CHARX PS... CAN BUS GCP protocol V1.41



Data sheet
109960_en_07

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1 Description

This document describes the CAN-based Grid Charge Protocol (GCP) communication protocol for communication between one or more power modules and a charging controller.

Here, the charging controller, as the higher-level controller, always handles communication with the bus devices on the linear CAN bus.

The CAN-based GCP communication protocol supports the following communication methods:

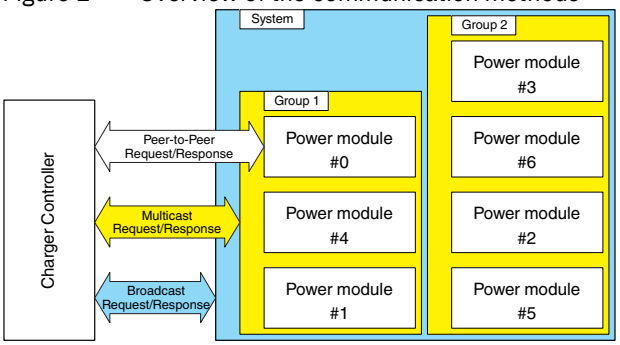
– Peer-to-peer
– Multicast
– Broadcast

Supported power modules

The following CHARX PS... power modules are currently supported by the CAN-based GCP communication protocol:

Item designation	Item no.
CHARX PS-M2/3AC/1000DC/30KW	1232243
CHARX PS-M2/825DC/1000DC/30KW	1296467

Figure 1 Overview of the communication methods



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3 Summary

3.1 CAN protocol

– Uses the extended frame mode CAN 2.0B
– The bit rate is 125 kbps for:

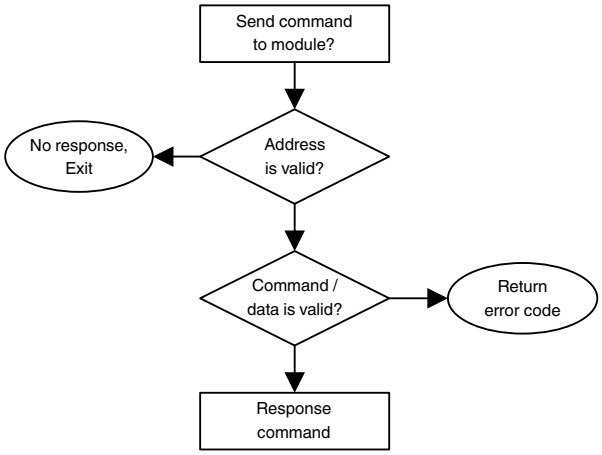
Item designation	Item no.
CHARX PS-M2/3AC/1000DC/30KW	1232243

– The bit rate is either 125 kbps or 500 kbps for:

Item designation	Item no.
CHARX PS-M2/825DC/1000DC/30KW	1296467

– 120 Ω termination resistors for terminating the CAN bus

3.2 Communication process



3.3 Data type

Send the bytes in an increasing sequence. Begin with byte 0. Depending on the command number, the data type of the command can contain fixed-point or floating-point numbers.

3.3.1 Fixed-point number

A fixed-point number can take up a length of 1 to 4 bytes. The detailed format can be found in Section 4.3 Command description.

3.3.2 Floating-point number

The storage format of the floating-point number is 4 bytes and is sent in the following sequence: sign bit, code, mantissa high bit, and mantissa low bit.

The floating-point number uses the IEEE 32-bit standard format for floating-point numbers (standard format for floating-point numbers for the C programming language), whereby the length is 32 bits and the format is structured as follows:

D31	D30-D23	D22-D16	D15-D8	D7-D0
Sign of the floating-point number	Code	Mantissa high bit	Mantissa middle bit	Mantissa low bit

If the code is E and the mantissa is M, then:
floating-point number = $\pm(1+M\times2^{-23})\cdot2^{E-127}$

Whether the floating-point number is positive or negative depends on the value of the sign bit (S).

Value of the sign bit (S)	Floating-point number
S = 1	Negative
S = 0	Positive

Example:

Conversion of 32-bit floating-point number to the value of the floating-point number

32-bit floating-point number	Value of the floating-point number
43H, FAH, 00H, 000 (S = 0, E = 135, M = 0x7A0000) $\hat{=}$ **61×2^{17}**	$(1+61\times2^{17}\times2^{-23})\ 2^{135-127}$ $\hat{=}$ **500**

Conversion of the value of the floating-point number to the sending sequence

Value of the floating point number	Sending sequence
40.0	42, 20, 00, 00
2.40	40, 19, 99, 9A

4 Application frame format and data definition

4.1 Frame format

Communication between the higher-level charging controller and one or more power module is via CAN 2.0B frames.

