

## Controller Remote Monitoring Communication Protocol

### I. Serial Port Setting

9600Baud/S, start bit: 1 bit, data bit: 8 bits, stop bit: 1 bit, no parity check bit.

### II. Data Frame Format Definition

Host and Slave send data frame in same format. Each frame includes 1 byte sync word, 1 byte slave code, 1 byte command, 12 bytes valid data, 1 byte CRC check code, all together 16 bytes. Please see details below.

| Byte Code | Name    | Meaning  |  |
|-----------|---------|--|--|
| Byte1     | SYN     | This byte is 0x8E and it is the start of one frame data,<br>If data not received after time of a frame, incomplete frame data of<br>buffer area is cleared and detection of Sync is restarted. |  |
| Byte2     | SN      | Slave number of machine polled or data post backed from.   |  |
| Byte3     | Command | Command sent by Host or data type post backed by Slave Machine.  |  |
| Byte4     | Data    | INT1_LOW   | Data field may contains 12 singed or unsigned<br>character-type data – 6 signed or unsigned short<br>integer data, 3 singed or unsigned long integer data,<br>and 3 single precision floating-point type data. |
| Byte5     |         | INT1_HIGH  |  |
| Byte6     |         | INT2_LOW   |  |
| Byte7     |         | INT2_HIGH  |  |
| Byte8     |         | INT3_LOW   |  |
| Byte9     |         | INT3_HIGH  |  |
| Byte10    |         | INT4_LOW   |  |
| Byte11    |         | INT4_HIGH  |  |
| Byte12    |         | INT5_LOW   |  |
| Byte13    |         | INT5_HIGH  |  |
| Byte14    |         | INT6_LOW   |  |
| Byte15    |         | INT6_HIGH  |  |
| Byte16    | CRC     | CRC8 check code of first 15 byte data, checking format is<br>CRC8=X8+X5+X4+1   |  |

Figure 1 Data Frame Format Definition

### III. Host Command Frame Format and Definition

| Byte Code | Name           | Meaning  |
|-----------|----------------|--|
| Byte1     | <b>SYN</b>     | This byte is 0x8E and it is the start of one frame data. |
| Byte2     | <b>SN</b>      | Slave number of machined polled in a range of 1 ~ 99     |
| Byte3     | <b>COMMAND</b> | Command Host sends to Slave in a range of 1 ~127         |
| Byte4     | <b>DATA</b>    | Function varies according to COMMAND.                    |
| ⋮         |                |  |
| Byte15    |                |  |
| Byte16    | <b>CRC</b>     | Check code of first 15 byte data.                        |

Figure 2 Host Command Frame Format and Definition

### Commands:

| COMMAND     | DATA  | Meaning   |
|-------------|---|---|
| <b>0x01</b> | Set to 0x00,<br>Slave doesn't process data of this part | Request controller to send PV voltage(Vol PV), PV current (Cur PV), Battery voltage(Vol Bat), (Load current) Cur Load, (Battery temperature(Temp Bat), State of Capacity(SOC), and Error. |
| <b>0x02</b> | Set to 0x00,<br>Slave doesn't process data of this part | Request controller to send Ah PV, Ah Load, Vol Float, Vol LVD, Vol LVR.   |
| <b>0x03</b> | <b>Byte4</b>  | <b>Byte4=0x01</b> , Request controller to remove LVD protection, other value invalid  |
|             | <b>Byte5</b>  | <b>Byte5=0x01</b> , Request controller to remove over load protection, other value invalid  |
|             | <b>Byte6</b>  | <b>Byte6=0x01</b> , Request controller to remove short circuit protection, other value invalid  |
|             | <b>Byte7</b>  | <b>Byte7=0x01</b> , Request controller to switch off load, other value invalid  |
|             | <b>Byte8</b>  | <b>Byte8=0x01</b> , Request controller to remove force switch off load , other value invalid  |
|             | <b>Byte9</b>  | <b>Byte9=0x01</b> , Request controller to remove overheat protection, other value invalid   |
|             | <b>Byte10</b>   | <b>Byte10=0x01</b> , Request controller to remove over voltage protection, other value invalid  |
|             | <b>Byte11</b>   | Arbitrary value, Slave doesn't process data of this part.   |
|             | .....   |   |
|             | <b>Byte15</b>   |   |
| <b>0x04</b> | Set to 0x00,<br>Slave doesn't process data of this part | Request controller to send Vol PV, Vol Bat, Cur PV, Cur Load, Temp Bat, Charge Mode, Load State, and Error.   |
| <b>0x05</b> | Set to 0x00,<br>Slave doesn't process data of this part | Request controller to send Vol Float, Vol abs, vol equ, time abs, time equ, interval equ, mode equ,class battery, bat detect, and stack battery.  |
| <b>0x06</b> | Set to 0x00,<br>Slave doesn't                           | Request controller to send Vol LVD, Vol LVR, vol dark, mode load, and temp sink.  |

|             |  |  |
|-------------|--|--|
|             | process data of this part                            |  |
| <b>0x07</b> | Set to 0x00, Slave doesn't process data of this part | Request controller to send vol_max_solar, vol_max_battery, cur_max_solar, cur_max_load, t_max_solar, t_max_envir, t_min_envir  |
| <b>0x08</b> | Set to 0x00, Slave doesn't process data of this part | Request controller to send num_LVD, num_SC_load, numb_OC_load, numb_OT_sink, days_work   |
| <b>0x09</b> | Set to 0x00, Slave doesn't process data of this part | Request controller to send battery charge kwh, battery discharge kwh, battery charge ah, battery discharge Ah, last day's max. charging power, last day's max. discharge power |
| <b>0x20</b> | Refer to Figure 4                                    | Set controller LVD protection voltage(vol_LVD), effective range 10V*stack_battery~15V* stack_battery, and vol_LVD<vol_LVR-0.2V   |
| <b>0x21</b> | Refer to Figure 4                                    | Set controller LVR protection voltage(vol_LVR), effective range 10V*stack_battery~15V* stack_battery, and vol_LVR >vol_LVD+0.2V  |
| <b>0x22</b> | Refer to Figure 4                                    | Set controller float charge volatage vol_float, effective range 13V*stack_battery~15V* stack_battery,  |

