Manual of AI-EtherCAT16 Converter V1.4

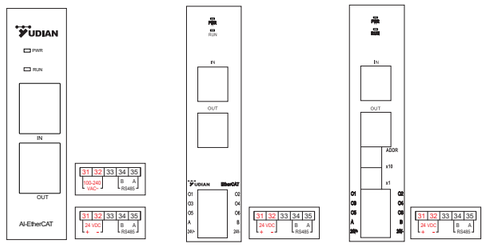
1.Revision history

Version	Content modified	Date
V1.0	First Release Version	2023-6-15
V1.1	Added 16-channel 8848 meter	2023-7-5
V1.1.1	Adjusted 8-channel meter register mapping	2023-11-10
V1.1.2	8-channel meter flags and channel polling status can be changed before meter communication	2024-1-28
V1.1.3	Manual setting of meter flags	2024-4-8
V1.2	Added support for 6-channel meters	2024-11-5
V1.3	Added support for 16-channel 6016 meters	2024-12-18
v1.4	Added D92 outline	2025-4-25

2.Model Description

AI - □ - □ - □			Description
Model	EtherCAT16		16-channel protocol converter
Form Factor	D71		
	D92		
	D92D		Dial address (default not selected)
Power Supply		100-240AC	default is 24VDC power supply
		24VDC	

3.Appearance and wiring



D71 Outline and Wiring Diagram　D92 Outline and Wiring Diagram　D92D Outline and Wiring Diagram

Indicator Lights: PWR: Power Indicator　**RUN**: Bus Indicator
Rotary Encoder : **x10**: EtherCAT Address Tens Digit (Decimal)
x1: EtherCAT Address Units Digit (Decimal)

Default is 0, in which case the EtherCAT address can be set via the host computer; when the DIP switch address is greater than 0, EtherCAT uses the DIP switch address.

Wiring Instructions

Port	Description
IN	EtherCAT input port
OUT	EtherCAT output port
A	RS485-A (external)
B	B　RS485-B (external)
24V+	24VD C power positive
24V-	24VDC power negative
O1-O6	Reserved

Other Notes:

1. Either the backplane 24VDC power supply or the panel 24VDC power supply can be connected;
2. The backplane RS485 and the panel RS485 are interconnected.

4.Overview

The AI-EtherCAT Converter V1.4 is compatible with Yudian's AI series temperature controllers (V9 version) supporting MODBUS RTU protocol, including:Single-channel meters:4-channel meters (e.g., 7048/7248/7648), 6-channel meters (e.g., 7268/7368/7668), 8-channel meters (e.g., 8388/8588).

Setup Requirements:Meter Configuration:Set meters to standard MODBUS RTU mode.For versions v9.05 and above, set the H bit of the AF parameter to 1 (decimal 128).For versions with AFC (v9.21+), set AFC to 0 to enable MODBUS.Set Baud rate to 19200.Address (Addr)

Settings:Single-channel meters (v9.0+): Addr range 1~16.

4-channel meters (e.g., 7X48, 8848): Addr = 1, 5, 9, or 13.

6-channel meters (e.g., 7X68):When used alone: Addr = 1 or 7.Mixed with other meters: Prioritize earlier channels (e.g., two 7X48 meters at Addr 1 and 5, and one 7X68 at Addr 9).

8-channel meters (e.g., 8X88): Addr = 1 or 9.

6016 meters: Addr = 1.

Meter Flag Settings:Default: 000 (converter auto-identifies single-channel and 7X48 meters).Manual flag settings:111: 8-channel meter.110: 6-channel meter.100: 4-channel meter (except 8848, set to 101).011: 16-channel meter (6616).001: Single-channel meter.

