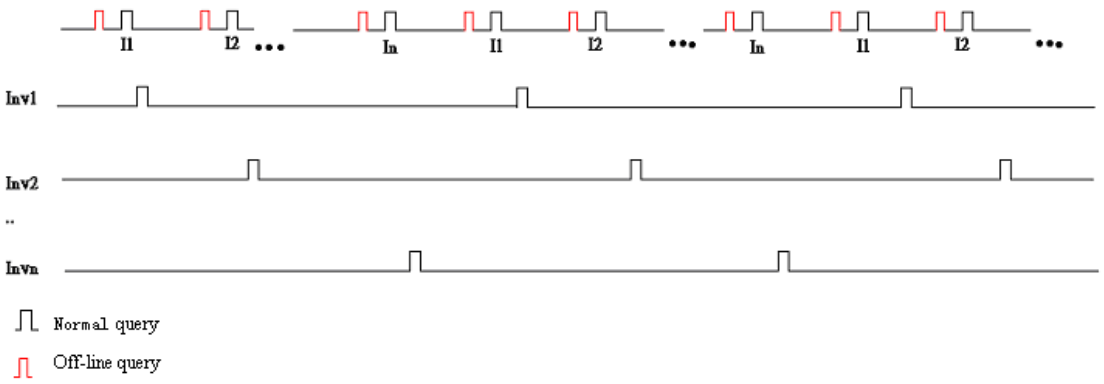
CONTENT

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 ,2 Bytes Checksum, 2 Bytes Ender. AP communicates with Inverter through RS232 port and its baud rate is set to 9600, besides, data length is 8 bits. There 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) is as follows:



- 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

Header	Source Address	Destination Address	Control Code	Function Code	Data length
2 Bytes (0x A5 A5)	1 Bytes (0xXX)	1Bytes (0xXX)	1 Byte	1 Byte	1 Byte (N)

Data0	Data1	Data2	Data3	…	Data(N-1)	Checksum	Ender
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	2 Bytes	2 Bytes (0x0A 0D)

2.2. Description

	Description
Header (0xA5 0xA5):	the header of each packet .
Source Address	designate the sender address . Range : 0x01~0xFE
Destination Address	designate the receiver address. Range : 0x01~0xFE
Control Code	there are 4 kinds: 1. Register(0x30) 2. Read(0x31) 3. Write(0x32) 4. Execute(0x33)
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) (Add up and Reverse by bit,then add 1)
Ender (0x0A 0D)	The ender for each packet

Note:

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

- Communication Parameter

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

- Communication timing

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 :0x30 'register'

Table 5-1

Control code	Function code	Vector	Description
0x30	0x40	AP →Inverter	Off-line query
0x30	0xBF	Inverter→AP	register request
0x30	0x41	AP →Inverter	send register address
0x30	0xBE	Inverter→AP	address confirm
0x30	0x42	AP →Inverter	remove register
0x30	0xBD	Inverter→AP	remove confirm
0x30	0x43	AP →Inverter	re-connect removed Inverter
0x30	0xBC	AP →Inverter	Re-register

3.2. Control Code :0x31 'Read'

Table5-2

Control code	Function code	Vector	Description
0x31	0x40	AP →Inverter	Read description
0x31	0xBF	Inverter→AP	Read description response
0x31	0x41	AP →Inverter	Read/Write description
0x31	0xBE	Inverter→AP	Read/Write description response
0x31	0x42	AP →Inverter	query normal info
0x31	0xBD	Inverter→AP	Response for query
0x31	0x43	AP →Inverter	query Inverter ID info
0x31	0xBC	Inverter→AP	reply ID data
0x31	0x44	AP →Inverter	read set info
0x31	0xBB	Inverter→AP	reply set info
0x31	0x45	AP →Inverter	Read RTC time
0x31	0xBA	Inverter→AP	Reply RTC time
0x31	0x46	AP →Inverter	read Model info(10K only)
0x31	0Xb9	AP →Inverter	Riello Fix size command
0x31	0x47	Inverter→AP	Reply Riello Fixsize command
0x31	0Xb8	AP →Inverter	Pv33 SlaveA information
0x31	0x48	Inverter→AP	Reply Pv33 SlaveA information
0x31	0xB7	AP →Inverter	Pv33 SlaveB information
0x31	0x49	Inverter→AP	Reply Pv33 SlaveB information
0x31	0xB6	Inverter→AP	reply Model info(10K only)
0x31	0x4A	AP →Inverter	Read DC Current Injection (10K only)
0x31	0xB5	Inverter→AP	Reply DC Current Injection (10K only)
0x31	0x4B	AP →Inverter	Read Master-Slave-Logger Version
0x31	0xB4	Inverter→AP	Reply Master-Slave-Logger Version

