Application Note – Interfacing with CAN bus

Table of Contents

1. Introduction

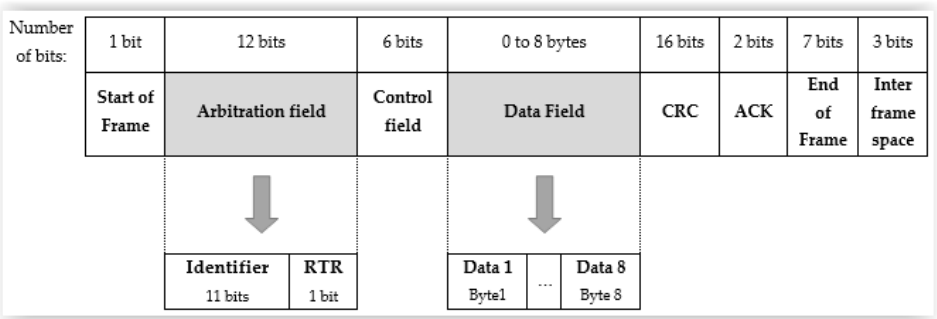
This document aims to describe how to interact with the BMPU products through CAN bus interface. A basic sequence will be described step by step to guide the user. This document is a complement to the datasheet.

2. CAN

The BMPU communication is based on CANopen protocol. CANopen structures the way to exchange data between one or multiple nodes. It provides frames format and several types of data exchanges.

CAN messages have two important fields that the user must define:

- **The identifier** field also called **frame id** in CANopen protocol which identifies the type of a frame and its destination.
- The data field that contains between 0 to 8 bytes of data depending on the type of the frame



The CAN message data format is little endian. It means that the first byte of a word is the least significant byte. An example is given below how to encode a frame with 4 words of different bit size to transmit request. The word fields and size are defined by the **frame id.**

	Word 0	Word 1	Word 2		Word 3			
Word Value	0x00	0x11	0x2233		0x44556677			
CAN data field	0x00	0x11	0x33	0x22	0x77	0x66	0x55	0x44
	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7

The reverse operation is required to decode a frame received by the BMPU.

	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
CAN data field	0x00	0x11	0x33	0x22	0x77	0x66	0x55	0x44
Word Value	0x00	0x11	0x2233		0x44556677			
	Word 0	Word 1	Word 2		Word 3			

3. Frame type

3.1. Heartbeat

Charger automatically transmits its communication state at regular intervals as evidence of its communication ability. This frame is sent by BMPU every 1 sec.

Charger also consumes the heartbeat of its master (expected to have the frame ID 0x701). So, the master shall emit every 1 second a heartbeat frame with an *operational* status (= 5). If this frame is not received by the BMPU, it will be stopped and go into fault state.

- Status = 0 at bootup (1 frame with 0 to be sent at boot)
- Status = 5 when node communication stack is operational (to be sent periodically)
- Status = 4 when node communication stack is stopped (to be sent periodically)
- Status = 127 when node communication stack is pre-operational (to be sent periodically)

Node	Frame ID	ID offset	Data length Field (bytes)	Byte 0
Charger	x750	x700	1	ChargerStatus
Master	x701	X700	1	MasterStatus

The charger heartbeat frame id is given here for a BMPU addressed with the value 0. If it is addressed with the value 2, its heartbeat frame id would be 0x752.

3.2. SYNC

The SYNC frame allows the user to trigger the sending of the BMPU's TPDOs (described in next subsection). Each time the user sends this frame, the charger will send the TPDOs frames on CAN bus giving some status / measurements to the user.

Frame ID	Data length Field (bytes)
x80	0

Thus the data field of the SYNC CAN message is empty and does not contain any data.

It is recommended to send the SYNC frame every 50 ms.

3.3. Charger TPDOs

The Charger TPDOs is the frames that are automatically send by the BMPU at the reception of a SYNC frame. It gives status and measurements information about the charger.

