CAN BUS COMMUNICATION MANUAL

BCV200-350-8S577

Converter system

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TABLE OF CONTENT

1. CAN BUS SAE J1939 Interface

CAN-bus communication allows complete integration of converter in the electrical system of the Vehicle.
CAN bus interface will be implemented according:

- SAE J1939-11 Physical Layer, 500 Kbits/s, Twisted Shielded Pair
- SAE J1939-21 Data Link Layer

The Converter CAN Bus interface allows for reception of messages for control of the converter and transmission of messages that reflect its status. Control message uses Proprietary A messages format and status messages uses Proprietary B message. For proprietary information (information used for manufacturing purpose diagnostic and development purpose) is used Proprietary A2 message. The data format within the J1939 CAN data frames adhere to the following conventions: each Can message consist of 8 bytes of data defined as 1-8 and each byte is defined as bits 0-7. More than 8bits variables are send LSB first. Values are normally given in decimal but may be also indicated in hexadecimal (preceding 0x) or binary (preceding 0b). Control message is indexed, which means that byte 1 of the data fields indicates the functional content of the other seven bytes. All control values for the converter are volatile and will be reset to their defaults at power on. If the system software requires values other than default, then it must set the values for the by sending control message to the converter. Default messages priority is 6, in standard J1939 messages (ACK, request, etc.) as defined in J1939.
Since DIRC functionality is implemented for BCV200-350-8S577 units, unit address is determined based on the state of MASTER_SLAVE_PIN when unit is powered up as follows:

MASTER_SLAVE_PIN state	Unit address	Unit mode
Floating	0xA1	Master
Grounded	0xA2	Slave

Changing the state of the MASTER_SLAVE_PIN after unit determines its address has no effect. For more information about DIRC functionality see product specification *2.1.12 DC input current ripple cancelation (DIRC).*

1.1 Scaling and used SLOTs

Parameter	Resolution	Offset	Data range	Data length	SAE SLOT ID
Voltage [V]	0.05 V/bit	0V	0 – 3212.75 V	2 bytes	80
Current [A]	0.05 A/bit	-1600 A	-1600 to 1612.75 A	2 bytes	104
Real Power [W]	2 W/bit	0 W	0 to 128510 W	2 bytes	107
Temperature [°C]	1 °C/bit	-40 °C	-40 to 210 °C	1 byte	67
Frequency [Hz]	0.05 Hz/bit	0 Hz	0 - 3212.75 HZ	2 bytes	-
Percentage [%]	0.5 %/bit	0 %	0 – 125%	1 byte	299
Time [s]	0.25 s/bit	0s	0 to 62.5 s	1 byte	SAEtm04

SAE SLOTS are defined in SAE J1939-71 APPENDIX A.

1.2 CAN Bus PGN definitions

PGN Hex	PGN Dec	Index (byte 1)	Description	Transmit interval
0x00FFD3	65491	NA	Submodule state	0.1s
0x00FFD4	65492	NA	Status message	0.1s
0x00FFD5	65493	NA	INV_Output1	0.1s
0x00FFD6	65494	NA	INV_Output2	0.1s
0x00FFD7	65495	NA	CHG_Input	0.1s
0x00FFD8	65496	NA	HV_Output, V_{BAT}, Temperature	0.1s
0x00FFD9	65497	NA	DNC_Output, FDNC_Output	0.1s
0x00FEDA	65242	NA	Version ID	10s
0x00FEEB	65259	NA	Component identification	On request
0x00EF00	61184		Output voltage and current setpoint	As needed
0x01EF00	126720	NA	Proprietary information	As needed
0x00E800	59392	NA	ACK message - J1939 standard	As needed
0x00FECA	65226	NA	DM1 OBD message- J1939 standard	1s/On change
0x00FECB	65227	NA	DM2 OBD message- J1939-73 standard	On request
0x00FECC	65228	NA	DM3 OBD message- J1939-73 standard	On request
0x00FED3	65235	NA	DM11 OBD message- J1939-73 standard	On request

1.2.1 PGN 0x00FFD5 – INV_Output1

Message: PGN 0x00FFD5
Message Type: Broadcast
Priority: 6
29 Bit identifier: 0x18FFD5yy
Transmission repetition rate: 0.1s when unit is in export power mode, no transmitted in charger mode

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FFD5yy	INV_VAC_OUT1		INV_VAC_OUT2		INV_IAC_OUT1		INV_IAC_OUT2	

INV_VAC_OUT1 – Rms value of the inverter output voltage L1.
INV_VAC_OUT2 – Rms value of the inverter output voltage L2.
INV_IAC_OUT1 – Rms value of the inverter output current L1.
INV_IAC_OUT2 – Rms value of the inverter output current L2.

1.2.2 PGN 0x00FFD6 – INV_Output2

Message: PGN 0x00FFD6
Message Type: Broadcast
Priority: 6
29 Bit identifier: 0x18FFD6yy
Transmission repetition rate: 0.1s when unit is in export power mode, no transmitted in charger mode

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FFD6yy	INV_IAC_OUTN		INV_PINV_LIM		INV_TIME_TO_OVL	DIRC_MODE	ALCI_FLAG	0xFF

INV_IAC_OUTN – Rms value of the inverter output current, neutral wire.
INV_PINV_LIM – Inverter power limit, based on energy priority and available power, refer to the product specification section *1.2 Energy flow and priority.*
INV_TIME_TO_OVL – Time to overload. When output power is over INV_PINV_LIM internal circuit breaker turns off output in INV_TIME_TO_OVL seconds.
DIRC_MODE – Represents DIRC mode of the unit. 1 = master mode, 4 = slave mode. This is determined based on MASTER_SLAVE_PIN when unit is powered up.
ALCI_FLAG – Status flag of ALCI.

Bit	Name	Description (set state)
0	bAlci	1 = ALCI protection tripped
1	bAlciTest	1 = ALCI test requested
2	bAlciReset	1 = ALCI reset requested
3	bAlciDisabled	1 = ALCI is deactivated

1.2.3 PGN 0x00FFD7 – CHG_Input

Message: PGN 0x00FFD7
Message Type: Broadcast
Priority: 6
29 Bit identifier: 0x18FFD7yy
Transmission repetition rate: 0.1s when unit is in charge mode

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FFD7yy	CHG_VAC_IN		CHG_IAC_IN		HV_IHV_AVAIL		0xFF	CHG_PILOT_DUTY

CHG_VAC_IN – Rms value of the charger input voltage.
CHG_IAC_IN – Rms value of the charger input current.
CHG_PILOT_DUTY – Control pilot duty cycle in percentage.
HV_IHV_AVAIL – Estimation of maximum available charging current I_{HV}.

