HIGH FREQUENCY BATTERY CHARGERS

RE Firmware

User Manual

Document Revisions

Document: **D02023**			
Rev.	**Date**	**Description**	**Author**
00	16/10/14	RE protocol document. Initial release	Nicola Pini
01	11/11/14	Document compliant to RE0.02 release	Nicola Pini
02	20/11/14	Document compliant to RE0.03 release	Nicola Pini
03	28/11/14	Document has been turned to Firmware Manual. Layout updated	Nicola Pini
04	29/12/14	Document compliant to RE0.04 release	Nicola Pini
05	16/07/15	Added specifications for SG3 implementation of RE firmware. Added RE0.05 revision for NG models	Nicola Pini
06	20/07/15	Minor document corrections	Nicola Pini

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1. INTRODUCTION

This document is a guide for the usage of RE Firmware in Zivan chargers. The RE firmware is meant for remote-control applications, where an external unit (BMS, Battery Management System) controls the charging process.
The RE firmware is an evolution of the QE firmware: the most immediate difference is that it is controlled by absolute current and voltage setpoint (rather than the relative values used in the QE). Anyway, the RE firmware has a rich set of new features that greatly improve the flexibility of the charger.

1.1 QE and RE compatibility

RE firmware is backward-compatible to BMSs that implement the QE protocol (see paragraph 3.9). Anyway, it is very important to point out that RE firmware MUST NOT be flashed upon a QE firmware, since the two firmware are based on different factory-calibration value. If it is needed to upgrade a charger from QE to RE, charger must be returned to your local distributor for recalibration.
The calibration type used in RE firmware ensures compatibility toward the standard CB firmware, in a way user can switch from autonomous charge (CB etc.) to remote charge (RE) using the same charger.

1.2 RE firmware updates

When flashing the RE firmware on a different kind of firmware (for example, CB), it is mandatory to perform a Clear EEEPROM command through the CANConsole in order to re-initialize the content of the memory. To make sure that the Clear EEPROM is executed and ensure a smooth firmware upgrade procedure, RE firmware features a new alarm A41 – CLEAR EEPROM REQUEST. For further information, please refer to Chapter 6.

2. CHARGING PRINCIPLES

RE firmware can be operated in various degrees of complexity.
The two most important parameters of the charger are MAXIMUM CURRENT and MAXIMUM VOLTAGE. MAXIMUM CURRENT represents the maximum output current allowed (its default value corresponds to the nominal current of the charger), while MAXIMUM VOLTAGE is the voltage control limit over the which the output current is cut off regardless of the output current request by the BMS. Its default value is 1.2 times the nominal charger voltage (e.g.: 57.6V for a 48V charger). Of course the BMS can control the voltage by itself.

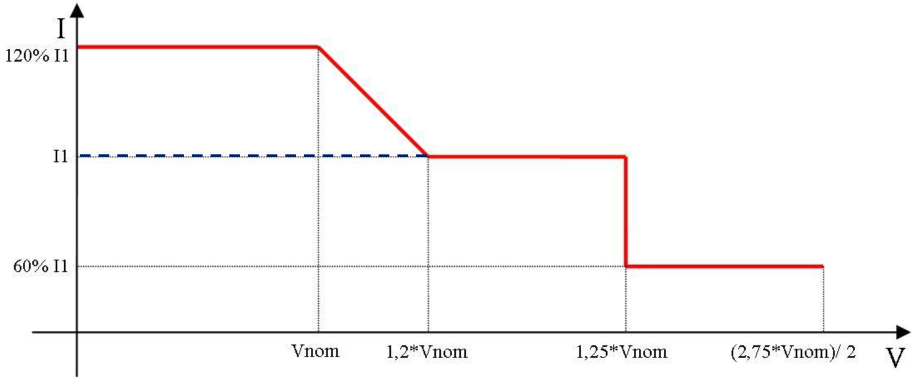
In the most simple implementation of the RE firmware, the BMS just sends the Current Percentage message (0x6C1) to modulate the output current. So, the output current will be

$$I_{out} = \text{MAXIMUM CURRENT} \cdot (\text{CurrentPercentage}/100)$$

Most sophisticated controls could require to dynamically change parameters, or even control peripherals such auxiliary outputs or the display. For more information, please refer to Chapter 3.