3.2.1. 'Read only': Data Code (Function code 0x42)

Table 5-3

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	0000 0011	Vpv3	0.1V	PV3 voltage	2 Bytes
04	0000 0100	Ipv1	01.A	PV1 Current	2 Bytes
05	0000 0101	Ipv2	0.1A	PV2 Current	2 Bytes
06	0000 0110	Ipv3	0.1A	PV3 Current	2 Bytes
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	0000 1110	Vpv4	0.1V	PV4 voltage	2 Bytess
0F	0000 1111	Vpv5	0.1V	PV5 voltage	2 Bytes
10	0001 0000	Vpv6	0.1V	PV6 voltage	2 Bytes
11	0001 0001	Ipv4	01.A	PV4 Current	2 Bytes
12	0001 0010	Ipv5	0.1A	PV5 Current	2 Bytes
13	0001 0011	Ipv6	0.1A	PV6 Current	2 Bytes
14	0001 0100	Vpv7	0.1V	PV7 voltage	2 Bytess
15	0001 0101	Vpv8	0.1V	PV8 voltage	2 Bytes
16	0001 0110	Vpv9	0.1V	PV9 voltage	2 Bytes
17	0001 0111	Ipv7	01.A	PV7 Current	2 Bytes
18	0001 1000	Ipv8	0.1A	PV8 Current	2 Bytes
19	0001 1001	Ipv9	0.1A	PV9 Current	2 Bytes
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	0011 1100	PV3FaultValue	0.1V	PV3 voltage fault value	2 Bytes
3D	0011 1101	GFCIFaultValue	0.001A	GFCI current fault value	2 Bytes
3E	0011 1110	Error message H		Failure description for status 'failure' Table5-5(3phase system)	2 Bytes
3F	0011 1111	Error message L		Failure description for status 'failure' Table5-5(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
4C	0100 1100	Mode		Operation Mode Table5-4	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' Table5-5	2 Bytes
7F	0111 1111	Error message L		Failure description for status 'failure' Table5-5	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 Table5-4	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 message H		Failure description for status 'failure' Table5-5	2 Bytes
BF	1011 1111	Error message L		Failure description for status 'failure' Table5-5	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 (T Phase)	2 Bytes
C2	1100 0010	Vac	0.1V	T Phase Grid voltage (T Phase)	2 Bytes
C3	1100 0011	Fac	0.01Hz	T Phase Grid frequency (T Phase)	2 Bytes
C4	1100 0100	Pac	W	T Phase Power to grid (T Phase)	2 Bytes
C5	1100 0101	Zac	mΩ	Grid impedance(T 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 (T Phase)	2 Bytes
C8	1100 1000	E-Total L	0.1KW.Hr	Energy to grid (T 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 Table5-4	2 Bytes
F8	1111 1000	GVFaultValue	0.1V	Grid voltage fault value (T Phase)	2 Bytes
F9	1111 1001	GFFaultValue	0.01Hz	Grid frequency fault value (T 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' Table5-5	2 Bytes
FF	1111 1111	Error message L		Failure description for status 'failure' Table5-5	2 Bytes

- **Description :**

Table 5-4

Mode		Description
Wait	0x00 0x00	PV voltage is between 70~130V 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 over130V, 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. The condition of entering Fault mode: 1.Temperature too high 2.Ground current too high 3.PV Voltage too high 4.Grid Voltage=0 5.Output impedance too high 6.Grid frequency out of range 7.Grid Voltage out of range 8.Isolation resistance too low
Permanent Fault	0x00 0x03	System Fault. The protect steps will be executed and auto restart disable The condition of entering Permanent Fault mode: 1. Grid current DC offset 2. Grid current too high 3. Eeprom cannot be read or write in 4. Communication between CPU is fail 5. Bus Voltage too low or high 6. Compare measured value from two CPU 7. Main bridge relay fail

Table 5-5

	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	Zac-Master-fail	The master impedance is out of tolerable range
Bit26	Zac-Slave-fail	The slave impedance is out of tolerable range
Bit25	Rly1-Fail	Relay is Fail
Bit24	MemFull-Warning	memory space is full
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	ENS-Zac-Fail	Different value between Master and Slave for grid impedance
Bit20	ENS-Mess-Fail	Different value between Master and Slave for dI, Fac, Uac or Zac
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	Test Fail	Auto Test failed
Bit13	Temperature -Fail	Over temperature fault

Bit12	M-S Version Fail	Master and Slave firmware version is unmatch
Bit11	Bus-Fail	Dc bus fault
Bit10	GFCI-Fail	Ground current is too high
Bit 9	No-Utility	Grid voltage =0
Bit8	Delta Z Fault	Delta GridZ Fault
Bit7	Device Fault	Device Fault
Bit6	Bus High-Fail	Dc Bus voltage is too high.
Bit5	Bus –Low Fail	Dc Bus voltage is too low
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
  ENS:
  Um die größtmögliche Sicherheit zu erreichen, besteht die selbsttätige Freischaltstelle aus zwei voneinander unabhängigen in Reihe aufgebauten
  Einrichtungen zur **N**etzüberwachung mit zugeordneten allpoligen **S**chaltern (ENS). Jede dieser Einrichtungen überwacht ständig die Qualität des angeschlossenen Netzes durch Prüfung der Spannung, Frequenz und Impedanz. Der redundante Aufbau sowie ein automatischer Selbsttest vor jeder Netzzuschaltung stellen die zuverlässige Funktion sicher.