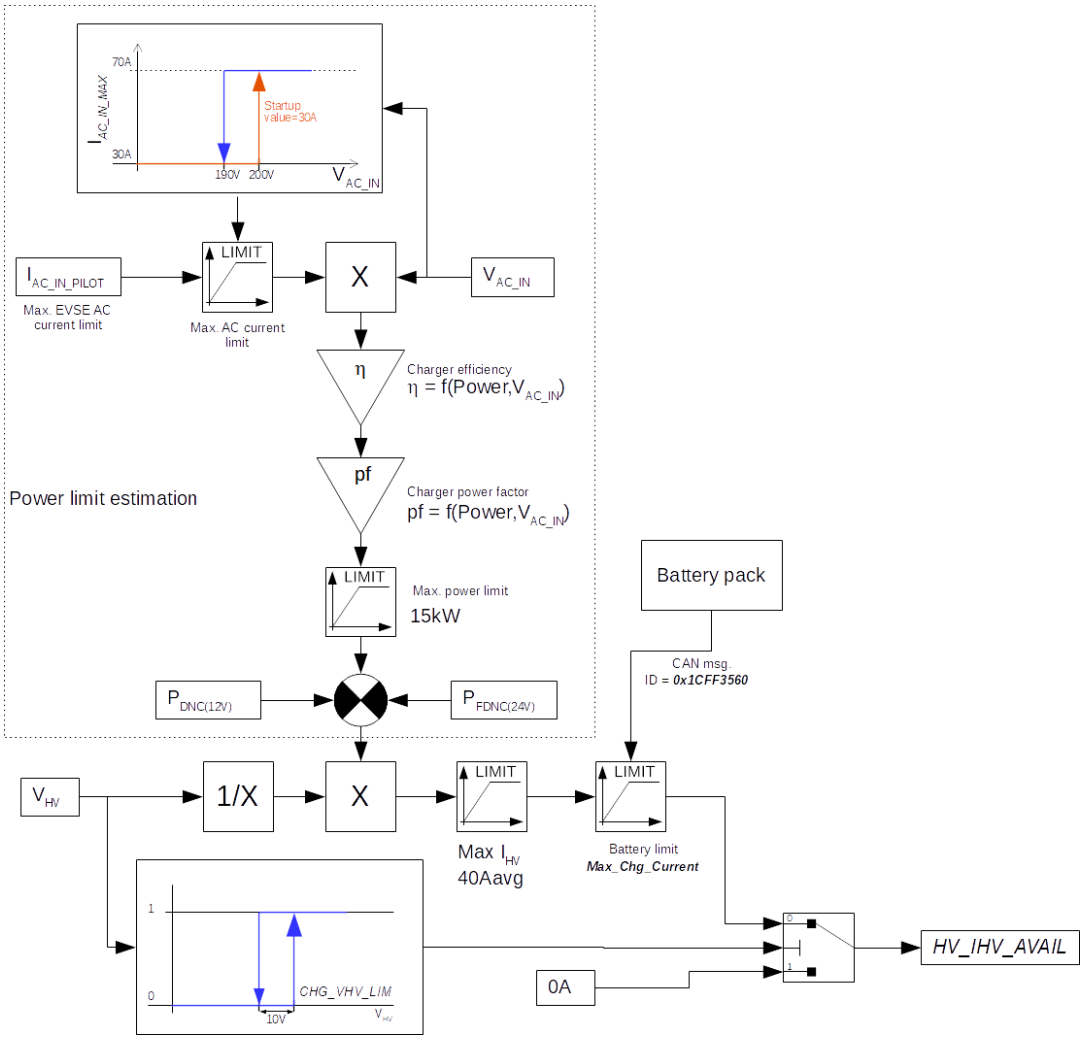

Figure 1. Calculation of HV_IHV_AVAIL

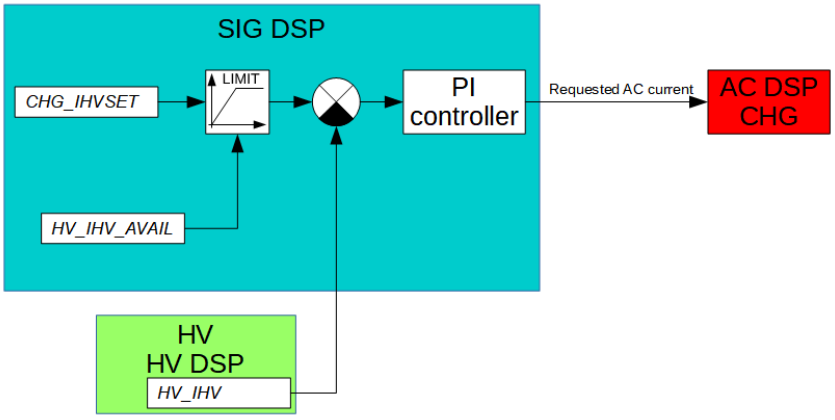

Figure 2. Principle of charging current regulation

1.2.4 PGN 0x00FFD8 – HV_Output, V_{BAT}, Temperature

Message: PGN 0x00FFD8
Message Type: Broadcast
Priority: 6
29 Bit identifier: 0x18FFD8yy
Transmission repetition rate: 0.1s

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FFD8yy	HV_VHV		HV_IHV		AUX_VBAT		TEMP_AMB	TEMP_CHAS

HV_VHV – High voltage battery voltage
HV_IHV – High voltage battery current
AUX_VBAT – 12V battery voltage
TEMP_AMB – internal ambient temperature (in dbc file as UNIT_TEMP_AMBIENT)
TEMP_CHAS - chassis temperature (in dbc file as UNIT_TEMP_CHASSIS)

1.2.5 PGN 0x00FFD9 – DNC_Output, FDNC_Output

Message: PGN 0x00FFD9
Message Type: Broadcast
Priority: 6
29 Bit identifier: 0x18FFD9yy
Transmission repetition rate: 0.1s