Figure 3 Commands from Host

**Note: Interval between bytes of data frame sent by Host to Slave must be less than 20mS, or data is discarded by Slave.**

| Byte Code     | Name             | Meaning  |
|---------------|------------------|--|
| <b>Byte1</b>  | <b>SYN</b>       | This byte is <b>0x8E</b> and it is the start of one frame data.  |
| <b>Byte2</b>  | <b>SN</b>        | Slave number of machine with data to be set, ranging 1~99  |
| <b>Byte3</b>  | <b>0x20</b>      | Host request to set controller LVD voltage (vol_LVD)   |
| <b>Byte4</b>  | <b>INT1_LOW</b>  | vol_LVD, INT1 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB              |
| <b>Byte5</b>  | <b>INT1_HIGH</b> |  |
| <b>Byte6</b>  | <b>INT2_LOW</b>  | INT2 is bitwise-NOT of INT1, only when INT1 equals to bitwise-NOTed INT2, data is to be modified, or is discarded. |
| <b>Byte7</b>  | <b>INT2_HIGH</b> |  |
| <b>Byte8</b>  | <b>INT3_LOW</b>  |  |
| <b>Byte9</b>  | <b>INT3_HIGH</b> |  |
| <b>Byte10</b> | <b>INT4_LOW</b>  |  |
| <b>Byte11</b> | <b>INT4_HIGH</b> |  |
| <b>Byte12</b> | <b>INT5_LOW</b>  |  |
| <b>Byte13</b> | <b>INT5_HIGH</b> |  |
| <b>Byte14</b> | <b>INT6_LOW</b>  |  |
| <b>Byte15</b> | <b>INT6_HIGH</b> |  |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data.  |

Figure 4 Data Formatting of LVD Protection Setting

| Byte Code     | Name             | Meaning   |
|---------------|------------------|---|
| <b>Byte1</b>  | <b>SYN</b>       | This byte is 0x8E and it is the start of one frame data.  |
| <b>Byte2</b>  | <b>SN</b>        | Slave number of machined polled in a range of 1 ~ 99  |
| <b>Byte3</b>  | <b>0x21</b>      | Host request to set controller LVR voltage (vol_LVR)  |
| <b>Byte4</b>  | <b>INT1_LOW</b>  | Low voltage reconnect (vol_LVR), INT1 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB |
| <b>Byte5</b>  | <b>INT1_HIGH</b> |   |
| <b>Byte6</b>  | <b>INT2_LOW</b>  | INT2 is bitwise-NOT of INT1, only when INT1 equals to bitwise-NOTed INT2, data is to be modified, or is discarded.            |
| <b>Byte7</b>  | <b>INT2_HIGH</b> |   |
| <b>Byte8</b>  | <b>INT3_LOW</b>  |   |
| <b>Byte9</b>  | <b>INT3_HIGH</b> |   |
| <b>Byte10</b> | <b>INT4_LOW</b>  |   |
| <b>Byte11</b> | <b>INT4_HIGH</b> |   |
| <b>Byte12</b> | <b>INT5_LOW</b>  |   |
| <b>Byte13</b> | <b>INT5_HIGH</b> |   |
| <b>Byte14</b> | <b>INT6_LOW</b>  |   |
| <b>Byte15</b> | <b>INT6_HIGH</b> |   |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data.   |

Figure 5 Data Formatting of LVR Setting

| Byte Code     | Name             | Meaning  |
|---------------|------------------|--|
| <b>Byte1</b>  | <b>SYN</b>       | This byte is 0x8E and it is the start of one frame data.   |
| <b>Byte2</b>  | <b>SN</b>        | Slave number of machine with data to be set, ranging 1~99  |
| <b>Byte3</b>  | <b>0x22</b>      | Host request to set controller Float Charge Voltage(vol_float)   |
| <b>Byte4</b>  | <b>INT1_LOW</b>  | vol_float, INT1 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB            |
| <b>Byte5</b>  | <b>INT1_HIGH</b> |  |
| <b>Byte6</b>  | <b>INT2_LOW</b>  | INT2 is bitwise-NOT of INT1, only when INT1 equals to bitwise-NOTed INT2, data is to be modified, or is discarded. |
| <b>Byte7</b>  | <b>INT2_HIGH</b> |  |
| <b>Byte8</b>  | <b>INT3_LOW</b>  |  |
| <b>Byte9</b>  | <b>INT3_HIGH</b> |  |
| <b>Byte10</b> | <b>INT4_LOW</b>  |  |
| <b>Byte11</b> | <b>INT4_HIGH</b> |  |
| <b>Byte12</b> | <b>INT5_LOW</b>  |  |
| <b>Byte13</b> | <b>INT5_HIGH</b> |  |
| <b>Byte14</b> | <b>INT6_LOW</b>  |  |
| <b>Byte15</b> | <b>INT6_HIGH</b> |  |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data.  |