2.1 Constant power profiles

The maximum possible current that the charger can physically supply depend on the output voltage. The default value of MAXIMUM CURRENT allows constant-current charging profiles up to “nominal charger voltage · 1.25”. Anyway, it is possible to achieve even higher currents that linearly decrease over a limited voltage range: this is what is normally called constant-power profile.
The RE firmware implements runtime control that define a so-called Safe Operating Area (SOA), represented in the two figures below (for NG models and for SG3 models, respectively):

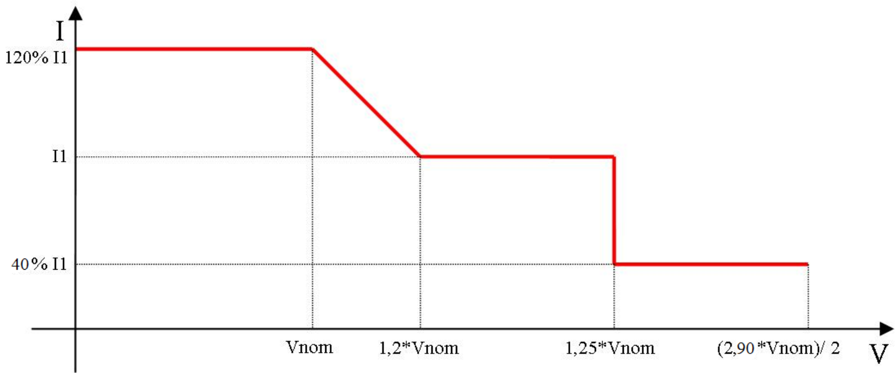


Vnom = nominal voltage of the charger.

Fig.1: Safe Operating Area, NG models

In fig.1, the blue dashed line represents the default MAXIMUM CURRENT value, while the red line represents the SOA. At runtime, the charger output current is clamped according to the SOA and the actual output voltage. Due to this, the current actually supplied by the charger may be lower than the one requested by the BMS.
Further information on how to change the parameter can be found on paragraph 3.2.

In SG3 models, the SOA has slightly different values:



Vnom = nominal voltage of the charger.

Fig.2: Safe Operating Area, SG3 models

Finally, when SG3 model are connected to 110Vac mains, all the current limits of the SOA are scaled by a factor equal to the value of the parameter “115 Vac POWER”. More information on paragraph 3.9.

3. RE PROTOCOL

In the following paragraph, there are many references to the word “node_id”. Node_id represents the CANBus node of the charger (which can vary from 1 to 20) multiplied by 4. For example: ID 0x280+node_id = 0x284 if node=1, 0x288 if node=2, etc.
The default node of the charger is 9, and its corresponding node_id is 0x24.

3.1 PDO Messages

Each charger sends two periodical messages, represented in the table below.

BYTE \ ID	0x380+node_id (period: 1,000S)		0x280+node_id (period: 4,000S)	
BYTE0	*reserved*		Zivan alarm flag	
BYTE1	*reserved*		0 (not used)	
BYTE2	Current (WORD - high BYTE)	0.1A/LSB	*reserved*	
BYTE3	Current (WORD - low BYTE)		Display alarm code	
BYTE4	Voltage (WORD - high BYTE)	0.1V/LSB	Hardware start/stop status	
BYTE5	Voltage (WORD - low BYTE)		Not used	
BYTE6	Ampere hours (WORD - high BYTE)	0.1Ah/LSB	Not used	
BYTE7	Ampere hours (WORD - low BYTE)		Not used	

Fig.3: PDO messages

Please note that all the IDs 0x380+node_id, with node up to 20 (example: 0x384, 0x388,..0x3D0), are reserved. <u>These IDs shall not be used by other devices (except Zivan chargers) on the same CANBus.</u>

ADDITIONAL INFORMATION

- 'Current' is the charger output current.
- 'Voltage' is the charger output voltage.
- 'Ampere hours' are the ampere hours calculated by the charger during the charge process.
- 'Zivan alarm flag' describes the type of alarm. Please refer to the specific table on Chapter 6.
- 'Display alarm code' is the code of the alarm shown on the display (if present). Please refer to the specific table on Chapter 6.
- 'Hardware start/stop status' describes the status of the start/stop digital input (1 means STOP).

3.2 Parameters broadcast

To change the parameters of the charger it is normally required to connect to the charger with PC-software Zivan CanConsole or to send specific SDO commands (see paragraph 3.8 and 3.9) to each charger.
Anyway, some of the most relevant parameters can be changed by broadcast message (understood by all charger regardless of their node) for user convenience.