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FFD9yy	DNC_VOUT12		DNC_IOUT12		FDNC_VOUT24		FDNC_IOUT24	

DNC_VOUT12 – 12V output voltage
DNC_IOUT12 – 12V output current
FDNC_VOUT24 – 24V output voltage
FDNC_IOUT24 – 24V output current

1.2.6 PGN 0x00FFDA – Additional_Output

Message: PGN 0x00FFDA
Message Type: Broadcast
Priority: 6
29 Bit identifier: 0x18FFD9yy
Transmission repetition rate: 0.1s

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FFDAyy					TEMP_POWER_BOARD	AUX_VBAT_DROP		

TEMP_POWER_BOARD – power board temperature (in dbc file as UNIT_TEMP_POWER_BOARD)
AUX_VBAT_DROP – value 1 means drop under 8.5V in AUX_VBAT has been detected. This could have resulted into potentially hazardous state when unit lost its power. In such case it is recommended to increase power of AUX_VBAT source. Value 0 means no voltage drop has been detected. When this flag is set, it is cleared automatically after ~1 second.

1.2.7 PGN 0x00FEEB – Component identification

Message: PGN 0x00FEEB
Message Type: Broadcast
Transmission repetition rate: 20s

Message is filled with string (ASCII characters):
"*__PART_NUMBER__*__BATCH__*__SERIAL__"

Explanation of the data fields:
PART_NUMBER – "*BCV200-350-8S577*"
BATCH_NUMBER - 8 digits
SERIAL_NUMBER - 5 digits

1.2.8 PGN 0x00FEDA – Software Identification

Message: PGN 0x00FEDA
Message Type: Broadcast
Transmission repetition rate: 20s

Byte:
1 - Number of software identification fields
2-n Software identification(s)
Delimiter (ASCII "*")
NOTE- The software identification field is variable in length and may contain up to 125 software identification designators. An ASCII "*" is used as a delimiter to separate multiple software identifications. Additional software identification fields may be added at the end, each separated by an ASCII "*" as a delimiter. An ASCII "*" is required at the end of the last software identification field, even if there is only one software identification designator.

Unit has its software ID:
8" FM4FI4FB4*BM4BI4HW4*FM3FI3FB3*BM3BI3HW3*FM2FI2FB2*BM2BI2HW2*FM1FI1FB1*BM1BI1HW1"

Where:

FM4: SIG uC Firmware Major version. String, range 0-99
FI4: SIG uC Firmware Minor version. String, range 0-99
FB4: SIG uC Firmware Build version. String, range 0-99
BM4: SIG uC Bootloader Major version. String, range 0-99
BI4: SIG uC Bootloader Minor version. String, range 0-99
HW4: SIG uC HW version. String, range 0-99

FM3: HV uC Firmware Major version. String, range 0-99
FI3: HV uC Firmware Minor version. String, range 0-99
FB3: HV uC Firmware Build version. String, range 0-99
BM3: HV uC Bootloader Major version. String, range 0-99
BI3: HV uC Bootloader Minor version. String, range 0-99
HW3: HV uC HW version. String, range 0-99

FM2: AC uC Firmware Major version. String, range 0-99

FI2: AC uC Firmware Minor version. String, range 0-99
FB2: AC uC Firmware Build version. String, range 0-99
BM2: AC uC Bootloader Major version. String, range 0-99
BI2: AC uC Bootloader Minor version. String, range 0-99
HW2: AC uC HW version. String, range 0-99

FM1: LV uC Firmware Major version. String, range 0-99
FI1: LV uC Firmware Minor version. String, range 0-99
FB1: LV uC Firmware Build version. String, range 0-99
BM1: LV uC Bootloader Major version. String, range 0-99
BI1: LV uC Bootloader Minor version. String, range 0-99
HW1: LV uC HW version. String, range 0-99

Version ID is standard J1939 message defined by J1939-71

Note: To read all firmware revisions, device has to be in stand by mode. Otherwise, only revision of Signal uC can be read.
If firmware is not loaded in uC, then string “NA” is sending instead each revision number.
(for example, 8” 000201*000501*000205*000301*NANANA*NANANA*010050*000502”)

1.2.9 PGN 0x00FFD4 – Status message

Message: PGN 0x00FFD4
Message Type: Broadcast
Priority: 6
29 Bit identifier: 0x18FFD4yy
Transmission repetition rate: 0.1s

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FFD4yy	CHG_STATUS_BITS					SIG_SHTDWN_RSN	0xFF	SIG_STATE

SIG_SHTDWN_RSN - lower 4 bits of this byte represents signal DSP shutdown error code. See Signal DSP shutdown error codes below.
SIG_STATE - actual SIG DSP state. See SIG_DSP states below.
CHG_STATUS_BITS – Status bits of signal DSP. See table CHG_STATUS_BITS bit map below.

Signal DSP shutdown error codes:

Value	Name	Description
0	"NONE"	-
1	"INIT_TIMEOUT"	Initialization failed
2	"EXT_WATCHDOG"	External CAN communication lost
3	"HW_ENABLE_FAIL"	HVIL not connected
4	"UPLOADING"	New firmware is uploading
5	"SLEEP_REQUEST"	Sleep request received
6	" OTP"	Over temperature occurred
7	"MODULE_FAIL "	Communication with submodules lost
8	“PILOT_F”	Pilot signal frequency out of range
9	“PILOT_DUTY”	Pilot signal PWM duty out of range
10	“PILOT_UNKNOWN”	Pilot signal fail (unspecified)

11	“AUX_OVP”	Auxiliary power supply overvoltage
12	“AUX_UVP”	Auxiliary power supply undervoltage

SIG DSP states:

Value	Name	Description
0	"INIT"	Initialisation sequence
1	"IDLE"	Idle state
2	"READY"	Unit is ready, modules are ready to be enabled
3	"SLEEP"	Sleep state
4	"FAULT"	Fault state
5	"OTP"	Over temperature protection active
6	" LATCHED_FAULT "	Latched fault state
7	" SOFT_FAULT "	Non applicable
8	"OUVP"	Non applicable
9	"OOVP"	Non applicable
10	"EXT_WATCHDOG",	Non applicable
11	"UPLOADING_START",	Firmware uploading starting
12	“UPLOADING_IN_PROGRESS”	Firmware uploading in progress
13	“AUX_OVP”	Auxiliary power supply overvoltage
14	“AUX_UVP”	Auxiliary power supply undervoltage

