Ezlogger MODBUS Interface Description

Version 06

Ezlogger MODBUS Interface Description

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1 Introduction

The MODBUS-TCP protocol is issued as a (de facto) automation standard. Since MODBUS is already well known, this document only includes information that is specific to EzLogger. However, this document tries to clarify which features of MODBUS-TCP are informative for both sides of the interaction.

1.1 Terminology, abbreviated definitions

Table 1- 1Terminology Definition

Name	Description
Master Node	In master-slave communication, the party that initiate the communication is called the master node.
Slave node	In master-slave communication, the party that passively responds to commands is called a slave node.
Broadcast address	Fixed to 0
Register address	The register address corresponds to a 2-byte message
U16	Unsigned 16-bit integer
U32	Unsigned 32-bit integer
U64	Unsigned 64-bit integer
I16	Singed 16-bit integer
I32	Singed 32-bit integer
I64	Singed 64-bit integer
STR	String
MLD	Multibyte
N/A	Not Applicable

2 Register Definition

RW type is a hold type signal, the data in the setting operation will take effect permanently until the next modification, supporting 0X03, 0X06, 0X10 commands.
WO type signal, 0X03 query instruction is not supported, but 0X06, 0X10 instruction is supported.
RO type signal, only 0X03 instruction is supported, but not 0X06, 0X10 instruction.

2.1 EzLogger register definition

Note: The following registers operate on the EzLogger itself, or on all inverters accessed by the EzLogger. The logical device ID in the communication protocol is filled with 0.

Table 2- 1 Register Definition

No.	Signal	Read/Write	Type	Unit	Gain	Address	Nbr	Range
1	System Time	RW	U32	N/A	1	20000	2	Era Seconds UTC
2	City	RW	U32	N/A	1	20002	2	（undeveloped）
3	Time Zone	RW	I32	S	1	20004	2	（undeveloped）
4	Local Time	RO	U32	N/A	1	20006	2	Era seconds, datalogger local time
5	Start-up	WO	U16	N/A	1	20008	1	The data field can only be 0
6	Shutdown	WO	U16	N/A	1	20009	1	The data field can only be 0
7	Switch On/Off	WO	U16	N/A	1	20010	1	0: Off 1: On
8	Switch On/Off	WO	U16	N/A	1	20011	1	0: On 1: Off
9	Array Reset	WO	U16	N/A	1	20012	1	The data field can only be 0

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10	Active power adjustment	RW	U32	kW	10	20013	2	Adjusts the total output active/reactive power of all inverters connected to the EzLogger Discard out-of-range scheduling values ***Note: This register is not used in conjunction with a single power scheduling register.***
11	Reactive power adjustment	RW	I32	kVar	10	20015	2	
12	Active power adjustment	RW	U32	kW	10	20017	2	Adjusts the total output active/reactive power of all inverters connected to the EzLogger ***Note: This register is not used in conjunction with a single power scheduling register.***
13	Reactive power adjustment	RW	I32	kVar	10	20019	2	
14	Set Active Power (percentage)	RW	U16	%	10	20021	1	Adjusts the total active power output of all inverters connected to the EzLogger,ranging from 0 to 100%. ***Note: This register is not used in conjunction with a single power scheduling register.***

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15	Set PF/Reactive Power	RW	I16	N/A	1	20022	1	Adjusts the total output reactive power of all inverters connected to the EzLogger, range 1~20, lagging 0.99~0.8 80~100, leading 0.8~1
16	Total Input Power	RO	I32	kW	1000	20023	2	Total input power of all inverters
17	Total Active Power	RO	I32	kW	1000	20025	2	Total output active power of all inverters
18	Power Factor	RO	I16	N/A	1000	20027	1	Total power factor of all inverters
19	Total Reactive Power	RO	I32	kVar	1000	20028	2	Total output reactive power of all inverters
20	Total DC Current	RO	I32	A	10	20030	2	Total input DC current of all inverters
21	Total Cumulative Generation	RO	U32	kWh	100	20032	2	Cumulative energy generation of all inverters
22	Total Daily Generation	RO	U32	kWh	10	20034	2	Daily energy generation inverters of all inverters
23	Total Generation Hour	RO	U32	h	1	20036	2	
24	Plants Status	RO	U16	N/A	1	20038	1	0: Power off 1: Grid connected