BYTE \ ID	**0x776 (broadcast; from BMS to chargers)**	
BYTE0	Maximum current setpoint (MSB)	0.1A/bit
BYTE1	Maximum current setpoint (LSB)	
BYTE2	Maximum voltage setpoint (MSB)	0.1V/bit
BYTE3	Maximum voltage setpoint (LSB)	
BYTE4	Not used.	
BYTE5	Not used.	
BYTE6	Battery detection threshold (MSB)	0.1V/bit
BYTE7	Battery detection threshold (LSB)	

Fig.4: 0x776 broadcast message

Please note that it is not necessary to periodically send this message, since these value are written into the charger EEPROM memory and remain stored even after the turn off.
Once the 0x776 message has been received, each charger will reply with 0x180+node_id message.

BYTE \ ID	**0x180+node_id (answer message; from charger to BMS)**	
BYTE0	Maximum programmed current (MSB) (*)	0.1A/bit
BYTE1	Maximum programmed current (LSB) (*)	
BYTE2	Maximum programmed voltage (MSB) (*)	0.1V/bit
BYTE3	Maximum programmed voltage (LSB) (*)	
BYTE4	End of pre-charge (1 if true).	
BYTE5	'O'	
BYTE6	‘K’	
BYTE7	Charger node.	

Fig.5: 0x180+node_id answer to 0x776

ADDITIONAL INFORMATION

- This message (0x180+node_id) is used also during the pre-charge process and not only to answer the 0x776 message.
- The values marked with (*), sent by the charger, are clamped to maximum values that the charger can supply

3.3 Current Percentage Broadcast

The current percentage broadcast message is the only mandatory message that the BMS need to implement to control the charger output current.

BYTE \ ID	0x6C1 (broadcast message; from BMS to charger) *Timeout: 4s*	
BYTE0	0	
BYTE1	0	
BYTE2	0	
BYTE3	0	
BYTE4	0	
BYTE5	0	
BYTE6	CurrentPercentage (WORD - high BYTE)	0.1%/LSB [max 100% = 1000]
BYTE7	CurrentPercentage (WORD - low BYTE)	

Fig.6: 0x6C1 Broadcast message

$$Iout = \text{MAXIMUM CURRENT} \cdot (\text{CurrentPercentage}/100)$$

The 0x6C1 message must be sent periodically, and has a timeout of 4s. If the timeout is reached, the charge stops and the alarm A02 – BMS OFFLINE is generated.

3.4 Peripheral Control Broadcast

It is possible to control the peripherals of the charger through a broadcast message.

BYTE \ ID	0x6A1 (broadcast message; from BMS to charger)	
BYTE0	AUX1 remote control	0x00 = don't care 0x01 = TURN OFF 0x02 = TURN ON
BYTE1	AUX2 remote control	
BYTE2	RED bigled remote control	
BYTE3	GREEN bigled remote control	
BYTE4	EXTERNAL RED bicolour led control	
BYTE5	EXTERNAL GREEN bicolour led control	
BYTE6	0	
BYTE7	0	

Fig.7: 0x6A1 Broadcast message

<u>WARNING:</u>

<u>After the BMS requests to control a specific charger hardware resource (by either sending 0x01 or 0x02), the charger stops to autonomously control that specific peripheral until charger is powered off.</u>

3.5 Display Control Broadcast

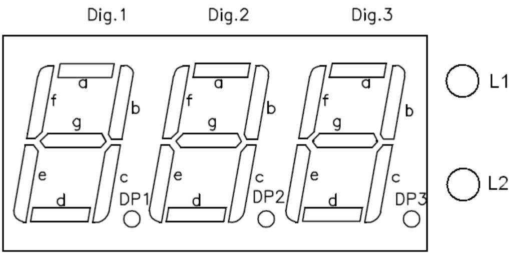
It is possible to control the display of the charger (if present) through a broadcast message.

BYTE \ ID	**0x6A3 (broadcast message; from BMS to charger)** ***Timeout: 5s***	
BYTE0	Display digit1 remote control	See additional information
BYTE1	Display digit2 remote control	
BYTE2	Display digit3 remote control	
BYTE3	Display bicolour leds remote control and status flags	
BYTE4	0	
BYTE5	0	
BYTE6	0	
BYTE7	0	

Fig.8: 0x6A3 Broadcast message

Once the display has been remoted, charger will automatically regain control of the display in case of temporary alarms, blocking alarms or when 0x6A3 timeout is reached (unless specifically asked not to do so – see “ALWAYS ON TOP” flag).

BYTE0, BYTE1, BYTE2 are coded as follows.