The frame format is illustrated in the following table:

Description	Code
Start of frame	SOF (1 bit)
Arbitration field	Identifier (11 bits)
	SRR
	IDE
	Identifier (18 bits)
	RTR
Control field	Reserved (1 bit)
	Data length (4 bits)
Data field	Data (0-8 bytes)
CRC field	CRC (16 bits)
Ack field	Ack (2 bits)
End of frame	(7 bits)

The data length in this protocol is 8 bytes. The controllable part is comprised of the identifier and the data.

Identifier			Data	
29 bits	Byte 0	Byte 1	...	Byte 7
Identifier	Data (8 bytes)			

4.2 Identifier

28-26	25-22	21-16	15-8	7-0
Error code (3 bits)	Device number (4 bits)	Command number (6 bits)	Target address (8 bits)	Source address (8 bits)

4.2.1 Error code

Error code	Description
0x00	Normal
0x01	Not used
0x02	Command invalid
0x03	Data invalid
--	Not used
0x07	Start of processing

4.2.2 Device number

Device number	Description
0x0A	Protocol between the charging controller and the individual power module
0x0B	Protocol between the charging controller and a module group

4.2.3 Command no.

Detailed information can be found in Section 4.3 Command description.

4.2.4 Target address/source address

Peer-to-peer

Describes equal-authority communication between the charging controller and individual power modules. The request/response pattern is reciprocal.

For peer-to-peer addressing, the target address is the automatically assigned module address. Set the device number to the value 0x0A.

Multicast

Describes the communication between the charging controller and a group of power modules. The charging controller sends a request with a group address. Depending on the command sent (command number), individual or all modules in the group respond. Set the device number to the value 0x0B.

Broadcast

Describes the communication between the charging controller and the entire system. The charging controller sends a request as a broadcast message.

For broadcast addressing, the target address is 0x3F. Set the device number to the value 0x0A.

	Target address/source address							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Power module	Reserved (0.0)		Module address: 00~0x3B, broadcast address: 3F					
Charging controller	Charging controller address: 0xF0~0xF8, default address: 0xF0							

- Supports 48 power modules in parallel:
  CHARX PS-M2/3AC/1000DC/30KW (1232243)
  CHARX PS-M2/825DC/1000DC/30KW (1296467)
- The power module will be assigned an address automatically after power on. The group number is set via the DIP switch on the panel.
- During the startup phase, the power modules exchange messages with error code 0x07: “Start of processing” in order to assign an address and exchange group information. At this time, the user may not send commands to the power module.

4.3 Command description

Note

In the following table, please note that the abbreviation Mdl = power module and Ctrl = charging controller in the listed examples.

Com-mand no.	Description							
0x01	**Read system information - actual values** Peer-to-peer: No Multicast: Yes, response only from group coordinator Broadcast: Yes, response from system coordinator							
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0	0	0	0	0	0	0	0
	Response	Vo: System output voltage (floating point)				Io: Total system output current (floating point)			
	Example	Ctrl transmits: 02 81 3F F0 00 00 00 00 00 00 00 00 Mdl responds: 02 81 F0 3F 43 FA 00 00 42 48 00 00 Ctrl transmits: 02 C1 01 F0 00 00 00 00 00 00 00 00 Mdl responds: 02 C1 F0 01 43 FA 00 00 40 A0 00 00				Read system information Response Vo 500 V, Io_total 50 A Read group #1 information Response Vo group 1 500 V, Io group1 5 A			
0x02	**Read system information - number of power modules** Peer-to-peer: No Multicast: Yes, response only from group coordinator Broadcast: Yes, response from system coordinator							
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0	0	0	0	0	0	0	0
	Response	0	0	Mdl quantity	0	0	0	0	0
	Note	Multicast addressing: The module returns the number of power modules in the group Broadcast addressing: The module returns the number of power modules in the system							
	Example	Ctrl transmits: 02 82 3F F0 00 00 00 00 00 00 00 00 Mdl responds: 02 82 F0 3F 00 00 07 00 00 00 00 00 Ctrl transmits: 02 C2 01 F0 00 00 00 00 00 00 00 00 Mdl responds: 02 C2 F0 01 00 00 03 00 00 00 00 00				Read number of power modules in the system 7 power modules detected in the system Read number of power modules in the group 3 power modules detected in group 1			
0x03	**Read power module information - actual values** Peer-to-peer: Yes Multicast: Yes, response from every power module in the group Broadcast: No							
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0	0	0	0	0	0	0	0
	Response	Power module #N output voltage (floating point)				Power module #N output current (floating point)			
	Example	Ctrl transmits: 02 83 00 F0 00 00 00 00 00 00 00 00 Mdl responds: 02 83 F0 00 43 FA 00 00 40 60 00 00				Read power module #0 information Power module #0 Vo 500 V, Io 3.5 A			
0x04	**Read power module status** Peer-to-peer: Yes Multicast: Yes, response from every power module in the group Broadcast: No							
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0	0	0	0	0	0	0	0
	Response	0	0	Mdl group#	Mdl status 3	Mdl temperature	Mdl status 2	Mdl status 1	Mdl status 0
	Note	Module temperature is signed char, 8 bits, -128°C ... 127°C Power module 01 status: automatic monitoring for high or low range (series or parallel operation), (default) 10: monitoring for low range (parallel operation), 11: monitoring for high range (series operation)							
	Example	Ctrl transmits: 02 84 01 F0 00 00 00 00 00 00 00 00 Mdl responds: 02 84 F0 01 00 00 02 00 1B 00 40 00				Read power module #1 information Power module #1 belongs to group #2, module temperature 27°C, enable access			

