Protocol Release Note

V2.0.0	14.11.19	Release official inverter protocol 2.0.0	YJY			
V2.0.1	15.3.19	1.Correct fault and unresonable in V2.0.0 2.Add Safty type NB/T 32004	YJY			
V2.0.2	15.9.21	1.Add Set/Query Grid style select(N in or not) （For three phase INV） 2. Add Safty type Mexico（MX-01、MX-02、MX-03）、KR PV-501、BR NBR 16149 :2013、Sri Lanka 3.Add Power on /off by Com	YJY			
Version	**Date**	**Modification**	**Prepared by**		**Approved by**	

CONTENT

1. General information

This document is the inverter protocol which help you a better understand the communication between inverter and AP (Application Program). Through the protocol, data packet will be transmitted between AP and inverter. Generally, the data packet is regarded as a frame which includes 2 Bytes Header, Source Address, Destination Address, 1 Byte control code and Function code, alterable Data parts and 2 Bytes Checksum. AP communicates with Inverter through RS232 port or RS485 port and its baud rate is setted 9600, besides, data length is 8 bits. The AP is master and Inverter is slave. Firstly each Inverter must send the register instruction to AP and AP will allocate a unique address for each Inverter after it has received the register request. The detailed illustration is as follows:

1.1 Packet Communication Method

- It is necessary to get address from AP for each inverter and the register address is unique for each inverter.
- The communication method is as follows: AP is master and inverter is slave, that is, firstly AP sends out the instruction to each inverter and inverter executes the operation when receiving its own instruction. Inverter can't actively send the instruction.
- The packet must include the sender and receiver address when AP sends query or control instruction to each Inverter. These instructions will be seen by all on-line Inverters. But the Inverter can only do when the instruction is suitable to its own address and the packet should include the sender and receiver address when Inverter responds to the instruction in the same way.
- AP routine query using the periodic query method (according to address ranking)
- It will firstly be sent when AP needs to write the data or allocate address while the routine query will be postponed.
- If AP can't receive the correct response to the sent command in 0.5Sec, AP will send the instruction again after 0.5Sec(the least interval between instructions). When it can't also receive the response for 3 times, AP will cancel the register and no longer send the instruction to the address.

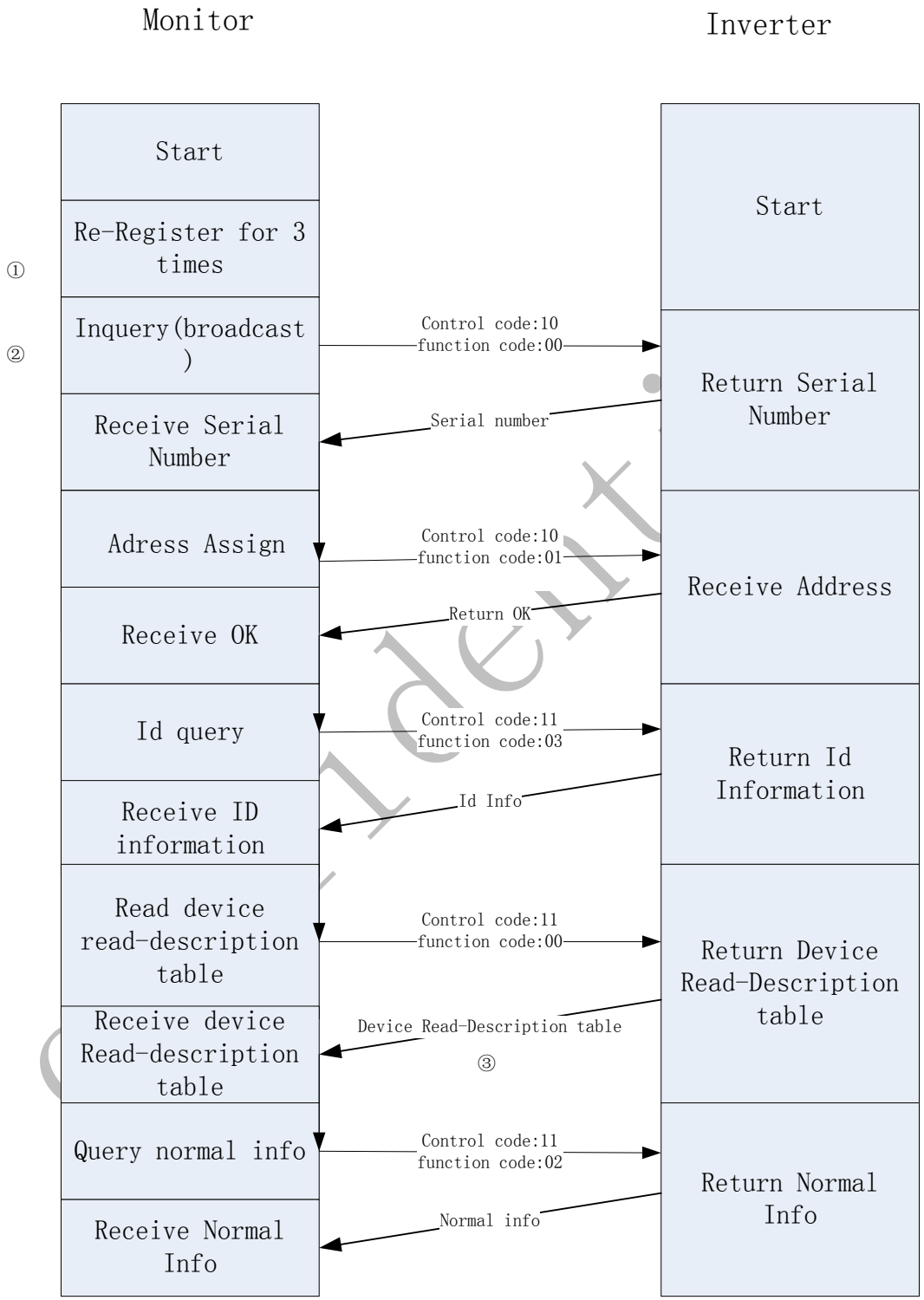
1.2 Inverter Address Allocation

- If an unregistered Inverter (state =0) wants to enter the communication net, it should send the register request instruction when it has received the 'off-line query' from AP. The request should include register request code and its serial number. AP will reply it (the content should also include register request code and corresponding serial number) after AP has received the information and allocated the address.
- The address will be used for the identification code for any communication after Inverter has finished the register program. The serial number for this machine will no longer be used.
- It need not wait before sending register request instruction after an unregistered Inverter receives the 'off-line query' info for the first time from AP. It will send again the register request instruction after several 'off-line query' intervals if the Inverter can't receive the response from AP (it is possibly due to noise or disturbances between every two Inverters). In order to get the different register time, the interval times will alter according to the serial number of machine.
- When register conflicts, the rules of interval times are as a short random time
- If AP can't receive the responses to an Inverter during 3 loops consecutively (3 times per loop), it will consider that communication has been halted, then cancel the register and no longer query address info.
- It will consider the communication has been halted if Inverter can't receive any its own instructions in excess of 10 minutes. The Inverter state will be set unregistered automatically. When receiving 'off-line query' again, the Inverter will register again and resume communication.
-

Note: (0x00 FF) is never allocated to any Inverter.

1.3 Communication process

Monitor and Inverters communication process is as follows.



Note：

①、After the monitor power on，It must send the Re-Register instruction for 3 times，in order to initialize all the inverters,So that all the inverters are waiting for registration .

②、Suggested every fixed cycle to send an inquery instruction，for example once per second.

③、The device read-description table means the sequence of the Normal information (Table 3-3)to be sended，for example :

The monitor send the instructions as follows :

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0xXX)	1Byte (0x11)	1Byte (0x00)	1Byte (0x00)	2 Bytes

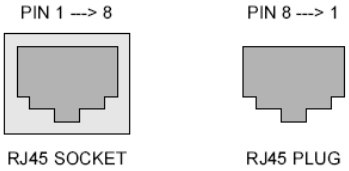
Then the inverter will responce the device Read-description as follows :

Header	Source Address	Destination Address	Control Code	Function Code	Data length
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	1 Byte (0x11)	1 Byte (0x80)	1 Byte (N)

Data0	Data1	Data2	Data3	…	Data(N-1)	Checksum
1Byte (0x00)	1 Byte (0x0D)	1 Byte (0x01)	1 Byte (0x02)	...	1 Byte	2 Bytes

Data0 is 0x00 ,Refer to table 3-3, means Temperature,So if we query normal information (Control code:11 function code:02) , Temperature will be sended firstly,then **Data1** is 0x0D,Refer to table 3-3, means E-today,so E-today will be sended secondly .The data length of each can always be seen in table 3-3.