5.Input mapping

5.1 Input Data Overview

index	Subindex	I/O product name	Type	Initial value	Notes
0x6000	1	Ch1 Operating Status	UINT16	0	Ch1~16 operating status, details can be found in 6.2
	2	Ch2 Operating Status	UINT16	0	
	3	Ch3 Operating Status	UINT16	0	
	4	Ch4 Operating Status	UINT16	0	
	5	Ch5 Operating Status	UINT16	0	
	6	Ch6 Operating Status	UINT16	0	
	7	Ch7 Operating Status	UINT16	0	
	8	Ch8 Operating Status	UINT16	0	
	9	Ch9 Operating Status	UINT16	0	
	10	Ch10 Operating Status	UINT16	0	
	11	Ch11 Operating Status	UINT16	0	
	12	Ch12 Operating Status	UINT16	0	
	13	Ch13 Operating Status	UINT16	0	
	14	Ch14 Operating Status	UINT16	0	
	15	Ch15 Operating Status	UINT16	0	
	16	Ch16 Operating Status	UINT16	0	
0x6001	1	Ch1 Process Data	INT16	0	Ch1-16 PV value, default unit is 0.1 ℃, which can be set on the instrument, please refer to the manual for details.
	2	Ch2 Process Data	INT16	0	
	3	Ch3 Process Data	INT16	0	
	4	Ch4 Process Data	INT16	0	
	5	Ch5 Process Data	INT16	0	
	6	Ch6 Process Data	INT16	0	
	7	Ch7 Process Data	INT16	0	
	8	Ch8 Process Data	INT16	0	
	9	Ch9 Process Data	INT16	0	
	10	Ch10 Process Data	INT16	0	
	11	Ch11 Process Data	INT16	0	
	12	Ch12 Process Data	INT16	0	
	13	Ch13 Process Data	INT16	0	
	14	Ch14 Process Data	INT16	0	
	15	Ch15 Process Data	INT16	0	
	16	Ch16 Process Data	INT16	0	
0x6002	1	Ch1 MV Monitor	INT16	0	Ch1~16 output percentage (MV)
	2	Ch2 MV Monitor	INT16	0	
	3	Ch3 MV Monitor	INT16	0	
	4	Ch4 MV Monitor	INT16	0	
	5	Ch5 MV Monitor	INT16	0	
	6	Ch6 MV Monitor	INT16	0	
	7	Ch7 MV Monitor	INT16	0	
	8	Ch8 MV Monitor	INT16	0	
	9	Ch9 MV Monitor	INT16	0	
	10	Ch10 MV Monitor	INT16	0	
	11	Ch11 MV Monitor	INT16	0	
	12	Ch12 MV Monitor	INT16	0	
	13	Ch13 MV Monitor	INT16	0	
	14	Ch14 MV Monitor	INT16	0	
	15	Ch15 MV Monitor	INT16	0	
	16	Ch16 MV Monitor	INT16	0	
0x6003	1	Ch1 Output and Alarm Status	INT16	0	Ch1-16 output and alarm status, details can be found in 5.3、5.4、5.5
	2	Ch2 Output and Alarm Status	INT16	0	
	3	Ch3 Output and Alarm Status	INT16	0	
	4	Ch4 Output and Alarm Status	INT16	0	
	5	Ch5 Output and Alarm Status	INT16	0	
	6	Ch6 Output and Alarm Status	INT16	0	
	7	Ch7 Output and Alarm Status	INT16	0	
	8	Ch8 Output and Alarm Status	INT16	0	
	9	Ch9 Output and Alarm Status	INT16	0	
	10	Ch10 Output and Alarm Status	INT16	0	
	11	Ch11 Output and Alarm Status	INT16	0	
	12	Ch12 Output and Alarm Status	INT16	0	
	13	Ch13 Output and Alarm Status	INT16	0	
	14	Ch14 Output and Alarm Status	INT16	0	
	15	Ch15 Output and Alarm Status	INT16	0	
	16	Ch16 Output and Alarm Status	INT16	0	
0x6004	1	Ch1 Proportional Band Monitor	INT16	0	Ch1~16 proportional band monitoring, with the same unit as the measured value
	2	Ch2 Proportional Band Monitor	INT16	0	
	3	Ch3 Proportional Band Monitor	INT16	0	
	4	Ch4 Proportional Band Monitor	INT16	0	
	5	Ch5 Proportional Band Monitor	INT16	0	
	6	Ch6 Proportional Band Monitor	INT16	0	
	7	Ch7 Proportional Band Monitor	INT16	0	
	8	Ch8 Proportional Band Monitor	INT16	0	
	9	Ch9 Proportional Band Monitor	INT16	0	
	10	Ch10 Proportional Band Monitor	INT16	0	
	11	Ch11 Proportional Band Monitor	INT16	0	
	12	Ch12 Proportional Band Monitor	INT16	0	
	13	Ch13 Proportional Band Monitor	INT16	0	
	14	Ch14 Proportional Band Monitor	INT16	0	
	15	Ch15 Proportional Band Monitor	INT16	0	
	16	Ch16 Proportional Band Monitor	INT16	0	
0x6005	1	Ch1 Integration Time Monitor	INT16	0	Ch1-16 Integration time monitoring, measured in seconds
	2	Ch2 Integration Time Monitor	INT16	0	
	3	Ch3 Integration Time Monitor	INT16	0	
	4	Ch4 Integration Time Monitor	INT16	0	
	5	Ch5 Integration Time Monitor	INT16	0	
	6	Ch6 Integration Time Monitor	INT16	0	
	7	Ch7 Integration Time Monitor	INT16	0	
	8	Ch8 Integration Time Monitor	INT16	0	
	9	Ch9 Integration Time Monitor	INT16	0	
	10	Ch10 Integration Time Monitor	INT16	0	
	11	Ch11 Integration Time Monitor	INT16	0	
	12	Ch12 Integration Time Monitor	INT16	0	
	13	Ch13 Integration Time Monitor	INT16	0	
	14	Ch14 Integration Time Monitor	INT16	0	
	15	Ch15 Integration Time Monitor	INT16	0	
	16	Ch16 Integration Time Monitor	INT16	0	
0x6006	1	Ch1 Derivative Time Monitor	INT16	0	Ch1-16 differential time monitoring, unit: 0.1 seconds
	2	Ch2 Derivative Time Monitor	INT16	0	
	3	Ch3 Derivative Time Monitor	INT16	0	
	4	Ch4 Derivative Time Monitor	INT16	0	
	5	Ch5 Derivative Time Monitor	INT16	0	
	6	Ch6 Derivative Time Monitor	INT16	0	
	7	Ch7 Derivative Time Monitor	INT16	0	
	8	Ch8 Derivative Time Monitor	INT16	0	
	9	Ch9 Derivative Time Monitor	INT16	0	
	10	Ch10 Derivative Time Monitor	INT16	0	
	11	Ch11 Derivative Time Monitor	INT16	0	
	12	Ch12 Derivative Time Monitor	INT16	0	
	13	Ch13 Derivative Time Monitor	INT16	0	
	14	Ch14 Derivative Time Monitor	INT16	0	
	15	Ch15 Derivative Time Monitor	INT16	0	
	16	Ch16 Derivative Time Monitor	INT16	0	

