

# Communication Protocol of PV Combiner Box (Modbus)

## V1.7.2.4

### 1. Introduction

This communication protocol, adopting Modbus RTU protocol, applies to the communication between Sungrow PV combiner box and upper computer (PC) monitoring software. This protocol can read the real-time operating data and fault states of the combiner box, and change the internal parameter setting.

Applicable version: PVS-20M / 24M -HV (fuse specification 15A)

PVS-20M / 24M -DB (2 sinks 1, fuse specification 30A)

PVS-20MH / 24MH (16-24 channels, fuse size 15-20A)

### 2. Communication Interface

RS485 (Baud rate: 9600bps; Check bits: Null; Data bits: 8; Stop bits: 1; Fluid control: Null.)

### 3. Definition of Address

Address of 3x type is read-only register, supporting the cmdcode inquiry of 0x04.

Address of 4x type is holding register, supporting the cmdcode inquiry of 0x03, and cmdcodes write-in of 0x10 and 0x06.

#### 3.1 Definition of Running Information Variable Address

No.	Name	Address	Data type (see Note 1)	Data range	Unit	Addr. type
Running data						
1	Device type code	7000	U16	PVS-20M: 0X00D5 PVS-24M: 0X00D6		3x
2	Max. input numbers	7001	U16	Depends on device type		3x
3	Protocol ver.	7002 - 7003	U32	e.g. V1.7.0.3 uploaded as 0X00030107		3x
4	Reserved	7004 - 7005	-			3x
5	DC bus voltage	7006	U16		0.1V	3x
6	Internal temperature	7007	S16		0.1℃	3x
7	Reserved	7008 - 7009	-			3x
8	Digit input	7010	U16	See 4.1 Definition of digit input		3x
9	Max. current	7011	U16	See 4.3 Glossary	0.01A	3x
10	Average current	7012	U16	See 4.3 Glossary	0.01A	3x
11	Current of 1 <sup>st</sup> input	7013	S16		0.01A	3x
12	Current of 2 <sup>nd</sup> input	7014	S16		0.01A	3x
13	Current of 3 <sup>rd</sup> input	7015	S16		0.01A	3x
14	Current of 4 <sup>th</sup> input	7016	S16		0.01A	3x

15	Current of 5 <sup>th</sup> input	7017	S16		0.01A	3x
16	Current of 6 <sup>th</sup> input	7018	S16		0.01A	3x
17	Current of 7 <sup>th</sup> input	7019	S16		0.01A	3x
18	Current of 8 <sup>th</sup> input	7020	S16		0.01A	3x
19	Current of 9 <sup>th</sup> input	7021	S16		0.01A	3x
20	Current of 10 <sup>th</sup> input	7022	S16		0.01A	3x
21	Current of 11 <sup>th</sup> input	7023	S16		0.01A	3x
22	Current of 12 <sup>th</sup> input	7024	S16		0.01A	3x
23	Current of 13 <sup>th</sup> input	7025	S16		0.01A	3x
24	Current of 14 <sup>th</sup> input	7026	S16		0.01A	3x
25	Current of 15 <sup>th</sup> input	7027	S16		0.01A	3x
26	Current of 16 <sup>th</sup> input	7028	S16		0.01A	3x
27	Reserved	7029 - 7030	U16			3x
28	Total current	7031 - 7032	U32	See 4.3 Glossary	0.1A	3x
29	Total DC power	7033 - 7034	U32		1 W	3x
30	Daily power yields	7035 - 7036	U32		0.1kWh	3x
31	Total power yields	7037 - 7038	U32		0.1kWh	3x
32	Reserved	7039 - 7040	-			3x
33	Work state	7041 - 7042	U32	See 4.2 Definition of Work State		3x
34	Short circuit data	7043 - 7044	U32	Each bit represents one channel, starting from the lowerbyte. 0: Invalid; 1: Valid		3x
35	Reverse current	7045 - 7046	U32	Each bit represents one channel, starting from the lower byte. 0: Invalid; 1: Valid		3x
36	High current data	7047 - 7048	U32	Each bit represents one channel, starting from the lower byte. 0: Invalid; 1: Valid		3x
37	Fuse blow	7049 - 7050	U32	Each bit represents one channel, starting from the lower byte. 0: Invalid; 1: Valid		3x
38	Low current data	7051 - 7052	U32	Each bit represents one channel, starting from the lower byte. 0: Invalid; 1: Valid		3x
39	Reserved	7053 - 7054	-			3x
40	Open circuit data	7055 - 7056	U32	Each bit represents one channel, starting from the		3x

