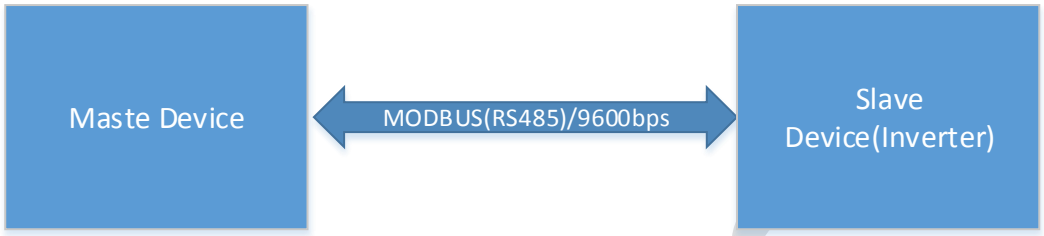
Inverter communication protocol

Version information

Version	Date	Remarks	Author
V 1.0	2017.09.09		Vincent
V 1.1	2017.10.08		Vincent
V 1.2	2018.03.28	Modify number of register to 2bytes when Master to read data	Vincent
V 1.3	2019.11.21	Modify content of register	Witt
V 1.4	2019.12.23	Add Modbus TCP	Witt
V 1.5	2019.12.24	Modify battery content of register	Stephen
V 1.6	2020.1.3	Add DI/DO register	Witt

1 ModBus RTU

1.1Communication flow chart:



1.2 Communication description:

RS485/MODBUS-RTU Communication
Communication interface: RS485
Communication connection mode: two-wire(RS85+,RS485-),shielded twisted pair conductors
Communication working mode: half-duplex
Communication speed: 9600bps

1.3 Transmission mode :

The information transmit in asynchronous mode in bytes , The Communication information transmitting between the host computer and the slave computer is the 10 bits format, including one initial bit ,8 data bit(Firstly Transmitting the least effective bit). Without parity check bit . 1 stop bit .

Data frame format
Master:

Address code	Function	Data	CRC check code
1 byte	1 byte	N byte	2 byte

Slave

Address code	Function	Data	CRC check code
1 byte	1 byte	N byte	2 byte

Address code: address code is loacated at beginning of frame ,decimal system is 1~247 in the inverter. **The default address is 0x55. Data area’ s illustration at part 3.**

Function code: function code tell the target terminal to execute what function, Below table list: function code used in this inverter, and their meaning and function.

Data area: data area includes the data needed by terminal for executing specific function, or the collected data when terminal is responding enquiry.

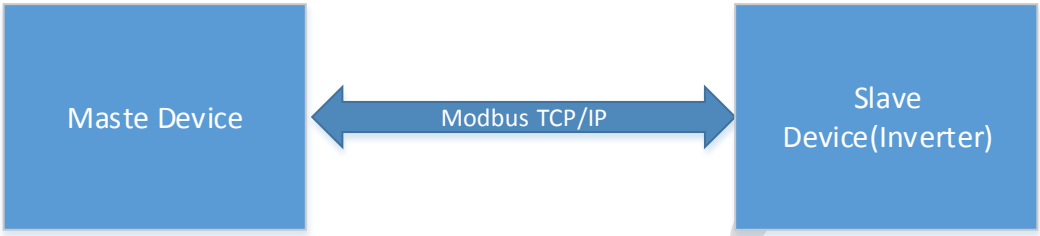
CRC check code : Error check(CRC) domain occupies 2 byte, including one 16 bit binary system value. CRC value is calculated by transmission device . and then attached to the data frame, the receiving device . while receiving, it calculates the CRC value again ,then comparing it with the receiving CRC domain value ,if these two values are not equal, it an error occurs.

Base on C language for CRC check code :

```
u16   CRC16_Check(const u8 *P   ,u16 ubCRCNum)            //CRC check code
{
      u8 temp;
      u8 i;
      u16 c;
      u8 TT;
      u16 crc = 0xffff;
      for(c=0;c<ubCRCNum;c++)
      {
            temp = P[c];
            crc =crc^temp;
            for(i=0;i<8;i++)
            {
                  TT = crc & 1;
                  crc = crc>>1;
                  crc = crc&0x7fff;
                  if(TT == 1)
                  {
                        crc = crc^0xa001;
                  }
                  crc = crc&0xffff;
            }
      }
      return crc;
}
```

2 ModBus TCP

2.1 Communication flow chart:



2.2 Communication description:

MODBUS-TCP Communication
Communication interface: TCP/IP

2.3 Transmission mode :

The information transmit in asynchronous mode in bytes , The Communication information transmitting between the host computer and the slave computer . **The default address is 0x55. Data area' s illustration at part 3.**

Data frame format
Master:

Transaction Identifier		Protocol Identifier		length	Unit Identifier	Funtion Code	Data
0x00	0x01	0x00	0x00	2 byte	1 byte	1byte	N byte

Slave

Transaction Identifier		Protocol Identifier		length	Unit Identifier	Funtion Code	Data
0x00	0x01	0x00	0x00	2 byte	1 byte	1byte	N byte

3 Data area

Function code: function code tell the target terminal to execute what function, Below table list: function code used in this inverter, and their meaning and function.