Com-mand no.	Description							
0x06	**Read AC input voltage information (NOTE: applies to AC/DC power modules)** Peer-to-peer: Yes Multicast: Yes, response from every power module in the group Broadcast: No							
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0	0	0	0	0	0	0	0
	Response	V_{L1_L2} / V_{IN}/ V± high byte	V_{L1_L2} / V_{IN}/ V± low byte	V_{L2_L3} high byte	V_{L2_L3} low byte	V_{L3_L1} high byte	V_{L3_L1} low byte	0	0
	Note	Single phase is V_{IN}, unit is 0.1 V							
	Example	Ctrl transmits: 02 86 01 F0 00 00 00 00 00 00 00 00 Read power module #1 information Mdl responds: 02 86 F0 01 0F B4 0F A5 0F A7 00 00 Power module #1 L1_L2 402 VL2_L3 400.5 V L3_L1 400.7 V							
0x06	**Read DC input voltage information (NOTE: applies to DC/DC power modules)** Peer-to-peer: Yes Multicast: Yes, response from every power module in the group Broadcast: No							
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0	0	0	0	0	0	0	0
	Response	V_{IN} / V± high byte	V_{IN} / V± low byte	V+_PE / V_{IN} high byte	V+_PE / V_{IN} low byte	V-_PE / V_{IN} high byte	V-_PE / V_{IN} low byte	0	0
	Note	Single phase is V_{IN}, unit is 0.1 V							
	Example	Ctrl transmits: 02 86 01 F0 00 00 00 00 00 00 00 00 Read power module #1 information Mdl responds: 02 86 F0 01 1B 50 0D 85 0D 74 00 00 Power module #1 V+_V- 699.6 V+_PE 353.4 V-_PE 346.2 V							
0x0C	**Read power module information** Peer-to-peer: Yes Multicast: Yes, response from every power module in the group Broadcast: No							
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0	0	0	0	0	0	0	0
	Response	Vext high byte	Vext low byte	Iavail high byte	Iavail low byte	0	0	0	0
	Note	Unit is 0.1 V/0.1 A Vext is the actual voltage on the output terminals of the module; Iavail is the currently available module current							
	Example	Ctrl transmits: 02 8C 00 F0 00 00 00 00 00 00 00 00 Read Mdl #0 information Mdl responds: 02 8C F0 00 13 58 01 66 00 00 00 00 Mdl #0 external voltage 495.2 V, available output current 35.8 A							
0x0E	**Read DC circuit board temperature** Peer-to-peer: Yes, without response Multicast: Yes, response from every power module in the group Broadcast: No							
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0x11	0x07	0	0	Mdl #N DC circuit board temperature (floating point)			
	Response	0x11	0x07	0	0	Mdl #N DC circuit board temperature (floating point)			
0x0E	**Read PFC circuit board temperature** Peer-to-peer: Yes, without response Multicast: Yes, response from every power module in the group Broadcast: No							
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0x11	0x08	0	0	Mdl #N PFC circuit board temperature (floating point)			
	Response	0x11	0x08	0	0	Mdl #N PFC circuit board temperature (floating point)			