5.2 Ch □ Operating Status

Name	Bit	Description
Start/Stop Status	bit0	00: Stop; 01: Run; 1X: Hold
	bit1	
AT Status	bit2	0: AT stopped; 1: AT running
Reserved	bit3	Reserved
Channel Status	bit4	0: Normal; 1: Offline
Manual/Auto Status	bit5	0: Auto; 1: Manual
Host Offline Protection	Bit6	0: Disabled; 1: Enabled. When enabled, the channel device stops running if the EtherCAT connection fails. This function is enabled by default.
Bits 7~11	bit7~11	Reserved
Meter Flag	bit12~14	000: Default; 001: Single-channel meter; 100: 4-channel meter (101--8848); 110: 6-channel meter; 111: 8-channel meter; 011: 16-channel meter;
Channel Polling Status	bit15	0: Normal; 1: Current channel not polling

注 1：仪表标志位未设置时，单路表及 7x48 系列仪表可自动识别，此时仪表标志为默认为 000。

5.3 Single-Channel Temperature Controller Ch □ Output and Alarm Status

Name	Bit	Description	Function
HIAL	bit0	High Limit Alarm	0: No Alarm; 1: Alarm
LOAL	bit1	Low Limit Alarm	0: No Alarm; 1: Alarm
HDAL	bit2	High Deviation Alarm	0: No Alarm; 1: Alarm
LDAL	bit3	Low Deviation Alarm	0: No Alarm; 1: Alarm
ORAL	bit4	Over Range Alarm	0: No Alarm; 1: Alarm
AL1	bit5	AL1 Output	0：OFF，1：ON
AL2	bit6	AL2 Output	0：OFF，1：ON
位 7	bit7	Reserved	
OP1	bit8	OP1 Output	0：OFF，1：ON
OP2	bit9	OP2 Output	0：OFF，1：ON
AU1	bit10	AU1 Output	0：OFF，1：ON
AU2	bit11	AU2 Output	0：OFF，1：ON
MIO	bit12	MIO Output	0：OFF，1：ON
位 13~15	bit13~15	Reserved	

5.4 7x48 and 7x68 Series Ch Output and Alarm Status

Name	Bit	Description	Function
HIAL	bit0	High Limit Alarm	0: No Alarm; 1: Alarm
LOAL	bit1	Low Limit Alarm	0: No Alarm; 1: Alarm
bit2~3	bit2~bit3	Reserved	
ORAL	bit4	Over Range Alarm	0: No Alarm; 1: Alarm
AL1*1	bit5	AL1 Output	0：OFF；1：ON
AL2*1	bit6	AL2 Output	0：OFF；1：ON
Bit7	bit7	Reserved	
OP1	bit8	OP1 Output	0：OFF；1：ON
Bit9~15	bit9~bit15	Reserved	

*1: Each channel of 7x48 and 7x68 shares the AL1 and AL2 ports.

5.5 8848, 8x88, and 6016 Series Ch □ Output and Alarm Status

Name	Bit	Description	Function
HIAL	bit0	High Limit Alarm	0: No Alarm; 1: Alarm
LOAL	bit1	Low Limit Alarm	0: No Alarm; 1: Alarm
HDAL	bit2	High Deviation Alarm	0: No Alarm; 1: Alarm
LDAL	bit3	Low Deviation Alarm	0: No Alarm; 1: Alarm
Bit4~15	bit4~15	Reserved	

