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Modular Power Conditioning System CAN/Modbus RS485 Manual

TE-PCS-100K-HM、TE-PCS-150K-HM
TE-PCS-175K-HM、TE-PCS-200K-HM

Version 01

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01 CAN communication

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1.Overview

1.1. Protocol Intro

This document describes the CAN communication between the TE-PCS-FM series and the Battery Management System (BMS).

1.2. Application Scope

This agreement applies to CAN communication between Teco's TE-PCS-FM series units and the Battery Management System (BMS).
This agreement applies to CAN communication.

2.Physics Layer

2.1. Port Definition

The PCS and BMS adopts CAN communication port.

2.2. Communication Configuration

- Baud rate: 250kbps
- Data bit: 8 bits
- Frame type: CAN extension frame

2.3. Communication Configuration

This protocol is appropriate for the communication of no host and slave, PCS and BMS send data to bus separately, communication cycle is 200ms. The data format adopts low byte front, high byte behind.

3.3. Protocol Basic Frame Format

3.1. CAN ID Definition

CAN ID definition: the 8 high bits are for the address definition of PCS, the 8 low bits are function code, they are used to distinguish the PCS request frame and BMS send frame. The detailed definition is as follows.

CAN ID (16 Bit)		Function
Address 8 high bits (hexadecimal)	Function code 8 low bits (hexadecimal)	
41 + ADDR	00	PCS request frame
41 + ADDR	10	BMS send frame 1 (battery pack total voltage, battery pack total current, SOC, SOH)
41 + ADDR	11	BMS send frame 2 (charge limited current, discharge limited current, charge limited voltage, discharge limited voltage)
41 + ADDR	12	BMS send frame 3 (available charged energy, available discharged energy, BMS status word, reserved)

NOTE

The PCS whose address is 1, sends request frame, the CAN ID is 4200.The PCS whose address is 2, sends request frame, the CAN ID is 4310.

3.2. Data Frame Details Illustration

3.2.1. Request Frame Format

- Function code：00

Byte	Signal name	Ratio	Offset	Unit	Remark
Byte 0	0x55				
Byte 1					
Byte 2	Battery voltage	0.1		V	optional
Byte 3					
Byte 4	PCS status word				optional Details refer to PCS status word bit definition
Byte 5					
Byte 6	0				
Byte 7					

3.2.2. Response Frame Format

- Function code：10

Byte	Signal name	Ratio coefficient	Offset	Unit	Remark
Byte 0 Byte 1	Total voltage of battery pack	0.1	2000	V	
Byte 2 Byte 3	Total current of battery pack	0.1		A	Example: D8 59 means the total current of battery pack is 300.0A (discharge); 68 42 means that total current of battery group is -300.0A (charge)
Byte 4 Byte 5	SOC	0.1		%	
Byte 6 Byte 7	SOH	0.1		%	

- Function code：11

Byte	Signal name	Ratio coefficient	Offset	Unit	Remark
Byte 0 Byte 1	Charge limited current	0.1		A	
Byte 2 Byte 3	Discharge limited current	0.1		A	
Byte 4 Byte 5	Charge limited voltage	0.1		V	
Byte 6 Byte 7	Discharge limited voltage	0.1		V	

- Function code：12

Byte	Signal name	Ratio coefficient	Offset	Unit	Remark
Byte 0 Byte 1	Available charged energy	0.1		kWh	
Byte 2 Byte 3	Available discharged energy	0.1		kWh	
Byte 4 Byte 5	BMS status word				Details please refer to BMS Status word bit definition
Byte 6	Cell min. voltage	0.001		V	optional

- PCS status word bit definition

Bit information	Data length	Data definition	Illustration
Bit 0~Bit 3	4 Bit	PCS running status	0- Halt 1- Standby 2- Fault 3- Charge 4- Discharge 5- Charge derating 6- Discharge derating
Bit 4	1 Bit	PCS with AC power or not	0- without AC power 1- with AC power
Bit 5~Bit 15	3 Bit	Undefined	Reserved word

- BMS status word bit definition

Bit	Data length	Data definition	Illustration
Bit 0~Bit 3	4 Bit	reserved	
Bit 4~Bit 6	3 Bit	BMS system status	00：Initial 01：Normal 02：Charge disabled 03：Discharge disabled 04：Alarm 05：Fault 06：Standby 07(optional): Forced charge
Bit 7~Bit 11	3 Bit	Undefined	Reserved word
Bit 12~Bit 15	4 Bit	BMS lifespan signal	0~15：lifespan signal

Remark

Charge disabled (BMS status word)

- Description: it is forbidden to charge the battery, but allowed to discharge.
- PCS action: when PCS works in grid-tied or off-grid mode, if it stays in charging status, PCS will stop charging; if it stays in discharging status, PCS will not be affected and can discharge normally.

Discharge disabled (BMS status word)

- Description: it is forbidden to discharge the battery, but allowed to charge.
- PCS action: when PCS works in grid-tied mode, if it stays in discharging status, it will stop discharging; if it stays in charging status, PCS will not be affected and can charge normally. When PCS works in off-grid mode, it will stop running.

02

TE-PCS-HM

Modbus RS485 Manual

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1.Overview

1.1. Protocol Intro

This document introduces the monitor protocol connected via RS485, Ethernet port of three-phase power conversion system. The protocol complies with standard Modbus specification.

1.2. Application Scope

This agreement applies to host communication of Teco's TE-PCS-HM series units.

