

CiA 418



Device profile for battery modules

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HISTORY

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2012-04-27	<i>Publication of Version 1.2.0</i> as public specification <ul style="list-style-type: none">— Completely re-chaptered and partially re-worded— Minor editorial corrections— Added new PDO communication parameters

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1 Scope

This device profile specifies a recommended practice for the communication link between a battery module and a battery charger. The required data messages are intended to be sufficient to allow a battery charge to be carried out. Optional data is a selection of data commonly used in the industry to provide enhanced features. Battery modules compliant to this standard shall use communication techniques, which conforms to those described in the CANopen application layer and communication profile.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

/CiA301/	CiA 301, CANopen application layer and communication profile
/CiA303-1/	CiA 303-1, CANopen recommendation – Part 1: Cabling and connector pin assignment
/ISO11898-2/	ISO 11898-2, Road vehicles – Controller area network (CAN) – Part 2: High-speed medium access unit
/ISO646/	ISO 646:1983, ISO 7-bit coded character set for information exchange

3 Terms and definitions

For the purpose of this document, the following terms and definitions and those given in /CiA301/, /CiA303-1/, /ISO11898-2/ and /ISO646/ apply.

4 Symbols and abbreviated terms

For the purpose of this document, the following symbols and abbreviated terms those given in /CiA301/, /CiA303-1/, /ISO11898-2/ and /ISO646/ apply.

CAN	Controller area network
CAN-ID	CAN identifier
COB-ID	Communication object identifier
PDO	Process data object
RPDO	Receive process data object
SDO	Service data object
TPDO	Transmit process data object
n.a.	not applicable

5 Physical layer specification

5.1 General

This clause specifies the physical layer for this document.

5.2 Transmission rates

The device compliant to this device profile shall support at least bit-rate of 125 kbit/s and may support the other bit-rates as defined in /CiA301/. The bit timing as defined in /CiA301/ shall be used. The CiA 418 device shall use a CAN transceiver compliant to the /ISO11898-2/. The termination resistor of 124 Ohm shall be included in the default battery module configuration.

5.3 Connectors

The battery module shall have a 5-wire interconnect. The communications bus shall use three of these lines (CAN_L, CAN_H, and ground), and two shall be used for the pilot signal (see Annex B). The actual connector used and its pin configuration will vary depending on the battery's application, and therefore is outside of the scope of this document. The CANopen compliant connectors with recommended pinning are provided in /CiA303-1/.

5.4 Node-ID assignment

The used node-ID assignment method is manufacturer-specific. The node-ID assignment via the CANopen object dictionary is not recommended.

5.5 Network topology

Unless otherwise specified, the line topology is used.

6 Error handling

6.1 General

This clause specifies the handling of errors. Emergency messages shall (may) be supported and triggered by internal errors in the device (see /CiA301/ for a description of emergency message handling). By default, the emergency messages contain the error field with pre-defined error numbers and additional information.

6.2 Error behavior

If a severe device failure is detected in NMT operational state, the device shall automatically enter by default the NMT pre-operational state (see NMT state machine in /CiA301/). If object 1029_h is implemented, the module may be alternatively configured in case of a device failure to automatically enter the stopped state or remain in the current state. Device failures shall include the following communication errors:

- Bus-off conditions on the CAN interface;
- Heartbeat event with state 'occurred'.

Severe device errors may also be caused by device (module) internal failures, e.g. missing the pilot signal.

6.3 Additional error codes

In addition to the error codes defined in /CiA301/ the additional error codes given in Table 1 shall be used if appropriate.

Table 1 – Additional error codes

Error code	Description
5010 _h	Temperature sensor fault

7 Operating principles

7.1 General

This clause provides a description of the operating principles.

7.2 Functional description

The purpose of the battery module is to provide charger with information required to perform charging. The battery module compliant to this device profile shall provide at least following information:

- battery type;
- battery capacity;
- number of cells;
- maximum charge current permissible
- battery temperature.

The additional information is provided optionally:

- values of various identifiers;
- charge history data;
- battery voltage;
- battery state of charge;
- requested current;
- water level status.

All devices compliant to this device profile shall support TPDO1 and RPDO1. Additionally TPDO2 to 3 and RPDO2 to 3 are specified. Battery parameter information may be read by SDO services. If the charger supports any of the optional data items, these may be read by SDO services. Battery module may support disabling and enabling of the PDOs.

8 General pre-definitions

8.1 General

This clause specifies pre-defined communication parameters

8.2 Network management and Heartbeat functionality

Devices compliant with this device profile shall support NMT slave functionality as defined in /CiA301/. Heartbeat functionality shall be supported. The CiA 418 device may optionally be a time-stamp consumer.

8.3 Pre-defined communication objects

8.3.1 General

This clause provides additional definitions with regard to the pre-defined communication objects in /CiA301/. Modules compliant with this device profile shall have default values for some communication objects (1000_h to 1FFF_h), which are not fully specified in /CiA301/.

8.3.2 Object 1000_h: Device type

This object shall provide the functionality of the battery module. Figure 1 illustrates the parameter structure as specified in /CiA301/. Table 2 specifies the parameter definition for the additional information bit field. The device profile number shall be 418_d. Table 3 specifies the object description, and Table 4 specifies the entry description.