The list of the BMPU's TPDOs is given below:

Frame ID	ID offset	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
x1D0	x180	8	itfc_current_state				itfc_critical_fault_word			
x2D0	x280	8	itfc_v_batt_max		itfc_i_batt_max		itfc_i_grid_max		itfc_P_grid_max	
x3D0	x380	8	itfc_pos_active_available_power		itfc_neg_active_available_power		itfc_pos_reactive_available_power		itfc_neg_reactive_available_power	
x4D0	x480	8	itfc_v_L1mL4_rms		itfc_i_L1_rms		itfc_P_L1		itfc_Q_L1	
x1B0	X160	8	itfc_v_L2mL4_rms		itfc_i_L2_rms		itfc_P_L2		itfc_Q_L2	
x2B0	X260	8	itfc_v_L3mL4_rms		itfc_i_L3_rms		itfc_P_L3		itfc_Q_L3	
x3B0	X360	8	itfc_v_grid		itfc_i_grid		itfc_P_grid		itfc_Q_grid	
x4B0	X460	8	itfc_v_batt		itfc_i_batt		itfc_P_batt		itfc_available_i_batt	

The frames ids are given here for a BMPU addressed with the value 0. If it is addressed with the value 2 the frames ids would be 0x1D2, 0x2D2, 0x3D2, …

The definition of all these fields is described in the datasheet.

Pay attention these words are either bit fields words or raw values on which a gain must be applied. You can find this information in the datasheet as well.

3.4. Charger RPDOs

The charger RPDOs are the frames that can be received by the charger. These frames are sent by the user and allows to send request to BMPU.

The list of the BMPU's RPDOs is given below:

Frame ID	ID offset	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
x250	x200	8	itfc_pfc_state_request	itfc_pfc_mode_request	itfc_grid_conf_request	itfc_v2l_frequency_setpoint	itfc_v2l_voltage_setpoint		Itfc_battery_voltage_setpoint	
x350	x300	8	itfc_i_charge_limit		itfc_i_discharge_limit		itfc_active_power_setpoint_W		itfc_reactive_power_setpoint_VAR	
X450	x400	6	itfc_i_L1_limit		itfc_i_L2_limit		itfc_i_L3_limit			

The frames ids are given here for a BMPU addressed with the value 0. If it is addressed with the value 2 the frames ids would be 0x252, 0x352 and 0x452.

The definition of all these fields is described in the datasheet.

Pay attention these words are either bit fields words or raw values on which a gain must be applied. The user is in charge to do the conversion on his own. You can find this information in the datasheet as well.

4. Basic sequence example

The example below is an example which shows how to launch a basic charge.

4.1. Send a periodic heartbeat

The user must send a periodic heartbeat frame at a frequency of 1 Hz (normative) or faster if desired. The heartbeat sent must have the value 5 in its data. If no heartbeat is received by the charger for 2.5 seconds, the charger is going into error.

Arb.ID	Length	Data	Time Stamp	Rate	dt Min	dt Max	# (total)
0x701	1	05	370.6674	1.85	0.516	0.591	49
0x750	1	05	370.4268	1.00	0.998	1.001	26

4.2. Send a SYNC frame

When the user provides a SYNC frame all the charger TPDOs are sent.

Arb.ID	Length	Data	Time Stamp	Rate	dt Min	dt Max	# (total)
0x80	0		2149.8930	13.01	5.037e-002	0.198	3760
0x1B0	8	01 00 00 00 00 00 FF FF	2149.8957	13.00	4.993e-002	0.198	3760
0x1D0	8	11 01 00 00 00 00 00 00	2149.8947	13.00	4.993e-002	0.199	3760
0x250	8	01 02 04 32 FC 08 00 00	2149.8935	13.01	5.018e-002	0.198	3760
0x2B0	8	05 00 00 00 00 00 FF FF	2149.8960	13.00	4.993e-002	0.198	3760
0x2D0	8	EC 13 40 01 AA 00 B0 04	2149.8950	13.00	4.993e-002	0.199	3760
0x350	8	00 00 00 00 00 00 00 00	2149.8945	13.01	4.994e-002	0.198	3760
0x3B0	8	02 00 00 00 FF FF FF FF	2149.8962	13.00	4.993e-002	0.198	3760
0x3D0	8	01 00 00 00 00 00 FF FF	2149.8952	13.00	4.993e-002	0.198	3760
0x450	6	B4 00 B4 00 B4 00	2149.0975	0.78	1.037	1.482	188
0x4B0	8	0B 00 FF FF FF FF 00 00	2149.8965	13.00	4.993e-002	0.198	3760
0x4D0	8	02 00 00 00 FF FF FF FF	2149.8955	13.00	4.993e-002	0.198	3760