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25	Total A-Phase-current	RO	I16	A	10	20039	1	Total A-phase current of all inverters
26	Total B-Phase current	RO	I16	A	10	20040	1	Total B-phase current of all inverters
27	Total C-Phase current	RO	I16	A	10	20041	1	Total C-phase current of all inverters
28	Vab	RO	U16	V	10	20042	1	
29	Vbc	RO	U16	V	10	20043	1	
30	Vca	RO	U16	V	10	20044	1	
31	Reserved	RO	U16	N/A	1	20045	10	
32	Inverter efficiency	RO	U16	%	100	20055	1	
33	Maximum value of reactive power regulation	RO	U32	kVar	1000	20056	2	Total maximum reactive power (to the grid) of all inverters connected to the parallel state
34	Minimum value of reactive power regulation	RO	I32	kVar	1000	20058	2	Total maximum reactive power (from the grid) of all inverters connected to the parallel state
35	Maximum value of active power regulation	RO	U32	k	1000	20060	2	Total maximum active power of all inverters connected to the parallel state
36	Locked status	RO	U16	N/A	1	20062	1	0: Locked 1: Unlocked

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37	DI Status	RO	U16	N/A	1	20063	1	Bit0: Bit7:DI8 1: Close 0: Open
38	ESN	RO	STR	N/A	1	20064	8	ASCII, 16 bytes
39	Reserved	RO	U16	N/A	1	20072	2	N/A
40	System Reset	WO	U16	N/A	1	20074	1	Datalogger reset command, The only data field can be 1
41	Target value of power dispatch	RO	U32	kW	10	20075	2	EzLogger active power regulation target (total active power)
42	Target value of reactive power dispatch	RO	I32	kVar	10	20077	2	EzLogger reactive power regulation target value: The gain is 10 for fixed values of total reactive power.
43	Percentage of active dispatch	RO	U32	%	1	20079	2	[0, 100]
44	System time: Year	RW	U16	N/A	1	20081	1	2000~2068（local time）
45	System time: month	RW	U16	N/A	1	20082	1	1~12
46	System time: day	RW	U16	N/A	1	20083	1	1~31
47	System time: hour	RW	U16	N/A	1	20084	1	0~23
48	System time: minutes	RW	U16	N/A	1	20085	1	0~59

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49	System Time: Seconds	RW	U16	N/A	1	20086	1	0~59
50	Reserved	RO	U16	N/A	1	20087	13	
51	Quantity of inverters connected to grid	RO	U16	N/A	1	20100	1	
52	Quantity of inverters in standby mode	RO	U16	N/A	1	20101	1	
53	Quantity of inverters off	RO	U16	N/A	1	20102	1	
54	Reserved	RO	U16	N/A	1	20103	97	
55	Active power adjustment mode	RW	U16	N/A	1	20200	1	0: turn off the mode, commands of active power control is invalid Non 0 value: Turn on the mode, commands of active power control is valid
56	Reactive power adjustment mode	RW	U16	N/A	1	20201	1	0: turn off the mode, commands of reactive power control is invalid Non 0 value: Turn on the mode, commands of reactive power control is valid
57	Reserved	RW	U16	N/A	1	20202	99	
58	Power factor	RW	I16	N/A	100	20301	1	Total PF of all inverters (-99~-80, 80~100)
59	QU curve	RW	U16	N/A	1	20302	1	1: ON, 0:OFF