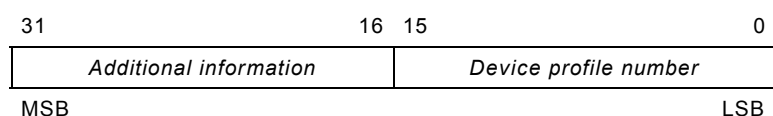


Figure 1 – Parameter structure

Table 2 – Parameter definition for the additional information

Bit	Value	Description
16	0 _b	RPDO2 not supported
	1 _b	RPDO2 supported
17	0 _b	RPDO3 not supported
	1 _b	RPDO3 supported
18	0 _b	TPDO2 not supported
	1 _b	TPDO2 supported
19	0 _b	TPDO3 not supported
	1 _b	TPDO3 supported
20 to 31	reserved (0) (NOTE)	
NOTE The value FFFF _h is reserved for multiple devices, see /CiA301/		

Table 3 – Object description

Attribute	Value
Index	1000 _h
Name	Device type
Object code	VAR
Data type	UNSIGNED32
Category	Mandatory

Table 4 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	No
Value range	See parameter definition
Default value	No

8.3.3 Object 1001_h: Error register

The device specific bit in the error register object shall indicate a temperature sensor fault. For details on object 1001_h see /CiA301/.

8.3.4 Object 1012_h: COB-ID time stamp object

This object is optional and is used in case device consumes TIME message. For details see /CiA301/.

8.3.5 Object 1017_h: Heartbeat producer time

The object description and entry description are defined in /CiA301/.

8.3.6 Object 1018_h: Identity

The product code and the revision number shall be supported. Devices implemented according to this profile may support the serial number. For details see /CiA301/.

8.3.7 Object 1029_h: Error behavior

This object is optional and may be used to configure alternative error behavior of the device (see clause “Error behavior”). For details see /CiA301/.

8.3.8 RPDO 1

8.3.8.1 General

The RPDO1 shall contain charger status. This RPDO shall be received asynchronously. The mapped objects shall be updated immediately after successful RPDO reception.

8.3.8.2 Object 1400_h: RPDO1 communication parameter

This object shall indicate the communication parameters for the first RPDO. The parameter definition is given in /CiA301/. Object description and entry description are provided in Table 5 and Table 6.

Table 5 – Object description

Attribute	Value
Index	1400 _h
Name	RPDO1 communication parameter
Object code	RECORD
Data type	PDO communication parameter record
Category	Mandatory

Table 6 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	See /CiA301/
Default value	No

Attribute	Value
Sub-index	01 _h
Description	COB-ID
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	8000 0200 _h + node-ID
Sub-index	02 _h
Description	Transmission type
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	FF _h
Sub-index	05 _h
Description	Event timer
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	0
Sub-index	06 _h
Description	SYNC start value
Entry category	Optional
Access	rw
PDO mapping	No
Value range	UNSIGNED8
Default value	Manufacturer-specific

8.3.8.3 Object 1600_h: RPDO1 mapping parameter

This object shall indicate the mapping parameters for the first RPDO. The parameter definition is given in /CiA301/. Object description and entry description are provided in Table 7 and Table 8.

Table 7 – Object description

Attribute	Value
Index	1600 _h
Name	RPDO1 mapping parameter
Object code	RECORD
Data type	PDO mapping parameter record
Category	Mandatory

Table 8 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	01 _h
Sub-index	01 _h
Description	Application object 1
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	6001 00 08 _h

8.3.9 TPDO 1

8.3.9.1 General

This TPDO shall contain battery status and temperature information. This TPDO shall be transmitted on a timer-driven basis. The data shall be updated before transmission, no matter if the transmission is triggered by the event timer or by CAN remote frame.

NOTE Do not use CAN implementations, which respond to remote frames automatically.

8.3.9.2 Object 1800_h: TPDO1 Communication parameter

This object shall indicate the communication parameters for the first TPDO. The parameter definition is given in /CiA301/. Table 9 and Table 10 provide the object description and the entry description.

Table 9 – Object description

Attribute	Value
Index	1800 _h
Name	TPDO1 communication parameter
Object code	RECORD
Data type	PDO communication parameter record
Category	Mandatory

Table 10 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	05 _h
Sub-index	01 _h
Description	COB-ID
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	8000 0180 _h + node-ID
Sub-index	02 _h
Description	Transmission type
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	FF _h
Sub-index	03 _h
Description	Inhibit time
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	0
Sub-index	05 _h
Description	Event timer
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	00C8 _h

Attribute	Value
Sub-index	06 _h
Description	SYNC start value
Entry category	Optional
Access	rw
PDO mapping	No
Value range	UNSIGNED8
Default value	Manufacturer-specific

8.3.9.3 Object 1A00_h: TPDO1 mapping parameter

This object shall indicate the mapping parameters for the first TPDO. The parameter definition is given in /CiA301/. Object description and entry description are provided in Table 11 and Table 12.

Table 11 – Object description

Attribute	Value
Index	1A00 _h
Name	TPDO1 mapping parameter
Object code	RECORD
Data type	PDO mapping parameter record
Category	Mandatory

Table 12 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	02 _h
Sub-index	01 _h
Description	Application object 1
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	6010 00 10 _h

Attribute	Value
Sub-index	02 _h
Description	Application object 2
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	6000 00 08 _h

8.3.10 RPDO 2

8.3.10.1 General

If RPDO2 is supported (see object 1000_h), it shall contain charger status and Ah returned from the last charge. The RPDO reception is performed asynchronously. The mapped objects shall be updated immediately after successful RPDO reception.

8.3.10.2 Object 1401_h: RPDO2 communication parameter

This object shall indicate the communication parameters for the second RPDO. The parameter definition is given in /CiA301/. Object description and entry description are provided in Table 13 and Table 14.

