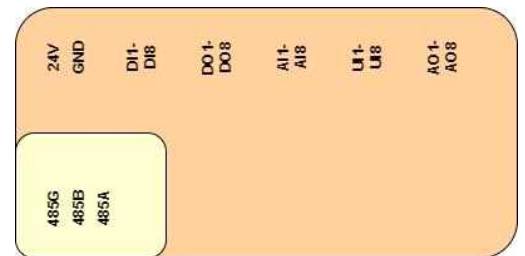
✔ **Dimensions**

Width 145 [mm], Depth 90 [mm], Height 41 [mm]

✔ **Fastening method**

Can be mounted on DIN rail

Can be fixed with 4 screws on the wall (hole distance: x axis = 135 [mm], y axis = 70 [mm])

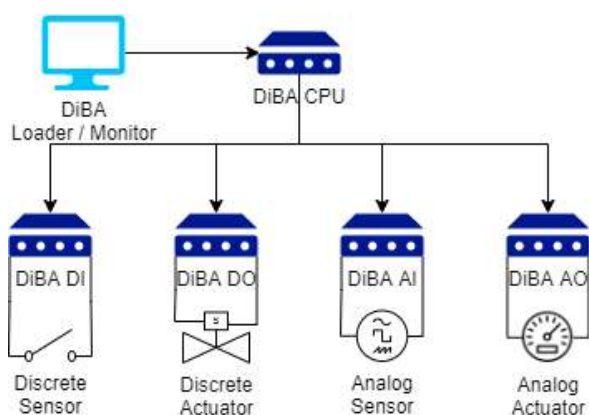


[Figure 1] Internal isolation of E4J

1. Summary

DG21E4J is an Input and Output module of DiBA (Diba) PLC (Programmable Logic Controller). DiBA PLC composes an automatic control system with modules for each function as shown in [Figure 2], and the user can select the optimal module configuration according to the size and characteristics of the control object.

The product name of the model name DG21E4J is MODBUS RTU IO. The model name consists of the Ilpum Corporation mark (DG), the year of release, and the representative model name (E4J).



[Figure 2] Configuration of automatic control system

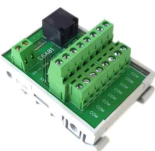
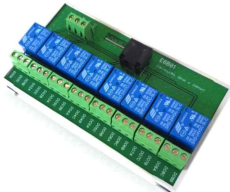

Since E4J operates only as a MODBUS RTU slave, it is controlled by a MODBUS RTU master such as E5A (DiBA PLC CPU module).

E4J is a module that handles various input/output of external devices. It converts the status of the external device into information readable by the PLC system, and outputs the information set in the PLC system to the external device. E4J provides 5 input/output terminals: DI (Digital Input), DO (Digital Output), AI (Analog Input), AO (Analog Output), and UI (Universal Input). Users can visually check the status of each E4J terminal in the field

through the LED, and the LED displays the status of AI, AO as well as DI, DO, and UI. Users can set thresholds for AI, AO, and UI to classify the status of input/output, and through this, you can easily check the operation of DiBA PLC and the status of external devices right on the spot. This function is protected by Patent No. 10-2214702.

As the input/output terminals of E4J use RJ45, it is connected to general external devices through a terminal board (RJ45 uses a direct cable). By separating the terminal board, the number of terminals can be increased and a terminal board suitable for the desired input/output characteristics can be selected. This interface is protected by Patent No. 10-2214702. If you connect the DI and DO terminals of E4J directly, you can use it by connecting only with an RJ45 direct cable without a terminal board. The terminal boards applicable to each input/output terminal of E4J are as follows.