MSBit LSBit

B7	B6	B5	B4	B3	B2	B1	B0
DP	a	b	c	d	e	f	g

Fig.9: display segments encoding

BYTE3 is coded as described in fig.9. Please note that when the “ALWAYS ON TOP” flag is set to ‘1’, the charger can never regain control of the display, even in case of alarms etc. BIT5, BIT6 and BIT7 are reserved and should be written as ‘0’

BIT	BYTE3 of message 0x6A3	
BIT0	L1 RED remote control	‘0’ = TURN OFF ‘1’ = TURN ON
BIT1	L1 GREEN remote control	
BIT2	L2 RED remote control	
BIT3	L2 GREEN remote control	
BIT4	ALWAYS ON TOP flag	
BIT5	*reserved*	
BIT6	*reserved*	
BIT7	*reserved*	

Fig.10: BYTE3 of message 0x6A3 encoding

3.6 Reserved messages

To ensure a correct behavior of the charger, it is mandatory not to send the following reserved messages:

- 0x48A
- 0x68A
- 0x69A
- 0x777
- 0x380+node_id, where node_id goes from 1 to 20 (0x384, 0x388,..0x3D0)
- 0x180+node_id, where node_id goes from 1 to 20 (0x184, 0x188,..0x1D0)

Please consider also that each charger “occupies” also the SDO IDs 0x600+node_id and 0x580+node_id (see paragraph 3.8)

A special consideration must be taken into account when using chargers that feature a remote display unit. In this case, the remote display default node is 21, but can be programmed to any value in the 1-30 range. Of course, there must not be node conflicts between the charger node(s) and the display node. Finally, remote display units autonomously send SDO messages to the all the chargers in the network.

3.7 Precharge protocol

The pre-charge process allows to set the charger output voltage to a value similar to the battery actual voltage before the connection happens. This helps preventing flashes and to limit in-rush currents during the connection, especially in high-voltage systems.
The pre-charge sequence is described in the fig. 10.
In case of parallel systems, the pre-charge sequence must be performed on just one charger.

ID	Messages (hex notation)	Notes
To charger : 0x600+node_id	22-60-60-01- V_HI-V_LO-0-0	V_HI : precharge voltage, high word V_HI : precharge voltage, low word Resolution : V*10 (e.g. : 48.0V = 480 bit)
From Charger : 0x580+node_id	60-60-60-01-0-0-0-0	Message received : OK
From Charger : 0x580+node_id	80-60-60-01-XX-XX-XX-XX	Message received : ERROR
From Charger : 0x180+node_id	I_HI-I_LO-V_HI-V_LO-01-‘O’-‘K’-n	Pre-charge ended. See paragraph 3.2 for the description of I_HI,I_LO,V_HI,V_LO
To charger : 0x600+node_id	22-60-60-02-0-0-0-0	Start normal charge. 0x6C1 messages can be sent now
From Charger : 0x580+node_id	60-60-60-02-0-0-0-0	Message received : OK
From Charger : 0x580+node_id	80-60-60-02-XX-XX-XX-XX	Message received : ERROR

Fig.11: Pre-charge protocol

3.8 SDO Messages

The parameters of the charger can be individually accessed by SDO messages, structured like in figure below.

BYTE \ ID	0x600+node_id (from BMS to charger)	0x580+node_id (from charger to BMS)
BYTE0	Command : 0x22 = Write, 0x40 = Read	0x60 = Write OK, 0x42 = Read OK, 0x80 = Error
BYTE1	Index (LO)	Index (LO)
BYTE2	Index (HI)	Index (HI)
BYTE3	Subindex	Subindex
BYTE4	*Data*	*Data*
BYTE5	*Data*	*Data*
BYTE6	*Data*	*Data*
BYTE7	*Data*	*Data*

Fig.12: SDO messages structure

The complete list of SDO messages is available in fig.12. The values shown in min, max and default columns represent only low-level value. For description of every parameter and the relationship between low level values and their physical meaning, please refer to paragraph 3.9.