				lower byte. 0: Invalid; 1: Valid		
41	Reserved	7057 - 7058	-			3x
42	Power of 1 <sup>st</sup> input	7059	U16		1W	3x
43	Power of 2 <sup>nd</sup> input	7060	U16		1W	3x
44	Power of 3 <sup>rd</sup> input	7061	U16		1W	3x
45	Power of 4 <sup>th</sup> input	7062	U16		1W	3x
46	Power of 5 <sup>th</sup> input	7063	U16		1W	3x
47	Power of 6 <sup>th</sup> input	7064	U16		1W	3x
48	Power of 7 <sup>th</sup> input	7065	U16		1W	3x
49	Power of 8 <sup>th</sup> input	7066	U16		1W	3x
50	Power of 9 <sup>th</sup> input	7067	U16		1W	3x
51	Power of 10 <sup>th</sup> input	7068	U16		1W	3x
52	Power of 11 <sup>th</sup> input	7069	U16		1W	3x
53	Power of 12 <sup>th</sup> input	7070	U16		1W	3x
54	Power of 13 <sup>th</sup> input	7071	U16		1W	3x
55	Power of 14 <sup>th</sup> input	7072	U16		1W	3x
56	Power of 15 <sup>th</sup> input	7073	U16		1W	3x
57	Power of 16 <sup>th</sup> input	7074	U16		1W	3x
58	Power of 17 <sup>th</sup> input	7075	U16		1W	3x
59	Power of 18 <sup>th</sup> input	7076	U16		1W	3x
60	Power of 19 <sup>th</sup> input	7077	U16		1W	3x
61	Power of 20 <sup>th</sup> input	7078	U16		1W	3x
62	Power of 21 <sup>th</sup> input	7079	U16		1W	3x
63	Power of 22 <sup>th</sup> input	7080	U16		1W	3x
64	Power of 23 <sup>th</sup> input	7081	U16		1W	3x
65	Power of 24 <sup>th</sup> input	7082	U16		1W	3x
66	Reserved	7083~7084	-			3x
67	Current of 17 <sup>th</sup> input	7085	S16		0.01A	3x
68	Current of 18 <sup>th</sup> input	7086	S16		0.01A	3x
69	Current of 19 <sup>th</sup> input	7087	S16		0.01A	3x
70	Current of 20 <sup>th</sup> input	7088	S16		0.01A	3x
71	Current of 21 <sup>th</sup> input	7089	S16		0.01A	3x
72	Current of 22 <sup>th</sup> input	7090	S16		0.01A	3x
73	Current of 23 <sup>th</sup> input	7091	S16		0.01A	3x
74	Current of 24 <sup>th</sup> input	7092	S16		0.01A	3x
75	Reserved	7093-7094				3x
76	S/N	7095-7104	U16*10	UTF-8 eg: P1906180001	-	3x

Note 1:

- ① U16: 16-bit unsigned integer
- ② U32---32-bit unsigned integer; little-endian for double-word data. Big-endian for byte data
- ③ S16---16-bit signed integer

④ S32---32-bit signed integer; little-endian for double-word data. Big-endian for byte data

#### Note 2

Read double-word data: little-endian

Example:

transmission order of U16 data 0x0102 is 01, 02

transmission order of U32 data 0x01020304 is 03, 04, 01, 02

#### Note 3

The hexadecimal address starts from 0000, therefore, read the actual address by subtracting 1. For example, the decimal address of Device type code is 7000, and the PC read address is 1B 57 rather than 1B 58.