Com-mand no.	Description							
0x0E	**Read fan speed** Peer-to-peer: Yes, without response Multicast: Yes, response from every power module in the group Broadcast: No							
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0x12	0x01	0	0	Mdl #N fan speed rpm (floating point)			
	Response	0x12	0x01	0	0	Mdl #N fan speed rpm (floating point)			
0x0F	**Set DC input: DC/DC or MPPT operating mode (NOTE: applies to DC/DC power modules)** Peer-to-peer: Yes Multicast: Yes Broadcast: Yes								
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0x11	0x11	0	0	0	0	0	DC/DC or MPPT operating mode
	Note	Operating mode: A0 = DC/DC operation (default), A1 = MPPT operation							
	Example	Ctrl transmits: 02 8F 3F F0 11 11 00 00 00 00 00 A1 Sets all power modules to MPPT (Maximum Power Point Tracker) Mdl responds: No response							
0x0F	**Fan operation function (noise emission reduction)** Peer-to-peer: Yes, without response Multicast: Yes, without response Broadcast: No								
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0x11	0x13	0	0	0	0	0	Fan operation
	Response	0x11	0x13	0	0	0	0	0	Fan operation
	Note	Fan operation: A0 = max. fan speed (default), A1 = medium fan speed, A2 = low fan speed							
0x0F	**Set DC power levels operating mode in device - switch between series or parallel operation (high or low range)** Peer-to-peer: Yes Multicast: Yes, response from every power module in the group Broadcast: Yes, without response								
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0x11	0x14	0	0	0	0	0	DC levels operating mode
	Response	0x11	0x14	0	0	0	0	0	DC levels operating mode
	Note	0xA2: automatic operation (series or parallel operation) (high or low range), (default) 0xA1: series operation (high range); 0xA0: parallel operation (low range), The operating mode can only be switched if operational readiness is disabled							
	Example	Ctrl transmits: 02 8F 3F F0 11 14 00 00 00 00 00 A1 Set all power modules to series operation Mdl responds: 02 8F F0 3F 11 14 00 00 00 00 00 A1 All power modules are in series operation							
0x0F	**Single or parallel string input (only in MPPT mode)** Peer-to-peer: Yes Multicast: Yes, response from every power module in the group Broadcast: Yes, without response								
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0x11	0x15	0	0	0	0	0	MPPT mode
	Response	0x11	0x15	0	0	0	0	0	MPPT mode
	Note	A0: MPPT input in single mode, the number of photovoltaic panels in a string or their total power is less than the nominal power of the power module (default) A1: MPPT input in parallel mode (2 power modules), the number of photovoltaic panels in a string or their total power is greater than the nominal power of a power module. Two power modules must be set to parallel input operation. A2: automatic assignment of single or parallel mode for MPPT							
	Example	Ctrl transmits: 02 8F 3F F0 11 15 00 00 00 00 00 A1 Both power modules set to MPPT input in parallel mode Mdl responds: 02 8F F0 3F 11 15 00 00 00 00 00 A1 Both power modules are set to MPPT input in parallel mode							

<table>
<tr><th>Com-
mand no.</th><th colspan="8">Description</th></tr>
<tr><td rowspan="8">0x0F</td><td colspan="8">Limit input current</td></tr>
<tr><td colspan="8">Peer-to-peer: Yes</td></tr>
<tr><td colspan="8">Multicast: Yes</td></tr>
<tr><td colspan="8">Broadcast: Yes</td></tr>
<tr><td></td><td>Byte 0</td><td>Byte 1</td><td>Byte 2</td><td>Byte 3</td><td>Byte 4</td><td>Byte 5</td><td>Byte 6</td><td>Byte 7</td></tr>
<tr><td>Request</td><td>0x12</td><td>0x05</td><td>0</td><td>0</td><td colspan="4">I_{IN} limitation (floating point)</td></tr>
<tr><td>Note</td><td colspan="8">AC setpoint: byte 4 ... byte 7
DC setpoint: I_{IN} / √3 (byte 4 ... byte 7)</td></tr>
<tr><td>Example</td><td colspan="8">Ctrl transmits: 02 8F 3F F0 12 05 00 00 41 80 00 00 Limit input current on all power modules to I_{IN} = 16 A
Mdl responds: No response</td></tr>
<tr><td rowspan="8">0x13</td><td colspan="8">Start up power modules slowly</td></tr>
<tr><td colspan="8">Peer-to-peer: Yes</td></tr>
<tr><td colspan="8">Multicast: Yes, response from every power module in the group</td></tr>
<tr><td colspan="8">Broadcast: Yes, without response</td></tr>
<tr><td></td><td>Byte 0</td><td>Byte 1</td><td>Byte 2</td><td>Byte 3</td><td>Byte 4</td><td>Byte 5</td><td>Byte 6</td><td>Byte 7</td></tr>
<tr><td>Request</td><td>0 = Off
1 = On</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td colspan="2">Time interval</td></tr>
<tr><td>Response</td><td>0 = Off
1 = On</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td colspan="2">Time interval</td></tr>
<tr><td>Note</td><td colspan="8">Time interval between sending the command to switch on the device and reaching the set output current
Default setting 5 s (bytes 6 & 7 each respond with 00) (default)
Time unit 0.01 s (time interval adjustable from 2 s ... 120 s)</td></tr>
<tr><td>Example</td><td colspan="8">Ctrl transmits: 02 93 3F F0 01 00 00 00 00 00 00 00 Set slow startup on all power modules
Mdl responds: No response
Ctrl transmits: 02 93 00 F0 00 00 00 00 00 00 00 00 Set slow startup deactivated on power module #0
Mdl responds: 02 93 F0 00 00 00 00 00 00 00 00 00 Slow startup of power module #0 deactivated</td></tr>
<tr><td rowspan="8">0x14</td><td colspan="8">LED of a power module – flashing green</td></tr>
<tr><td colspan="8">Peer-to-peer: Yes</td></tr>
<tr><td colspan="8">Multicast: Yes</td></tr>
<tr><td colspan="8">Broadcast: Yes</td></tr>
<tr><td></td><td>Byte 0</td><td>Byte 1</td><td>Byte 2</td><td>Byte 3</td><td>Byte 4</td><td>Byte 5</td><td>Byte 6</td><td>Byte 7</td></tr>
<tr><td>Request</td><td>0 = On
1 = Off</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Response</td><td>0 = On
1 = Off</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Example</td><td colspan="8">Ctrl transmits: 02 94 00 F0 01 00 00 00 00 00 00 00 Control of LED flashing green, power module #0
Mdl responds: 02 94 00 F0 01 00 00 00 00 00 00 00 LED flashing green, power module #0
Ctrl transmits: 02 94 00 F0 00 00 00 00 00 00 00 00 Cancel control of LED flashing green, power module #0
Mdl responds: 02 94 00 F0 00 00 00 00 00 00 00 00 LED off, power module #0</td></tr>
<tr><td rowspan="8">0x16</td><td colspan="8">Set group number (only if DIP switch function is changed to module number or MPPT mode is used)</td></tr>
<tr><td colspan="8">Peer-to-peer: Yes, with response</td></tr>
<tr><td colspan="8">Multicast: Yes, response from every power module in the group</td></tr>
<tr><td colspan="8">Broadcast: Yes, without response</td></tr>
<tr><td></td><td>Byte 0</td><td>Byte 1</td><td>Byte 2</td><td>Byte 3</td><td>Byte 4</td><td>Byte 5</td><td>Byte 6</td><td>Byte 7</td></tr>
<tr><td>Request</td><td>Group no.</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Response</td><td>Group no.</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Note</td><td colspan="8">To assign the power modules to the respective groups, send the group number once when switching on. If this is not done, all power modules are automatically assigned to group 0. During the boot process of the CAN bus, the devices are identified again and organized on the CAN bus.</td></tr>
<tr><td>Example</td><td colspan="8">Ctrl transmits: 02 9F 3F F0 01 00 00 00 00 00 00 00 Software-based definition of module addressing for DIP switch function
Mdl responds: No response
Ctrl transmits: 02 96 02 F0 01 00 00 00 00 00 00 00 Module #2 assigned to group 1
Mdl responds: No response</td></tr>
</table>