According to the TPDOs definition and the information given in the datasheet the following values can be deduced:

name	hex value	decimal value	gain	actual value	Unit
itfc_current_state	0x00000111	273	N/A	N/A	NA
itfc_critical_fault_word	0x00000000	0	N/A	N/A	NA
itfc_v_batt_max	0x13EC	5100	0.1	510	V
itfc_i_batt_max	0x012C	300	0.1	30	A
itfc_i_grid_max	0x00B4	180	0.1	18	A
itfc_P_grid_max	0x0450	1104	10	11040	W
itfc_pos_active_available_power	0x0000	0	10	0	W
itfc_neg_active_available_power	0x0000	0	10	0	W
itfc_pos_reactive_available_power	0x0000	0	10	0	VAR
itfc_neg_reactive_available_power	0x0000	0	10	0	VAR
itfc_v_L1mL4_rms	0x001B	27	0.1	2.7	V
itfc_i_L1_rms	0x0000	0	0.1	0	A
itfc_P_L1	0x0000	0	10	0	W
itfc_Q_L1	0x0000	0	10	0	VAR
itfc_v_L2mL4_rms	0x0016	22	0.1	2.2	V
itfc_i_L2_rms	0x0000	0	0.1	0	A
itfc_P_L2	0x0000	0	10	0	W
itfc_Q_L2	0xFFFF	-1	10	-10	VAR
itfc_v_L3mL4_rms	0x001E	30	0.1	3	V
itfc_i_L3_rms	0x0000	0	0.1	0	A
itfc_P_L3	0x0000	0	10	0	W
itfc_Q_L3	0x0000	0	10	0	VAR
itfc_v_grid	0x0000	0	0.1	0	V
itfc_i_grid	0x0000	0	0.1	0	A
itfc_P_grid	0x0000	0	10	0	W
itfc_Q_grid	0x0000	0	10	0	VAR
itfc_v_batt	0x000C	12	0.1	1.2	V
itfc_i_batt	0x0000	0	0.1	0	A
itfc_P_batt	0x0000	0	10	0	W
itfc_available_i_batt	0x0000	0	0.1	0	A

The value of itfc_current_state is equal to 0x00000111:

The definition of the status word given in the datasheet gives:

- SystemState = 1 => Charger in STANDBY
- SystemSubState = 1 => Charger in SUBSTATE_STANDBY
- SystemDCDCState = 1 => DCDC in DCDC_STANDBY
- SystemMode = 0 => MODE_UNKNOWN
- SystemConfiguration = 0 => CONF_UNKNOWN
- The other flags equal 0

Before going in another state than STANDBY, the SystemConfiguration and SystemMode must be defined. These parameters are considered only in standby mode, a change of this parameter is ignored when in another state.

4.3. Define configuration

The configuration is set via the charger RPDOs.

The following requests are made to use a power control of the BMPU using a grid of three phases and a neutral wire:

- Request_state => STANDBY => 1
- Mode_request => MODE_PFC_POWER => 2
- Conf_request => CONF_THREE_PHASE_FOUR_WIRE => 4
- V2L frequency => 50Hz

- V2L voltage => 230V

name	actual value	Unit	Gain	decimal value	Hex value
itfc_pfc_state_request	1	NA	N/A	1	0x01
itfc_pfc_mode_request	2	NA	N/A	2	0x02
itfc_grid_conf_request	4	NA	N/A	4	0x04
itfc_v2l_frequency_setpoint	50	Hz	1	50	0x32
itfc_v2l_voltage_setpoint	230	V	0.1	2300	0x08FC
itfc_battery_voltage_setpoint	0	V	0.1	0	0x0000
itfc_i_charge_limit	0	A	0.1	0	0x0000
itfc_i_discharge_limit	0	A	0.1	0	0x0000
itfc_active_power_setpoint	0	W	10	0	0x0000
itfc_reactive_power_setpoint	0	VAR	10	0	0x0000
itfc_i_L1_limit	18	A	0.1	180	0x00B4
itfc_i_L2_limit	18	A	0.1	180	0x00B4
itfc_i_L3_limit	18	A	0.1	180	0x00B4

