Modbus TCP

PSU Series

START GUIDE

ISO-9001 CERTIFIED MANUFACTURER

GW INSTEK

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Overview

This document serves as a comprehensive guide to the Modbus functions. It begins with a "Quick Guide Function Setting" chapter, offering users a straightforward method for rapid configuration.

The "Modbus TCP" chapter introduces the function codes, packet formats, and setting steps of TCP, and provides practical examples.

The "Data Type" section lists various data types used in Modbus, accompanied by examples demonstrating their application.

Finally, the "Exception Code List" chapter is dedicated to outlining the response codes for handling unexpected situations in Modbus operations.

Note

This function is a non-standard function, and the applicable firmware version must be at least V2.01 (please refer to the user manual to check the firmware version), and it needs to be activated or a license purchased before the machine leaves the factory.

For more information, please contact your local dealer or GW Instek at www.gwinstek.com/marketing@goodwill.com.tw.

Quick guide function setting

TCP
1. Connect an Ethernet cable from the network to the rear panel Ethernet port. 2. Set IP address (F-39~F-42). 3. Set Subnet Mask (F-43~F-46). 4. Set Gateway (F-47~F-50).

Note Socket server port number is 502 for Modbus master application.

Modbus TCP

Introduction

Overview

Modbus TCP messages consist of MBAP header and PDU. Different from RTU, there is no Slave address and CRC.

Modbus TCP is based on Ethernet. Modbus TCP socket port number is 502.

MBAP header

Transaction ID	Protocol ID	Length	Unit ID
Byte0,1	Byte2,3	Byte4,5	Byte6

Function code

The function codes provided for use are as follows.

Function code	Description
0x03	Read Holding Registers
0x06	Write Single Registers
0x10	Write Multiple Registers

Read Holding Registers (FC 0x03)

Request:

MBAP header	Function code	Starting registers	Number of register
Byte 0~6	Byte7	Byte8,9	Byte10,11

Response:

MBAP header	Function code	Length of data	Data
Byte 0~6	Byte7	Byte8	Byte9~259

Write Single Registers (FC 0x06)

Request:

MBAP header	Function code	Starting registers	Data
Byte 0~6	Byte7	Byte8,9	Byte10,11

Response:

MBAP header	Function code	Starting registers	Data
Byte 0~6	Byte7	Byte8,9	Byte10,11

Write Multiple Registers (FC 0x10)

Request:

MBAP header	Function code	Starting registers	Number of register	Data byte	Data
Byte 0~6	Byte7	Byte8,9	Byte10,11	Byte12	Byte13 ~259

Response:

MBAP header	Function code	Starting registers	Number of register
Byte 0~6	Byte7	Byte8,9	Byte10,11

Using Modbus TCP

Overview

Modbus TCP is based on Ethernet. Modbus TCP socket port number is 502. The Ethernet related configurations are shown as Table **Ethernet Menu** below.

Operation

1. Connect an Ethernet cable from the network to the rear panel Ethernet port.

2. Press the Function key to enter the Normal configuration settings.

Table Ethernet Menu

Menu	Function	Item
F-30	MAC Address-1	0x00~0xFF
F-31	MAC Address-2	0x00~0xFF
F-32	MAC Address-3	0x00~0xFF
F-33	MAC Address-4	0x00~0xFF
F-34	MAC Address-5	0x00~0xFF
F-35	MAC Address-6	0x00~0xFF
F-37	DHCP	0 = OFF, 1 = ON
F-39	IP Address-1	0~255
F-40	IP Address-2	0~255
F-41	IP Address-3	0~255
F-42	IP Address-4	0~255
F-43	Subnet Mask-1	0~255
F-44	Subnet Mask-2	0~255
F-45	Subnet Mask-3	0~255
F-46	Subnet Mask-4	0~255
F-47	Gateway-1	0~255
F-48	Gateway-2	0~255
F-49	Gateway-3	0~255
F-50	Gateway-4	0~255
F-51	DNS address-1	0~255
F-52	DNS address-2	0~255
F-53	DNS address-3	0~255
F-54	DNS address-4	0~255

Function check

Function check steps are as follows:

Functionality Check

1. Connect an Ethernet cable from the network to the rear panel Ethernet port.
2. Set PSU settings related to Modbus TCP (**Please refer to Table Ethernet Menu related settings)**.
3. Invoke a Modbus TCP master application.
4. Use PC application to send an ADU package to PSU (**Please refer to the Register List**).

   According to Modbus register list, we are using "Identification register" to present this function check.