Table 13 – Object description

Attribute	Value
Index	1401 _h
Name	RPDO2 communication parameter
Object code	RECORD
Data type	PDO communication parameter record
Category	Conditional: Mandatory if bit 16 in object 1000h equal 1

Table 14 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	No
Sub-index	01 _h
Description	COB-ID
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	(0000 0300 _h or 4000 0300 _h) + node-ID

Attribute	Value
Sub-index	02 _h
Description	Transmission type
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	FF _h
Sub-index	05 _h
Description	Event timer
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	0000 _h
Sub-index	06 _h
Description	SYNC start value
Entry category	Optional
Access	rw
PDO mapping	No
Value range	UNSIGNED8
Default value	Manufacturer-specific

8.3.10.3 Object 1601_h: RPDO2 mapping parameter

This object shall indicate the mapping parameters for the second RPDO. The parameter definition is given in /CiA301/. Object description and entry description are provided in Table 15 and Table 16.

Table 15 – Object description

Attribute	Value
Index	1601 _h
Name	RPDO2 mapping parameter
Object code	RECORD
Data type	PDO mapping parameter record
Category	Conditional: Mandatory if 1401 _h supported

Table 16 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	02 _h
Sub-index	01 _h
Description	Application object 1
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	6001 00 08 _h
Sub-index	02 _h
Description	Application object 2
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	6052 00 10 _h

8.3.11 TPDO 2

8.3.11.1 General

If this TPDO is supported (see object 1000_h), it shall contain the battery voltage, temperature and status. If the battery supports this TPDO, the charger may disable the TPDO1 and enable this one if desired. The data shall be updated before transmission, no matter if the transmission is triggered by the event timer or by CAN remote frame.

NOTE Do not use CAN implementations, which respond to remote frames automatically.

8.3.11.2 Object 1801_h: TPDO2 Communication parameter

This object shall indicate the communication parameters for the second TPDO. The parameter definition is given in /CiA301/. Table 9 and Table 10 provide the object description and the entry description.

Table 17 – Object description

Attribute	Value
Index	1801 _h
Name	TPDO2 communication parameter
Object code	RECORD
Data type	PDO communication parameter record
Category	Conditional: Mandatory if bit 17 in object 1000h equal 1

Table 18 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	05 _h
Sub-index	01 _h
Description	COB-ID
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	8000 0280 _h + node-ID
Sub-index	02 _h
Description	Transmission type
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	FF _h
Sub-index	03 _h
Description	Inhibit time
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	0

Attribute	Value
Sub-index	05 _h
Description	Event timer
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	00C8 _h
Sub-index	06 _h
Description	SYNC start value
Entry category	Optional
Access	rw
PDO mapping	No
Value range	UNSIGNED8
Default value	Manufacturer-specific

8.3.11.3 Object 1A01_h: TPDO2 mapping parameter

This object shall indicate the mapping parameters for the second TPDO. The parameter definition is given in /CiA301/. Object description and entry description are provided in Table 11 and Table 12.

Table 19 – Object description

Attribute	Value
Index	1A01 _h
Name	TPDO2 mapping parameter
Object code	RECORD
Data type	PDO mapping parameter record
Category	Conditional: Mandatory if 1801 _h supported

Table 20 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	03 _h

Attribute	Value
Sub-index	01 _n
Description	Application object 1
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	6010 00 10 _n
Sub-index	02 _n
Description	Application object 2
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	6000 00 08 _n
Sub-index	03 _n
Description	Application object 3
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	6060 00 20 _n

8.3.12 RPDO 3

8.3.12.1 General

If RPDO3 is supported (see object 1000_n), it shall contain receive charger status, Ah returned from the last charge and charger state of charge. This RPDO shall be received asynchronously. The mapped objects shall be updated immediately after successful RPDO reception.

8.3.12.2 Object 1402_n: RPDO3 communication parameter

This object shall indicate the communication parameters for the third RPDO. The parameter definition is given in /CiA301/. Object description and entry description are provided in Table 21 and Table 23.

Table 21 – Object description

Attribute	Value
Index	1402 _n
Name	RPDO3 communication parameter
Object code	RECORD
Data type	PDO communication parameter record
Category	Conditional: Mandatory if bit 18 in object 1000h equal 1

Table 22 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	No
Sub-index	01 _h
Description	COB-ID
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	(0000 0400 _h or 4000 0400 _h) + node-ID
Sub-index	02 _h
Description	Transmission type
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	FF _h
Sub-index	05 _h
Description	Event timer
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	0000 _h
Sub-index	06 _h
Description	SYNC start value
Entry category	Optional
Access	rw
PDO mapping	No
Value range	UNSIGNED8
Default value	Manufacturer-specific

8.3.12.3 Object 1602_h: RPDO3 mapping parameter

This object shall indicate the mapping parameters for the third RPDO. The parameter definition is given in /CiA301/. Object description and entry description are provided in Table 15 and Table 16.

Table 23 – Object description

Attribute	Value
Index	1602 _h
Name	RPDO3 mapping parameter
Object code	RECORD
Data type	PDO mapping parameter record
Category	Conditional: Mandatory if 1402 _h supported

Table 24 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	03 _h
Sub-index	01 _h
Description	Application object 1
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	6001 00 08 _h
Sub-index	02 _h
Description	Application object 2
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	6052 00 10 _h

Sub-index	03 _h
Description	Application object 3
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	6080 00 08 _h

8.3.13 TPDO 3

8.3.13.1 General

If TPDO3 is supported (see object 1000_h), it shall contain a requested current value and the battery-state of charge to the charger. The data shall be updated before transmission, no matter if the transmission is triggered by the event timer or by CAN remote frame.