It gives the following RPDOs messages:

Arb.ID	Length	Data	Time Stamp	Rate	dt Min	dt Max	# (total)
0x80	0		438.2250	17.39	5.048e-002	0.118	142
0x250	8	01 02 04 32 FC 08 00 00	438.2255	17.41	5.042e-002	0.118	142
0x350	8	00 00 00 00 00 00 00 00	438.2267	17.37	5.033e-002	0.118	142
0x450	6	B4 00 B4 00 B4 00	438.0379	0.89	1.074	1.213	7

4.4. Set charge targets

The charge targets also need to be defined. The previous values are kept but we change here the following parameters:

- P_setpoint=7kW
- Q_setpoint=1kVar
- I_charging_limit=30A
- I_discharging_limit=30A
- Battery_voltage_setpoint=480V

name	actual value	Unit	Gain	decimal value	Hex value
itfc_pfc_state_request	1	NA	N/A	1	0x01
itfc_pfc_mode_request	2	NA	N/A	2	0x02
itfc_grid_conf_request	4	NA	N/A	4	0x04
itfc_v2l_frequency_setpoint	50	Hz	1	50	0x32
itfc_v2l_voltage_setpoint	230	V	0.1	2300	0x08FC
itfc_battery_voltage_setpoint	480	V	0.1	4800	0x12C0
itfc_i_charge_limit	30	A	0.1	300	0x012C
itfc_i_discharge_limit	30	A	0.1	300	0x012C
itfc_active_power_setpoint	7000	W	10	700	0x02BC
itfc_reactive_power_setpoint	1000	VAR	10	100	0x0064
itfc_i_L1_limit	18	A	0.1	180	0x00B4
itfc_i_L2_limit	18	A	0.1	180	0x00B4
itfc_i_L3_limit	18	A	0.1	180	0x00B4

The RPDOs message has now these values:

Arb.ID	Length	Data	Time Stamp	Rate	dt Min	dt Max	# (total)
0x80	0		573.1806	11.62	5.037e-002	0.162	2483
0x250	8	01 02 04 32 FC 08 C0 12	573.1811	11.62	5.026e-002	0.162	2483
0x350	8	2C 01 2C 01 BC 02 64 00	573.1821	11.61	5.019e-002	0.162	2483
0x450	6	B4 00 B4 00 B4 00	572.9411	0.79	1.035	1.402	124

4.5. Grid Connection

We now connect a 230V grid and a 360V battery. At this state, if we look at the BMPU TPDOs, we obtain something like:

Arb.ID	Length	Data	Time Stamp	Rate	dt Min	dt Max	# (total)
0x80	0		854.1977	16.02	5.051e-002	0.165	230
0x1B0	8	02 00 00 00 00 00 FF FF	854.2009	15.89	5.017e-002	0.166	230
0x1D0	8	11 91 00 00 00 00 00 00	854.1999	15.89	4.993e-002	0.166	230
0x250	8	01 02 04 32 FC 08 C0 12	854.1983	15.98	5.049e-002	0.166	230
0x2B0	8	05 00 00 00 FF FF 00 00	854.2012	15.90	5.016e-002	0.166	230
0x2D0	8	EC 13 40 01 AA 00 B0 04	854.2002	15.89	4.993e-002	0.166	230
0x350	8	2C 01 2C 01 BC 02 64 00	854.1993	16.01	5.023e-002	0.165	230
0x3B0	8	02 00 00 00 FF FF FF FF	854.2014	15.90	5.016e-002	0.166	230
0x3D0	8	01 00 FE FF 00 00 FF FF	854.2004	15.89	5.017e-002	0.166	230
0x450	6	B4 00 B4 00 B4 00	853.2230	0.93	1.053	1.277	11
0x4B0	8	FD 0D FF FF FF FF 00 00	854.2017	15.90	5.016e-002	0.166	230
0x4D0	8	02 00 00 00 FF FF FF FF	854.2007	15.89	5.017e-002	0.166	230