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60	Reserved	RW	U16	N/A	1	20303	97	
61	PV module capacity	RO	U32	kW	1000	20400	2	[0, 2000000]
62	Rated plant capacity	RO	U32	kW	1000	20402	2	N/A
63	Total rated capacity of grid-connecte d inverters	RO	U32	kW	1000	20404	2	N/A
64	Conversion coefficient	RO	U32	N/A	1000	20406	2	N/A
65	Communicaton status	RO	U16	N/A	1	20408	1	Status of communication between the EzLogger and the servers of Japanese power companies: 0: Connection success 1: Connection failed
66	Type of the secondary device	RO	I16	N/A	1	20500 …… 20755	1 …… 1	Starting from 20500 to 20755 indicates the device type of the device whose modbus address is (x -20499). For example, 20500 indicates the type of device whose modbus address is 1. 20501 indicates device type with modbus address 2; Device type code:

								No device = -1 UT320 = 0, HT1500 = 1, MiniInv = 2, SMT = 3, GT = 4, HT1100 = 5, SMT_US = 6, ET50 = 7, PCS = 8, BMS = 9, SDT_G3 = 10, SMT80 = 11, SDT_G2 = 12, MTT = 13, SMT_JP = 14, Box_ = 100, Env_ = 101
67	Alarm message 1	RO	U16	N/A	1	50000	1	N/A
68	Alarm message 2	RO	U16	N/A	1	50001	1	N/A

2.2 Ezlogger Alarm Definition

Table 2-2 Alarm Definition

Alarm	Reason	Grade	Register Address	Bit
Device Address Conflict	There is an address conflict between the EzLogger setup address and the access device	Important	50000	0
EzIO communication failure	EzIO expansion board and Ezlogger communication failure	Important	50000	1
DI1 custom alarm	The dry contact signal of the external device feeding into the DI interface corresponding to the digital pickup is abnormal		50001	0
DI2 custom alarm			50001	1

DI3 custom alarm			50001	2
DI4 custom alarm			50001	3
DI5 custom alarm			50001	4
DI6 custom alarm			50001	5
DI7 custom alarm			50001	6
DI8 custom alarm			50001	7

2.3 Weather Station Register Definition

The following registers are operated by the corresponding weather station, and the logical device ID in the communication protocol is filled in as the RS485 address of the weather station.

Please refer to the description of the MODBUS interface definition of the weather station for the specific register definition.

2.4 Smart Meter Register Definition

The following registers operate on the corresponding smart meters, and the logical device ID in the communication protocol is filled in as the RS485 address of the smart meter.
Please refer to the smart meter MODBUS interface definition description for the specific register definition.

2.5 Inverter Register Definition

The operation object of the following register is the corresponding inverter, and the logical device ID in the communication protocol is filled in as the RS485 address of the inverter.
Please refer to the description of inverter MODBUS interface definition for specific register definition.

2.6 Box Transformer Measurement and Control Device Register Definition

The operation object of the following register is the corresponding box transformer measurement and control device, and the logical device ID in the communication protocol is filled in as the RS485 address of the box transformer measurement and control device.
Please refer to the description of box transformer measurement and control device MODBUS interface definition for specific register definition.

Note: the remote signal and telemetry of the MV station are read by 03 function code, and the remote signal analysis can be analyzed according to the actual function code;

2.7 Mapping Signal Definition

The mapped registers are accessed using EzLogger addresses. By default, each device occupies 25 registers, and the register addresses are derived from the starting register address, the offset address, and the device address conversion. The device address is the Modbus physical address of the device. Devices supported for mapping: inverters, weather station.

The calculation formula is as follows.

- Register Address = Start Register Address + (25 * (Device Address - 1)) + Offset Address
- Start register address = 51000.
- In order for the registers to be contiguous, the device addresses must also be assigned in strict order.

