

CiA Draft Standard 418



Device profile for battery modules

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1 Scope

This device profile describes 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 References

- | | |
|--------------|---|
| /CiA301/ | CiA 301, CANopen application layer and communication profile |
| /ISO11898-1/ | ISO 11898-1, Road vehicles – Controller area network (CAN) – Part 1: Data link layer and physical signaling |
| /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 |
| /CiA419/ | CiA 419, CANopenprofile for battery chargers |

3 Abbreviations and definitions

3.1 Abbreviations

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

3.2 Definitions

The definitions given in /CiA301/ apply to this specification, too.

4 Operating principles

4.1 General

The purpose of the battery module is to provide information to a charger sufficient to allow a charge to be carried out. The minimum information required is the battery type, battery capacity, number of cells, maximum charge current permissible, and the battery temperature. All devices conforming to this specification shall provide this information in the manner described. Additional, optional information, such as various identifiers, charge history data, battery voltage, battery state of charge, requested current and water level status are also defined. Conforming devices need not supply this information, but if they do, they shall provide it in the manner described herein.

A default TPDO is defined to send the battery temperature and status information on a timer driven basis. Optional TPDOs are defined for transmitting battery voltage, current requests and state of charge. A default RPDO is defined to receive charger status. An optional RPDO adds charge returned to the data received. 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. If the module supports the optional PDOs, then they can be configured via SDO services.

The battery module shall support the heartbeat function, and may optionally be a time-stamp consumer.

4.2 Physical layer

4.2.1 Connector

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 appendix B). The actual connector used and its pin configuration will vary depending on the battery's application, and thus is outside of the scope of this document.

4.2.2 CAN transceiver

The CAN bus shall use standard high-speed differential transceivers compliant to /ISO11898-2/. The battery module shall support at least the 125 kbit/s default bit-rate. A termination resistor of 124 Ohm shall be included in the default battery module configuration.

5 Error handling

5.1 Principle

Emergency messages are triggered by internal errors in the device, and are assigned the highest possible priority to minimize latency on access to the bus. The emergency message contains the emergency error code, and the error register object /CiA301/. Additional data bytes are included in the message, which may be used for manufacturer specific information.

5.2 Error behavior

If a serious device failure is detected, the module shall enter the pre-operational state by default. If object 1029_h is implemented, the module may be configured to enter the stopped state or remain in the current state as alternatives. Device failures shall include the following communication errors:

- CAN bus-off condition
- Heartbeat event with the state 'occurred'

Device failure may also be caused by internal module failures, e.g. missing the pilot signal.

5.3 Additional error code meanings

The CANopen standard error codes are given in /CiA301/. Additional error codes specific to the battery module are given in Table 1.

Table 1: Additional error codes

Error code	Meaning
5010 _h	temperature sensor fault

6 Communication object definitions

6.1 Introduction

One default RPDO and one default TPDO are defined. All modules compliant to this device profile shall support these PDOs, which transmit battery status and battery temperature from the battery module, and receive charger status from the charger. Two optional RPDOs and one optional TPDO are defined as alternate PDO formats. These PDOs shall contain additional data (battery voltage in the TPDO, and Ah returned and state of charge in the RPDOs), and, if supported by a module, they may be enabled via SDO services, and the default PDO disabled. One additional optional TPDO is defined for transmitting optional information (current requested and state of charge).

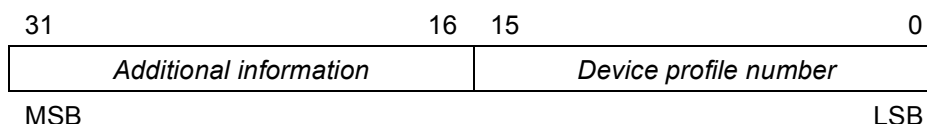
Modules compliant with this device profile shall have default values for some communication objects (1000_h to 1FFF_h), which are not fully specified in /CiA301/.

6.2 Detailed object definitions

6.2.1 Object 1000_h: Device type

This object describes the battery module's functionality.

VALUE DEFINITION



Device profile number: 418_d

Additional information: Bits 16 through 19 shall be used to indicate support for optional features. The other bits are reserved (and shall read as 0). Table 2 shows the optional features associated with each bit. The bits shall be 1 if the feature is supported, and shall be 0 if they are not supported.