name	hex value	decimal value	gain	actual value	Unit
itfc_current_state	0x9111	37137	N/A	N/A	NA
itfc_critical_fault_word	0x00000000	0	N/A	N/A	NA
itfc_v_batt_max	0x13EC	5100	0.1	510	V
itfc_i_batt_max	0x0140	320	0.1	32	A
itfc_i_grid_max	0x00AA	170	0.1	17	A
itfc_P_grid_max	0x04B0	1200	10	12000	W
itfc_pos_active_available_power	0x0001	1	10	10	W
itfc_neg_active_available_power	0xFFFE	-2	10	-20	W
itfc_pos_reactive_available_power	0x0000	0	10	0	VAR
itfc_neg_reactive_available_power	0xFFFF	-1	10	-10	VAR
itfc_v_L1mL4_rms	0x0002	2	0.1	0.2	V
itfc_i_L1_rms	0x0000	0	0.1	0	A
itfc_P_L1	0xFFFF	-1	10	-10	W
itfc_Q_L1	0xFFFF	-1	10	-10	VAR
itfc_v_L2mL4_rms	0x0002	2	0.1	0.2	V
itfc_i_L2_rms	0x0000	0	0.1	0	A
itfc_P_L2	0x0000	0	10	0	W
itfc_Q_L2	0xFFFF	-1	10	-10	VAR
itfc_v_L3mL4_rms	0x0005	5	0.1	0.5	V
itfc_i_L3_rms	0x0000	0	0.1	0	A
itfc_P_L3	0xFFFF	-1	10	-10	W
itfc_Q_L3	0x0000	0	10	0	VAR
itfc_v_grid	0x0002	2	0.1	0.2	V
itfc_i_grid	0x0000	0	0.1	0	A
itfc_P_grid	0xFFFF	-1	10	-10	W
itfc_Q_grid	0xFFFF	-1	10	-10	VAR
itfc_v_batt	0x0DFD	3581	0.1	358.1	V
itfc_i_batt	0xFFFF	-1	0.1	-0.1	A
itfc_P_batt	0xFFFF	-1	10	-10	W
itfc_available_i_batt	0x0000	0	0.1	0	A

The following information are interesting:

- Itfc_current_state = 0x00009111

  - SystemState = 1 => Charger in STANDBY
  - SystemSubState = 1 => Charger in SUBSTATE_STANDBY
  - SystemDCDCState = 1 => DCDC in DCDC_STANDBY
  - SystemMode = 2 => MODE_PFC_POWER => 2
  - SystemConfiguration = 4 => CONF_THREE_PHASE_FOUR_WIRE
- Battery voltage gives 358.1V
- Grid voltage remains close to zero because AC relays are not closed yet at this stage

4.6. Request power on

By setting the itfc_pfc_state_request of RPDO 0x250 to 2 (POWER_ON), a power on request is sent to the BMPU. This state is a mandatory state to go in charge, the BMPU prepare itself to send or absorb power. It prepares its intermediary DC bus.

During power on sequence, you can see the value itfc_current_state evolves depending on the state machine path followed by the power unit (see state machine in datasheet).

In nominal course, you should observe the current state evolve as following:

1. Itfc_current state
   a. SystemState = 1 => Charger in STANDBY
   b. SystemSubState = 1 => Charger in SUBSTATE_STANDBY
2. Itfc_current state
   a. SystemState = 2 => Charger in STATE_POWER_ON
   b. SystemSubState = 2 => Charger in SUBSTATE_STANDBY_PASSIVE_PRECHARGE
3. Itfc_current state
   a. SystemState = 2 => Charger in STATE_POWER_ON
   b. SystemSubState = 3 => Charger in SUBSTATE_STANDBY_PASSIVE_PRECHARGE_DRIVER_ON
4. Itfc_current state
   a. SystemState = 2 => Charger in STATE_POWER_ON
   b. SystemSubState = 4 => Charger in SUBSTATE_STANDBY_ACTIVE_PRECHARGE

After the power on sequence is finished the BMPU is now able to go in charge.