SDO COMMANDS TABLE

ID	BYTE0 Command	BYTE1 Index	BYTE2	BYTE3 Sub.	BYTE4 data	BYTE5	BYTE6	BYTE7	Description	min	max	default
0x600+node_id	0x22 (w) 0x40 (r)	0xE4	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	Maximum voltage	60	195	160
0x600+node_id	0x22 (w) 0x40 (r)	0xE3	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	Maximum current	0	100	100
0x600+node_id	0x22 (w) 0x40 (r)	0xBB	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	Starting voltage	0	240	150
0x600+node_id	0x22 (w) 0x40 (r)	0xB2	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	Max Safety Voltage	60	195	195
0x600+node_id	0x22 (w) 0x40 (r)	0xB1	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	Recovery current	0	100	0
0x600+node_id	0x22 (w) 0x40 (r)	0xB0	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	Recovery voltage	0	170	0
0x600+node_id	0x22 (w) 0x40 (r)	0xBF	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	Mode button	0	1	1
0x600+node_id	0x22 (w) 0x40 (r)	0xD4	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	Start/Stop Hardware	0	1	0
0x600+node_id	0x22 (w) 0x40 (r)	0xD0	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	AUX1 options	0	1	0
0x600+node_id	0x22 (w) 0x40 (r)	0xB8	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	AUX2 options	0	1	1
0x600+node_id	0x22 (w) 0x40 (r)	0xDA	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	CANBUS Speed	0	4	0
0x600+node_id	0x22 (w) 0x40 (r)	0xDA	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	CANBUS Speed	1	5	2
0x600+node_id	0x22 (w) 0x40 (r)	0xDE	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	CANBUS Node	1	20	9
0x600+node_id	0x22 (w) 0x40 (r)	0xB5	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	Alternative Protocol	0	1	0
0x600+node_id	0x22 (w) 0x40 (r)	0xB4	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	QE: N° of cells	0	255	(*)
0x600+node_id	0x22 (w) 0x40 (r)	0xB3	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	QE: minimum control voltage	0	255	30
0x600+node_id	0x22 (w) 0x40 (r)	0xBC	0x20	0x01	xx (w) 0x00 (r)	0x00	0x00	0x00	115Vac POWER	30	50	43
0x600+node_id	0x22	0x10	0x10	0x01	0x73	0x61	0x76	0x65	Save all the par. to EEPROM.	-	-	-
0x600+node_id	0x22	0x80	0x24	0x02	0x00	0x00	0x00	0x00	Stop charge command.	-	-	-
0x600+node_id	0x22	0x80	0x24	0x01	0x00	0x00	0x00	0x00	Restart charge command.	-	-	-

SG3-only parameter

(*) : depends on nominal charger voltage

Fig.13: SDO commands table.

3.9 Parameter description

This paragraph describes all the parameters implement in RE firmware. When using CanConsole all parameters are expressed in absolute engineering units (Volt, Ampere, etc.). In case of parameter modification by SDO commands, charger internal representation values must be specified. See specifications below for each parameter representation.
Last, when modifying parameters (both with CANConsole or SDO), it is necessary perform a Save command in order to permanently store modifications.

- *MAXIMUM VOLTAGE*

Maximum output voltage, as described in Chapter 2. Minimum value is 1.40 Vpc (for an equivalent Pb-acid battery), maximum value is 2.75 Vpc (unless differently specified), default value is 2.40 Vpc.
Internal parameter value: (Voltage/charger nominal voltage)·200 – 80
*SDO example: 60V for a 48V harger = (60/48)*200-80 = 170 lsb.*
CANConsole example: for a 48V charger, min = 33.6V, max = 66V, default = 57.6V.

- *MAXIMUM CURRENT*

Maximum output current, as described in Chapter 2, expressed in percentage of the charger nominal current (internal parameter value) or Ampere (CanConsole).
Internal parameter value: (Current/charger nominal current)·100
*SDO example: 40A for an 80A charger = (40/80)*100 = 50 lsb.*

- *STARTING VOLTAGE*

Minimum voltage above the which a connection with a battery is recognized. Default vale is 1.50 Vpc, maximum value is 2.40 Vpc.
Internal parameter value: (Voltage/charger nominal voltage)·200
*SDO example: 30V for a 48V charger = (30/48)*200 = 125 lsb.*
CANConsole example: for a 48V charger, max = 57.6V, default = 36V.

- *MAX SAFETY VOLTAGE*

Safety threshold voltage, used to compare at runtime the voltage setpoint supplied by the charger (received or set by the BMS). Whenever the voltage setpoint exceeds this parameter, the non-blocking alarm A40 – BMS OVERVOLTAGE is generated. Default value is 2.75 Vpc.
Internal parameter value: (Voltage/charger nominal voltage)·200 – 80
*SDO example: 60V for a 48V charger = (60/48)*200-80 = 170 lsb.*
CANConsole Example: for a 48V Charger, max = default = 66V

- *RECOVERY CURRENT*

Output current of the Recovery Mode (see Chapter 4), expressed in percentage of the charger nominal current (Internal parameter value) or Ampere (CanConsole). Default value is 0.

Internal parameter value: (Current/charger nominal current)·100
*SDO example: 40A for an 80A charger = (40/80)*100 = 50 lsb.*

- *RECOVERY VOLTAGE*

Output voltage of the Recovery Mode (see Chapter 4). Minimum and default value is 0, maximum value is 2.50 Vpc.