1.3. Related Terms and Description

Name	Description
Host	The part that initiatively start to communicate
Slave	The part that passively respond the command
UINT16	Unsigned integer of 16 bit. High byte front, low byte behind
UINT32	Unsigned integer of 32 bit. High byte front, low byte behind
INT16	Signed integer of 16 bit. High byte front, low byte behind
INT32	Signed integer of 32 bit. High byte front, low byte behind
String	Character string that every byte marked by ASCII
MLB	Multibyte
Bitfield16	The data that with 16-bit width and shows by bit. High byte front, low byte behind
RW	The register that can be read and written
RO	The register that can be read only

1.4. Communication Configuration

This protocol is suitable for RS485 and Ethernet communication mode.

Table1-1 Communication configuration of RS485 port

Name	Description
Transmission mode	RTU
Baud rate	Default is 9600bps, and it can be set to 4800bps, 9600bps, 19200bps, 38400bps
Start bit	1bit
Data bit	8bits
Parity bit	None
Stop bit	1bit
Frame interval	Not less than the transmission time of 3.5 bytes
Intra-frame character interval	Not larger than the transmission time of 1.5 bytes
Max. frame length	200 bytes
Max. response time of the slave	The transmission time of 150 bytes
Min. polling interval of the host	The transmission time of 200 bytes

Table1-2 Communication Configuration of Ethernet Port

Name	Description
Transmission mode	TCP/IP
Baud rate	10M/100M
Port ID	502
Max. response time of the slave	100ms
Min. polling interval of the host	100ms
IP	Default: 192.168.28.240
Subnet mask	Default: 255.255.255.0
Gateway	Default: 192.168.28.1

2. Register Definition

2.1. Input Register Definition

Operation way: read: 0x04

Register address	Meaning	Byte quantity	Data type	Read & write	Remark
4800-4809	Device model	20	String	RO	
4810-4819	Reserved	2*10			
4820-4824	HMI software version	10	String	RO	
4825-4834	Device S/N	20	String	RO	
4835-4849	Reserved	2*5			
4850	Device type	2	UINT16	RO	20-three-phas power conversion system
4851	Reserved	2			
4852	Protocol type	2	UINT16	RO	2-Three-phase centralized power Conversion system protocol 3-Three-phase modular power conversion system protocol

Register address	Meaning	Byte quantity	Data type	Read & write	Remark
4853-4857	Protocol version	10	String	RO	V3.03
4858-4872	Manufacturer info	30	String	RO	
4873-4874	Reserved	2*2			
4875-4884	Device S/N	2*12	String	RO	
4885-4889	Control software 1 version of unit 1	10	String	RO	
4890-4894	Control software 2 version of unit 1	10	String	RO	
4895-4899	Control software 3 version of unit 1	10	String	RO	
4900-4904	Control software 4 version of unit 1	10	String	RO	
4905-4909	Control software 5 version of unit 1	10	String	RO	
4910-4914	Control software 6 version of unit 1	10	String	RO	
4915-4919	Hardware 1 version of unit 1	10	String	RO	
4920-4924	Hardware 2 version of unit 1	10	String	RO	
4925-4929	Hardware 3 version of unit 1	10	String	RO	
4930-4934	Hardware 4 version of unit 1	10	String	RO	

4935-4984	Software & hardware version of unit 2	2*50			
4985-5034	Software & hardware version of unit 3	2*50			
5035-5084	Software & hardware version of unit 4	2*50			
5085-5134	Software & hardware version of unit 5	2*50			
5135-5184	Software & hardware version of unit 6	2*50			
5185	Rated power	2	UINT16	RO	1kW
5186	Max.apparent power (max. scheduling value)	2	UINT16	RO	1kVA
5187	Max. active power (max. scheduling value)	2	UINT16	RO	1kW
5188	Max. eactive ower (max. scheduling value)	2	UINT16	RO	1kVar
5189	Min. power factor (min. scheduling value)	2	UINT16	RO	0.01

2.2. Holding Resister Definition

Operation way: read function code: 0x03; write single register function code: 0x06; write multi registers function code: 0x10

2.2.1. System Info

Register address	Meaning	Byte quantity	Data type	Read & write	Remark
7000	Running status	2	UINT16	RO	0-Halt (no fault and the contactor is disconnected); 1-Standby (no fault and the contactor is closed, and with no charge/discharge power); 2-Fault (with fault, the contactor is disconnected); 3-Charge (stay in charging status); 4-Discharge (stay in discharging status); 5-Charge derating (stay in charging status, derating for over-temperature); 6-Discharge derating (stay in discharging status, derating for over-temperature)

Register address	Meaning	Byte quantity	Data type	Read & write	Remark
7001-7002	System apparent power	4	UINT32	RO	1VA
7003-7004	System active power	4	INT32	RO	1W
7005-7006	System reactive power	4	INT32	RO	1Var
7007-7009	Reserved	2*3	UINT32	RO	
7010	Power factor	2	INT16	RO	0.01
7011	System output U current	2	UINT16	RO	0.1A
7012	System output V current	2	UINT16	RO	0.1A
7013	System output W current	2	UINT16	RO	0.1A
7014-7015	Day charged	4	UINT32	RO	0.1kWh
7016-7017	Day discharged	4	UINT32	RO	0.1kWh
7018-7019	Total charged	4	UINT32	RO	1kWh
7020-7021	Total discharged	4	UINT32	RO	1kWh
7022	AC side charge active power	2	INT16	RO	1kW
7023	AC side capacitive reactive power	2	UINT16	RO	1kVar

Register address	Meaning	Byte quantity	Data type	Read & write	Remark
7024	AC side discharge active power	2	INT16	RO	1kW
7025	AC side inductive reactive power	2	UINT16	RO	1kVar
7026	Max. capacitive reactive power capacity	2	INT16	RO	1kVar
7027	Max. inductive reactive power capacity	2	INT16	RO	1kVar
7028	Max. chargeable power	2	INT16	RO	1kW
7029	Max. dischargeable power	2	INT16	RO	1kW
7030	AC switch status	2	UINT16	RO	0-OFF; 1-ON
7031	DC switch status	2	UINT16	RO	0-OFF; 1-ON
7032	Remote input/exit status	2	UINT16	RO	0-Exit; 1-Input
7033-7199	Reserved	2*167			