Read hold register(0x03):

Frame Format From Master:

Data	Explain
0x03H (Hexadecimal)	Read data register
High Byte of Start Register Addr.	
Low Byte of Start Register Addr.	
High Byte of Register No.	
Low Byte of Register No.	

Frame Format From Slave(data reading successfully)

Data	Explain
03H (Hexadecimal)	Read data register
No. of Bytes(2*N)	Length of retruned data.
No.1 High Byte of Data	Data1 high byte.
No.1 Low Byte of Data	Data1 low byte.
.....	
.....	
No.N High Byte of Data	DataN high byte.
No.N High Byte of Data	DataN low byte.

Write register(0x10):

Frame Format From Master:

Data	Explain
0x10H (Hexadecimal)	Write data register
High Byte of Start Register Addr.	
Low Byte of Start Register Addr.	
High Byte of Register No.	
Low Byte of Register No.	
No. of Bytes	
No.1 High Byte of Data	Data1 high byte.
No.1 Low Byte of Data	Data1 low byte.
.....	
.....	
No.N High Byte of Data	DataN high byte.
No.N High Byte of Data	DataN low byte.

Frame Format From Slave(data writing successfully):

Data	Explain
0x10H (Hexadecimal)	Write data register
High Byte of Start Register Addr.	

Low Byte of Start Register Addr.	
High Byte of Register No.	
Low Byte of Register No.	

Write single register(0x06):

Frame Format From Master:

Data	Explain
0x06H (Hexadecimal)	Write data register
High Byte of Start Register Addr.	
Low Byte of Start Register Addr.	
High Byte of Data	high byte.
Low Byte of Data	low byte.

Frame Format From Slave(data writing successfully):

Data	Explain
0x06H (Hexadecimal)	Write data register
High Byte of Start Register Addr.	
Low Byte of Start Register Addr.	
High Byte of Data	high byte.
Low Byte of Data	low byte.

Error operation salve return:

Data	Explain
Function Code + 0x80	Write data register
Error Code	

4 Parameter address table and application details

Address Register	variable	Belong to R/W	Data format	Data Model	Remarks
Meter					
0000H 0001H	Active power of A phase(Grid Meter)	R	Occupy 4 byte	int	1w/bit
0002H 0003H	Active power of B phase(Grid Meter)	R	Occupy 4 byte	int	1w/bit
0004H 0005H	Active power of C phase(Grid Meter)	R	Occupy 4 byte	int	1w/bit
0006H 0007H	Total Active power(Grid Meter)	R	Occupy 4byte	int	1w/bit
0008H 0009H	Total energy feed to grid(Grid Meter)	R	Occupy 4 byte	unsigned int	0.01KWh/bit
000AH 000BH	Total energy consume from grid(Grid Meter)	R	Occupy 4 byte	unsigned int	0.01KWh/bit
000CH 000DH	Active power of A phase(PV Meter)	R	Occupy 4 byte	int	1w/bit
000EH 000FH	Active power of B phase(PV Meter)	R	Occupy 4 byte	int	1w/bit
0010H 0011H	Active power of C phase(PV Meter)	R	Occupy 4 byte	int	1w/bit
0012H 0013H	Total Active power(PV Meter)	R	Occupy 4 byte	int	1w/bit
0014H 0015H	Total energy feed to grid(PV Meter)	R	Occupy 4 byte	unsigned int	0.01KWh/bit
Household Battery					
0100H	Battery voltage	R	Occupy 2 byte	unsigned short	0.1V/bit
0101H	Battery current	R	Occupy 2 byte	short	0.1A/bit
0102H	Battery SOC	R	Occupy 2 byte	unsigned short	0.1%/bit
0103H	Battery status	R	Occupy 2 byte	unsigned short	
0104H	Battery relay status	R	Occupy 2 byte	unsigned short	