Internal parameter value: (Voltage/nominal voltage)·200 – 80
*SDO example: 55.2V for a 48V charger = (55.2/48)*200-80 = 150 lsb.*
CANConsole example: for a 48V Charger, max = 60V.

- *MODE BUTTON*

Enables or disables the MODE button (where available). Default value is ON.

Internal parameter value: 1 = enable, 0 = disable
CANConsole: value is ON/OFF

- *HARDWARE START/STOP*

Enables or disables the Start/Stop Hardware. This parameter is available only in chargers equipped with ZR167 logic. On other chargers (ZR147 logic), the start/stop control is always active. Default value is OFF.

Internal parameter value: 1 = enable, 0 = disable
CANConsole: value is ON/OFF

- *AUX1 OPTIONS*

Determines the function associated to AUX1. Option “NONE” (default value) means in charge/not in charge (AUX closes when in charge). Option “Option #1” means mains-presence (AUX always closed as soon as charger is turned on).

Internal parameter value: 1 = always-on, 0 = in charge/not in charge

- *AUX2 OPTIONS*

Determines the function associated to AUX2. Option “NONE” means in BMS not null current command (AUX closes when current command is not zero). Option “Option #1” (default value) means mains-presence (AUX always closed as soon as charger is turned on).

Internal parameter value: 1 = always-on, 0 = BMS not null current command

- *CAN SPEED*

Determines the baudrate of the CANBus peripheral. ‘0’ = 125Kbps (default), ‘1’ = 250Kbps, ‘2’=500Kbps, ‘3’=800Kbps, ‘4’=1Mbps.
Internal parameter value: as above. 0 = 125 Kbps, 1 = 250 Kbps, etc.
CANConsole Example: as above. 0 = 125 Kbps, 1 = 250 Kbps, etc.

- *CAN SPEED (SG3 ONLY)*

Determines the baudrate of the CANBus peripheral. ‘1’ = 50Kbps, ‘2’ = 125Kbps (default), ‘3’=250Kbps, ‘4’=500Kbps, ‘5’=800 Kbps.
Internal parameter value: as above. 1 = 50 Kbps, 2 = 125 Kbps, etc.
CANConsole Example: as above. 1 = 50 Kbps, 2 = 125 Kbps, etc.

- *CAN NODE*

Determines the CANBus node of the charger. Minimum value is 1, maximum value is 20, default value is 9.
Internal parameter value: node number, from 1 to 20
CANConsole Example: node number, from 1 to 20

- *ALTERNATIVE PROTOCOL*

Enable the usage of protocols different from the RE. For CANConsole, Option “NONE” (default value) means RE protocol, Option “Option #1” means QE protocol. Please note that when QE Protocol is enabled:

- Most of the specification of this document are not valid. Refer to QE documentation instead.
- It is mandatory to program the “QE: N° of cells” and “QE: cell min. Vpc” parameters.

Low-level value: 1 = QE Protocol, 0 = RE Protocol

- *115Vac POWER (SG3 ONLY)*

Determines the scale factor of the output current when the charger is connected to 115Vac mains.
Internal parameter value: percentage, from 30% to 50%
CANConsole Example: percentage, from 30% to 50%

- *QE: N° OF CELLS*

N° of series-connected cells for QE protocol.
Internal parameter value: number of series-connected cells, from 0 to 255
CANConsole Example: of series-connected cells, from 0 to 255

- *QE: MINIMUM CONTROL VOLTAGE*

Minimum control voltage for QE protocol. If QE protocol is active the output control voltage is:

MAXIMUM VOLTAGE = N° OF CELLS · (MINIMUM CONTROL VOLTAGE + 0.01· Vs) [V]

Where Vs is the data received on the BYTE1 of the 0x776 CAN message (see QE protocol documentation).

*Low-level value: Vpc * 10*

SDO example: 3.60Vpc = 36 lsb

CANConsole: value expressed in Vpc.

4. Recovery Profile

In case when BMS is not available, it is still possible to recharge batteries by using the Recovery Profile. Recovery profile is basically a IUo curve, as shown in fig. 13.