Command no.	Description								
0x19	**Enable/disable module deactivation** Peer-to-peer: Yes Multicast: Yes, response from every power module in the group Broadcast: Yes, without response								
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	Deactivation on/off	0	0	0	0	0	0	0
	Response	Deactivation on/off	0	0	0	0	0	0	0
	Note	0x00: deactivation off (default), 0x01: deactivation on If an output power is required that is lower than the maximum system power, individual modules can be deactivated for efficiency reasons. Operational readiness is disabled for the deactivated module. The operational readiness of the deactivated module cannot be restored using the “Enable/disable operational readiness” command. Example: In a system with 3 x 30 kW power modules, only 60 kW of output power is required. One power module is deactivated using this command. When transmitting the broadcast to the system with the required output power, the operational readiness of the deactivated module remains disabled. The two remaining power modules each provide the maximum output power with higher efficiency.							
	Example	Ctrl transmits: 02 99 3F F0 01 00 00 00 00 00 00 00 — Set all modules to deactivation mode on Mdl responds: No response Ctrl transmits: 02 99 00 F0 00 00 00 00 00 00 00 00 — Module #0 to deactivation mode off Mdl responds: 02 99 F0 00 00 00 00 00 00 00 00 00 — Module #0 responds deactivation mode off							
0x1A	**Enable/disable operational readiness** Peer-to-peer: Yes Multicast: Yes, response from every power module in the group Broadcast: Yes, without response								
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Request	0 = On 1 = Off	0	0	0	0	0	0	0
	Response	0 = On 1 = Off	0	0	0	0	0	0	0
	Note	After enabling operational readiness, an open-circuit voltage of 100 V DC is present at the output of the power module.							
	Example	Ctrl transmits: 02 9A 3F F0 01 00 00 00 00 00 00 00 — Switch off all power modules Ctrl transmits: 02 9A 01 F0 01 00 00 00 00 00 00 00 — Switch off power module #1 Mdl responds: 02 9A F0 01 01 00 00 00 00 00 00 00 — Power module #1 response off Ctrl transmits: 02 DA 02 F0 01 00 00 00 00 00 00 00 — Switch off power modules in group #2							
0x1B	**Set system output voltage and total output current** Peer-to-peer: No Multicast: Yes, response only from group coordinator Broadcast: Yes, response from system coordinator								
		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		MSB			LSB	MSB			LSB
	Request	Setpoint - output voltage (mV)				Setpoint - total output current (mA)			
	Response	Setpoint - output voltage (mV)				Setpoint - total output current (mA)			
	Note	Multicast addressing: system output voltage and total output current for the entire group Broadcast addressing: system output voltage and total output current for the entire system							
	Example	Ctrl transmits: 02 9B 3F F0 00 04 93 E0 00 00 27 10 — Set all power modules to Vo 300 V, Io_total 10 A (If there are 2 power modules in the system, then the Io of each power module is 5 A) Ctrl transmits: 02 DB 02 F0 00 03 0D 40 00 00 13 88 — Set group #2 to Vo 200 V, Io_group2total 5 A (If there are 2 power modules in a group, then the Io of each power module is 2.5 A) Mdl responds: 02 DB F0 02 00 03 0D 40 00 00 13 88 — Read power module numbers of this group							