Figure 6 Data Formatting of Float Charging Setting

## IV. Commands

The following is the command frame of controller numbered 1:

| Command | Function   | Data Frame  |
|---------|--|---|
| 0x01    | Read out charging data of controller numbered 1.           | 8E 01 01 00 00 00 00 00 00 00 00 00 00 00 00 00 84    |
| 0x02    | Read out setting parameters and accumulated charging data. | 8E 01 02 00 00 00 00 00 00 00 00 00 00 00 00 00 F0    |
| 0x03    | Remove LVD protection of controller numbered 1.            | 8E 01 03 01 00 00 00 00 00 00 00 00 00 00 00 00 BB    |
| 0x03    | Remove Over-load protection of controller numbered 1.      | 8E 01 03 00 01 00 00 00 00 00 00 00 00 00 00 00 3A    |
| 0x03    | Remove Short-circuit protection of controller numbered 1.  | 8E 01 03 00 00 01 00 00 00 00 00 00 00 00 00 00 96    |
| 0x03    | Force switch off load of controller numbered 1.            | 8E 01 03 00 00 00 01 00 00 00 00 00 00 00 00 00 69    |
| 0x03    | Remove force-switch –off-load of controller numbered 1.    | 8E 01 03 00 00 00 00 01 00 00 00 00 00 00 00 00 95    |
| 0x03    | Remove Over-heat protection of controller numbered 1.      | 8E 01 03 00 00 00 00 00 01 00 00 00 00 00 00 00 35    |
| 0x03    | Remove Over-voltage protection of controller numbered 1.   | 8E 01 03 00 00 00 00 00 00 01 00 00 00 00 00 00 8B    |
| 0x04    |  | 8E 01 04 00 00 00 00 00 00 00 00 00 00 00 00 00 18    |
| 0x05    |  | 8E 01 05 00 00 00 00 00 00 00 00 00 00 00 00 00 34    |
| 0x06    |  | 8E 01 06 00 00 00 00 00 00 00 00 00 00 00 00 00 40    |
| 0x07    |  | 8E 01 07 00 00 00 00 00 00 00 00 00 00 00 00 00 6C    |
| 0x08    |  | 8E 01 08 00 00 00 00 00 00 00 00 00 00 00 00 00 F9    |
| 0x09    |  | 8E 01 09 00 00 00 00 00 00 00 00 00 00 00 00 00 D5    |
| 0x20    | Set LVD protection voltage as 45.0V                        | 8E 01 20 94 11 6B EE 00 00 00 00 00 00 00 00 00 F6    |
| 0x21    | Set LVR voltage as 50.7V                                   | 8E 01 21 CE 13 31 EC 00 00 00 00 00 00 00 00 00 00 67 |
| 0x22    | Set float charge voltage as 55.6V                          | 8E 01 22 B8 15 47 EA 00 00 00 00 00 00 00 00 00 00 6B |

Figure 7 Host Sample Data

## V. Formatting and Meaning of Data Returned by Slave

| Byte Code    | Name       | Meaning  |
|--------------|------------|--|
| <b>Byte1</b> | <b>SYN</b> | This byte is 0x8E and it is the start of one frame data. |

|               |                  |  |
|---------------|------------------|--|
| <b>Byte2</b>  | <b>SN</b>        | Slave number of machine with data returned from, ranging 1~99  |
| <b>Byte3</b>  | <b>0x01</b>      | Data returned by Slave responding to Host's command 0x01   |
| <b>Byte4</b>  | <b>INT1_LOW</b>  | PV voltage(vol_PV), INT1 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB   |
| <b>Byte5</b>  | <b>INT1_HIGH</b> |  |
| <b>Byte6</b>  | <b>INT2_LOW</b>  | PV current(Cur_PV), INT2 is a 16bit signed integer number ranging -32768~32767, current calibration is 0.01A/LSB   |
| <b>Byte7</b>  | <b>INT2_HIGH</b> |  |
| <b>Byte8</b>  | <b>INT3_LOW</b>  | Battery voltage(Vol_Bat), INT3 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB   |
| <b>Byte9</b>  | <b>INT3_HIGH</b> |  |
| <b>Byte10</b> | <b>INT4_LOW</b>  | Load current(Cur_Load), INT4 is a 16bit signed integer number ranging -32768~32767, current calibration is 0.01A/LSB   |
| <b>Byte11</b> | <b>INT4_HIGH</b> |  |
| <b>Byte12</b> | <b>INT5_LOW</b>  | Battery temperature(Temp_Bat), Byte12 is a 8bit signed number ranging -128~127, 127 means error with temperature sensor and question mark displayed instead of temperature value, temperature calibration is 1°C/LSB   |
| <b>Byte13</b> | <b>INT5_HIGH</b> | State of capacity (SOC), Byte13 is a 8bit signed number, ranging 0~100, means 0% ~ 100%.   |
| <b>Byte14</b> | <b>INT6_LOW</b>  | Symbol : Error,<br>bit0=1 LVD protection,<br>bit1=1 Load Over-current protection,<br>bit2=1 Load Short-circuit protection,<br>bit3=1 Force switch off load,<br>bit4=1 Battery Over-voltage protection,<br>bit5=1 Over-heat protection,<br>bit6=1 PV Over-voltage protection,<br>bit7=1 PV not detected in 24hrs,<br>0 : no Error |
| <b>Byte15</b> | <b>INT6_HIGH</b> |  |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data.  |