6、Output mapping

6.1 Output Data Overview

Index	Sub-Index	I/O Port Name	Type	Initial Value	Notes
0x7000	1	Ch1 Operation Command	UINT16	0	Ch1~16 Run Command, details see 5.2
	2	Ch2 Operation Command	UINT16	0	
	3	Ch3 Operation Command	UINT16	0	
	4	Ch4 Operation Command	UINT16	0	
	5	Ch5 Operation Command	UINT16	0	
	6	Ch6 Operation Command	UINT16	0	
	7	Ch7 Operation Command	UINT16	0	
	8	Ch8 Operation Command	UINT16	0	
	9	Ch9 Operation Command	UINT16	0	
	10	Ch10 Operation Command	UINT16	0	
	11	Ch11 Operation Command	UINT16	0	
	12	Ch12 Operation Command	UINT16	0	
	13	Ch13 Operation Command	UINT16	0	
	14	Ch14 Operation Command	UINT16	0	
	15	Ch15 Operation Command	UINT16	0	
	16	Ch16 Operation Command	UINT16	0	
0x7001	1	Ch1 Set Value	INT16	0	Ch1~16 SV (Set Value), unit same as measured value
	2	Ch2 Set Value	INT16	0	
	3	Ch3 Set Value	INT16	0	
	4	Ch4 Set Value	INT16	0	
	5	Ch5 Set Value	INT16	0	
	6	Ch6 Set Value	INT16	0	
	7	Ch7 Set Value	INT16	0	
	8	Ch8 Set Value	INT16	0	
	9	Ch9 Set Value	INT16	0	
	10	Ch10 Set Value	INT16	0	
	11	Ch11 Set Value	INT16	0	
	12	Ch12 Set Value	INT16	0	
	13	Ch13 Set Value	INT16	0	
	14	Ch14 Set Value	INT16	0	
	15	Ch15 Set Value	INT16	0	
	16	Ch16 Set Value	INT16	0	
0x7002	1	Ch1 PV Input Shift	INT16	0	Ch1~16 SCB value
	2	Ch2 PV Input Shift	INT16	0	
	3	Ch3 PV Input Shift	INT16	0	
	4	Ch4 PV Input Shift	INT16	0	
	5	Ch5 PV Input Shift	INT16	0	
	6	Ch6 PV Input Shift	INT16	0	
	7	Ch7 PV Input Shift	INT16	0	
	8	Ch8 PV Input Shift	INT16	0	
	9	Ch9 PV Input Shift	INT16	0	
	10	Ch10 PV Input Shift	INT16	0	
	11	Ch11 PV Input Shift	INT16	0	
	12	Ch12 PV Input Shift	INT16	0	
	13	Ch13 PV Input Shift	INT16	0	
	14	Ch14 PV Input Shift	INT16	0	
	15	Ch15 PV Input Shift	INT16	0	
	16	Ch16 PV Input Shift	INT16	0	
0x7003	1	Ch1 Manual MV	INT16	0	Ch1-16 manual MV, measured in the same units as the measured value
	2	Ch2 Manual MV	INT16	0	
	3	Ch3 Manual MV	INT16	0	
	4	Ch4 Manual MV	INT16	0	
	5	Ch5Manual MV	INT16	0	
	6	Ch6 Manual MV	INT16	0	
	7	Ch7 Manual MV	INT16	0	
	8	Ch8 Manual MV	INT16	0	
	9	Ch9 Manual MV	INT16	0	
	10	Ch10 Manual MV	INT16	0	
	11	Ch11 Manual MV	INT16	0	
	12	Ch12 Manual MV	INT16	0	
	13	Ch13 Manual MV	INT16	0	
	14	Ch14 Manual MV	INT16	0	
	15	Ch15 Manual MV	INT16	0	
	16	Ch16 Manual MV	INT16	0	
0x7005	1	Ch1 Proportional Band	INT16	0	Ch1~16 P Band, same unit as measured value
	2	Ch2 Proportional Band	INT16	0	
	3	Ch3 Proportional Band	INT16	0	
	4	Ch4 Proportional Band	INT16	0	
	5	Ch5 Proportional Band	INT16	0	
	6	Ch6 Proportional Band	INT16	0	
	7	Ch7 Proportional Band	INT16	0	
	8	Ch8 Proportional Band	INT16	0	
	9	Ch9 Proportional Band	INT16	0	
	10	Ch10 Proportional Band	INT16	0	
	11	Ch11 Proportional Band	INT16	0	
	12	Ch12 Proportional Band	INT16	0	
