

## APPENDIX

### A.Serial Communication Protocol Manual

#### 1. General concept

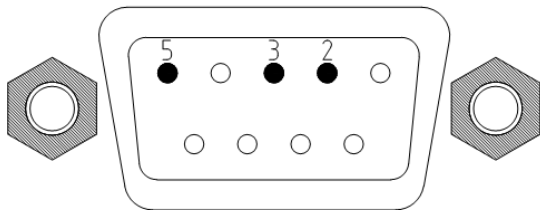
1)At upper grade equipment, the Power Supply can be controlled and monitored by RS-232 and RS-485 communication, and monitor power supply operation status.

2)Baud rate applies 9600bps, stop bit applies 1bit, No parity, 8 bit for data bit, and asynchronous communication, we recommend over 100ms as the communication cycle.

3) Pin-Map of a communication port is as follows.

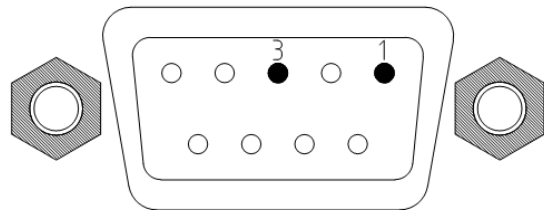
4) This manual is for Protocol Type 3 of Menu 5.Communication set.

#### RS-232



Pin	Name	Description
2	RXD.D	RS-232 receive data
3	TXD.D	RS-232 transmit data
5	COM.D	Data common

#### RS-485



Pin	Name	Description
1	TRXD+	RS-485 (+) Transmit / Receive data
3	TRXD-	RS-485 (-) Transmit /Receive data

## 2. Frame composition

### 1) 0x60 ~ 0x8F (Writing Command Frame)

Header	Hex Data	Hex Data	ETX
Command	–	–	0x03

- ※ It is composed of Header, Hex Data, ETX, and 2byte for Hex Data.
- ※ Return Frame of 0x60 ~ 0x8f replies Echo information of 1byte.
- ※ 0x06 : ACK (Communication success), 0x04: ERR (Communication failure)

### 2) 0x90 ~ 0xBF (Reading Command Frame)

Header	ETX
Command	0x03

- ※ It is composed of 2byte transmit Data of Header and ETX.

## 3. Command composition of RS485

### 1) 0x60 ~ 0x8F (Writing Command Frame)

IP Address	Header	Hex Data	Hex Data	ETX
ID Number	Command	–	–	0x03

- ※ It is composed of IP Address ,Header, Hex Data, ETX, and Hex Data composes of 2byte.
- ※ Return Data Frame of 0x60 ~ 0x8F replies Echo information of 2byte.

IP Address	Echo
ID Number	0x06/0x04

- ※ 0x06 : ACK (Communication success), 0x04: ERR (Communication failure)

### 2) 0x90 ~ 0xBF (Reading Command Frame)

IP Address	Header	ETX
ID Number	Command	0x03

- ※ It is composed of IP Address ,Header, and 3byte transmission data of ETX.
- ※ Please refer to the following tables for Return Data Frame.

### 3. Command structure and contents

#### 1) Command type

The following table shows protocol commands type and its operation of RS-232 communication, and it is composed to get control parameter and data for output status.

Command (1byte)	Format		Description	Return data
	Cmd	Data		
0x60	1byte	2byte	Max Power value setting up 10 ~ 100 (1.0 ~ 10.0 [kW]) 10.0kW : 0x60006403	1byte - 0x06 : ACK - 0x04 : ERR
0x61	1byte	2byte	Max Current value setting up 50 ~ 250 (5.0 ~ 25.0 [A]) 50.0A : 0x6100FA03	
0x62	1byte	2byte	Max Voltage value setting up 500 ~ 800 (500 ~ 800 [V]) 800V : 0x62032003	
0x63	1byte	2byte	Ramp time setting up 500 ~ 3000 (500 ~ 3000 [ms]) 500ms : 0x6301F403	
0x64	1byte	2byte	Pulse Sync setting up INT : 0, EXT: 1 INT : 0x64000003	
0x65	1byte	2byte	Pulse Freq. setting up 20 ~ 150 (20 ~ 150kHz) 50kHz : 0x65003203	
0x66	1byte	2byte	Rev Time setting up 0/10 ~ 70 (DC/1.0 ~ 7.0us) 2.0us : 0x66001403	
0x67	1byte	2byte	Target life setting up 0 ~ 2710 (0 ~ 9999 [kW], OFF) OFF : 0x67271003 9999kW : 0x67270F03	
0x68	1byte	2byte	Run Time Sq setting up (Input it in a second unit) 0 ~ 32400 (OFF/0:00:01 ~ 9:00:00) OFF : 0x68000003 9:00:00 : 0x687E9003	