Register address	Signal name	Byte quantity	Data type	Read & write	Remark/unit
7215	Alarm 16 of unit 1	2	Bitfield16	RO	
7216	Grid U/UV voltage of unit 1	2	UINT16	RO	0.1V
7217	Grid V/VW voltage of unit 1	2	UINT16	RO	0.1V
7218	Grid W/WU voltage of unit 1	2	UINT16	RO	0.1V
7219	Output U current of unit 1	2	UINT16	RO	0.1A
7220	Output V current of unit 1	2	UINT16	RO	0.1A
7221	Output W current of unit 1	2	UINT16	RO	0.1A
7222-7223	Apparent power of unit 1	4	UINT32	RO	1VA
7224-7225	Active power of unit 1	4	INT32	RO	1W
7226-7227	Reactive power of unit 1	4	INT32	RO	1Var
7228	Power factor of unit 1	2	INT16	RO	0.01
7229	DC voltage of unit 1	2	UINT16	RO	0.1V

Register address	Signal name	Byte quantity	Data type	Read & write	Remark/unit
7230	DC current of unit 1	2	INT16	RO	0.1A
7231-7232	DC power of unit 1	4	INT32	RO	1W
7233	Frequency of unit 1	2	UINT16	RO	0.01Hz
7234	Inner temperature of unit 1	2	INT16	RO	0.1℃
7235	Phase-U IGBT temperature of unit 1	2	INT16	RO	0.1℃
7236	Phase-V IGBT temperature of unit 1	2	INT16	RO	0.1℃
7237	Phase-W IGBT temperature of unit 1	2	INT16	RO	0.1℃
7238	On-grid/off-grid status of unit 1	2	UINT16	RO	0- Grid-tied; 1- Off-grid; 2-VSG; 3-Grid forming; 4-Auto grid-tied/off-grid
7239	Available power of unit 1	2	UINT16	RO	0.1kVA
7240	Total load ratio of unit 1	2	UINT16	RO	0.1%

Register address	Signal name	Byte quantity	Data type	Read & write	Remark/unit
7241	AC residual current of unit 1	2	UINT16	RO	0.1mA
7242	Insulation resistance of unit 1	2	UINT16	RO	0.1kΩ
7243-7299	Unit 1 reserved	2*57			
7300-7399	Info of unit 2	2*100			The same as unit 1
7400-7499	Info of unit 3	2*100			The same as unit 1
7500-7599	Info of unit 4	2*100			The same as unit 1
7600-7699	Info of unit 5	2*100			The same as unit 1
7700-7799	Info of unit 6	2*100			The same as unit 1
7800	ON/OFF	2	UINT16	RW	0- OFF; 1-ON
7801	Auto-start when power on	2	UINT16	RW	0-Disable; 1-Enable
7802	Grid rated frequency	2	UINT16	RW	0-50Hz; 1-60Hz

Register address	Signal name	Byte quantity	Data type	Read & write	Remark/unit
7803	H/LVRT	2	UINT16	RW	0-Disable; 1-Enable (Reactive Support Mode); 2- Enable (Zero Current Mode)
7804	Active islanding	2	UINT16	RW	0-Disable; 1-Enable
7805	Run according to plan curve	2	UINT16	RW	0- Off; 1- On
7806	System running mode	2	UINT16	RW	0-Constant power; 1-Constant current
7807	Active power control	2	UINT16	RW	0-Disable; 1-Enable
7808	Reactive power running mode	2	UINT16	RW	0-Constant reactive power; 1- Constant power factor
7809	Reactive power control	2	UINT16	RW	0-Disable; 1-Enable
7810	Power factor control	2	UINT16	RW	0-Disable; 1-Enable
7811	Active power	2	INT16	RW	1kW
7812	Reactive power	2	INT16	RW	1kVar

Register address	Signal name	Byte quantity	Data type	Read & write	Remark/unit
7813	Power factor	2	INT16	RW	0.01
7814	Current of constant current mode	2	INT16	RW	0.1A
7815-7816	Power prestart rate	4	UINT32	RW	0.01%/s, it is the power change rate during operating.
7817-7818	ON/OFF prestart rate	4	UINT32	RW	0.01%/s, it is the power change rate during ON/OFF.
7819	Reserved	2	UINT16	RW	
7820	Recover grid-tied	2	UINT16	RW	0- Not recover; 1- recover. It is only valid when the Grid abnormal auto-recover is disabled and the gridrecover normal from abnormal status.
7821	Grid abnormal auto-recover	2	UINT16	RW	0-Disable; 1-Enable
7822	SVG function	2	UINT16	RW	0-Disable; 1-Enable
7823	Anti-PID function	2	UINT16	RW	0-Disable; 1-Enable
7824	Fault recovery time	2	UINT16	RW	1s

Register address	Signal name	Byte quantity	Data type	Read & write	Remark/unit
7825	DC voltage of constant voltage mode	2	UINT16	RW	0.1V
7826	Discharge locked time	2	UINT16	RW	1s
7827-7849	Reserved	2*23			
7850-7855	System time-year	6*2	MLB	RW	The register 7850-7855 must be written at one time, or the setting will be invalid. e.g.: set the system time to 2020/1/514:15:30, the register 7850-7855 must be written 0x07E4 0x0001 0x0005 0x000E 0x000F 0x001E at one time.
	System time-month				
	System time-day				
	System time-hour				
	System time-minute				
	System time-second				
7856-7863	Reserved	2*8			
7864	Plan curve-period quantity	2	UINT16	RW	The register 7864-7896 must be written at one time, or the setting will be invalid.
7865	Plan curve-start tim of period 1	2	UINT16	RW	High byte - hour Low byte - minute