1.4 RJ45 Pin Definition



Pin1------- TX+
Pin2-------TX-
Pin3-------RX+
Pin4-------GND
Pin5-------GND
Pin6-------RX-
Pin7-------+7V
Pin8-------+7V

2. Packet Format

2.1. Packet Format

The data packet include Header(0xAA 0x55),Source Address(2 bytes),Destination Address(2 bytes),Control Code(1 byte),Function Code(1 byte),Data Length(1 byte),Data(alterable) and Check Sum(2 bytes),packet format as following Note2-1:

Note 2-1

Header	Source Address	Destination Address	Control Code	Function Code	Data length
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0xXX)	2 Bytes (0xXX 0xXX)	1 Byte	1 Byte	1 Byte (N)

Data0	Data1	Data2	Data3	…	Data(N-1)	Checksum
1 Byte	1 Byte	1 Byte	1 Byte	...	1 Byte	2 Bytes

2.2. Description

Every frame is described as following Table 2-1:

Table 2-1

	Description
Header (0xAA 0x55):	the header of each packet .
Source Address	designate the sender address . (it is XX00 for AP, or it is 00XX for Inverter)
Destination Address	designate the receiver address. (it is XX00 for AP, or it is 00XX for Inverter)
Control Code	there are 4 kinds: 1. Register(0x10) 2. Read(0x11) 3. Write(0x12) 4. Execute(0x13) 5. Updata(0x14)
Function Code	designate the function
Data length	designate the data length. (If there is not the data column, the data length is 0)
Data0,1,2..	Data column
Checksum	Header + Source Address + Destination Address + Control Code +Function Code + Data length +Data0 + .. +Data (N-1)

Note:

When sending the LSB will be firstly transmitted as a packet of word format.

■ Communication Parameter

Table 2-2

Parameter	Value
Speed	9600bps
Data bit	8
Parity	None
Stop bit	1

■ Communication timing

Table 2-3

Timing parameter	Value
Delay before Inverter begins to send response	0~0.5 Sec
Inter-character delay	0~0.2 Sec
The least interval time between two instructions	0.5 Sec
Time out for Inverter communication	10 Min

3. Instruction Set

3.1. Control Code :0x10 'register'

Table 3-1

Control code	Function code	Vector	Description
0x10	0x00	AP →Inverter	Register query(Note3.1-1)
0x10	0x80	Inverter→AP	Registration request(Note3.1-2)
0x10	0x01	AP →Inverter	Allocate register address (Note3.1-3)
0x10	0x81	Inverter→AP	Address confirm(Note3.1-4)
0x10	0x02	AP →Inverter	Remove register(Note3.1-5)
0x10	0x82	Inverter→AP	Remove confirm(Note3.1-6)
0x10	0x03	AP →Inverter	Re-connect removed Inverter(Note3.1-7)
0x10	0x04	AP →Inverter	Re-register(Note3.1-8)

Note :

(1).Note3.1-1

0x10	0x00	AP → Inverter	register query

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0xXX)	1Byte (0x11)	1Byte (0x00)	1Byte (0x00)	2 Bytes

(2).Note3.1-2

0x10	0x80	Inverter→AP	reply registration request

For example :

Header	Source Address	Destination Address	Control Code	Function Code	Data length
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0x00)	2 Bytes (0xXX 0x00)	0x10	0x80	0x12

Data0-15 DataSerial Num	Data16-17 Protocol Ver	Checksum
16 Bytes	2 Bytes	2 Bytes

Data16-17(Protocol Ver) :
0x0001 : protocol V1.0.0 for single phase inverter CCB
0x0002 : protocol V1.0.0 for three phase inverter CCB
0x0300 :Protocol V2.0.0 :

(3).Note3.1-3

0x10	0x01	AP →Inverter	Allocate register address

Header	Source Address	Destination Address	Control Code	Function Code	Data length
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0x00)	0x10	0x01	0x11

Data0-15 Serial Num	Data16 Address	Checksum
16 Bytes	1 Bytes	2 Bytes

The rules of AP allocating address

- AP should record every allocated address of Inverter that has been registered and set up a map for allocated address.
- AP will allocate a proper address to Inverter according to records of the map of allocated address.
- Register address range is allowed form1 to 254. Address 0,and 255 is reserved

(4).Note3.1-4

0x10	0x81	Inverter→AP	Address confirm

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0x11)	2 Bytes (0x01 0x00)	1Byte (0x10)	1 Byte (0x81)	1Byte (0x01)	1Byte (0x06)	2 Bytes

The state of Inverter will be changed from 'not registration 'state to 'registration' state after Inverter has finished the register program, then it will not respond to the 'off-line query' from AP.

(5).Note3.1-5

0x10	0x02	AP →Inverter	Remove register

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0x01 0x00)	2 Bytes (0x00 0x11)	1Byte (0x10)	1 Byte (0x02)	1Byte (0x00)	2 Bytes

AP removes the registered Inverter from 'the map of allocated address'

(6).Note3.1-6

0x10	0x82	Inverter→AP	Remove confirm

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0x11)	2 Bytes (0x01 0x00)	1 Byte (0x10)	1 Byte (0x82)	1Byte (0x01)	1Byte ACK (0x06)	2 Bytes

- Inverter will set the state to 'register removed' after receiving register removing and save it into EEPROM. It won't respond to any other AP instruction except 'reconnect removed Inverter' instruction.
- The object of instruction is to make Inverter needn't register again when receiving query from AP even after shutdown and restarting.

(7).Note3.1-7

0x10	0x03	AP →Inverter	Re-connect removed Inverter

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0x01 0x00	2 Bytes (0x00 0x01)	1Byte (0x10)	1 Byte (0x03)	1Byte (0x00)	2 Bytes

Inverter clears the 'register removed' state and re-registers when receiving the 'off-line query' info and the register method is similar to the first item.

(8).Note3.1-8

0x10	0x04	AP →Inverter	Re-register

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0x01 0x00)	2 Bytes (0x00 0x01)	1Byte (0x10)	1 Byte (0x04)	1Byte (0x00)	2 Bytes

Inverter clears the 'register removed' state and re-registers when receiving 'off-line query' info and the register method is similar to the first item.

3.2. Control Code :0x11 'Read'

Table3-2

Control code	Function code	Vector	Description
0x11	0x00	AP →Inverter	Query read description(Note3.2-0)
0x11	0x80	Inverter→AP	Reply read description (Note3.2-1)
0x11	0x01	AP →Inverter	Query write description (Note3.2-0)
0x11	0x81	Inverter→AP	Reply write description (Note3.2-2)
0x11	0x02	AP →Inverter	Query normal information(such as temperature) (Note3.2-0)
0x11	0x82	Inverter→AP	Reply normal information(such as temperature) (Note3.2-3)
0x11	0x03	AP →Inverter	Query Inverter ID info,HMI's software Ver,HMI's hardware Ver,HMI Ver(Note3.2-0)
0x11	0x83	Inverter→AP	Reply Inverter ID data、HMI's software Ver、 HMI's hardware Ver、HMI Ver(Note3.2-4)
0x11	0x05	AP →Inverter	Query inverter info(S/W Ver,HW VER, Manufacturer brand, device name Function model, etc) (Note3.2-0)
0x11	0x85	Inverter→AP	Reply inverter info(Note3.2-5)
0x11	0x06	AP →Inverter	Query inverter safety type (Note3.2-0)
0x11	0x86	Inverter→AP	Reply inverter safety type(Note3.2-6)
0x11	0x08	AP →Inverter	Query inverter grid voltage protection's threshold,response time and recovery voltage (Note3.2-0)
0x11	0x88	Inverter→AP	Reply inverter grid voltage protection's threshold,response time and recovery voltage (Note3.2-7)
0x11	0x09	AP →Inverter	Query inverter grid frequency protection's threshold,response time and recovery frequency (Note3.2-0)
0x11	0x89	Inverter→AP	Reply inverter grid frequency protection's threshold,response time and recovery frequency (Note3.2-8)
0x11	0x0A	AP →Inverter	Query display Language (Note3.2-0)
0x11	0x8A	Inverter→AP	Reply display Language (Note3.2-9)
0x11	0x0B	AP →Inverter	Query brand market(Note3.2-0)
0x11	0x8B	Inverter→AP	Reply brand market(Note3.2-10)
0x11	0x0E	AP →Inverter	Query Vpv-start，T-start，Reconnet-time(Note3.2-0)
0x11	0x8E	Inverter→AP	Reply Vpv-start，T-start，Reconnet-time (Note3.2-11)
0x11	0x1D	AP →Inverter	Query safety type(Inverter support) (Note3.2-0)
0x11	0x9D	Inverter→AP	Reply safety type(Inverter support) (Note3.2-12)