NOTE Do not use CAN implementations, which respond to remote frames automatically.

8.3.13.2 Object 1802_h: TPDO3 Communication parameter

This object shall indicate the communication parameters for the third TPDO. The parameter definition is given in /CiA301/. Table 25 and Table 26 provide the object description and the entry description.

Table 25 – Object description

Attribute	Value
Index	1802 _h
Name	TPDO3 communication parameter
Object code	RECORD
Data type	PDO communication parameter record
Category	Conditional: Mandatory if bit 19 in object 1000h equal 1

Table 26 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	05 _h
Sub-index	01 _h
Description	COB-ID
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	See /CiA301/
Default value	8000 0380 _h + node-ID

Attribute	Value
Sub-index	02 _h
Description	Transmission type
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	FF _h
Sub-index	03 _h
Description	Inhibit time
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	0
Sub-index	05 _h
Description	Event timer
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	00C8 _h
Sub-index	06 _h
Description	SYNC start value
Entry category	Optional
Access	rw
PDO mapping	No
Value range	UNSIGNED8
Default value	Manufacturer-specific

8.3.13.3 Object 1A02_h: TPDO3 mapping parameter

This object shall indicate the mapping parameters for the third TPDO. The parameter definition is given in /CiA301/. Object description and entry description are provided in Table 27 and Table 28.

Table 27 – Object description

Attribute	Value
Index	1A02 _h
Name	TPDO3 mapping parameter
Object code	RECORD
Data type	PDO mapping parameter record
Category	Conditional: Mandatory if 1802 _h supported

Table 28 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	02 _h
Sub-index	01 _h
Description	Application object 1
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	6070 00 10 _h
Sub-index	02 _h
Description	Application object 2
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	See /CiA301/
Default value	6081 00 08 _h

9 Detailed parameter specification

9.1 General

This clause provides the detailed parameter specifications. All parameters in this profile are grouped in the object dictionary, and defined by attributes as defined in /CiA301/. Each object within the CANopen object dictionary is addressed uniquely by using a 16-bit index and an 8-bit sub-index. The objects may be read respectively written via the CANopen network. The standardized device profile area in the index range of 6000_h to 9FFF_h contains all application objects, e.g. configuration parameter, process data, diagnostic information, etc., common to this document.

Table 30 – Parameter definition

Name	Bit	Value	Description
Bit 0	0	0 _b	Not ready
		1 _b	Ready
r	1 to 7	Reserved (always 0)	

Table 31 specifies the object description and Table 32 specifies the entry description.

Table 31 – Object description

Attribute	Value
Index	6000 _h
Name	Battery status
Object code	VAR
Data type	UNSIGNED8
Category	Mandatory

Table 32 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	Default
Value range	See parameter definition
Default value	No

9.3.3 Object 6001_h: Charger status

This object shall indicate readiness (as ready or not ready) of the charger to deliver a charge to the battery. Figure 3 illustrates the parameter structure. Table 33 provides the parameter definition.

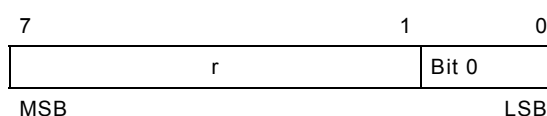


Figure 3 – Parameter structure

Table 33 – Parameter definition

Name	Bit	Value	Description
Bit 0	0	0 _b	Not ready
		1 _b	Ready
r	1 to 7	Reserved (always 0)	

Table 34 specifies the object description and Table 35 specifies the entry description.

Table 34 – Object description

Attribute	Value
Index	6001 _h
Name	Charger status
Object code	VAR
Data type	UNSIGNED8
Category	Mandatory

Table 35 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	Default
Value range	See parameter definition
Default value	00 _h

9.3.4 Object 6010_h: Temperature

This object shall provide the temperature of the battery pack as measured by a temperature reading device physically mounted somewhere on the battery module. The value shall be given in multiples of 0,125 °C. The minimum range of values shall be -320_d to +680_d (i.e. -40.0 °C to +85.0 °C). The invalid value is 8000_h (see definition of INTEGER16 in /CiA301/). Table 36 specifies the object description and Table 37 specifies the entry description.

Table 36 – Object description

Attribute	Value
Index	6010 _h
Name	Temperature
Object code	VAR
Data type	INTEGER16
Category	Mandatory

Table 37 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	Default
Value range	FEC0 _h to 02A8 _h
Default value	No

9.3.5 Object 6020_h: Battery parameters

This object shall provide the battery parameters. The parameter definition is specified in the object 0080_h. The sub-index 01_h shall provide generic description of the battery chemistry and configuration as specified in the Annex A. The sub-index 02_h shall provide nominal energy capacity in Ampere-hours as provided by the battery manufacturer. The sub-index 03_h shall provide maximum current in Amperes that is safely delivered to the battery without causing physical damage to the battery or its interconnecting straps or cables. The sub-index 04_h shall provide number of battery cells that make up the battery pack. Table 38 specifies the object description and Table 39 specifies the entry description.