Register address	Signal name	Byte quantity	Data type	Read & write	Remark/unit
7866	Plan curve-ending time of period 1	2	UINT16	RW	High byte - hour Low byte - minute
7867	Plan curve- start time of period 2	2	UINT16	RW	High byte – hour Low byte - minute
7868	Plan curve- ending time of period 2	2	UINT16	RW	High byte - hour Low byte - minute
7869	Plan curve- start time of period 3	2	UINT16	RW	High byte - hour Low byte - minute
7870	Plan curve- ending time of period 3	2	UINT16	RW	High byte - hour Low byte - minute
7871	Plan curve- start time of period 4	2	UINT16	RW	High byte - hour Low byte - minute
7872	Plan curve- ending time of period 4	2	UINT16	RW	High byte - hour Low byte - minute
7873	Plan curve- start time of period 5	2	UINT16	RW	High byte - hour Low byte - minute
7874	Plan curve- ending time of period 5	2	UINT16	RW	High byte - hour Low byte - minute
7875	Plan curve- start time of period 6	2	UINT16	RW	High byte - hour Low byte - minute
7876	Plan curve- ending time of period 6	2	UINT16	RW	High byte – hour Low byte - minute
7877	Plan curve- start time of period 7	2	UINT16	RW	High byte - hour Low byte - minute
7878	Plan curve- ending time of period 7	2	UINT16	RW	High byte - hour Low byte - minute
7879	Plan curve- start time of period 8	2	UINT16	RW	High byte - hour Low byte - minute

Register address	Signal name	Byte quantity	Data type	Read & write	Remark/unit
7880	Plan curve- ending time of period 8	2	UINT16	RW	High byte - hour Low byte - minute
7881	Plan curve-active power of period 1	2	INT16	RW	1kW
7882	Plan curve-reactive power of period 1	2	INT16	RW	1kvar
7883	Plan curve-active power of period 2	2	INT16	RW	1kW
7884	Plan curve-reactive power of period 2	2	INT16	RW	1kvar
7885	Plan curve- active power of period 3	2	INT16	RW	1kW
7886	Plan curve- reactive power of period 3	2	INT16	RW	1kvar
7887	Plan curve- active power of period 4	2	INT16	RW	1kW
7888	Plan curve- reactive power of period 4	2	INT16	RW	1kvar
7889	Plan curve- active power of period 5	2	INT16	RW	1kW
7890	Plan curve- reactive power of period 5	2	INT16	RW	1kvar
7891	Plan curve- active power of period 6	2	INT16	RW	1kW
7892	Plan curve- reactive power of period 6	2	INT16	RW	1kvar
7893	Plan curve- active power of period 7	2	INT16	RW	1kW

Register address	Signal name	Byte quantity	Data type	Read & write	Remark/unit
7894	Plan curve- reactive power of period 7	2	INT16	RW	1kvar
7895	Plan curve- active power of period 8	2	INT16	RW	1kW
7896	Plan curve- reactive power of period 8	2	INT16	RW	1kvar
7900	On-grid/off-grid mode of unit 1	2	UINT16	RW	0-Grid-tied; 1-Off-grid; 2-VSG; 3-Grid forming; 4=Auto grid-tied/off-grid
7901	Single/Parallel mode	2	UINT16	RW	0-Single; 1-Parallel
7902-7919	Reserved	2*18			
7920-7939	Parameter setting of unit 2	2*20			Reference unit 1
7940-7959	Parameter setting of unit 3	2*20			Reference unit 1
7960-7979	Parameter setting of unit 4	2*20			Reference unit 1
7980-7999	Parameter setting of unit 5	2*20			Reference unit 1
8000-8019	Parameter setting of unit 6	2*20			Reference unit 1

2.2.2. Battery Info

Register address	Signal name	Byte quantity	Data type	Read & write	Remark/unit
8200	BMS system status	2	UINT16	RO	0-Initial 1-Normal 2-Charge disabled 3-Discharge disabled 4-Alarm 5-Fault 6-Standby
8201	Battery pack total voltage	2	UINT16	RO	0.1V
8202	Battery pack total current	2	INT16	RO	0.1A
8203	Battery pack SOC	2	UINT16	RO	0.1%
8204	Battery pack SOH	2	UINT16	RO	0.1%
8205	Charge limited current	2	UINT16	RO	0.1A
8206	Discharge limited current	2	UINT16	RO	0.1A
8207	Charge limited voltage	2	UINT16	RO	0.1V
8208	Discharge limited voltage	2	UINT16	RO	0.1V
8209-8210	Available charged energy	4	UINT32	RO	0.1kWh
8211-8212	Available discharged energy	4	UINT32	RO	0.1kWh

Register address	Signal name	Byte quantity	Data type	Read & write	Remark/unit
8213-8379	Reserved	2*167			
8380	Equalized charge voltage	2	UINT16	RW	1V
8381	Floating charge voltage	2	UINT16	RW	1V
8382	Equalized charge holding time	2	UINT16	RW	1min
8383	Current threshold from equalized charge to floating charge	2	UINT16	RW	1A
8384	Battery over-voltage protection value	2	UINT16	RW	1V
8385	Discharge ending voltage	2	UINT16	RW	1V
8386	Battery under-voltage alarm value	2	UINT16	RW	1V
8387	Battery under-voltage protection value	2	UINT16	RW	1V
8388	Battery under-voltage protection value (heavy load)	2	UINT16	RW	1V
8389	Battery over-voltage hysteresis value	2	UINT16	RW	1V
8390	Battery under-voltage hysteresis value	2	UINT16	RW	1V
8391	Battery under-voltage hysteresis value (heavy load)	2	UINT16	RW	1V
8392	Max. equalized charge time	2	UINT16	RW	1s
8393	Discharge ending voltage hysteresis value	2	UINT16	RW	1V
8394-8499	Reserved	2*106			