Command (1byte)	Format		Description	Return data
	Cmd	Data		
0x70	1byte	2byte	Delay time setting up 0 ~ 5 (0 ~ 5 [us]) 0us : 0x70000003	1byte return - 0x06 : ACK - 0x04 : ERR
0x71	1byte	2byte	Pause time setting up 40 ~ 200 (40 ~ 200 [us]) 50us : 0x71003203	
0x72	1byte	2byte	Low voltage detection level setting up 10 ~ 100 (Disable, 11 ~ 100 [V]) Disable : 0x72000A03 50V : 0x72003203	
0x73	1byte	2byte	Increment A level setting up 5 ~ 30 (5 ~ 30 [A]) 10A : 0x73000A03	
0x74	1byte	2byte	Sensitivity level setting up 0 ~ 5 [step] 0 (Disable) : 0x74000003 1 (Ultra low) : 0x74000103 2 (low) : 0x74000203 3 (Middle) : 0x74000303 4 (High) : 0x74000403 5 (Ultra high) : 0x74000503	
0x75	1byte	2byte	Limit ARC Number setting up 0 ~ 4000 (Disable, 1 ~ 4000/s) Disable : 0x75000003 4000/s : 0x750FA003	
0x76	1byte	2byte	Total ARC Number setting up 0 ~ 65535 (Disable, 1 ~ 65535) Disable : 0x76000003 65535 : 0x76FFFF03	

Command (1byte)	Format		Description	Return data
	Cmd	Data		
0x7A	1byte	2byte	Non support.	
0x7B	1byte	2byte	ONOFF Master setting up ( 0 ~ 3) Origin : 0x7B000003 Local : 0x7B000103 Remote : 0x7B000203 Host : 0x7B000303	
0x7C	1byte	2byte	Refer.Master setting up ( 0 ~ 3) Origin : 0x7C000003 Local : 0x7C000103 Remote : 0x7C000203 Host : 0x7C000303	
0x7D	1byte	2byte	Mode Master setting up ( 0 ~ 4) Origin : 0x7D000003 Local : 0x7D000103 Remote : 0x7D000203 Host : 0x7D000303 Always : 0x7D000403	1byte - 0x06 : ACK - 0x04 : ERR
0x80	1byte	2byte	Output On/Off control 0 ~ 1 (On, Off) On : 0x80000103 Off : 0x80000203	
0x81	1byte	2byte	Control mode (Regulation) setting up Voltage : 0x81000103 Current : 0x81000203 Power : 0x81000303	
0x83	1byte	2byte	Setting up output value in control mode (Output level) Voltage : [0 ~ 800] 8301F403 (500V) Current : [0 ~ 250] 83008203 (13.0A) Power : [0 ~ 100] 83006403 (10.0kW)	
Command (1byte)	Format (Cmd)	Description		Return data

