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Communication Protocol

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CAN Communication Protocol

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Preface

Overview

This document describes in detail the protocol for communication between the rectifier module and the monitoring unit.

Audience

Applicable to monitoring software developers of partners, used to monitor our company's rectifier module.

1. CAN protocol specification

The rectifier module of our company supports Controller Area Network (CAN) protocol. This protocol adopts CAN 2.0B with extended frames and 29bits identifier. The monitoring unit can control, configure and query the rectifier module through the CAN bus protocol. The baud rate is 125kbs, the unit of all voltages is mV, and the unit of all currents is mA.

The format of CAN message is as follows:

ID Field: 29Bits	Data Field: 8Bytes
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1.1 ID field

The formats of ID field are defined as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
0x01	Monitor - (0x01~0x0F) BroadCast - 0	Module - (0x01~0x7F) BroadCast - 0	1~31 (optional)	0 (optional)

Protocol: (4 bits)

0x01: Communication protocol number between the rectifier module and the monitoring unit.

Monitor Address: (4bits)

bit21~bit24 indicates the address of the monitoring unit. The address is set from 0x01 to 0x0F, and the default monitor address is 0x01.

0x00: broadcast.

Module Address: (7bits)

bit14~bit20 is the address of the rectifier module. The module address range is 0x01~0x1F.

0x00: broadcast.

Production Day: (5bits)

Date of production (1-31).

Serial Number Low Part: (9bits)

The lower part of product serial number, which indicates the product development stage ('P'represents PT stage,'E'represents EVT stage, and'D'represents DVT stage, and'0'represents MP stage) .

1.2 Data Fields

The formats of Data field are defined as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
Group Address	Message Type	Command Type	Reserved		Command Data			
Group Address (0x01~0x0F)	Set Data - 0	Vout, - 0	0					
BroadCast - 0	Set Data Response-1 Read Data - 2	Iout_slow, - 1						
	Read Data Response-3	Vout Reference, -2						
	Read Serial Number	Iout Limit, -3						
	Response-4	Shut Down DC-DC, -4 Read SN,-5						
	All Set Data-11	ModuleS tatus, -8						
	All Set Data Response -12	Vab, -20						
		Vbc, -21						
		Vca, -22						
		Tin, -30						
		Iout_fastest, -47						
		Iout_fast, -48						
		Vbat, -61						
		Group Address, -89						
		HiMode_LoMode _Selection, -95						
		HiMode_LoMode_ Status, - 96						
		Vout_fast, -98						
		TrueHiLo_Status, -101						
		Current Capability, -104						
		Do Run In Boot Mode, -107						
		Current And Capabi ty, - 114						
		Fan Speed1 -120						
		Fan Speed2 -121						
		Fan Speed3 -122						
		Temp Margin -123						
		Hardware Version, - 125						

		Fan RPMPCT, -126		
		Command Ex, -127	Sleep Time,-23 Work Time,-24	

1.2.1 Byte 0 data

Byte 0 data consists of two parts, the high 4 bits is the group address, the low 4 bits is the message type;

1. Group address

The group address range is 0x01 to 0x0F. 0x00 indicates broadcast communication. **The default group address is 1;**

2. Message type

Message type	Description
0x00	Set Data
0x01	Set Data Response
0x02	Read Data
0x03	Read Data Response
0x04	Read Serial Number Response

1.2.2 Bytes 1 data

The command type indicates the command corresponding to the data information.

Command	Description	R/W	Save to EEPROM
0	Read output voltage	R	N
1	Read output current	R	N
2	Set output voltage reference	R/W	N
3	Set output limiting current point	R/W	N
4	Power on/Shut down	W	N
5	Read module serial number	R	Y
8	Read module status	R	N
20	Line voltage AB	R	N
21	Line voltage BC	R	N
22	Line voltage CA	R	N
30	Inlet air temperature	R	N
61	Battery Voltage	R	N