3. Alarm Information Definition

3.1. Alarm Info

No.	Bit	Alarm name	No.	Bit	Alarm name
Alarm 1	bit0	Insulation resistance abnormal	Alarm 2	bit0	Inner over-temperature
	bit1	AC residual current abnormal		bit1	AC softstart abnormal
	bit2	DC over-voltage		bit2	Heat exchanger abnormal
	bit3	Grid over-voltage abnormal		bit3	AC SPD abnormal
	bit4	Grid under-voltage abnormal		bit4	Inner EPO fault
	bit5	Grid over-frequency abnormal		bit5	External EPO fault
	bit6	Grid under-frequency abnormal		bit6	Bus voltage mismatch startup condition
	bit7	Power module over-temperature		bit7	Bus over-current
	bit8	Grid phase sequence abnormal		bit8	Zero-offset correction abnormal
	bit9	Inverter software over-current		bit9	Access control alarm
	bit10	DC softstart abnormal		bit10	Phase lock abnormal
	bit11	DC switch abnormal		bit11	DC SPD abnormal
	bit12	AC fan abnormal		bit12	Smart meter communication abnormal

No.	Bit	Alarm name	No.	Bit	Alarm name
Alarm 1	bit13	AC switch abnormal	Alarm 2	bit13	Inverter hardware over-current
	bit14	Temperature switch abnormal		bit14	Driver abnormal
	bit15	Inner abnormal		bit15	ID conflict
Alarm 3	bit0	Info sharing CAN communication abnormal	Alarm 4	bit0	Grid voltage unbalance alarm
	bit1	Parallel communication wire abnormal		bit1	Low voltage ride through running
	bit2	Sync CAN communication abnormal		bit2	High voltage ride through running
	bit3	DC arc abnormal		bit3	DC fan abnormal
	bit4	Zero-sequence over-current		bit4	Heat sink temperature switch abnormal
	bit5	DC main contactor abnormal		bit5	External temperature switch abnormal
	bit6	Smog alarm		bit6	Auxiliary power transformer temperature switch abnormal
	bit7	Parallel communication abnormal		bit7	Inductor temperature switch abnormal

No.	Bit	Alarm name	No.	Bit	Alarm name
Alarm 3	bit8	HMI CAN communication abnormal	Alarm 4	bit8	Positive grounding abnormal
	bit9	Model setting error		bit9	Negative grounding abnormal
	bit10	HMI RS485 communication abnormal		bit10	AC grounding abnormal
	bit11	Remote communication abnormal		bit11	Grid-tied grounding abnormal
	bit12	Fault (total)		bit12	BMS emergency power off
	bit13	Alarm (total)		bit13	Reserved
	bit14	DC parallel model setting error		bit14	Grid over-frequency/under-frequency standby alarm
	bit15	System parameters mismatch		bit15	Power module over-temperature alarm
Alarm 5	bit0	Battery over-voltage	Alarm 6	bit0	BMS system fault
	bit1	Battery under-voltage with light-load		bit1	BMS communication abnormal
	bit2	DC over-current		bit2	BMS dry contact abnormal
	bit3	Output voltage abnormal		bit3	BMS charge disabled

No.	Bit	Alarm name	No.	Bit	Alarm name
Alarm 5	bit4	Output voltage mismatch off-grid condition	Alarm 6	bit4	BMS discharge disabled
	bit5	Overload protection		bit5	BMS standby
	bit6	Short-circuit protection		bit6	BMS alarm
	bit7	Inner fan abnormal		bit7	Reserved
	bit8	DC fuse abnormal		bit8	Heat sink over-temperature alarm
	bit9	Battery under-voltage with heavy-load		bit9	Fault (total)
	bit10	Battery under-voltage alarm		bit10	Alarm (total)
	bit11	External fan abnormal		bit11	AC fan lifespan abnormal
	bit12	Battery reverse connected		bit12	DC fan lifespan abnormal
	bit13	Battery voltage mismatch charge condition		bit13	AC switch lifespan abnormal
	bit14	Overload alarm		bit14	DC switch lifespan abnormal
	bit15	DC arc module communication abnormal		bit15	Reserved

No.	Bit	Alarm name	No.	Bit	Alarm name
Alarm 7	bit0	Reserved	Alarm 8	bit0	Reserved
	bit1	Reserved		bit1	Reserved
	bit2	Reserved		bit2	Reserved
	bit3	Reserved		bit3	Reserved
	bit4	Reserved		bit4	Reserved
	bit5	Reserved		bit5	Reserved
	bit6	Reserved		bit6	Reserved
	bit7	Reserved		bit7	Reserved
	bit8	Reserved		bit8	Reserved
	bit9	Reserved		bit9	Reserved
	bit10	Reserved		bit10	Reserved
	bit11	Reserved		bit11	Reserved
	bit12	Reserved		bit12	Reserved
	bit13	Reserved		bit13	Reserved
	bit14	Reserved		bit14	Reserved
	bit15	Reserved		bit15	Reserved
Alarm 9	bit0	Reserved	Alarm 10	bit0	Reserved
	bit1	Reserved		bit1	Reserved
	bit2	Reserved		bit2	Reserved
	bit3	Reserved		bit3	Reserved
	bit4	Reserved		bit4	Reserved

