Revision-contract

Index	Modification	Date
A	Init	09.05.19/ph
B	Register 0x0014, 0x002C: error corrections	12.03.20/qz

Changes concerning previous versions are marked

0 Content

1 Basics

1.1 Common

This API specifies a subset of communication protocol of EVCC2/3, that enables a standard communication between external applications and charge controller:

- Setting of max charge current of outlet (I_{cmax})
- Reading status of outlet (A,B,C,F and E) and present current per phase
- Reading config of outlet and setting device-ID of outlet

1.2 Common settings

RS485-I/F	38400Bd, 8E1
MODBUS-type	MODBUS ASCII
Supported MODBUS-function	0x03 Read 16bit-registers 0x10 Write 16bit-registers
Valid range of Device-ID	0x00 Broadcast 0x01…0x10 Device-ID

1.3 Typical communication patterns

Read firmware revision of EVSE (device-ID 0x01)

SBC→pcba	:010300010002F9	
pcba→SBC	>01030401011237AD	V1.2 150215 & DCRCM attached Welding detection enabled cable

Read EV current (device-ID 0x01)[long]

SBC→pcba	:0103002E0005C9	
pcba→SBC	>01030A2EC3810A0064006400001F	C3 State C2 (I >1A) 810A U_{CP} ≤ 10V; I_{cmax} = 16A (26.6%) 0064 I_{CT1} = 10A 0064 I_{CT2} = 10A 0000 I_{CT3} = 0A

Read EV current (device-ID 0x01)[short]

SBC→pcba	:010300330003C6	
pcba→SBC	>0103063380C30A0A00EC	80 U_{CP} ≤ 10V
		C3 State C2 (I >1A) 0A I_{CT1} = 10A 0A I_{CT2} = 10A 00 I_{CT3} = 0A

Set I_{cmax} of EVSE to 10A (device-ID 0x01)

SBC→pcba	:0110001400010200A632	Duty cycle 16.6%
pcba→SBC	>011000140001DA	OK
	>0190046B	Failed

1.4 Frame settings

1.4.1 Reading

The answer to a reading-request includes the number of the register that the answer is concerning to.
This information is fixed up in the final 8 bits of the register-bits.

Read one 16bit-register (R1)

Request to device (e.g. register 0x0003) [4.9ms]		
byte	Value	Description
2	0x01	Device ID
3	0x03	Function code “read”
4..5	0x0003	Starting address
6..7	0x0001	Qty of registers
8	0xF8	LRC
		:010300030001F8 CRLF

Response of device (OK) [4.3ms]		
byte	Value	Description
2	0x01	Device ID
3	0x03	Function code “read“
4	0x02	No of value bytes
5..6	0x0327	Value of register 0x0003
7	0xD0	LRC
		>0103020327D0 CRLF

Read two contiguous 16bit-register (R2)

Request to device (e.g. register 0x0001) [4.9ms]		
byte	Value	Description
2	0x01	Device ID
3	0x03	Function code “read”
4..5	0x0001	Starting address
6..7	0x0002	Qty of registers
8	0xF9	LRC
		:010300010002F9 CRLF

Response of device (OK) [5.4ms]		
byte	Value	Description
2	0x01	Device ID
3	0x03	Function code „read“
4	0x04	No of value bytes
5..6	0x010F	Value of register 0x0001
7..8	0x1509	Value of register 0x0002
9	0xCA	LRC
		>010304010F1509CA CRLF

Read three contiguous 16bit-register (R3)

Request to device (e.g. register 0x0033) [4.9ms]		
byte	Value	Description
2	0x01	Device ID
3	0x03	Function code “read”
4..5	0x0033	Starting address
6..7	0x0003	Qty of registers
8	0xC6	LRC
		:010300330003C6 CRLF

Response of device (OK) [6.6ms]		
byte	Value	Description
2	0x01	Device ID
3	0x03	Function code „read“
4	0x06	No of value bytes
5..6	0x3300	Value of register 0x0033
7..8	0xA164	Value of register 0x0034
9..10	0x6464	Value of register 0x0035
9	0xF6	LRC
		>0103063300A1646464F6 CRLF

Read five contiguous 16bit-register (R5)

Request to device (e.g. register 0x0014)[4.9ms]		
byte	Value	Description
2	0x01	Device ID
3	0x03	Function code “read”
4..5	0x0014	Starting address
6..7	0x0005	Qty of registers
8	0xE3	LRC
		:010300140005E3 CRLF

