EDN GROUP S.r.l.

BATTERY CHARGER CAN MESSAGES SPECIFICATIONS

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HISTORY OF THE DOCUMENT

Revision	*Date*	*Author*	*Validator*	*Amendment*
A	09/04/2018	Daniele Prataviera	Roberto Tagliabue	Creation of the document
B	22/05/2019	Daniele Prataviera	Roberto Tagliabue	Added description relative to the reduced consumption mode in the description of the control message, the status machine diagram and the Flow chart when charger is compliant with EN61851
C	29/07/2019	Daniele Prataviera	Roberto Tagliabue	Added paragraph 8.4 that explains better in detail the features of the EVO22K considering the SAE J1772 or EN61851 enabled or not
D	28/04/2020	Daniele Prataviera	Roberto Tagliabue	It was added the reduced consumption mode also in case SAE J1772 is enabled. Modified description of the reduced consumption mode at page 49 and added at page 61.

1 Introduction

CAN BUS is a standard multi-master serial bus for connecting Electronic Control Units [ECU] also known as nodes. Two or more nodes are required on the CAN network to communicate. The complexity of the node can range from a simple I/O device up to an embedded computer with a CAN interface. The node could also be a gateway allowing a standard computer to communicate over a USB to the devices on a CAN network. All nodes are connected to each other through a two wire bus with a reference wire called CAN shield.

This document defines the CAN Messages exchanged between the EDN GROUP's chargers and user's control logic (ECU, BMS) or the Vehicle Management Unit (VMU) and also a PC system monitoring software application.

2 CAN Bus communication structure:

EDN charger can transmit messages with a hierarchy defined on four levels:
LEVEL 1: Control and Real time diagnostic messages
LEVEL 2: On demand diagnostic messages
LEVEL 3: CAN Service messages
LEVEL 4: Charger Setup messages
LEVEL 5: Boot loading messages

There are also two CAN bus Line on the charger:
A ***Main CAN bus*** Line where are present the messages for LEVEL1, LEVEL2 and LEVEL4
A ***Service CAN bus*** line where are transmitted the LEVEL3 messages.

For each line, the termination resistor is not present. For more details about the connection of the CAN BUS, the user's manual of EVO chargers should be checked.

For EVO22K series, the charger will send two set of messages. For example a charger with ID set at 0x0 will send massages with ID defined by the columns "ID charger1 (ID 0x61x)" and "ID Charger 2 (ID 0x60x)" and there will be only one control message (Ctl) with ID 0x618.

2.1 Main CAN Bus specification

CAN Spec.:	CAN 2.0B (CAN 2.0A compatible)
Bitrate:	125kbit/s, 250kbit/s, 500 kbit/s, 1Mbit/s
Message Type:	Standard (11-bit Identifier) & Extended (29-bit Identifier)
Remote Frame:	Not used
Terminating Resistor:	Not present
Data Format:	Motorola

Default bitrate: 500kbit/s
Default Message type: Standard (11-bit Identifier)

2.2 Main CAN Bus Data Field specification

Data order (as sent):

Byte: from 0 to 7
Bit: 8 bits transferred MSB first
Word: transferred High Byte first
Long: transferred High Word first

All Bits not indicated are transferred as “0”.

2.3 Service CAN Bus specification

CAN Spec.:	CAN 2.0B (CAN 2.0A compatible)
Bitrate:	500 kbit/s
Message Type:	Standard (11-bit Identifier)
Remote Frame:	Not used
Terminating Resistor:	Not present
Data Format:	Motorola

2.4 Service CAN Bus Data Field specification

Data order (as sent):

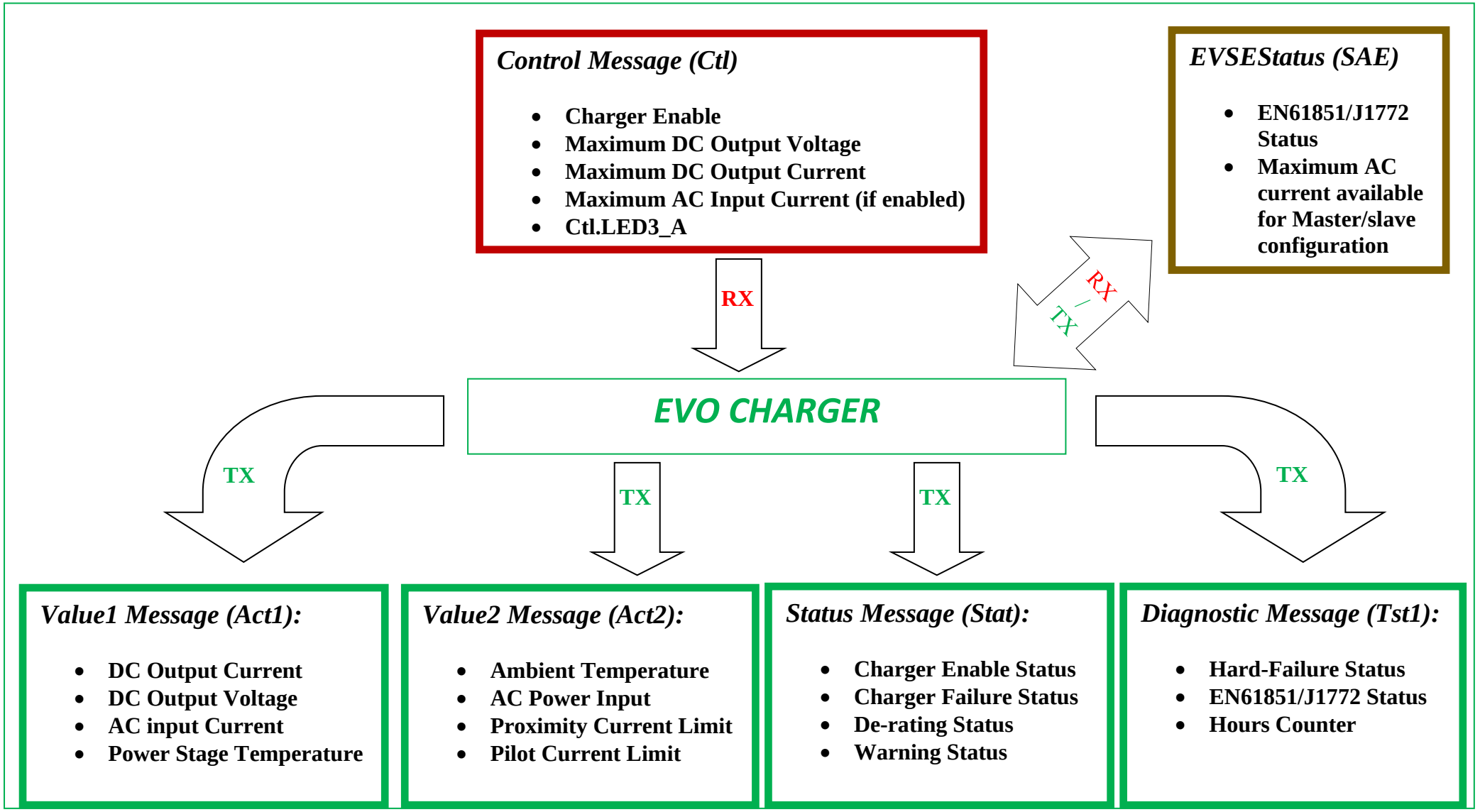
Byte: from 0 to 7
Bit: 8 bits transferred MSB first
Word: transferred High Byte first
Long: transferred High Word first

All Bits not indicated are transferred as “0”.

2.5 LEVEL 1 Description:

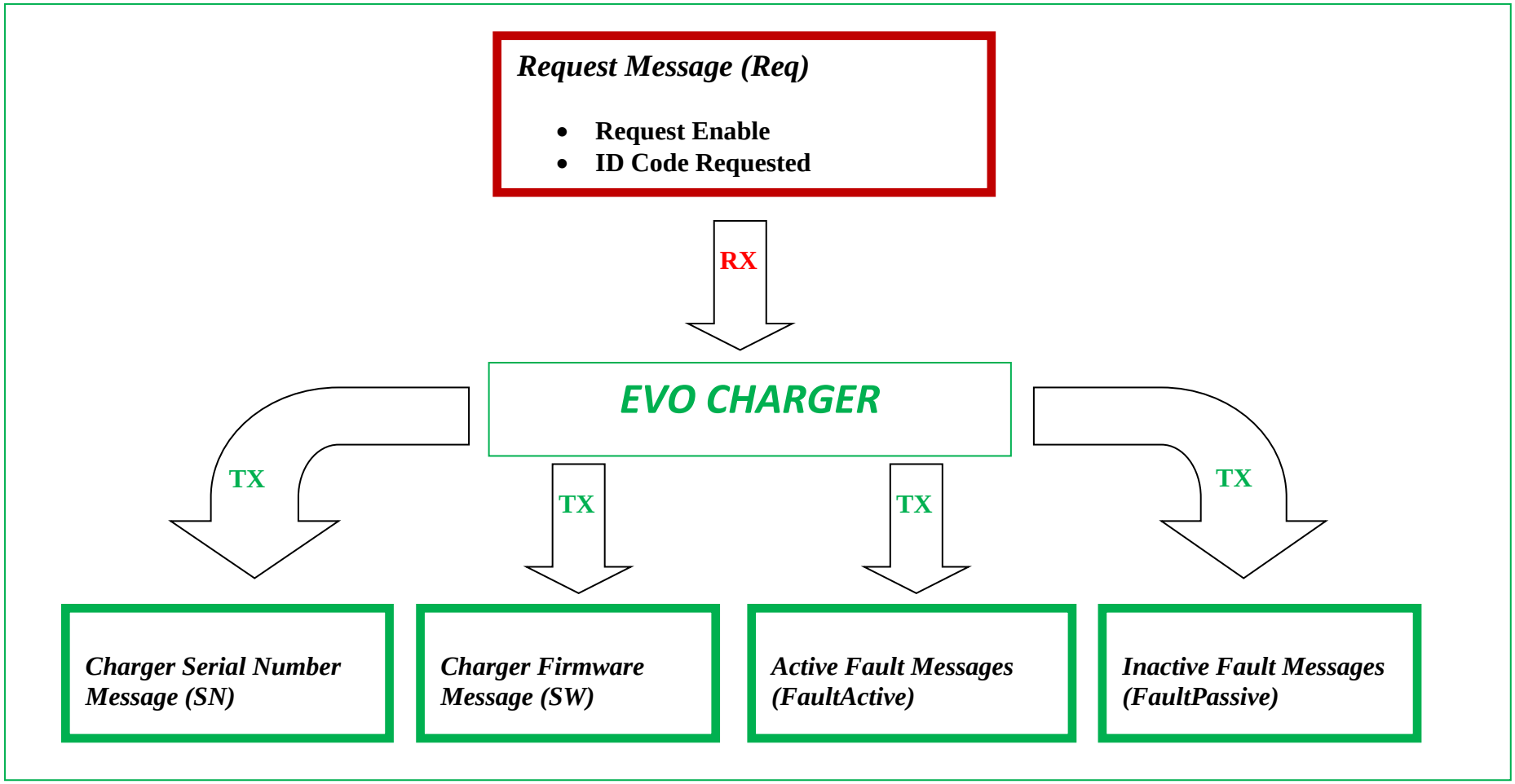
At this level, there are the most important messages needed for the charger to provide output power.
The charger should receive a Control Message (Ctl) every 100ms where maximum output voltage and current value are defined. If this message is not received, the charger doesn’t provide output power. The charger transmits a message for actual values measured (Act1 & Act2) and some information about the status of the charger (Tst1).

The description of each byte will be discussed in deep in the next paragraphs.



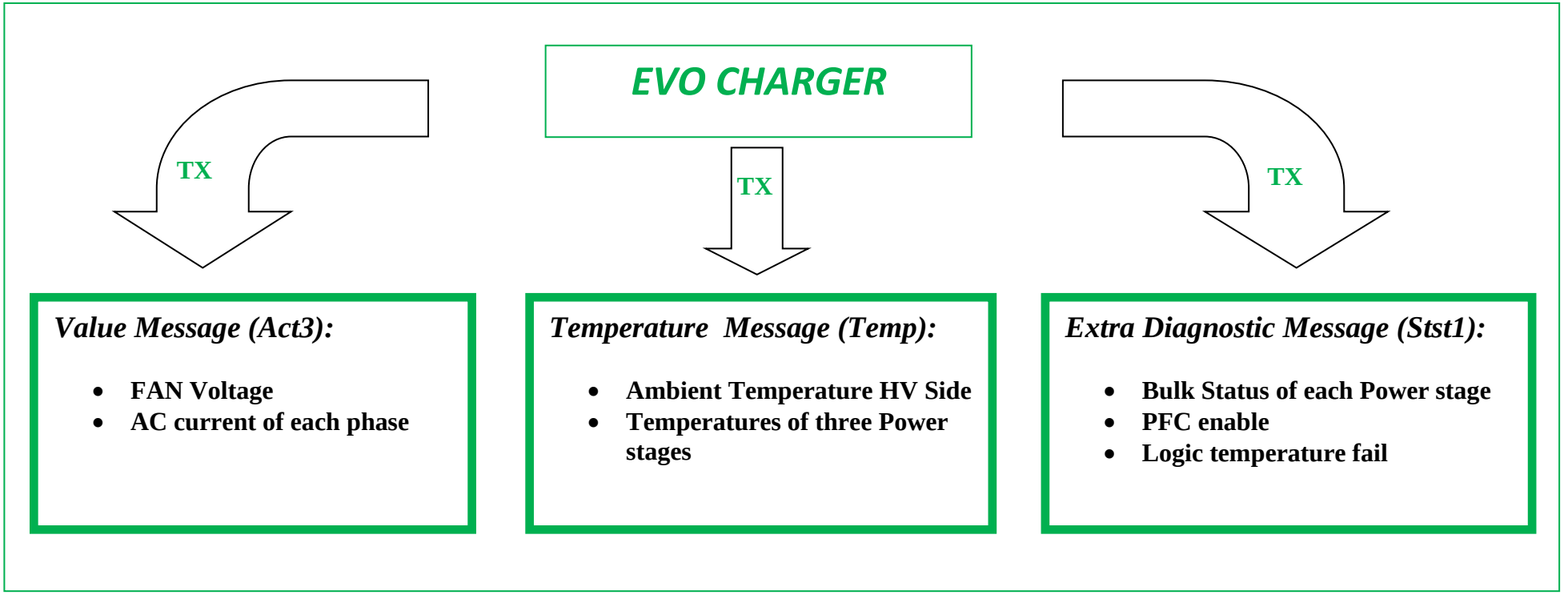
2.6 LEVEL 2 Description:

At this level, there are the messages for a complete control of diagnostic status of the charger.
This is an “On demand diagnostic”, where with a request message it’s possible to understand all the event happened during the running. It is also possible to read the firmware and the serial number of the charger.



