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1 General information

The guide is to give you the definition of the protocol 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 set to 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 follows:
  - There is no wait and then to directly send for the first time , SN= the serial number of machine.
  - If it does not succeed , the second wait times=SN%15, SN=SN/15.
  - The third wait times= SN%15, SN=SN/15.
  - The fourth wait times= SN%15, SN=SN/15.

    in turn
- 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.

2 Packet Format

2.1. Packet Format

Table 2-1

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	1 Byte	1 Byte (N)

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

2.2. Description

Table 2-2

	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)
Function Code	
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 2-3

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

- Communication timing

Table 2-4

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	Off-line query
0x10	0x80	Inverter→AP	register request
0x10	0x01	AP →Inverter	send register address
0x10	0x81	Inverter→AP	address confirm
0x10	0x02	AP →Inverter	remove register
0x10	0x82	Inverter→AP	remove confirm
0x10	0x03	AP →Inverter	re-connect removed Inverter
0x10	0x04	AP →Inverter	Re-register

3.2. Control Code :0x11 'Read'

Table3-2

Control code	Function code	Vector	Description
0x11	0x00	AP →Inverter	Read description
0x11	0x80	Inverter→AP	Read description response
0x11	0x01	AP →Inverter	Read/Write description
0x11	0x81	Inverter→AP	Read/Write description response
0x11	0x02	AP →Inverter	query normal info
0x11	0x82	Inverter→AP	Response for query
0x11	0x03	AP →Inverter	query Inverter ID info
0x11	0x83	Inverter→AP	reply ID data
0x11	0x04	AP →Inverter	read set info
0x11	0x84	Inverter→AP	reply set info
0x11	0x05	AP →Inverter	Query Inverter S/W Version(17K only)
0x11	0x85	Inverter→AP	Response S/W Version(17K only)
0x11	0x10	AP →Inverter	Fix size command
0x11	0x90	Inverter→AP	Reply Fix size command
0x11	0x11	AP →Inverter	Pv17 MasterA information
0x11	0x91	Inverter→AP	Reply Pv17 MasterA information
0x11	0x12	AP →Inverter	Pv17 SlaveB information
0x11	0x92	Inverter→AP	Reply Pv17 SlaveB information
0x11	0x40	AP →Inverter	read Model info(17K only)
0x11	0xC0	Inverter→AP	reply Model info(17K only)
0x11	0x41	AP →Inverter	Read DC Current Injection (17K only)
0x11	0xC1	Inverter→AP	Reply DC Current Injection (17K only)
0x11	0x42	AP →Inverter	Read Master-Slave-Logger Version
0x11	0xC2	Inverter→AP	Reply Master-Slave-Logger Version

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

Table 3-3

Data Code (hex)	Data Code (bin)	Measuring Channels	Unit	Description	Length
00	0000 0000	Temperature	0.1 degree C	Inverter internal temperature	2 Bytess
01	0000 0001	Vpv1	0.1V	PV1 voltage	2 Bytess
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 Table5-4(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
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 message H		Failure description for status ‘failure’ Table3-7(3phase system)	2 Bytes
3F	0011 1111	Error message L		Failure description for status ‘failure’ Table3-7(3phase system)	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	Vpv	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

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4C	0100 1100	Mode		Operation Mode Table3-6	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 message H		Failure description for status 'failure' Table3-7	2 Bytes
7F	0111 1111	Error message L		Failure description for status 'failure' Table3-7	2 Bytes

■ S phase of 3 phase system:

Table 3-4

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 Table3-6	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 message H		Failure description for status 'failure' Table3-7	2 Bytes
BF	1011 1111	Error message L		Failure description for status 'failure' Table3-7	2 Bytes

■ T phase of 3 phase system

Table 3-5

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

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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 Table3-6	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 message H		Failure description for status 'failure' Table3-7	2 Bytes
FF	1111 1111	Error message L		Failure description for status 'failure' Table3-7	2 Bytes

- **Description :**

Table 3-6

Mode		Description
Wait	0x00 0x00	PV voltage is less than start voltage and there isn't any fault .In the state there is not output power transmitted to grid voltage.
Normal	0x00 0x01	If PV voltage is larger than start voltage, the state changes to Normal state in Wait 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

Table 3-7

	Error message	Description
Bit31	Master-Slave-Fail	Communication between microcontrollers is failing
Bit30	EEPROM-Fail	EEPROM cannot be read or written
Bit29	Fac-Master-Fail	The master-frequency is out of tolerable range
Bit28	Fac-Slave-Fail	The slave-frequency is out of tolerable range
Bit27	NA	NA
Bit26	NA	NA
Bit25	Rly1-Fail	Relay is Fail