Response of device (OK) [8.9ms]		
byte	Value	Description
2	0x01	Device ID
3	0x03	Function code „read“
4	0x0A	No of value bytes (10)
5..6	0x1400	Value of register 0x0014
7..8	0x0249	Value of register 0x0015
9..10	0x0AFA	Value of register 0x0016
11..12	0x0200	Value of register 0x0017
13..14	0x01FF	Value of register 0x0018
15	0x8D	LRC
		>01030A140002490AFA020001FF8D CRLF

Read eight contiguous 16bit-register (R8)

Request to device (e.g. register 0x0014)[4.9ms]		
byte	Value	Description
2	0x01	Device ID
3	0x03	Function code “read”
4..5	0x0050	Starting address
6..7	0x0008	Qty of registers
8	0xA4	LRC
		:010300500008A4 CRLF

Response of device (OK) [12.6ms]		
byte	Value	Description
2	0x01	Device ID
3	0x03	Function code „read“
4	0x10	No of value bytes (16)
5..6	0x5000	Value of register 0x0050
7..8	0x3257	Value of register 0x0051
9..10	0x3232	Value of register 0x0052
11..12	0x7879	Value of register 0x0053
13..14	0x3031	Value of register 0x0054
15..16	0x3233	Value of register 0x0055
17..18	0x3435	Value of register 0x0056
19..20	0x3637	Value of register 0x0057
21	0x22	LRC
		>0103105000325732327879303132333435363722 CRLF
		(Serial number: 2W22xy01234567)

1.4.2 Writing

Write 16bit value to one 16bit-register

Request to device (e.g. register 0x0013) [6.6ms]		
byte	Value	Description
2	0x01	Device ID
3	0x10	Function code “write”
4..5	0x0013	Starting address
6..7	0x0001	Qty of registers
8	0x02	No of value bytes
9..10	0x010B	Value for register 0x0013
11	0xCD	LRC
		:01100013000102010BCD CRLF

Response of device (OK)(except BC) [4.9ms]		
byte	Value	Description
2	0x01	Device ID
3	0x10	Function code “write“
4..5	0x0013	Starting address
6..7	0x0001	Qty of registers
8	0xD8	LRC
		>011000130001D8 CRLF

1.4.3 Error-handling

Example:

Response of device (FAILURE))(except BC)[3.2ms]		
byte	Value	Description
2	0x01	Device ID
3	0x90	Function code “error“
4	0x04	Exception code “Writing registers failed”
5	0x6B	LRC
		>0190046B <CRLF>

No response is returned, if

- device receives a request, but detects a communication error (parity, LRC, CRC, ...)
- function code is neither 0x03 (read) nor 0x10 (write)
- write-request does not access a valid register for writing
- qty of registers of a write-request does not meet requirements of accessed register
- number of value-bytes write-request does not meet qty of registers
- read-request does not access a valid register for reading

2 Protocol

0x0001 - Read device-ID and firmware-revision

Function	Read device-ID, firmware-revision and config
Type	R2
1st Register	0x0001
Last register	0x0002
Broadcast supported	Yes
Remarks	Each outlet is identified by its individual device-ID

Register-Bit	Value	Description
31..24	0x01	Register which the answer is referring to
23..22	 00 01 10 11	Hardware: pcba: 141215 pcba: 160307 pcba: 170725 not used
21..16	0x01…0x10	device-ID (default: 0x01)
15..12		Major revision
11..8		Minor revision
7	1	Reading of coding resistor at socket-input CS for rated current I_{CS} of adapter enabled
6	1	Upstream-timeout enabled
5	1	Internal phase-current meter enabled
4	1	Internal RDC-MD enabled
3	1	Socket enabled
2	1	Welding detection (contactor) enabled
1..0	00 01 10 11	No function Must be closed for transition B1->B2 Closed: Outlet enabled Invalid

0x0003 – Read MODBUS settings

Function	Read MODBUS-setting
Type	R1
1st Register	0x0003
Last register	0x0003
Broadcast supported	no
Remarks	

Register-Bit	Value	Description
15..8	0x03	Register which the answer is referring to
7..6	00 11	1 stop bit (default) 2 stop bit
5..4	00 01 10 11	No parity Parity odd Parity even (default) Invalid
3..0	0000 0101 0110 0111 1000 others	(reserved) 9600 Bd 19200 Bd 38400 Bd (default) 57600 Bd Invalid