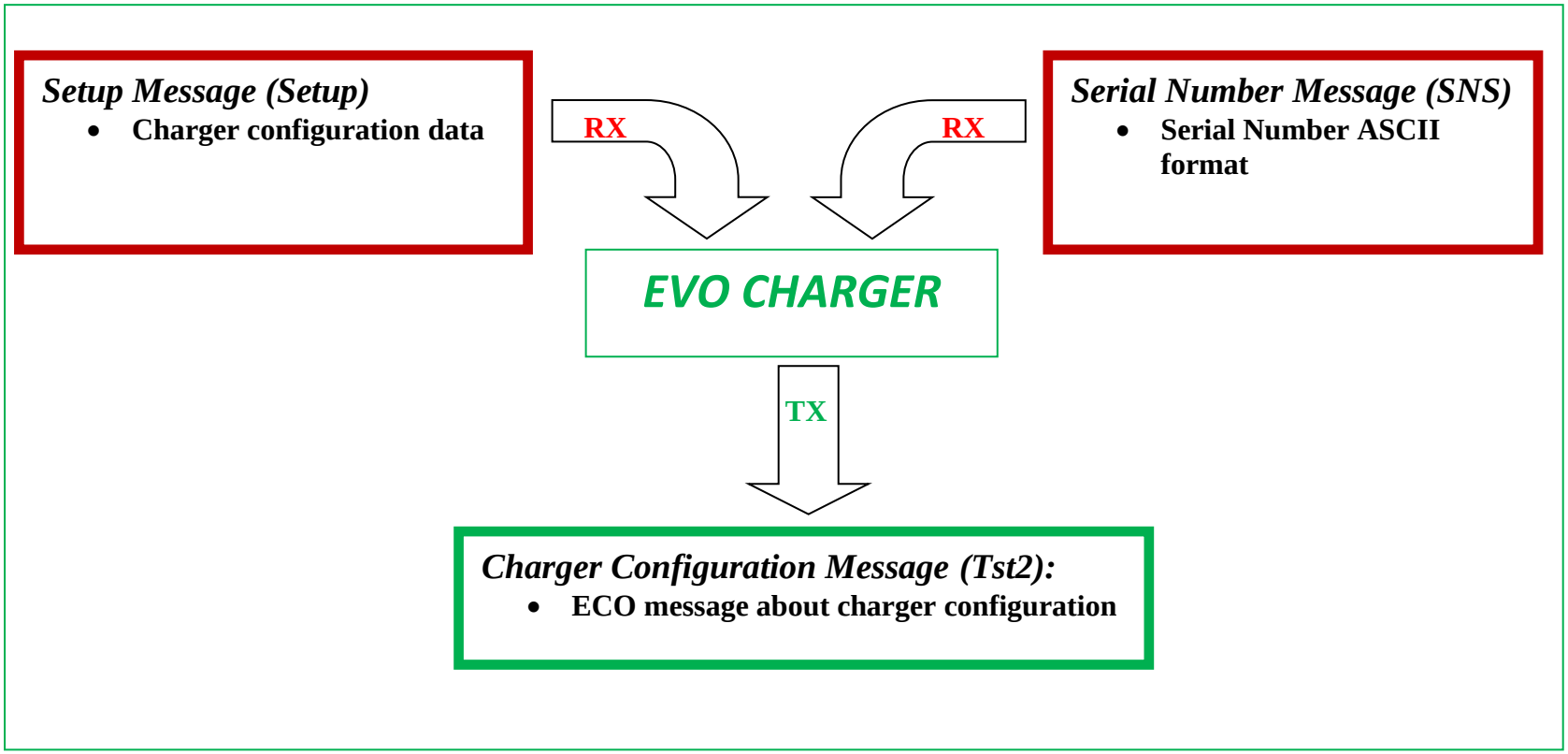
2.7 LEVEL 3 Description:

At this level, there are the messages used to have a comprehensive overview of the real time charger's parameters used for testing and troubleshooting like temperature, each phase AC input current and the status of the charger in real time. These messages are present only over the CAN service Bus Line and are generally used by EDN personnel in order to diagnose the behavior of the charger.



2.8 LEVEL 4 Description:

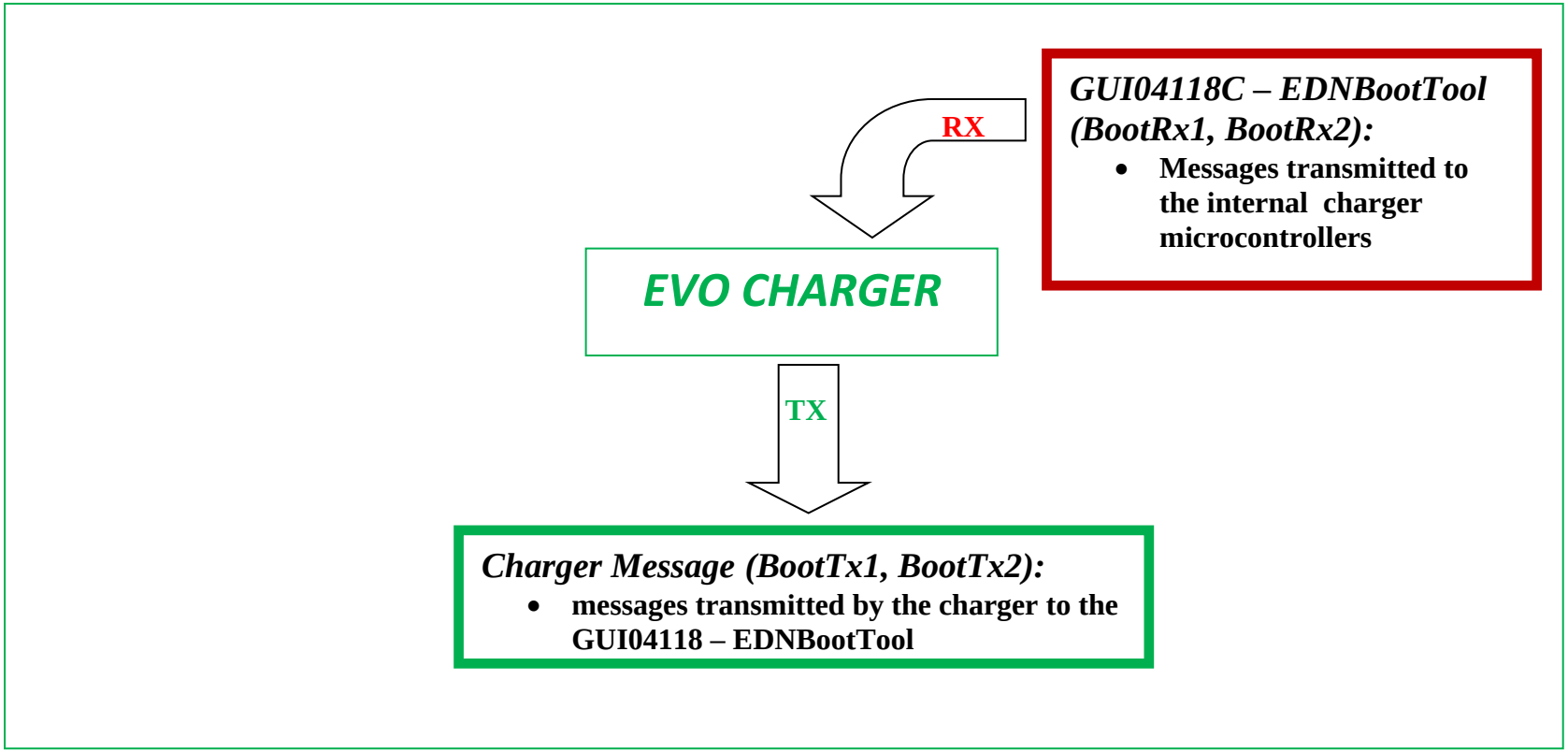
At this level are present the messages used to define the configuration of the charger. In particular in this part are defined the serial number of the charger and the electrical and CAN bus characteristics. There is a particular procedure to set-up the converter and it's defined deeply in the next paragraphs.



2.9 LEVEL 5 Description:

At this level are present the messages used when a new firmware is uploaded into the charger using the GUI04118 – EDNBootTool.

In particular, in this part are defined the message IDs exchanged between the internal microcontroller of the charger and the GUI04118 – EDNBootTool during the bootloading phase. It is defined deeply in the next paragraphs.



3 LEVEL 1: Control and Real time diagnostic messages

3.1 LEVEL 1 Messages Overview

Messages contents		
Control Message	Ctl	Iout & Vout reference value, control bits
Values 1	Act1	Actual values measured from the charger
Values 2	Act2	Actual values of power and AC current Limit
Diagnostic	Tst1	Real Time Diagnostic
Status	Stat	Status of Charger
EVSEStatus	SAE	EVSE status (Transmitted only if the EN61851/J1772 features active)

Rx,Tx	***Message Name***	***ID Charger 1***	***ID Charger 2***	***ID Charger 3***	***ID Charger 4***	***ID Charger 5***	***ID Charger 6***	***ID Charger 7***	***ID Charger 8***	***ID Charger 9***	***ID Charger 10***	***ID Charger 11***	***ID Charger 12***	***ID Charger 15***	***ID Charger 16***	***DLC***	***Transmit Time (ms)***
Charger ID Value on Setup Message ID0x617		0	1	2	3	4	5	6	7	8	9	10	11	14	15		
Rx	Ctl	0x618	0x608	0x5F8	0x5E8	0x5D8	0x5C8	0x5B8	0x5A8	0x598	0x588	0x578	0x568	0x038	0x028	***7***	100
Tx	Stat	0x610	0x600	0x5F0	0x5E0	0x5D0	0x5C0	0x5B0	0x5A0	0x590	0x580	0x570	0x560	0x030	0x020	4	1000
Tx	Act1	0x611	0x601	0x5F1	0x5E1	0x5D1	0x5C1	0x5B1	0x5A1	0x591	0x581	0x571	0x561	0x031	0x021	8	100
Tx	Act2	0x614	0x604	0x5F4	0x5E4	0x5D4	0x5C4	0x5B4	0x5A4	0x594	0x584	0x574	0x564	0x034	0x024	8	1000
Tx	Tst1	0x615	0x605	0x5F5	0x5E5	0x5D5	0x5C5	0x5B5	0x5A5	0x595	0x585	0x575	0x565	0x035	0x025	8	100
Rx/Tx	SAE	0x619	0x619	0x619	0x619	0x619	0x619	0x619	0x619	0x619	0x619	0x619	0x619	0x619	0x619	8	100

Both EVO22 chargers and EVO11K chargers can be connected in parallel in order to increase the output power. When you use more chargers connected in parallel, you have

to set different IDs in order to monitor the status and control each charger. You can choose from ID1 to ID12 (ID15 and ID16 are customized addresses). In this way you can monitor and control up to 12 EVO11K chargers in parallel or up to 6 EVO22K chargers in parallel.
When you use more chargers connected in parallel, you can control them with a unique control message or with several control messages (one different for each charger).
When you control several chargers connected in parallel with a unique control message, the control message that you have to use is ID0x618.
Otherwise, if you prefer to use several control messages in order to control several chargers connected in parallel, for each charger you have to use the control message ID related to the charger ID. For example, for the charger with ID5, the control message ID to be used is ID0x5D8.

When you use an EVO22K you have to check two sets of messages over Main CAN BUS. One module (master – the upper one) communicates with the set of messages related to the charger ID. The other module (slave – the lower one) communicates with the next ID set of messages. For example, if you assign to the EVO22K the charger ID6, one module (master) communicates with the message set of charger ID6 (ID0x5C0, ID0x5C1, ID0x5C4, ID0x5C5) and the other module (slave) communicates with the message set of charger ID7 (ID0x5B0, ID0x5B1, ID0x5B4, ID0x5B5).
With an EVO22K, you use only one control message in order to control both modules (master and slave). The control message to adopt is the control message ID related to the charger ID. So, if you assign to the EVO22K the charger ID6, the control message ID is ID0x5C8 for both modules.

Notice that the charger ID assume a value from 0 to 11 on the Setup message ID0x617.

3.2 LEVEL 1 Control Message Specification

Rx,Tx	Message Name	Signal Name	ID Charger A	Start Byte	Start Bit	Bit Lenght	DLC	Transmit Time (ms)	Physical Value		Application Value		Resolution Signal	Offset Signal	Unit
									Min	Max	Min	Max			
Rx	Ctl		0x618				7	100							
		Ctl.CanEnable		0	7	1			0	1	False	True			
		Ctl.LED3_A		0	3	1			0	1	False	True			
		Ctl.IacMaxSet		1	15	16			0	500	0	50	0,1	0	A
		Ctl.VoutMaxSet		3	31	16			0	10000	0	1000	0,1	0	V
		Ctl.IoutMaxSet		5	47	16			0	1500	0	150	0,1	0	A

Signal Name	Description ID 0x618
Ctl.CanEnable	If both Ctl.CanEnable and hardware enable pin(1) are active and no error occurs, the charger is ready to start (true condition)
Ctl.LED3_A	If True, a Led connected to the pins 10 and one of 13, 14, 15 could be powered when AC Mains is provided (see page 33, chapter 5.9.4.8 of the User's Manual EVO Series)
Ctl.IacMaxSet	Set Iac Max set (not used if J1772 or EN61851 are enabled)
Ctl.VoutMaxSet	Set DC Maximum Output voltage
Ctl.IoutMaxSet	Set DC Maximum Output current

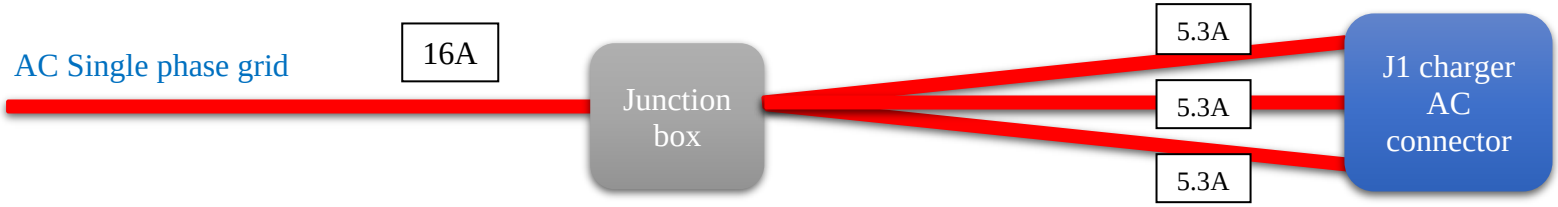
D0	D1	D2	D3	D4	D5	D6	D7	00x618 Ctl Messages Examples
80	00	A0	0E	10	00	AA		0x80 = Ctl.CanEnable enabled ; IacMaxset = 0x00A0 = 16A , Vout = 0x0E10 = 360V, Iout = 0x00AA = 17 A
88	00	A0	13	88	00	AA		0x88 = Ctl.CanEnable enabled and Ctl.LED3 enabled; IacMaxset = 0x00A0 = 16A , Vout = 0x1388 = 500V, Iout = 0x00AA = 17 A

(1) Hardware Enable Pins: to enable the charger, the hardware connection to be controlled is the HVIL on connector J3 (HVDC output connector). If the connector is plugged correctly, the charger can start to provide output power. From 25 July 2016 (serial number ME292830152203) the HVIL signal management become passive. So, the HVIL connection has to be managed externally by the VCU.