No.	Bit	Alarm name	No.	Bit	Alarm name
Alarm 9	bit5	Reserved	Alarm 10	bit5	Reserved
	bit6	Reserved		bit6	Reserved
	bit7	Reserved		bit7	Reserved
	bit8	Reserved		bit8	Reserved
	bit9	Reserved		bit9	Reserved
	bit10	Reserved		bit10	Reserved
	bit11	Reserved		bit11	Reserved
	bit12	Reserved		bit12	Reserved
	bit13	Reserved		bit13	Reserved
	bit14	Reserved		bit14	Reserved
	bit15	Reserved		bit15	Reserved
Alarm 11	bit0	Reserved	Alarm 12	bit0	Reserved
	bit1	Reserved		bit1	Reserved
	bit2	Reserved		bit2	Reserved
	bit3	Reserved		bit3	Reserved

No.	Bit	Alarm name	No.	Bit	Alarm name
Alarm 11	bit9	Reserved	Alarm 12	bit9	Reserved
	bit10	Reserved		bit10	Reserved
	bit11	Reserved		bit11	Reserved
	bit12	Reserved		bit12	Reserved
	bit13	Reserved		bit13	Reserved
	bit14	Reserved		bit14	Reserved
	bit15	Reserved		bit15	Reserved
Alarm 13	bit0	Reserved	Alarm 14	bit0	Reserved
	bit1	Reserved		bit1	Reserved
	bit2	Reserved		bit2	Reserved
	bit3	Reserved		bit3	Reserved
	bit4	Reserved		bit4	Reserved
	bit5	Reserved		bit5	Reserved
	bit6	Reserved		bit6	Reserved
	bit7	Reserved		bit7	Reserved
	bit8	Reserved		bit8	Reserved
	bit9	Reserved		bit9	Reserved
	bit10	Reserved		bit10	Reserved
	bit11	Reserved		bit11	Reserved
	bit12	Reserved		bit12	Reserved

No.	Bit	Alarm name	No.	Bit	Alarm name
Alarm 13	bit13	Reserved	Alarm 14	bit13	Reserved
	bit14	Reserved		bit14	Reserved
	bit15	Reserved		bit15	Reserved
Alarm 15	bit0	Reserved	Alarm 16	bit0	Reserved
	bit1	Reserved		bit1	Reserved
	bit2	Reserved		bit2	Reserved
	bit3	Reserved		bit3	Reserved
	bit4	Reserved		bit4	Reserved
	bit5	Reserved		bit5	Reserved
	bit6	Reserved		bit6	Reserved
	bit7	Reserved		bit7	Reserved
	bit8	Reserved		bit8	Reserved
	bit9	Reserved		bit9	Reserved
	bit10	Reserved		bit10	Reserved
	bit11	Reserved		bit11	Reserved
	bit12	Reserved		bit12	Reserved
	bit13	Reserved		bit13	Reserved
	bit14	Reserved		bit14	Reserved
	bit15	Reserved		bit15	Reserved

4. A Modbus Communication Protocol

4.1. Function Code Description

This protocol is appropriate for the communication between host and slave, the host requires data from the slave circularly, the slave receives the request command and responds corresponding data. This protocol is based on Standard Modbus Protocol. Details as follows.This protocol is appropriate for the communication between host and slave, the host requires data from the slave circularly, the slave receives the request command and responds corresponding data. This protocol is based on Standard Modbus Protocol. Details as follows.

Function code	Meaning	Remark
0x01	Read coil status	Read by byte
0x02	Read input status	Read by byte
0x03	Read holding registers	Read by word
0x04	Read input registers	Read by word
0x05	Force single coil	OFF-0x0000; ON-0xFF00
0x06	Preset single register	Write by word
0x10	Preset multiple registers	Write by word
0xE0	Write multiple registers (inner function code)	Write by word

4.2. Modbus RTU Instruction Details

4.2.1. Read Coil Status (Function Code: 0x01)

Host request (Hexadecimal)

ID	Function code	Register starting address		Quantity		CRC16	
		High byte	Low byte	High byte	Low byte	Low byte	High byte
xx	0x01	xx	xx	xx	xx	xx	xx

Slave response (Hexadecimal)

ID	Function code		Byte quantity	Register 1	...	Register N	CRC16	
							Low byte	High byte
xx	0x01		xx	xx	...	xx	xx	xx

NOTE

The bit 0 of register 1 of response information is corresponding to the starting address in the request, If the returned register quantity is less than 8 or not a multiple of eight, the remaining bits in the final register will be filled with zeros.

4.2.2. Read Input Status (Function Code: 0x02)

Host request (Hexadecimal)

ID	Function code	Register starting address		Quantity		CRC16	
		High byte	Low byte	High byte	Low byte	Low byte	High byte
xx	0x02	xx	xx	xx	xx	xx	xx

ID	Function code	Byte quantity	Register 1	...	Register N	CRC16	
						Low byte	High byte
xx	0x02	xx	xx	...	xx	xx	xx

NOTE

The bit 0 of register 1 of response information is corresponding to the starting address in the request, If the returned register quantity is less than 8 or not a multiple of eight, the remaining bits in the final register will be filled with zeros.

4.2.3. Read Holding Registers (Function Code: 0x03)

Host request (Hexadecimal)

ID	Function code	Register starting address		Register quantity		CRC16	
		High byte	Low byte	High byte	Low byte	Low byte	High byte
xx	0x03	xx	xx	xx	xx	xx	xx

Slave response (Hexadecimal)

ID	Function code	Byte quantity	Register 1		...		Register N		CRC16	
			High byte	Low byte	...	...	High byte	Low byte	Low byte	High byte
xx	0x03	xx	xx	xx	...	...	xx	xx	xx	xx

NOTE

Reading one or more registers is distinguished by the quantity of register. If the quantity of register is 1, it means that there is one register. If the quantity of register is more than 1, it means that there are several registers. Register 1 is corresponding to the starting address.