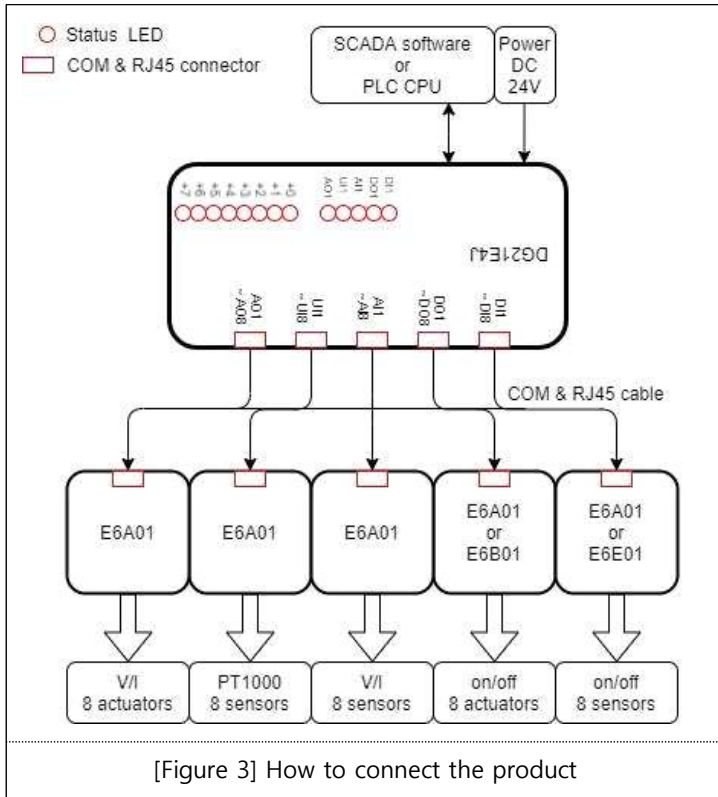
Terminal board	DI	DO	AI	AO	UI
E6A01 (Direct connection type 8 terminals)	○	○	○	○	○
E6B01 (Relay type 8 terminals, Max 10[A], Max 30[Vdc] or 250[Vac])		○			
E6E01 (Individual isolation type 8 terminals, Outer power voltage 10~30[Vdc], No polarity)	○				

Terminal board	E6A01	E6B01	E6E01
Photograph			

In order for the user of the automatic control system to safely control various devices, the E4J has an isolation design (refer to [Figure 1]). The inner area (isolated group 1) connected to the MODBUS RTU master contains power and RS485, and the outer area (isolated group 2) includes all input and output.

2. Composition of the product

E4J can be connected with terminal board E6A01(Direct connection type 8 terminals), E6B01(Relay type 8 terminals, Max 10[A], Max 30[Vdc] or 250[Vac]), E6E01(Individual isolation type 8 terminals, Outer power voltage 10~30[Vdc], No polarity).



[Figure 3] How to connect the product



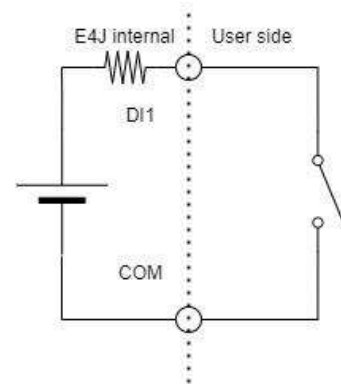
[Figure 4] Connection example picture

Status display LED of E4J consists of 5 group LEDs and 8 terminal LEDs, and displays the status of terminals grouped by RJ45 modular jack unit. The 8 terminal LEDs from +0 to +7 indicate the terminal status of the lit group among the 5 LEDs indicating the group. That is, when DI1 LED is on, +0~+7 LEDs indicate the status of DI1~DI8 terminals, and when AO1 LED is on, +0~+7 LEDs indicate the status of AO1~AO8 terminals. The group LED lights up in sequence for 2 seconds to indicate the status of each of the terminals (8) belonging to the RJ45 modular jack unit, showing the status of all 40 terminals in turn for 10 seconds.

Group LED \ Terminal LED	Terminal LED							
	+0	+1	+2	+3	+4	+5	+6	+7
DI1	DI1	DI2	DI3	DI4	DI5	DI6	DI7	DI8
DO1	DO1	DO2	DO3	DO4	DO5	DO6	DO7	DO8
AI1	AI1	AI2	AI3	AI4	AI5	AI6	AI7	AI8
UI1	UI1	UI2	UI3	UI4	UI5	UI6	UI7	UI8
AO1	AO1	AO2	AO3	AO4	AO5	AO6	AO7	AO8

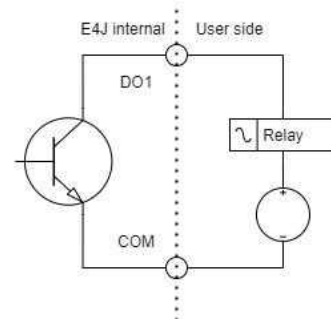
3. Circuit model and wiring

E4J has 8 DIs. [Figure 5] is an easy-to-understand representation of the internal circuit of DI1. The rest of the DIs have the same shape. The DI supply is isolated from the supply driving the E4J. The DI provides power to measure the state of the external DO. [Figure 5] is an example of connecting a switch as an external DO. The current state of [Figure 5] is that the switch is off (open), and DI1 of E4J is recognized as OFF. When the circuit is connected (shorted) by pressing the switch, the E4J recognizes DI1 as ON.