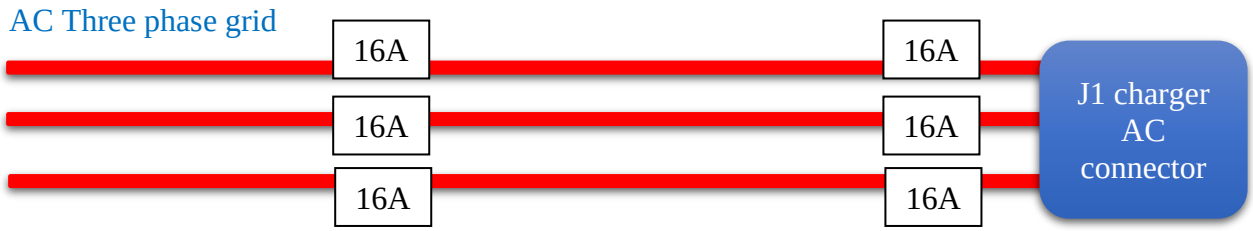
For an EVO22K the Maximum allowed output current and the Maximum allowed input current are doubled compared to the corresponding EVO11K chargers (same range).So, for example, if you use a EVO11KLR4 charger, the Maximum allowed output current is 20A, while for the EVO22KLR4, the Maximum allowed output current is 40A (the total of both modules, master and slave).

When the charger is set in Single phase AC configuration, the IacMaxSet represents the overall maximum input AC current that the charger can draw from AC grid. If the charger is set in Three phase AC configuration, the IactMaxSet represent the maximum input AC current that can be drawn from each phase of the AC grid.
If the charger is compliant with EN61851 or SAE J1772 standards, the IacMaxSet is not considered because this value is defined by the EVSE.

Thus, if Single phase AC grid configuration is set and if the Ctl.IacMaxSet value is 16A, it means that the overall current drawn by the charger from the grid is 16A. In other words, the charger draws from AC grid 16/3= 5.3A from each phase of the J1 AC connector. Indeed, although the charger is supplied by a Single phase, all the three phases of the J1 input AC connector have to be connected.



Otherwise, if the Three phase AC grid configuration is set and if the Ctl.IacMaxSet value is 16A, it means that the charger draws 16A per AC grid phase. In other words, in this case, the overall current absorbed by the charger from AC grid is 16*3=48A.



Ctl.CanEnable: in case the charger is compliant with the standard EN61851, if the Enable command is not detected for 5 minutes after the supply is provided or after the charger waked up from the Sleep Mode, the charger enters in a reduce energy consumption mode and stop communicating over CAN. The unique way to wake it up, is to disconnect the AC Plug and reconnect it to the vehicle. In this way the charger detects the proximity status change and wakes up start communicating again over CAN.

3.3 ID618 Frames definition parameters

Ctl.VoutMaxSet	This parameter sets the maximum output voltage of the charger during runtime The upper limit value is defined by factory and depends by charger model. It can be find in: ID616.Tst2.VoutMaxSet. The output voltage value is calculated as follow: Ctl.VoutMaxSet = Vout x 10 = ... [hex] (Ex. 360V: 360 x 10 = 3600 in hexadecimal = 0E10)
Ctl.IoutMaxSet	This parameter sets the maximum output current of the charger during runtime The upper limit value is defined by factory and depends by charger model. It can be find in: ID616.Tst2.IoutMaxSet. The output current value is calculated as follow: Ctl.IoutMaxSet = Iout x 10 = ... [hex] (Ex. 17A: 17 x 10 = 170 in hexadecimal = 00AA)
Ctl.IacMaxSet	This parameter sets the maximum AC input current of the charger The upper limit value is defined by factory and depends by charger model. The AC input current value is calculated as follow: Ctl.IacmMaxSet = Iac x 10 = ... [hex] (Ex. 32A: 32 x 5 = 160 in hexadecimal = A0)

3.4 LEVEL 1 Frames Specification

Rx,Tx	Message Name	Signal Name		ID Charger 1	Start Byte	Start Bit	Bit Lenght	DLC	Transmit Time (ms)		Physical Value		Application Value		Resolution Signal	*Offset Signal*	*Unit*
											Min	Max	Min	Max			
Tx	**Stat**			**0x610**				**4**	**1000**								
		Stat.PowerEnable			0	7	1				0	1	False	True			
		Stat.ErrorLatch			0	6	1				0	1	False	True			
		Stat.WarnLimit			0	5	1				0	1	False	True			
		Stat.LimTemp			0	3	1				0	1	False	True			
		Stat.WarningHV			0	1	1				0	1	False	True			
		Stat.Bulks			0	0	1				0	1	False	True			
Tx	**Act1**			**0x611**				**8**	**100**								
		Act1.Iacm			0	7	16				0	500	0	50	0,1	0	A
		Act1.Temp			2	23	16				0	65535	-40	+300	0.005188	+40	°C
		Act1.VOut			4	39	16				0	10000	0	1000	0,1	0	V
		Act1.IOut			6	55	16				0	1500	0	150	0,1	0	A
Tx	**Act2**			**0x614**				**8**	**1000**								
		Act2.TempLogLV			0	7	16				0	65535	-40	+300	0.005188	+40	°C
		Act2.AcPower			2	23	16				0	1000	0	10	0,01	0	kW
		Act2.ProxcurrentLimit			4	39	16				0	1000	0	100	0,1	0	A
		Act2.PilotcurrentLimit			6	55	16				0	1000	0	100	0,1	0	A

Signal Name	Description ID 0x611 and ID 0x614 and ID 0x610
Stat.PowerEnable	Indicates if the hardware enable pin is active. From 25 July 2016 (serial number ME292830152203) the HVIL signal management is passive. So, it is not still monitored and the flag value is always equal to 1.
Stat.ErrorLatch	If True, a failure or a soft failure has occurred (See the table 1 of Fault Code)
Stat.WarnLimit	If True, a warning condition is present (See the table 1 of Fault Code)
Stat.LimTemp	If True, the de-rating characteristic is active
Stat.WarningHV	If True, the CAN SERVICE communication with HV side is not implemented (the CAN Service pins are not connected)
Stat.Bulks	If True, a Bulk error is present (See the table 1 of Fault Code)
Act1.Iacm	AC Input Current
Act1.Temp	Temperature over Power Stage
Act1.VOut	DC Output Voltage
Act1.IOut	DC Output Current
Act2.TempLogLV	Temperature over Logic LV Stage
Act2.AcPower	AC input power
Act2.ProxcurrentLimit	It defines the maximum AC input current available considering Proximity Signal (EN61851 only)
Act2.PilotcurrentLimit	It defines the maximum AC input current available considering Pilot Signal (this value is divided by the number of the EVO chargers detected over CAN)

Rx,Tx	*Message Name*	*Signal Name*	*ID Charger 1*	*Start Byte*	*Start Bit*	*Bit Lenght*	*DLC*	*Transmit Time (ms)*	*Physical Value*		*Application Value*		*Resolution Signal*	*Offset Signal*	*Unit*
									Min	Max	Min	Max			
Tx	**Tst1**		**0x615**				**8**	**100**							
		Tst1.ACok		0	7	1			0	1	False	True			
		Tst1.PrCompl		0	6	1			0	1	False	True			
		Tst1.PwrOk		0	5	1			0	1	False	True			
		Tst1.VoutOk		0	4	1			0	1	False	True			
		Tst1.Neutral		0	3	1			0	1	False	True			
		Tst1.LED3		0	2	1			0	1	False	True			
		Tst1.LED618		0	1	1			0	1	False	True			
		Tst1.ovp		1	15	1			0	1	False	True			
		Tst1.connOpen		1	14	1			0	1	False	True			
		TSìst1.TherFail		1	10	1			0	1	False	True			
		Tst1.rx618Fail		1	8	1			0	1	False	True			
		Tst1.bulk1_fail		2	23	1			0	1	False	True			
		Tst1.bulk2_fail		2	22	1			0	1	False	True			
		Tst1.bulk3_fail		2	21	1			0	1	False	True			
		Tst1.PUMPon		2	20	1			0	1	False	True			
		Tst1.FANon		2	19	1			0	1	False	True			
		Tst1.HVrxFail		2	18	1			0	1	False	True			
		Tst1.CoolingFail		2	17	1			0	1	False	True			
		Tst1.Rx619fail		2	16	1			0	1	False	True			
		Tst1.Neutro1		3	31	1			0	1	False	True			
		Tst1.Neutro2		3	30	1			0	1	False	True			
		Tst1.ThreePhase		3	29	1			0	1	False	True			

Rx,Tx	*Message Name*	*Signal Name*	*ID Charger 1*	*Start Byte*	*Start Bit*	*Bit Lenght*	*DLC*	*Transmit Time (ms)*	*Physical Value*		*Application Value*		*Resolution Signal*	*Offset Signal*	*Unit*
									Min	**Max**	**Min**	**Max**			
		Tst1.IacFail		3	26	1			0	1	False	True			
		Tst1.Ignition		3	25	1			0	1	False	True			
		Tst1.LVBatteryNP		3	24	1			0	1	False	True			
		Tst1.ProxOk		4	39	1			0	1	False	True			
		Tst1.PilotOk		4	37	1			0	1	False	True			
		Tst1.S2Ok		4	35	1			0	1	False	True			
		Tst1.cntHours		6	55	16			0	65535	0	65535	1	0	hours

Signal Name	**Description ID 0x615**
Tst1.ACok	True if AC Mains is connected (this flag became true a little time before (300ms) the precharge starts)
Tst1.PrCompl	True if AC Mains connected and pre-charge completed
Tst1.PwrOk	True if the charger starts to provide output power
Tst1.VoutOk	True if the Output voltage is present on charger side
Tst1.Neutral	If False, the Neutral is connected correctly. It is referred to the correct connection of the Neutral in the following AC configurations: - 3-phase star configuration - 1-phase configuration This flag is linked to the other flags: Tst.1Neutro1 and Tst1.Neutro2. So, if the Tst.1Neutro1 is True and Tst.1Neutro2 is True, then Tst.1Neutral is False. The Tst.1Neutral is TRUE only if there is a problem on the Neutral cable connection.
Tst1.LED3	This flag becomes true when: Tst1.LED618 is True, charger supplied with AC Mains and 12Vdc are provided to the pins 10 and one of 13, 14, 15.
Tst1.LED618	This flag became true when Ctl.LED3 is True. Tst1.LED618 represents an echo of the Ctl.LED3 command. If True, a Led connected to the pins 10 and one of 13, 14, 15 could be powered when AC Mains is provided (see page 33, chapter 5.9.4.8 of the User's Manual EVO Series)
Tst1.ovp	True if there is a DC output over voltage flag (the overvoltage is referred to the maximum output voltage allowed by the charger range)
Tst1.connOpen	Control loop Fail flag (HVIL on DC output connector), true if the output connector is not connected. From 25 July 2016 (serial number ME292830152203) the HVIL signal management is passive. So, it is not still monitored and this flag is not still evaluated.
TSìst1.TherFail	If True, the charger is working in de-rating condition (see page 45, chapter 5.12 of the User's Manual)
Tst1.rx618Fail	RX ID618 fail flag, true if the control message is not received for more than 600ms.
Tst1.bulk1_fail	If True, a Bulk error related to the channel 1 is present (See the table 1 of Fault Code)
Tst1.bulk2_fail	If True, a Bulk error related to the channel 2 is present (See the table 1 of Fault Code)
Tst1.bulk3_fail	If True, a Bulk error related to the channel 3 is present (See the table 1 of Fault Code)
Tst1.PUMPon	True if there is a Pump active request (when Act1.Temp or Act2.TempLogLV value is over 35°C)

Signal Name	Description ID 0x615
Tst1.FANon	True if there is a Fan active request (when Act1.Temp or Act2.TempLogLV value is over 40°C)
Tst1.HVrxFail	If true, the communication with HV side of charger is erratic
Tst1.CoolingFail	If true, the cooling circuit is not connected or the liquid coolant is not present
Tst1.Rx619fail	RX ID619 fail flag (used only if there are several charger in parallel for SAE J1772 or EN61851), true if the ID619 is not detected by slave chargers
Tst1.Neutro1	If true, there is a good connection on neutral cable. Tst.1Neutro1 and Tst.1Neutro2 are linked to an internal system that detects the neutral disconnection.
Tst1.Neutro2	
Tst1.ThreePhase	True if Three phase AC configuration is set (Pin 8 of J2 connector NOT short circuited to GND; this is the default condition), False if Single phase AC configuration is set (Pin 8 of J2 connector short circuited to one of GND pins of the J2 connector) (*)
Tst1IacFail	If True, the Iac current value is over the maximum Iac value permitted
Tst1.Ignition	If True, the ignition run signal wakes up the charger from SLEEP when SAE J1772 or EN61851 is enabled (see page 29, chapter 5.9.4.2 of the User's Manual)
Tst1.LVBatteryNP	If True, the LV Battery always hot is not present
Tst1.ProxOk	True if Proximity level is correct (only when EN61851/SAEJ1772 enabled)
Tst1.PilotOk	True if pilot signal is correct (only when EN61851/SAEJ1772 enabled)
Tst1.S2Ok	True if S2 is closed (only when EN61851/SAEJ1772 enabled)
Tst1.cntHours	Hours counter (hours registered when the charger is providing output power. It is not considered the functioning of the charger when the control board is powered only with LV Battery always hot)

The error flags are gradually reset during the startup procedure. See the startup procedure at page 16 of the User's Manual EVO Series.
(*) During the startup sequence of the charger, the "Digital I/O" signal status is monitored. If the pin 8 of the J2 connector is short circuited to ground (one of pins 13, 14 or 15), it means that the Single phase AC configuration is set. Otherwise, if the pin 8 of the J2 connector is left NOT connected, it means that the Three phase AC configuration is set. When the internal precharge starts and then during the functioning of the charger, the "Digital I/O" signal status is not still monitored (see the Start up sequence at page 16 chapter 5.1.3 of the User's Manual). Therefore, if you want to modify the AC configuration you have to stop supplying the charger, modify the AC grid configuration, then modify the Pin 8 status and restart supplying the charger. A suggestion in order to modify rapidly the pin 8 status is to use a Switch.
Thus, the bit 29 of the ID0x615 ("Tst1.ThreePhase") message represents the echo of the "Digital I/O" signal status.

3.5 EVSE Status Message: ID 0x619

The ID 0x619 is a message where it's shown the status of the EVSE and the chargers present on the vehicle.
When there are several chargers on the vehicle and the EN61851/SAE J1772 is active, there is a Master/slave control of the Charge and the EVSE management.
There is only one Master charger that is connected to the EVSE and one or more slave chargers. The maximum current available to be drawn from AC grid for each charger is defined in accordance the values sent from the master charger over the ID 0x619 message.