Table 2: Support of optional PDOs

Bit	Optional feature
16	2 nd RPDO
17	3 rd RPDO
18	2 nd TPDO
19	3 rd TPDO
20 to 31	reserved

OBJECT DESCRIPTION

See /CiA301/.

ENTRY DESCRIPTION

See /CiA301/.

6.2.2 Object 1001_h: Error register

The device specific bit of the error register shall indicate a temperature sensor fault.

6.2.3 1st RPDO

6.2.3.1 General

This RPDO shall be received asynchronously. The mapped objects shall be updated immediately after successful RPDO reception.

6.2.3.2 Object 1400_h: Communication parameter**VALUE DEFINITION**

See /CiA301/.

OBJECT DESCRIPTION

INDEX	1400 _h
Name	RPDO parameter
Object code	RECORD
Data type	PDO CommPar
Category	Mandatory

ENTRY DESCRIPTION

Sub-index	00 _h
Description	highest sub-index supported
Entry category	Mandatory
Access	ro
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 0200 _h or 4000 0200 _h) + node-ID

Sub-index	02 _h
Description	transmission type
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	255 _d

Sub-index	05 _h
Description	event timer
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	0 _d

6.2.3.3 Object 1600_h: Mapping parameter

VALUE DEFINITION

See /CiA301/.

OBJECT DESCRIPTION

INDEX	1600 _h
Name	RPDO mapping
Object code	RECORD
Data type	PDO mapping
Category	Mandatory

ENTRY DESCRIPTION

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	charger status
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	6001 00 08 _h

6.2.4 1st TPDO

6.2.4.1 General

The battery module shall transmit periodically status and temperature information, if this TPDO has been enabled. The data shall be updated before transmission regardless of whether 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).

6.2.4.2 Object 1800_h: Communication parameter**VALUE DEFINITION**

See /CiA301/.

OBJECT DESCRIPTION

INDEX	1800 _h
Name	TPDO parameter
Object code	RECORD
Data type	PDO CommPar
Category	Mandatory

ENTRY DESCRIPTION

Sub-index	00 _h
Description	highest sub-index supported
Entry category	Mandatory
Access	ro
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	80000 0180 _h + node-ID

Sub-index	02 _h
Description	transmission type
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	255 _d

Sub-index	03 _h
Description	inhibit time
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	0 _d

Sub-index	05 _h
Description	event timer
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	200 _d

6.2.4.3 Object 1A00_n: Mapping parameter

VALUE DEFINITION

See /CiA301/.

OBJECT DESCRIPTION

INDEX	1A00 _n
Name	TPDO mapping
Object code	RECORD
Data type	PDO mapping
Category	Mandatory

ENTRY DESCRIPTION

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	temperature
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	6010 00 10 _h

Sub-index	02 _h
Description	battery status
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	6000 00 08 _h

6.2.5 2nd RPDO

6.2.5.1 General

This RPDO is optional and contains in addition to the charger status the Ah returned during the charge in progress. It shall be received asynchronously; the mapped objects shall be updated immediately after successful RPDP reception.

6.2.5.2 Object 1401_h: Communication parameter

VALUE DEFINITION

See /CiA301/.

OBJECT DESCRIPTION

INDEX	1401 _h
Name	RPDO parameter
Object code	RECORD
Data type	PDO CommPar
Category	Conditional: Bit 16 = 1 in object 1000 _h

ENTRY DESCRIPTION

Sub-index	00 _h
Description	highest sub-index supported
Entry category	Mandatory
Access	ro
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

Sub-index	02 _h
Description	transmission type
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	255 _d

Sub-index	05 _h
Description	event timer
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	0 _d

6.2.5.3 Object 1601_h: Mapping parameter

VALUE DEFINITION

See /CiA301/.

OBJECT DESCRIPTION

INDEX	1601 _h
Name	RPDO mapping
Object code	RECORD
Data type	PDO mapping
Category	Conditional: Bit 16 = 1 in object 1000 _h

ENTRY DESCRIPTION

Sub-index	00 _h
Description	number of mapped objects
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	02 _h

Sub-index	01 _h
Description	Charger status
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	6001 00 08 _h

Sub-index	02 _h
Description	Ah returned during last charge
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	6052 00 10 _h

6.2.6 2nd TPDO**6.2.6.1 General**

This TPDO is an optional substitute for the 1st TPDO, and adds the battery voltage to the transmission of the temperature and status. If the module supports this TPDO, the charger may disable the 1st TPDO and enable this one if desired. The data shall be updated before transmission regardless of whether 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).