Table 2-7 Inverter Register Definition

No.	Signal	Read/ Write	Type	Unit	Gain	Offset Address	Nbr	Range
1	Active Power	RO	I32	kW	1000	0	2	
2	Reactive Power	RO	I32	kVar	1000	2	2	
3	Input Power	RO	I32	kW	1000	4	2	
4	Insulation impedance value	RO	U16	KΩ	1	6	1	
5	Power Factor	RO	I16	N/A	1000	7	1	
6	Inverter Operating Mode	RO	U16	N/A	1	8	1	Referring to the specific inverter MODBUS interface definition description, EzLogger additionally adds the following status. 0xA000:Communication broken link 0xB000:Loading
7	Reserve	RO	U16	N/A	1	9	1	

8	Reserve	RO	U16	N/A	1	10	1	
9	Internal Temperature	RO	I16	℃	10	11	1	
10	DSP Failure	RO	U32	N/A	1	12	2	
11	Slave DSP Failure	RO	U32	N/A	1	14	2	
12	Reserve 1	RO	U16	N/A	N/A	16	1	
13	Reserve 2	RO	U16	N/A	N/A	17	1	
14	Reserve 3	RO	U16	N/A	N/A	18	1	
15	Reserve 4	RO	U16	N/A	N/A	19	1	
16	Reserve 5	RO	U16	N/A	N/A	20	1	
17	Reserve 6	RO	U16	N/A	N/A	21	1	
18	Reserve 7	RO	U16	N/A	N/A	22	1	
19	Reserve 8	RO	U16	N/A	N/A	23	1	
20	Reserve 9	RO	U16	N/A	N/A	24	1	

Table 2-8 Weather Station Register Definition

No.	Signal	Read/ Write	Type	Unit	Gain	Offset Address	Nbr	Range
1	Wind Speed	RO	I16	m/s	10	0	1	
2	Wind direction	RO	I16	°	1	1	1	
3	Photovoltaic module temperature	RO	I16	℃	10	2	1	
4	Ambient temperature	RO	I16	℃	10	3	1	
5	Total irradiance	RO	I16	W/㎡	10	4	1	
6	Daily irradiance	RO	U32	MJ/㎡	10	5	2	
7	Total irradiance2	RO	I16	W/㎡	10	7	1	
8	Daily irradiance2	RO	U32	MJ/㎡	1000	8	2	
9	Custom 1	RO	I16	N/A	10	10	1	
10	Custom 2	RO	I16	N/A	10	11	1	
11	Daily irradiance	RO	U32	kWh/	1000	12	2	
12	Daily irradiance2	RO	U32	kWh/	1000	14	2	
13	Reserved1	RO	U16	N/A	N/A	16	1	

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14	Reserved2	RO	U16	N/A	N/A	17	1	
15	Reserved 3	RO	U16	N/A	N/A	18	1	
16	Retention 4	RO	U16	N/A	N/A	19	1	
17	Retention 5	RO	U16	N/A	N/A	20	1	
18	Retention 6	RO	U16	N/A	N/A	21	1	
19	Retention 7	RO	U16	N/A	N/A	22	1	
20	Retention 8	RO	U16	N/A	N/A	23	1	
21	Retention 9	RO	U16	N/A	N/A	24	1	

3 Communication Protocol Overview

The ModBus-TCP communication protocol is divided into the following layers, which are described in layers:

3.1 Physical layer

Communication via Ethernet;
port number: 502;

3.2 Data Link Layer

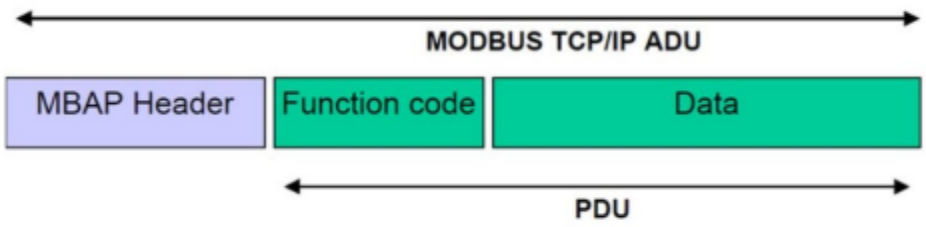
3.2.1 Addressing Mode

MODBUS-TCP data frames distinguish different devices through logical addresses, and the logical address allocation rules are shown in the table below.