Rx,Tx	Message Name	Signal Name	ID Charger A	Start Byte	Start Bit	Bit Lenght	DLC	Transmit Time (ms)	Physical Value		Application Value		Resolution Signal	Offset Signal	Unit
									Min	Max	Min	Max			
Rx	SAE		0x619				8	100							
		SAE.Prox		0	7	1			0	1	False	True			
		SAE.Pilot		0	6	1			0	1	False	True			
		SAE.S2		0	5	1			0	1	False	True			
		SAE.MasterFail		0	4	1			0	1	False	True			
		SAE.CH2_605		0	3	1			0	1	False	True			
		SAE.CH3_5F5		0	2	1			0	1	False	True			
		SAE.CH4_5E5		0	1	1			0	1	False	True			
		SAE.CH5_5D5		0	0	1			0	1	False	True			
		SAE.CH6_5C5		1	15	1			0	1	False	True			
		SAE.CH7_5B5		1	14	1			0	1	False	True			
		SAE.CH8_5A5		1	13	1			0	1	False	True			
		SAE.CH9_595		1	12	1			0	1	False	True			
		SAE.CH10_585		1	11	1			0	1	False	True			
		SAE.CH11_575		1	10	1			0	1	False	True			
		SAE.CH12_565		1	9	1			0	1	False	True			
		SAE.CH1_615		1	8	1			0	1	False	True			
		SAE.ChNumber		3	24	8			0	16	0	16	1		
		SAE.Current		6	48	16			0	1000	0	100	0,1	0	A

Signal Name	Description ID 0x619
SAE.Prox	True if the Proximity signal is detected correctly
SAE.Pilot	True if the Pilot signal is detected correctly
SAE.S2	True if the S2 is closed and the EVSE AC mains is enabled
SAE.MasterFail	True if a failure is detected on the Master charger
SAE.CH2_605	True if on the bus is present a charger with ID605
SAE.CH3_5F5	True if on the bus is present a charger with ID5F5
SAE.CH4_5E5	True if on the bus is present a charger with ID5E5
SAE.CH5_5D5	True if on the bus is present a charger with ID5D5
SAE.CH6_5C5	True if on the bus is present a charger with ID5C5
SAE.CH7_5B5	True if on the bus is present a charger with ID5B5
SAE.CH8_5A5	True if on the bus is present a charger with ID5A5
SAE.CH9_595	True if on the bus is present a charger with ID595
SAE.CH10_585	True if on the bus is present a charger with ID585
SAE.CH11_575	True if on the bus is present a charger with ID575
SAE.CH12_565	True if on the bus is present a charger with ID565
SAE.CH1_615	True if on the bus is present a charger with ID615
SAE.ChNumber	It defines the number of chargers on the CAN bus
SAE.Current	It defines the maximum current available for each charger.

D0	*D1*	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*0x619 SAE Messages Examples*
E8	01	00	02	00	00	96	00	0xE8 = Proximity & Pilot & S2 are true (correct) and ID0x605 is present on the CAN bus; 0x01 = ID0x615 is present on the CAN bus ; 0x02 = there are two chargers on the vehicle, 0x0096 = 15A = maximum current available from AC grid
88	01	00	02	00	00	00	00	0x88 = Proximity is true (correct) and ID0x605 is present on the CAN bus; 0x01 = ID0x615 is present on the CAN bus ; 0x02 = there are two chargers on the vehicle, 0x0000 = 0A = no current available from AC grid

4 LEVEL 2: On demand diagnostic messages

The charger records the faults detected during the running and it provides the information of the fault (for example, the “fault Code”, timing, occurrence, severity) defined in the following paragraphs.

This Diagnostic messages are transmitted by CAN “On Demand”: When the charger will receive a request (Request message (Req) with ID0x61B), the charger will send back some messages with the faults recorded and other information about the firmware and serial number of the charger. In particular:

- ID 0x61C for inactive fault stored in the charger;
- ID 0x61D for active fault stored in the charger;
- ID 0x61E for the software present in the charger;
- ID 0x61F for the Serial Number of the charger (sent only once when the charger is switched on).

For every fault stored (ID 0x61C and ID 0x61D), the charger will send a single frame where is defined a code of the fault, the occurrence, the severity, the first time that the fault and the last time the fault happened.
If there is more than one fault stored, the charger will send a frame for each fault with a time delay transmission of 100ms.
Every fault will have a particular Binary code which defines his name. It is defined the severity of failure: failure = 11, soft failure = 10, warning = 01;
The structure of the frame is the same for Active fault (ID: 0x61D) and for Inactive fault (ID: 0x61C).
Active faults are all the faults still present when a request is done while Inactive faults are previous fault that are re-set when the request is done.

4.1 LEVEL 2 Message Overview:

Messages contents			**DLC**
Request	Req	Message request	4
FaultActive	FltA	Message with Fault active detected	8
FaultPassive	FltP	Message with Fault inactive detected	8
SW	SW	Message with the software present on the charger	8
SN	SN	Message with Serial Number	8
RestartTx	ResTx	Restart the transmission when the communication is stopped	4

Rx, Tx	***Message Name***	***ID Charger 1***	***ID Charger 2***	***ID Charger 3***	***ID Charger 4***	***ID Charger 5***	***ID Charger 6***	***ID Charger 7***	***ID Charger 8***	***ID Charger 9***	***ID Charger 10***	***ID Charger 11***	***ID Charger 12***	***ID Charger 15***	***ID Charger 16***	***DLC***	***Transmit Time (ms)***
Charger ID Value on Setup Message ID0x617		0	1	2	3	4	5	6	7	8	9	10	11	14	15		
Rx	Req	**0x61B**	**0x60B**	**0x5FB**	**0x5EB**	**0x5DB**	**0x5CB**	**0x6BB**	**0x6AB**	**0x69B**	**0x68B**	**0x67B**	**0x66B**	**0x03B**	**0x02B**	4	-
Tx	FltA	0x61D	0x60D	0x5FD	0x5ED	0x5DD	0x5CD	0x5BD	0x5AD	0x59D	0x58D	0x57D	0x56D	0x03D	0x02D	8	100
Tx	FltP	0x61C	0x60C	0x5FC	0x5EC	0x5DC	0x5CC	0x5BC	0x5AC	0x59C	0x58C	0x57C	0x56C	0x03C	0x02C	8	100
Tx	SW	0x61E	0x60E	0x5FE	0x5EE	0x5DE	0x5CE	0x5BE	0x5AE	0x59E	0x58E	0x57E	0x56E	0x03E	0x02E	8	-
Tx	SN	0x61F	0x60F	0x5FF	0x5EF	0x5DF	0x5CF	0x5BF	0x5AF	0x59F	0x58F	0x57F	0x56F	0x03F	0x02F	8	-

4.2 Request Message Specification (ID 0x61B, Req)

Rx,Tx	Message Name	Signal Name		ID	Start Byte	Start Bit	Bit Length	DLC	Physical Value		Application Value		Resolution Signal	Offset Signal	Unit	Note
									Min	Max	Min	Max				
Rx	Req			0x61B				4								
		Req. RequestEnable			0	7	1		0	1	False	True				Bit Enable of Request to the charger
		Req.IDmsb			2	23	8		0	65535	0	65535				MSB of ID requested
		Req.IDmsb			3	31	8		0	65535	0	65535				LSB of ID requested

Example and type of request:

D0	D1	D2	D3	0x61B Req Messages Examples	Type of request
80	00	06	1C	Req. RequestEnable: Enabled, ID requested 0x61C	This frame is the request to send the fault inactive stored
80	00	06	1D	Req. RequestEnable: Enabled, ID requested 0x61D	This frame is the request to send the fault active stored
80	00	06	1E	Req. RequestEnable : Enabled, ID requested 0x61E	This frame is the request to send the software present in the charger

4.3 Software Message (ID 0x61E)

Rx,Tx	*Message Name*	*Signal Name*	*ID*	*Start Byte*	*Start Bit*	*Bit Length*	*DLC*	*Physical Value*		*Application Value*		*Resolution Signal*	*Offset Signal*	*Unit*	*Note*
								Min	**Max**	**Min**	**Max**				
Tx	SW		0x61E				8								
		SW.firstByte		0	7	8		0	65535	0	65535				First ASCII Byte of the software
		SW.SecondByte		1	15	8		0	65535	0	65535				Second ASCII Byte of the software
		SW.ThirdByte		2	23	8		0	65535	0	65535				Third ASCII Byte of the software
		SW.FourthByte		3	31	8		0	65535	0	65535				Fourth ASCII Byte of the software
		SW.fifthByte		4	39	8		0	65535	0	65535				Fifth ASCII Byte of the software
		SW.SixthByte		5	47	8		0	65535	0	65535				Sixth ASCII Byte of the software
		SW.SeventhByte		6	55	8		0	65535	0	65535				Seventh ASCII Byte of the software
		SW.EighthByte		7	63	8		0	65535	0	65535				Eighth ASCII Byte of the software

D0	*D1*	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*0x61E Software Messages Examples*
53	57	33	32	32	38	41	35	The software of the charger is SW3225A5 and it is transmitted in ASCII Code

4.4 Active Fault (ID 0x61D)

Rx,Tx	Message Name	Signal Name	ID	Start Byte	Start Bit	Bit Length	DLC	Physical Value		Application Value		Resolution Signal	Offset Signal	Unit	Note
								Min	Max	Min	Max				
Tx	FltA		0x61D				8								
		FltA.TypeFrame		0	7	2		0	3	1	2				Define if there is one or more fault to transmit (MULTI frame, SINGLE frame)
		FltA.Totalerror		0	5	6		0	63						Define the total number of fault
		FltA.framenumber		1	13	6		0	63						Define the number of frame which is transmitting at that time
		FltA.Flt.codeerror		2	23	8		0	255						Define the code of the fault
		FltA.Occurence		3	31	6		0	63						Define the occurrence of the fault
		FltA.FailureLevel		3	25	2		0	15						Define the level of the failure
		FltA.First		4	39	16		0	65535	0	65535	1		h	Define the first time that fault occurred
		FltA.Last		6	55	16		0	65535	0	65535	1		h	Define the last time that fault occurred

D0	D1	D2	D3	D4	D5	D6	D7	0x61D Active Fault Messages Examples
41	01	A8	17	00	1E	00	78	Single frame, frame total 1, frame in transmission 1, code error 0xA8, hard failure, occurrence 5, First time 30h, last time 120h
00	FF	FF	FF	FF	FF	FF	FF	This is the particular frame for No fault detected

4.5 Inactive Fault (ID 0x61C)

Rx,Tx	*Message Name*	*Signal Name*		*ID*	*Start Byte*	*Start Bit*	*Bit Length*	*DLC*	*Physical Value*		*Application Value*		*Resolution Signal*	*Offset Signal*	*Unit*	*Note*
									Min	**Max**	**Min**	**Max**				
Tx	FltP			0x61C				8								
		FltP.Typeframe			0	7	2		0	3	1	2				Define if there is one or more fault to transmit (MULTI frame, SINGLE frame).
		FltP.Totalerror			0	5	6		0	63						Define the total number of fault
		FltP.framenumber			1	13	6		0	63						Define the number of frame which is transmitting at that time
		FltP.Flt.codeerror			2	23	8		0	255						Define the code of the fault
		FltP.Occurence			3	31	6		0	63						Define the occurrence of the fault
		FltP.FailureLevel			3	25	2		0	3						Define the level of the failure
		FltP.First			4	39	16		0	65535	0	65535	1		h	Define the first time that fault occurred
		FltP.Last			6	55	16		0	65535	0	65535	1		h	Define the last time that fault occurred

D0	*D1*	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*0x61C Inactive Fault Messages Examples*
41	01	A0	17	00	1E	00	78	Single frame, frame total 1, frame in transmission 1, code error 0xA0, hard failure, occurrence 5, First time 30h, last time 120h
00	FF	FF	FF	FF	FF	FF	FF	This is the particular frame for No fault detected

4.6 Table of FAULT CODE

In the table below are shown the fault detected and stored in the charger.

Error Code [Hex]	Signal	Description	Trigger Condition	Exit Condition	Failure type (3)
A0	**Bulk 1 Voltage**	Internal charger voltage supply is under the minimum voltage level	Trigger condition shall be the Charger detects an internal Bulk voltage error (Vbulk less than 350Vdc)	Exit condition shall be if bulk voltage is above 360Vdc for 1s the soft failure is reset.	**Soft Failure**
A1	**Bulk 2 Voltage**	Internal charger voltage supply is under the minimum voltage level	Trigger condition shall be the Charger detects an internal Bulk voltage error (Vbulk less than 350Vdc)	Exit condition shall be if bulk voltage is above 360Vdc for 1s the soft failure is reset.	**Soft Failure**
A2	**Bulk 3 Voltage**	Internal charger voltage supply is under the minimum voltage level	Trigger condition shall be the Charger detects an internal Bulk voltage error (Vbulk less than 350Vdc)	Exit condition shall be if bulk voltage is above 360Vdc for 1s the soft failure is reset.	**Soft Failure**
A3	**Bulk Error**	Internal charger voltage supply is under the minimum voltage level for long time	Trigger condition shall be if the BULK1 or BULK2 or BULK3 voltage error is present for more than 1 minute	Exit condition shall be made when AC MAINS Line is disconnected and reconnected	**Failure**
A4	**CAN Registers**	Main indicator of CAN broadcasting. CAN registers are monitored by charger ECU	Trigger condition shall be the based on a Charger counter of non- sequential message errors reaching 127, with every good message causing the same counter to decrement until it saturates at zero.	Exit condition shall be if the counter return to zero, the warning is reset.	**Warning**
A5	**CAN Command**	Main indicator of CAN Command is not received by the charger	Trigger condition shall be the CAN Command not received for 600 ms or greater	Exit condition shall be at first valid CAN Command received the Soft Failure is reset	**Soft Failure**
A6	**Cold plate temperature: LOW**	Main indicator of charger temperature is too low	Trigger condition shall be when the cold plate temperature is less than -30 degC for 1 second or greater	Exit condition shall be if cold plate temperature is above -25 degC for 1 second, the warning is reset	**Soft Failure**

A7	**Cold plate temperature: DERATING**	Main indicator of charger temperature too high. If the temperature is over of limit temperature so the output power is derated	Trigger condition shall be when the cold plate temperature is Higher than +65 degC for 1 second or greater. Charger shall derate the Output current to keep the temperature below the maximum cold plate temperature	Exit condition shall be if cold plate temperature is below +60 degC for 1 second, the warning is reset	**Warning**
A8	**Cold plate temperature: HIGH**	Main indicator of charger temperature is over maximum cold plate temperature.	Trigger condition shall be when the cold plate temperature is higher than the maximum cold plate temperature for 1 second or greater.	Exit condition shall be if cold plate temperature is below the maximum cold plate temperature for 1 second, the Soft Failure is reset	**Soft Failure**
A9	**Cold plate temperature: FAILED**	Main indicator of the soft failure for temperature not happened	Trigger condition shall be when the cold plate temperature is Higher than the maximum cold plate temperature and the charger works yet and the soft failure is not happened	Exit condition shall be made when AC MAINS Line is disconnected and reconnected	**Failure**
AA	**Input current MAX**	Alternating Current Input limit is overcame.	Trigger condition shall be when the Input Current exceeds 16.5 amps for more than 1 minute.	Exit condition shall be made when AC MAINS Line is disconnected and reconnected	**Failure**
AB	**HVIL Interlock loop**	High voltage interlock loop signal	Trigger condition shall be when the connector interlock is open (*)	Exit condition shall be made when connector interlock is closed (*)	**Soft Failure**
AC	**Logic temperature**	Logic circuit temperature is too high	Trigger condition shall be when the Logic temperature exceeds Maximum logic temperature for 1 second or greater.	Exit condition shall be if logic board temperature is below the maximum cold plate temperature for 1 second, the soft failure is reset	**Soft Failure**
AD	**Output Overvoltage**	Charger output voltage higher than max output limit.	Trigger condition shall be when the DC voltage exceeds, Maximum Output volltage limit of the charger or the Output volltage limit sent in the Command Message for 300 ms.	Exit condition shall be made when AC MAINS Line is disconnected and reconnected	**Failure**

(3) Failure Type:

Warning: Charger work normally, but in de-rated way.
Soft Failure: Charger stop to work, but the charger will re-start only if the fault disappear.
Failure: Charger stop to work, but the charger will re-start only if the AC Mains is disconnected and re-connected.