0105H	Pack ID of min cell voltage	R	Occupy 2 byte	unsigned short	
0106H	Cell ID of min cell voltage	R	Occupy 2 byte	unsigned short	
0107H	Min cell voltage	R	Occupy 2 byte	unsigned short	0.001V/bit
0108H	Pack ID of max cell voltage	R	Occupy 2 byte	unsigned short	
0109H	Cell ID of max cell voltage	R	Occupy 2 byte	unsigned short	
010AH	Max cell voltage	R	Occupy 2 byte	unsigned short	0.001V/bit
010BH	Pack ID of min cell temperature	R	Occupy 2 byte	unsigned short	
010CH	Cell ID of min cell temperature	R	Occupy 2 byte	unsigned short	
010DH	Min cell temperature	R	Occupy 2 byte	short	0.1℃/bit
010EH	Pack ID of max cell temperature	R	Occupy 2 byte	unsigned short	
010FH	Cell ID of max cell temperature	R	Occupy 2 byte	unsigned short	
0110H	Max cell temperature	R	Occupy 2 byte	short	0.1℃/bit
0111H	Battery max charge current	R	Occupy 2 byte	unsigned short	0.1A/bit
0112H	Battery max discharge current	R	Occupy 2 byte	unsigned short	0.1A/bit
0113H	Battery charge cut-off voltage	R	Occupy 2 byte	unsigned short	0.1V/bit
0114H	Battery discharge cut-off voltage	R	Occupy 2 byte	unsigned short	0.1V/bit
0115H	BMU software version	R	Occupy 2 byte	unsigned short	
0116H	LMU software version	R	Occupy 2 byte	unsigned short	
0117H	ISO software version	R	Occupy 2 byte	unsigned short	

0118H	Battery num	R	Occupy 2 byte	unsigned short	
0119H	Battery capacity	R	Occupy 2 byte	unsigned short	0.1KWH/bit
011AH	Battery type	R	Occupy 2 byte	unsigned short	
011BH	Battery SOH	R	Occupy 2 byte	unsigned short	0.1%/bit
011CH 011DH	Battery warning	R	Occupy 4 byte	unsigned int	Note 1
011EH 011FH	Battery fault	R	Occupy 4 byte	unsigned int	Note 2
0120H 0121H	Battery charge energy	R/W	Occupy 4 byte	unsigned int	0.1KWH/bit
0122H 0123H	Battery discharge energy	R/W	Occupy 4 byte	unsigned int	0.1KWH/bit
0124H 0125H	Battery energy charge from grid	R/W	Occupy 4 byte	unsigned int	0.1KWH/bit
Industry Battery					
Household Inverter					
0400H	Inverter_Voltage_L1	R	Occupy 2 byte	unsigned short	0.1V/bit
0401H	Inverter _Voltage_L2	R	Occupy 2 byte	unsigned short	0.1V/bit
0402H	Inverter_Voltage_L3	R	Occupy 2 byte	unsigned short	0.1V/bit
0403H	Inverter_Current_L1	R	Occupy 2 byte	short	0.1A/bit

0404H	Inverter_Current_L2	R	Occupy 2 byte	short	0.1A/bit
0405H	Inverter_Current_L3	R	Occupy 2 byte	short	0.1A/bit
0406H 0407H	Inverter_Power_L1	R	Occupy 4 byte	int	1W/bit
0408H 0409H	Inverter_Power_L2	R	Occupy 4 byte	int	1W/bit
040AH 040BH	Inverter_Power_L3	R	Occupy 4 byte	int	1W/bit
040CH 040DH	Inverter_Power_Total	R	Occupy 4 byte	int	1W/bit
040EH	Inverter_Backup_Voltage_L1	R	Occupy 2 byte	unsigned short	0.1V/bit
040FH	Inverter_Backup_Voltage_L2	R	Occupy 2 byte	unsigned short	0.1V/bit
0410H	Inverter_Backup_Voltage_L3	R	Occupy 2 byte	unsigned short	0.1V/bit
0411H	Inverter_Backup_Current_L 1	R	Occupy 2 byte	unsigned short	0.1A/bit
0412H	Inverter_Backup_Current_L2	R	Occupy 2 byte	unsigned short	0.1A/bit
0413H	Inverter_Backup_Current_L3	R	Occupy 2 byte	unsigned short	0.1A/bit
0414H 0415H	Inverter_Backup_Power_L1	R	Occupy 4 byte	unsigned int	1W/bit
0416H 0417H	Inverter_Backup_Power_L2	R	Occupy 4 byte	unsigned int	1W/bit
0418H 0419H	Inverter_Backup_Power_L3	R	Occupy 4 byte	unsigned int	1W/bit
041AH 041BH	Inverter_Backup_Power_Total	R	Occupy 4 byte	unsigned int	1W/bit
041CH	Inverter Grid Frequency	R	Occupy 2 byte	unsigned short	0.01Hz/bit
041DH	PV1 Voltage	R	Occupy 2 byte	unsigned short	0.1V/bit
041EH	PV1 Current	R	Occupy 2 byte	unsigned short	0.1A/bit