0x90	1byte	Request status mode information – Control mode(MD1;MD0) 01: Voltage 10: Current 11: Power – Others : Active high Send data “ 0x9003	2byte (f3/f2/f1/f0) f0 = Set point   Ramp   START   N.A f1 = N.A   N.A   MD1   MD0 f2 = N.A   N.A   N.A   N.A f3 = ARC   N.A   Protection  E_STOP *Refer to the 0x91 Command
0x91	1byte	Request operation mode – REF_MD (RD1;RD0) 00: Origin 01: Local 10: Remote 11: Host – ONOFF_MD(SD1;SD0) 00: Origin 01: Local 10: Remote 11: Host – CON_MD (CD1;CD0) 00: Origin 01: Local 10: Remote 11: Host Send data : 0x9103	2byte (f3/f2/f1/f0) f0 = Fault   N.A   N.A   N.A f1 = RD1   RD0   SD1   SD0 f2 = Master   N.A   CD1   CD0 f3 = N.A   N.A   N.A   N.A  ex) 0x91123403 this, 1 is f3 at Data 0x1234, 2 is f2, 3 is f1. And 4 informs f0. If f1 is B to 0xB→0B1011, Ref Master is Remote, ONOFF Master is set up to Remote
0x92	1byte	Request Reference value Send data : 0x9203	2byte Reference value (0 ~ 800)
0x93	1byte	Request output power value Send data : 0x9303	2byte Output power (0 ~ 100)
0x94	1byte	Request output current value Send data : 0x9403	2byte Output current (0 ~ 250)
0x95	1byte	Request output voltage value Send data : 0x9503	2byte Output voltage ( 0 ~ 800)
0x96	1byte	Request the number of arc occurrence Send data : 0x9603	2byte Arc per second
0x97	1byte	Request output pulse voltage value Send data : 0x9703	2byte Output pulse voltage (Vp)
0x9A	1byte	Request output power/ current/ Voltage value at the same time Send data : 0x9A03	6byte Power/ Current / Voltage

Command (1byte)	Format (Cmd)	Description	Return data
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0xA0	1byte	Request Max Power set value Send data : 0xA003	2byte Max Power (10 ~ 100/10.0kW)
0xA1	1byte	Request Max Current set value Send data : 0xA103	2byte Max Current (50 ~ 250/25.0A)
0xA2	1byte	Request Max voltage set value Send data : 0xA203	2byte Max Voltage (500 ~ 800V)
0xA3	1byte	Request Ramp time set value Send data : 0xA303	2byte Ramp time (500 ~ 3000ms)
0xA4	1byte	Request Pulse Sync set value Send data : 0xA403	2byte INT : 0, EXT: 1
0xA5	1byte	Request Pulse Freq. set value Send data : 0xA503	2byte Pulse Freq. (20 ~ 150 kHz)
0xA6	1byte	Request Rev Time set value Send data : 0xA603	2byte Rev Time (DC / 1.0 ~ 7.0 us)
0xA7	1byte	Request Target life set value Send data : 0xA703	2byte Target life (0 ~ 9999kWh, 100000/OFF)
0xA8	1byte	Request Run Time Sq. set value Send data : 0xA803	2byte Run Time Sq (0/OFF ~ 32400/9:00:00)

Command (1byte)	Format (Cmd)	Description	Return data
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0xB0	1byte	Request delay time set value Send data : 0xB003	2byte Delay time (0 ~ 5us)
0xB1	1byte	Request Pause time set value Send data : 0xB103	2byte Pause time (40 ~ 200us)
0xB2	1byte	Request Low voltage value Send data : 0xB203	2byte Low voltage (10/Disable, 11 ~ 100V)
0xB3	1byte	Request Increment A set value Send data : 0xB303	2byte Increment current (5 ~ 30A)
0xB4	1byte	Request Sensitivity set value Send data : 0xB403	2byte Sensitivity (0 ~ 5)
0xB5	1byte	Request Limit ARC Number set value Send data : 0xB503	2byte Limit ARC Number (0/Disable, 1 ~ 4000/s)
0xB6	1byte	Request Total ARC Number set value Send data : 0xB603	2byte Total ARC Number (0/Disable, 1 ~ 65535)
0xBB	1byte	Request ONOFF Master set status Send data : 0xBB03	2byte ONOFF Master (0 ~ 3) *Refer to the 0xBD Command
0xBC	1byte	Request Refer. Master set status Send data: 0xBC03	2byte Refer. Master (0 ~ 3) *Refer to the 0xBD Command
0xBD	1byte	Request Mode Master set status Send data : 0xBD03	2byte Control Mode Status (0 ~ 4)  Origin : 0x00 Local : 0x01 Remote : 0x02 Host : 0x03 Always : 0x04