(*) From 25 July 2016 (serial number ME292830152203) the HVIL signal management is passive. So, it is not still monitored and this failure is not still evaluated.

5 LEVEL 3: CAN Service messages

5.1 LEVEL 3 Messages Overview

Messages contents		
Values	Act3	AC input current of each module
Values	Temp	Temperature of each thermal sensor
Diagnostic	Stst1	Extra Real Time diagnostic
Values	Act4	Temperature FAN

Rx ,Tx	***Message Name***	***ID Charger 1***	***ID Charger 2***	***ID Charger 3***	***ID Charger 4***	***ID Charger 5***	***ID Charger 6***	***ID Charger 7***	***ID Charger 8***	***ID Charger 9***	***ID Charger 10***	***ID Charger 11***	***ID Charger 12***	***ID Charger 15***	***ID Charger 16***	***DLC***	***Transmit Time (ms)***
Charger ID Value on Setup Message ID0x617		0	1	2	3	4	5	6	7	8	9	10	11	14	15		
Tx	Act3	0x712	0x702	0x6F2	0x6E2	0x6D2	0x6C2	0x6B2	0x6A2	0x692	0x682	0x672	0x662	0x032	0x022	8	100
Tx	Temp	0x713	0x703	0x6F3	0x6E3	0x6D3	0x6C3	0x6B3	0x6A3	0x693	0x683	0x673	0x663	0x033	0x023	8	100
Tx	Stst1	0x715	0x705	0x6F5	0x6E5	0x6D5	0x6C5	0x6B5	0x6A5	0x695	0x685	0x675	0x665	0x037	0x027	8	100
Tx	Act4	0x714	0x704	0x6F4	0x6E4	0x6D4	0x6C4	0x6B4	0x6A4	0x694	0x684	0x674	0x664	0x039	0x029	8	100

5.2 LEVEL 3 Frame Specifications

Rx,Tx	Message Name	Signal Name	ID Charger 1	Start Byte	Start Bit	Bit Lenght	DLC	Transmit Time (ms)	Physical Value		Application Value		Resolution Signal	Offset Signal	Unit
									Min	Max	Min	Max			
Tx	**Act3**		**0x712**				**8**	**100**							
		Act3.FANVoltage		0	7	16			0	300	0	30	0,1	0	V
		Act3.Iacm1		2	23	16			0	500	0	50	0,1	0	A
		Act3.Iacm2		4	39	16			0	500	0	50	0,1	0	A
		Act3.Iacm3		6	55	16			0	500	0	50	0,1	0	A
Tx	**Temp**		**0x713**				**8**	**100**							
		Temp.LogHV		0	7	16			0	65535	-40	+300	0.005188	+40	°C
		Temp.Power1		2	23	16			0	65535	-40	+300	0.005188	+40	°C
		Temp.Power2		4	39	16			0	65535	-40	+300	0.005188	+40	°C
		Temp.Power3		6	55	16			0	65535	-40	+300	0.005188	+40	°C
Tx	**Act4**		**0x714**				**8**	**100**							
		Act4TemplogFAN_A		0	7	16			0	65535	-40	+300	0.005188	+40	°C
		Act4Iout1_A		2	23	16			0	65535	0	65535	1	0	/
		Act4Iout2_A		4	39	16			0	65535	0	65535	1	0	/
		Act4Iout3_A		6	55	16			0	65535	0	65535	1	0	/

Signal Name	Description ID 0x712 & ID 0x713 & ID 0x714
Act3.FANVoltage	DC voltage applied to the FAN (only for EVO11KA)
Act3.Iacm1	AC Input Current Phase 1
Act3.Iacm2	AC Input Current Phase 2
Act3.Iacm3	AC Input Current Phase 3
Temp.LogHV	Temperature over Logic Board HV Side
Temp.Power1	Temperature over Power Stage 1
Temp.Power2	Temperature over Power Stage 2
Temp.Power3	Temperature over Power Stage 3
Act4TemplogFAN_A	Temperature over Logic Board FAN Supplier Side
Act4Iout1_A	Output current of channel 1 measured on the HVDC output stage
Act4Iout2_A	Output current of channel 2 measured on the HVDC output stage
Act4Iout3_A	Output current of channel 3 measured on the HVDC output stage

Rx,Tx	Message Name	Signal Name	ID Charger 1	Start Byte	Start Bit	Bit Lenght	DLC	Transmit Time (ms)	Physical Value		Application Value		Resolution Signal	Offset Signal	Unit
									Min	Max	Min	Max			
Tx	**Stst1**		**0x715**				**8**	**100**							
		Tst1.PFCEnable		0	2	1			0	1	False	True			
		Tst1.LogTempHigh		1	13	1			0	1	False	True			
		Tst1.LogTempLow		1	12	1			0	1	False	True			
		Tst1.uvloLog		1	11	1			0	1	False	True			
		Tst1.therLowFail		1	10	1			0	1	False	True			
		Tst1.rx618Fail		1	8	1			0	1	False	True			
		Tst1.bulk1_fail		2	23	1			0	1	False	True			
		Tst1.bulk2_fail		2	22	1			0	1	False	True			
		Tst1.bulk3_fail		2	21	1			0	1	False	True			
		Tst1CoolingFail1		2	20	1			0	1	False	True			
		Tst1CoolingFail2		2	19	1			0	1	False	True			
		Tst1CoolingFail3		2	18	1			0	1	False	True			
		Tst1.uvloLogLV		3	27	1			0	1	False	True			
		Tst1BatOver		3	25	1			0	1	False	True			
		Tst1BatUnder		3	24	1			0	1	False	True			

Signal Name	Description ID 0x715
Tst1.PFCEnable	PFC Stage enable flag
Tst1.LogTempHigh	Thermal Fail flag, True if the Logic temperature is over the maximum level
Tst1.LogTempLow	Thermal Fail flag, True if the Logic temperature is under the minimum level
Tst1.uvloLog	UVLO (under voltage HV logic) flag
Tst1.therLowFail	It is an error reported about the temperature measured by the internal temperature sensors. If it is -40°C it means that there is an error.
Tst1.rx618Fail	RX internal ID618 fail flag
Tst1.bulk1_fail	DC bulk1 fail flag
Tst1.bulk2_fail	DC bulk2 fail flag
Tst1.bulk3_fail	DC bulk2 fail flag
Tst1CoolingFail1	Cooling fail detected over power stage 1
Tst1CoolingFail2	Cooling fail detected over power stage 2
Tst1CoolingFail3	Cooling fail detected over power stage 3
Tst1uvloLogLV	UVLO (under voltage LV logic) flag
Tst1BatOver	True if the voltage of Always hot Battery is over 32Vdc (only when EN61851/SAEJ1772 enabled)
Tst1BatUnder	True if the voltage of Always hot Battery is under 8Vdc (only when EN61851/SAEJ1772 enabled)

6 LEVEL 4: SETUP CAN Specifications

Level 4 messages are reserved and normally not used by the customers.

6.1 LEVEL 4 Messages Overview

Messages contents		
Setup	Setup	Charger configuration definition message
Charger configuration	Tst2	Charger configuration message
Serial Number	SNSetup	Serial number definition message

Rx,Tx	***Message Name***	***ID Charger 1***	***ID Charger 2***	***ID Charger 3***	***ID Charger 4***	***ID Charger 5***	***ID Charger 6***	***ID Charger 7***	***ID Charger 8***	***ID Charger 9***	***ID Charger 10***	***ID Charger 11***	***ID Charger 12***	***ID Charger 15***	***ID Charger 16***	***DLC***	***Transmit Time (ms)***
Charger ID Value on Setup Message ID0x617		0	1	2	3	4	5	6	7	8	9	10	11	14	15		
Rx	Setup	***0x617***	***0x617***	***0x617***	***0x617***	***0x617***	***0x617***	***0x617***	***0x617***	***0x617***	***0x617***	***0x617***	***0x617***	***0x617***	***0x617***	8	Single Shot
Tx	Tst2	0x616	0x606	0x5F6	0x5E6	0x5D6	0x5C6	0x5B6	0x5A6	0x596	0x586	0x576	0x566	0x036	0x026	8	Single Shot
Rx	SNSetup	0x61A	0x61A	0x61A	0x61A	0x61A	0x61A	0x61A	0x61A	0x61A	0x61A	0x61A	0x61A	0x61A	0x61A	8	Single Shot

6.2 Charger configuration definition message (ID 0x617)

This part generally should not be performed. ID 0x617 is a setup message used to modify initial charger set-up. When the Charger leaves the factory, it has already entered with the default setup. It is preferred not to enter the Setup mode if the existing one is already acceptable.

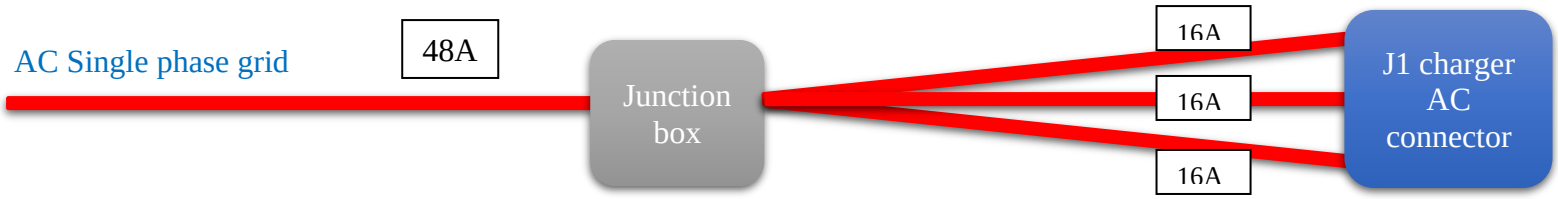
Rx,Tx	Message Name	Signal Name	ID	Start Byte	Start Bit	Bit Lenght	DLC	Transmit Time (ms)	Physical Value (dec)		Application Value		Resolution Signal	Offset Signal	Unit
									Min	Max	Min	Max			
Rx	**Setup**		**0x617**				**8**	**-**							
		Setup.Baudrate		0	7	2			0	3	0b00	0b11			
		Setup.IDType		0	5	1			0	1	False	True			
		Setup.IacControl		0	4	2			0	3	0b00	0b11			
		Setup.Range		0	2	2			0	3	0b00	0b11			
		Setup.3Pconfig		0	0	1			0	1	False	True			
		Setup.Slave		1	15	1			0	1	False	True			
		Setup.EVOmodel		1	14	1			0	1	False	True			
		Setup.IDsetting		1	13	4			0	16	0b0000	0b1111			
		Setup.ParallelCtrl		1	9	1			0	1	False	True			
		Setup.AirCooler		1	8	1			0	1	False	True			
		Setup.IacmMaxSet		2	23	8			0	255	0	51	0,2	0	A
		Setup.VoutMaxSet		3	31	16			0	10000	0	1000	0.1	0	V
		Setup.IoutMaxSet		5	47	16			0	1500	0	150	0.1	0	A
		Setup.Psw		7	63	8			0	255	0	255			

Signal Name	Description ID 0x617
Setup.Baudrate	Defines the baudrate of the charger: 00 = 500kbit/s; 01=250kbit/s; 10= 125kbit/s; 11=1Mbit/s
Setup.IDType	Defines the ID Format: 0 = Standard Frame 11bit; 1= Extended Frame 29bit
Setup.IacControl	Defines how AC current is controlled: 00= not controlled (HW set); 01 = SAE J1772 Enabled; 10 = EN61851 Enabled; 11 = AC current controlled by ID618
Setup.Range	Defines the range of the Output voltage of EVO charger: 00 = Range R1; 01 = Range R2; 10 = Range R3; 11 = Range R4 (for more details see EVO User's Manual)
Setup. 3Pconfig	Considered if the charger is connected to a Three-phase AC grid, True if the charger is connected to an AC Delta Grid (US three-phase), False if the charger is connected to a AC Y Grid (this is the default value).
Setup. Slave	Considered If there are several chargers in parallel and the EN61851 or J1772 is active, True if the charger is in Slave configuration. False if the charger is considered the Master (default condition) (*)
Setup.EVOmodel	True if the charger is a EVO22K, false if the charger is a EVO11K
Setup.IDsetting	Defines the address of the charger (used for several chargers in parallel)
Setup.AirCooler	True if the charger is a EVO11KA (air), false if the charger is a EVO11KL(liquid)
Setup.ParallelCtrl	Define the control of several charger in parallel. True if several chargers in parallel has got several CAN Control message ; false if several chargers has got the same CAN Control message
Setup.IacmMaxSet	Define the maximum AC input current (**)
Setup.VoutMaxSet	Define the maximum DC output voltage
Setup.IoutMaxSet	Define the maximum DC output current
Setup.Password	System Password: 0b10100101 (0xA5)

D0	*D1*	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*0x617 Setup Messages Examples*
00	00	A0	0E	10	00	AA	A5	0x00: Baudtate: 500kbit/s, Standard frame, Iac not controlled ; Range 1 ;0x00 : TxIDSet set to Charger 1; 0xA0: AC Iin = 32A; 0x0E10 = DC Vout = 360V, 0x00AA = DC Iout = 17A, 0x0A : 0xA5: Psw
02	00	A0	0E	10	00	AA	A5	0x02: Baudtate: 500kbit/s, Standard frame, Iac J1772 controlled , Range 1; 0x00 : TxIDSet set to Charger 1; 0xA0: AC Iin = 32A; 0x0E10 = DC Vout = 360V, 0x00AA = DC Iout = 17A, 0xA5: Psw

(*) When the EN61851 or SAE J1772 are enabled, the Master charger is connected to the charging station and it sends over CAN the ID0x619 message where there are the information about the Proximity, Pilot and S2 status and the max Iac current (that all the chargers connected in parallel can draw from AC grid). Therefore, the Master charger communicates to all the Slave chargers what is the amount of maximum Iac current that each charger can draw from AC Grid. See chapter 8.3 for more detailed explanation.
(**) When the charger is set with Single phase AC configuration, the IacMaxSet represents the overall maximum input AC current that the charger can draw from AC grid divided by three. If the charger is set with Three phase AC configuration, the IacMaxSet represent the maximum input AC current that can be drawn from each AC grid phase. Thus, if Single phase AC grid configuration is set and if the Setup.IacmMaxSet value is 16A, it means that the overall current drawn by the charger from the grid is 48A.