89	Group address	R/W	Y
95	Set high or low voltage mode	W	Y
96	Read high or low voltage mode status	R	N
101	Read the actual high or low voltage mode status	R	N
104	Read output current capability	R	N
107	Read DCDC is run in APP or BOOT	R	N
114	Read output current and output current capability	R	N
120	Fan 1 speed	R	N
121	Fan 2 speed	R	N
122	Fan 3 speed	R	N
123	Temperature margin	R	N
125	Read hardware version	R	Y
126	Read maximum fan speed percentage	R	N
127	Extend type commands	R/W	Y/N

1.2.3 Bytes 2~3 data

(1) If it is the module's read serial number response, byte 2 and byte 3 data are the upper 16 bits of the module's serial number, as defined below:

Bits	Definition	Description
7:0	ProductionWeek	Production Week (1~54)
15:8	ProductionYear	Production Year (0~127, 0 is year 2000)

(2) If CommandType is 127 (CommandEx), byte 2 and byte 3 is Expand subcommands (CommandSup):

CommandSup	Description	R/W	Save to EEPROM
23	SleepTime	R	Y
24	WorkTime	R	Y

(3) Byte 2 and byte 3 data are reserved.

1.2.4 Bytes 4~7 data

Byte 4 to byte 7 are the command data part, total 4 bytes.

The Byte1(CommandType) and Byte4~Byte7(CommandData) are defined as follows:

Command type	Description
0	Module output voltage (mV)
1	Module output current (mA)
2	Module output voltage reference (mV)
3	Module output limit current (mA)
4	Power on/Shut down (0 on, 1 off)
5	The higher 48 bits parts of the module serial number
8	Module status
20	Line voltage AB (mV)
21	Line voltage BC (mV)
22	Line voltage CA (mV)
30	Inlet temperature (m°C)
61	Battery Voltage (mV)
95	Set the module high or low voltage mode (1: High Voltage Mode 2: Low Voltage Mode 3: Automatic Mode) (Can be set successfully only in the shutdown state) (Mode 1,2 not save in EEPROM, Mode 3 save in EEPROM)
96	Read module high or low voltage mode (1: High Voltage Mode 2: Low Voltage Mode 3: Automatic Mode)
101	Read the actual high or low voltage mode status (1: High Voltage Mode 2: Low Voltage Mode 3: Automatic Mode)
104	Read module output current capability (mA)
107	Read DCDC is run in APP or BOOT (1.BOOT, 2.APP (or normal work))
114	Read output current and output current capability (0.1A)
120	Fan 1 speed unit: 1rpm
121	Fan 2 speed unit: 1rpm
122	Fan 3 speed unit: 1rpm
123	Temperature margin (m°C)
125	Hardware Version
126	Maximum fan speed percentage (1000 is 100%)

127	CommandSup
	SleepTime-23 (h)
	WorkTime-24 (h)

The definition of module status bits is as follows: (The detailed definition of module status bits is attached in the appendix):

Bits	Definition	Description
Bit0	AC input fault	Ac over voltage 1: Abnormal. 0: Normal
Bit1		Ac under voltage 1: Abnormal. 0: Normal
Bit2	Module protection	AC overvoltage disconnected (AC overvoltage shutdown) 1: Abnormal. 0: Normal
Bit3	PFC bus overvoltage	PFC bus over voltage 1: Abnormal. 0: Normal
Bit4	PFC bus undervoltage	PFC bus under voltage 1: Abnormal. 0: Normal
Bit5	The PFC bus is unbalanced	The PFC bus is unbalanced 1: Abnormal. 0: Normal
Bit6	Dc output overvoltage	Dc output overvoltage 1: Abnormal. 0: Normal
Bit7	Module protection	Dc overvoltage shutdown 1: Abnormal. 0: Normal
Bit8	Dc output undervoltage	Dc output undervoltage 1: Abnormal. 0: Normal
Bit9	Fan failure	Fan is not running 1: Abnormal. 0: Normal
Bit10	Reserve	Reserve
Bit11	The fan drive circuit is damaged	The fan drive circuit is damaged 1: Abnormal. 0: Normal
Bit12	Over temperature protection	Ambient overtemperature 1: Abnormal. 0: Normal
Bit13	Under temperature protection	Ambient under temperature 1: Abnormal. 0: Normal
Bit14	Over temperature protection	PFC overtemperature protection 1 1: Abnormal. 0: Normal
Bit15		Output relay fault 1: Abnormal. 0: Normal
Bit16		DC overtemperature protection 1 1: Abnormal. 0: Normal
Bit17		Reserve
Bit18	Module failure	Internal communication fail (The communication between the PFC and the DCDC fails) 1: Abnormal. 0: Normal
Bit19	Reserve	Reserve
Bit20	Module failure	PFC fail 1: Abnormal. 0: Normal