CHG_STATUS_BITS bit map:

Bit	Name	Description (set state)
0	bInvChgCanEn	1 - Inverter or charger enabled via CAN command
1	bDnc12CanEn	1 - Dnc 12V enabled via CAN command
2	bFdnc24CanEn	1 - Fdnc 24V enabled via CAN command
3	Non applicable	Non applicable
4	bKeySwitch	0 - Key switch connected
5	bHvilOk	1 - Hvil loop connected (necessary condition for any output)
6	bDCbus_UV	1 - DC bus voltage under limit
7	bDCbus_OV	1 - DC bus voltage over limit
8	bCanOk	1 - CAN initialized succesfully
9	bEepromOk	1 - EEPROM (memory) initialized succesfully
10	bNTC_Fault	1 - Thermistor short or thermistor disconnected
11	bI2C_Fault	1 - I2C read failed
12	bOtp_Fault	1 - Unit is in over-temperature protection state - all outputs temporary disabled (see section 1.5 Temperature related derating)
13	bHVDspModuleOk	1 - HV submodule is up and communicating
14	bACDspModuleOk	1 - AC submodule is up and communicating
15	bLVDspModuleOk	1 - LV submodule is up and communicating
16	bCanEnable	1 - CAN enable command for any submodule was received
17	bHwEnable	1 - Hardware conditions are met (HVIL connected), output can be enabled
18	bInitOk	1 - Unit initialization succesfull (memory, communication, etc.)
19	bHvTimerEna1	0 - HV was disabled because inverter was disabled for internal failure
20	bHvTimerEna2	0 - HV was disabled because Dnc12V, Fdnc24 or Upc48V was disabled for internal failure (none of Dnc12V Fdnc24 or Upc48V is in running state)
21	bPropMsgUnlckd	1 - Proprietary communication is unlocked
22	bIntCanSilent	1 - Internal CAN is in silent mode
23	bUploadModeActive	1 - Upload mode is active, only bootloader messages are accepted

24	bHvModuleBootMode	1 - HV submodule is in bootloader
25	bAcModuleBootMode	1 - AC submodule is in bootloader
26	bLvModuleBootMode	1 - LV submodule is in bootloader
27	bFault	1 - Fault condition met
28	bExtCanWatchdog	0 - No communication outage for longer then 100ms occurred. When bit is cleared, it means that unit received no command on external CAN for longer than 100ms (in this case unit disables all outputs).
29	bSleepMode	1 - Unit is in sleep mode
30	bPilotOK	1 - Pilot signal frequency and duty is in range (necessary condition for charging)
31	bProximityOK	1 - Connector inserted and latched (necessary condition for charging)
32	bOtpWarning	1 - Internal temperature measurements are close to OTP limit (see section 1.5 Temperature related derating)
33	bSleepDisabled	1 - Sleep mode is disabled
34	bLatchFault	1 - Unit is in latch fault
35	bAUX_OK	1 - Aux voltage is in range
36	bIntCanOut	1 - Internal CAN communication is enabled on external connector
37	bProxPilEn	1 - Proximity and pilot functions are enabled
38	bQuickTempRise	1 - Power derating active (see section 1.5 Temperature related derating)
39	bBurnIn	1 - Burn In mode active

1.2.10 PGN 0x00FFD3 – Submodule states

Message: PGN 0x00FFD3
Message Type: Broadcast
Priority: 6
29 Bit identifier: 0x18FFD3yy
Transmission repetition rate: 0.1s

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FFD3xx	Dnc_12V_State	Dnc_12V_ShtdwnRsn	Dnc_24V_State	Dnc_24V_ShtdwnRsn	InvChg_State	InvChg_ShtdwnRsn	Hv_State	Hv_ShtdwnRsn

Dnc_12V_State, Dnc_24V_State, InvChg_State, Hv_State – represent current state of that particular stage. See tables below.
Dnc_12V_ShtdwnRsn, Dnc_24V_ ShtdwnRsn, InvChg_ ShtdwnRsn, Hv_ ShtdwnRsn – represent last shutdown error code of that particular stage. See tables below.

Dnc_12V_State and Dnc_24V_States:

Value	Name	Description
0	"FIRST_START"	First start of a module
1	"IDLE"	Idle state
2	"STARTUP_CHECK"	Module is checking startup conditions
3	"SOFTSTART"	Module is starting
4	"RUNNING"	Module is in running state
5	"SHUT_OFF"	Module is turning off
6	"RPP"	Reverse polarity protection mode
7	"OVERVOLTAGE"	Output overvoltage protection mode
8	"SENSE_ERR"	Detected difference between internal and remote voltage measurement
9	"SHORTCIRCUIT"	Short circuit protection mode
10	"DCBUS_ERR"	DC bus overvoltage mode

11	"12VBAT_UVP"	12V battery low voltage protection mode
12	"OTP"	Overtemperature protection state
13	"CAN_WATCHDOG"	CAN watchdog fail mode
14	"LATCHED_FAULT"	Latched fault state
15	"JUMP_BOOTLOADER"	Jump to bootloader will occure
16	"Debug_Calibration"	Unit is in debug / calibration mode
17	“UNDERVOLTAGE	Output undervoltage occured

Dnc_12V_ShtdwnRsn and Dnc_24V_ShtdwnRsn:

Value	Name	Descritpiton
0	"STARTUP_ERR"	Error occurred in startup sequence
1	"CAN_RQST"	Module was requested to turn off via CAN command
2	"OUT_UV"	Output undervoltage occured
3	"OUT_OV"	Output overvoltage occured
4	"SENSE_ERR"	Detected difference between internal and remote voltage measurement
5	"SHORT"	Short detected
6	"BUS_OV"	Bus voltage over limit detected
7	"BUS_UV"	Bus voltage under limit detected
8	"12VBAT_UV"	12V Bat voltage was under limit
9	"OTP"	OTP occured
10	"NTC_FAULT"	Thermistor is disconnected or thermistor is short
11	"CAN_WATCHDOG"	CAN communication lost
12	"RPP"	Reverse polarity detected