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Bit24	NA	NA
Bit23	ENS-Vac-Fail	Different value between Master and Slave for grid voltage
Bit22	ENS-Fac-Fail	Different value between Master and Slave for grid frequency
Bit21	NA	NA
Bit20	ENS-Mess-Fail	Different value between Master and Slave for Fac, Uac
Bit19	Offset-Iac-Fail;	The DC injection check for grid Current is fail
Bit18	Zpv-PE-Fail	Isolation resistance of PV-plant out of tolerable range before connecting to the grid
Bit17	Vac-Master-Fail	Master-grid voltage measurement-value out of tolerable range
Bit16	FanLock-Warning	Fan Lock
Bit15	VpvMax-Fail	Pv input voltage is over the tolerable maximum value
Bit14	NA	NA
Bit13	Temperature -Fail	Over temperature fault
Bit12	M-S Version Fail	Master and Slave firmware version is unmatch(only for three phase inv)
Bit11	Bus-Fail	Dc bus fault
Bit10	GFCI-Fail	Ground current is too high
Bit 9	No-Utility	Grid voltage =0
Bit8	NA	NA
Bit7	Device Fault	Device Fault
Bit6	Bus_High-Fail	Dc Bus voltage is too high.
Bit5	NA	NA
Bit4	ENS-GFCI-Fault	Different value between Master and Slave for GFCI
Bit 3	ENS-DCI- Fault	Different value between Master and Slave for output DC current
Bit 2	Ref 2.5V Fault	The 2.5V reference inside are abnormal
Bit 1	DC Sensor Fault	The DC output sensor is abnormal
Bit 0	GFCI Failure	The GFCI detection circuit is abnormal

- **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.

3.2.2. Reply Id info: the Data X defined by table 3-8 (Function code 0x03)

Table 3-8

Data X	Length		Description
0	1 Byte	Phase number	31h: single phase/33h: three phases
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	
60~63	4 Bytes	Nom_Vpv	Nominal PV voltage: Example 360.0V= '33h 36h 30h 30h' , unit 0.1V

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3.2.3. Set information: Data number defined by table 3-9(Function code 0x04)

Table 3-9

Data number	Length	Name	Unit	Description
(01)00 0000	2 Bytes	Vpv-Start	0.1V	PV start-up voltage
(01)00 0001	2 Bytes	T-Start	S	Time to connect grid
(01)00 0010	2 Bytes	NA	NA	NA
(01)00 0011	2 Bytes	NA	NA	NA
(01)00 0100	2 Bytes	Vac-Min	0.1V	Minimum operational grid voltage
(01)00 0101	2 Bytes	Vac-Maxta	0.1V	Maximum operational grid voltage
(01)00 0110	2 Bytes	Fac-Min	0.01Hz	Minimum operational grid Frequency
(01)00 0111	2 Bytes	Fac-Max	0.01Hz	Maximum operational grid Frequency
(01)00 1000	2 Bytes	NA	NA	NA
(01)00 1001	2 Bytes	NA	NA	NA

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3.2.4. 'Fix size' Read only data table(Control Code 0x11 Function code 0x10)
Table 3-10

Item	Measuring Channels	Unit	Description	Length
00	Temperature	0.1 degree C	Inverter internal temperature	2 Bytes
01	Vpv1	0.1V	PV1 voltage	2 Bytes
02	Vpv2	0.1V	PV2 voltage	2 Bytes
03	NA	NA	NA	NA
04	Ipv1	01.A	PV1 Current	2 Bytes
05	Ipv2	0.1A	PV2 Current	2 Bytes
06	NA	NA	NA	NA
07	Iac_R	0.1A	Phase R Current to grid	2 Bytes
08	Iac_S	0.1A	Phase S Current to grid	2 Bytes
09	Iac_T	0.1A	Phase T Current to grid	2 Bytes
10	Vac_R	0.1V	Phase R Grid voltage	2 Bytes
11	Vac_S	0.1V	Phase S Grid voltage	2 Bytes
12	Vac_T	0.1V	Phase T Grid voltage	2 Bytes
13	Fac	0.01Hz	Grid frequency	2 Bytes
14	Pac_R	W	Power to grid	2 Bytes
15	Pac_S	W	Power to grid	2 Bytes
16	Pac_T	W	Power to grid	2 Bytes
17	NA	NA	NA	NA
18	NA	NA	NA	NA
19	NA	NA	NA	NA
20	E-Total H	0.1KW.Hr	Total energy to grid	2 Bytes
21	E-Total L	0.1KW.Hr	Total energy to grid	2 Bytes
22	h-Total H	Hr	Total operation hours	2 Bytes
23	h-Total L	Hr	Total operation hours	2 Bytes
24	Mode		Operation Mode Table3-6	2 Bytes
25	GVFaultValue	0.1V	Grid voltage fault value	2 Bytes
26	GFFaultValue	0.01Hz	Grid frequency fault value	2 Bytes
27	GZFaultValue	0.001Ω	Grid impedance fault value	2 Bytes
28	TmpFaultValue	01. Degree C	Temperature fault value	2 Bytes
29	PVFaultValue	0.1V	PV voltage fault value	2 Bytes
30	GFCIFaultValue	0.001A	GFCI current fault value	2 Bytes
31	Error message H		Failure description for status 'failure' Table3-7	2 Bytes
32	Error message L		Failure description for status 'failure' Table3-7	2 Bytes