Bit21		DCDC fail	1: Abnormal. 0: Normal
Bit22	AC Volume reduction	AC voltage leads to capacitance reduction	1: Abnormal. 0: Normal
Bit23	Temperature Volume reduction	Temperature leads to capacitance reduction	1: Abnormal. 0: Normal
Bit24	Reserve	Reserve	Reserve
Bit25	Module status	The DCDC is not running	1: Power off 0: Power on
Bit26	Output loop state	Output loop state	3: reserved 2: current loop
Bit27			1: reserved 0: voltage loop
Bit28	The DC output voltage is unbalanced	The DC output voltage is unbalanced	1: Abnormal. 0: Normal
Bit29	Modules with the same serial number were found	Modules with the same serial number were found	1: Abnormal. 0: Normal
Bit30	Reserve	Reserve	Reserve
Bit31	Module failure	The discharge circuit is abnormal	1: Abnormal. 0: Normal

1.2.5 The format of message type AllSetData and AllSetDataResponse

When the message type is AllSetData, AllSetDataResponse, the data field format is defined as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
Group Address	Message Type	On Off_and_HiLoMode	Iout Limit	Vbattery	Vout Reference			
Group Address (0x01~0x0F)	AllSetData-11		Output current limit point (unit: 0.1A)	Battery voltage (Unit: 0.1V)	Output voltage reference (Unit: 0.1V)			
BroadCast - 0	AllSetDataResponse-12							

7:6	5:2	1:0
Hi LoMode Selection	reserved	OnOff
No Selection - 0 HiMode - 2 LoMode - 3	0	Turn On- 0 Shut Down(DC,not PFC) – 1 Turn On(DC, PFC)-2 Shut Down(DC,PFC) -3
(When you select LoMode or HiMode, if the module is not running on the right mode, The Module will shutdown automatically and configure to the right mode you need, then restart.)		

2. Examples of common commands

2.1 Set output voltage for all modules

Monitor Sends Broadcast Message to set the output voltage of all rectifier modules to 475.55V. The following is an example of the CAN communication frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1(Optional)	0x00	Optional	Optional

The following is an example of a CAN communication frame data field:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x00	0x02	Optional	Optional	0x00	0x07	0x41	0x9E
0x7419E								

Note: Since the voltage unit is mV, 475.55V is converted to 475550 mV, which is converted to hex number 0x7419E. The rectifier module receives the broadcast setting command and does not respond to the monitor.

2.2 Set output voltage of module 1 (module 1 address is 0x01)

Monitor sends the output voltage reference of module1 to 475.55V. The following is an example of the CAN communication frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1(Optional)	0x01	Optional	Optional

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x00	0x02	Optional	Optional	0x00	0x07	0x41	0x9E
0x7419E								

The rectifier module receives the setting command and responds the data. An example of the CAN communication frame ID field is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Serial number information	Serial number information

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x01	0x02	Optional	Optional	0x00	0x07	0x41	0x9E
0x7419E								

2.3 Set limit current for all modules

Monitor sends broadcast message to set the limit current of all rectifier modules to 10.5A. The following is an example of the CAN communication frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1(Optional)	0x00	Optional	Optional

The following is an example of the CAN communication frame data field:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x00	0x03	Optional	Optional	0x00	0x00	0x29	0x04
0x2904								

Note: Since the unit of current is mA, 10.5A is converted to 10500 mA, which is converted to hexadecimal number 0x2904. The rectifier module receives the broadcast setting command and does not respond to the monitor.