	13	Ch13 Proportional Band	INT16	0	
	14	Ch14 Proportional Band	INT16	0	
	15	Ch15 Proportional Band	INT16	0	
	16	Ch16 Proportional Band	INT16	0	
0x7006	1	Ch1 Integration Time	INT16	0	Ch1~16 Integral Time, unit in seconds
	2	Ch2 Integration Time	INT16	0	
	3	Ch3 Integration Time	INT16	0	
	4	Ch4 Integration Time	INT16	0	
	5	Ch5 Integration Time	INT16	0	
	6	Ch6 Integration Time	INT16	0	
	7	Ch7 Integration Time	INT16	0	
	8	Ch8 Integration Time	INT16	0	
	9	Ch9 Integration Time	INT16	0	
	10	Ch10 Integration Time	INT16	0	
	11	Ch11 Integration Time	INT16	0	
	12	Ch12 Integration Time	INT16	0	
	13	Ch13 Integration Time	INT16	0	
	14	Ch14 Integration Time	INT16	0	
	15	Ch15 Integration Time	INT16	0	
	16	Ch16 Integration Time	INT16	0	
0x7007	1	Ch1 Derivative Time	INT16	0	Ch1~16 Derivative Time, unit in 0.1 seconds
	2	Ch2 Derivative Time	INT16	0	
	3	Ch3 Derivative Time	INT16	0	
	4	Ch4 Derivative Time	INT16	0	
	5	Ch5 Derivative Time	INT16	0	
	6	Ch6 Derivative Time	INT16	0	
	7	Ch7 Derivative Time	INT16	0	
	8	Ch8 Derivative Time	INT16	0	
	9	Ch9 Derivative Time	INT16	0	
	10	Ch10 Derivative Time	INT16	0	
	11	Ch11 Derivative Time	INT16	0	
	12	Ch12 Derivative Time	INT16	0	
	13	Ch13 Derivative Time	INT16	0	
	14	Ch14 Derivative Time	INT16	0	
	15	Ch15 Derivative Time	INT16	0	
	16	Ch16 Derivative Time	INT16	0	
0x7008	1	Ch1 Alarm Value Upper Limit	INT16	0	Ch1~16 High Limit Alarm, unit same as measured value
	2	Ch2 Alarm Value Upper Limit	INT16	0	
	3	Ch3 Alarm Value Upper Limit	INT16	0	
	4	Ch4 Alarm Value Upper Limit	INT16	0	
	5	Ch5 Alarm Value Upper Limit	INT16	0	
	6	Ch6 Alarm Value Upper Limit	INT16	0	
	7	Ch7 Alarm Value Upper Limit	INT16	0	
	8	Ch8 Alarm Value Upper Limit	INT16	0	
	9	Ch9 Alarm Value Upper Limit	INT16	0	
	10	Ch10 Alarm Value Upper Limit	INT16	0	
	11	Ch11 Alarm Value Upper Limit	INT16	0	
	12	Ch12 Alarm Value Upper Limit	INT16	0	
	13	Ch13 Alarm Value Upper Limit	INT16	0	
	14	Ch14 Alarm Value Upper Limit	INT16	0	
	15	Ch15 Alarm Value Upper Limit	INT16	0	
	16	Ch16 Alarm Value Upper Limit	INT16	0	
0x7009	1	Ch1 Alarm Value Lower Limit	INT16	0	Ch1~16 Low Limit Alarm, unit same as measured value
	2	Ch2 Alarm Value Lower Limit	INT16	0	
	3	Ch3 Alarm Value Lower Limit	INT16	0	
	4	Ch4 Alarm Value Lower Limit	INT16	0	
	5	Ch5 Alarm Value Lower Limit	INT16	0	
	6	Ch6 Alarm Value Lower Limit	INT16	0	
	7	Ch7 Alarm Value Lower Limit	INT16	0	
	8	Ch8 Alarm Value Lower Limit	INT16	0	
	9	Ch9 Alarm Value Lower Limit	INT16	0	
	10	Ch10 Alarm Value Lower Limit	INT16	0	
	11	Ch11 Alarm Value Lower Limit	INT16	0	
	12	Ch12 Alarm Value Lower Limit	INT16	0	
	13	Ch13 Alarm Value Lower Limit	INT16	0	
	14	Ch14 Alarm Value Lower Limit	INT16	0	
	15	Ch15 Alarm Value Lower Limit	INT16	0	
	16	Ch16 Alarm Value Lower Limit	INT16	0	

