# Protocol for Solar Inverter Family

## Release Note

| Version | Date | Modification | *Prepared by* | | *Approved by* | |
|---|---|---|---|---|---|---|
| 1.0 | 20110713 | The First draft of this document | ivan | | team | |
| 1.1 | 20110714 | 1. added restriction for AP's and inverter's address<br>2. modified the initial value of inverter's address from 0xFF to 0x7F | ivan | | ivan | |
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## 1 General information

The guide is to give you the definition of the protocol between Inverter and AP (Application Program, such as EzLogger, EzExplorer, ATS, etc). 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, 1 Byte Source, Destination Address, control code and Function code, alterable Data parts and 2 Bytes Checksum. AP communicates with Inverter through USB 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. **There can be several slaves in the communication network, but only one master in it**. 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 initiatively 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 **(10sec as one period)**
- 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 receive the response for 3 times either, 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 network, 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 also should include **allocate address code and corresponding serial number and the address allocated**) 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.
- The first bit of AP's address should be 1 and the first bit of Inverter's address should be 0.

# 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) | 1 Byte | 1 Byte | 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: | the header of each packet (0xAA 0x55 ). |
| Source Address | designate the sender address |
| Destination Address | designate the receiver address |
| Control Code | there are 2 kinds:<br>1. Register(0x00)<br>2. Read(0x01) |
| Function Code | to be descripted |
| Data length | designate the data length. (0 if there is no data column) |
| Data0,1,2..N | data column |
| Checksum | Header + Source/Dstination Address + Control Code +Function Code + Data length +Data0 + .. +Data (N-1) |

**Note**:

When sending the MSB 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 2-5

| Timing parameter | Value |
|---|---|
| Delay before Inverter begins to send response | <0.5 Sec |
| Inter-character delay | <0.2 Sec |
| The interval time between sending same instructions twice | >0.5 Sec |
| Time out for Inverter communication | 10 Min |

# 3 Instruction Set

## 3.1. Control Code :0x00 'Register'

Table 3-1

| Control code | Function code | Vector | Description |
|---|---|---|---|
| 0x00 | 0x00 | AP →Inverter | Off-line Query |
| 0x00 | 0x80 | Inverter→AP | Register Request |
| 0x00 | 0x01 | AP →Inverter | Allocate Register Address |
| 0x00 | 0x81 | Inverter→AP | Address Confirm |
| 0x00 | 0x02 | AP →Inverter | Remove Register |
| 0x00 | 0x82 | Inverter→AP | Remove Confirm |

Notice : Before slave registers, the address initialized as 0x7F

**Off-line Query Data Packet Format:**

| Header | Source Address | Destination Address | Control Code | Function Code | Data length |
|---|---|---|---|---|---|
| 2 Bytes(0xAA 0x55) | 0b1******* | 0x7F | 0x00 | 0x00 | 0 |

| Checksum |
|---|
| 2 Bytes |

**Register Request Data Packet Format:**

| Header | Source Address | Destination Address | Control Code | Function Code | Data length |
|---|---|---|---|---|---|
| 2 Bytes(0xAA 0x55) | 0x7F | 0b1******* | 0x00 | 0x80 | 16 |

| Data0 | Data1 | Data2 | Data3 | ... | Data(N-1) | Checksum |
|---|---|---|---|---|---|---|
| SN1 | SN2 | SN3 | SN4 | … | SN16 | 2 Bytes |

**Allocate Register Address Data Packet Format:**

| Header | Source Address | Destination Address | Control Code | Function Code | Data length |
|---|---|---|---|---|---|
| 2 Bytes(0xAA 0x55) | 0b1******* | 0x7F | 0x00 | 0x01 | 17 |

| Data0 | Data1 | Data2 | Data3 | ... | Data(N-2) | Data(N-2) | Checksum |
|---|---|---|---|---|---|---|---|
| SN1 | SN2 | SN3 | SN4 | … | SN16 | Address | 2 Bytes |

**Address Confirm Data Packet Format:**

| Header | Source Address | Destination Address | Control Code | Function Code | Data length |
|---|---|---|---|---|---|
| 2 Bytes(0xAA 0x55) | Address | 0b1******* | 0x00 | 0x81 | 0 |

| Checksum |
|---|
| 2 Bytes |

Notice : The source address in Address Confirm data packet is address allocated from AP

**Remove Register Data Packet Format:**

| Header | Source Address | Destination Address | Control Code | Function Code | Data length |
|---|---|---|---|---|---|
| 2 Bytes(0xAA 0x55) | 0b1******* | Address | 0x00 | 0x02 | 0 |

| Checksum |
|---|
| 2 Bytes |

**Remove Confirm Data Packet Format:**

| Header | Source Address | Destination Address | Control Code | Function Code | Data length |
|---|---|---|---|---|---|
| 2 Bytes(0xAA 0x55) | Address | 0b1******* | 0x00 | 0x82 | 0 |

| Checksum |
|---|
| 2 Bytes |

Notice : After removed from network the address of inverter changes back to 0x7F and status as off-line. And will response if it receives off-line query command.