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3.3. Control Code :0x12 'Write'

Table 3-11

Control code	Function code	Name	Unit	Valid Range		Default Value
				High limit	Low limit	
0x12	0x00	Vpv-Start	0.1V	Refer to specification	Refer to specification	Refer to specification
0x12	0x01	T-Start	S			
0x12	0x02	Vpv-High-Stop	0.1V			
0x12	0x03	Vpv-Low-Stop	0.1V			
0x12	0x04	Vac-Min	0.1V			
0x12	0x05	Vac-Max	0.1V			
0x12	0x06	Fac-Min	0.01Hz			
0x12	0x07	Fac-Max	0.01Hz			
0x12	0x20	Control Power		"2 " dec Power	"8 " inc power	
0x12	0x3F	SerNum	ASCII	16 Bytes		
0x12	0x3D	DC Current Limit	CNT	for model		

批注 [雨林木风1]: Add to control PCU power

3.4. Control Code :0x13 'execute'

Table 3-12

Control code	Function code	Description
0x13	0x00	Reset E-total and h-Total record
0x13	0x01	Enable DC Current calibrate function
0x13	0x02	Enable Grid Voltage Calibrate function
0x13	0x03	Enable DC Current mid point calibrate function
0x13	0x04	PV17K Isolation Pv Voltage ADJ
0x13	0x05	TL series Dc injection Adjust
0x13	0x06	Set Model(17K only)
0x13	0x07	PV17K European Efficiency Test
0x13	0x08	PV 17K ISO Va Calibrate function
0x13	0x09	PV 17K Remote ON
0x13	0x0A	Remote OFF
0x13	0x0B	PV 17K ISO Va Calibrate function 2
0x13	0x0C	17K PV Voltage Calibrate function
0x13	0x10	Modify Model Name
0x13	0x11	Modify Firmware Version
0x13	0x12	Modify safety and language information
0x13	0x13	Modify customer information
0x13	0x14	set RTC time
0x13	0x16	Autotest_logger
0x13	0x17	Watt load adjust parameter is set 1
0x13	0x18	Watt load adjust parameter is set 2
0x13	0x80	Reset E-total and h-Total record ACK

4 Examples

4.1. Off-line query:

- AP queries whether there is a new Inverter added (Control Code:0x10 Function Code 0x00)

Table 4-1

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum

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2 Bytes (0xAA 0x55)	2 Bytes (0x01 0x00)	2 Bytes (0x00 0x00)	1 Byte (0x10)	1 Byte (0x00)	1 Byte (0x00)	2 Bytes

- The off-line Inverter reply register request(Control Code:0x10, Function Code 0x80)
  If pv_inverter serial number is '0123456789abcdef'

Table 4-2

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0x00)	2 Bytes (0x01 0x00)	1 Byte (0x10)	1 Byte (0x80)	1Byte (0x10)	1 Byte (0x30)

Data1	Data2	Data3	…	Data15	Checksum
1 Byte (0x31)	1 Byte (0x32)	1 Byte (0x33)	1 Byte (..)	1 Byte (0x39)	2 Bytes

  - **Description:** Data0 to Data15 is Inverter serial number

- AP allocates address for Inverter (Control Code:0x10 Function Code 0x01)
  If AP allocate register address(0x11) to Inverter.

Table 4-3

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0
2 Bytes (0xAA 0x55)	2 Bytes (0x01 0x00)	2 Bytes (0x00 0x00)	1 Byte (0x10)	1 Byte (0x01)	1Byte (0x11)	1 Byte (0x30)

Data1	Data2	Data3	…	Data15	Data16	Checksum
1 Byte (0x31)	1 Byte (0x32)	1 Byte (0x33)	1 Byte (..)	1 Byte (0x39..)	1Byte(register Address) (0x11)	2 Bytes

  - **Description:** 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

- Inverter reply address confirm (Control Code:0x10 Function Code 0x81)

Table 4-4

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 ACK(0x06)	2 Bytes

  - **Description:** 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.