[Figure 5] DI's internal circuit model and example of DI use

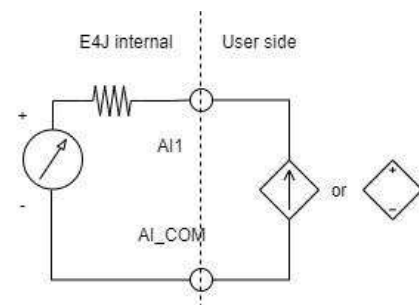
E4J has 8 DOs. [Figure 6] is an easy-to-understand representation of DO1's internal circuit. The rest of the DOs have the same shape. In [Figure 6], DO1 and COM terminals are open (disconnected) or shorted (connected) according to the set value. The state of DO at the initial stage when E4J power is supplied is OFF, and DO1 and COM terminals are open (power-on default). [Figure 6] is an example of an external relay installed.



[Figure 6] DO's internal circuit model and example of DO use

E4J has 8 AIs. [Figure 7] is an easy-to-understand representation of the internal circuit of AI1. The rest of the AI has the same shape.

AI measures the voltage or current supplied by the sensor. The internal resistance of AI is 500 [Ω], so if 20 [mA] is supplied from the sensor side, 10 [V] is measured at the AI terminal.

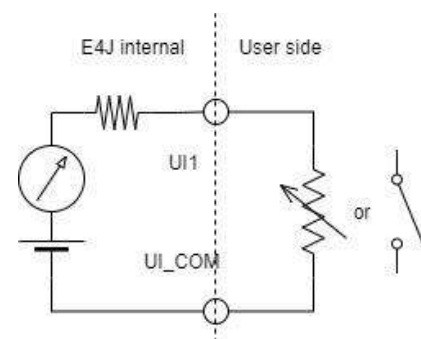


[Figure 7] AI's internal circuit model and example of AI use

E4J has 8 UIs. [Figure 8] is an easy-to-understand representation of the internal circuit of UI1. The rest of the UI has the same shape. Users can connect switches, resistors, and temperature sensors (PT1000) to the UI and use them.

(Caution) Connecting power to the sensor side of the UI may cause product failure.

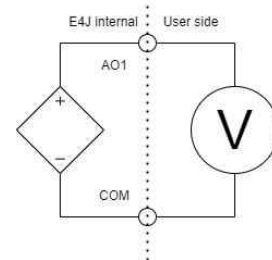
The UI measures the resistance of the sensor side. An example of use is an equivalent circuit for the case where a



[Figure 8] UI's internal circuit model and example of UI use

temperature sensor (PT1000) is connected. If you connect a switch instead of a variable resistor, ON/OFF can be read.

The E4J has 8 AOs. [Figure 9] is an easy-to-understand representation of the internal circuit of AO1. The rest of the AOs have the same shape. In [Figure 9], AO1 and COM terminals output a voltage between 0 and 10 [V] according to the set value. [Figure 9] is an example of an external voltmeter installed.



[Figure 9] AO's internal circuit model and example of AO use

4. Operational Basics

All E4J information is mapped to the Holding Register area of MODBUS and cannot be accessed in other areas. When the request sent to E4J by the MODBUS RTU master cannot be processed normally, an error response is returned. The error response contains an error code, and the error codes used by E4J are:

Error code	Error name	Error content
1	Illegal Function	Function not supported
2	Illegal Address	Non-existent Register or write request to read-only
3	Illegal Value	Value outside the valid range

Operate E4J's Dip Switch to set the baudrate and Slave ID. Push the Dip Switch to the inside of the E4J body to turn it ON, and push it to the outside of the E4J to turn it OFF. Baudrate can be set as follows:

Dip Switch: Baudrate1	Dip Switch: Baudrate0	Set baudrate [bps]	Commojn settings
OFF	OFF	9600	No Parity 8 Data Bits 1 Stop Bit
OFF	ON	19200	
ON	OFF	38400	
ON	ON	57600	

Slave ID of E4J is the same as the value read by Dip Switch in binary. If Dip Switch is ON, it is regarded as 1, if it is OFF, it is regarded as 0, and Slave ID is calculated by considering Address5 ~ Address0 as $2^5(=32) \sim 2^0(=1)$. Two examples are given below and summarized in a table. (2# is an indicator for binary notation) If Slave ID is set to 0, E4J does not respond at all.