The access device address is the RS485 address of the device, which can be read through the embedded Web of EzLogger.

Datalogger Local Address	Slave Node Address	Reserve
0	1~247	248~255

3.2.2 Frame structure



The maximum frame length is not greater than 256 bytes;
All frame structure definitions in this article only include function code and data;

Table 3- 1 MBAP Definition

data field	Length (Bytes)	Description	Client	Server

Transport Identifier	2	Request frame and response frame match identification	Client-side assignment, it is recommended that each data request transmission identifier is different for each frame	The identifier in the response frame on the server side must be consistent with the request frame
Protocol Type	2	0 = MODBUS protocol	Client assignment, default is 0	The identifier in the response frame on the server side must be consistent with the request frame
Data Length	2	Subsequent data length Marking area fraction own device or The number of connected Sub-device 0 EzLogger 1~247 Inverters or other device	Client allocation based on actual frames	Server assigns according to the actual frame length
Logical Device ID	1	Request frame and response frame match identification	Client allocation based on actual frames based on the actual frame request	The identifier in the server-side response frame must be consistent with the request frame.

3.2.3 Data encoding

MODBUS uses a 'big-Endian' to represent addresses and data items. This means that when sending multiple bytes, the most significant bit is sent first.

E.g:

Register size	Value
16 bits	0x1234

The first byte sent is 0x12 then 0x34

3.2.4 Interaction process

In any way, the communication process is initiated by the master node, and the slave node does not actively initiate communication.

In the unicast mode, a question-and-answer method is adopted, and the slave node responds to the command of the master node. If the master node does not receive a response from the slave node within 5 seconds, it is considered that the communication has timed out.

In the broadcast mode, the slave node only receives the command sent by the master node, and does not respond to the command frame sent by the master node.

3.3 Application layer

3.3.1 List of function codes

Table 3-2 Function Code

Function Code	Meaning	Remarks
0x03	Read register	Support single and multiple registers read continuously
0x06	Write single register	Support single register write action
0x10	Write multiple registers	Support multi-register sequential write action

3.3.2 Abnormal code list

Table 3-3 Abnormal Code List

Code	Name	Meaning
0x01	Illegal Function	The function code received in the interrogation is an unallowable operation for the server (or slave). This is probably because the function code is only applicable to the new device and is not implementable in the selected unit. It is also noted that the server (or slave) processes such a request in an error state, e.g., because it is unconfigured and requires the return of the register value.
0x02	Illegal data address	For the server (or slave), the data address received in the query is an unallowable address. In particular, the combination of reference number and transmission length is invalid. For a controller with 100 registers, a request with offset 96 and length 4 will succeed, and a request with offset 96 and length 5 will generate exception code 02.
0x03	Illegal data value	For the server (or slave), the value included in the query is an unallowable value. This value indicates a fault in the remaining structure of the combined request, e.g., the implied length is incorrect. It does not mean that, because the MODBUS protocol does not know the significance of any particular value of any particular register, the data item being submitted for storage in the register has a value other than that expected by the application.
0x06	Slave device busy	The server cannot accept MODBUS request PDUs. it is the responsibility of the client application to decide if and when to resend the request.

3.3.3 Read register (0X03)

3.3.3.1 Master node request frame format

Data Fields	Length	Description
Function Code	1 byte	0x03
Register start address	2 byte	0x0000~0xFFFF
Number of registers	2 byte	1~125

3.3.3.3 Slave node exception response frame format

Data Fields	Length	Description
Function Code	1 byte	0x83
Abnormal Code	1 byte	See 3.3.2 List of exception codes

3.3.3.4 Example

The master node sends a query (register address: 50000/0XC350) request to the slave node (logical device ID: 00).