2.4 Set limit current for module 1 (module 1 address is 0x01)

Monitor sends the limit current of module1 to 10.5A. The following is an example of the CAN communication frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Optional	Optional

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x00	0x03	Optional	Optional	0x00	0x00	0x29	0x04

					0x2904
--	--	--	--	--	--------

The rectifier module receives the setting command and responds the data. An example of the CAN communication frame ID field is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Serial number information	Serial number information

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x01	0x03	Optional	Optional	0x00	0x00	0x29	0x04
							0x2904	

2.5 Read output voltage of all modules

The following is an example of the CAN frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1(Optional)	0x00	Optional	Optional

The following is an example of a data field:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x02	0x00	Optional	Optional	Optional	Optional	Optional	Optional

After receiving the broadcast command to read the module voltage, the rectifier module sends back the information respectively. The following is an example of the CAN frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1(Optional)	0xXX(address)	Serial Number	SerialNumber

The following is an example of a data field:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7			
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0			
0x01	0x03	0x00	Optional	Optional							
					Get the current module voltage value						

2.6 Read output voltage of module 1 (module 1 address is 0x01)

The following is an example of the CAN frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Optional	Optional

Examples of data fields are as follows:

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x02	0x00	Optional	Optional	Optional	Optional	Optional

After the rectifier module receives the command of read the module voltage, it sends back the information. An example of the CAN communication frame ID field is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Serial number information	Serial number information

Examples of data fields are as follows:

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7				
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0				
0x01	0x03	0x00	Optional	Optional							
					Get the current module voltage value						

2.7 Read output current of all modules

The following is an example of the CAN frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1(Optional)	0x00	Optional	Optional

The following is an example of a data field:

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x02	0x01	Optional	Optional	Optional	Optional	Optional

After receiving the broadcast command to read the module current, the rectifier module sends back the information respectively. The following is an example of the CAN frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part

1	1(Optional)	0xXX(address)	Serial Number	Serial Number
---	-------------	---------------	---------------	---------------

The following is an example of a data field:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x03	0x01	Optional	Optional				
Get the current module current value								

2.8 Read output current of module 1 (module 1 address is 0x01)

The following is an example of the CAN frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Optional	Optional

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x02	0x01	Optional	Optional	Optional	Optional	Optional	Optional

After the rectifier module receives the command of read the module current, it sends back the information. An example of the CAN communication frame ID field is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Serial number	Serial number

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x03	0x01	Optional	Optional				
Get the current current value of the module								

2.9 Power on all modules

Monitor sends broadcast messages to power on all modules. The following is an example of the CAN frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1(Optional)	0x00	Optional	Optional

The following is an example of a data field:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x00	0x04	Optional	Optional	0x00	0x00	0x00	0x00
0x00								

The rectifier module receives the broadcast command and does not respond to the monitor.

2.10 Power on module 1 (Module 1 address is 0x01)

The following is an example of the CAN frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Optional	Optional

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x00	0x04	Optional	Optional	0x00	0x00	0x00	0x00
0x00								

After the rectifier module receives the command, it sends back the information. An example of the CAN communication frame ID field is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Serial number	Serial number

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x01	0x04	Optional	Optional	0x00	0x00	0x00	0x00
0x00								

2.11 Shut down all modules

Monitor sends broadcast messages to shut down all modules. The following is an example of the CAN frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1(Optional)	0x00	Optional	Optional

The following is an example of a data field:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x00	0x04	Optional	Optional	0x00	0x00	0x00	0x01
0x01								

The rectifier module receives the broadcast command and does not respond to data.