4.2.4. Read Input Registers (Function Code: 0x04)

Host request (Hexadecimal)orem ipsum

ID	Function code	Register starting address		Register quantity		CRC16	
		High byte	Low byte	High byte	Low byte	Low byte	High byte
xx	0x04	xx	xx	xx	xx	xx	xx

Slave response (Hexadecimal)

ID	Function code	Byte quantity	Register 1		...		Register N		CRC16	
			High byte	Low byte	...	...	High byte	Low byte	Low byte	High byte
xx	0x04	xx	xx	xx	...	...	xx	xx	xx	xx

NOTE

Reading one or more registers is distinguished by the quantity of register. If the quantity of register is 1, it means that there is one register. If the quantity of register is more than 1, it means that there are several registers. Register 1 is corresponding to the starting address.

4.2.5. Force Single Coil (Function Code: 0x05)

Host request (Hexadecimal)

ID	Function code	Register starting address		Register setting value		CRC16	
		High byte	Low byte	High byte	Low byte	Low byte	High byte
xx	0x05	xx	xx	xx	xx	xx	xx

For the write input status can be ON/OFF only, 0xFF00 request input status is ON, 0x0000 request input status is OFF.

Slave response (Hexadecimal)

ID	Function code	Register address		Register setting value		CRC16	
		High byte	Low byte	High byte	Low byte	Low byte	High byte
xx	0x05	xx	xx	xx	xx	xx	xx

4.2.6. Preset Single Register (Function Code: 0x06)

Host request (Hexadecimal)

ID	Function code	Register address		Register setting value		CRC16	
		High byte	Low byte	High byte	Low byte	Low byte	High byte
xx	0x06	xx	xx	xx	xx	xx	xx

Slave response (Hexadecimal)

ID	Function code	Register address		Register setting value		CRC16	
		High byte	Low byte	High byte	Low byte	Low byte	High byte
xx	0x06	xx	xx	xx	xx	xx	xx

4.2.7. Preset Multiple Registers (Function Code: 0x10)

Host request (Hexadecimal)

ID	Function code	Register setting start address		Register setting quantity(N)		Byte quantity	Register setting value		Register ...	CRC16	
		High byte	Low byte	High byte	Low byte	2*N	High byte	Low byte	...	Low byte	High byte
xx	0x10	xx	xx	xx	xx	xx	xx	xx	...	xx	xx

Slave response (Hexadecimal)

ID	Function code	Register address		Preset register quantity		CRC16	
		High byte	Low byte	High byte	Low byte	Low byte	High byte
xx	0x10	xx	xx	xx	xx	xx	xx

4.2.8. Write Multiple Registers (Inner Function Code: 0xE0)

Host request (Hexadecimal)

ID	Function code	Register setting start address		Register setting quantity(N)		Byte quantity	Register setting value		Register ...	CRC16	
		High byte	Low byte	High byte	Low byte	2*N	High byte	Low byte	...	Low byte	High byte
xx	0xE0	xx	xx	xx	xx	xx	xx	xx	...	xx	xx

Slave response (Hexadecimal)

ID	Function code	Register address		Preset register quantity		CRC16	
		High byte	Low byte	High byte	Low byte	Low byte	High byte
xx	0xE0	xx	xx	xx	xx	xx	xx

4.2.9. Error Information and Data Processing

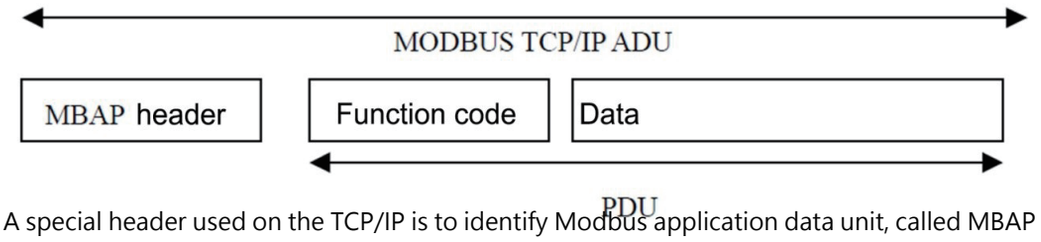
Slave response(Hexadecimal)

ID	Function code	Error code	CRC16	
			Low byte	High byte
xx	xx|0x80	xx	xx	xx

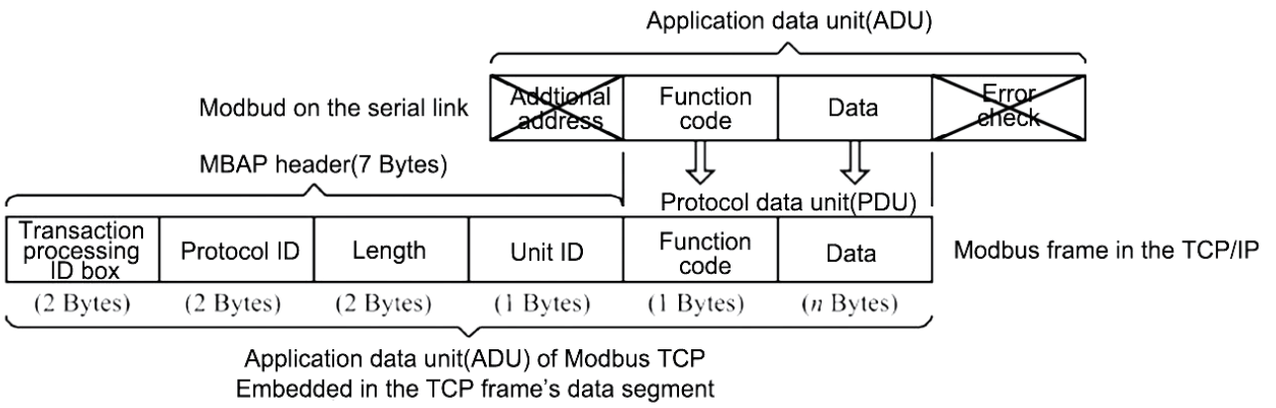
When the communication module of the inverter detects error except CRC error, it must send the information to the host. The highest bit of function codes is 1, that is, add 128 at the sent function code of host. The responded and sent error codes of inverter's communication module are as follows:

Error code	Definition	Remark
0x01	Invalid function code	The server does not understand the function code
0x02	Invalid data address	Related to the request
0x03	Invalid data value	Related to the request
0x04	Service fault	The communication module of inverter cannot take out the data fault during processing
0x10	Wrong register setting value	Password mismatch, setting exceed setting range, etc.
0x11	No authority	

5. Modbus TCP Instruction Details



A special header used on the TCP/IP is to identify Modbus application data unit, called MBAP header (Modbus protocol header).
The difference between Modbus TCP data frame and serial link data frame:



MBAP header includes the following fields:

Field	Length	Description	Client	Server
Transaction ID	2 byte	Modbus request response transaction processing ID	Client start	Server recopies from the received request
Protocol ID	2 byte	0: Modbus protocol	Client start	Server recopies from the received request
Length	2 byte	Number of bytes	Client start(request)	Client(response) start
Unit ID	1 byte	The ID of the remote slave connected to the serial link or other bus	Client start	Server recopies from the received request

Header length is 7 bytes:

- Transaction processing ID: Used for transaction matching. In response, the Modbus server copies the transaction processing ID of the request.
- Protocol ID: Used for multiplexing within system. The Modbus protocol is identified by a value of 0.
- Length: The length filed is the number of bytes in the next field, including unit ID and data field.
- Unit ID: This field is used for intra-system routing. Dedicated to communication between Modbus or Modbus+ serial link slaves by a gateway between an Ethernet TCP-IP network and a Modbus serial link. The Modbus client sets this field in the request, and the server must return this field with the same value in the response.
- All Modbus/TCP ADUs are sent through TCP on the registered port 502.

5.1. Read Coil Status (Function Code: 0x01)

Request PDU

Function code	Starting address		Quantity	
	High byte	Low byte	High byte	Low byte
0x01	xx	xx	xx	xx

Response PDU

Function code	Byte quantity	Status of No.1 byte coil	...	Status of No.N byte coil
0x01	xx	xx	...	xx

NOTE

The bit 0 of register 1 of response information is corresponding to the starting address in the request, If the returned register quantity is less than 8 or not a multiple of eight, the remaining bits in the final register will be filled with zeros.

5.2. Read Input Status (Function Code: 0x02)

Request PDU

Function code	Starting address		Quantity	
	High byte	Low byte	High byte	Low byte
0x02	xx	xx	xx	xx

Response PDU

Function code	Byte quantity	Register 1	...	Register N
0x02	xx	xx	...	xx

NOTE

The bit 0 of register 1 of response information is corresponding to the starting address in the request, If the returned register quantity is less than 8 or not a multiple of eight, the remaining bits in the final register will be filled with zeros.

5.3. Read Holding Registers (Function Code: 0x03)

Request PDU

Function code	Starting address		Register quantity	
	High byte	Low byte	High byte	Low byte
0x03	xx	xx	xx	xx

Response PDU

Function code	Byte quantity	Register 1		...		Register N	
		High byte	Low byte	...	...	High byte	Low byte
0x03	xx	xx	xx	...	...	xx	xx

NOTE

Reading one or more registers is distinguished by the quantity of register. If the quantity of register is 1, it means that there is one register. If the quantity of register is more than 1, it means that there are several registers. Register 1 is corresponding to the starting address.

5.4. Read Input Registers (Function Code: 0x04)

Request PDU

Function code	Starting address		Register quantity	
	High byte	Low byte	High byte	Low byte
0x04	xx	xx	xx	xx

Response PDU

Function code	Byte quantity	Register 1		...		Register N	
		High byte	Low byte	...	...	High byte	Low byte
0x04	xx	xx	xx	...	...	xx	xx

NOTE

Reading one or more registers is distinguished by the quantity of register. If the quantity of register is 1, it means that there is one register. If the quantity of register is more than 1, it means that there are several registers. Register 1 is corresponding to the starting address.

5.5. Force Single Coil (Function Code: 0x05)

Request PDU

Function code	Register address		Register setting value	
	High byte	Low byte	High byte	Low byte
0x05	xx	xx	xx	xx

NOTE

For the write input status can be ON/OFF only, 0xFF00 request input status is ON, 0x0000 request input status is OFF.

5.6. Preset Single Register (Function Code: 0x06)

Request PDU

Function code	Register address		Register setting value	
	High byte	Low byte	High byte	Low byte
0x06	xx	xx	xx	xx

Response PDU

Function code	Register address		Register setting value	
	High byte	Low byte	High byte	Low byte
0x06	xx	xx	xx	xx

5.7. Preset Multiple Registers (Function Code: 0x10)

Request PDU

Function code	Register setting start address		Register setting quantity(N)		Byte quantity	Register setting value		Register ...
	High byte	Low byte	High byte	Low byte	2*N	High byte	Low byte	...
0x10	xx	xx	xx	xx	xx	xx	xx	...

Response PDU

Function code	Register address		Reset register quantity	
	High byte	Low byte	High byte	Low byte
0x10	xx	xx	xx	xx

5.8. Error Information and Data Processing

Request PDU

Function code	Error code
xx|0x80	xx

When the communication module of slave detects error except CRC error, it must send the information to the host. The highest bit of function code is 1, that is, add 128 at the sent function code of host.
The responded and sent error codes of slave's communication module are as follows:

Error code	Definition	Remark
0x01	Invalid function code	The server does not understand the function code
0x02	Invalid data address	Related to the request
0x03	Invalid data value	Related to the request
0x04	Service fault	The communication module of slave cannot take out the data fault during processing

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About IE

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