InvChg_States:

Value	Name	Description
0	"FIRST_START"	First start of the module
1	"INIT"	Module is initialising
2	"IDLE"	Idle state
3	"BUS_UV_OV"	Bus over/undervoltage protection state
4	"STARTUP"	Starting sequence
5	"INV_RUNNING"	Inverter is running
6	"CHG_RUNNING"	Charger is running
7	"LATCHED_FAULT"	Latched fault state
8	"OTP"	Overtemperature protection active
9	"OVERLOAD"	Overload protection active
10	"SHORTCIRCUIT"	Short circuit protection active
11	"JUMP_BOOTLOADER"	Jump to bootloader will occure
12	"WATCHDOG"	CAN watchdog fail mode
13	"AUX_DRV_SOFTSTART"	Aux driver soft start
14	"BRINGUP"	Debug state 1
15	"DEBUG"	Debug state 2
16	"AC_UV_OV"	AC voltage under/over voltage protection state
17	"INV_RELAY_START"	Inverter relay starting
18	"CHG_RELAY_START"	Charger relay starting
19	"ALCI_LATCH"	ALCI is in latched state
20	"DEBUG_CHG"	Debug state 3
21	"START_DELAY"	Delay in startup sequence (waiting for HV module)
22	"BUS_OV"	Bus overvoltage protection state

23	“HV_TEST”	Proprietary
24	“BUS_UV_OV_SHUTDOWN”	Internal bus under/overvoltage
25	“AC_UV_OV_SHUTDOWN”	Non-applicable
26	”INCOMPATIBLE_HW”	Harwdare revision of the unit not compatible with firmware

InvChg_ShtdwnRsn:

Value	Name	Descritpiton
0	"CAN"	Module was requested to turn off via CAN command
1	"AC"	AC voltage fault detected
2	"SHORT_L1"	Short circuit detected (phase 1)
3	"THM_FAULT"	Thermistor fault detected
4	"BUS"	Bus voltage fault detected
5	"OTP"	Overtemperature occurred
6	"WATCHDOG"	CAN communication lost
7	"OVERLOAD"	Output overload occurred
8	"ALCI"	ALCI occurred
9	"BUS_OV"	Bus overvoltage occurred
10	“NONE”	No shutdown reason
11	“OVERLOAD_L2”	Overload (phase 2)
12	“OVERLOAD_N”	Overload (neutral)
13	“SHORT_L2”	Short circuit detected (phase 2)
14	“SHORT_N”	Short circuit detected (neutral)
15	“SHORT_CBC”	Short circuit detected (export mode)

Hv_States:

Value	Name	Description
0	"FIRST_START"	First start of the module
1	"INIT"	Module is initializing
2	"IDLE"	Idle state
3	"UV_OV"	Over/under voltage protection state
4	"STARTUP"	Starting sequence
5	"RUNNING"	Module is running
6	"LATCHED_FAULT"	Module is in latched fault state
7	"BUS_ERROR"	Bus error state
8	"OTP"	Overtemperature protection state
9	"OVERLOAD"	Overload protection state
10	"SHORTCIRCUIT"	Short circuit protection state
11	"BB_SOFTSTART"	Buck-boost soft start active
12	"SOFTSTART"	Soft start active
13	"JUMP_BOOTLOADER"	Jump to bootloader will occure
14	"BB_DEBUG"	Debug state 1
15	"DC1_DEBUG"	Debug state 2
16	"DC2_DEBUG"	Debug state 3
17	"WATCHDOG"	CAN communication lost
18	"AUX_DRV_SOFTSTART"	Aux drivers soft start sequence
19	"AUX_DRV_RUNNING"	Aux drivers running
20	"BRINGUP"	Debug state 4
21	"BUS_FAULT"	Bus fault state
22	"DEBUG"	Debug state 5
23	”INCOMPATIBLE_HW”	Harwdare revision of the unit not compatible with firmware

24	“UV_OV_SHUTDOWN”	Under/over voltage occured

Hv_ShtdwnRsn:

Value	Name	Descritpiton
0	"CAN"	Module was requested to turn off via CAN command
1	"AC"	Not applicable
2	"HV"	Not applicable
3	"SHORT"	Short circuit detected
4	"THM_FAULT"	Thermistor fault detected
5	"BUS"	Bus voltage fail occurred
6	"BUCK_OV"	Buck overvoltage detected
7	"OTP"	Overtemperature occurred
8	"WATCHDOG"	CAN communication lost
9	"OVERLOAD_B1"	Output overload occurred (buck phase 1)
10	“NONE”	No shutdown reason
11	“SHORT_DC1”	Short circuit detected DC-DC1 module
12	“SHORT_DC2”	Short circuit detected DC-DC2 module
13	“SHORT_BB1”	Short circuit detected on buck phase 1
14	“HV_OV”	Overvoltage on HV side
15	“HV_UV”	Undervoltage on HV side
16	“SHORT_BB2”	Short circuit detected on buck phase 2
17	"OVERLOAD_B2"	Output overload occurred (buck phase 2)

1.2.10.1 PGN 0x00FFD2 – DIRC_State

Message: PGN 0x00FFD2
Message Type: Broadcast
Priority: 6
29 Bit identifier: 0x18FFD2yy
Transmission repetition rate: 0.1s

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FFD2yy	DIRC_State	DIRC_ShtdwnRsn	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF

DIRC_State – determines current state of the unit in relation to DIRC functionality.
DIRC_ShtdwnRsn - determines last shutdown reason of the unit in relation to DIRC functionality.

DIRC_State values:

Value	Name	Description
16	„DISABLED“	DIRC functionality is disabled in unit memmory settings
17	„INITIALIZATION“	DIRC functionality is being initialized
18	„MASTER MODE“	Unit is in MASTER mode
19	„SLAVE MODE“	Unit is in SLAVE mode
20	„ERROR“	Error related to sync signal has been detected. To clear this error, inverter must be disabled by CAN command.