0x11	0x20	AP →Inverter	Query active power output curve. (Note3.2-0)
0x11	0xA0	Inverter→AP	Reply active power output curve. (Note3.2-13)
0x11	0x21	AP →Inverter	Query reactive power output curve(Note3.2-14)
0x11	0xA1	Inverter→AP	Reply reactive power output curve(Note3.2-14)
0x11	0x23	AP →Inverter	Query the curve of active power feed-in at overfrequency(Note3.2-0)
0x11	0xA3	Inverter→AP	Reply the curve of active power feed-in at overfrequency(Note3.2-15)
0x11	0x26	AP →Inverter	Query the curve of active power feed in at over grid volt (Note3.2-0)
0x11	0xA6	Inverter→AP	Reply the curve of active power feed in at over grid volt (Note3.2-16)
0x11	0x30	AP →Inverter	Query device address of modbus communication (Only for PCU,address from 3 to 247) (Note3.2-0)
0x11	0XB0	Inverter→AP	Reply device address of modbus communication (Note3.2-17)
0x11	0x31	AP →Inverter	Query PV input model(Note3.2-0)
0x11	0xB1	Inverter→AP	Reply PV input model (Note3.2-18)
0x11	0x32	AP →Inverter	Query Grid style selecet(Note3.2-0)
0x11	0xB2	Inverter→AP	Reply Grid style selecet (Note3.2-19)
0x11	0x41	AP →Inverter	Query load %Pn per minute(Note3.2-0)
0x11	0xC1	Inverter→AP	Reply load %Pn per minute(Note3.2-20)

Note :

0.Note3.2-0 :

The query instruction refer to following :

0x11	Function code	AP → Inverter	Query instruction

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0xXX)	1 Byte 0x11	1 Byte (0xXX)	1 Byte (0x00)	2 Bytes

1.Note3.2-1 :

Replay :

0x11	0x80	Inverter → AP	read description

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0x80	1 Byte (N)	N Byte	2 Bytes

Depend on different inverter type,the Data Length is alterable.The Data designate the first list(**Data Code=(hex)**) in table3.2-1.

For example if **Data0** is 0x00 ,refer to table 3-3, means temperature,so we query normal information (Control code:11 function code:02) , temperature will be sended firstly.Then **Data1** is 0x0D,refer to table 3-3, means E-today,so E-today will be sended secondly.

2.Note3.2-2

Replay :

0x11	0x81	Inverter → AP	Reply write description

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0x81	1 Byte	N Byte	2 Bytes

Depend on different inverter type,the Data Length is alterable.The Data designate the parameter whitch AP can set.

3.Note3.2-3
Replay :

0x11	0x82	Inverter → AP	Reply normal information(such as temperature)

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0x82	1 Byte	N Bytes	2 Bytes

Depend on different inverter type,the Data Length is alterable.The Data refer to table3.2-1.

4.Note3.2-4
Replay :

0x11	0x83	Inverter → AP	Reply set information

Header	Source Address	Destination Address	Control Code	Function Code	Data Length
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0x83	1 Byte (0x7F/0x4D)

Data0 Machine type	Data1-6 Power rating	Data7-11 Firmware Ver	Data12-27 Model Name	Data28-43 Manufacturer	Data44-59 Serial number	Data60-63 Nom_Vpv	Data64-76 Internal Ver
1 Byte	6 Bytes	5 Bytes	16 Bytes	16 Bytes	16 Bytes	4 Bytes	13 Bytes

Data77-96 HMI's software Ver	Data97-107 HMI's hardware Ver	Data108-120 HMI Ver	Data121-133 Inter Slave Ver	Check Sum
20 Bytes	11 Bytes	13 Bytes	13 Bytes	2 Bytes

The meaning of Data can also refer to table3.2-2
The inverter type what have no corresponding information will set default 0.

5.Note3.2-5
Replay :

0x11	0x85	Inverter → AP	Reply inverter info(S/W Ver,HW VER, Manufacturer brand, device name Function model, etc)

Header	Source Address	Destination Address	Control Code	Function Code	Data length
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0x85	1 Byte (0x29)

Data0-4 Software Ver	Data5-8 Hardware Ver	Data9-24 Manufacturer brand	Data25-36 Device name	Data37-40 Function model select	Checksum
5 Bytes	4 Bytes	16 Bytes	12 Bytes	4 Bytes	2 Bytes

Data37-40(Function model select)can refer to **Title 4.1**.

6.Note3.2-6
Replay :

0x11	0x86	Inverter → AP	Reply inverter safety type

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data0 Safty type	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0x86	1 Byte (0x01)	1 Byte	2 Bytes

Data0 (Safty type) indicate the safty type what the inverter supply.And the safty type code can refer to **Title 4.2**.

7.Note3.2-7
Replay :

0x11	0x88	Inverter → AP	Reply inverter grid voltage protection's threshold,response time and recovery voltage

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0x88	1 Byte (0x28)	40 Bytes	2 Bytes

The format of Data can refer to title 4.3(1).

8.Note3.2-8
Replay :

0x11	0x89	Inverter → AP	Reply inverter grid frequency protection's threshold,response time and recovery frequency

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0x89	1 Byte (0x28)	40 Bytes	2 Bytes

The format of Data can refer to title 4.3(2).

9.Note3.2-9
Replay :

0x11	0x8A	Inverter → AP	Reply display Language

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data0 Language	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0x8A	1 Byte (0x01)	1 Byte	2 Bytes

The inverter supply these languages can refer to title 4.4.

10.Note3.2-10

Replay :

0x11	0x8B	Inverter → AP	Reply brand market

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data0-15 brand market	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0x8B	1 Byte (0x10)	16 Byte	2 Bytes

This instruction can query the brand maket,and the reply by characters.For example, the default brand maket is Zeversolar,the reply is 'Z','e','v','e','r','s','o','l','a','r',' ',' ',' ',' ',' ',' ',' ',' '.

11.Note3.2-11

Replay :

0x11	0x8E	Inverter → AP	Reply Vpv-start，T-start，Reconnet-time

Header	Source Address	Destination Address	Control Code	Function Code	Data Length
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0x8E	1 Byte (0x06)

Data 0-1 Vpv-Start	Data 2-3 T-Start	Data4-5 Reconnet-time	Check Sum
2 Bytes	2 Bytes	2 Bytes	2 Bytes

Data 0-1 Vpv-Start —— Inverter needs the input-voltage to work nomally
Data 2-3 T-Start —— Inverter needs the time from Wait State to Normal State for first working..
Data 4-5 Reconnet-time —— If inverter recover from error/warning,it need the time from Wait State to Normal State

12.Note3.2-12

Replay :

0x11	0x9D	Inverter → AP	Reply safety type(Inverter support)

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data0-(N-1) Safty Type	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0x96	1 Byte (N)	N Bytes	2 Bytes

Data 1-N :This inverter support the safty type code.
For example,if a inverter support VDE0126,VDE4105 and G83/2,the Data 0 is 0x03,and the Data1-N are 0x00,0x0A and 0x07.

13.Note3.2-13

Replay :

0x11	0xA0	Inverter → AP	Reply active power output curve

Header	Source Address	Destination Address	Control Code	Function Code	Data Length
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0xA0	1 Byte (0x02)

Data 0 Percentage	Data 1 Response time	Check Sum
1 Byte	1 Byte	2 Bytes

Data 0(Percentage) and Data 1(Response time) can refer to title 4.5(1).

14.Note3.2-14
Query :

0x11	0x21	AP → Inverter	Query reactive power output curve

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data 0 Mode	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0xXX)	0x11	0x21	1 Byte (0x01)	1 Byte	2 Bytes

Data 0(Mode) is used to select specific mode and read the corresponding data. refer to title 4.5(2).
Replay :

0x11	0xA1	Inverter → AP	Reply reactive power output curve

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data 0-7	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0xA1	1 Byte (0x08)	8 Byte	2 Bytes

Data0-7 are usede to set curve mode and curve parameter,refer to title 4.5(2).

15.Note3.2-15
Replay :

0x11	0xA3	Inverter → AP	Reply the curve of active power feed-in at overfrequency

Header	Source Address	Destination Address	Control Code	Function Code	Data Length
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0xA3	1 Byte (0x08)

Data 0 Mode select	Data 1 Delay T1	Data 2-3 F-start	Data 4-5 F-stop	Data 6-7 F-back	Check Sum
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes	2 Bytes

The protocol supply two kinds of adjusting mode whitch all need F-start,F-back and F-stop.And specific operation refer to title 4.6

16. Note3.2-16
Reply :

0x11	0xA6	Inverter → AP	Reply the curve of active power feed in at over grid volt

Header	Source Address	Destination Address	Control Code	Function Code	Data length
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0xXX)	0x11	0xA6	1 Byte (0x08)

Data0 Mode	Data1 Delay T1	Data2-3 Delay T2	Data4 U-start	Data5 P-start	Data6 U-stop	Data7 P-stop	Checksum
1 Byte (0x00)	1 Byte	2 Bytes	1 Byte	1 Byte	1 Byte	1 Byte	2 Bytes

Specific operation refer to title 4.7.