<table>
<tr><th>Com-
mand no.</th><th colspan="9">Description</th></tr>
<tr><td rowspan="10">0x1C</td><td colspan="9">Set output voltage and output current of a power module</td></tr>
<tr><td colspan="9">Peer-to-peer: Yes</td></tr>
<tr><td colspan="9">Multicast: Yes, response from every power module in the group</td></tr>
<tr><td colspan="9">Broadcast: Yes, without response</td></tr>
<tr><td></td><td>Byte 0</td><td>Byte 1</td><td>Byte 2</td><td>Byte 3</td><td>Byte 4</td><td>Byte 5</td><td>Byte 6</td><td>Byte 7</td></tr>
<tr><td></td><td>MSB</td><td></td><td></td><td>LSB</td><td>MSB</td><td></td><td></td><td>LSB</td></tr>
<tr><td>Request</td><td colspan="4">Setpoint - output voltage (mV)</td><td colspan="4">Setpoint - output current (mA)</td></tr>
<tr><td>Response</td><td colspan="4">Setpoint - output voltage (mV)</td><td colspan="4">Setpoint - output current (mA)</td></tr>
<tr><td>Note</td><td colspan="8">The coordinating power module responds with the actual set value.</td></tr>
<tr><td>Example</td><td colspan="8">Ctrl transmits: 02 9C 3F F0 00 04 93 E0 00 00 27 10 Set all power modules to Vo 300 V, Io 10 A
Ctrl transmits: 02 DC 02 F0 00 03 0D 40 00 00 13 88 Set group #2 to Vo 200 V, set lo_group_2 to 5 A for each power module in group #2
Mdl responds: 02 DC F0 00 00 03 0D 40 00 00 13 88 Group #2 power modules #0
Mdl responds: 02 DC F0 01 00 03 0D 40 00 00 13 88 Group #2 power modules #1</td></tr>
<tr><td rowspan="8">0x1E</td><td colspan="9">Execute power cycle function via reset command (switch off/set)</td></tr>
<tr><td colspan="9">Peer-to-peer: Yes</td></tr>
<tr><td colspan="9">Multicast: Yes, response from every power module in the group</td></tr>
<tr><td colspan="9">Broadcast: Yes</td></tr>
<tr><td></td><td>Byte 0</td><td>Byte 1</td><td>Byte 2</td><td>Byte 3</td><td>Byte 4</td><td>Byte 5</td><td>Byte 6</td><td>Byte 7</td></tr>
<tr><td>Request</td><td>Reset power module</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Response</td><td>Reset power module</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Note</td><td colspan="8">A5: reset power module
To clear an error, e.g., due to overvoltage or overcurrent, the power module requires a power cycle
- Send command only in the status “Module deactivation switched on” 0x19 (standby).
- If the power module is switched on, do not transmit during operation.
- For security or false alarms, see Section 4.4 Status description
- The command resets all module settings.</td></tr>
<tr><td>Example</td><td colspan="8">Ctrl transmits: 02 9E 3F F0 A5 00 00 00 00 00 00 00 Set all power modules to reset mode
Mdl responds: 02 9E F0 F3 A5 00 00 00 00 00 00 00 All power modules are in reset mode
Ctrl transmits: 02 DE 02 F0 A5 00 00 00 00 00 00 00 Set all power modules in group #2 to reset mode
Mdl responds: 02 DE F0 02 A5 00 00 00 00 00 00 00 All power modules in group #2 are in reset mode</td></tr>
<tr><td rowspan="8">0x1F</td><td colspan="9">Set DIP switch function</td></tr>
<tr><td colspan="9">Peer-to-peer: No</td></tr>
<tr><td colspan="9">Multicast: No</td></tr>
<tr><td colspan="9">Broadcast: Yes, without response</td></tr>
<tr><td></td><td>Byte 0</td><td>Byte 1</td><td>Byte 2</td><td>Byte 3</td><td>Byte 4</td><td>Byte 5</td><td>Byte 6</td><td>Byte 7</td></tr>
<tr><td>Request</td><td>Group or module number</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Response</td><td>Group or module number</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Note</td><td colspan="8">0xA0: group number (default), 0xA1: module number (sent once after startup)</td></tr>
<tr><td>Example</td><td colspan="8">Ctrl transmits: 02 9F 3F F0 01 00 00 00 00 00 00 00 Software-based definition of module addressing for DIP switch function
Mdl responds: No response</td></tr>
</table>