MODBUS Address (Decimal)	0x01	0x03	0x05	0x06	0x10	Description	Access	Data type	Data length in byte	Number of register	Data
0		X				Identification	R	char	100	50	ASCII

Function Code: 0x03
Start Address: 0
Number of Register: 50

The request packets of MBAP header and ADU are as follows:

MBAP header	Function code	Starting registers	Number of register
Byte 0~6	Byte7	Byte8,9	Byte10,11
0x00 0x18 (Transaction ID) 0x00 0x00 (Protocol ID) 0x00 0x06(Length) 0x00 (Unit ID)	0x03	0x00 0x00	0x00 0x32
MBAP header	Read Holding Registers	Registers address	Account for 50 registers

5. And instrument will Response:

MBAP header	Function code	Length of data	Number of register
Byte 0~6	Byte7	Byte8	Byte9~259
0x00 0x18 (Transaction ID) 0x00 0x00 (Protocol ID) 0x00 0x06(Length) 0x00 (Unit ID)	0x03	0x00 0x64	0x47 0x57 0x2D 0x49 0x4E 0x53 … 0x00 0x00 0x00
MBAP header	Read Holding Registers	100 byte	GW-INSTEK …

Data Type

Overview

This chapter will introduce the data package format of each data type and provide data type examples for reference. The following are the types of data provided:

Char	Uint16	Uint32	Float
1 Byte	2 Byte	4 Byte	4 Byte

Char

Examples of character data types are as follows:

This example is to read the identification data, refer to Register List as shown below:

MODBUS Address (Decimal)	0x01	0x03	0x05	0x06	0x10	Description	Access	Data type	Data length in byte	Number of register	Data
0		X				Identification	R	char	100	50	ASCII

The read identification function code is 0x03, the starting register is 0, and the number of registers is 50.

Based on the above, the requested PDU is as follows:

Function code	Starting registers	Number of register
0x03	0x00 0x00	0x00 0x32
Read	0 (Identification)	50 register (100 byte)

Response PDU:

Function code	Length of data	Data
0x03	0x64	0x47 0x57 0x2D 0x49 0x4E 0x53 ... 0x00 0x00 0x00
Read	100 byte	GW-INSTEK...

Uint16

There are two value types of Uint16:

Normal value

This example is to read/write the Buzzer control, refer to Register List as shown below:

MODBUS Address (Decimal)	0x01	0x03	0x05	0x06	0x10	Description	Access	Data type	Data length in byte	Number of register	Data
801		X		X		Buzzer ON/OFF control	R/W	uint(16)	2	1	

The starting register for read/write buzzer control is 801, and the number of registers is 1.

Based on the above, the PDU is as follows:

Write

Request PDU:

Function code	Starting registers	Data
0x06	0x03 0x21	0x00 0x01
Write	801(Buzzer on/ off)	Buzzer on

Response PDU:

Function code	Starting registers	Data
0x06	0x03 0x21	0x00 0x01
Write	801(Buzzer on/off)	Buzzer on

Read

Request PDU:

Function code	Starting registers	Number of register
0x03	0x03 0x21	0x00 0x01
Read	801(Buzzer on/ off)	One register

Response PDU:

Function code	Length of data	Data
0x03	0x02	0x00 0x01
Read	2 byte	Buzzer on

Percent value

The percent value conversion formula is as follows:

Real value
= Nominal value * percent value/ 52428
Percent value = 52428 * Nominal/Rated value

This example is to read/write the Voltage Setting, refer to Register List as shown below:

MODBUS Address (Decimal)	0x01	0x03	0x05	0x06	0x10	Description	Access	Data type	Data length in byte	Number of register	Data
3800		X		X		Voltage Setting (DC)	R/W	uint(16)	2	1	

The starting register for read/write Voltage Setting is 3800, and the number of registers is 1.

Based on the above, the PDU is as follows:

Write

Request PDU:

Function code	Starting registers	Data
0x06	0x0E 0xD8	0x66 0x66
Write	3800 (Voltage Setting)	26214 (Percent value)

Response PDU:

Function code	Starting registers	Data
0x06	0x0E 0xD8	0x66 0x66
Write	3800 (Voltage Setting)	26214 (Percent value)

For PSU 100-15:

Nominal Voltage: 100V

Percent value: 26214

Voltage setting (real value)
= 100 * 26214 / 52428 = 50V

Read

Request PDU:

Function code	Starting registers	Number of register
0x03	0x0E 0xD8	0x00 0x01
Read	3800(Voltage Setting)	One register

Response PDU:

Function code	Length of data	Data
0x03	0x02	0x66 0x66
Read	2 byte	26214 (Percent value)

Uint32

Examples of Uint32 data types are as follows:

This example is the reading/writing of the output delay time, refer to Register List as shown below:

MODBUS Address (Decimal)	0x01	0x03	0x05	0x06	0x10	Description	Access	Data type	Data length in byte	Number of register	Data
4200		X			X	Output ON delay time	R/W	uint(32)	4	2	

The starting position of the register for the read and write output delay time is 4200, and the number of registers is 2.