0x0005 – Modify state

Function	Modify state of outlet
Type	W1
1st Register	0x0005
Last register	0x0005
Broadcast supported	yes
Remarks	0xE0E0 and 0xE2E2 are used normally

Register-Bit	Value	Description
15..0	0x3838	Load Imbalance Detection (20A) enabled (E2 required)
	0x5A5A	Reset
	0xA1A1	Jump to state A1 (E0 or E2 required)
	0xE0E0	Jump to state E0
	0xE2E2	Jump to state E2 (A1 or E0 required)
	0xF1F1	Jump to state F1 (RCD is tripped, if configured)
	others	Must not be used

0x0006– Read system-flags

Function	Read system-flags
Type	R2
1st Register	0x0006
Last register	0x0007
Broadcast supported	no
Remarks	

Register-Bit	Value	Description
31..24	0x06	Register which the answer is referring to
23..16		Pointer of state-machine
15	0	Upstream-Timeout triggers F14 instead of F4
	1	Upstream-Timeout triggers F4 instead of F14
14	0	B1->B2 enabled after power-cycle
	1	B1->B2 disabled after power-cycle
13..12	00	Use default limits for CP detection and timing
	10	Use China limits for CP detection and timing
	01	(reserved)
	11	(reserved)
11..10		(reserved)
9	0	Upstream communication established
	1	Upstream communication lost (BC6); timeout may trigger F4/F14
8	0	No load imbalance detected
	1	Load imbalance detected (BC3)
7	0	Onboard temperature less of equal 60°C
	1	Onboard temperature 60°C < T < 80°C (BC5)
6	0	Internal phase current metering available
	1	Internal phase current metering available failed (BC4)
5	0	E0->A1 enabled
	1	E0->A1 disabled
4	0	B1->B2 enabled
	1	B1->B2 disabled
3	0	A1->B1 enabled
	1	A1->B1 disabled
2..0	000	EV Current $\leq$ 100 % I_c
	001	100% I_c < EV Current ≤ 105% I_c
	101	105% I_c < EV Current ≤ 110% I_c (failure aft. 1000s; not for China)
	011	110% I_c < EV Current ≤ 120% I_c (failure aft. 100s; China: 5s)
	111	EV Current > 120 % I_c (failure aft. 10s; China: 5s)

0x0014– Set I_{cmax}

Function	Set I_{cmax}
Type	W1
1st Register	0x0014
Last register	0x0014
Broadcast supported	yes
Remarks	./.

Register-Bit	Value	Description
15..0	0x0050...0x03E8	Duty cycle I_{cmax} [%]*10 (8...100%)

0x002C – Set device-ID

Function	Set device-ID, Upstream-Timeout and transition B1->B2 after power-cycle
Type	W1
1st Register	0x002C
Last register	0x002C
Broadcast supported	yes
Remarks	Outlet must be in state E2

Register-Bit	Value	Description
15..14	00 01 10 11	No change Upstream-Timeout and failure F4 are disabled Upstream-Timeout and failure F4 are enabled No change
13..12	00 01 10 11	No change Outlet enters B2 after power-cycle, if EV connected Outlet stops in B1 after power-cycle, if EV connected. Enable required No change
11..8	0000	(reserved)
7..0	0x01…0x10	Device-ID

0x002E – Read current (full)

Function	Read state, digital inputs, max charge current I_C and current of each phase (resolution 0.1A)
Type	R5
1st Register	0x002E
Last register	0x0032
Broadcast supported	no
Remarks	

Register-Bit	Value	Description
79..72	0x2E	Register which the answer is referring to
71..64	0x..	State of EVSE
63	0 1	$U_{CP} > 10V$ (no EV connected, not valid in state Ex and Fx) $U_{CP} \leq 10V$ (EV connected, not valid in state Ex and Fx)
62	0 1	Duty cycle is not reduced due to BC3-BC6 Duty cycle reduced due to BC3-BC6
61	0 1	EN2 open EN2 closed
60	0 1	EN1 open EN1 closed
59..48	0x000…0x3E8	Duty cycle I_c [%]*10 (0…100%)
47..32	0x0000…0x0320 0x03E8	I_{ct1} [0,1A] (0…80A) Phase current meter not available or state A
31..16	0x0000…0x0320 0x03E8	I_{ct2} [0,1A] (0…80A) Phase current meter not available or state A
15..0	0x0000…0x0320 0x03E8	I_{ct3} [0,1A] (0…80A) Phase current meter not available or state A