Description	MBAP Header							Function Code	Data			
	Identifier		Protocol Type		Length		Logic ID		Register Address		Register Number	
Frame data	00	01	00	00	00	06	00	03	C3	50	00	02

Slave node normal response:

Description	MBAP							Function Code	Data				
	Identifier		Protocol Type		Length		Logic ID		Number of bytes	Register Data			
Frame data	00	01	00	00	00	07	00	03	04	00	00	00	01

Slave node abnormal response:

Description	MBAP							Function	Data
	Identifier		Protocol Type		Length		Logic ID	Code	Error Code
Frame data	00	01	00	00	00	03	00	83	03

3.3.4 Writing a single register (0X06)

3.3.4.1 Master node request frame format

Data Field	Length	Description
Function Code	1 byte	0x06
Register Address	2 byte	0x0000~0xFFFF
Register Value	2 byte	0x0000~0xFFFF

3.3.4.2 Slave node normal response frame format

Data Field	Length	Description
Function Code	1 byte	0x06
Register Address	2 byte	0x0000~0xFFFF
Register Value	2 byte	0x0000~0xFFFF

3.3.4.3 Slave node exception response frame format

Data Fields	Length	Description
Function Code	1 byte	0x86
Abnormal Code	1 byte	See 3.3.2 List of exception codes

3.3.4.4 Example

Request for the master node to send a command (register address: 20074/0X4E6A) to the slave node (address: 00).

Description	MBAP Header	Function	Data

	Identifier		Protocol Type		Length		Logic ID	Code	Register Address		Register Number	
Frame data	00	01	00	00	00	06	00	06	4E	6A	00	00

Slave node normal response:

Description	MBAP Header							Function Code	Data			
	Identifier		Protocol Type		Length		Logic ID		Register Address		Register Number	
Frame data	00	01	00	00	00	06	00	06	4E	6A	00	00

Slave node abnormal response:

Description	MBAP							Function Code	Data
	Identifier		Protocol Type		Length		Logic ID		Error Code
Frame data	00	01	00	00	00	03	00	86	04

3.3.5 Write multiple registers (0X10)

3.3.5.1 Master node request frame format

Data Field	Length	Description
Function Code	1 byte	0x10
Register Start Address	2 byte	0x0000~0xFFFF
Register Number	2 byte	0x0000~0x007b
Byte Number	1 byte	2×N
Register Value	2×N byte	Value

N is the number of registers.

3.3.5.2 Slave node normal response frame format

Data Field	Length	Description
Function Code	1 byte	0x10
Register Address	2 byte	0x0000~0xFFFF
Register Value	2 byte	0x0000~0x007b

3.3.5.3 Slave node exception response frame format

Data Fields	Length	Description
Function Code	1 byte	0x90
Abnormal Code	1 byte	See 3.3.2 List of exception codes

3.3.5.4 Example

The master node sets (register address: 20085/0X4E75) to 2 to the slave node (address: 00) and (register address: 20086/0X4E76) is set to 3, and the request frame format is as follows.

Description	MBAP Header							Function Code	Data								
	Identifier		Protocol Type		Length		Logic ID		Register Address		Register Number		Byte Number	Register Data			
Frame data	00	01	00	00	00	0B	00	10	4E	75	00	02	04	00	02	00	03

Slave node normal response:

Description	MBAP							Function Code	Data			
	Identifier		Protocol Type		Length		Logic ID		Register Address		Register Number	
Frame data	00	01	00	00	00	06	00	10	4E	75	00	02

Slave node abnormal response:

Description	MBAP							Function Code	Data
	Identifier		Protocol Type		Length		Logic ID		Error Code
Frame data	00	01	00	00	00	03	00	90	04