In other words, the charger draws from AC grid 16A from each wire of the J1 AC connector. Indeed, although the charger is supplied by a Single phase, all the three phase wires of the J1 input AC connector have to be connected.



Otherwise, if the Three phase AC grid configuration is set and if the Setup.IacmMaxSet value is 16A, it means that the charger draws 16A per AC grid phase. In other words, in this case, the overall current absorbed by the charger from AC grid is 16*3=48A.

6.3 Charger Configuration definition message: Standard values

The charger Setup configuration is normally defined with the standard value before the shipment. **If the customer desire a different setup value it is recommended to be noticed during the order release.** Below the standard value of the Setup message ID 0x617 referred to EVO Series.

Range	*EVO11KL (Liquid Cooled chargers)*		*EVO11KA (Air Cooled chargers)*		*EVO22KL (Liquid Cooled chargers)*
R1	18 00 50 10 68 01 90 A5		18 01 50 10 68 01 90 A5		18 40 A0 10 68 03 20 A5
R2	1A 00 50 13 88 01 4A A5		1A 01 50 13 88 01 4A A5		1A 40 A0 13 88 02 94 A5
R3	1C 00 50 1A 2C 00 FA A5		1C 01 50 1A 2C 00 FA A5		1C 40 A0 1A 2C 01 F4 A5
R4	1E 00 50 20 D0 00 C8 A5		1E 01 50 20 D0 00 C8 A5		1E 40 A0 20 D0 01 90 A5

The standard value is related to:

- Baudrate: 0 (500kbit/s)
- ID Type: 0 (Standard format, 11bit)
- IacControl: 3 (AC current controlled by ID618)
- Range: **it is defined during the order release and it can't be changed**.
- 3Pconfig: False (the charger is connected to a star AC grid configuration)
- Slave: False (the charger is Master)
- EVOmodel: **it is defined during the order release and it can't be changed**.
- IDsetting: 0 (defines the address of the charger; used for several chargers in parallel)
- AirCooler: **it is defined during the order release and it can't be changed**.
- ParallelCtrl: False (several chargers has got the same CAN Control message)
- IacmMaxset: 16A per phase maximum (for EVO11K Series), 32A per phase maximum (for EVO22KL Series)
- VoutMaxset: this value cannot exceed the Maximum value allowed by the range.
- IoutMaxset: this value cannot exceed the Maximum value allowed by the range.
- Password: System Password: 0b10100101 (0xA5)

6.4 Charger Configuration Message (ID 0x616)

The message “Tst2” with ID 0x616 shows the charger configuration. In this message there are all the parameters defined during setup procedure. Normally these parameters are defined in the Factory.
When the charger is switched on, the charger immediately sends this message once.

Rx,Tx	Message Name	Signal Name	ID Charger 1	Start Byte	Start Bit	Bit Lenght	DLC	Transmit Time (ms)	Physical Value (dec)		Application Value		Resolution Signal	Offset Signal	Unit
									Min	Max	Min	Max			
Tx	**Tst2**		**0x616**				**8**	**-**							
		Tst2.Baudrate		0	7	2			0	3	0b00	0b11			
		Tst2.IDType		0	5	1			0	1	False	True			
		Tst2.IacControl		0	4	2			0	3	0b00	0b11			
		Tst2.Range		0	2	2			0	3	0b00	0b11			
		Tst2. 3Pconfig		0	0	1			0	1	False	True			
		Tst2. Slave		1	15	1			0	1	False	True			
		Tst2.EVOmodel		1	14	1			0	1	False	True			
		Tst2.IDsetting		1	13	4			0	16	0b0000	0b1111			
		Tst2.AirCooler		1	8	1			0	1	False	True			
		Tst2.ParallelCtrl		1	9	1			0	1	False	True			
		Tst2.IacmMaxSet		2	23	8			0	255	0	51	0,2	0	A
		Tst2.VoutMaxSet		3	31	16			0	10000	0	1000	0.1	0	V
		Tst2.IoutMaxSet		5	47	16			0	1500	0	150	0.1	0	A
		Tst2.Psw		7	63	8			0	255	0	255			

Signal Name	Description ID 0x616
Tst2.Baudrate	Defines the baudrate of the charger: 00 = 500kbit/s; 01=250kbit/s; 10= 125kbit/s; 11=1Mbit/s
Tst2.IDType	Defines the ID Format: 0 = Standard Frame 11bit; 1= Extended Frame 29bit
Tst2.IacControl	Defines how AC current is controlled: 00= not controlled (HW set); 01 = SAE J1772 Enabled; 10 = EN61851 Enabled; 11 = AC current controlled by ID618
Tst2.Range	Defines the range of the Output voltage of EVO charger: 00 = Range R1; 01 = Range R2; 10 = Range R3; 11 = Range R4 (for more details see EVO User's Manual)
Tst2. 3Pconfig	Considered if the charger is connected to a Three-phase gird, true if the charger is connected to a AC Delta Grid (US three-phase), False if the charger is connected to a AC Y Grid
Tst2.Slave	Considered If there are several chargers in parallel and the EN61851/J1772 is active, true if the charger is in slave configuration. False if the charger is considered the Master (default condition) (*)
Tst2.EVOmodel	True if the charger is a EVO22K, false if the charger is a EVO11K
Tst2.IDsetting	Defines the address of the charger (used for several chargers in parallel)
Tst2.AirCooler	True if the charger is a EVO11KA (air), false if the charger is a EVO11KL(liquid)
Tst2.ParallelCtrl	Define the control of several charger in parallel. False if several chargers has got the same CAN command message; true if several chargers in parallel has got several CAN command message
Tst2.IacmMaxSet	Define the maximum AC input current (**)
Tst2.VoutMaxSet	Define the maximum DC output voltage
Tst2.IoutMaxSet	Define the maximum DC output current
Tst2.Password	System Password: 0b10100101 (0xA5)

(*) When the EN61851 or SAE J1772 are enabled, the Master charger is connected to the charging station and send over CAN the ID0x619 message where the information about the Proximity, Pilot and S2 status and the max Iac current (that all the chargers connected in parallel can draw from AC grid) are present. In this way the Master charger communicates to all the Slave chargers what is the amount of maximum Iac current that each charger can draw from AC Grid.
(**) When the charger is set with Single phase AC configuration, the IacMaxSet represents the overall maximum input AC current that the charger can draw from AC grid divided by three. If the charger is set with Three phase AC configuration, the IacMaxSet represent the maximum input AC current that can be drawn from each AC grid phase. See also the notes in the chapter 6.2.

6.5 ID617 Frames definition parameters

Setup.VoutMaxSet	This parameter sets the maximum output voltage of the charger during runtime The upper limit value is defined by factory and depends by charger model. It can be find in: ID616.Tst2.VoutMaxSet. The output voltage value is calculated as follow: Ctl.VoutMaxSet = Vout x 10 = ... [hex] (Ex. 360V: 360 x 10 = 3600 in hexadecimal = 0E10)

Setup.IoutMaxSet	This parameter sets the maximum output current of the charger during runtime The upper limit value is defined by factory and depends by charger model. It can be find in: ID616.Tst2.IoutMaxSet. The output current value is calculated as follow: Ctl.IoutMaxSet = Iout x 10 = ... [hex] (Ex. 17A: 17 x 10 = 170 in hexadecimal = 00AA)

Setup.IacmMaxSet	This parameter sets the maximum AC input current of the charger The upper limit value is defined by factory and depends by charger model. The AC input current value is calculated as follow: Ctl.IacmMaxSet = Iac x 10 = ... [hex] (Ex. 32A: 32 x 5 = 160 in hexadecimal = A0)

6.6 *Starting Up Setup Mode*

During start up, the charger send one ID616 message with the factory's set parameters.
These parameters can be changed by the customer.
In case of charger re-flash, it is possible to set again the charger setup defining the set-up parameters by ID 0x617.

EDN will provide the procedure for re-flashing and the procedure for set-up the parameters of the charger.

In particular there is a document to change the settings:

- **QSP4189A**: Quick Setup procedure.

Otherwise it is possible to use the following EDN Tools:

- GUI04118 – EDNBootTool (a graphical user interface that allow you to upload a new firmware; it can be used for upgrade the firmware)
- GUI04468 – EVOSetTool (a graphical user interface that allow you to change easily the charger setup)
- MFP04118 - User's Manual EDNBootTool
- MFP04190 - User's Manual EVOSetTool

Notice that in order to use the GUI04118 and GUI04190, you need to use the Peak PCAN-USB:
http://www.peak-system.com/PCAN-USB.199.0.html?&L=1

PCAN-USB: PEAK-System

www.peak-system.com

The PCAN-USB adapter enables simple connection to CAN networks.

Its compact plastic casing makes it suitable for mobile applications.

7 LEVEL 5: Boot CAN Specifications (reserved)

Level 5 messages are reserved and normally **not** managed by the customers.
When you have to upload a new firmware into the charger using the GUI04118 - EDNBootTool, it exchanges the following message IDs with the charger (in standard or extended format):

- **ID300**: message related to the transmission of the information of the new firmware for EVO11K charger or the Master Module (the upper one) for EVO22K chargers
- **ID301**: message related to the transmission of the information of the new firmware for Slave Module (the lower one) for EVO22K chargers

The charger answers to the GUI04118C - EDNBootTool with the following message IDs:

- **ID200**: information transmitted by the Microcontroller of the EVO11K charger or the Master Module (the upper one) of the EVO22K chargers
- **ID201**: information transmitted by the Microcontroller of the Slave Module (the lower one) of the EVO22K chargers

This happens only during the Bootloading phase (the first 10s of the start-up sequence) when you start supplying the charger with LV Always Hot or AC Mains.
If during the Bootloading phase, other messages with the same IDs are exchanged over CAN Bus, there could be the possibility that the microcontroller memory is overwritten.

In case of the charger has not assigned the charger ID 16, there are also other reserved message IDs: 0x028, 0x020, 0x021, 0x024, 0x025, 0x026.

8 State machine diagram:

There isn't a state machine definition over CAN. Anyway, it is possible to check the ID610, ID611, ID614 and ID615 message value. Looking at the ID615 message it is possible to understand the following information:

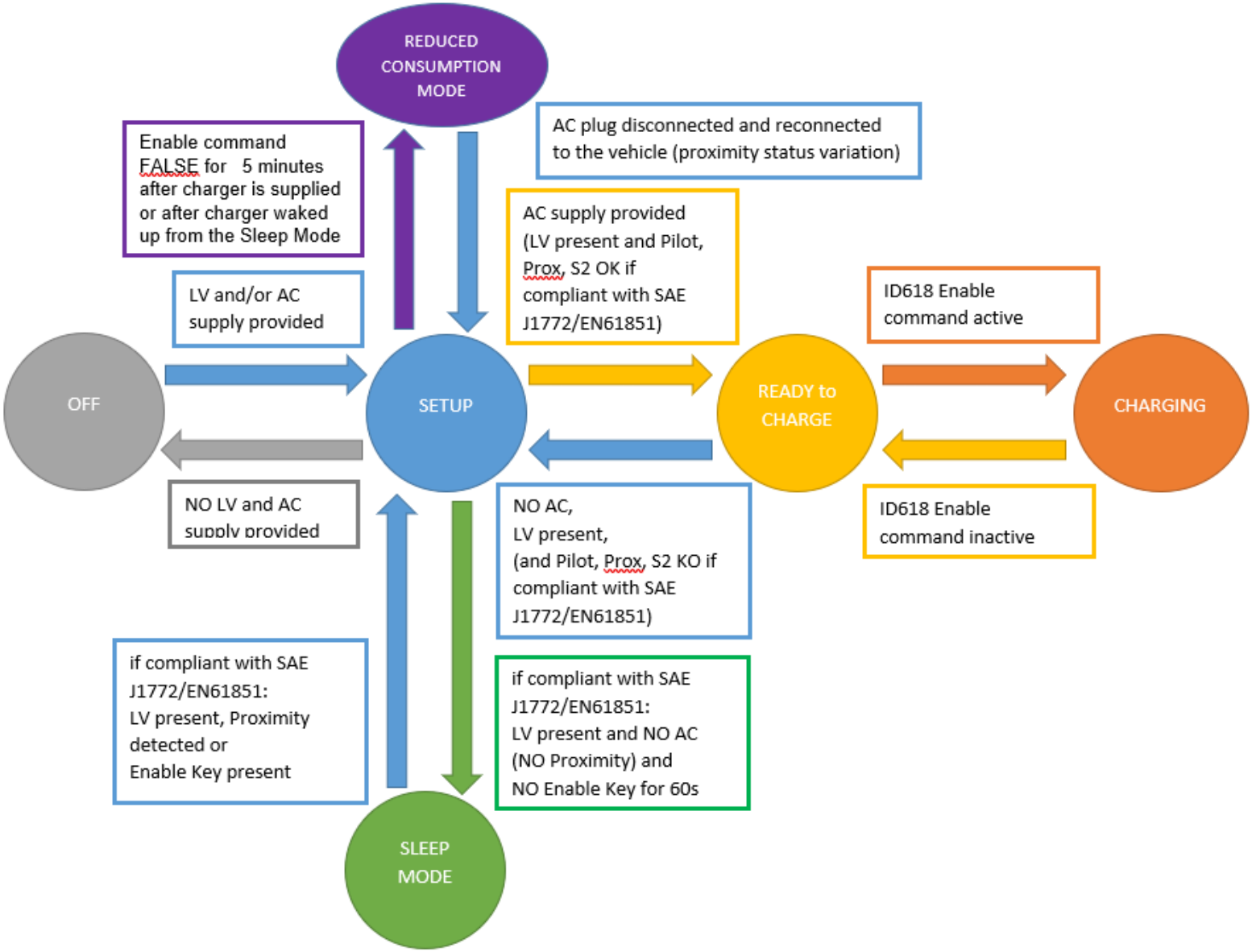
- **Charger Ready to charge:**
  - Communication present over CAN
  - AC Mains provided to the charger: Tst1.ACok = 1
  - AC precharge completed: Tst1.PrCompl = 1
  - No problem about Neutral cable connection: Tst1.Neutral = 0
  - No error present: Tst1.bulk1,2,3_fail = 0, Tst1.HVrxFail = 0, Tst1.Neutro1,2 = 1, (Tst1.ProxOk = 1 and Tst1.PilotOk = 1 and Tst1.S2Ok = 1 if OBC is compliant with EN61851 or SAE J1772)

- **Charger in Sleep mode:**
  - When the OBC is compliant with SAEJ1772 or EN61851:
    - No AC Mains present (no Proximity detected)
    - Enable key is low
    - LV provided to the charger (it goes into sleep mode after 60s if it doesn't detect Proximity signal and Enable Key signal is LOW)
    - When the OBC enters into the Sleep Mode, it stops communicating over CAN
    - The charger exits from the Sleep Mode if Proximity or Enable Key signal is provided.
  - When the OBC is **NOT** compliant with SAEJ1772 or EN61851:
    - Enable key is low
    - LV provided to the charger (it goes into sleep mode after 5s the Enable Key signal becomes and remained LOW)
    - When the OBC enters into the Sleep Mode, it stops communicating over CAN
    - The charger exits from the Sleep Mode if Enable Key signal is provided.