4.2. Register removing:

- AP removes the registered Inverter from 'the map of allocated address' (Control Code:0x10 Function Code 0x02)

Table 4-5

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

- Inverter reply removing confirm (Control Code:0x10 Function Code 0x82)

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Table 4-6

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

- **Description:**
  - 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.

4.3. Reconnect Removed Inverter

- AP asks the 'register removed' Inverter to reconnect (Control Code:0x10 Function Code 0x03)

Table 4-7

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

- **Description:** 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.

4.4. AP asks Inverter to re-register (Control Code:0x10 Function Code 0x04)

Table 4-8

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

- **Description:** 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.

4.5. AP queries Inverter Read (Control Code:0x11 Function Code 0x00)

Table 4-9

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0x01 0x 00)	2 Bytes (0x00 0x11)	1Byte (0x11)	1 Byte (0x00)	1Byte (0x00)	2 Bytes

- Inverter reply Read

Table 4-10

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0x11)	2Bytes (0x01 0x00)	1Byte (0x11)	1Byte (0x80)	1 Byte	1Byte (DataNoxx)

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

- **Description:** 'Read Data lists 'Read only Data' of the Inverter and each 'Read only description' has own Data number such as the table 3-3. This information will be used to identify the data sent

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back when AP executes query instruction of 'Read only Data'.

4.6. AP queries Inverter Read/Write (Control Code:0x11 Function Code 0x01)

Table 4-11

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0x01 0x 00)	2 Bytes (0x00 0x11)	1Byte (0x11)	1 Byte (0x01)	1Byte (0x00)	2 Bytes

- Inverter reply Read/Write

Table 4-12

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0x11)	2Bytes (0x01x00)	1Byte (0x11)	1Byte (0x81)	1 Byte	1 Byte

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

- **Description:** 'Read/Write Data' lists the 'Read/Write Data' of the Inverter and each 'Read/Write Data' has own Data number such as the table 3-3. This information will be used to identify the data sent back when AP executes query instruction of 'Read/Write Data'.

4.7. AP queries Inverter normal info (Control Code:0x11 Function Code 0x02)

Table 4-13

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0x01 0x 00)	2 Bytes (0x00 0x11)	1.Byte (0x11)	1 Byte (0x02)	1byte (0x00)	2 Bytes

- Inverter reply' Read only Data' (Control Code:0x11 Function Code 0x82)

Table 4-14

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

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

- **Description:** Because each 'Read only Data' has own Data number such as the table 3-3, moreover, the length of it is 1 byte, AP will get the expressive meaning of data0 Data1…data (N-1) via the instruction of 'Read Data' which sends back the Data number and sequence.

4.8. AP query Inverter ID info (Control Code:0x11 Function Code 0x03)

Table 4-15

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0x01 0x 00)	2 Bytes (0x00 0x11)	1Byte (0x11)	1 Byte (0x03)	1Byte (0x00)	2 Bytes

- Inverter reply Inverter ID info (Control Code:0x11 Function Code 0x83)

Table 4-16

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0x11)	2Bytes (0x01 0x00)	1Byte (0x11)	1Byte (0x83)	1 Byte	1 Byte

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

- **Description:** Because each 'Read/Write Data' has own Data number such as the table 3-8, moreover, the length of it is 1 byte, AP will get the expressive meaning of data0 Data1…data (N-1) via the instruction of 'Read/write Data'.

4.9. AP query Inverter set info (Control Code:0x11 Function Code 0x04)

Table 4-17

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum
2 Bytes (0xAA 0x55)	2 Bytes (0x01 0x 00)	2 Bytes (0x00 0x11)	1Byte (0x11)	1 Byte (0x04)	1Byte (0x00)	2 Bytes

- Inverter reply Inverter set info (Control Code:0x11 Function Code 0x84)

Table 4-18

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0
2 Bytes (0xAA 0x55)	2 Bytes (0x00 0x11)	2Bytes (0x01 0x00)	1Byte (0x11)	1Byte (0x84)	1 Byte	1 Byte

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

- **Description:** Because each 'Read/Write Data' has own Data number such as the table 3-9, moreover, the length of it is 1 byte, AP will get the expressive meaning of data0 Data1…data (N-1) via the instruction of 'Read/write Data'.