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 5-6 (Function code 0x43)

Table 5-6

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 1000' = '50h 76h 2Dh 49h 6Eh 76h 20h 31h 30h 30h 30h 20h 20h 20h 20h 20h'
28~43	16 bytes	Manufacturer	'PHOENIXTEC' = '50h 48h 4Fh 45h 4Eh 49h 58h 54h 45h 43h 20h 20h 20h 20h 20h 20h'
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

3.2.3. Set information: Data number defined by table 5-7(Function code 0x44)

Table 5-7

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	Vpv-High-Stop	0.1V	High PV voltage stop fed power to grid
(01)00 0011	2 Bytes	Vpv-Low-Stop	0.1V	Low PV voltage stop fed Power to grid
(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	Zac-Max	m Ω	Maximum operational grid impedance
(01)00 1001	2 Bytes	Dzac	m Ω	Allowable delta Zac of operation
(01)00 1010	2 Bytes	PW_Max%	%	Maximum output power percentage
(01)00 1011	2 Bytes	P.F	0.01	Power Factor

■

4 Examples

4.1. Off-line query:

■ AP queries whether there is a new Inverter added (Control Code:0x30 Function Code 0x40)

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Check sum	Ender
2 Bytes (0xA5 0xA5)	2 Bytes 0x01	2 Bytes 0x00	1 Byte (0x30)	1 Byte (0x40)	1 Byte (0x00)	2 Bytes	2 Bytes (0x0A 0x0D)

■ The off-line Inverter reply register request(Control Code:0x30, Function Code 0xBF)
If pv_inverter serial number is '0123456789'

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0
2 Bytes (0xA5 0xA5)	2 Bytes 0x00	2 Bytes 0x01	1 Byte (0x30)	1 Byte (0xBF)	1Byte (0x0A)	1 Byte (0x30)

Data1	Data2	Data3	…	Data9	Checksum	Ender
1 Byte (0x31)	1 Byte (0x32)	1 Byte (0x33)	1 Byte (..)	1 Byte (0x39)	2 Bytes	2 Bytes (0x0A 0x0D)

➢ **Description:** Data0 to Data9 is Inverter serial number

■ AP allocates address for Inverter (Control Code:0x30 Function Code 0x41)
If AP allocate register address(0x11) to Inverter.

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0
2 Bytes (0xA5 0xA5)	2 Bytes 0x01	2 Bytes 0x00	1 Byte (0x30)	1 Byte (0x41)	1Byte (0x0B)	1 Byte (0x30)

Data1	Data2	Data3	…	Data9	Data10	Checksum	Ender
1 Byte (0x31)	1 Byte (0x32)	1 Byte (0x33)	1 Byte (..)	1 Byte (0x39..)	1Byte(register Address) (0x11)	2 Bytes	2 Bytes (0x0A 0x0D)

➢ **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:0x30 Function Code 0xBE)

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0	Check sum	Ender
2 Bytes (0Xa5 0xA5)	2 Bytes (0x11)	2 Bytes (0x01)	1Byte (0x30)	1 Byte (0xBE)	1Byte (0x01)	1Byte ACK(0x06)	2 Bytes	2 Bytes (0x0A 0x0D)

- **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:0x30 Function Code 0x42)

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum	Ender
2 Bytes (0xA5 0xA5)	2 Bytes (0x01)	2 Bytes (0x11)	1Byte (0x30)	1 Byte (0x42)	1Byte (0x00)	2 Bytes	2 Bytes (0x0A 0x0D)

- Inverter reply removing confirm (Control Code:0x00 Function Code 0xBC)

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0	Check sum	Ender
2 Bytes (0xA5 0xA5)	2 Bytes (0x11)	2 Bytes (0x01)	1 Byte (0x30)	1 Byte (0xBC)	1Byte (0x01)	1Byte ACK (0x06)	2 Bytes	2 Bytes (0x0A 0x0D)

- **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:0x30 Function Code 0x43)

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum	Ender
2 Bytes (0Xa5 0xA5)	2 Bytes (0x01	2 Bytes (0x00)	1Byte (0x30)	1 Byte (0x43)	1Byte (0x00)	2 Bytes	2 Bytes (0x0A 0x0D)