Based on the above, the PDU is as follows:

Write

Request PDU:

Function code	Starting registers	Number of register	Length of data	Data
0x10	0x10 0x68	0x00 0x02	0x04	0x00 0x00 0x00 0x64
Write	4200 (Output on delay)	2 register	4 byte	100 (1sec)

Response PDU:

Function code	Starting registers	Number of register
0x10	0x10 0x68	0x00 0x02
Write	4200 (Output on delay)	2 register

Read

Request PDU:

Function code	Starting registers	Number of register
0x03	0x10 0x68	0x00 0x02
Read	4200 (Output on delay)	2 register

Response PDU:

Function code	Length of data	Data
0x03	0x04	0x00 0x00 0x00 0x64
Read	4 byte	100 (1sec)

Float

Examples of float data types are as follows:

This example is the reading/writing of the rising voltage slew rate, refer to Register List as shown below:

MODBUS Address (Decimal)	0x01	0x03	0x05	0x06	0x10	Description	Access	Data type	Data length in byte	Number of register	Data
3901		X			X	Rising voltage slew rate	R/W	float	4	2	IEEE 754

The starting position of the register for the read and write rising voltage slew rate is 3901, and the number of registers is 2 (The arithmetic standard for floating is IEEE 754).

Based on the above, the PDU is as follows:

Write

Request PDU:

Function code	Starting registers	Number of register	Length of data	Data
0x10	0x0F 0x3D	0x00 0x02	0x04	0x3D 0xCC 0xCC 0xCD
Write	3901 (Rising voltage slew rate)	2 register	4 byte	0.1 V/sec

Response PDU:

Function code	Starting registers	Number of register
0x10	0x0F 0x3D	0x00 0x02
Write	3901(Rising voltage slew rate)	2 register

Read

Request PDU:

Function code	Starting registers	Number of register
0x03	0x0F 0x3D	0x00 0x02
Read	3901(Rising voltage slew rate)	2 register

Response PDU:

Function code	Length of data	Data
0x03	0x04	0x3D 0xCC 0xCC 0xCD
Read	4 byte	0.1 V/sec

Exception Code List

List

Exception Code	Name	Description
01 (0x01)	Illegal function	The function code received in the request is not an authorized action for the slave. The slave may be in the wrong state to process a specific request.
02 (0x02)	Illegal data address	The data address received by the slave is not an authorized address for the slave.
03 (0x03)	Illegal data value	The value in the request data field is not an authorized value for the slave.
04 (0x04)	Slave device failure	The slave fails to perform a requested action because of an unrecoverable error.
05 (0x05)	Acknowledge	The slave accepts the request but needs a long time to process it.
06 (0x06)	Slave device busy	The slave is busy processing another command. The master must send the request once the slave is available.
08 (0x08)	Memory parity error	The slave detects a parity error in the memory when attempting to read extended memory.
10 (0x0A)	Gateway path unavailable	The gateway is overloaded or not correctly configured.
11 (0x0B)	Gateway target device failed to respond	The slave is not present on the network.

Example

Suppose we want to read the data of Rising voltage slew rate, but the number of register is incorrectly.

MODBUS Address (Decimal)	0x01	0x03	0x05	0x06	0x10	Description	Access	Data type	Data length in byte	Number of register	Data
3901		X			X	Rising voltage slew rate	R/W	float	4	2	IEEE 754

Request PDU:

Function code	Starting registers	Number of register
0x03	0x0F 0x3D	0x00 0x01
Read	3901(Rising voltage slew rate)	2 register

Then we will receive the following response:

Response PDU:

Function Code in Exception Response	Exception Code
0x83	0x02
1000 0011	Illegal data address

When an exception occurs, the highest bit of the Function code will be set to 1 and returned. So the original function code 0000 0011 becomes 1000 0011.

According to the Exception Code List, the description of 0x02 is as follows:

The data address received by the slave is not an authorized address for the slave.