17.Note3.2-17
Replay :

0x11	0xB0	Inverter → AP	Reply device address of modbus communication

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data 0-1 Address	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0xB0	1 Byte (0x02)	2 Bytes	2 Bytes

This instruct is only for setting Modbus protocol address.Data 0-1(Address) are range from 3 to 247,default address is 3.

18.Note3.2-18
Replay :

0x11	0xB1	Inverter → AP	Reply PV input model

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0 Input mode	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0xB1	1 Byte (0x01)	0/1	2 Bytes

Data0(Input mode) :
0——Different panel input
1——Same panel input

19. Note3.2-19
Reply :

0x11	0xB2	Inverter → AP	Reply Grid style selecet

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data 0 Grid style Selected	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0xXX)	1 Byte (0x11)	1 Byte (0xB2)	1 Byte (0x01)	1 Byte	2 Bytes

Data0(Grid style selected)：
0——N in 1——No N

20.Note3.2-20
Replay :

0x11	0xC1	Inverter → AP	Reply load %Pn per minute

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0-1 Delta %Pn	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	0x11	0xC1	1 Byte (0x02)	2 Bytes	2 Bytes

Inverter start working, at first,the output power is 0w,then inverter output power rise at %pn per minute until full load.

3.2.1. 'Reply normal information' : (Control code 0x11,Function code 0x82)

Table 3.2-1

	Data Code (bin)	Measuring Channels	Unit	Description	Length
00	0000 0000	Temperature	0.1 degree C	Inverter internal temperature	2 Bytes
01	0000 0001	Vpv1	0.1V	PV1 voltage	2 Bytes
02	0000 0010	Vpv2	0.1V	PV2 voltage	2 Bytes
03	NA	NA	NA	NA	NA
04	0000 0100	Ipv1	01.A	PV1 Current	2 Bytes
05	0000 0101	Ipv2	0.1A	PV2 Current	2 Bytes
06	NA	NA	NA	NA	NA
07	0000 0111	E-Total H	0.1KW.Hr	Total energy to grid (3phase)	2 Bytes
08	0000 1000	E-Total L	0.1KW.Hr	Total energy to grid (3phase)	2 Bytes
09	0000 1001	h-Total H	Hr	Total operation hours(3 Phase)	2 Bytes
0A	0000 1010	h-Total L	Hr	Total operation hours(3 Phase)	2 Bytes
0B	0000 1101	Pac	W	Total Power to grid(3 Phase)	2 Bytes
0C	0000 1100	Mode		Operation Mode Table3.2-4-1 (3 Phase)	2 Bytes
0D	0000 1101	E-Today	0.01KW.Hr	The accumulated kWh of that day(3 Phase)	2 Bytes
0E	NA	NA	NA	NA	NA
0F	NA	NA	NA	NA	NA
10	NA	NA	NA	NA	NA
11	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA
13	NA	NA	NA	NA	NA
14	NA	NA	NA	NA	NA
15	NA	NA	NA	NA	NA
16	NA	NA	NA	NA	NA
17	NA	NA	NA	NA	NA
18	NA	NA	NA	NA	NA
19	NA	NA	NA	NA	NA
20	0001 0100	surTemp	0.1 degree C	Ambient Temperature(Sensor)	2 Bytes
21	0001 0101	bdTemp	0.1 degree C	Panel Temp(Sensor)	2 Bytes
22	0001 0110	irr	0.1 W / M2	RAD(Sensor)	2 Bytes
23	0001 0111	windSpeed	0.1 M / S	Speed of Wind(Sensor)	2 Bytes
36	00110110	Cos(Phi)	NA	JA_JR_Cos_phi	2Bytes
37	00110111	Phase	NA	JA_JR_Pase（1—leading, 2—lagging）	2Bytes
38	00111000	WaitingTime	1S	Waite time on connected(3phase)	2Bytes
39	0011 1001	TmpFaultValue	01. Degree C	Temperature fault value	2 Bytes
3A	0011 1010	PV1FaultValue	0.1V	PV1 voltage fault value	2 Bytes
3B	0011 1011	PV2FaultValue	0.1V	PV2 voltage fault value	2 Bytes
3C	NA	NA	NA	NA	NA
3D	0011 1101	GFCIFaultValue	0.001A	GFCI current fault value	2 Bytes
3E	0011 1110	Error/Waining message H		Error description refer to title3.2.5	2 Bytes
3F	0011 1111	Error/Waining message L		Error description refer to title3.2.5	2 Bytes

- Single phase or R phase of 3 phase system

Data Code (hex)	Data Code (bin)	Measuring Channels	Unit	Description	Data Length
40	0100 0000	Vpv1	0.1V	PV voltage	2 Bytes
41	0100 0001	Iac	0.1A	Current to grid (R Phase)	2 Bytes
42	0100 0010	Vac	0.1V	Grid voltage(R Phase)	2 Bytes
43	0100 0011	Fac	0.01Hz	Grid frequency(R Phase)	2 Bytes
44	0100 0100	Pac	W	Power to grid(R Phase)	2 Bytes
45	0100 0101	Zac	mΩ	Grid impedance(R Phase)	2 Bytes
46	0100 0110	Ipv	0.1A	PV Current	2 Bytes
47	0100 0111	E-Total H	0.1KW.Hr	Energy to grid (R Phase)	2 Bytes
48	0100 1000	E-Total L	0.1KW.Hr	Energy to grid (R Phase)	2 Bytes
49	0100 1001	h-Total H	Hr	Total operation hours	2 Bytes
4A	0100 1010	h-Total L	Hr	Total operation hours	2 Bytes
4B	0100 1011	Power On		Number of time the Inverter starts feeding to the grid	2 Bytes
4C	0100 1100	Mode		Operation Mode Table3.2-4-2	2 Bytes
78	0111 1000	GVFaultValue	0.1V	Grid voltage fault value(R Phase)	2 Bytes
79	0111 1001	GFFaultValue	0.01Hz	Grid frequency fault value(R Phase)	2 Bytes
7A	0111 1010	GZFaultValue	0.001Ω	Grid impedance fault value(R Phase)	2 Bytes
7B	0111 1011	TmpFaultValue	01. Degree C	Temperature fault value	2 Bytes
7C	0111 1100	PV1FaultValue	0.1V	PV1 voltage fault value	2 Bytes
7D	0111 1101	GFCIFaultValue	0.001A	GFCI current fault value	2 Bytes
7E	0111 1110	Error/Waining message H		Error description refer to title3.2.5	2 Bytes
7F	0111 1111	Error/Waining message L		Error description refer to title3.2.5	2 Bytes

- S phase of 3 phase system :

Data Code (hex)	Data Code (bin)	Measuring Channels	Unit	Description	Data Length
80	1000 0000	Vpv2	0.1V	PV voltage	2 Bytes
81	1000 0001	Iac	0.1A	Current to grid(S Phase)	2 Bytes
82	1000 0010	Vac	0.1V	Grid voltage(S Phase)	2 Bytes
83	1000 0011	Fac	0.01Hz	Grid frequency(S Phase)	2 Bytes
84	1000 0100	Pac	W	Power to grid(S Phase)	2 Bytes
85	1000 0101	Zac	mΩ	Grid impedance	2 Bytes
86	1000 0110	Ipv	0.1A	PV Current	2 Bytes
87	1000 0111	E-Total H	0.1KW.Hr	Energy to grid (S Phase)	2 Bytes
88	1000 1000	E-Total L	0.1KW.Hr	Energy to grid (S Phase)	2 Bytes
89	1000 1001	h-Total H	Hr	Total operation hours	2 Bytes
8A	1000 1010	h-Total L	Hr	Total operation hours	2 Bytes
8B	1000 1011	Power On		Number of time the Inverter starts feeding to the grid	2 Bytes
8C	1000 1100	Mode		Operation Mode Tltle3.2-4	2 Bytes
B8	1011 1000	GVFaultValue	0.1V	Grid voltage fault value (S Phase)	2 Bytes
B9	1011 1001	GFFaultValue	0.01Hz	Grid frequency fault value (S Phase)	2 Bytes
BA	1011 1010	GZFaultValue	0.001Ω	Grid impedance fault value	2 Bytes
BB	1011 1011	TmpFaultValue	01. Degree C	Temperature fault value	2 Bytes
BC	1011 1100	PV2FaultValue	0.1V	PV2 voltage fault value	2 Bytes

BD	1011 1101	GFCIFaultValue	0.001A	GFCI current fault value	2 Bytes
BE	1011 1110	Error/Waining message H		Fault description refer to title3.2.5	2 Bytes
BF	1011 1111	Error/Waining message L		Fault description refer to title3.2.5	2 Bytes