(Example 1) Set Slave ID to 37. Address5 ~ Address0 = 2#100101

(Example 2) Set Slave ID to 1. Address5 ~ Address0 = 2#000001

Dip Switch name	Place value	(Example 1) 37 = 2#100101 = $1 \times 2^5 + 0 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$	(Example 2) 1 = 2#000001 = $0 \times 2^5 + 0 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$
Address5	2^5	1 = ON	0 = OFF
Address4	2^4	0 = OFF	0 = OFF
Address3	2^3	0 = OFF	0 = OFF
Address2	2^2	1 = ON	0 = OFF
Address1	2^1	0 = OFF	0 = OFF
Address0	2^0	1 = ON	1 = ON

The voltage measured at the AI terminal is stored in “AI Voltage” (unit [mV]), and the AI LED information is stored in “AI LED”. ON/OFF of “AI LED” is determined by comparing “AI Threshold” (unit [mV]) and “AI Voltage”. The factory default of “AI Threshold” is 5000 (= 5 [V]). Users can change the “AI Threshold” to specify that the “AI LED” displays the desired state. The conditions for E4J to display the status of “AI LED” are as follows:

State of “AI LED”	Condition
ON	“AI Voltage” >= “AI Threshold”
OFF	“AI Voltage” < “AI Threshold”

The information saved by the user as “AO Voltage” (unit [mV]) is output to the AO terminal, compared with “AO Threshold” (unit [mV]) and stored in “AO LED”. The factory default of “AO Threshold” is 5000 (= 5 [V]). Users can change the “AO Threshold” to specify that the “AO LED” displays the desired state. The conditions for E4J to display the status of “AO LED” are as follows:

State of “AO LED”	Condition
ON	“AO Voltage” >= “AO Threshold”
OFF	“AO Voltage” < “AO Threshold”

The temperature measured at the UI terminal is stored in “RTD” (unit [0.1 °C]), and UI LED information is stored in “UI LED”. ON/OFF of “UI LED” is determined by comparing “RTD Threshold” (unit [0.1 °C]) and “RTD”. The factory default of “RTD Threshold” is 8000 (= 800 [°C]). Users can change the “RTD Threshold” to specify that the “UI LED” displays the desired state. The conditions for E4J to display the status of “UI LED” are as follows:

State of “UI LED”	Condition
ON	“RTD” < “RTD Threshold”
OFF	“RTD” >= “RTD Threshold”

5. MODBUS Protocol Memory Map

E4J provides only Holding Register as MODBUS slave. Holding Register is an area where both reading and writing are possible, but both reading and writing are impossible at addresses that E4J does not provide registers. Also, since there are addresses that can only be read, the MODBUS master should access it referring to the table below. Addresses not shown in the table do not have a Register.

Address	Read/Write	Name	Value (= Meaning)
0	R/W	DO 1~8	0~255 = bit mapped in the word Bit 0 (LSB): DO 1 {1 is ON, 0 is OFF} ... Bit 7: DO 8 {1 is ON, 0 is OFF}
10	R	DI 1~8	0~255 = bit mapped in the word Bit 0 (LSB): DI 1 {1 is ON, 0 is OFF} ... Bit 7: DI 8 {1 is ON, 0 is OFF}
20	R	AI LED 1~8	0~255 = bit mapped in the word Bit 0 (LSB): AI LED 1 {1 is ON, 0 is OFF} ... Bit 7: AI LED 8 {1 is ON, 0 is OFF}
30	R	AO LED 1~8	0~255 = bit mapped in the word Bit 0 (LSB): AO LED 1 {1 is ON, 0 is OFF} ... Bit 7: AO LED 8 {1 is ON, 0 is OFF}
40	R	UI LED 1~8	0~255 = bit mapped in the word Bit 0 (LSB): UI LED 1 {1 is ON, 0 is OFF} ... Bit 7: UI LED 8 {1 is ON, 0 is OFF}
100	R/W	DI 1 Counter	0~65535 = Number of occurrences of rising edge Up counter (increment by 1, 65535 cycles to 0) If you change the value, counts from that value.
101	R/W	DI 2 Counter	0~65535 = Number of occurrences of rising edge
102	R/W	DI 3 Counter	0~65535 = Number of occurrences of rising edge
103	R/W	DI 4 Counter	0~65535 = Number of occurrences of rising edge
104	R/W	DI 5 Counter	0~65535 = Number of occurrences of rising edge
105	R/W	DI 6 Counter	0~65535 = Number of occurrences of rising edge
106	R/W	DI 7 Counter	0~65535 = Number of occurrences of rising edge
107	R/W	DI 8 Counter	0~65535 = Number of occurrences of rising edge
200	R	AI Voltage 1	0~10000 = Voltage [mV]
201	R	AI Voltage 2	0~10000 = Voltage [mV]
202	R	AI Voltage 3	0~10000 = Voltage [mV]
203	R	AI Voltage 4	0~10000 = Voltage [mV]
204	R	AI Voltage 5	0~10000 = Voltage [mV]