4.4 Status description

	Bit	Description	Condition	Power module status	LED	Required user action
Status 2	7	1: PFC circuit is OFF	1: PFC circuit is OFF	OFF	Not applicable	Not applicable
	6	1: Overvoltage at the input	1: Vin > 535 V AC	OFF	Yellow	No activities required When the input voltage returns to the permissible normal range, the power module automatically returns to normal operation
			0: Vin < 520 V AC	ON	Flashing yellow	
			1: Vin > 825 V DC	OFF	Yellow	
			0: Vin < 815 V DC	ON	Flashing yellow	
	5	1: Undervoltage at the input	1: Vin < 255 V AC	OFF	Yellow	
			0: Vin > 275 V AC	ON	Flashing yellow	
			1: Vin < 300 V DC	OFF	Yellow	
			0: Vin > 315 V DC	ON	Flashing yellow	
	4	1: Input asymmetry	Not applicable	Not applicable	Not applicable	Not applicable
	3	1: Input phase lost	1: One phase lost (input overvoltage if single phase first)	OFF	Yellow	No activities required When the external event is no longer active, the power module automatically returns to normal operation
	2	1: Load sharing	1: Iavg_system > 20%, I0 < 2%	ON	Red	If there is no change of status, troubleshooting is required If the error cannot be rectified, please contact Phoenix Contact Support Power cycle (switch off/set) Switch off: shut down power module completely Set: perform remote reset of the power module
	1	1: Module ID repetition	1: Barcode or address repetition	OFF	Red	Charging controller: check user programming If the error message cannot be acknowledged, troubleshooting must be carried out. If the error cannot be rectified, please contact Phoenix Contact Support.
	0	1: Power limitation	1: Limitation of the output power for high temperatures or low input voltages	ON	Not applicable	The power module is in derating mode due to thermal or electrical conditions (see data sheet)

	Bit	Description	Condition	Power module status	LED	Required user action
Status 1	7	1: CAN command interruption	1: No CAN signal from the charging controller for 10 seconds	OFF	Flashing yellow	Power module: check CAN bus data lines and connections Charging controller: check CAN bus data lines and connections and user programming
	6	1: Slow startup	1: Slow power module startup activated	Not applicable	Not applicable	Not applicable
	5	1: Overvoltage at the output	1: Vo > Overvoltage point	OFF	Red	When the external event returns to the normal status, the power module returns to normal operation Power cycle (switch off/set) Switch off: shut down power module completely Set: perform remote reset of the power module
			1: Vext > Vext overvoltage point	OFF	Yellow	
	4	1: Temperature threshold value exceeded	1: Temperature threshold for ambient temperature > 80°C or PCB temperature > 100°C (reference value)	OFF	Yellow	No activities required When the temperature falls below the temperature thresholds again, the power module automatically returns to normal operation
	3	1: Fan error	1: Fan error signal active	OFF	Flashing red	Contact Phoenix Contact Support
	2	1: Module protection	1: Input undervoltage or input overvoltage or overtemperature	OFF	Yellow	No activities required When the external event is no longer active, the power module automatically returns to normal operation
	1	1: Module error	1: Output overvoltage or output short circuit or power module ID duplication or no load sharing	OFF (except load sharing)	Red	Power cycle (switch off/set) Switch off: shut down power module Set: perform remote reset If no status change is performed, troubleshooting must be carried out. If the error cannot be rectified, please contact Phoenix Contact Support.
	0	1: DC side is OFF	1: DC side is OFF	OFF	Not applicable	Not applicable

	Bit	Description	Condition	Power module status	LED	Required user action
Status 0	7 6	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	5	1: Discharge exhibiting deviating behavior	1: Vo > 50 V 2 seconds after OFF	ON	Yellow	If no status change is performed, trouble-shooting must be carried out. If the error cannot be rectified, please contact Phoenix Contact Support. Power cycle (switch off/set) Switch off: shut down power module Set: perform remote reset
	4	1: Exclusion to reduce switch-on attempts (MPPT mode)	0: If the power module consumes a power of ≤ 500 W for 30 seconds, the delay counter is reset to zero.	OFF	Not applicable	Not applicable
			1: Power module is switched to MPPT mode when a power of > 500 W is consumed for 30 seconds.	ON		
	3	1: PFC circuit exhibiting deviating behavior	1: Vbus overvoltage/undervoltage or Vin overvoltage/undervoltage or overtemperature	OFF	Yellow	Power cycle (switch off/set) Switch off: shut down power module Set: perform remote reset If no status change is performed, trouble-shooting must be carried out. If the error cannot be rectified, please contact Phoenix Contact Support.
	2	1: Internal communication interruption	1: Communication interruption between PFC and DC	OFF	Yellow/red*	Power cycle (switch off/set) Switch off: shut down power module Set: perform remote reset If no status change is performed, trouble-shooting must be carried out. If the error cannot be rectified, please contact Phoenix Contact Support.
	1	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	0	1: Output short circuit	1: Vo < 25 V, Io > 10% for 2 seconds	OFF	Red	Power cycle (switch off/set) Switch off: shut down power module Set: perform remote reset If no status change is performed, trouble-shooting must be carried out. If the error cannot be rectified, please contact Phoenix Contact Support.