6. 2 Ch □ Operation Command

Name	Bit	Description
Start/Stop Command	bit0	00: Stop; 01: Run; 1X: Hold
	bit1	
AT Execution	bit2	0 → 1 AT execution, rising edge effective
Reserved	Reserved	
AT Cancel	bit4	0 → 1 AT cancel, rising edge effective
Manual/Auto	bit5	Level, 0: Auto; 1: Manual
Host Offline Protection	bit6	0: Disabled; 1: Enabled. When EtherCAT connection fails, the channel device stops running.
Bit7~11	bit7~11	Reserved
Meter Flag	bit12~14	000: Default; 001: Single-channel meter; 100: 4-channel meter (101-8848); 110: 6-channel meter; 111: 8-channel meter; 011: 16-channel meter;
Channel Polling Status	bit15	0: Normal; 1: Current channel not polling

Note 1: The manual and automatic states are only supported during operation, meaning that in the stopped state, there is no distinction between manual and automatic states.
Note 2: When writing commands, the initial value of the corresponding bit is 0. The value is only written to the temperature control meter when a change in that bit is detected. Different bits do not affect each other.
Note 3: When writing commands, the channel polling status only takes effect at the starting address of the meter.
Note 4: When writing commands, the meter flag bits only take effect at the starting address of the meter.

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