#### Note 4 Check type

CRC16 generates polynomial 0xA001, little-endian.

#### Note 5

Short circuit data, Reverse current, High current data, Fuse blow, Low current data, and Open circuit data are all U32 data, corresponding to data of 32-input. However, only 1-16 input are used by now. Sometimes, fault is 1 and normal is 0.

For example, the return of Open circuit data is 0X00080000; according to the following table, it can be determined that the 4<sup>th</sup> input is in open-circuit state.

Input	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
State	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0

Input	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
State	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0

### 3.2 Parameter setting address definition

No.	Name	Address	Data type (see Note 1)	Data range	Unit	Addr. type	No.
1	Password for setting area	7000~7001	U32	Input the password for the setting area (i.e. enter setting)	0x55A855A9 effective	-	4x
2	Password time left	7002	U16	For return display only; no setting respond	-	1 second	4x
3	Reserved	7003~7004	U32	-	-	-	4x
4	Shunt trip Command (Need hardware support)	7005	U16	0XA8A9Valid	-	-	4x
5	Shunt trip enable (Need hardware support)	7006	U16	Enable:0XA8A9 Disable:0XA5A6	-	-	4x

6	Actual input connected	7007~7008	U32	Each bit represents one input, starting from the lower byte. 0: Not connect; 1: Connect (input numbers cannot bigger than the max. input numbers)	Self-adaption according to the types. Default: all connected	-	4x
7	Reserved	7009	-	-	-	-	4x
8	Over temperature data	7010	U16	800-1000	800	0.1 °C	4x
9	String fault diagnosis	7011	U16	JUD_switch, Fault switch, allow ignore	Enable:0xA A Disable:0x5 5	-	4x
10	Overvoltage Value	7012	U16	200~1505	1520	1V	4x
11	Judge current	7013	U16	20 - 2000	200	0.01A	4x
12	Tolerance $\delta$	7014	U16	10-1000	200	0.1%	4x
13	Count threshold $\theta$	7015 - 7016	U32	-	21600	-	4x
14	Fuse type	7017	-	-	-	-	4x
15	Short-circuit current	7018	U16	50-5000	1400	0.01A	4x
16	Reserved	7019	-	-	-	-	4x

Note 1:

Any write-in operation to the parameter setting address areas starts with “input setting area password”, i.e. after writing in 0X55A855A9 to address 7000-7001, the parameters in address area of 7007-7047 can be set. If the address return value for address 7000-7001 read by command 03 is 0X58, the password input is correct.

The effective time is 10 minutes. After 10 minutes, the return value for address 7000-7001 is 0X00, i.e. you cannot perform write-in operation to the parameter setting address. to operate again, you need to “input setting area password” again.

Note 2

The default fuse specification is 15A. If you use the fuse blow function, please set the fuse class to the actual value. Mismatched fuse specification may cause non-report or misreport “fuse blow” fault.

Note 3

There can be no background software “parameter setting” function. Even there has such function, it is not available to the plant operators unless they has high level managing rights or password.

## 4. Definition of State and Glossary

### 4.1 Definition of digit input

Bit	State	State code
bit 0	SPD state	0: Fault 1: Normal
bit 1	Reserved	-
bit 2	Reserved	-
bit 3	Switch trip or off (optional, supported by hardware)	0: ON 1: Trip or OFF

