Freedom Won CAN BUS BMS Protocol

This document is intended for manufacturers of inverters that can communicate with a CANbus connected BMS as it describes the protocol and PGN's that the inverter needs to recognize and respond to accordingly.

Freedom Lite batteries transmit battery information and control commands to the inverter to ensure a robust and versatile system. The CAN BUS protocol below is the standard used by Freedom Won. If adaptations to below, or completely different protocols, are required by the inverter manufacturer Freedom Won can accommodate such variations although it is strongly preferred to stay with this standard protocol.

1. General

1.1 Connections

The CAN Bus from the Freedom Lite battery is connected to the CAN port on the inverter(s) or to a separate system controller that will then in turn have a form of communication with the inverter(s) to relay the battery commands.

A termination resistor is required on each end of the CAN Bus. Many inverters have a termination resistor built-in, but others require one to be plugged into a second CAN Bus port. The Lite will require a 120 Ohm termination resistor using appropriate pin configuration, CAN H on Pin 7 and CAN L on Pin 8 (see the Lite Installation Manual for further details). A Victron termination resistor will work.

For examples of detailed installer documentation, refer to the Freedom Lite installation manual along with the respective inverter brand's manual.

1.2 CAN Bus specification

Standard frame format, 11-bit identifier, also known as CAN 2.0A.
500kbps baud rate is standard but 250kbps is also supported. The installer needs to contact Freedom Won for assistance with changing the setting on the battery if a system requires 250kbps

1.4 Communication Intervals

The Freedom Lite battery transmits the CAN messages at 1000ms intervals. If a different interval is required, please contact Freedom Won.

1.5 Installer documentation

Please refer to the Freedom Lite installation manual and the respective inverter manual for the required installation information.

2. Messages sent from BMS to the Inverter

The messages and ID's are derived from the original SMA CAN BUS protocol for interfacing an inverter with a lithium battery BMS, however new messages have been added for additional features and functionality.

The minimum CAN-IDs required for the core functionality are 0x351, 0x355, 0x356 and 0x35A. All other fields are optional. The messages 0x35E and 0x35F are also required if the inverter needs a battery identification.

CAN ID	Offset (bytes)	Name	Data type	Scaling	Unit
0x351	0	Charge voltage limit	un16	0.1	V
	2	Max charge current	sn16	0.1	A
	4	Max discharge current	sn16	0.1	A
	6	Discharge voltage	un16	0.1	V
0x355	0	SOC value	un16	1	%
	2	SOH value	un16	1	%
	4	High res SOC (optional)	un16	0.1	%
	6	Pack Amp Hours	un16	1	Ah

CAN ID	Offset (bytes)	Name	Data type	Scaling	Unit
0x356	0	Battery voltage	un16	0.1	V
	2	Battery current	sn16	0.1	A
	4	Battery temperature	sn16	0.1	C
	6	Total pack cycles	un16	1	
0x35A	0 (bit 0+1)	General alarm	(not implemented)		
	0 (bit 2+3)	Battery high voltage alarm			
	0 (bit 4+5)	Battery low voltage alarm			
	0 (bit 6+7)	Battery high temperature alarm			
	1 (bit 0+1)	Battery low temperature alarm			
	1 (bit 2+3)	Battery high temperature charge			
	1 (bit 4+5)	Battery low temperature charge			
	1 (bit 6+7)	Battery high current alarm			
	2 (bit 0+1)	Battery high charge current alarm			
	2 (bit 2+3)	Contactor Alarm	(not implemented)		
	2 (bit 4+5)	Short circuit Alarm	(not implemented)		
	2 (bit 6+7)	BMS internal alarm			
	3 (bit 0+1)	Cell imbalance alarm			
	3 (bit 2+3)	Reserved			
	3 (bit 4+5)	Reserved			
	3 (bit 6+7)	Reserved			
	4 (bit 0+1)	General warning	(not implemented)		
	4 (bit 2+3)	Battery high voltage warning			
	4 (bit 4+5)	Battery low voltage warning			
	4 (bit 6+7)	Battery high temperature warning			
	5 (bit 0+1)	Battery low temperature warning			
	5 (bit 2+3)	Battery high temperature charge			
	5 (bit 4+5)	Battery low temperature charge			
	5 (bit 6+7)	Battery high current warning			
	6 (bit 0+1)	Battery high charge current warning			
	6 (bit 2+3)	Contactor warning	(not implemented)		
	6 (bit 4+5)	Short circuit warning	(not implemented)		
	6 (bit 6+7)	BMS internal warning			
	7 (bit 0+1)	Cell imbalance warning			
	7 (bit 2+3)	System status (online/offline) [1]			
	7 (rest)	Reserved			