■ T phase of 3 phase system

Data Code (hex)	Data Code (bin)	Measuring Channels	Unit	Description	Data Length
C0	1100 0000	Vpv3	0.1V	PV voltage	2 Bytes
C1	1100 0001	Iac	0.1A	Current to grid (3 Phase)	2 Bytes
C2	1100 0010	Vac	0.1V	T Phase Grid voltage (3 Phase)	2 Bytes
C3	1100 0011	Fac	0.01Hz	T Phase Grid frequency (3 Phase)	2 Bytes
C4	1100 0100	Pac	W	T Phase Power to grid (3 Phase)	2 Bytes
C5	1100 0101	Zac	mΩ	Grid impedance(3 Phase)	2 Bytes
C6	1100 0110	Ipv	0.1A	PV Current	2 Bytes
C7	1100 0111	E-Total H	0.1KW.Hr	Energy to grid (3 Phase)	2 Bytes
C8	1100 1000	E-Total L	0.1KW.Hr	Energy to grid (3 Phase)	2 Bytes
C9	1100 1001	h-Total H	Hr	Total operation hours	2 Bytes
CA	1100 1010	h-Total L	Hr	Total operation hours	2 Bytes
CB	1100 1011	Power On		Number of time the Inverter starts feeding to the grid	2 Bytes
4C	1100 1100	Mode		Operation Mode Tltle3.2-4	2 Bytes
F8	1111 1000	GVFaultValue	0.1V	Grid voltage fault value (3 Phase)	2 Bytes
F9	1111 1001	GFFaultValue	0.01Hz	Grid frequency fault value (3 Phase)	2 Bytes
FA	1111 1010	GZFaultValue	0.001Ω	Grid impedance fault value	2 Bytes
FB	1111 1011	TmpFaultValue	01 Degree C	Temperature fault value	2 Bytes
FC	1111 1100	PV3FaultValue	0.1V	PV3 voltage fault value	2 Bytes
FD	1111 1101	GFCIFaultValue	0.001A	GFCI current fault value	2 Bytes
FE	1111 1110	Error/Waining message H		Error description refer to title3.2.5	2 Bytes
FF	1111 1111	Error/Waining message L		Error description refer to title3.2.5	2 Bytes

3.2.2. Reply Inverter ID data、HMI's software Ver、 HMI's hardware Ver、HMI Ver (Control Code 0x11,Function code 0x83)

Table 3.2-2

Data X	Length		Description
0	1 Byte	Machine type	Refer to follow table
1~6	6 Bytes	VA rating	1KVA = '30h 30h 31h 30h 30h 30h' , 3KVA= '30h 30h 33h 30h 30h 30h'
7~11	5 Bytes	Firmware Ver.	Firmware Version, Example '01.00' = '30h 31h 2Eh 30h 30h'
12-27	16 Bytes	Model Name	'Pv-Inv 1800' = '50h 76h 2Dh 49h 6Eh 76h 20h 31h 38h 30h 30h 20h 20h 20h 20h 20h'
28~43	16 bytes	Manufacturer	'EVERSOLAR' = '45h 56h 45h 52h 53h 4Fh 4Ch 41h 52h'
44~59	16 bytes	Serial number	Indicate the unique identify for every inverter,can setted by application.
60~63	4 Bytes	Nom_Vpv	Nominal PV voltage : Example 360.0V= '33h 36h 30h 30h' , unit 0.1V

64-76	13Bytes	InternalVer	Formal InternalVer :'V','6','1','0','-','0','1','0','0','5','-','0','4' Temporary InternalVer :'L','6','1','0','-','0','1','0','0','7','-','0','0'
77-96	20Bytes	HMI's software Ver.	Three phase inverter : HMI's software Ver.
97-107	11Bytes	HMI's hardware Ver .	Three phase inverter : HMI's hardware Ver.
108-120	13Bytes	HMI Ver.	Three phase inverter:HMI Ver.
121-133	13Bytes	Inter slave Ver	Formal InternalVer :'V','6','1','0','-','0','1','0','0','6','-','0','4' Temporary InternalVer :'L','6','1','0','-','0','1','0','0','8','-','0','0'

Machine type	Description
0x31	Single phase inverter
0x33	Three phase inverter

3.2.4. Operation Mode

Table 3.2-4-1Three phase inverter

Mode	H	L	Description
Waiting	0x00	0x00	PV voltage is less than start voltage and there aren't any fault .In this state, there is no output power transmitted to grid voltage.
Normal	0x00	0x01	If PV voltage is higher than start voltage, the state changes from waiting state to Normal state. In the normal state, output power will be transmitted to grid voltage and MPPT calculation will be executed, bus voltage will be adjusted and output power as well as the sum of output power will be calculated.
Fault	0x00	0x02	Fault signal occurs: execute the protect steps, insulate the grid voltage to system, detect the grid voltage and fault and judge whether the fault has been removed. The state can be resumed automatically after the fault has been removed.
Check	0x00	0x04	Check state act before feeding in grid.The inverter will check GFCI device,ISO device,ISO and Relay device.
Flash	0x00	0x05	Flash state is descripted as Inverter upgrade softer on-line.At flash state ,there is no output power transmit to grid ,and the communications light will be flashing.

Table 3.2-4-2Single phase inverter

Mode	H	L	Description
Waiting	0x00	0x00	PV voltage is less than start voltage and there aren't any fault .In this state, there is no output power transmitted to grid voltage.
Normal	0x00	0x01	If PV voltage is higher than start voltage, the state changes from waiting state to Normal state. In the normal state, output power will be transmitted to grid voltage and MPPT calculation will be executed, bus voltage will be adjusted and output power as well as the sum of output power will be calculated.
Fault	0x00	0x02	Fault signal occurs: execute the protect steps, insulate the grid voltage to system, detect the grid voltage and fault and judge whether the fault has been removed. The state can be resumed automatically after the fault has been removed.
Permanent Fault	0x00	0x03	System Fault. The protect steps will be executed and auto restart in 20s later. The condition of entering Permanent Fault mode : 1.Grid current DC offset 2.Eeprom cannot be read or write in 3.Communication between CPU is fail 4.Bus Voltage too high 5.Compare measured values from two CPU 6.relay check fail 7.GFCI Device check fail 8.HCT check fail
Flash	0x00	0x04	Flash state is descripted as Inverter upgrade softer on-line.At flash state ,there is no output power transmit to grid ,and the communications light will be flashing.

3.2.5. Error Message Description：

The Error messages consists of four bytes(refer table 3.2.5-1).The first byte value is equal to 0xFF,how to explain the Warning message in Table 3.2.5-2,and how to explain the Error message in Table 3.2.5-3.

Table 3.2.5-1

Error message H		Error message L
1Byte	1Byte	2Bytes
0xFF	Warning Code Detail in Table 3.2.5-2	Error code Detail in Table 3.2.5-3

Table 3.2.5-2

Warning code	**Description**
0	No warning
30	Recover from warning
31	PV1 input over voltage
32	PV2 input over voltage
33	PV3 input over voltage
34	PV1 input over current-software
35	PV1 input over current-hardware
36	PV2 input over current-software
37	PV2 input over current-hardware
38	PV3 input over current-software
39	PV3 input over current-hardware
40	BUS over voltage-software
41	BUS over voltage-hardware
42	BUS voltage unbalance(for three phase inverter)
43	Grid voltage over 110% rated voltage for ten minutes
44	Grid voltage over instant
45	output over current-software
46	output over current-hardware
47	anti-islanding
48	LVRT
49	Output power reduce at over at frequency
50	Output power reduce over at temperature
51	Output power reduce at input-current limit
52	Output power reduce output-current limit
53	Low Temperature
54	Data Flash Abnormal
55	Inverter R phase
56	Inverter S phase
57	Inverter T phase
58	Fan Abnormal

Table 3.2.5-3

Error code	**Error Message(need to display in monitor)**	**Description**
1	Communication Fails between M-S	Communication Fails between M-S

2	EEPROM R/W Fail	EEPROM R/W Fail
3	Relay check Fail	Relay check Fail
4	DC Injection High	DC Injection High
5	The result of Auto Test Function is fail	The result of Auto Test Function is fail
6	DC bus is too high	DC bus is too high
7	The voltage reference inside is abnormal	The voltage reference inside is abnormal
8	AC HCT Failure	AC HCT Failure
9	GFCI Device Failure	GFCI Device Failure
10	Device fault	Device fault
11	M-S version unmatch	M-S version unmatch
12~32	reserve	Reserve
33	Fac Faulure :Fac Out of Range	Fac Faulure :Fac Out of Range
34	AC Voltage Out of Range	AC Voltage Out of Range
35	Utility Loss	Utility Loss
36	GFCI Failure	GFCI Failure
37	PV Over Voltage	PV Over Voltage
38	Isolation Fault	Isolation Fault
40	Over temperature in Inverter	Over temperature in Inverter
41	Consistent Fault :Vac differs for M-S	Consistent Fault :Vac differs for M-S
42	Consistent Fault :Fac differs for M-S	Consistent Fault :Fac differs for M-S
43	Consistent Fault :Groud I differs for M-S	Consistent Fault :Groud I differs for M-S
44	Consistent Fault :DC inj. Differs for M-S	DC inj. Differs for M-S
45	Consistent Fault :Fac,Vac differs for M-S	Consistent Fault :Fac,Vac differs for M-S
46	Hign DC bus	Hign DC bus
47	Consistent Fault	Consistent Fault
48	Average volt of ten minutes Fault	Average volt of ten minutes Fault
49	PV1-SPD Fault	PV1-SPD Fault
50	PV2-SPD Fault	PV2-SPD Fault
51	Fuse Fault	Fuse Fault
52~65535	Reserve	Reserve

- **Description :**

Slave : Redundant Control System
Master : Major Control System

In order to achieve the greatest possible security, the automatic de-energizing place consists of two independent mechanisms developed in row for net monitoring with assigned allpoligen switches (ENS). Each of these mechanisms constantly supervises the quality of the attached net by examination of the tension, frequency and impedance. The redundant structure as well as an automatic self-check before each net netzzuschaltung guarantee the reliable function.