## 4.2 Definition of work state

Bit	State	State code	State	Alarm	Fault
bit 0	----	----	----	----	----
bit 1	----	----	----	----	----
bit 2	SPD fault	0: Normal 1: Fault	----	----	Fault
bit 3	High internal temp.	0: Normal 1: Fault	----	----	Fault
bit 4	High DC voltage	0: Normal 1: Fault	----	----	----
bit 5	Short-circuit	0: Normal 1: Fault	----	Alarm	----
bit 6	High current	0: Normal 1: Alarm	----	Alarm	----
bit 7	Low current	0: Normal 1: Alarm	----	Alarm	----
bit 8	Open circuit	0: Normal 1: Alarm	----	Alarm	----
bit 9	Reverse current	0: Normal 1: Fault	----	----	Fault
bit 10	Fuse blow	0: Normal 1: Fault	----	----	Fault
bit 11	Reserved	----	----	----	----
bit 12	Reserved	----	----	----	----
bit 13	Switch trip	0: Normal 1: Trip	State	----	----
bit 14	Trip	0 : Normal 1 : Trip abnormal	----	----	Fault
bit 15	Detected busbar losing electricity shunt trip	0 : Normal 1 : Self-test trip	----	----	Fault

bit 16	Shunt trip command complete	0 : Normal 1 : Commandtrip	State	----	----
bit 17	Switch trip enable	0 : Enable 1 : Disable	State	----	----

**Note 1. The max. alarm internal temperature is 80.0℃.**

#### 4.3 Glossary

##### Max. current

The max. current among the currents of the n inputs that are actually connected.

##### Average current

The mean of the sum of the n inputs that are actually connected.

##### Total current

The sum of the currents of the n inputs that are actually connected.

##### Actual input connected

4 bytes and each bit represents one input. 0: Not connect; 1: Connect. According to the field cable connection situation, set the unconnected input number to 0 so that device will not detect the fault state of this input and thus to reduce false report. Ignore this address if all inputs are connected.

##### Judge current

Fault detection function is closed automatically when the average current is smaller than the judge current. The default judge current is 2 A.

##### Tolerance $\delta$

Tolerance $\delta$  is to check the monitoring sensitivity of the string current, i.e. degree that the string current can deviate from the average. When the string current exceeds the Tolerance limit, overcurrent or undercurrent fault alarm of this input will be reported. Default value is 20%.

For example: suppose the average current is 5.0A, the defaulttolerance is  $5 * (1+0.2) = 6A$ ;  $5 * (1-0.2) = 4A$ . The software of the combiner box will take the current higher than 6A as “Overcurrent” and lower than 4 A as Undercurrent.

##### Short-circuit current

Short-circuit fault occurs when the string current is higher than the short-circuit current. The default value is 11.00A, or set according to the short-circuit specification of the string PV panels in series connection

#### 4.4、digital display

##### Fault code display

SPD fault	E 60
High internal temp	E 61

High DC voltage	E 62
Short-circuit	E0163~E2463 (01-24 refers to the corresponding number)
Open circuit	E0164~E2464(01-24 refers to the corresponding number)
Reverse current	E0165~E2465(01-24 refers to the corresponding number)
Fuse blow	E0166~E2466(01-24 refers to the corresponding number)
Trip fault	E 67

## 5. Examples

### 5.1 Read one piece of information (e.g. internal temperature)

Send data: 01 04 1B 5E 00 01 56 FC

Sequence	Content	Explanation	
0	01	Address of the combiner box	
1	04	Read command word	
2-3	1B 5E	Read the address of internal temperature 7007 (actual send address 1b 5e)	
4-5	00 01	Length, read one register	
6	56	CRCL	
7	FC	CRCH	

Replayed data by the combiner box: 01 04 02 01 26 39 7A

Sequence	Content	Explanation	
0	01	Address of the combiner box	
1	04	Read command word	
2	02	Return 2 bytes	
3-4	01 26	internal temperature: 29.4	
5	39	CRCL	
6	7A	CRCH	

### 5.2 Read all data

Send data: 01 04 1B 57 00 3B 06 ED

Sequence	Content	Explanation	
0	01	Address of the combiner box	
1	04	Read command word	
2-3	1B 57	Read from the first byte of address 7000	
4-5	00 3B	Length, read 95 registers	
6	06	CRCL	
7	ED	CRCH	