4.10. AP writes data to Inverter (Control Code:0x12)

Table 4-19

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0
2 Bytes (0xAA 0x55)	2 Bytes (0x01 0x00)	2Bytes (0x00 0x11)	1Byte (0x12)	1Byte	1 Byte	1 Byte

Data1	Checksum
1 Byte	2 Bytes

- Inverter reply 'Write Data'

- Set Successfully

Table 4-20

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 (0x12)	1 Byte	1Byte (0x01)	1Byte ACK (0x06)	2 Bytes

- Disable Set

Table 4-21

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0	Checksum
2 Bytes (0xAA0x55)	2 Bytes (0x00 0x11)	2Bytes (0x01 0x00)	1Byte (0x12)	1 Byte	1Byte (0x01)	1Byte NAK (0x15)	2 Bytes

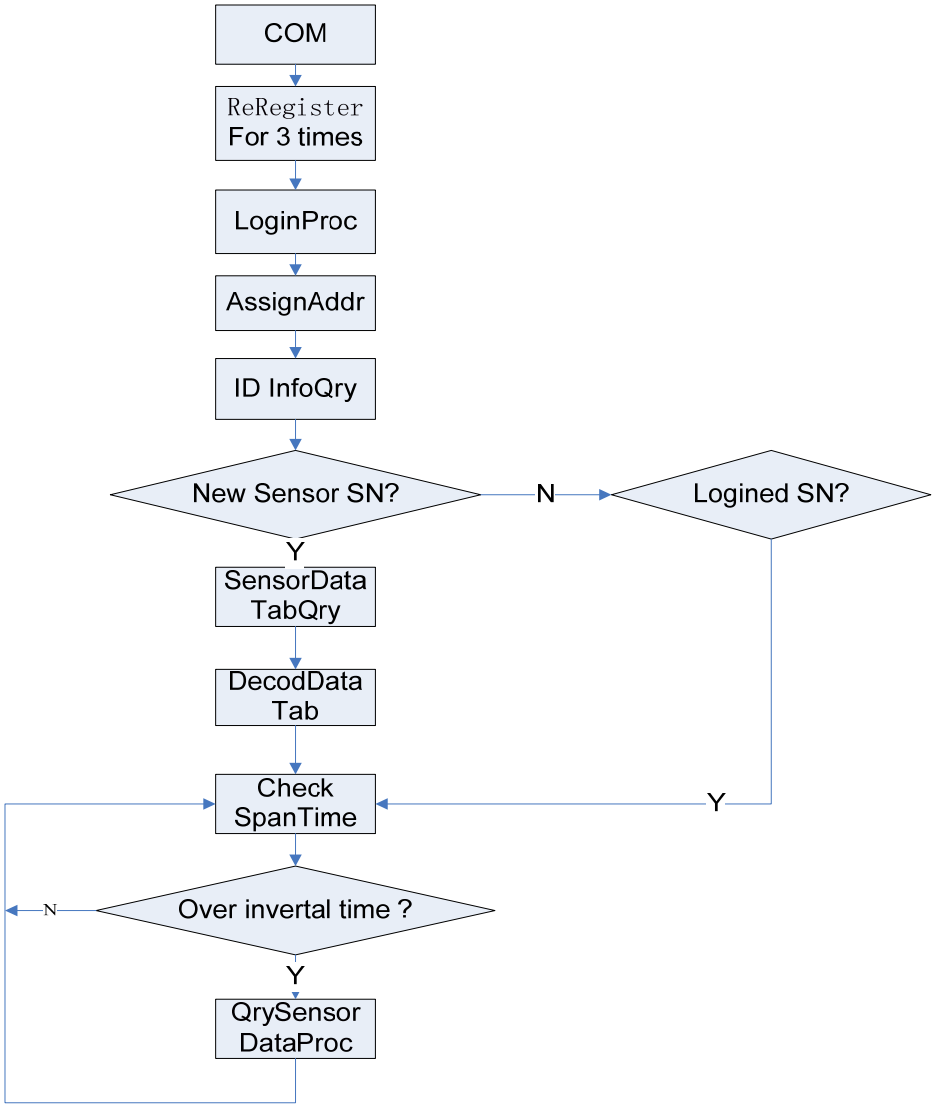
- Checksum Error or Format Error

Table 4-22

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0	Checksum
2 Bytes (0xAA0x55)	2 Bytes (0x00 0x11)	2 Bytes (0x01 0x00)	1Byte (0x12)	1 Byte	1Byte (0x01)	1Byte NULL (0x00)	2 Bytes

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

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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