## 3.2. Control Code :0x01 'Read'

Table3-2

| Control code | Function code | Vector | Description |
|---|---|---|---|
| 0x01 | 0x01 | AP →Inverter | Query Running Info |
| 0x01 | 0x81 | Inverter→AP | Response Running Info |
| 0x01 | 0x02 | AP →Inverter | Query ID Info |
| 0x01 | 0x82 | Inverter→AP | Response ID Info |
| 0x01 | 0x03 | AP →Inverter | Query Setting Info |
| 0x01 | 0x83 | Inverter→AP | Response Setting Info |
| | | | |

## 3.2.1. 'Running Info List' : (Function Code : 0x81)

Table 3-3

| Data Index | Measuring Channels | Unit | Description | Length |
|---|---|---|---|---|
| 0x00 | Vpv1 | 0.1V | PV1 voltage | 2 Bytess |
| 0x01 | Vpv2 | 0.1V | PV2 voltage | 2 Bytes |
| 0x02 | Ipv1 | 0.1A | PV1 current | 2 Bytes |
| 0x03 | Ipv2 | 0.1A | PV2 current | 2 Bytes |
| 0x04 | Vac1 | 0.1V | Phase L1 voltage | 2 Bytes |
| 0x05 | Vac2 | 0.1V | Phase L2 voltage | 2 Bytes |
| 0x06 | Vac3 | 0.1V | Phase L3 voltage | 2 Bytes |
| 0x07 | Iac1 | 0.1A | Phase L1 current | 2 Bytes |
| 0x08 | Iac2 | 0.1A | Phase L2 current | 2 Bytes |
| 0x09 | Iac3 | 0.1A | Phase L3 current | 2 Bytes |
| 0x0A | Fac1 | 0.01Hz | Phase L1 frequency | 2 Bytes |
| 0x0B | Fac2 | 0.01Hz | Phase L2 frequency | 2 Bytes |
| 0x0C | Fac3 | 0.01Hz | Phase L3 frequency | 2 Bytes |
| 0x0D | Pac | 1W | Feeding power | 2 Bytes |
| 0x0E | Work Mode | NA | Work Mode Table3-6 | 2 Bytes |
| 0x0F | Temperature | 0.1 degree C | Inverter internal temperature | 2 Bytes |
| 0x10 | Error Message H | NA | Failure description for status 'failure' Table3-7 | 2 Bytes |
| 0x11 | Error Message L | NA | Failure description for status 'failure' Table3-7 | 2 Bytes |

批注 [微软中国1]: Only available for DT series inverter

批注 [微软中国2]: Only available for DT series inverter

批注 [微软中国3]: Only available for DT series inverter

批注 [微软中国4]: Only available for DT series inverter

批注 [微软中国5]: Only available for DT series inverter

批注 [微软中国6]: Only available for DT series inverter

| | | | | |
|---|---|---|---|---|
| 0x12 | E-Total H | 0.1KW.Hr | Total Feed Energy to grid | 2 Bytes |
| 0x13 | E-Total L | 0.1KW.Hr | Total Feed Energy to grid | 2 Bytes |
| 0x14 | h-Total H | Hr | Total feeding hours | 2 Bytes |
| 0x15 | h-Total L | Hr | Total feeding hours | 2 Bytes |
| 0x16 | TmpFaultValue | 0.1 Degree C | Temperature fault value | 2 Bytes |
| 0x17 | PV1FaultValue | 0.1V | PV1 voltage fault value | 2 Bytes |
| 0x18 | PV2FaultValue | 0.1V | PV2 voltage fault value | 2 Bytes |
| 0x19 | Line1VFaultValue | 0.1V | Phase L1 voltage fault value | 2 Bytes |
| 0x1A | Line2VFaultValue | 0.1V | Phase L2 voltage fault value | 2 Bytes |
| 0x1B | Line3VFaultValue | 0.1V | Phase L3 voltage fault value | 2 Bytes |
| 0x1C | Line1FFaultValue | 0.01Hz | Phase L1 frequency fault value | 2 Bytes |
| 0x1D | Line2FFalutValue | 0.01Hz | Phase L2 frequency fault value | 2 Bytes |
| 0x1E | Line3FFaultValue | 0.01Hz | Phase L3 frequency fault value | 2 Bytes |
| 0x1F | GFCIFaultValue | 1mA | GFCI fault value | 2 Bytes |
| 0x20 | E-Day | 0.1KW.Hr | Feed Engery to grid in today | 2 Bytes |