Register List

	MODBUS Address (Decimal)	0x01	0x03	0x05	0x06	0x10	Description	Access	Data type	Data length in byte	Number of register	Data	Example or description
Information													
Information	0		X				Identification	R	char	100	50	ASCII	
	50		X				Nominal Voltage	R	float	4	2	IEEE 754	PSU 100-15:Nominal Voltage Value=100(V)
	52		X				Nominal Current	R	float	4	2	IEEE 754	PSU 100-15:Nominal Current Value=15(A)
	54		X				Nominal Power	R	float	4	2	IEEE 754	PSU 100-15:Nominal Power Value=1500(W)
System													
Normal	800		X		X		Lock Mode	R/W	uint(16)	2	1		0:Lock Panel, Allow Output OFF 1:Lock Panel, Allow Output ON/OFF
	801		X		X		Buzzer ON/OFF control	R/W	uint(16)	2	1		Bit0: Buzzer 0 = OFF, 1 = ON
	802		X		X		Memory Recall Display	R/W	uint(16)	2	1		Display memory parameter when recalling M1, M2, M3) 0 = OFF, 1 = ON
DC source	900		X		X		Bleeder circuit control	R/W	uint(16)	2	1		0 = OFF , 1 = ON , 2 = AUTO
	901		X		X		CV Control	R/W	uint(16)	2	1		0 = Control by Local 1 = Control by External Voltage 2 = Control by External Resistor Rising 3 = Control by External Resistor Falling 4 = Control by Isolated Board
	902		X		X		CC Control	R/W	uint(16)	2	1		0 = Control by Local 1 = Control by External Voltage 2 = Control by External Resistor Rising 3 = Control by External Resistor Falling 4 = Control by Isolated Board
	903		X		X		External Output Logic	R/W	uint(16)	2	1		0 = High ON, 1 = Low ON
	904		X			X	Internal Resistance Setting	R/W	float	4	2	IEEE 754	
Status													
Status	2800		X		X		Status Questionable Condition	R/W	uint(16)	2	1		
	2801		X		X		Status Operation Condition	R/W	uint(16)	2	1		
DC Source													
Normal	3800		X		X		Voltage Setting (DC)	R/W	uint(16)	2	1		This value is percent value.(Note 1)
	3801		X		X		Current Setting (DC)	R/W	uint(16)	2	1		This value is percent value.(Note 1)
	3803		X		X		DC Output	R/W	uint(16)	2	1		
Voltage	3900		X		X		Voltage Setting Limit (V Limit)	R/W	uint(16)	2	1		
	3901		X			X	Rising voltage slew rate	R/W	float	4	2	IEEE 754	
	3903		X			X	Falling voltage slew rate	R/W	float	4	2	IEEE 754	
	3905		X			X	Apply Voltage Setting on Trigger	R/W	float	4	2	IEEE 754	0 ~ rated voltage
Current	4000		X		X		Current Setting Limit (I Limit)	R/W	uint(16)	2	1		
	4001		X			X	Rising current slew rate	R/W	float	4	2	IEEE 754	
	4003		X			X	Falling current slew rate	R/W	float	4	2	IEEE 754	
	4005		X			X	Apply Current Setting on Trigger	R/W	float	4	2	IEEE 754	0 ~ rated current
Output	4200		X			X	Output ON delay time	R/W	uint(32)	4	2		data = 100, time = 1S
	4202		X			X	Output OFF delay time	R/W	uint(32)	4	2		data = 100, time = 1S
	4204		X		X		V-I mode slew rate select	R/W	uint(16)	2	1		0 = CV high speed priority (CVHS) 1 = CC high speed priority (CCHS) 2 = CV slew rate priority (CVLS) 3 = CC slew rate priority (CCLS)
	4205		X		X		Power-ON Output	R/W	uint(16)	2	1		0 = Safe Mode (Output OFF at startup) 1 = Force Mode (Output ON at startup) 2 = Auto Mode (Status before last time Power OFF
	4206		X		X		Output State When Receiving Trigger	R/W	uint(16)	2	1		0 = OFF, 1 = ON
Protection	4300		X		X		OVP	R/W	uint(16)	2	1		This value is percent value.(Note 1)
	4301		X		X		OCP	R/W	uint(16)	2	1		This value is percent value.(Note 1)
	4302		X		X		UVL	R/W	uint(16)	2	1		This value is percent value.(Note 1)
	4303		X			X	Detection Time of OCP (OCP Delay Time)	R/W	uint(32)	4	2		data = 1000, time = 1S
Measurement	4305		X		X		Alarm Recovery and Output Status	R/W	uint(16)	2	1		0 = Safe Mode, 1 = Force Mode