CAN ID	Offset (bytes)	Name	Data type	Scaling	Unit
0x35E	0	Manufacturer name	string (8		
0x35F	0	Battery Model	un16		
	2	Firmware version	un16		
	4	Total pack capacity	un16	0.1	Ah
0x370	0	Battery / BMS name part 1	string (8		
0x371	0	Battery / BMS name part 2	string (8		
0x372	0	Number of modules OK	un16		
	2	Number of modules blocking charge	un16		
	4	Number of modules blocking	un16		
	6	Number of modules offline	un16		
0x373	0	Min. cell voltage [1]	un16	mV	
	2	Max. cell voltage [1]	un16	mV	
	4	Lowest cell temperature [1]	un16	Kelvin	
	6	Highest cell temperature [1]	un16	Kelvin	

[1]: PGN extension in addition to the original SMA protocol

0x351 - Charge voltage (CVL), discharge current limit (DCL) and charge current limit (CCL) and battery discharge voltage

Discharge voltage – the Lite will transmit a Discharge Current Limit (DCL) = 0 when the lower voltage threshold is reached.
Charge Current Limit (CCL) – This is set to zero if the battery urgently needs the inverter/charger to stop charging it. The Charge Voltage Limit (CVL) is used as the first form of control to avoid over charging.

When the grid is disconnected, ie the system is running in “inverter” or “island mode”, the maximum discharge current cannot be regulated. Discharge current depends solely on the loads and will continue until the BMS sends DCL = 0 or the voltage has dropped to the low disconnect voltages configured in the inverter/charger by the installer.

- A max discharge current of 0A must disable discharge.
- If the grid is connected, loads will be powered from the grid. Battery power must not be used.
- If the grid is disconnected, the inverter must stop supplying energy to the loads.

Charging will be allowed if max charge current exceeds 0A.

Both max discharge current and max charge current are communicated as positive values.

0x356 - Batt voltage, current and temp

By default, as sent from the BMS on CAN Bus, a negative current indicates discharge, positive current indicates charge.

Temperature is in degrees Celsius.

0x35A - Warnings and Alarms

The Lite does not transmit alarms on CAN Bus. If specific alarms are required by an inverter, please discuss with Freedom Won.

0x35E - Manufacturer name

8 char long name, encoded in 7-bit ascii (FreedWON)
The data will be used by the inverter to identify the battery, and may be used as battery name (see below for more information)

0x35F - Battery type and software versions

Two byte type ID
Two byte firmware versions (big-endian ordering, MSB first)

0x370 and 0x371 - Battery Name

together these two fields can contain a 16 char long name of the battery. Encoded in 7-bit ascii, the data is concatenated, starting with 0x370, and appending 0x371 to the right.

If the name is shorter than 16 characters, the remainder should be padded with zeros.

Freedom Won transmits – “Freedom [space]” for 0x370 and “Lite” for 0x371

0x372 - Module status

The intention behind this field is to help installers and support engineers do initial troubleshooting on systems that are not performing correctly.

0x373 to 0x377 - Min/max cell voltage and temperature

0x373 contains the data.

0x374 to 0x377 is for identification:

The strings are to be encoded in 7-bit ASCII. Unused characters to be set to 0.
Unprintable characters will be ignored.
Free format: Freedom Won provides the module number and cell ID that helps an engineer to identify which cell or unit is potentially giving problems.
Use the string to allow a service engineer to identify which module and cell is giving a low or high voltage.
Integers must be encoded as ASCII.

0x378 - Total energy in and out (note that this is not presently implemented)

Two 32-bit values for energy in (charge) and energy out (discharge).
100Wh units are used because this gives the best balance between resolution and maximum value.
A maximum energy value of 42MWh can be recorded.
If this value is exceeded, the counter should roll over to zero.

0x379 - Installed capacity

The total of all packs online in Ah is given here.

0x380 and 0x381 - Serial number

This field is optional.

The definition is the same as for 0x370 and 0x371, and the cell voltage and temperature id fields. Free format ASCII.

0x382 - Battery family name (this field is presently not implemented by Freedom Won)

This field is optional and supplementary to the information in 0x35E. It identifies the name of the battery family or series. The purpose of this field is to make it possible to distinguish between different types of batteries made by the same manufacturer. The Format is the same as for 0x35E: A 7-bit ASCII string identifying the family name of the battery.

3. Messages sent by the Inverter to the BMS

0x305 [Keepalive from inverter to BMS]

This is not required with a Freedom Lite battery but may be sent by the inverter as a way of confirming that the inverter CAN bus is active.