- **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:0x30 Function Code 0x44)

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

2 Bytes (0xA5 0xA5)	2 Bytes (0x01	2 Bytes (0x00)	1Byte (0x30)	1 Byte (0x44)	1Byte (0x00)	2 Bytes	2 Bytes (0x0A 0x0D)

- **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:0x31 Function Code 0x40)

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum	Ender
2 Bytes (0x A5 A5)	2 Bytes (0x01)	2 Bytes (0x11)	1Byte (0x31)	1 Byte (0x40)	1Byte (0x00)	2 Bytes	2 Bytes (0x0A 0x0D)

- Inverter reply Read

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0
2 Bytes (0x A5A5)	2 Bytes (0x11)	2Bytes (0x01)	1Byte (0x31)	1Byte (0xBF)	1 Byte	1Byte (DataNoxx)

Data1	Data2	Data3	…	Data (N-1)	Checksum	Ender
1 Byte (DataNoxx)	1 Byte (DataNoxx)	1 Byte (DataNoxx)	1 Byte (DataNoxx)	1 Byte (DataNoxx)	2 Bytes	2 Bytes (0x0A 0x0D)

- **Description:** 'Read Data lists 'Read only Data' of the Inverter and each 'Read only description' has own Data number such as the table 5-3. This information will be used to identify the data sent back when AP executes query instruction of 'Read only Data'.

4.6. AP queries Inverter Read/Write (Control Code:0x31 Function Code 0x41)

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Checksum	Ender
2 Bytes (0x A5 A5)	2 Bytes (0x01)	2 Bytes (0x11)	1Byte (0x31)	1 Byte (0x41)	1Byte (0x00)	2 Bytes	2 Bytes (0x0A 0x0D)

- Inverter reply Read/Write

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0
2 Bytes (0x A5 A5)	2 Bytes (0x11)	2Bytes (0x01)	1Byte (0x31)	1Byte (0xBE)	1 Byte	1 Byte

Data1	Data2	Data3	…	Data (N-1)	Checksum	Ender
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	2 Bytes	2 Bytes (0x0A 0x0D)

- **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 5-3. 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:0x31 Function Code 0x42)

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Check sum	Ender
2 Bytes (0x A5 A5)	2 Bytes (0x01)	2 Bytes (0x11)	1.Byte (0x31)	1 Byte (0x42)	1byte (0x00)	2 Bytes	2 Bytes (0x0A 0x0D)

- Inverter reply' Read only Data' (Control Code:0x31 Function Code 0xBD)

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0
2 Bytes (0x A5 A5)	2 Bytes (0x11)	2Bytes (0x01)	1Byte (0x31)	1Byte (0xBD)	1 Byte	1 Byte

Data1	Data2	Data3	…	Data (N-1)	Checksum	Ender
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	2 Bytes	2 Bytes (0x0A 0x0D)

- **Description:** Because each 'Read only Data' has own Data number such as the table 5-3, 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:0x31 Function Code 0x43)

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Check sum	Ender
2 Bytes (0x A5 A5)	2 Bytes (0x01)	2 Bytes (0x11)	1Byte (0x31)	1 Byte (0x43)	1Byte (0x00)	2 Bytes	2 Bytes (0x0A 0x0D)

- Inverter reply Inverter ID info (Control Code:0x01 Function Code 0x83)

Header	Source Address	Destination Address	Control Code	Function Code	Data Length	Data0
2 Bytes (0x A5 A5)	2 Bytes (0x11)	2Bytes (0x01)	1Byte (0x31)	1Byte (0xBC)	1 Byte	1 Byte

Data1	Data2	Data3	…	Data (N-1)	Checksum	Ender
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	2 Bytes	2 Bytes (0x0A 0x0D)

- **Description:** Because each 'Read/Write Data' has own Data number such as the table 5-6, 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:0x31 Function Code 0x44)

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Check sum	Ender
2 Bytes (0x A5 A5)	2 Bytes (0x01)	2 Bytes (0x11)	1Byte (0x031)	1 Byte (0x44)	1Byte (0x00)	2 Bytes	2 Bytes (0x0A 0x0D)

- Inverter reply Inverter set info (Control Code:0x31 Function Code 0xBB)

Header	Source Address	Destination Address	Control Code	Function Code	Data length	Data0
2 Bytes (0x A5 A5)	2 Bytes (0x11)	2Bytes (0x01)	1Byte (0x31)	1Byte (0xBB)	1 Byte	1 Byte

Data1	Data2	Data3	…	Data (N-1)	Checksum	Ender
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	2 Bytes	2 Bytes (0x0A 0x0D)

- **Description:** Because each 'Read/Write Data' has own Data number such as the table 5-7, 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'.