	4400		X				Measure Voltage	R	uint(16)	2	1		This value is percent value.(Note 1)
	4401		X				Measure Current	R	uint(16)	2	1		This value is percent value.(Note 1)
	4402		X				Measure Power	R	uint(16)	2	1		This value is percent value.(Note 1)
	4403		X		X		Measurement Average Setting	R/W	uint(16)	2	1		0 = Low, 1 = Middle, 2 = High
	4404		X				Measure Voltage (High resolution)	R	float	4	2	IEEE 754	
	4406		X				Measure Current (High resolution)	R	float	4	2	IEEE 754	
	4408		X				Measure Power (High resolution)	R	float	4	2	IEEE 754	
Trigger	4500				X		Trigger Output(Software Trigger)	W	uint(16)	2	1		Set any value = Generates an immediate trigger for the output trigger system.
	4501		X		X		Trigger Output Source(Software Trigger)	R/W	uint(16)	2	1		0 = BUS:Output trigger is generated by the bus. 1 = IMMediate:Output trigger is immediately generated. 2 = EXTernal:The output trigger is generated when an external signal triggers it.
	4502				X		Trigger Transient(Software Trigger)	W	uint(16)	2	1		Set any value = Generates an immediate trigger for the transient trigger system.
	4503		X		X		Trigger Transient Source(Software Trigger)	R/W	uint(16)	2	1		0 = BUS:Transient trigger is generated by the bus. 1 = IMMediate:Transient trigger is immediately generated. 2 = EXTernal:The transient trigger is generated when an external signal triggers it.
	4504		X			X	Trigger Input Pulse Width	R/W	uint(32)	4	2		0~60ms. 0 = trigger controlled by trigger level.
	4506		X		X		Trigger Input Action	R/W	uint(16)	2	1		0 = None 1 = Output ON/OFF 2 = Setting 3 = Memory
	4507		X			X	Trigger Output Pulse Width	R/W	uint(32)	4	2		0 ~ 60ms. 0 = trigger output is set to the active level, not pulse width.
	4509		X		X		Trigger Output Level	R/W	uint(16)	2	1		0 = LOW, 1 = HIGH
	4510		X		X		Trigger Source	R/W	uint(16)	2	1		0 = None 1 = Switching the output on or off 2 = Changing a setting 3 = Recalling a memory
	4511		X		X		Recall memory number	R/W	uint(16)	2	1		0 ~ 2 (M1 ~ M3)
Interface													
UART	12901		X			X	UART Baud Rate	R/W	uint(32)	4	2		
	12903		X		X		UART Data Bits	R/W	uint(16)	2	1		0 = 7bit, 1 = 8bit
	12904		X		X		UART Parity	R/W	uint(16)	2	1		0 = none, 1 = odd, 2 = even
	12905		X		X		UART Stop Bit	R/W	uint(16)	2	1		0 = bit, 1 = 2bit
	12906		X				UART TCP	R	uint(16)	2	1		0 = SCPI, 1= LEGACY, 2 = MODBUS-RTU
	12907		X				UART Address	R	uint(16)	2	1		
USB	13000		X				Front panel USB State	R	uint(16)	2	1		
	13001		X				Rear panel USB State	R	uint(16)	2	1		
GPIB	13100		X		X		GPIB address	R/W	uint(16)	2	1		
	13102		X				Show GPIB available status	R	uint(16)	2	1		
	13103		X		X		GPIB Enable/Disable	R/W	uint(16)	2	1		0 = Disable GPIB, 1 = Enable GPIB
Ethernet	13200		X				MAC Address	R	uint(16)	6	3	Bytes 0 - 5: 0..255	
	13204		X		X		DHCP	R/W	uint(16)	2	1		
	13205		X			X	IP Address	R/W	uint(16)	4	2	Bytes 0 - 3: 0..255	
	13207		X			X	Subnet Mask	R/W	uint(16)	4	2	Bytes 0 - 3: 0..255	
	13209		X			X	Gateway	R/W	uint(16)	4	2	Bytes 0 - 3: 0..255	
	13211		X			X	DNS address	R/W	uint(16)	4	2	Bytes 0 - 3: 0..255	
	13216		X		X		Web password active	R/W	uint(16)	2	1		0 = Disable, 1 = Enable
	13217		X		X		Web setting password	R/W	uint(16)	2	1		0000~9999

Note 1

Real value = Nominal value * percent value/52428

Example 1

For PSU 100-15
Nominal Voltage : 100V
Assume voltage setting(percent value) : 26214

voltage setting(real value) = 100 * 26214/52428

= 50V