Data replayed by the combiner box: 01 04 76 00 D1 00 10 00 00 01 03 00 00 00 00 16 26 01 27 00 00 00 00 00 08 BA 54 0E 7C 02 DF 02 E4 02 EB 02 F0 02 F6 02 FC 03 02 03 07 03 0E 03 13 03 18 03 1F 03 24 03 29 03 30 BA 54 00 00



```
00 00 17 2D 00 00 22 42 00 01 00 49 00 00 4C 0E 00 55 00 00 00 00 20 25 00 00 80 00 00 00 00 00 00 00 00 00  
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 1E 67
```

Sequence	Content	Explanation	
0	01	Address of the combiner box	
1	04	Read command word	
2	76	Return 118byte registers	
3-4	.....	Analyze according to protocol	
.....	.....	Analyze according to protocol	
119	.....	Analyze according to protocol	
120	.....	Analyze according to protocol	
121	1E	CRCL	
122	67	CRCH	

### 5.3Set actual connected input

The parameters can be set only after entering the correct password.

For combiner box with 16 input, if only connect the 1<sup>st</sup> -14<sup>th</sup> input and leave the 15<sup>th</sup> and 16<sup>th</sup> not connected, the data value are 0011 1111 1111 1111.

Send data: 01 10 1b 5E 00 02 04 3F FF 00 00 F5 CB

Sequence	Content	Explanation	
0	01	Address of the combiner box	
1	10	Write multi-register command word	
2-3	1b 5E	Write from address 7007	
4-5	00 02	Write 2 registers	
6	04	Write 4 bytes	
7-8	3F FF	The 15 <sup>th</sup> and 16 <sup>th</sup> input are not connected among the 1 <sup>st</sup> -16 <sup>th</sup> input	
9-10	00 00	17 <sup>th</sup> -32 <sup>th</sup> are not connected	
11	F5	CRCL	
12	CB	CRCH	

### 5.4 Change the judge current to above 2.5 A

The parameters can be set only after entering the correct password.

Send data: 01 06 1b 64 00 FA 00 10

Sequence	Content	Explanation	
0	01	Address of the combiner box	
1	06	Write 1 register	
2-3	1b 64	Address 7013	
4-5	00 FA	Content: 250, i.e. 2.50A	
6	00	CRCL	
7	10	CRCH	

### 5.5 Change the Tolerance to 22%

The parameters can be set only after entering the correct password.

Send data: 01 06 1b 65 00 dc 9E A8

Sequence	Content	Explanation	
0	01	Address of the combiner box	
1	06	Write 1 register	
2-3	1b 65	Address 7014	
4-5	00 dc	Content: 220, i.e. 22%	
6	9E	CRCL	
7	A8	CRCH	

**5.6 Change the short-circuit current to 10 A**

The parameters can be set only after entering the correct password.

Send data: 01 06 1b 69 03 E8 5F 8C

Sequence	Content	Explanation	
0	01	Address of the combiner box	
1	06	Write 1 register	
2-3	1b 69	Address: 7018	
4-5	03 E8	Content: 1000, i.e. 10.00A	
6	5F	CRCL	
7	8C	CRCH	

**5.7 Read the parameter setting area**

For example:

To read the short circuit current, you need to use the 03 command word.

Send data: 01 03 1b 69 00 01 52 f2

Sequence	Content	Explanation	
0	01	Address of the combiner box	
1	03	Read command	
2-3	1b 69	Address 7018	
4-5	00 01	Read 1 register	
6	52	CRCL	
7	F2	CRCH	

Data replayed by the combiner box: 01 03 02 03 E8 B8 FA

Sequence	Content	Explanation	
0	01	Address of the combiner box	
1	03	Read command	
2	02	Return 2 bytes	
3-4	03 08	Content: 1000, i.e. 10.00A	
5	B8	CRCL	
6	FA	CRCH	