Figure 8 Formatting of Data Frame Slave Responding to 0x01 Command

| Byte Code     | Name             | Meaning   |
|---------------|------------------|---|
| <b>Byte1</b>  | <b>SYN</b>       | This byte is <b>0x8E</b> and it is the start of one frame data.   |
| <b>Byte2</b>  | <b>SN</b>        | Slave number of machine with data returned from, ranging 1~99   |
| <b>Byte3</b>  | <b>0x02</b>      | Data returned by Slave responding to Host's command 0x02  |
| <b>Byte4</b>  | <b>INT1_LOW</b>  | Ah_PV, INT1 is a 16bit unsigned integer number ranging 0~65535, Ah calibration is 1Ah/LSB               |
| <b>Byte5</b>  | <b>INT1_HIGH</b> |   |
| <b>Byte6</b>  | <b>INT2_LOW</b>  | Ah_Load, INT2 is a 16bit unsigned integer number ranging 0~65535, Ah calibration is 1Ah/LSB             |
| <b>Byte7</b>  | <b>INT2_HIGH</b> |   |
| <b>Byte8</b>  | <b>INT3_LOW</b>  | Vol_Float, INT3 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB |
| <b>Byte9</b>  | <b>INT3_HIGH</b> |   |
| <b>Byte10</b> | <b>INT4_LOW</b>  | Vol_Cut, INT4 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB   |
| <b>Byte11</b> | <b>INT4_HIGH</b> |   |
| <b>Byte12</b> | <b>INT5_LOW</b>  | Vol_Reconnect, INT5 is a 16bit signed integer number ranging  |

|               |                  |  |
|---------------|------------------|--|
| <b>Byte13</b> | <b>INT5_HIGH</b> | -32768~32767, voltage calibration is 0.01V/LSB |
| <b>Byte14</b> | <b>INT6_LOW</b>  |  |
| <b>Byte15</b> | <b>INT6_HIGH</b> |  |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data.              |

Figure 9 Formatting of Data Frame Slave Responding to 0x02 Command

| Byte Code     | Name             | Meaning  |
|---------------|------------------|--|
| <b>Byte1</b>  | <b>SYN</b>       | This byte is <b>0x8E</b> and it is the start of one frame data.  |
| <b>Byte2</b>  | <b>SN</b>        | Slave number of machine with data returned from, ranging 1~99  |
| <b>Byte3</b>  | <b>0x03</b>      | Data returned by Slave responding to Host's command 0x03   |
| <b>Byte4</b>  | <b>INT1_LOW</b>  | PV voltage(vol_PV), INT1 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB   |
| <b>Byte5</b>  | <b>INT1_HIGH</b> |  |
| <b>Byte6</b>  | <b>INT2_LOW</b>  | PV current(Cur_PV), INT2 is a 16bit signed integer number ranging -32768~32767, current calibration is 0.01A/LSB   |
| <b>Byte7</b>  | <b>INT2_HIGH</b> |  |
| <b>Byte8</b>  | <b>INT3_LOW</b>  | Battery voltage(Vol_Bat), INT3 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB   |
| <b>Byte9</b>  | <b>INT3_HIGH</b> |  |
| <b>Byte10</b> | <b>INT4_LOW</b>  | Load current(Cur_Load), INT4 is a 16bit signed integer number ranging -32768~32767, current calibration is 0.01A/LSB   |
| <b>Byte11</b> | <b>INT4_HIGH</b> |  |
| <b>Byte12</b> | <b>INT5_LOW</b>  | Battery temperature(Temp_Bat), Byte12 is a 8bit signed number ranging -128~127, 127 means error with temperature sensor and question mark displayed instead of temperature value, temperature calibration is 1°C/LSB   |
| <b>Byte13</b> | <b>INT5_HIGH</b> | State of capacity (SOC), Byte13 is a 8bit signed number, ranging 0~100, means 0% ~ 100%.   |
| <b>Byte14</b> | <b>INT6_LOW</b>  | Symbol : Error,<br>bit0=1 LVD protection,<br>bit1=1 Load Over-current protection,<br>bit2=1 Load Short-circuit protection,<br>bit3=1 Force switch off load,<br>bit4=1 Battery Over-voltage protection,<br>bit5=1 Over-heat protection,<br>bit6=1 PV Over-voltage protection,<br>bit7=1 PV not detected in 24hrs,<br>0 : no Error |
| <b>Byte15</b> | <b>INT6_HIGH</b> |  |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data.  |

Figure 10 Formatting of Data Frame Slave Responding to 0x03 Command

| Byte Code    | Name             | Meaning  |
|--------------|------------------|--|
| <b>Byte1</b> | <b>SYN</b>       | This byte is <b>0x8E</b> and it is the start of one frame data.  |
| <b>Byte2</b> | <b>SN</b>        | Slave number of machine with data returned from, ranging 1~99  |
| <b>Byte3</b> | <b>0x04</b>      | Data returned by Slave responding to Host's command 0x04   |
| <b>Byte4</b> | <b>INT1_LOW</b>  | PV voltage(vol_PV), INT1 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB |
| <b>Byte5</b> | <b>INT1_HIGH</b> |  |