DIRC_ShtdwnRsn values:

Value	Name	Description
0	„NONE“	No last shutdown reason

4	„SYNC SHORT“	Invalid sync signal caused inverter mode to stop

1.2.11 PGN 0x00EF00 – Setpoint

Message: PGN 0x00EF00
Message Type: Command
Priority: 6
29 Bit identifier: 0x18EFyyxx (xx – Source address)

1.2.11.1 Index byte = 0: INVCHG_Setpoint

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18EFyyxx	0x00	INVCHG_MODE	INVCHG_EN	CHG_IHVSET		CHG_VHV_LIM		0xFF

INVCHG_MODE – mode of operation: 0 – Charger, 1 – Inverter 50Hz output; 2 – Inverter 60Hz output. Transition between modes is allowed only if INVCHG_EN = 0.
INVCHG_EN – 0 = output disabled, 1 = output enabled.
CHG_IHVSET – I_{HV} requested charging current, range 0-40A.
CHG_VHV_LIM – Voltage limit for charging. Over this voltage charging current is set to zero. 10V hysteresis. Range 220-450V.

1.2.11.2 Index byte = 1: INVCHG_ALCI

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18EFyyxx	0x01	0xFF	INVCHG_ALCI_RST	INVCHG_ALCI_TEST	0xFF	0xFF	0xFF	0xFF

INVCHG_ALCI_RST – Reset signal for ALCI; 1 = reset ALCI if tripped; 0 = no change.
INVCHG_ALCI_TEST – Test ALCI; 1 = perform ALCI test; 0 = no change. ALCI test can be run when unit is in Export mode, output on or off.

1.2.11.3 Index byte = 0x10: DNC_Setpoint

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18EFyyxx	0x10	DNC_VOUT12_SET		DNC_IOUT12_SET		DNC_EN	0xFF	0xFF

DNC_VOUT12_SET – Set voltage for 12V output, range 9V - 14.4V.
DNC_IOUT12_SET – Set current for 12V output, range 0 – 278A.
DNC_EN – 0 = output disabled, 1 = output enabled.

1.2.11.4 Index byte = 0x20: FDNC_Setpoint

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18EFyyxx	0x20	FDNC_VOUT24_SET		FDNC_IOUT24_SET		FDNC_EN	0xFF	0xFF

FDNC_VOUT24_SET – Set voltage for 24V output, range 18V – 28.8V.
FDNC_IOUT24_SET – Set current for 24V output, range 0 -34.7.
FDNC_EN – 0 = output disabled, 1 = output enabled.

1.2.11.5 Index byte = 0x41: SIG_EVSE_WAKE_OUT, SLEEP

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18EFyyxx	0x41	SIG_WAKE_EN	SIG_SLEEP	0xFF	0xFF	0xFF	0xFF	0xFF

SIG_WAKE_EN – 1 = enable EVSE_WAKE_OUT signal; 0 = disable EVSE_WAKE_OUT signal.
SIG_SLEEP - 1 = Set Sleep -> unit goes to sleep mode; 0 = normal operation.

1.2.11.6 Index byte = 0x50: CENTRAL STOP

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18EFyyxx	0x50	STOP_KEY	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF

STOP_KEY = 0xCE, this message stops all running submodules (Dnc, Fdnc, Upc, Inverter, Charger).

1.2.11.7 Index byte = 0x80: Proximity & Pilot disable / enable

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18EFyyxx	0x80	ProxPil Enable/ Disable	ProxVal	PilotDuty	0xFF	0xFF	0xFF	0xFF

ProxPil Enable/ Disable - *0xB0 - enables proximity and pilot functions: w*hen these functions are enabled real pilot PWM duty cycle and proximity state are detected and used by unit.

0xBB - disables proximity and pilot functions: when these functions are disabled, control pilot signal and proximity detection are "simulated" via this CAN message. Pilot signal limit is set to ***PilotDuty*** value, and proximity detection state is set to connected state if **ProxVal** is set to 0x00. Any other value sets proximity to disconnected state. Following example shows how to set fixed pilot value to 97% (97=0x61) and proximity detection to fixed connected state.

0x18EFA011: 0x80, 0xBB, 0x00, 0x61

Note: status bit bProxPilEn(38) informs whether pilot and proximity functions are enabled or disabled.
Warning: when proximity and pilot functions are disabled, pilot PWM no longer limits charging current. In this case charging current can be controlled only via CAN command.

1.2.12 Battery pack charging limit

Message transmitted by BMS, period rate 200ms.

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x1CFF3560	Max_Chg_Current							

Max_Chg_Current - this signal presents additional limiting factor in computation of HV_IHV_AVAIL, which limits charging current. BCV200-350-8S577 unit will not exceed this value with charging current if this command is broadcasted. If this message is not presented on CAN BUS, this current limitation is not executed. If this message is being broadcasted and then suddenly stops, last received value will be used – periodicity of this message is not checked by BCV200-350-8S577 unit. Scaling of this signal is 0.1A/bit. Other signals from message are ignored.

1.3 PGN 0x01EF00 - Proprietary information

This message is reserved for manufacturing and development purpose. There is no reason for using this PGN for customer.

1.4 PGN 0xFECA - DM1 OBD message

Converter CAN Bus interface support SAE J1939-73 DM1 message for active Diagnostic Trouble Codes. See section 5.7.1 of J1939-73 for explanation of the format and data fields of a DM1 message.
The conditions that cause active DTC and the associated SPN's and FMI are for Converter is show below in

DTC	SPN	FMI	FMI Description	example coding DM1 data field Byte3,4,5 (hex)
I2C bus fault (I2C_F)	520453 (0x7F105)	0	Internal I2C bus failure	05 F1 E0
EEPROM memory fault (EEPROM_F)	520453 (0x7F105)	1	Internal EEPROM memory failure	05 F1 E1
Thermistor warning / fault (THM_F)	520455 (0x7F107)	1	Very low temperature, or possible ambient temperature sensor disconnected	07 F1 E1
Thermistor warning / fault (THM_F)	520455 (0x7F107)	3	Very low temperature, or possible plate temperature sensor disconnected	07 F1 E3
Thermistor fault (THM_F)	520455 (0x7F107)	4	Ambient temperature sensor is short circuit	07 F1 E4
Thermistor fault (THM_F)	520455 (0x7F107)	6	Plate temperature sensor is short circuit	07 F1 E6

A DM1 message shall be transmitted, regardless of the presence or absence of any DTC, once every second and on state change.

In the event that multiple active DTC's occur at once on the Converter, the DM1 message must be transmitted in multiple frames. The multiple frames are broadcast using the Transport Protocol with a connection management type of Broadcast Announce Message (BAM).