Table 38 – Object description

Attribute	Value
Index	6020 _h
Name	Battery parameters
Object code	RECORD
Data type	See object 0080 _h
Category	Mandatory

Table 39 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	04 _h
Default value	No
Sub-index	01 _h
Description	Battery type
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	UNSIGNED8
Default value	No
Sub-index	02 _h
Description	Ah capacity
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	UNSIGNED16
Default value	No
Sub-index	03 _h
Description	Maximum charge current
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	UNSIGNED16
Default value	No

Attribute	Value
Sub-index	04 _h
Description	Number of cells
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	UNSIGNED16
Default value	No

9.3.6 Object 6030_h: Battery serial number

This object shall provide a character string (numeric or alphanumeric) associated with a battery pack, usually applied by the battery manufacturer. The battery serial number may not be unique across the entire population of batteries. Maximum number of characters shall be 10. This character string in the battery module shall be split into several UNSIGNED32 value for transmission, using expedited SDO services. Table 40 specifies the object description and Table 41 specifies the entry description.

Example 1: The character string "BATTERY" (7-bit coded representation //ISO646/: 42 41 54 54 45 52 59) is represented as follows:

Sub-index 00h: 2
 Sub-index 01h: 54544142
 Sub-index 02h: 00595245

Table 40 – Object description

Attribute	Value
Index	6030 _h
Name	Battery serial number
Object code	ARRAY
Data type	UNSIGNED32
Category	Optional

Table 41 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01 _h to 03 _h
Default value	No

Attribute	Value
Sub-index	01 _h
Description	ASCII characters 1 to 4
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	UNSIGNED32
Default value	No
Sub-index	02 _h
Description	ASCII characters 5 to 8
Entry category	Optional
Access	ro
PDO mapping	No
Value range	UNSIGNED32
Default value	No
Sub-index	03 _h
Description	ASCII characters 9 to 10
Entry category	Optional
Access	ro
PDO mapping	No
Value range	UNSIGNED32
Default value	No

9.3.7 Object 6031_h: Battery ID

This object shall provide a character string (numeric or alpha-numeric) associated with a battery pack that uniquely identifies it to the owner. The battery ID may not be unique across the entire population of batteries. Maximum number of characters shall be 20. This character string in the battery module shall be split into several UNSIGNED32 value for transmission, using expedited SDO services. Table 42 specifies the object description and Table 43 specifies the entry description.

Example 2: The character string "BATTERY123456789BATT" (7-bit coded representation /ISO646/: 42 41 54 54 45 52 59 31 32 33 34 35 36 37 38 39 42 41 54 54) is represented as follows:

Sub-index 00h: 4
 Sub-index 01h: 54544142
 Sub-index 02h: 31595245
 Sub-index 03h: 35343332
 Sub-index 04h: 39383736
 Sub-index 05h: 54544142

Table 42 – Object description

Attribute	Value
Index	6031 _h
Name	Battery ID
Object code	ARRAY
Data type	UNSIGNED32
Category	Optional

Table 43 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01 _h to 05 _h
Default value	No
Sub-index	01 _h
Description	ASCII characters 1 to 4
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	UNSIGNED32
Default value	No
Sub-index	02 _h
Description	ASCII characters 5 to 8
Entry category	Optional
Access	ro
PDO mapping	No
Value range	UNSIGNED32
Default value	No
to	
Sub-index	05 _h
Description	ASCII characters 17 to 20
Entry category	Optional
Access	ro
PDO mapping	No
Value range	UNSIGNED32
Default value	No

9.3.8 Object 6040_h: Vehicle serial number

This object shall provide a character string (numeric or alpha-numeric) associated with a vehicle, usually applied by the manufacturer. The vehicle serial number may not be unique across the entire population of vehicles. Maximum number of characters shall be 20. This character string in the battery module shall be split into several UNSIGNED32 value for transmission, using expedited SDO services. Table 44 specifies the object description and Table 45 specifies the entry description.

NOTE See the example 2 (object 6031_h) for value representation.

Table 44 – Object description

Attribute	Value
Index	6040 _h
Name	Vehicle serial number
Object code	ARRAY
Data type	UNSIGNED32
Category	Mandatory

Table 45 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01 _h to 05 _h
Default value	No
Sub-index	01 _h
Description	ASCII characters 1 to 4
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	UNSIGNED32
Default value	No
Sub-index	02 _h
Description	ASCII characters 5 to 8
Entry category	Optional
Access	ro
PDO mapping	No
Value range	UNSIGNED32
Default value	No
to	

Attribute	Value
Sub-index	05 _h
Description	ASCII characters 17 to 20
Entry category	Optional
Access	ro
PDO mapping	No
Value range	UNSIGNED32
Default value	No

9.3.9 Object 6041_h: Vehicle ID

This object shall provide a character string (numeric or alpha-numeric) associated with a vehicle that uniquely identifies it to the owner. The vehicle ID may be a manufacturer's serial number or an asset number applied by the owner. The vehicle ID number may not be unique across the entire population of vehicles. Maximum number of characters shall be 20. This character string in the battery module shall be split into several UNSIGNED32 value for transmission, using expedited SDO services. Table 46 specifies the object description and Table 47 specifies the entry description.

NOTE See the example 2 (object 6031_h) for value representation.

Table 46 – Object description

Attribute	Value
Index	6041 _h
Name	Vehicle ID
Object code	ARRAY
Data type	UNSIGNED32
Category	Optional

Table 47 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01 _h to 05 _h
Default value	No
Sub-index	01 _h
Description	ASCII characters 1 to 4
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	UNSIGNED32
Default value	No

Attribute	Value
Sub-index	02 _h
Description	ASCII characters 5 to 8
Entry category	Optional
Access	ro
PDO mapping	No
Value range	UNSIGNED32
Default value	No
to	
Sub-index	05 _h
Description	ASCII characters 17 to 20
Entry category	Optional
Access	ro
PDO mapping	No
Value range	UNSIGNED32
Default value	No

9.3.10 Object 6050_h: Cumulative total Ah charge

This object shall provide the cumulative number of Ampere-hours delivered to the battery by the charger over the life of the battery. This shall be a read-only value in order to protect the integrity of the data. The battery module logic may use the Ah delivered value to internally increment the cumulative value. The values shall be given in multiples of 1 Ah. Table 48 specifies the object description and Table 49 specifies the entry description.