|               |                  |   |
|---------------|------------------|---|
| <b>Byte6</b>  | <b>INT2_LOW</b>  | PV current(Cur_PV), INT2 is a 16bit signed integer number ranging -32768~32767, current calibration is 0.01A/LSB  |
| <b>Byte7</b>  | <b>INT2_HIGH</b> |   |
| <b>Byte8</b>  | <b>INT3_LOW</b>  | Battery voltage(Vol_Bat), INT3 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB  |
| <b>Byte9</b>  | <b>INT3_HIGH</b> |   |
| <b>Byte10</b> | <b>INT4_LOW</b>  | Load current(Cur_Load), INT4 is a 16bit signed integer number ranging -32768~32767, current calibration is 0.01A/LSB  |
| <b>Byte11</b> | <b>INT4_HIGH</b> |   |
| <b>Byte12</b> | <b>INT5_LOW</b>  | Battery temperature(Temp_Bat), Byte12 is a 8bit signed number ranging -128~127, 127 means error with temperature sensor and question mark displayed instead of temperature value, temperature calibration is 1 °C/LSB   |
| <b>Byte13</b> | <b>INT5_HIGH</b> | <b>INT5_HIGH is 1 byte unsigned number</b><br>Low byte 4bit means stage of charge(step_charge)<br>0-bulk, 1-absorption, 2-float, 3-equation<br>High byte 4bit means load status(load_status)<br>0-load off, 1-load on   |
| <b>Byte14</b> | <b>INT6_LOW</b>  | Symbol : Error,<br>bit0=1 LVD protection,<br>bit1=1 Load Over-current protection,<br>bit2=1 Load Short-circuit protection,<br>bit3=1 Force switch off load,<br>bit4=1 Battery Over-voltage protection,<br>bit5=1 Over-heat protection,<br>bit6=1 PV Over-voltage protection,<br>bit7=1 PV not detected in 24hrs,<br>bit9=1 PV Over-current protection<br>0 : no Error |
| <b>Byte15</b> | <b>INT6_HIGH</b> |   |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data.   |

Figure 11 Formatting of Data Frame Slave Responding to 0x04 Command

| Byte Code     | Name             | Meaning   |
|---------------|------------------|---|
| <b>Byte1</b>  | <b>SYN</b>       | This byte is <b>0x8E</b> and it is the start of one frame data.   |
| <b>Byte2</b>  | <b>SN</b>        | Slave number of machine with data returned from, ranging 1~99   |
| <b>Byte3</b>  | <b>0x05</b>      | Data returned by Slave responding to Host's command 0x05  |
| <b>Byte4</b>  | <b>INT1_LOW</b>  | Vol_Float, INT1 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB |
| <b>Byte5</b>  | <b>INT1_HIGH</b> |   |
| <b>Byte6</b>  | <b>INT2_LOW</b>  | vol_abs, INT2 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB   |
| <b>Byte7</b>  | <b>INT2_HIGH</b> |   |
| <b>Byte8</b>  | <b>INT3_LOW</b>  | vol_equ, INT3 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB   |
| <b>Byte9</b>  | <b>INT3_HIGH</b> |   |
| <b>Byte10</b> | <b>INT4_LOW</b>  | Absorption charging time, 0~3 hrs, time calibration is 1h/LSB   |
| <b>Byte11</b> | <b>INT4_HIGH</b> | Equalized charging time, 0~3 hrs, time calibration is 1h/LSB  |
| <b>Byte12</b> | <b>INT5_LOW</b>  | Auto equalized charging days, day calibration 1day/LSB  |



|               |                  |   |
|---------------|------------------|---|
| <b>Byte13</b> | <b>INT5_HIGH</b> |   |
| <b>Byte14</b> | <b>INT6_LOW</b>  | <b>INT6_LOW</b> is 1 byte unsigned number<br>Low byte 4bit means equalized charging(Mode_equ)<br>0-Manual,1-Auto<br>High byte 4bit means battery type (class_battery)<br>0-Auto, 1-GEL, 2-Sealed,3-flood  |
| <b>Byte15</b> | <b>INT6_HIGH</b> | <b>INT6_HIGH</b> is 1 byte unsigned number<br>Low byte 4bit means battery voltage graded<br>0-Auto,1-fixed12V, 2-fixed24V, 4-fixed48V,<br>High byte 4bit means number of battery in serial connection(stack_battery)<br>0-Unknown, 1-12V, 2-24V,4-48V |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data.   |

Figure 12 Formatting of Data Frame Slave Responding to 0x05 Command

| Byte Code     | Name             | Meaning   |
|---------------|------------------|---|
| <b>Byte1</b>  | <b>SYN</b>       | This byte is 0x8E and it is the start of one frame data.  |
| <b>Byte2</b>  | <b>SN</b>        | Slave number of machine with data returned from, ranging 1~99   |
| <b>Byte3</b>  | <b>0x06</b>      | Data returned by Slave responding to Host's command 0x06  |
| <b>Byte4</b>  | <b>INT1_LOW</b>  | Vol_LVD , INT1 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB  |
| <b>Byte5</b>  | <b>INT1_HIGH</b> |   |
| <b>Byte6</b>  | <b>INT2_LOW</b>  | Vol_Reconnect , INT2 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB  |
| <b>Byte7</b>  | <b>INT2_HIGH</b> |   |
| <b>Byte8</b>  | <b>INT3_LOW</b>  | vol_dark, INT3 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB  |
| <b>Byte9</b>  | <b>INT3_HIGH</b> |   |
| <b>Byte10</b> | <b>INT4_LOW</b>  |   |
| <b>Byte11</b> | <b>INT4_HIGH</b> |   |
| <b>Byte12</b> | <b>INT5_LOW</b>  |   |
| <b>Byte13</b> | <b>INT5_HIGH</b> |   |
| <b>Byte14</b> | <b>INT6_LOW</b>  | <b>INT6_HIGH</b> 1 byte unsigned number<br>High byte 3bit means load working mode( mode_load)<br>0-Regular Control Mode,1-Light Control with switch-off point at night and switch-on point before dawn, 3-Light Control Mode    |
| <b>Byte15</b> | <b>INT6_HIGH</b> | Temperature of sink (temp_sink), <b>INT6_HIGH</b> is a 8bit signed number ranging -128~127,127 means error with temperature sensor and question mark displayed instead of temperature value, temperature calibration is 1°C/LSB |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data.   |