For example:

DM1 Data Field Format – **No Active DTC's**

When there are no active DTC's, the Converter does normally transmit DM1 messages.
The data fields for the DM1 message with no active DTC's is:

Byte 1: 0x00 – All Lamp Status Codes are off
Byte 2: 0xFF – All bits reserved
Byte 3: 0x00 – Recommended setting for not active DTC's
Byte 4: 0x00 – Recommended setting for not active DTC's
Byte 5: 0x00 – Recommended setting for not active DTC's
Byte 6: 0x00 – Recommended setting for not active DTC's
Byte 7: 0xFF – Not used
Byte 8: 0xFF – Not used

DM1 Data Field Format – Single Frame Message, Active DTC
“Input voltage under limit”

Byte 1: 0x04 – Amber Warning Lamp is on.
Byte 2: 0x00 – All bits reserved.
Byte 3: 0x02 – 8 least significant bits of SPN
Byte 4: 0xF1 – Second byte of SPN
Byte 5: 0xE0 – Bits 8-6 = 3 most significant bits of SPN
Bits 5-1 = FMI (0)
Byte 6: OC Bit 8 = SPN Conversion Method (0)
Bits 7-1 = Occurrence Count, OC.
Byte 7: 0xFF – Not used.
Byte 8: 0xFF – Not used

DM1 Data Field Format – Single Frame Message, Active DTC
“Input voltage over limit”

Byte 1: 0x04 – Amber Warning Lamp is on.
Byte 2: 0x00 – All bits reserved.
Byte 3: 0x02 – 8 least significant bits of SPN
Byte 4: 0xF1 – Second byte of SPN

Byte 5: 0xE1 – Bits 8-6 = 3 most significant bits of SPN
Bits 5-1 = FMI (1)
Byte 6: OC Bit 8 = SPN Conversion Method (0)
Bits 7-1 = Occurrence Count, OC.
Byte 7: 0xFF– Not used.
Byte 8: 0xFF – Not used

Format is the same for all other single message.

DM1 Data Field Format – Multiple Frame Messages, Multiple Active DTC’s
Four reports are active

Byte 1: 0x20 – Control Byte = BAM
Byte 2: 0x12 – (Variable) DM1 message size in bytes, low byte
Byte 3: 0x00 – (Variable) DM1 message size in bytes, high byte
Byte 4: 0x03 – (Variable) DM1 message number of packets
Byte 5: 0xFF – Reserved
Byte 6: 0xCA – DM1 PGN low byte
Byte 7: 0xFE – DM1 PGN middle byte
Byte 8: 0x00 – DM1 PGN high byte

First Frame:
Byte 1: 0x01 – Packet Sequence Number
Byte 2: 0x04 – Amber Warning Lamp
Byte 3: 0x00 – Reserved
Byte 4: DTC1 – SPN low bits
Byte 5: DTC1 – SPN middle bits

Byte 6: DTC1 – SPN upper 3 bits, + FMI
Byte 7: DTC1 – CM, + occurrence count
Byte 8: DTC2 – SPN low bits

Second Frame:
Byte 9: 0x02 – Packet Sequence Number
Byte 10: DTC2 – SPN middle bits
Byte 11: DTC2 – SPN upper 3 bits, FMI
Byte 12: DTC2 – CM, + occurrence count
Byte 13: DTC3 – SPN low bits
Byte 14: DTC3 – SPN middle bits
Byte 15: DTC3 – SPN upper 3 bits, + FMI
Byte 16: DTC3 – CM, + occurrence count

Next Frame:
Byte 17: 0x03 – Packet Sequence Number
Byte 18: DTC4 – SPN low bits
Byte 19: DTC4 – SPN middle bits
Byte 20: DTC4 – SPN upper 3 bits, + FMI
Byte 21: DTC4 – CM, + occurrence count
Byte 22: 0xFF
Byte 23: 0xFF
Byte 24: 0xFF

Additional packets may be transmitted if there are more active DTC's.

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1.5 Temperature related derating

Protection mechanisms are implemented to protect unit against high temperatures and sudden temperatures rises. If any protection is active, it is signalized by following status bits.

- bOtpWarning
- bQuickTempRise
- bOtp

Detailed description follows.

1.5.1 bOtpWarning

When this bit is set, protection against possible overtemperature is active. This mechanism is activated when unit detects measured temperatures exceeding following limits:

- UNIT_TEMP_AMBIENT > 83 °C
- UNIT_TEMP_POWER_BOARD > 78 °C
- UNIT_TEMP_ CHASSIS > 59°C

This warning flag is cleared when all temperatures fall below following limits:

- UNIT_TEMP_ AMBIENT < 77 °C
- UNIT_TEMP_POWER_BOARD < 75 °C
- UNIT_TEMP_ CHASSIS < 56 °C

When flag is set following limitations applies:

- maximal I_{AC} is lowered from 70 A to 63 A
- maximal I_{HV} is lowered from 40 A to 36 A
- 12V DNC maximal current is lowered from 278A to 250 A
- 24V DNC maximal current is lowered from 34 A to 30 A
- maximal total unit power is lowered from 15 kW to 13,5kW (this is power of HV stage, to transform it to AC stage power subtraction of power of both DNC stages and multiplication by unit efficiency which is 92% is required; $P_{AC}=(P_{HV} - P_{12VDNC} - P_{24VDNC}) * 0.92$).

1.5.2 bQuickTempRise

This flag is set when quick temperature rise is detected in relation to actual currents measured internally by the unit. Primary function of this flag is to catch situations when cooling system is not working properly. The detection algorithm incorporates multiple differential equations and temperature history. When this flag is set, following restriction applies:

- total unit power is lowered to 4950W,
- maximal charging current is lowered to 20A.

This flag is cleared after fixed 10 minutes of unit operation with no excessive temperature rising detected.

1.5.3 bOtp

This flag is set when any of measured temperatures exceeds limits of safe unit operation. In such case all unit outputs are shut down and none can be enabled until all temperatures return to normal operation level. Overtemperature protection is activated if any measured temperature exceeds following limits.