For your information, you can directly request the state charge from standby, the power on sequence will be executed and the charger will go into charge as soon as it has finished its power on sequence.

Arb.ID	Length	Data	Time Stamp	Rate	dt Min	dt Max	# (total)
0x80	0		908.6366	12.03	5.036e-002	0.105	93
0x1B0	8	F8 08 16 00 09 00 21 00	908.6397	11.95	5.009e-002	0.106	93
0x1D0	8	42 92 80 10 00 00 00 00	908.6388	11.92	4.993e-002	0.106	93
0x250	8	02 02 04 32 FC 08 C0 12	908.6371	12.06	5.038e-002	0.105	93
0x2B0	8	F7 08 16 00 08 00 20 00	908.6400	11.95	5.008e-002	0.106	93
0x2D0	8	EC 13 40 01 AA 00 B0 04	908.6390	11.92	4.993e-002	0.106	93
0x350	8	2C 01 2C 01 BC 02 64 00	908.6380	12.10	5.028e-002	0.105	93
0x3B0	8	F2 08 16 00 26 00 6C 00	908.6402	11.96	5.008e-002	0.106	93
0x3D0	8	4B 04 B4 FB DF 01 20 FE	908.6393	11.95	5.010e-002	0.106	93
0x450	6	B4 00 B4 00 B4 00	907.5679	0.95	1.048	1.122	4
0x4B0	8	03 0E FF FF FF FF 21 01	908.6405	11.96	5.008e-002	0.106	93
0x4D0	8	E7 08 16 00 09 00 21 00	908.6395	11.96	5.009e-002	0.106	93

4.7. Request charge

To go in charge state, you must now set the value of itfc_pfc_state_request in RPDO 0x250 to 3 (CHARGE). The BMPU will provide or absorb some powers depending on the configuration applied.

name	actual value	Unit	Gain	decimal value	Hex value
itfc_pfc_state_request	3	NA	N/A	3	0x03
itfc_pfc_mode_request	2	NA	N/A	2	0x02
itfc_grid_conf_request	4	NA	N/A	4	0x04
itfc_v2l_frequency_setpoint	50	Hz	1	50	0x32
itfc_v2l_voltage_setpoint	230	V	0.1	2300	0x08FC
itfc_battery_voltage_setpoint	480	V	0.1	4800	0x12C0
itfc_i_charge_limit	30	A	0.1	300	0x012C
itfc_i_discharge_limit	30	A	0.1	300	0x012C
itfc_active_power_setpoint	7000	W	10	700	0x02BC
itfc_reactive_power_setpoint	1000	VAR	10	100	0x0064
itfc_i_L1_limit	18	A	0.1	180	0x00B4
itfc_i_L2_limit	18	A	0.1	180	0x00B4
itfc_i_L3_limit	18	A	0.1	180	0x00B4

Arb.ID	Length	Data	Time Stamp	Rate	dt Min	dt Max	# (total)
0x80	0		1028.4403	18.47	5.065e-002	0.124	88
0x250	8	03 02 04 32 FC 08 C0 12	1028.4408	18.51	5.063e-002	0.124	88
0x350	8	2C 01 2C 01 BC 02 64 00	1028.4419	18.47	5.043e-002	0.124	88
0x450	6	B4 00 B4 00 B4 00	1027.6130	0.92	1.063	1.089	4

You can still access to the measurements made by the charger in the TPDOs

Arb.ID	Length	Data	Time Stamp	Rate	dt Min	dt Max	# (total)
0x80	0		942.8224	19.64	5.063e-002	0.114	73
0x1B0	8	EB 08 69 00 E6 00 1D 00	942.8257	19.55	5.016e-002	0.114	73
0x1D0	8	53 93 8D 11 00 00 00 00	942.8246	19.63	4.993e-002	0.114	73
0x250	8	03 02 04 32 FC 08 C0 12	942.8228	19.65	5.057e-002	0.114	73
0x2B0	8	E5 08 69 00 D8 00 46 00	942.8260	19.56	5.016e-002	0.114	73
0x2D0	8	EC 13 40 01 AA 00 B0 04	942.8248	19.63	4.993e-002	0.114	73
0x350	8	2C 01 2C 01 BC 02 64 00	942.8239	19.64	5.032e-002	0.114	73
0x3B0	8	E1 08 69 00 BB 02 64 00	942.8262	19.56	5.015e-002	0.114	73
0x3D0	8	43 04 BC FB DB 01 24 FE	942.8250	19.64	5.017e-002	0.114	73
0x450	6	B4 00 B4 00 B4 00	942.8253	0.96	1.041	1.269	4
0x4B0	8	0C 0E B9 00 9B 02 1E 01	942.8264	19.56	5.015e-002	0.114	73
0x4D0	8	D4 08 69 00 FD 00 3E 00	942.8255	19.55	5.016e-002	0.114	73