- **Charger in reduced consumption mode:**
  - EN61851 or SAE J1772 enabled
  - Enable command of the control message is False for at least 5 minutes after the charger supply or after the charger is waked up from Sleep Mode.
  - The charger exits from the reduced consumption mode if AC plug is disconnected and reconnected again (it is detected a variation on the Proximity status). Otherwise, the charger can exit from this mode if it is possible to set again to True the Enable present on the control message (CAN communication necessary for this second option).

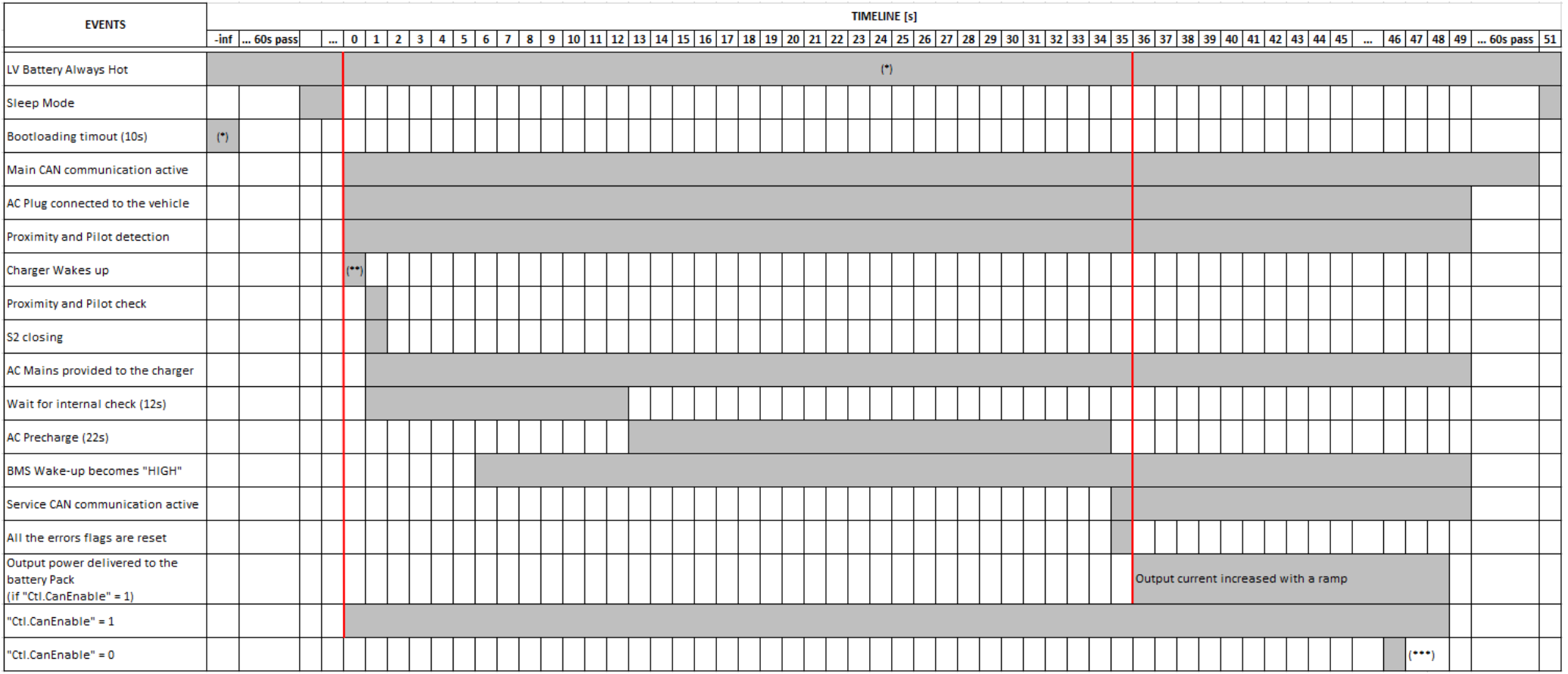
- **Charger in charge condition:**
  - Communication present over CAN
  - AC Mains provided to the charger: Tst1.ACok = 1
  - AC precharge completed: Tst1.PrCompl = 1
  - No problem about Neutral cable connection: Tst1.Neutral = 0
  - No error present: Tst1.bulk1,2,3_fail = 0, Tst1.HVrxFail = 0, Tst1.Neutro1,2 = 1, (Tst1.ProxOk = 1 and Tst1.PilotOk = 1 and Tst1.S2Ok = 1 if OBC compliant with EN61851/SAE J1772), Tst1.rx618Fail = 0
  - Tst1.VoutOk = 1
  - Tst1.PwrOk = 1

- **Charger in Setup definition condition:**
  - Communication present over CAN
  - LV or AC provided to the charger
  - message ID617 sent to the charger in order to modify the charger setup
  - ID616 echo message, its values can be checked by the customer



8.1 Start-up sequence Timing diagram:

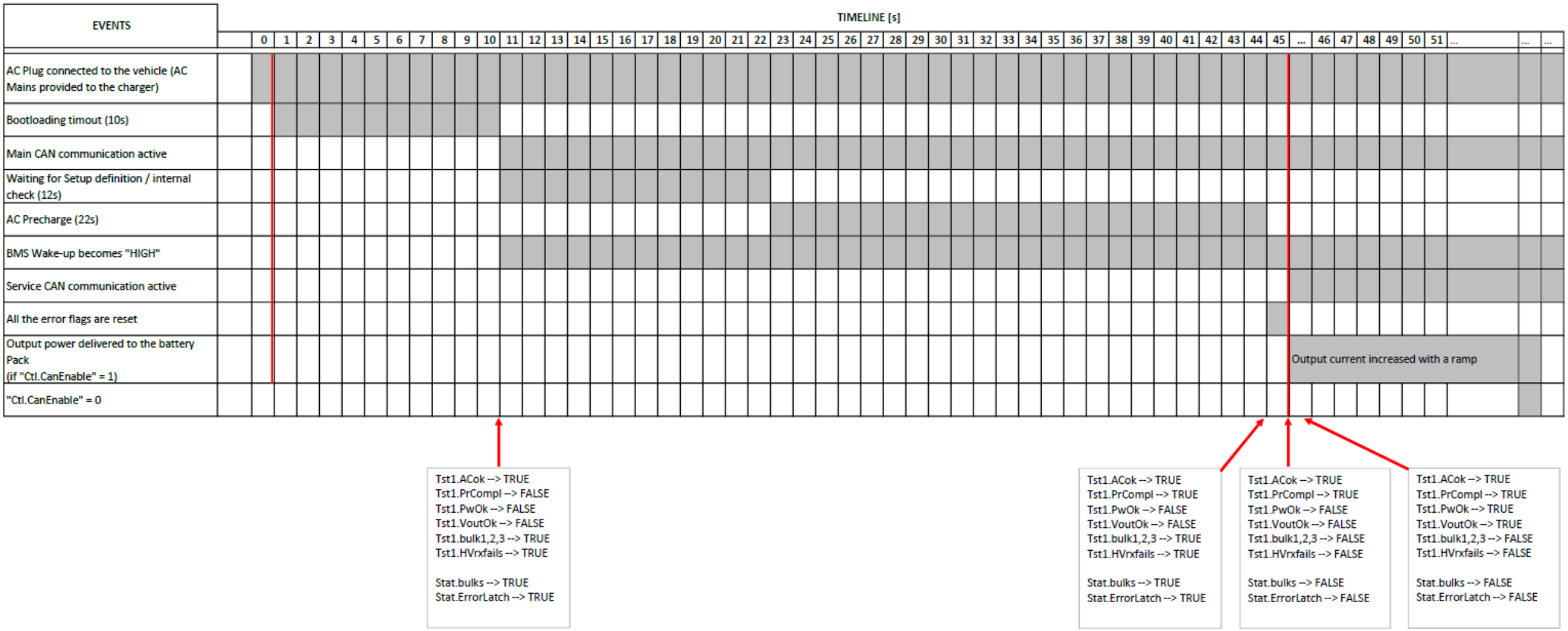
If the SAE J1772 or EN61851 are active, the start-up sequence timing diagram is the following:



(*) When LV Battery always Hot is provided to the charger, the charger executes the Bootloading timout and it waits for the AC mains (it waits the proximity detection). If this situation does not happen for 60s and Enable Key is "LOW", the charger goes into sleep mode. In order to wake up the charger, you have to provide the Proximity or the Enable Key supply (Enable Key "HIGH").
(**) When the Proximity is provided to the charger connecting the AC Plug, the charger wakes up (exit from Sleep Mode).

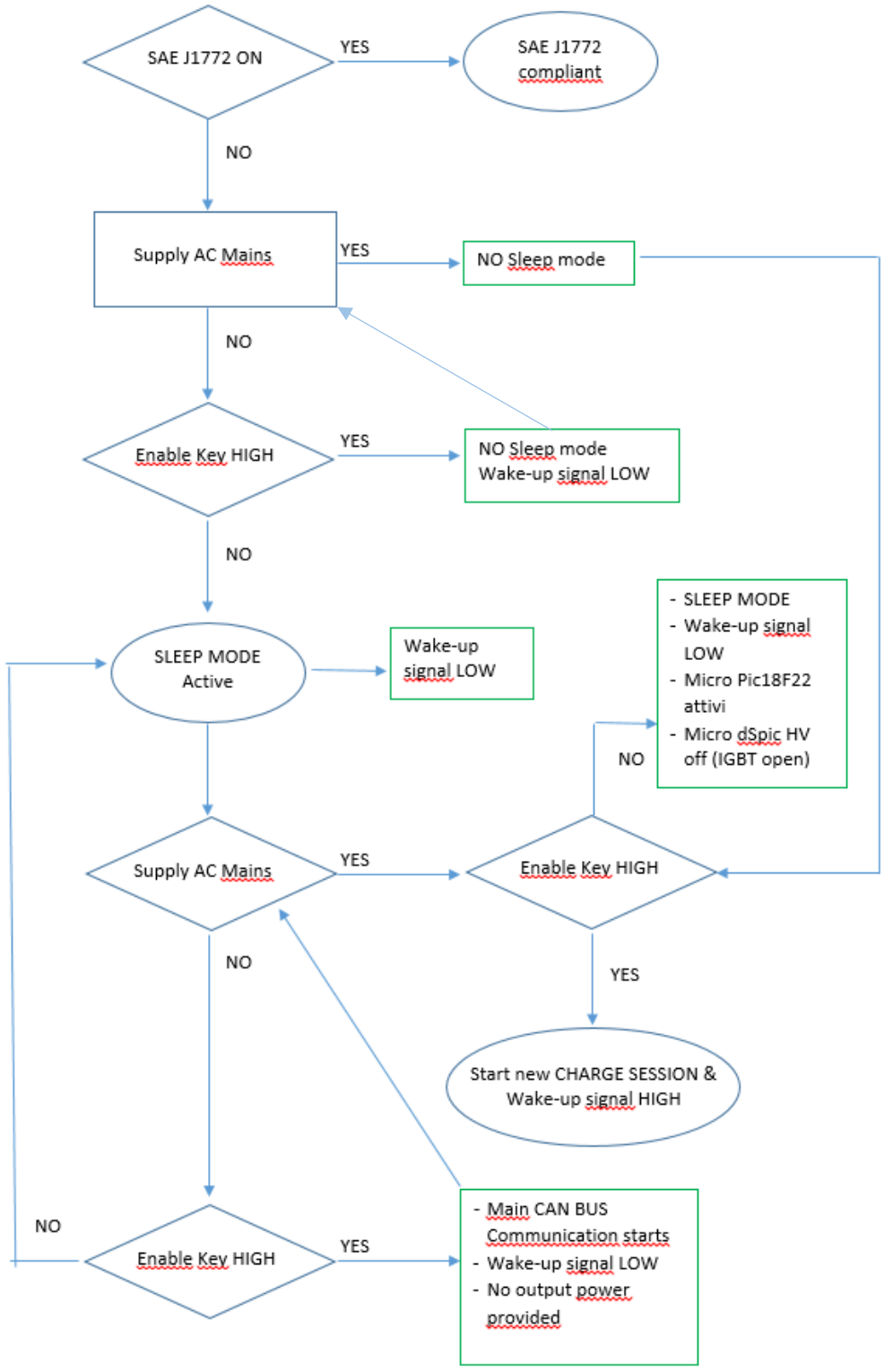
(***) the charger does not provide the output voltage anymore. If the battery Pack is disconnected, the output Voltage becomes less than 30V within 5s. The output current becomes zero within 1s.

If the SAE J1772 or EN61851 are **inactive**, the start-up sequence timing diagram is the following:



8.2 How the charger works when SAE J1772 or EN61851 are NOT active:

Below a flux diagram, that shows the charger functionality:



Thus, the charger enters in sleep mode when:

- Enable key is low

Then it exits from sleep mode when:

- Enable Key is high

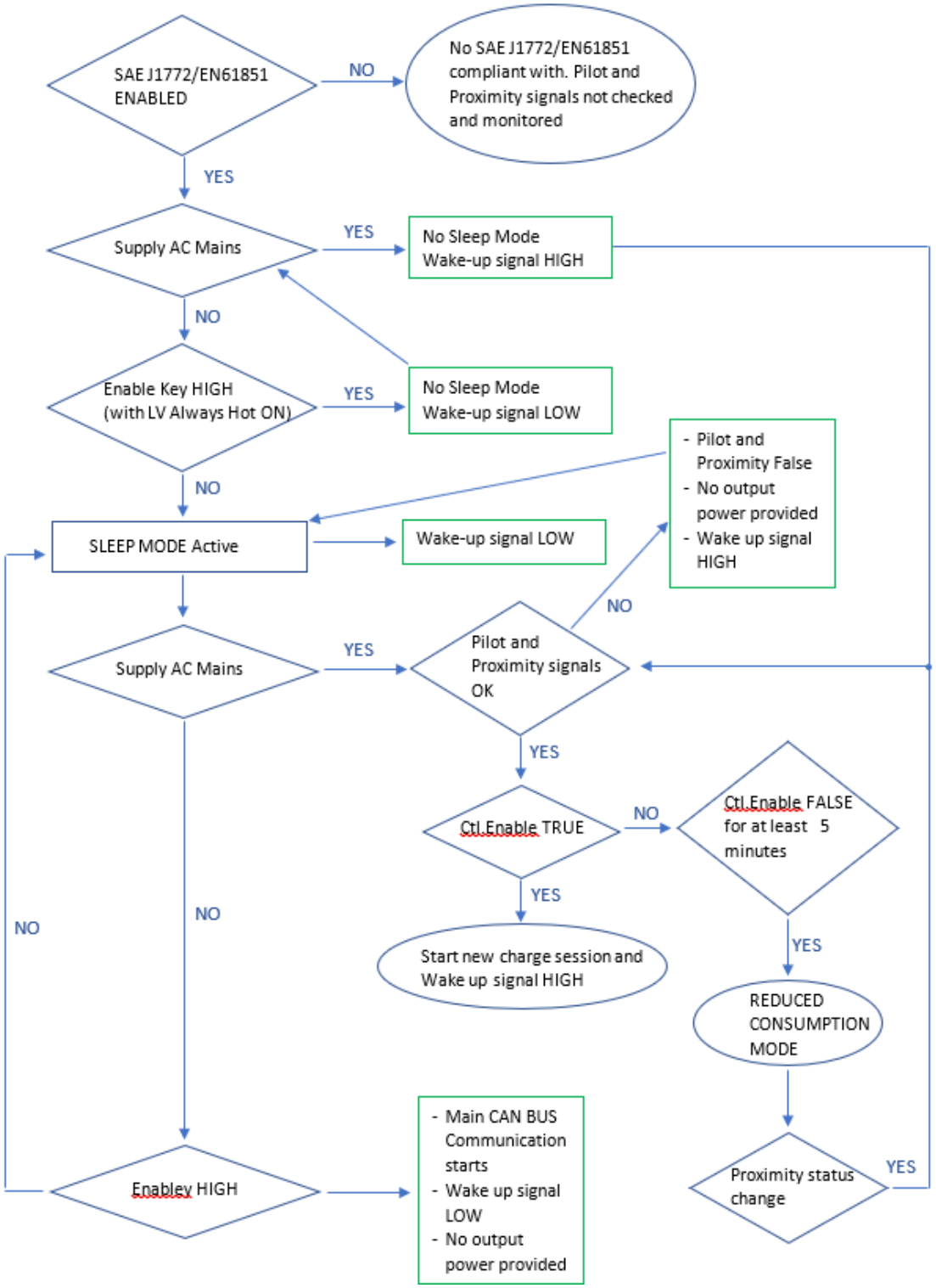
The charger starts a new charge session when:

- The charger is not in sleep mode (Enable Key is high)
- AC Mains present

Although the standards SAE J1772 or EN61851 are not active, thanks to the Sleep Mode presence, the consumption of the charger from the Auxiliary battery is reduced when a charge session is not performed. The Sleep Mode functionality is useful when you use more chargers connected in parallel.