Figure 13 Formatting of Data Frame Slave Responding to 0x06 Command

| Byte Code | Name | Meaning |
|-----------|------|---------|
|-----------|------|---------|

|               |                  |   |
|---------------|------------------|---|
| <b>Byte1</b>  | <b>SYN</b>       | This byte is 0x8E and it is the start of one frame data.  |
| <b>Byte2</b>  | <b>SN</b>        | Slave number of machine with data returned from, ranging 1~99   |
| <b>Byte3</b>  | <b>0x07</b>      | Data returned by Slave responding to Host's command 0x07  |
| <b>Byte4</b>  | <b>INT1_LOW</b>  | vol_max_solar, INT1 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB   |
| <b>Byte5</b>  | <b>INT1_HIGH</b> |   |
| <b>Byte6</b>  | <b>INT2_LOW</b>  | vol_max_battery, INT2 is a 16bit signed integer number ranging -32768~32767, voltage calibration is 0.01V/LSB   |
| <b>Byte7</b>  | <b>INT2_HIGH</b> |   |
| <b>Byte8</b>  | <b>INT3_LOW</b>  | Not used  |
| <b>Byte9</b>  | <b>INT3_HIGH</b> | Not used  |
| <b>Byte10</b> | <b>INT4_LOW</b>  | cur_max_solar, INT4_LOW is a 8bit unsigned integer number ranging 0~255, current calibration is 1A/LSB  |
| <b>Byte11</b> | <b>INT4_HIGH</b> | cur_max_load, INT4_HIGH is a 8bit unsigned integer number ranging 0~255, current calibration is 1A/LSB  |
| <b>Byte12</b> | <b>INT5_LOW</b>  | t_max_sink, INT5_LOW a 8bit signed number ranging -128~127,127 means error with temperature sensor and question mark displayed instead of temperature value, temperature calibration is 1°C/LSB   |
| <b>Byte13</b> | <b>INT5_HIGH</b> | t_max_envir, INT5_HIGH a 8bit signed number ranging -128~127,127 means error with temperature sensor and question mark displayed instead of temperature value, temperature calibration is 1°C/LSB |
| <b>Byte14</b> | <b>INT6_LOW</b>  | t_min_envir, INT6_LOW a 8bit signed number ranging -128~127,127 means error with temperature sensor and question mark displayed instead of temperature value, temperature calibration is 1°C/LSB  |
| <b>Byte15</b> | <b>INT6_HIGH</b> |   |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data.   |

Figure 14 Formatting of Data Frame Slave Responding to 0x07 Command

| Byte Code     | Name             | Meaning   |
|---------------|------------------|---|
| <b>Byte1</b>  | <b>SYN</b>       | This byte is 0x8E and it is the start of one frame data.  |
| <b>Byte2</b>  | <b>SN</b>        | Slave number of machine with data returned from, ranging 1~99   |
| <b>Byte3</b>  | <b>0x08</b>      | Data returned by Slave responding to Host's command 0x08  |
| <b>Byte4</b>  | <b>INT1_LOW</b>  | Accumulated number of times of LVD (statistic_ram.num_LVD), INT1 is a 16bit unsigned integer number ranging 0~65535, calibration is 1 time/LSB                              |
| <b>Byte5</b>  | <b>INT1_HIGH</b> |   |
| <b>Byte6</b>  | <b>INT2_LOW</b>  | Accumulated number of times of Short-circuit protection (statistic_ram.num_SC_load), INT2 is a 16bit unsigned integer number ranging 0~65535, calibration is 1 time/LSB     |
| <b>Byte7</b>  | <b>INT2_HIGH</b> |   |
| <b>Byte8</b>  | <b>INT3_LOW</b>  | Accumulated number of times of load over-current protection (statistic_ram.num_OC_load), INT3 is a 16bit unsigned integer number ranging 0~65535, calibration is 1 time/LSB |
| <b>Byte9</b>  | <b>INT3_HIGH</b> |   |
| <b>Byte10</b> | <b>INT4_LOW</b>  | Accumulated number of times of over-heat protection (statistic_ram.num_OT_sink),INT4 is a 16bit unsigned integer number ranging 0~65535, calibration is 1 time/LSB          |
| <b>Byte11</b> | <b>INT4_HIGH</b> |   |

|               |                  |  |
|---------------|------------------|--|
| <b>Byte12</b> | <b>INT5_LOW</b>  | Accumulated days of working of controller( days_work), INT5 is a 16bit unsigned integer number ranging 0~65535, calibration is 1 day/LSB |
| <b>Byte13</b> | <b>INT5_HIGH</b> |  |
| <b>Byte14</b> | <b>INT6_LOW</b>  |  |
| <b>Byte15</b> | <b>INT6_HIGH</b> |  |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data.  |