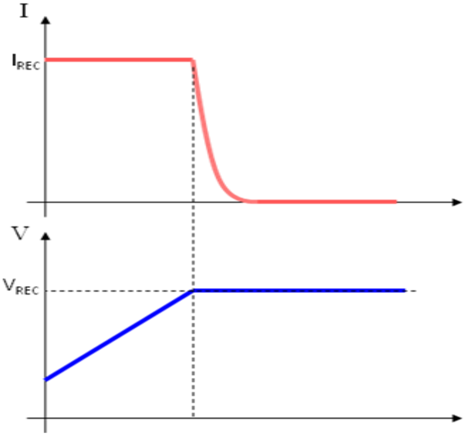


Fig.14: Recovery profile

To run the Recovery profile, it is mandatory to:

- Configure the dedicated parameters “RECOVERY VOLTAGE” and “RECOVERY CURRENT” to the desired value. Eventually, you can configure also the “STARTING VOLTAGE” parameter. These parameters (except “STARTING VOLTAGE”) are set to zero by default. For further information, refer to paragraph 3.9.
- Close the recovery input first (see below), and then turn on the charger. Remember that if the recovery parameters are set to zero (default), the Recovery Profile will not start even if the recovery input is closed.

If the Recovery Profile is successfully started, the display (where available) will blink “rEC” in the charge data roll.

As recovery input pin, please use:

- NG1/NG3 chargers: pin2 of the micro-fit connector. Must be shorted to pin3 to start recovery.
- NG5/7/9 chargers: pin2 of the 4-way mini-fit connector D. Must be shorted to pin1 to start recovery
- SG3 chargers: available only for special models. Please con

Finally, remember that the recovery profile is individual: in case of chargers in parallel, starting the recovery profile on one charger will not start the recovery profile on other chargers (even though they will blink “rEC” on the display to signal that current is actually flowing).

5. MODE button and display functions

The MODE button has basically two functions: the first is entering the Configuration Mode of the charger, the second is locking the visualization of the display.

In Configuration Mode, it is possible to configure the CAN Node of the charger. To enter Configuration Mode:

- Turn on charger while pressing the MODE button.
- Keep pressed until charger ID appears on the display.
- Click repeatedly on the MODE button to reach the desired value
- Keep pressed the button to confirm the selection.

Once the configuration mode is terminated, the display enters data roll mode, which periodically shows:

- Blinking "rEC", if charger is performing Recovery Profile (see Chapter 4)
- Output current. In case of chargers in parallel, the display shows the total current of the system (the sum of all the currents flowing)
- Output voltage.
- Total charging time, expressed in hours
- Charged ampere-hour. In case of chargers in parallel, the display shows the total ampere-hour charged by the system
- Eventual non-blocking alarms.

By clicking the MODE button during data roll mode, it is possible to lock the visualization of the display on one of the information listed above (except "rEC").

5.1 BIGLEDs and external LED

The behavior of the BIGLEDs and the external LED is described in the following table:

Phase	BIGLEDs	Ext. LED
Iout > 50% nominal setpoint	RED	RED
Iout within 20%-50% nominal setpoint	RED BLINKING	RED BLINKING
Iout < 20% nominal setpoint	GREEN BLINKING	GREEN
A02 alarm	GREEN	GREEN
Other alarms	RED AND GREEN BLINKING	YELLOW BLINKING
MODE button programming	RED AND GREEN	RED/GREEN ALTERNATE
Start/Stop Hardware, Stop charge SDO	RED/GREEN ALTERNATE	RED/GREEN ALTERNATE

Fig.15: BIGLEDs and external LED behavior

6. Alarm Table

The alarm list is shown in fig. 16.

Alarm Definition	Display alarm code	Zivan alarm flag
LOGIC FAILURE #1	1	9
BMS OFFLINE	2	4
WATCHDOG	3	9
MISSING PHASE	6	5
OVERCURRENT	7	5
HIGH TEMP.	8	9
MISMATCH VOLT.	9	9
LOGIC FAILURE #2	16	5
FLASH CHECKSUM	17	9
EEPROM KO	18	9
LOGIC FAILURE #3	21	9
POWER FAILURE #1	23	9
WRONG INPUT VOLT	24	9
SHORTED OUTPUT	25	9
WRONG MARKER EEP	26	9
NO MAINS	27	5
LOW TEMPERATURE	28	5
CLK BATTERY OFF	29	4
NODES MISMATCH	31	4
MASTER NOT FOUND	33	9
BMS OVERVOLTAGE	40	4
CLEAR EEPROM REQUEST	41	9

NOTES:
SG3-Only alarms
4 (Zivan alarm flag) = alarms not recorded into the alarm logbook. 5 (Zivan alarm flag) = temporary alarm. Alarms recorded into the alarm logbook. 9 (Zivan alarm flag) = blocking alarm. Alarms not recorded into the alarm logbook.

Fig. 16: alarm table

- *A01 – LOGIC FAILURE #1*

Blocking alarm. This error occurs whenever the battery current exceeds the current setpoint plus a given safety limit for more than 10 seconds, which means that the current is out of control.