2.12 Shut down module 1 (Module 1 address is 0x01)

An example of the CAN communication frame ID field is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (optional)	0x01	Optional	Optional

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x00	0x04	Optional	Optional	0x00	0x00	0x00	0x01
0x01								

After the rectifier module receives the command, it sends back the information. An example of the CAN communication frame ID field is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Serial number	Serial number

数据域示例如下：

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x01	0x04	Optional	Optional	0x00	0x00	0x00	0x01
0x01								

2.13 Read Module Status for all modules

An example of a CAN communication frame ID field is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (optional)	0x00	Optional	Optional

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x02	0x08	Optional	Optional	Optional	Optional	Optional	Optional

After receiving the broadcast command to read the module status bits, the rectifier module sends back the information respectively. The following is an example of the CAN frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0xXX	Serial number	Serial number

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7			
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0			
0x01	0x03	0x08	Optional	Optional							
					Get the current state of the module						

2.14 Read Module Status of module 1 (Module 1 address is 0x01)

An example of a CAN communication frame ID field is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Optional	Optional

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x02	0x08	Optional	Optional	Optional	Optional	Optional	Optional

After the rectifier module receives the command to read the module status, it sends back the information. An example of a CAN communication frame ID field is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Serial number	Serial number

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7			
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0			
0x01	0x03	0x08	Optional	Optional							
					Get the current state of the module						

2.15 Set high or low output mode for module 1 (Module 1 address is 0x01)

The following is an example of the CAN frame ID field. If the maximum output voltage is 1000V, the value in the data field is 0x01

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Optional	Optional

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x00	0x5F	Optional	Optional	0x00	0x00	0x00	0x01
					0x01			

2.16 Read high or low output mode status of Module 1 (Module 1 address is 0x01)

An example of a CAN communication frame ID field is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (optional)	0x01	Optional	Optional

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x02	0x60	Optional	Optional	Optional	Optional	Optional	Optional

After receiving the broadcast command to read the module high or low voltage mode, the rectifier module sends back the information. The following is an example of the CAN frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Serial number	Serial number

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x03	0x60	Optional	Optional				
					Get the module high and low voltage mode			

2.17 Read serial number of module 1 (Module 1 address is 0x01)

The following is an example of the CAN frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1(Optional)	0x00	Optional	Optional

The following is an example of a data field:

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x02	0x05	Optional	Optional	Optional	Optional	Optional

After receiving the command to read the module serial number, the rectifier module sends back the information. The following is an example of the CAN frame ID field:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1(Optional)	0x01	Serial Number	Serial Number

The following is an example of a data field:

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x04	0x05					
Get module serial number							

The CAN ID of the return serial number of the rectifier module is 0x02240144, The following is an example of a data field: 14 05 17 08 0C 30 07 57

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x04	0x05	0x17	0x08	0x0C	0x30	0x07

The 14 bits SN code is composed of the low 9 bits of CAN communication frame ID and the byte2~byte7 of data domain.

Year: 0x17 23

Week: 0x08 8

Serial number: 0x0C*1000+0x30*10+0x07 12487

Place of production: 0x57 ‘W’

Stage of production: 0x44 ‘D’

2.18 The AllSetData to turn on and off of module 1 (module 1 address is 0x01)

Monitor sends the AllSetData to turn on module 1. CommandType is 0 (on DC), and the corresponding parameters: output current limit point is 10.5A, battery voltage is 470.5V, output voltage is 475.5V. The CAN communication frame ID field example is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Optional	Optional

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x0B	0x00	0x00	0x69	0x12	0x61	0x12	0x93
			0x0069			0x1261		0x1293

Note: Because the current unit is 0.1A, 10.5A is multiplied by 10 to convert to 105, converted to a hexadecimal number to 0x0069, and the voltage unit is 0.1V, so 470.5V is multiplied by 10 to convert to 4705, converted to a hexadecimal number to 0x1261, 475.5V is multiplied by 10 to convert to 4755, and converted to a hexadecimal number is 0x1293.