name	hex value	decimal value	gain	actual value	Unit
itfc_current_state	0x118D9353	294490963	N/A	N/A	NA
itfc_critical_fault_word	0x00000000	0	N/A	N/A	NA
itfc_v_batt_max	0x13EC	5100	0.1	510	V
itfc_i_batt_max	0x0140	320	0.1	32	A
itfc_i_grid_max	0x00AA	170	0.1	17	A
itfc_P_grid_max	0x04B0	1200	10	12000	W
itfc_pos_active_available_power	0x0443	1091	10	10910	W
itfc_neg_active_available_power	0xFBBC	-1092	10	-10920	W
itfc_pos_reactive_available_power	0x01DB	475	10	4750	VAR
itfc_neg_reactive_available_power	0xFE24	-476	10	-4760	VAR
itfc_v_L1mL4_rms	0x08D4	2260	0.1	226	V
itfc_i_L1_rms	0x0069	105	0.1	10.5	A
itfc_P_L1	0x00FD	253	10	2530	W
itfc_Q_L1	0x003E	62	10	620	VAR
itfc_v_L2mL4_rms	0x08EB	2283	0.1	228.3	V
itfc_i_L2_rms	0x0069	105	0.1	10.5	A
itfc_P_L2	0x00E6	230	10	2300	W
itfc_Q_L2	0x001D	29	10	290	VAR
itfc_v_L3mL4_rms	0x08E5	2277	0.1	227.7	V
itfc_i_L3_rms	0x0069	105	0.1	10.5	A
itfc_P_L3	0x00D8	216	10	2160	W
itfc_Q_L3	0x0046	70	10	700	VAR
itfc_v_grid	0x08E1	2273	0.1	227.3	V
itfc_i_grid	0x0069	105	0.1	10.5	A
itfc_P_grid	0x02BB	699	10	6990	W
itfc_Q_grid	0x0064	100	10	1000	VAR
itfc_v_batt	0x0E0C	3596	0.1	359.6	V
itfc_i_batt	0x00B9	185	0.1	18.5	A
itfc_P_batt	0x029B	667	10	6670	W
itfc_available_i_batt	0x011E	286	0.1	28.6	A

The following information are interesting:

- Itfc_current_state = 0x118D9353
  - SystemState = 3 => Charger in CHARGE
  - SystemSubState = 5 => Charger in SUBSTATE_PFC_CHARGING
  - SystemDCDCState = 3 => DCDC in DCDC_CHARGE
  - SystemMode = 2 => MODE_PFC_POWER => 2
  - SystemConfiguration = 4 => CONF_THREE_PHASE_FOUR_WIRE
  - CurrentRegulationFlag =1 => Charger is regulating DC current
  - ActivePowerRegulationFlag =1 => Charger is regulation AC active power
  - ReactivePowerRegulationFlag =1 => Charger is regulation AC reactive power
  - PfcOnFlag = 1 => PFC stage is powered
  - DcdcOnFlag =1 => DCDC stage is powered
  - GridDetectionFlag =1 => Detected grid configuration is corresponding to requested SystemConfiguration (This flag must be on to allow power flow. It is updated during passive pre-charge step. In V2L moden this flag is set to 1 by default)

- Grid voltage = 227.3 V
- Grid current = 10.5 A
- AC active power = 6990 W
- AC reactive power = 1000 VAR
- Battery voltage = 359.6 V
- Battery current = 18.5 A
- DC power = 6670 W
- Available DC current = 28.6 A