- UNIT_TEMP_AMBIENT > 86 °C
- UNIT_TEMP_POWER_BOARD > 82 °C
- UNIT_TEMP_ CHASSIS > 67°C

This flag is cleared when all temperatures fall below following limits:

- UNIT_TEMP_ AMBIENT < 80 °C
- UNIT_TEMP_POWER_BOARD < 76 °C
- UNIT_TEMP_ CHASSIS < 60 °C

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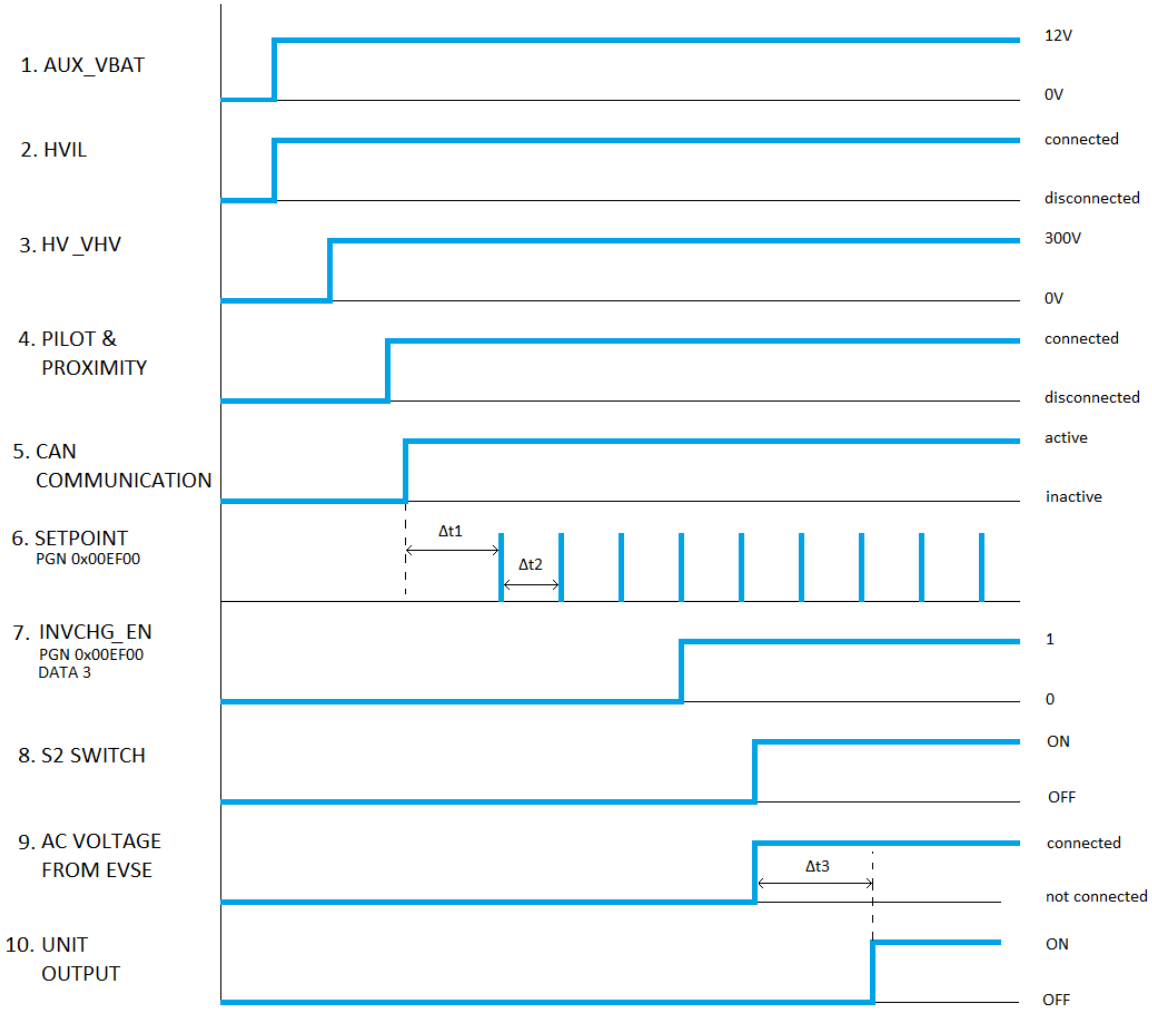
2. TYPICAL START-UP SEQUENCE

Following image describes typical (example of) start-up sequence.



1. AUX_VBAT is typically set to 12V.
2. HVIL is typically connected with AUX_VBAT.
3. HV_VHV should be within range of 220-450V.
4. Pilot duty between 8-97% is applied and proximity connector is inserted and latched.
5. Unit is turned on – CAN messages from unit can be observed on CAN BUS.
6. Setpoint commands from VCU starts (PGN 0x00EF00). Δt1 – time must be kept under 5s, otherwise unit enters sleep mode.
7. INVCHG_EN (data 3 in setpoint command) is set to 1 (1 = enable output). Δt2 – time must be kept under 100ms when output is enabled, otherwise unite turns it off and enters CAN watchdog protection mode.
8. S2 switch is turned on automatically by the unit.
9. AC voltage is connected by charging station when S2 switch is turned ON.
10. Unit turns ON output. Δt3 – a minimal delay of about 1.5 second is expected between applying AC voltage and unit output enabling.

3. REVISION HISTORY

Rev	Description of Change	Release Date	Required Fw Rev	Dbc file Rev	Author
A	Initial release (based on BCA.20016_1), changes: CAN baud is fixed 500kbps, command to change CAN base address removed, added section describing unit addressing based on MASTER_SLAVE_PIN, added section PGN 0x00FFD2 – DIRC State Added new sections: Additional output and Typical start-up sequence	13-Sep-2021		005	Marek Masár
B	Added new section ”Temperature related derating” and some notes about dbc file	25-Nov-2021		006	Marek Masár
C	Added signals DIRC_MODE and ALCI_FLAG to message INV_Output2, updated transmission repetition rate for software and component identification, removed battery manufacturer name	8-Dec-2021		007	Marek Masár

For more information on these products consult: tech.support@psbel.com

NUCLEAR AND MEDICAL APPLICATIONS - Products are not designed or intended for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems.
TECHNICAL REVISIONS - The appearance of products, including safety agency certifications pictured on labels, may change depending on the date manufactured. Specifications are subject to change without notice.