**批注 [微软中国7]:** Only available for DT series inverter

**批注 [微软中国8]:** Only available for DT series inverter

**批注 [微软中国9]:** Only available for DT series inverter

**批注 [微软中国10]:** Only available for DT series inverter

- **Description :**

Table 3-7

| Bit NO | Error message | Description |
|---|---|---|
| Bit31 | Internal Communication Failure | Communication between microcontrollers is failure |
| Bit30 | EEPROM R/W Failure | EEPROM cannot be read or written |
| Bit29 | Fac Failure | The grid frequency is out of tolerable range |
| Bit28 | TBD | NA |
| Bit27 | TBD | NA |
| Bit26 | TBD | NA |
| Bit25 | Relay Check Failure | Relay check is failure |
| Bit24 | TBD | NA |
| Bit23 | Vac Consistency Failure | Different value between Master and Slave for grid voltage |
| Bit22 | Fac Consistency Failure | Different value between Master and Slave for grid frequency |
| Bit21 | TBD | NA |
| Bit20 | TBD | NA |
| Bit19 | DC Injection High | The DC injection to grid is too high |
| Bit18 | Isolation Failure | Isolation resistance of PV-plant out of tolerable range |
| Bit17 | Vac Failure | Grid voltage out of tolerable range |
| Bit16 | Fan Failure | Fan Lock |
| Bit15 | PV Over Voltage | Pv input voltage is over the tolerable maximum value |
| Bit14 | Auto Test Failure | Auto test failure |
| Bit13 | Over Temperature | Temperature is too high |
| Bit12 | Internal Version Unmatch | Master and slave firmware version is unmatch |
| Bit11 | DC Bus High | Dc bus is too high |
| Bit10 | Gournd I Failure | Ground current is too high |
| Bit9 | Utility Loss | Utility is unavailable |
| Bit8 | TBD | NA |
| Bit7 | TBD | NA |
| Bit6 | TBD | NA |
| Bit5 | TBD | NA |
| Bit4 | GFCI Consistency Failure | Different value between Master and Slave for GFCI |
| Bit3 | DCI Consistency Failure | Different value between Master and Slave for output DC current |
| Bit2 | TBD | NA |
| Bit1 | AC HCT Failure | The output current sensor is abnormal |
| Bit0 | GFCI Device Failure | The GFCI detecting circuit is abnormal |
| | | |

## 3.2.2. Respone ID Info Packet Format (Function Code: 0x82)

Table 3-8

| Data NO | Length | Content | Description |
|---|---|---|---|
| 0~4 | 5 Bytes | Firmware Ver. | Firmware Version, Example '01.00' = '30h 31h 2Eh 30h 30h' |
| 5~14 | 10 Bytes | Model Name | Example 'GW3000-SS ' |
| 15~30 | 16 Bytes | Manufacturer | 'GOODWE' = 'xxh xxh xxh xxh xxh xxh 20h 20h...20h' |
| 31~46 | 16 Bytes | Serial number | Example '13000SSU11000008' |
| 47~50 | 4 Bytes | Nom_Vpv | Nominal PV voltage: Example 360.0V= '33h 36h 30h 30h' Unit :0.1V |
| 51~62 | 12 Bytes | Internal Version | Example '410-00000-00' |
| 63 | 1 Byte | Safety Country Code | Table 3-10 |

## 3.2.3. Respone Setting Info Packet Format : (Function Code : 0x83)

Table 3-9

| Data NO | Length | Name | Unit | Description |
|---|---|---|---|---|
| 0~1 | 2 Bytes | Vpv-Start | 0.1V | PV start-up voltage |
| 2~3 | 2 Bytes | T-Start | 1Sec | Time to connect grid |
| 4~5 | 2 Bytes | Vac-Min | 0.1V | Minimum operational grid voltage |
| 6~7 | 2 Bytes | Vac-Max | 0.1V | Maximum operational grid voltage |
| 8~9 | 2 Bytes | Fac-Min | 0.01Hz | Minimum operational grid Frequency |
| 10~11 | 2 Bytes | Fac-Max | 0.01Hz | Maximum operational grid Frequency |

## 3.3 Safety Country Code :

Table 3-10

| Code | Description |
|---|---|
| 0x00 | Italy |
| 0x01 | Czech |
| 0x02 | Germany |
| 0x03 | Spain |
| 0x04 | GreeceMainland |
| 0x05 | GreeceIslands |
| 0x06 | Belgium |
| 0x07 | ItalianSpecial |
| 0x08 | G83Spec |
| 0x09 | Australian |
| 0x0A | France |