Table 48 – Object description

Attribute	Value
Index	6050 _h
Name	Cumulative total Ah charge
Object code	VAR
Data type	UNSIGNED32
Category	Optional

Table 49 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	No
Value range	UNSIGNED32
Default value	No

9.3.11 Object 6051_h: Ah expended since last charge

This object shall provide the number of Ampere-hours discharged from the battery pack since the last charge event. This value may represent a net energy output if the vehicle is equipped with regenerative braking. The values shall be given in multiples of 0,125 Ah. Table 50 specifies the object description and Table 51 specifies the entry description.

Table 50 – Object description

Attribute	Value
Index	6051 _h
Name	Ah expended since last charge
Object code	VAR
Data type	UNSIGNED16
Category	Optional

Table 51 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	No
Value range	UNSIGNED16
Default value	No

9.3.12 Object 6052_h: Ah returned during last charge

This object shall indicate the number of Ampere-hours delivered to the battery by the charger during the last charge event. This is a read-write message to allow the charger to read the previous value and write the current value at the completion of charge. The values shall be given in multiples of 0,125 Ah. Table 52 specifies the object description and Table 53 specifies the entry description.

Table 52 – Object description

Attribute	Value
Index	6052 _h
Name	Ah returned during last charge
Object code	VAR
Data type	UNSIGNED16
Category	Conditional: Mandatory if RPDO2 supported

Table 53 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	Default, if RPDO2 supported
Value range	UNSIGNED16
Default value	0

9.3.13 Object 6053_h: Ah since last equalization

This object shall indicate the cumulative number of Ampere-hours delivered to the battery by the charger – over the course of several charge events – since the last equalization charge. The values shall be given in multiples of 0,125 Ah. Table 54 specifies the object description and Table 55 specifies the entry description.

Table 54 – Object description

Attribute	Value
Index	6053 _h
Name	Ah since last equalization
Object code	VAR
Data type	UNSIGNED16
Category	Optional

Table 55 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	No
Value range	UNSIGNED16
Default value	0

9.3.14 Object 6054_h: Date of last equalization

This object shall indicate the date of the last equalization charge. The number of minutes, counted since midnight and the number of days counted since January 1, 1984 shall be given in minutes and days respectively. Table 56 specifies the object description and Table 57 specifies the entry description.

Table 56 – Object description

Attribute	Value
Index	6054 _h
Name	Date of last equalization
Object code	ARRAY
Data type	UNSIGNED16
Category	Optional

Table 57 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	const
PDO mapping	No
Value range	02 _h
Default value	02 _h

Attribute	Value
Sub-index	01 _h
Description	Number of minutes
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	UNSIGNED16
Default value	0
Sub-index	02 _h
Description	Number of days
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	UNSIGNED16
Default value	0

9.3.15 Object 6060_h: Battery voltage

This object shall provide the instantaneous voltage across the battery terminals as measured by a voltage-measuring device on the battery or charger. The values shall be given in multiples of (1/1024) V. Table 58 specifies the object description and Table 59 specifies the entry description.

Table 58 – Object description

Attribute	Value
Index	6060 _h
Name	Battery voltage
Object code	VAR
Data type	UNSIGNED32
Category	Conditional: Mandatory, if TPDO2 supported

Table 59 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	Default, if TPDO2 supported
Value range	UNSIGNED32
Default value	No

9.3.16 Object 6070_h: Charge current requested

This object shall provide the electrical current in Amperes requested by the battery module to be delivered by the charger to the battery. The values shall be given in multiples of (1/16) A. The value FFFF_h shall indicate the invalid value. Table 60 specifies the object description and Table 61 specifies the entry description.

Table 60 – Object description

Attribute	Value
Index	6070 _h
Name	Charge current requested
Object code	VAR
Data type	UNSIGNED16
Category	Conditional: Mandatory, if TPDO3 supported

Table 61 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	Default, if TPDO3 supported
Value range	UNSIGNED16
Default value	No

9.3.17 Object 6080_h: Charger state of charge

This object shall indicate the charger's estimation of the amount of energy contained in the battery, expressed as a percentage of the total amount of energy the battery can store. The values shall be given in multiples of 1 %. The value FF_h shall indicate the invalid value. Table 62 specifies the object description and Table 63 specifies the entry description.

Table 62 – Object description

Attribute	Value
Index	6080 _h
Name	Charger state of charge
Object code	VAR
Data type	UNSIGNED8
Category	Conditional: Mandatory, if RPDO2 to 3 supported

Table 63 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	Default, if RPDO2 to 3 supported
Value range	UNSIGNED8
Default value	FF _h

9.3.18 Object 6081_h: Battery state of charge

This object shall provide the battery's measurement of the amount of energy contained in the battery, expressed as a percentage of the total amount of energy the battery can store. The values shall be given in multiples of 1 %. The value FF_h shall indicate the invalid value. Table 64 specifies the object description and Table 65 specifies the entry description.