- *A02 – BMS OFFLINE*

Temporary alarm. The timeout on the 0x6C1 timer has expired (RE protocol, 4s. QE protocol, 20s).

- *A03 – WATCHDOG*

Blocking alarm. This error occurs whenever the microprocessor of the logic board fails to complete properly its internal tasks.

- *A06 – MISSING PHASE*

Temporary alarm. This error occurs whenever the charger detects the absence of one of the three input phases. This control is performed only in 3-phase systems. When this alarm condition is met, the charger stops and waits for the error to clear before restarting the charge from the point it was interrupted

- *A07 – OVERCURRENT*

Temporary alarm. This error occurs whenever the charger detects an anomalous current absorption. When this happens, the charger temporary halts and after some seconds, the alarm is cleared and the charger tries to resume the charge from the point it was interrupted.

- *A08 – HIGH TEMPERATURE*

Blocking alarm. This error occurs whenever the internal temperature of the battery charger, in the power components section, is too high.

- *A09 – MISMATCH VOLTAGE*

Temporary alarm. Zivan chargers are provided with a safety redundant battery voltage measuring system. This error occurs whenever the readings from the two channels differ from each other exceedingly, meaning that for some reason the charger no longer has a correct voltage reading. This alarm has a blocking behaviour in order to protect the battery from being charged improperly.

- *A16 – LOGIC FAILURE #2*

Temporary alarm. This error reports a problem in the voltage levels of the internal power supply, which is typically caused by holes in the mains voltage. During this alarm the charger stops and after few seconds tries to resume the charge from the point it was interrupted.

- *A17 – FLASH CHECKSUM*

Blocking alarm. This error occurs when the microprocessor detects a corruption in its internal flash memory.

- *A18 – EEPROM KO*

Blocking alarm. This error occurs whenever there microprocessor detects communications problem with the EEPROM memory and/or Clock Calendar peripheral.

- *A21 – LOGIC FAILURE #3*

Blocking alarm. This error occurs when the charger's detects an output voltage that exceeds a safety threshold.

- *A23 – POWER FAILURE #1 (SG3 ONLY)*

Blocking alarm. This error occurs when the charger's detects a wrong reading from the current transducer.

- *A24 – WRONG INPUT VOLTAGE (SG3 ONLY)*

Blocking alarm. This error occurs when the charger's detects an input voltage that exceeds the charger's maximum and minimum limits

- *A25 – SHORTED OUTPUT (SG3 ONLY)*

Blocking alarm. This error occurs when the charger's output is shorted

- *A26 – WRONG MARKER EEP (SG3 ONLY)*

Blocking alarm. This error occurs when the charger's memory is corrupted

- *A27 – NO MAINS (SG3 ONLY)*

Temporary alarm. This error occurs when the charger does not detect a correct sinusoidal voltage from the mains

- *A28 – LOW TEMPERATURE (SG3 ONLY)*

Temporary alarm. This error occurs when the charger's internal temperature falls below -30°C. Alarm is cleared when temperature increases above -25°C.

- *A29 – CLOCK BATTERY OFF*

Non-blocking alarm. This error occurs whenever the Year indication of the Clock Calendar is zero. This happens when the coin cell battery in the logic board is discharged or removed.

- *A31 – NODES MISMATCH*

Non-blocking alarm, available only in remote display units. This alarm is detected when the number of connected chargers is different from the value programmed with the parameter "NUMBER OF NODES". This alarm can be useful to check for module faults inside parallel systems.

- *A33 – MASTER NOT FOUND*

Blocking alarm, available only in remote display units. This alarm is detected when the remote display cannot find any charger on the CANBus.

- *A40 – BMS OVERVOLTAGE*

Non-blocking alarm. This alarm is generated whenever the voltage setpoint exceeds the MAXIMUM SAFETY VOTAGE parameter.

- *A41 – CLEAR EEPROM REQUEST*

Blocking alarm. This alarm is generated whenever the RE firmware is flashed upon a different firmware. When this alarm is active, it is mandatory to perform a Clear Eeprom with CANConsole in order to correctly re-initialize the contents of the memory.

7. Firmware Revision Index (NG models)

- *RE 0.03 – 28/11/14*

First official release of the RE firmware.

- *RE 0.04 – 29/12/14*

Improved charger-to-charger communication in parallel systems.

- *RE 0.05 – 16/07/15*

- The charge Stop/Restart SDO messages force the start of a new charge. This allows a new pre-charge process to be started (if desired) after the restart.
- The output current slew rate has been significantly increased
- Minor bugfixes

8. Firmware Revision Index (SG3 models)

- *RE 0.01 – 10/07/15*

First official release of the RE firmware for SG3