8.3 How the charger works when SAE J1772 or EN61851 are active:

Below a flux diagram, that shows the charger functionality:



Thus, the charger enters in sleep mode when:

- No AC Mains presence (NO Proximity presence)
- Enable key is low

Then it exits from sleep mode when:

- Enable Key is high
- or AC Mains present (Proximity present)

The charger starts a new charge session when:

- AC Mains present (Proximity present)
- Pilot and Proximity signals OK
- Charger enabled trough the control message

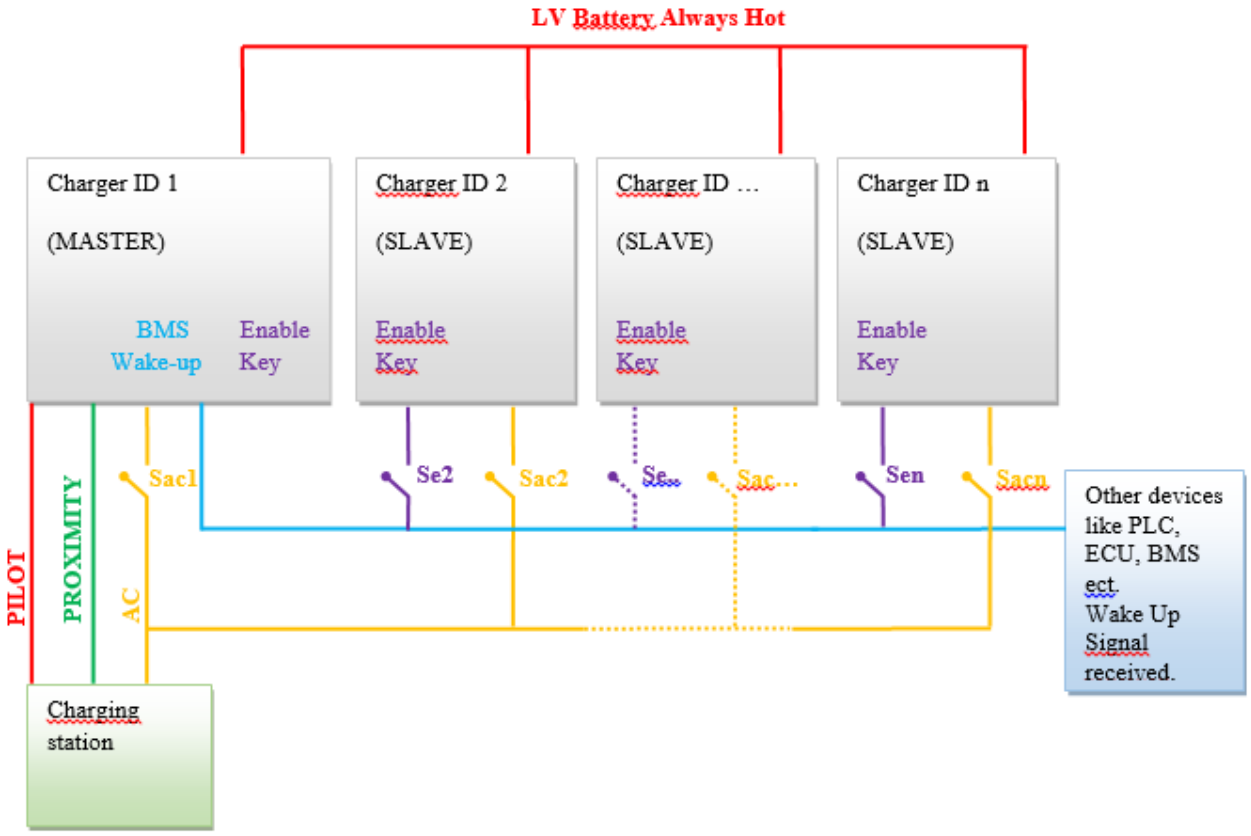
The charger enters in reduced consumption mode when:

- Enable command FALSE for 5 minutes after charger is supplied or after charger waked up from the Sleep Mode

Then it exits from reduced consumption mode when:

- AC Plug disconnected and reconnected to the vehicle

When more chargers are connected in parallel and they are compliant with SAE J1772 or EN61851 Standard, the suggested configuration is the following:



- When AC Mains plug (that contains the Proximity and Pilot signals) is connected to the vehicle (and so to the charger) and Proximity signal is detected, the charger ID1 (Master) wakes-up from the Sleep mode and it checks continuously the Pilot and Proximity Signals.
- If these signals are ok, the charger will close the internal S2 switch and the charge station will provide AC Mains to the chargers.
- When AC Mains is provided to the chargers, the Wake up signal of the charger ID1 (Master) becomes “HIGH” and, in this manner, the Enable Key Signal of all the other chargers connected in parallel (Slaves) becomes “HIGH”. Therefore, the Slave chargers can exit from their Sleep mode.
- The charger ID1 (Master) detects how many chargers are connected in parallel and define, through the CAN message ID619, the input AC current that each charger can draw from AC grid. Indeed the Master charger takes the input ac current limitation that comes from charge station and divide it by the number of the charger detected over CAN.

Resuming:

- Pilot and Proximity signals are connected only to the Master unit
- The BMS Wake up of the Master unit can be connected to the Enable key of the Slave units
- The LV Battery always hot is connected to all the units
- The Master unit wakes up only when the Proximity presence is detected

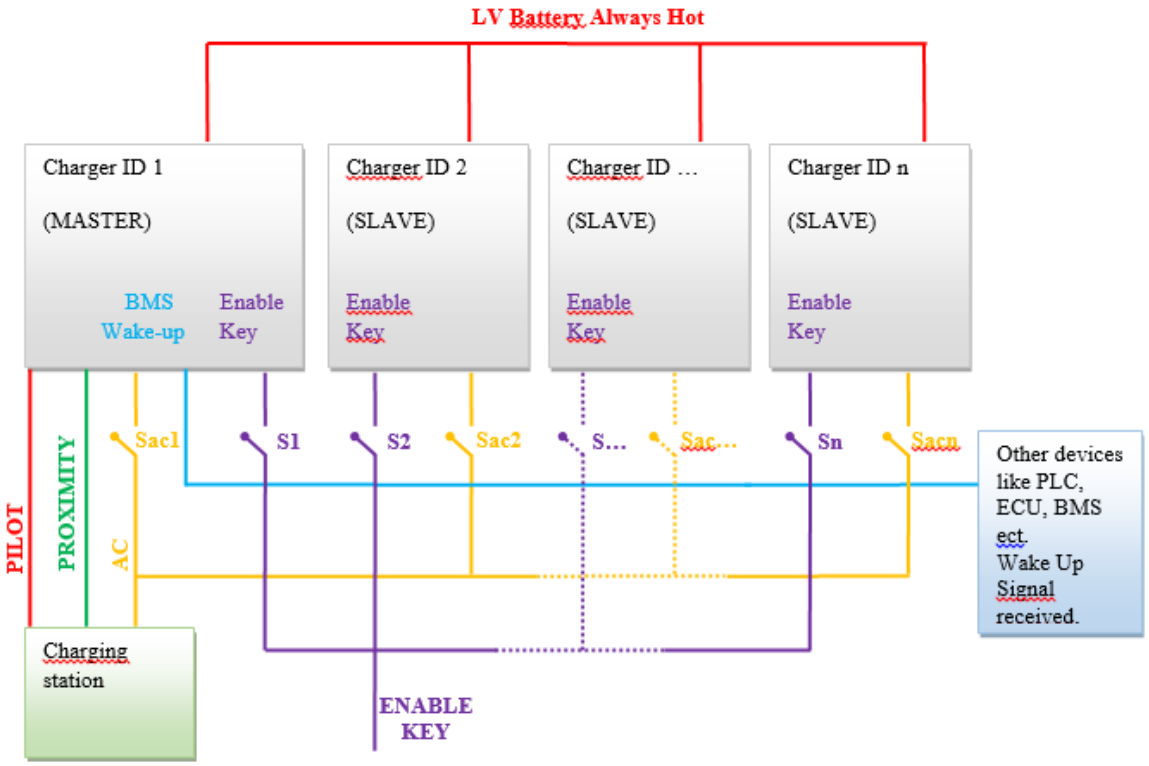
- Then, if the Pilot and Proximity values are ok, the charger allows the charge station to provide AC Mains
- All the units are supplied with AC Mains and the Master unit provide the BMS Wake up to the Slave charger/s in order to wake them up
- The chargers are ready to start the charge session.

It is noticed that if you want to set the charger with single phase AC configuration, the Pin 8 of the J2 signal connector has to be short circuited to one of the ground pins of the J2 signal connector.

- When the output charger current decreases, it is possible to switch off the chargers one by one in the following manner:
  - Switching off the corresponding AC breaker (Sac1, Sac2, …, Sacn)
  - Switching off the corresponding Enable Key breaker (Se2, …, Sen)
- In this way the chargers that are not supplied by AC Mains and Enable Key Signal, enter into the Sleep mode within 5s and stop the CAN communication.
- When the chargers enter into the Sleep mode, they don't communicate over CAN BUS anymore. Then, the Master charger doesn't detect them and it modify correspondingly the AC Input current value for each charger.
- This sequence can be adopted until only one charger is enabled and providing output power.

This procedure allows optimizing the charge session using the chargers with their maximum efficiency.

- Below an alternative configuration where Enable Key signal is provided directly to each charger (it doesn't come from the Wake-up signal). In this case the differences are:
  - One additional power supply is needed (relative to Enable Key)
  - All the chargers can exit from sleep mode before AC Mains is provided. So, the start up time is reduced.



8.4 EVO22KL features:

- **Case of SAE J1772 / EN61851 disabled:**
    - LV and Enable Key provided to the charger: both the modules communicate over CAN
    - LV provided to the charger but not the Enable Key: both the modules stop communicating over CAN in 5s
    - AC and Enable Key provided to the charger: both the modules communicate over CAN
    - AC provided to the charger but not the Enable Key: both the modules stop communicating over CAN in 5s

- **EN 61851 Enabled:**
    - LV, Proximity and Pilot signals provided to the charger: the charger works in compliance with the standard.
    - **Sleep Mode:**
        - Module A: no Proximity, no Enable Key → 60s → Sleep Mode → Proximity ok → Wake-up
        - Module C: (it reads the Proximity and Pilot status over CAN looking at the ID619 message); no Enable Key → 5s →Sleep Mode → Enable Key → Wake-up.

          It is possible to mount a jumper between the pin 4 and 9 of the signal connector so that, when AC is present, BMS Wake up signal is “high” and Enable Key signal is “high” too. Thus, Proximity presence → S2 closed → AC presence → BMS Wake up “high” → Enable Key “high”.
          If the Proximity is not provided to the charger, both the modules goes into Sleep Mode.
    - **Reduced consumption Mode:**
        - Module A: Proximity ok, no Enable in the Control message → 5 minutes → S2 opened → no AC → Reduced consumption Mode → Proximity state variation (AC plug disconnected and reconnected) → Wake-up
        - Module C: Proximity ok, no Enable in the Control message → 5 minutes → S2 opened → no AC (→ no BMS Wake-up → no Enable Key) → Reduced consumption Mode → Proximity state variation (AC plug disconnected and reconnected) → S2 closed again → AC (→ BMS Wake-up “high” → Enable Key “high”) → Wake-up

          If it is present the jumper between the pin 4 and 9 of the J2 signal connector, it has to be considered that the BMS Wake-up signal is present (“high”) only if AC is present.

- **SAE J1772 Enabled:**
    - LV, Proximity and Pilot signals provided to the charger: the charger works in compliance with the standard.

- **Sleep Mode:**
  - Module A: no Proximity, no Enable Key → 60s → Sleep Mode → Proximity → Wake-up
  - Module C: (it reads the Proximity and Pilot status over CAN looking at the ID619 message); no Enable Key → 10s →Sleep Mode → Enable Key → Wake-up.

    It is possible to mount a jumper between the pin 4 and 9 of the signal connector so that, when AC is present, BMS Wake up signal is "high" and Enable Key signal is "high" too. Thus, Proximity presence → S2 closed → AC presence → BMS Wake up "high" → Enable Key "high".
    If the Proximity is not provided to the charger, both the modules goes into Sleep Mode.

- **Reduced consumption Mode:**
  - Module A: Proximity ok, no Enable in the Control message → 5 minutes → S2 opened → no AC → Reduced consumption Mode → Proximity state variation (AC plug disconnected and reconnected) → Wake-up
  - Module C: Proximity ok, no Enable in the Control message → 5 minutes → S2 opened → no AC (→ no BMS Wake-up → no Enable Key) → Reduced consumption Mode → Proximity state variation (AC plug disconnected and reconnected) → S2 closed again → AC (→ BMS Wake-up "high" → Enable Key "high") → Wake-up

    If it is present the jumper between the pin 4 and 9 of the J2 signal connector, it has to be considered that the BMS Wake-up signal is present ("high") only if AC is present.