3.3. Control Code :0x12 'Write'

0x12	0x0D	40 Bytes	AP →Inverter		Set inverter grid voltage protection's threshold,response time and recovery voltage (Note3.3-1)
0x12	0x8D	1 Byte	Inverter→AP	NA	Reply setting sucess/fail(Note3.3-0)
0x12	0x0E	40 Bytes	AP →Inverter		Set inverter grid frequency protection's threshold,response time and recovery frequency (Note3.3-2)

0x12	0x8E	1 Byte	Inverter→AP	NA	Reply setting sucess/fail(Note3.3-0)
0x12	0x23	8 Bytes	AP →Inverter	NA	Set curve of active power feed-in at overfrequency(Note3.3-3)
0x12	0xA3	1 Byte	Inverter→AP	NA	Reply setting sucess/fail(Note3.3-0)
0x12	0x26	8 Bytes	AP →Inverter	NA	Set curve of active power feed-in at over grid volt (Note3.3-4)
0x12	0xA6	1 Byte	Inverter→AP	NA	Reply sucess/fail(Note3.3-0)
0x12	0x41	2 Bytes	AP →Inverter	%Pn	Set load %Pn per minute(Note3.3-5)
0x12	0xC1	1 Byte	Inverter→AP	NA	Reply setting sucess/fail(Note3.3-0)

Note :

0.Note3.3-0

The reply instruction refer to following :

0x12	Function code	Inverter → AP	Reply instruction

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data 0	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	1 Byte (0x12)	1 Byte (0xXX)	1 Byte (0x01)	1 Byte (0x15/0x06)	2 Bytes

Data 0 description :

Data0 :0x06——Set successfully

Data0 :0x15—Set failed

1.Note3.3-1

0x12	0x0D	AP → Inverter	Set inverter grid voltage protection's threshold,response time and recovery voltage

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data 0-39	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0xXX)	1 Byte (0x12)	1 Byte (0x0D)	1 Byte (0x28)	40 Byte	2 Bytes

The format of Data can refer to title 4.3(1).

2.Note3.3-2

0x12	0x0E	AP → Inverter	Set inverter grid frequency protection's threshold,response time and recovery frequency

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data 0-39	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0xXX)	1 Byte (0x12)	1 Byte (0x0E)	1 Byte (0x28)	40 Byte	2 Bytes

The format of Data can refer to title 4.3(2).

3.Note3.3-3

0x12	0x23	AP → Inverter	Set curve of active power feed-in at overfrequency

Header	Source Address	Destination Address	Control Code	Function Code	Data Length
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0xXX)	1 Byte (0x22)	1 Byte (0x23)	1 Byte (0x08)

Data 0 Mode select	Data1-2 F-start	Data3-4 F-back	Data5 Slope	Data6-7 Reserve	Check Sum
1 Byte	2 Bytes	2 Bytes	1 Byte	2 Bytes	2 Bytes

The protocol supply two kinds of adjusting mode whitch all need F-start,F-back and Slope.And specific operation refer to title 4.6

4.Note3.3-4

0x12	0x26	AP → Inverter	Set curve of active power feed-in at over grid volt

Header	Source Address	Destination Address	Control Code	Function Code	Data Length
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0xXX)	1 Byte (0x12)	1 Byte (0x26)	1 Byte (0x08)

Data0 Mode	Data1 Delay T1	Data2-3 Delay T2	Data4 U-start	Data5 P-start	Data6 U-stop	Data7 P-stop	Checksum
1 Byte (0x00)	1 Byte	2 Bytes	1 Byte	1 Byte	1 Byte	1 Byte	2 Bytes

Specific operation refer to title 4.7.

5.Note3.3-5

0x12	0x41	AP → Inverter	Set load %Pn per minute

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data 0-1 Delta %Pn	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0xXX)	1 Byte (0x12)	1 Byte (0x41)	1 Byte (0x02)	2 Bytes	2 Bytes

Inverter start working, at first,the output power is 0w,then inverter output power rise at %pn per minute until full load.

3.4. Control Code :0x13 'execute'

Control code	Function code	Vector	Description
0x13	0x15	AP →Inverter	Power on/off by Com(Note3.4-1)
0x13	0x95	Inverter → AP	Reply set success/fail(Note3.4-0)
0x13	0x20	AP →Inverter	Set active power output curve (Note3.4-2)
0x13	0xA0	Inverter → AP	Reply set success/fail(Note3.4-0)
0x13	0x21	AP →Inverter	Set reactive power output curve (Note3.4-3)
0x13	0xA1	Inverter → AP	Reply set success/fail(Note3.4-0)

Note :

0.Note3.4-0

The reply instruction refer to following :

0x13	Function code	Inverter → AP	Reply instruction

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data 0	Check Sum

2 Bytes (0xAA 0x55)	2 Bytes (0x00 0xXX)	2 Bytes (0xXX 0x00)	1 Byte (0x13)	1 Byte (0xXX)	1 Byte (0x01)	1 Byte (0x15/0x06)	2 Bytes

Data 0 description :
Data0 :0x06——Set/Calibrate/Enable successfully
Data0 :0x15—Set/Calibrate/Enable failed

1.Note3.4-1
Power on/off :

0x13	0x15	AP → Inverter	Power on/off by Com

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data 0 Power on /off	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0xXX)	1 Byte (0x13)	1 Byte (0x15)	1 Byte (0x01)	1 Bytes	2 Bytes

This instruction can control inverter power on/off by Com(such as combox or PMU).
Data 0(Power on/off) :
1—Power off
0—Power on(default)

2.Note3.4-2

0x13	0x20	AP →Inverter	Set active power output curve

Header	Source Address	Destination Address	Control Code	Function Code	Data length
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0xXX)	1 Byte (0x13)	1 Byte (0x20)	1 Byte (0x02)

Data 0 Percentage	Data 1 Response time	Check Sum
1 Byte	1 Byte	2 Bytes

Data 0(Percentage) and Data 1(Response time) can refer to title 4.5(1).

3.Note3.4-4

0x13	0x21	AP →Inverter	Set reactive power output curve

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data 0-7	Check Sum
2 Bytes (0xAA 0x55)	2 Bytes (0xXX 0x00)	2 Bytes (0x00 0xXX)	1 Byte (0x13)	1 Byte (0x21)	1 Byte (0x08)	8 Bytes	2 Bytes

Data0-7 are usede to set curve mode and curve parameter,refer to title 4.5(2).

4. Instruction description

4.1 Function model select(Control Code 0x11,Function code 0x85,Data37-40)

Function model bits define:
The first four-high bits indicate the EEPROM Ver.,so the four bits are writed to 0xAxxxxxxx;

wFuncEnable default	0xAFFFFFFF
GFCI protect enable	0xA0008000
ISO protect enable	0xA0004000
DCI detection enable	0xA0002000
LVRT enable	0xA0001000
Gridvolt detection enable	0xA0000800
Grid frequency detection enable	0xA0000400
Islanding protect enable	0xA0000200
Fan detection enable	0xA0000100
VDE 10Min add Load enable	0xA0000040
VDE Over-Freq derating enable	0xA0000020
110%+10min protection enable	0xA0000010
Reactive power adjust enable	0xA0000008
Active power adjust enable	0xA0000004
Over grid volt derating enable	0xA0000002
others	reserved

NOTE: The variable is saved to EEPROM and recovered after a loss of power

4.2 Define Safety Type (Control Code 0x11,Function code 0x86)

This table description the safety type and the corresponding code. for example, received the safety type is "1", it means the safety type is "CQC".