Adress	Read/Write	Name	Value (= Meaning)
205	R	AI Voltage 6	0~10000 = Voltage [mV]
206	R	AI Voltage 7	0~10000 = Voltage [mV]
207	R	AI Voltage 8	0~10000 = Voltage [mV]
300	R/W	AO Voltage 1	0~10000 = Voltage [mV]
301	R/W	AO Voltage 2	0~10000 = Voltage [mV]
302	R/W	AO Voltage 3	0~10000 = Voltage [mV]
303	R/W	AO Voltage 4	0~10000 = Voltage [mV]
304	R/W	AO Voltage 5	0~10000 = Voltage [mV]
305	R/W	AO Voltage 6	0~10000 = Voltage [mV]
306	R/W	AO Voltage 7	0~10000 = Voltage [mV]
307	R/W	AO Voltage 8	0~10000 = Voltage [mV]
400	R	RTD 1 (PT1000)	-2000~8000 = Temperature [0.1 °C] (Example) If read as -123, it is -12.3 [°C]
401	R	RTD 2 (PT1000)	-2000~8000 = Temperature [0.1 °C]
402	R	RTD 3 (PT1000)	-2000~8000 = Temperature [0.1 °C]
403	R	RTD 4 (PT1000)	-2000~8000 = Temperature [0.1 °C]
404	R	RTD 5 (PT1000)	-2000~8000 = Temperature [0.1 °C]
405	R	RTD 6 (PT1000)	-2000~8000 = Temperature [0.1 °C]
406	R	RTD 7 (PT1000)	-2000~8000 = Temperature [0.1 °C]
407	R	RTD 8 (PT1000)	-2000~8000 = Temperature [0.1 °C]
1200	R/W	AI Threshold 1	0~10000 = Voltage [mV] Factory default = 5000 Changed thresholds are maintained even when the power is turned off.
1201	R/W	AI Threshold 2	0~10000 = Voltage [mV]
1202	R/W	AI Threshold 3	0~10000 = Voltage [mV]
1203	R/W	AI Threshold 4	0~10000 = Voltage [mV]
1204	R/W	AI Threshold 5	0~10000 = Voltage [mV]
1205	R/W	AI Threshold 6	0~10000 = Voltage [mV]
1206	R/W	AI Threshold 7	0~10000 = Voltage [mV]
1207	R/W	AI Threshold 8	0~10000 = Voltage [mV]
1300	R/W	AO Threshold 1	0~10000 = Voltage [mV] Factory default = 5000 Changed thresholds are maintained even when the power is turned off.
1301	R/W	AO Threshold 2	0~10000 = Voltage [mV]

Adress	Read/Write	Name	Value (= Meaning)
1302	R/W	AO Threshold 3	0~10000 = Voltage [mV]
1303	R/W	AO Threshold 4	0~10000 = Voltage [mV]
1304	R/W	AO Threshold 5	0~10000 = Voltage [mV]
1305	R/W	AO Threshold 6	0~10000 = Voltage [mV]
1306	R/W	AO Threshold 7	0~10000 = Voltage [mV]
1307	R/W	AO Threshold 8	0~10000 = Voltage [mV]
1400	R/W	RTD Threshold 1	-2000~8000 = Temperature [0.1 °C] Factory default = 8000 Changed thresholds are maintained even when the power is turned off. (Example) If read as -123, it is -12.3 [°C]
1401	R/W	RTD Threshold 2	-2000~8000 = Temperature [0.1 °C]
1402	R/W	RTD Threshold 3	-2000~8000 = Temperature [0.1 °C]
1403	R/W	RTD Threshold 4	-2000~8000 = Temperature [0.1 °C]
1404	R/W	RTD Threshold 5	-2000~8000 = Temperature [0.1 °C]
1405	R/W	RTD Threshold 6	-2000~8000 = Temperature [0.1 °C]
1406	R/W	RTD Threshold 7	-2000~8000 = Temperature [0.1 °C]
1407	R/W	RTD Threshold 8	-2000~8000 = Temperature [0.1 °C]
9000	R	Number of input/output available	40
9001	R	Number of DI	8
9002	R	Number of DO	8
9003	R	Number of AI	8
9004	R	Number of AO	8
9005	R	Number of UI(RTD)	8
9900	R	Design Year	2021
9901	R	Family Number	69
9902	R	Product Number	4
9903	R	Compatibility Number	74
9990	R	Version	1
9991	R	Lot	0~199