Figure 15 Formatting of Data Frame Slave Responding to 0x08 Command

| Byte Code     | Name             | Meaning  |
|---------------|------------------|--|
| <b>Byte1</b>  | <b>SYN</b>       | This byte is 0x8E and it is the start of one frame data.   |
| <b>Byte2</b>  | <b>SN</b>        | Slave number of machine with data returned from, ranging 1~99  |
| <b>Byte3</b>  | <b>0x09</b>      | Data returned by Slave responding to Host's command 0x09   |
| <b>Byte4</b>  | <b>INT1_LOW</b>  | kwh_solar, INT1 is a 16bit unsigned integer number ranging 0~65535, calibration is 0.1kwh/LSB                |
| <b>Byte5</b>  | <b>INT1_HIGH</b> |  |
| <b>Byte6</b>  | <b>INT2_LOW</b>  | kwh_load, INT2 is a 16bit unsigned integer number ranging 0~65535, calibration is 0.1kwh/LSB                 |
| <b>Byte7</b>  | <b>INT2_HIGH</b> |  |
| <b>Byte8</b>  | <b>INT3_LOW</b>  | ah_solar, INT3 is a 16bit unsigned integer number ranging 0~65535, calibration is 1Ah/LSB                    |
| <b>Byte9</b>  | <b>INT3_HIGH</b> |  |
| <b>Byte10</b> | <b>INT4_LOW</b>  | ah_solar, INT4 is a 16bit unsigned integer number ranging 0~65535, calibration is 1Ah/LSB                    |
| <b>Byte11</b> | <b>INT4_HIGH</b> |  |
| <b>Byte12</b> | <b>INT5_LOW</b>  | data_yesterday.pow_max_solar, INT5 is a 16bit unsigned integer number ranging 0~65535, calibration is 1W/LSB |
| <b>Byte13</b> | <b>INT5_HIGH</b> |  |
| <b>Byte14</b> | <b>INT6_LOW</b>  | data_yesterday.pow_max_load, INT6 is a 16bit unsigned integer number ranging 0~65535, calibration is 1W/LSB  |
| <b>Byte15</b> | <b>INT6_HIGH</b> |  |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data.  |

Figure 16 Formatting of Data Frame Slave Responding to 0x09 Command

| Byte Code     | Name             | Meaning   |
|---------------|------------------|---|
| <b>Byte1</b>  | <b>SYN</b>       | This byte is 0x8E and it is the start of one frame data.  |
| <b>Byte2</b>  | <b>SN</b>        | Slave number of machine with data returned from, ranging 1~99   |
| <b>Byte3</b>  | <b>0x20</b>      | Data returned by Slave responding to Host's command 0x20  |
| <b>Byte4</b>  | <b>INT1_LOW</b>  | vol_LVD, INT1 is a 16bit unsigned integer number ranging 0~65535, calibration is 0.01V/LSB  |
| <b>Byte5</b>  | <b>INT1_HIGH</b> |   |
| <b>Byte6</b>  | <b>INT2_LOW</b>  | INT2_LOW=0x00, setting successful ,<br>INT2_LOW=0x01,error in communication process<br>INT2_LOW=0x02,value beyond valid range, setting failed |
| <b>Byte7</b>  | <b>INT2_HIGH</b> | 0x00  |
| <b>Byte8</b>  | <b>INT3_LOW</b>  | 0x00  |
| <b>Byte9</b>  | <b>INT3_HIGH</b> |   |
| <b>Byte10</b> | <b>INT4_LOW</b>  | 0x00  |

|               |                  |                                   |
|---------------|------------------|-----------------------------------|
| <b>Byte11</b> | <b>INT4_HIGH</b> |                                   |
| <b>Byte12</b> | <b>INT5_LOW</b>  | 0x00                              |
| <b>Byte13</b> | <b>INT5_HIGH</b> |                                   |
| <b>Byte14</b> | <b>INT6_LOW</b>  | 0x00                              |
| <b>Byte15</b> | <b>INT6_HIGH</b> |                                   |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data. |

Figure 17 Formatting of Data Frame Slave Responding to 0x20 Command

| Byte Code     | Name             | Meaning   |
|---------------|------------------|---|
| <b>Byte1</b>  | <b>SYN</b>       | This byte is 0x8E and it is the start of one frame data.  |
| <b>Byte2</b>  | <b>SN</b>        | Slave number of machine with data returned from, ranging 1~99   |
| <b>Byte3</b>  | <b>0x21</b>      | Host request to set controller voltage of LVD(vol_LVR)  |
| <b>Byte4</b>  | <b>INT1_LOW</b>  | vol_LVR, INT1 is a 16bit signed integer number ranging 0~65535, calibration is 0.01V/LSB  |
| <b>Byte5</b>  | <b>INT1_HIGH</b> |   |
| <b>Byte6</b>  | <b>INT2_LOW</b>  | INT2_LOW=0x00, setting successful ,<br>INT2_LOW=0x01,error in communication process<br>INT2_LOW=0x02,value beyond valid range, setting failed |
| <b>Byte7</b>  | <b>INT2_HIGH</b> | 0x00  |
| <b>Byte8</b>  | <b>INT3_LOW</b>  | 0x00  |
| <b>Byte9</b>  | <b>INT3_HIGH</b> |   |
| <b>Byte10</b> | <b>INT4_LOW</b>  | 0x00  |
| <b>Byte11</b> | <b>INT4_HIGH</b> |   |
| <b>Byte12</b> | <b>INT5_LOW</b>  | 0x00  |
| <b>Byte13</b> | <b>INT5_HIGH</b> |   |
| <b>Byte14</b> | <b>INT6_LOW</b>  | 0x00  |
| <b>Byte15</b> | <b>INT6_HIGH</b> |   |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data.   |