* Red if the internal communication is interrupted for longer than 2 minutes

Note: Communication interruption

If the power module does not receive any signals from the charging controller within 10 seconds, the power module switches off.

Note: Interval time for controller requests

The interval time for control requests should be between 50 ms and 200 ms.

4.5 Communication methods with addressing examples

Note: Different address ranges

Different address ranges for the response/request are used for the different communication methods.

The following examples apply for the examples shown: Group 0x03 is assigned to Mdl#0, Mdl#1

Peer-to-peer addressing

	Request	Response
		Mdl#0
Source address	0xF0	0x00
Target address	0x00	0xF0
Command no.	0x03	0x03
Device number	0x0A	0x0B
Error code	0x00	0x00

Identifier	0x028300F0	0x0283F000

Multicast addressing with group response

Command 0x01, 0x02, 0x1B

	Request	Response
		Group 0x03
Source address	0xF0	0x03
Target address	0x03	0xF0
Command no.	0x01	0x01
Device number	0x0B	0x0B
Error code	0x00	0x00

Identifier	0x02C103F0	0x02C1F003

Multicast addressing with module response

Command 0x03, 0x04, 0x06, 0x0C, 0x1A, 0x1C

	Request	Response	
		Mdl#0	Mdl#1
Source address	0xF0	0x00	0x01
Target address	0x00	0xF0	0xF0
Command no.	0x03	0x03	0x03
Device number	0x0B	0x0B	0x0B
Error code	0x00	0x00	0x00

Identifier	0x02C300F0	0x02C3F000	0x02C3F001

Broadcast addressing with response

Command 0x01, 0x02, 0x1B

	Request	Response
		System coordinator
Source address	0xF0	0x3F
Target address	0x3F	0xF0
Command no.	0x01	0x01
Device number	0x0A	0x0A
Error code	0x00	0x00

Identifier	0x02813FF0	0x0281F03F

Broadcast addressing without response

Command 0x1A, 0x1C

	Request
Source address	0xF0
Target address	0x3F
Command no.	0x01A
Device number	0x0A
Error code	0x00

Identifier	0x029A3FF0

5 Reference

5.1 Recommended sequence when switching on

– Power on
– Set the output voltage and output current for the power module
– Close the system relay
– Switch the power module on

5.2 Recommended sequence when shutting down

– Switch the power module off
– Open the system relay

5.3 Example of communication sequence

The following table illustrates the communication sequence between the higher-level charging controller and three power modules.

	Direction	ID	Data	Description
	Power module receives	02 9A 3F F0	01 00 00 00 00 00 00 00	Switch off all modules (ensure defined status)
Set and call up information continuously	Power module receives	02 9C 3F F0	00 0B 71 B0 00 00 3A 98	Set 750 V, 15 A
		02 9A 3F F0	00 00 00 00 00 00 00 00	Switch on all modules (begin charging)
		02 81 3F F0	00 00 00 00 00 00 00 00	
	Power module transmits	02 81 F0 3F	44 3B 80 00 41 6F 33 33	750 V, 14.95 A
	Power module receives	02 82 01 F0	00 00 00 00 00 00 00 00	
	Power module transmits	02 82 F0 01	00 00 03 00 00 00 00 00	3 modules in the system
	Power module receives	02 9C 3F F0	00 0B 71 B0 00 00 3A 98	Set 750 V, 15 A
		02 9A 3F F0	00 00 00 00 00 00 00 00	Switch on all modules
		02 84 00 F0	00 00 00 00 00 00 00 00	
	Power module transmits	02 84 F0 00	00 00 00 00 16 00 40 00	Power module #0, 22°C, access enabled
	Power module receives	02 84 01 F0	00 00 00 00 00 00 00 00	
	Power module transmits	02 84 F0 01	00 00 00 00 18 00 40 00	Power module #1, 24°C, access enabled
	Power module receives	02 84 02 F0	00 00 00 00 00 00 00 00	
	Power module transmits	02 84 F0 02	00 00 00 00 17 00 40 00	Power module #2, 23°C, access enabled
	Power module receives	02 9A 3F F0	01 00 00 00 00 00 00 00	Switch off all modules (end charging, ensure defined status)

Note: Use of frame 0x0757F8XX in the charging controller not permitted

The power modules use the frame 0x0757F8XX for internal communication with each other. Additional use of this frame in the charging controller is not permitted.