Code(8 bit)	Safety Type
0x0	德国 VDE0126-1-1(2013 版)
0x 1	中国 CQC
0x 2	西班牙 RD1663
0x 3	意大利 DK5940
0x 4	英国G59-3
0x 5	德国中压 BDEW
0x 6	荷兰 Holand
0x 7	英国G83-2
0x 8	希腊 GreeceMainl8and
0x 9	中国台湾 BSMI
0x A	德国 VDE4105
0x B	法国 France
0x C	比利时 Belgium
0x D	意大利 ENEL
0x E	澳大利亚 AS4777
0x F	希腊岛屿 cGreeceIslands
0x 10	保加利亚 cBulgaria
0x11	瑞典 cSweden
0x 12	丹麦 cDenmark
0x 13	北美 cETL
0x 14	瑞士 cSwitzerland

0x15	捷克 cCzech
0x16	土耳其 Turkey
0x17	爱尔兰 Ireland
0x18	德国 VDE0126(2006 版)
0x19	欧盟 EN50438
0X1A	泰国 Thailand(MEA)
0X1B	泰国 Thailand(PEA)
0X1C	奥地利 Austria
0X1D	菲律宾 Philippines
0X1E	墨西哥 Mexico
0X1F	印度 India
0x20	英国 G83-1
0x21	英国 G59-1
0x22	奥地利 TOR D4
0x23	中国新能标 NB/T 32004
0x24	中国新能标 CN GB/T 19964
0x25	荷兰 NL EN50438:2013
0x26	墨西哥 MX-01
0x27	墨西哥 MX-02
0x28	墨西哥 MX-03
0x29	南韩 KR PV-501
0x2A	巴西 BR NBR 16149:2013
0x2B	斯里兰卡 Sri Lanka

4.3 Define the format of threshold voltage/frequency

The range of parameters is just a reference value.Different inverter type may reply success or fail for the same setting.So suggest that AP/customer can confirm the inverter mode before setting this instructions.

(1).Format of threshold voltage protection(Control Code 0x11,Function code 0x08, and Control Code 0x12,Function code 0x0D)

Data code	Description	unit	range	Length
Data 0-1	Grid voltage high limit3	0.1v	240-295v	2 bytes
Data 2-5	Grid voltage high limit time3	Grid period	20-5100ms	4 bytes
Data 6-7	Grid voltage high limit2	0.1v	240-295v	2 bytes
Data 8-11	Grid voltage high limit time2	Grid period	20-720000ms	4 bytes
Data 12-13	Grid voltage high limit1	0.1v	240-295v	2 bytes
Data 14-17	Grid voltage high limit time1	Grid period	20-720000ms	4 bytes
Data 18-19	Grid voltage low limit3	0.1v	110-230v	2 bytes
Data 20-23	Grid voltage low limit time3	Grid period	20-5100ms	4 bytes
Data 24-25	Grid voltage low limit2	0.1v	110-230v	2 bytes
Data 26-29	Grid voltage low limit time2	Grid period	20-720000ms	4 bytes
Data 30-31	Grid voltage low limit1	0.1v	110-230v	2 bytes
Data 32-35	Grid voltage low limit time1	Grid period	20-720000ms	4 bytes
Data 36-37	Grid voltage high recovery value	0.1v	230-OVP1:Volt	2 bytes

Data 38-39	Grid voltage low recovery value	0.1v	UVP1:Volt-230	2 bytes

(2).Format of threshold frequency protection(Control Code 0x11,Function code 0x09, and Control Code 0x12,Function code 0x0E)

Data code	Description	unit	range	Length
Data 0-1	Grid frequency high limit1	0.01Hz	45-65Hz	2 bytes
Data 2-5	Grid frequency high limit time1	Grid period	20-5100ms	4 bytes
Data 6-7	Grid frequency high limit2	0.01Hz	45-65Hz	2 bytes
Data 8-11	Grid frequency high limit time2	Grid period	20-720000ms	4 bytes
Data 12-13	Grid frequency high limit3	0.01Hz	45-65Hz	2 bytes
Data 14-17	Grid frequency high limit time3	Grid period	20-720000ms	4 bytes
Data 18-19	Grid frequency low limit1	0.01Hz	45-65Hz	2 bytes
Data 20-23	Grid frequency low limit time1	Grid period	20-5100ms	4 bytes
Data 24-25	Grid frequency low limit2	0.01Hz	45-65Hz	2 bytes
Data 26-29	Grid frequency low limit time2	Grid period	20-720000ms	4 bytes
Data 30-31	Grid frequency low limit3	0.01Hz	45-65Hz	2 bytes
Data 32-35	Grid frequency low limit time3	Grid period	20-720000ms	4 bytes
Data 36-37	Grid frequency high recovery value	0.01Hz	45-OFP1:Freq	2 bytes
Data 38-39	Grid frequency low recovery value	0.01Hz	UFP1:Freq-65	2 bytes

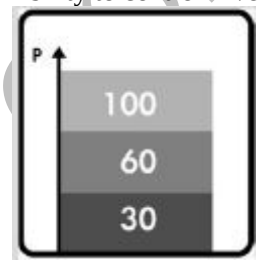
4.4 Language code description(Control Code 0x11,Function code 0x8A)

This table descript the language of PCU displaying and AP receiveing. For example, receive the Language code is "0",meaning English.

Language	Code	Len
English	0	1Byte
Simplified Chinese	1	1Byte
German	2	1Byte
Traditional Chinese	3	1Byte
Italian	4	1Byte
Spanish	5	1Byte
French	6	1Byte
Default(English)	99	1Byte

4.5 Active power adjust & Reactive power adjust command format

(1) Active power adjust(Control Code 0x11,Function code 0x20, and Control Code 0x13,Function code 0x20)

Data0	Ability to control Inverter output a specified percentage of power rating (Remote Dispatch)  a specified percentage of nominal power rating（100：Full output，0：no output power）
Data1	Response time（the time of process that the output power is adusted to the specified value is not less than the value of Data1，unit：s）

For example, limit value is 90% of Full output power，action time >= 30s

The data format is following：

In Broadcast Mode :

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0	Data1	Checksum
0xAA 0x55	2 Bytes	2 Bytes	0x11(read)/ 0x13(set)	0x20	0x02	90	30	2 Bytes

In Single Mode :

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0	Data1	Checksum
0xAA 0x55	2 Bytes	2 Bytes	0x11(read)/ 0x13(set)	0x20	0x02	90	30	2 Bytes

(2) Reactive power adjust (Control Code 0x11,Function code 0x21, and Control Code 0x13,Function code 0x21)

Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0(Mode0)	0	0	0	0	0	0	0
1(Mode1)	cosφ	0x01 :leading 0x02 :lagging	0	0	0	0	0
2(Mode2)	P1(%Sn)	cosφ1	0x01 : leading 0x02 : lagging	P2(%Sn)	cosφ2	0x01 : leading 0x02 : lagging	0
3(Mode3)	cosφ	0x01 :leading 0x02 :lagging	0	0	0	0	0
4(Mode4)	Q(%Sn)	0x01 :leading 0x02 :lagging	0	0	0	0	0
5(Mode5)	U1(%Un)	Q1	0x01 : leading 0x02 : lagging	U2(%Un)	Q2	0x01 : leading 0x02 : lagging	1Byte
6(Mode6)	Q(%Sn)	0x01 :leading 0x02 :lagging	0	0	0	0	0
7(Mode7)	U1(%Un)	Umax(%Un)	Q1	U2(%Un)	Umin(%Un)	Q2	1Byte
Data0	**Data1**	**Data2**	**Data3**	**Data4**	……		
8(Mode8)	Delay time	P1(%Sn)	cosφ1	0x01 : leading 0x02 : lagging	……		
9(Mode9)	Delay time	U1(%Un)	Q1	0x01 : leading 0x02 : lagging	……		

Note :

(1) cosφ ∈[0,100],ex.PF = 0.98,the value of cosφ = 98
(2) Q ∈[0,100],ex.Reactive Power = 50%*Sn, the value of Q = 50
(3) U ∈[0,120],ex.90%Un,the value of U = 90
(4) Mode0-7,the data 7 stand for delay time ,rangeing from 0s to 60s.
(5) Mode8 and mode9 are dynamic data length mode ,
Data1 stand for delay time ,rangeing from 0s to 60s;
Mode8: the following datas arrengment as Px(%Sn), cosφx,aspect(x=0,1,2……) until over.
Mode9: the following datas arrengment as Ux(%Sn), Qx,aspect(x=0,1,2……) until over.