041FH 0420H	PV1 power	R	Occupy 4 byte	unsigned int	1w/bit
0421H	PV2 Voltage	R	Occupy 2 byte	unsigned short	0.1V/bit
0422H	PV2 Current	R	Occupy 2 byte	unsigned short	0.1A/bit
0423H 0424H	PV2 power	R	Occupy 4 byte	unsigned int	1w/bit
0425H	PV3 Voltage	R	Occupy 2 byte	unsigned short	0.1V/bit
0426H	PV3 Current	R	Occupy 2 byte	unsigned short	0.1A/bit
0427H 0428H	PV3 power	R	Occupy 4 byte	unsigned int	1w/bit
0429H	INV Temperature	R	Occupy 2 byte	unsigned short	0.1℃/bit
042AH 042BH	Inverter warning	R	Occupy 4 byte	unsigned int	Note 3
042CH 042DH	Inverter fault	R	Occupy 4 byte	unsigned int	Note 4
042EH 042FH	Totol PV Energy	R/W	Occupy 4 byte	unsigned int	0.1KWH/bit
Industry Inverter					
System					
0700H	Feed into grid percent	R	Occupy 2 byte	unsigned short	1%/bit
0701H 0702H	System fault	R	Occupy 4 byte	unsigned int	Note5

0703H	System_time：(year)-(month)	R	Occupy 2 byte	unsigned short	Data format hex；0xYYMM，example：Send 0x1109; year:0x11(2017) month:0x09(09);
0704H	System_time：(day)-(hour)	R	Occupy 2 byte	unsigned short	Data format hex；0xDDHH，example：Send 0x1109; day:0x11(The 17 day) hour:0x09(09);
0705H	System_time：(minute)-(second)	R	Occupy 2 byte	unsigned short	Data format hex；0xmmss，example：Send 0x1109; min:0x11(17) second:0x09(09);
0706H	EMS SN byte1-2	R	Occupy 2 byte	unsigned short	EMS SN :ASCII 0x3132==’12’
0707H	EMS SN byte3-4	R	Occupy 2 byte	unsigned short	EMS SN :ASCII 0x3132==’12’
0708H	EMS SN byte5-6	R	Occupy 2 byte	unsigned short	EMS SN :ASCII 0x3132==’12’
0709H	EMS SN byte7-8	R	Occupy 2 byte	unsigned short	EMS SN :ASCII 0x3132==’12’
070AH	EMS SN byte9-10	R	Occupy 2 byte	unsigned short	EMS SN :ASCII 0x3132==’12’
070BH	EMS SN byte11-12	R	Occupy 2 byte	unsigned short	EMS SN :ASCII 0x3132==’12’
070CH	EMS SN byte13-14	R	Occupy 2 byte	unsigned short	EMS SN :ASCII 0x3132==’12’
070DH	EMS SN byte15-16	R	Occupy 2 byte	unsigned short	EMS SN :ASCII 0x3132==’12’
070EH	EMS DO0	W	Occupy 2 byte	unsigned short	Bypass Control function
070FH	EMS DO1	W	Occupy 2 byte	unsigned short	

0710H	EMS DI0	R	Occupy 2 byte	unsigned short	Signal from outside
0711H	EMS DI1	R	Occupy 2 byte	unsigned short	Signal from outside

5 Annex

Note2： battery fault

Alarm code	Description
Bit 0	
Bit 1	
Bit 2	Cell Temp Differ
Bit 3	Balancer Fault
Bit 4	Charge Over Current
Bit 5	Balancer Mos Fault
Bit 6	Dischage Over Current
Bit 7	Pole Over Temp
Bit 8	Cell Over Volt
Bit 9	Cell Volt Differ
Bit 10	Discharge Low Temp
Bit 11	Low Volt ShutDown
Bit 12	Cell Low Volt
Bit 13	ISO Comm Fault
Bit 14	LMU SN Repeat
Bit 15	BMU SN Repeat
Bit 16	IR Fault
Bit 17	LMU Comm Fault
Bit 18	Cell Over Temp
Bit 19	BMU Comm Fault
Bit 20	INV Comm Fault
Bit 21	Charge Low Temp
Bit 22	TOPBMU Comm Fault
Bit 23	Volt Detect Fault
Bit 24	Wire Harness Fault
Bit 25	Cluster Cut Fault
Bit 26	Relay Fault
Bit 27	LMU ID Repeat
Bit 28	LMU ID Discontinuous
Bit 29	Current Sensor Fault
Bit 30	
Bit 31	Temp Sensor Fault

Note2： EMS fault

Alarm code	Description
Bit 0	
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	BMS_Lost
Bit 7	MEC Lost
Bit 8	
Bit 9	
Bit 10	
Bit 11	
Bit 12	
Bit 13	
Bit 14	
Bit 15	