The rectifier responds the data, and the example of the CAN communication frame ID field is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Serial number	Serial number

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x0C	0x00	0x00	0x69	0x12	0x61	0x12	0x93
			0x0069			0x1261		0x1293

2.19 Set group address of module 1(module 1 address is 0x02)

The monitor set the group address of module1 to 0x02, and the CAN communication frame ID field is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Optional	Optional

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0

可选	0x00	0x59	Optional	Optional	0x00	0x00	0x00	0x02
0x00000002								

The rectifier module receives the setting command and responds the data. An example of a CAN communication frame ID field is as follows:

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1 (Optional)	0x01	Serial number information	Serial number information

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x02	0x01	0x59	Optional	Optional	0x00	0x00	0x00	0x02
0x00000002								

3 Appendix

3.1 The definition of module status bit

Module status bit specific definition:

```
struct MODULE_STATUS_BITS {
    uint32_t AcOV :1; // 0 AC overvoltage
    uint32_t AcUV :1; // 1 AC undervoltage
    uint32_t AcOVDisconnected :1; // 2 AC overvoltage disconnected
    uint32_t PfcOV :1; // 3 PFC bus over voltage
    uint32_t PfcUV :1; // 4 PFC bus under voltage
    uint32_t PfcUnbalance :1; // 5 PFC bus is unbalanced
    uint32_t DcOV :1; // 6 Dc output overvoltage
    uint32_t DcOVShutDown :1; // 7 Dc overvoltage shutdown
    uint32_t DcUV :1; // 8 Dc output undervoltage
    uint32_t FanNotRun :1; // 9 Fan failure
    uint32_t Reserved_10 :1; // 10
    uint32_t FanDriverFail :1; // 11 Fan drive circuit damaged
    uint32_t AmbientOT :1; // 12 Ambient overtemperature
    uint32_t AmbientUT :1; // 13 Ambient undertemperature
    uint32_t Pfc1_OT :1; // 14 PFC overtemperature protection 1
    uint32_t OutputRelayFault :1; // 15 Output relay fault
    uint32_t Dcdc1_OT :1; // 16 DC overtemperature protection 1
    uint32_t Reserved_17 :1; // 17
    uint32_t SciIsNotOK :1; // 18 Internal communication fail
}
```

```

    uint32_t Reserved_19 :1; // 19
    uint32_t PfcFail :1; // 20 PFC fail
    uint32_t DcdcFail :1; // 21 DCDC fail
    uint32_t PoDeratedByAC :1; // 22 AC Volume reduction
    uint32_t PoDeratedByT :1; // 23 Temperature Volume reduction
    uint32_t Reserved_24 :1; // 24
    uint32_t DcdcNotRun :1; // 25 DCDC is not running
    uint32_t OutputLoopMode :2; // 26:27 Output loop state
    uint32_t DcVoltageUnbalance :1; // 28 DC output voltage is unbalanced
    uint32_t GetSameSN :1; // 29 Modules with same serial number
    uint32_t Reserved_30 :1; // 30
    uint32_t BleederNotWork :1; // 31 Discharge circuit abnormal
};

union MODULE_STATUS_REG
{
    uint32_t all;
    struct MODULE_STATUS_BITS bit;
};


```

3.2 The definition of module serial number

The company's module serial number consist of Year+Week+Serial number+Place of production+Stage of production, take module serial number 230812487WD as an example, the SN takes up 7 bytes (56bit), the high 48 bits are in the byte2~byte7 of data domain, and the low 8 bits are in the bit8:bit0 of ID.

CAN communication frame ID field example

28:25	24:21	20:14	13:9	8:0
Protocol	Monitor Address	Module Address	Production Day	Serial Number Low Part
1	1(option)	0x01		The low 9 bits of SN

Examples of data fields are as follows:

Byte0		Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7:4	3:0	7:0	7:0	7:0	7:0	7:0	7:0	7:0
0x01	0x04	0x05	The high 48 bits of SN					

23	08	12487			W	D
Year (0~127, 0 is 2000)	Week (1~54)	Module serial number(1~99999)			Place of production (S: Shanghai, W:Wujiang)	Stage of production (‘P’is PT stage, ‘E’ is EVT stage, ‘D’ is DVT stage, ‘0’ is MP stage)
Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	ID[7:0]
0x17	0x08	0x0C	0x30	0x07	0x57	0x44