For example : If set mode 1, cosφ= 0.95, lagging, response time >=30s, The data format is following：

In Broadcast Mode :

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0	Data1	Data2	Data3~7	Checksum
0xAA	2 Bytes	2 Bytes	0x11/	0x8F/	0x08	1	95	2	0	2 Bytes

0x55			0x13	0x21						

In Single Mode :

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0	Data1	Data2	Data3~7	Checksum
0xAA 0x55	2 Bytes	2 Bytes	0x11/ 0x13	0x8F/ 0x21	0x08	1	95	2	0	2 Bytes

4.6Descript active power feed-in at overfrequency (Control Code 0x11,Function code 0xA3, and Control Code 0x12,Function code 0x23)

Data code	Description	Length
Data 0 (Mode select)	The protocol supply two kinds of adjusting mode . Mode 0 :non-hysteresis mode,refer to fig 4.6-1 Mode 1 :hysteresis mode,refer to fig 4.6-2 Mode 2 :No enable,only for 0x11 0x23	1 Byte
Data 1 (Delay time)	Receive the instruction after N s ,then execute. Unit :S,default 0s	1Byte
Data2-3 (F-start)	This frequency is used to be start point when reduce active power at overfrequency,unit :0.01Hz	2 Bytes
Data 4-5 (F-stop)	This frequency is used to be stop point when reduce active power at overfrequency,unit :0.01Hz	2 Bytes
Data 6-7 (F-back)	This frequency is used to be end point when reduce active power at overfrequency,unit :0.01Hz	2 Bytes

Fig 4.6-1

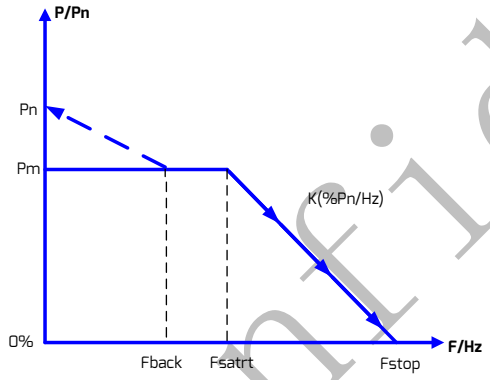
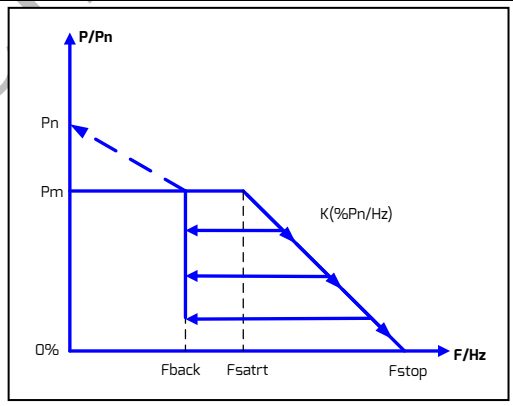


Fig 4.6-2



For example.if set non-hysteresis mode,F-start is 50.2Hz,F-back is 50Hz, Slope k is 40%.The data format is following：

In Broadcast Mode :

Header	Source Address	Destination Address	Control Code	Function Code	Data length
0xAA 0x55	2 Bytes	2 Bytes	0x11(read)/ 0x12(write)	0xA3/ 0x23	0x08

Data0 Mode	Data1 Delay T	Data2-3 F-star	Data4-5 F-stop	Data6-7 F-back	Checksum
0	0	5020	5270	5020	2 Bytes

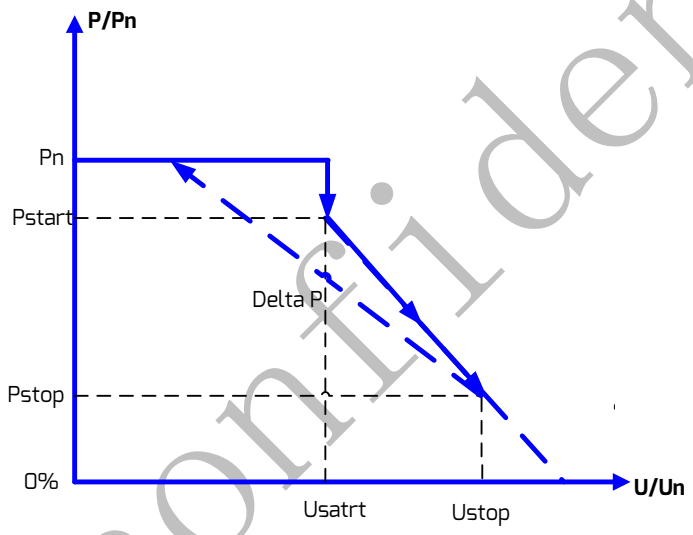
In Single Mode :

Header	Source Address	Destination Address	Control Code	Function Code	Data length
0xAA 0x55	2 Bytes	2 Bytes	0x11(read)/ 0x12(write)	0xA3/ 0x23	0x08

Data0 Mode	Data1 Delay T	Data2-3 F-star	Data4-5 F-stop	Data6-7 F-back	Checksum
0	0	5020	5270	5020	2 Bytes

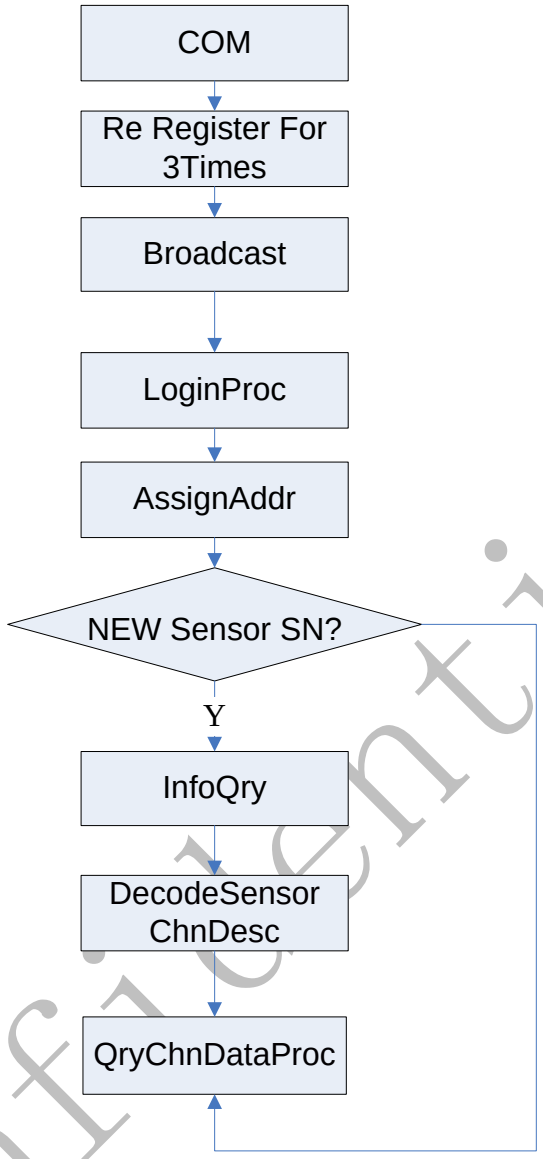
4.7 Descript active power feed-in at over grid volt (Control Code 0x11,Function code 0xA6, and Control Code 0x12,Function code 0x26)

Data code	Description	Length
Data 0 (Mode select)	The protocol supply two kinds of adjusting mode . Mode 0 :non-hysteresis mode	1 Byte
Data 1 (Delay T1)	Before decrase active power delay Ns. Unit :S,default 0s	1Byte
Data 2-3 (Delay T2)	Before recover active power delay Ns. Unit :S,default 0s	2Bytes
Data4 (U-start)	This volt is used to be start point when reduce active power at over gird volt,unit :%Un	1Byte
Data 5 (P-start)	This power is used to be start point when reduce active power at over gird volt,unit :%Pn	1Byte
Data 6 (U-stop)	This volt is used to be stop point when reduce active power at over gird volt,unit :%Un	1Byte
Data 7 (P-stop)	This power is used to be stop point when reduce active power at over gird volt,unit :%Pn	1Byte



5.Sensor Instruction Set

PMU and sensor communication process is as follows.



5.1. Control Code :0x10 'register'

Table 5-1

Control code	Function code	Vector	Description
0x10	0x00	AP →Sensor	Off-line query
0x10	0x80	Sensor →AP	register request
0x10	0x01	AP → Sensor	send register address
0x10	0x81	Sensor →AP	address confirm

5.2. Control Code :0x11 'Read'

Table 5-2

Control code	Function code	Vector	Description
0x11	0x00	AP → Sensor	Read description
0x11	0x80	Sensor →AP	Read description response
0x11	0x02	AP → Sensor	query data info

0x11	0x82	Sensor →AP	Response for data info
0x11	0x03	AP → Sensor	query Sensor ID info
0x11	0x83	Sensor →AP	reply ID data

5.2.1. 'Read only': Data Code (Function code 0x02)

Table 5-3

Data Code (hex)	Data Code (bin)	Measuring Channels	Unit	Description	Length
20	0001 0100	surTemp	0.1 degree C	Ambient Temperature(Sensor)	2 Bytes
21	0001 0101	bdTemp	0.1 degree C	Panel temp(Sensor)	2 Bytes
22	0001 0110	irr	0.1 W / M2	RAD(Sensor)	2 Bytes
23	0001 0111	windSpeed	0.1 M / S	Speed of wind(Sensor)	2 Bytes