Figure 18 Formatting of Data Frame Slave Responding to 0x21 Command

| Byte Code    | Name             | Meaning   |
|--------------|------------------|---|
| <b>Byte1</b> | <b>SYN</b>       | This byte is 0x8E and it is the start of one frame data.  |
| <b>Byte2</b> | <b>SN</b>        | Slave number of machine with data returned from, ranging 1~99   |
| <b>Byte3</b> | <b>0x22</b>      | Host requests to set controller float charge voltag (vol_float)   |
| <b>Byte4</b> | <b>INT1_LOW</b>  | vol_float , INT1 is a 16bit signed integer number ranging -32768~32767, calibration is 0.01V/LSB  |
| <b>Byte5</b> | <b>INT1_HIGH</b> |   |
| <b>Byte6</b> | <b>INT2_LOW</b>  | INT2_LOW=0x00, setting successful ,<br>INT2_LOW=0x01,error in communication process<br>INT2_LOW=0x02,value beyond valid range, setting failed |
| <b>Byte7</b> | <b>INT2_HIGH</b> | 0x00  |
| <b>Byte8</b> | <b>INT3_LOW</b>  | 0x00  |

|               |                  |                                   |
|---------------|------------------|-----------------------------------|
| <b>Byte9</b>  | <b>INT3_HIGH</b> |                                   |
| <b>Byte10</b> | <b>INT4_LOW</b>  | 0x00                              |
| <b>Byte11</b> | <b>INT4_HIGH</b> |                                   |
| <b>Byte12</b> | <b>INT5_LOW</b>  | 0x00                              |
| <b>Byte13</b> | <b>INT5_HIGH</b> |                                   |
| <b>Byte14</b> | <b>INT6_LOW</b>  | 0x00                              |
| <b>Byte15</b> | <b>INT6_HIGH</b> |                                   |
| <b>Byte16</b> | <b>CRC</b>       | Check code of first 15 byte data. |

Figure 19 Formatting of Data Frame Slave Responding to 0x22 Command

## VI.CRC8 Verification

CRC8 Sample function generated by check code :

```

/*****
/*CRC8 check code generates function*/
/*ptr orienting data to be checked*/
/*num number of data to be checked*/
*****/
unsigned char crc8_generate(unsigned char *ptr,unsigned char num)
{
    unsigned char temp=0;
    unsigned char crc8=0;
    while (num)
    {
        crc8=temp^(*ptr++);
        temp=crc8_tab[crc8];          // Look up value of byte shifted out in checking table
        num--;
    }
    return(crc8_tab[crc8]);
}

//crc8 checking table
const unsigned char crc8_tab[256]=
{0x00,0x31,0x62,0x53,0xc4,0xf5,0xa6,0x97,
 0xb9,0x88,0xdb,0xea,0x7d,0x4c,0x1f,0x2e,
 0x43,0x72,0x21,0x10,0x87,0xb6,0xe5,0xd4,
 0xfa,0xcb,0x98,0xa9,0x3e,0x0f,0x5c,0x6d,
 0x86,0xb7,0xe4,0xd5,0x42,0x73,0x20,0x11,
 0x3f,0x0e,0x5d,0x6c,0xfb,0xca,0x99,0xa8,
 0xc5,0xf4,0xa7,0x96,0x01,0x30,0x63,0x52,
 0x7c,0x4d,0x1e,0x2f,0xb8,0x89,0xda,0xeb,
 0x3d,0x0c,0x5f,0x6e,0xf9,0xc8,0x9b,0xaa,
 0x84,0xb5,0xe6,0xd7,0x40,0x71,0x22,0x13,
 0x7e,0x4f,0x1c,0x2d,0xba,0x8b,0xd8,0xe9,
 0xc7,0xf6,0xa5,0x94,0x03,0x32,0x61,0x50,
 0xbb,0x8a,0xd9,0xe8,0x7f,0x4e,0x1d,0x2c,
 0x02,0x33,0x60,0x51,0xc6,0xf7,0xa4,0x95,
 0xf8,0xc9,0x9a,0xab,0x3c,0x0d,0x5e,0x6f,
 0x41,0x70,0x23,0x12,0x85,0xb4,0xe7,0xd6,

```

```
0x7a,0x4b,0x18,0x29,0xbe,0x8f,0xdc,0xed,  
0xc3,0xf2,0xa1,0x90,0x07,0x36,0x65,0x54,  
0x39,0x08,0x5b,0x6a,0xfd,0xcc,0x9f,0xae,  
0x80,0xb1,0xe2,0xd3,0x44,0x75,0x26,0x17,  
0xfc,0xcd,0x9e,0xaf,0x38,0x09,0x5a,0x6b,  
0x45,0x74,0x27,0x16,0x81,0xb0,0xe3,0xd2,  
0xbf,0x8e,0xdd,0xec,0x7b,0x4a,0x19,0x28,  
0x06,0x37,0x64,0x55,0xc2,0xf3,0xa0,0x91,  
0x47,0x76,0x25,0x14,0x83,0xb2,0xe1,0xd0,  
0xfe,0xcf,0x9c,0xad,0x3a,0x0b,0x58,0x69,  
0x04,0x35,0x66,0x57,0xc0,0xf1,0xa2,0x93,  
0xbd,0x8c,0xdf,0xee,0x79,0x48,0x1b,0x2a,  
0xc1,0xf0,0xa3,0x92,0x05,0x34,0x67,0x56,  
0x78,0x49,0x1a,0x2b,0xbc,0x8d,0xde,0xef,  
0x82,0xb3,0xe0,0xd1,0x46,0x77,0x24,0x15,  
0x3b,0x0a,0x59,0x68,0xff,0xce,0x9d,0xac  
};
```