0x0033 – Read current amps

Function	Read state and current of each phase (1A)
Type	R3
1st Register	0x0033
Last register	0x0035
Broadcast supported	no
Remarks	

Register-Bit	Value	Description
47..40	0x33	Register which the answer is referring to
39	0 1	$U_{CP} > 10V$ (no EV connected, not valid in state Ex and Fx) $U_{CP} \leq 10V$ (EV connected, not valid in state Ex and Fx)
38..32	0x00	
31..24	0x..	State of EVSE
23..16	0x00…0x50 0x64	I_{ct1} [A] (0…80A) Phase current meter not available or state A
15..8	0x00…0x50 0x64	I_{ct2} [A] (0…80A) Phase current meter not available or state A
7..0	0x00…0x50 0x64	I_{ct3} [A] (0…80A) Phase current meter not available or state A

3 Annex

3.1 Abbreviations

Sorted alphabetically

ADC	Analog-to-Digital Converter
BC	Error-reaction, that is just possible in state B or C => no own state
bd	Baud = Unit to the symbol-transmission-rate per second (1 symbol in ASCII = 2 hexadecimal numbers)
CP	Control Pilot (EV-Information)
CS	Control Signal (Cable-Information)
RDC-MD	Residual Direct Current Monitoring Device
EV	Electrical vehicle
EVCC	Electric Vehicle Charge Control (quite often used as a synonym to pcba)
EVSE	The whole charching-system
HMI	Human-Machine Interface
LCM	Load current measurement = METER, Measures the load current of each phase and compares it with present I_c using pcba 150212, In case of lost communication with pcba 150212 I_{cmax} is limited to 10A
LID	Load Imbalance Detection
LM	Load current management
LRC	Longitudinal Redundancy Check
pcba	priced circuit board assembly
PWM	Pulse-width modulation
SBC	Connected single board computer, which is used for communicating with the pcba throughout upstream communication
TP	Testing points on pcba 160307 (rests of the third switch)
UID	Unique Identifier
WD	Welding detection

3.2 PWM duty cycle provided by EV supply equipment

Maximum current I_{av}	Nominal control pilot duty cycle D_N	Description
I_{av} = 0 A	D_N = 0 %	Continuous -12 V, EV supply equipment not available; state F
	D_N = 100 %	No current available – state x1 (see Table A.5)
Maximum current is indicated via digital communication	D_N = 5 %	A duty cycle of 5 % indicates that digital communication is required and shall be established between the EV supply equipment and EV before enabling energy supply. If digital communication cannot be established, the EV supply equipment shall: • stay in 5 % duty cycle or • change to x1 (100 % duty cycle) for at least 3 s or • change to x1 (100 % duty cycle) for at least 3 s and then change to a duty cycle between 10 % and 96 %.
6 A ≤ I_{av} ≤ 51 A	D_N = I_{av} / 0,6 A	10 %≤ D_N ≤ 85 %
51 A < I_{av} ≤ 80 A	D_N = (I_{av} / 2,5 A + 64)	85 %< D_N ≤ 96 %

(Source: IEC 61851-1_Ed 3_2017.pdf)

3.3 Definition of current

I_{rated}	Rated current of outlet
$I_{default}$	Max. charging current due to rated current of outlet, wiring of installation etc. $I_{default}$ is internally limited to I_{rated}
I_{cmax}	Max. charging current, that can be provided to this outlet due to external control etc. If I_{cmax} is not modified externally, than I_{cmax} = $I_{default}$ I_{cmax} is internally limited to $I_{default}$, except for setting 100%, that indicates “no current allowed” to EV
I_{cs}	Outlet with socket: Rated current of charging adapter Outlet with cable: I_{cs} = $I_{default}$
I_c	Max. current, that EV may take I_c is internally limited to I_{cmax} or I_{cs} or other internal values (e.g. due to error conditions), whichever is lower

3.4 Definition of states

State	Description
A1	Waiting for EV
B1	EV is asking for charging
B2	EV has the permission to charge
C2	EV is charged
C3	C2, reduced current (error F16, F17)
C4	C2, reduced current (imbalance F15)
E0	Outlet disabled
E1	Production test
E2	EVCC setup mode
E3	Bus idle
F1	Unintended closed contact (Welding)
F2	Internal error
F3	DC residual current detected
F4	Upstream communication timeout
F5	Lock of socket failed
F6	CS out of range
F7	State D requested by EV
F8	CP out of range
F9	Overcurrent detected
F10	Temperature outside limits
F11	Unintended opened contact