Table 64 – Object description

Attribute	Value
Index	6081 _h
Name	Battery state of charge
Object code	VAR
Data type	UNSIGNED8
Category	Conditional: Mandatory, if TPDO3 supported

Table 65 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	Default, if TPDO3 supported
Value range	UNSIGNED16
Default value	No

9.3.19 Object 6090_h: Water level status

This object shall indicate the need for additional water in a flooded battery i.e. full or low. Figure 4 illustrates the parameter structure. Table 66 provides the parameter definition.

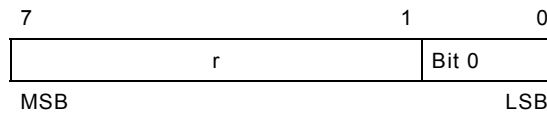


Figure 4 – Parameter structure

Table 66 – Parameter definition

Name	Bit	Value	Description
Bit 0	0	0 _b	Low
		1 _b	Full
r	1 to 7	Reserved (always 0)	

Table 67 specifies the object description and Table 68 specifies the entry description.

Table 67 – Object description

Attribute	Value
Index	6090 _h
Name	Water level status
Object code	VAR
Data type	UNSIGNED8
Category	Optional

Table 68 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	No
Value range	See parameter structure
Default value	No

Annex A (normative): Battery type parameter

The parameter structure and parameter definition for several battery types are provided in this Annex. Figure 5 illustrates the parameter structure and Table 69 provides the parameter definition of the battery type parameter (see object 6020_n sub-index 01_n). The parameter definition for lead acid (PbA) as flooded is defined in Table 69. The parameter definition for lead acid (PbA) as maintenance free is defined in Table 70. The parameter definition for nickel-cadmium is defined in Table 71. The parameter definition for nickel-zinc is defined in Table 72. The parameter definition for nickel-iron is defined in Table 73. The parameter definition for silver oxide is defined in Table 74. The parameter definition for nickel-hydrogen is defined in Table 75. The parameter definition for nickel-metal-hybrid is defined in Table 76. The parameter definition for alkaline is defined in Table 77. The parameter definition for lithium-ion is defined in Table 78. The parameter definition for zinc-bromine is defined in Table 79. The parameter definition for metal-air is defined in Table 80. The parameter definition for lithium-ion sulfides is defined in Table 81. The parameter definition for sodium beta is defined in Table 82.

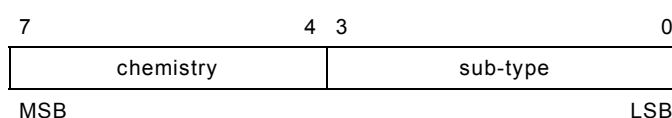


Figure 5 – Parameter structure

Table 69 – Parameter definition for lead acid (PbA) as flooded

Name	Bit	Value	Description
sub-type	0	0 _b	Flat plates
		1 _b	Tubular
	1	0 _b	Normal
		1 _b	High gravity
	2	0 _b	Reserved
		1 _b	Reserved
	3	0 _b	Flooded
		1 _b	n.a.
chemistry	4 to 7	0001 _b	lead acid

Table 70 – Parameter definition for lead acid (PbA) as maintenance free

Name	Bit	Value	Description
sub-type	0 to 1	00 _b	AGM
		01 _b	Gel
		10 _b	Hybrid
		11 _b	Not used
	2	0 _b	Reserved
		1 _b	Reserved
	3	0 _b	n.a.
		1 _b	Maintenance free
chemistry	4 to 7	0001 _b	lead acid

Table 71 – Parameter definition for nickel-cadmium

Name	Bit	Value	Description
sub-type	0	0 _b	Pocketed plate
		1 _b	Sintered plate
	1	0 _b	Reserved
		1 _b	Reserved
	2	0 _b	Reserved
		1 _b	Reserved
	3	0 _b	Vented
		1 _b	Sealed
chemistry	4 to 7	0010 _b	nickel-cadmium

Table 72 – Parameter definition for nickel-zinc (NiZn)

Name	Bit	Value	Description
sub-type	0	0 _b	Reserved
		1 _b	Reserved
	1	0 _b	Reserved
		1 _b	Reserved
	2	0 _b	Reserved
		1 _b	Reserved
	3	0 _b	n.a.
		1 _b	Sealed
chemistry	4 to 7	0011 _b	nickel-zinc

Table 73 – Parameter definition for nickel-iron (NiFe)

Name	Bit	Value	Description
sub-type	0	0 _b	Reserved
		1 _b	Reserved
	1	0 _b	Reserved
		1 _b	Reserved
	2	0 _b	Reserved
		1 _b	Reserved
	3	0 _b	Reserved
		1 _b	Reserved
chemistry	4 to 7	0101 _b	nickel-iron

Table 74 – Parameter definition for silver oxide (Ag₂O)

Name	Bit	Value	Description
sub-type	0 to 1	00 _b	AgZn
		01 _b	AgCd
		10 _b	AgFe
		11 _b	Not used
	2	0 _b	Reserved
		1 _b	Reserved
	3	0 _b	Reserved
		1 _b	Reserved
chemistry	4 to 7	0110 _b	silver oxide

Table 75 – Parameter definition for nickel-hydrogen (NiH₂)

Name	Bit	Value	Description
sub-type	0	0 _b	Reserved
		1 _b	Reserved
	1	0 _b	Reserved
		1 _b	Reserved
	2	0 _b	Reserved
		1 _b	Reserved
	3	0 _b	Reserved
		1 _b	Reserved
chemistry	4 to 7	0111 _b	nickel-hydrogen

Table 76 – Parameter definition for nickel-metal-hybrid (NiMH)

Name	Bit	Value	Description
sub-type	0	0 _b	Reserved
		1 _b	Reserved
	1	0 _b	Reserved
		1 _b	Reserved
	2	0 _b	Reserved
		1 _b	Reserved
	3	0 _b	Reserved
		1 _b	Reserved
chemistry	4 to 7	1000 _b	nickel-metal-hybrid

Table 77 – Parameter definition for alkaline as zinc and manganese dioxide (Zn-Mn₂O)

Name	Bit	Value	Description
sub-type	0	0 _b	Reserved
		1 _b	Reserved
	1	0 _b	Reserved
		1 _b	Reserved
	2	0 _b	Reserved
		1 _b	Reserved
	3	0 _b	Reserved
		1 _b	Reserved
chemistry	4 to 7	1001 _b	alkaline

Table 78 – Parameter definition for lithium-ion

Name	Bit	Value	Description
sub-type	0	0 _b	Reserved
		1 _b	Reserved
	1	0 _b	Reserved
		1 _b	Reserved
	2	0 _b	Reserved
		1 _b	Reserved
	3	0 _b	Reserved
		1 _b	Reserved
chemistry	4 to 7	1010 _b	lithium-ion

Table 79 – Parameter definition for zinc bromine

Name	Bit	Value	Description
sub-type	0	0 _b	Reserved
		1 _b	Reserved
	1	0 _b	Reserved
		1 _b	Reserved
	2	0 _b	Reserved
		1 _b	Reserved
	3	0 _b	Reserved
		1 _b	Reserved
chemistry	4 to 7	1011 _b	zinc bromine

Table 80 – Parameter definition for metal-air

Name	Bit	Value	Description
sub-type	0	0 _b	Reserved
		1 _b	Reserved
	1	0 _b	Reserved
		1 _b	Reserved
	2	0 _b	Reserved
		1 _b	Reserved
	3	0 _b	Reserved
		1 _b	Reserved
chemistry	4 to 7	1100 _b	metal-air

Table 81 – Parameter definition for lithium-iron sulfide (LiFeS or LiFeS₂)

Name	Bit	Value	Description
sub-type	0	0 _b	Reserved
		1 _b	Reserved
	1	0 _b	Reserved
		1 _b	Reserved
	2	0 _b	Reserved
		1 _b	Reserved
	3	0 _b	Reserved
		1 _b	Reserved
chemistry	4 to 7	1101 _b	lithium-iron sulfide

Table 82 – Parameter definition for sodium beta

Name	Bit	Value	Description
sub-type	0	0 _b	Reserved
		1 _b	Reserved
	1	0 _b	Reserved
		1 _b	Reserved
	2	0 _b	Reserved
		1 _b	Reserved
	3	0 _b	Reserved
		1 _b	Reserved
chemistry	4 to 7	1110 _b	sodium beta

Annex B (normative): Pilot signal

The Figure 6 shows a schematic of the pilot circuit, which may be used to allow the charger and battery module to detect each other's presence without any of the latency involved in checking that a communication link is active. Its main purpose is to allow the charger to quickly reduce its output current when the connection to the battery is lost in order to limit arcing between the connector contacts.

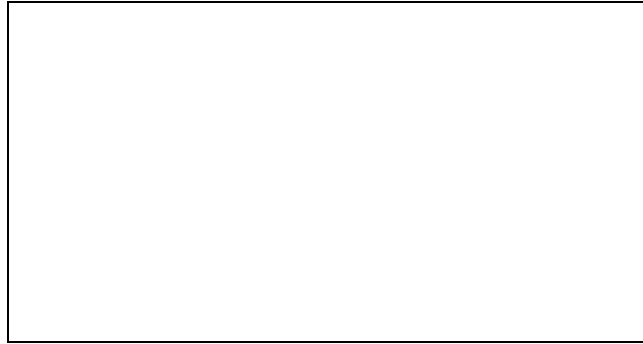


Figure 6 – Connection between charger and vehicle battery

Annex C (informative): Overview on application objects

The battery module specific mandatory and optional application objects are listed in Table 83

Table 83 – Overview on application objects

Index	Object code	Name	Data type	Access	Category
6000 _n	VAR	Battery status	UNSIGNED8	ro	M
6001 _n	VAR	Charger status	UNSIGNED8	rw	M
6010 _n	VAR	Temperature	INTEGER16	ro	M
6020 _n	RECORD	Battery parameters	BatteryPar (see object 0080 _n)	ro	M
6030 _n	ARRAY	Battery serial number	UNSIGNED32	ro	O
6031 _n	ARRAY	Battery ID	UNSIGNED32	ro	O
6040 _n	ARRAY	Vehicle serial number	UNSIGNED32	ro	O
6041 _n	ARRAY	Vehicle ID	UNSIGNED32	ro	O
6050 _n	VAR	Cumulative total Ah charge	UNSIGNED32	ro	O
6051 _n	VAR	Ah expended since last charge	UNSIGNED16	ro	O
6052 _n	VAR	Ah returned during last charge	UNSIGNED16	rw	C
6053 _n	VAR	Ah since last equalization	UNSIGNED16	rw	O
6054 _n	ARRAY	Date of last equalization	UNSIGNED16	rw	O
6060 _n	VAR	Battery voltage	UNSIGNED32	ro	C
6070 _n	VAR	Charge current requested	UNSIGNED16	ro	C
6080 _n	VAR	Charger state of charge	UNSIGNED8	rw	C
6081 _n	VAR	Battery state of charge	UNSIGNED8	ro	C
6090 _n	VAR	Water level status	UNSIGNED8	ro	O