6.2.6.2 Object 1801_h: Communication parameter**VALUE DEFINITION**

See /CiA301/.

OBJECT DESCRIPTION

INDEX	1801 _h
Name	TPDO parameter
Object code	RECORD
Data type	PDO CommPar
Category	Conditional: Bit 18 = 1 in object 1000 _h

ENTRY DESCRIPTION

Sub-index	00 _h
Description	highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	<i>see</i> /CiA301/
Default value	05 _h

Sub-index	01 _h
Description	COB-ID
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	<i>see</i> /CiA301/
Default value	8000 0280 _h + node-ID

Sub-index	02 _h
Description	transmission type
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	<i>see</i> /CiA301/
Default value	255 _d

Sub-index	03 _h
Description	inhibit timer
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	0 _d

Sub-index	05 _h
Description	event timer
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	200 _d

6.2.6.3 Object 1A01_n: Mapping parameter

VALUE DEFINITION

See /CiA301/.

OBJECT DESCRIPTION

INDEX	1A01 _n
Name	TPDO mapping
Object code	RECORD
Data type	PDO mapping
Category	Conditional: Bit 18 = 1 in object 1000 _n

ENTRY DESCRIPTION

Sub-index	00 _h
Description	number of mapped objects
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	03 _h

Sub-index	01 _h
Description	temperature
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	6010 00 10 _h

Sub-index	02 _h
Description	battery status
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	6000 00 08 _h

Sub-index	03 _h
Description	battery voltage
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	6060 00 20 _h

6.2.7 3rd RPDO

6.2.7.1 General

This RPDO is optional and contains in addition to the charger status the Ah returned during the charge in progress to the transmission of the charger status and the charger state of charge.

6.2.7.2 Object 1402_h: Communication parameter

VALUE DEFINITION

See /CiA301/.

OBJECT DESCRIPTION

INDEX	1402 _h
Name	RPDO parameter
Object code	RECORD
Data type	PDO CommPar
Category	Conditional: Bit 17 = 1 in object 1000 _h

ENTRY DESCRIPTION

Sub-index	00 _h
Description	highest sub-index supported
Entry category	Mandatory
Access	ro
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	ro
PDO mapping	No
Value range	see /CiA301/
Default value	255 _d

Sub-index	05 _h
Description	event timer
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	0 _d

6.2.7.3 Object 1602_h: Mapping parameter

VALUE DEFINITION

See /CiA301/.

OBJECT DESCRIPTION

INDEX	1602 _h
Name	RPDO mapping
Object code	RECORD
Data type	PDO mapping
Category	Conditional: Bit 17 = 1 in object 1000 _h

ENTRY DESCRIPTION

Sub-index	00 _h
Description	number of mapped objects
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	<i>see</i> /CiA301/
Default value	03 _h

Sub-index	01 _h
Description	Charger status
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	<i>see</i> /CiA301/
Default value	6001 00 08 _h

Sub-index	02 _h
Description	Ah returned during last charge
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	<i>see</i> /CiA301/
Default value	6052 00 10 _h

Sub-index	03 _h
Description	chargers state of charge
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	<i>see</i> /CiA301/
Default value	6080 00 08 _h

6.2.8 3rd TPDO**6.2.8.1 General**

This TPDO is an optional additional object with which the module can transmit a requested current value and the battery-state of charge to the charger. The data shall be updated before transmission regardless of whether 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).

6.2.8.2 Object 1802_h: Communication parameter**VALUE DEFINITION**

See /CiA301/.

OBJECT DESCRIPTION

INDEX	1802 _h
Name	TPDO parameter
Object code	RECORD
Data type	PDO CommPar
Category	Conditional: Bit 19 = 1 in object 1000 _h

ENTRY DESCRIPTION

Sub-index	00 _h
Description	highest sub-index supported
Entry category	Mandatory
Access	ro
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 0380 _h + node-ID

Sub-index	02 _h
Description	transmission type
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	255 _d

Sub-index	03 _h
Description	inhibit timer
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	0 _d

Sub-index	05 _h
Description	event timer
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	200 _d

6.2.8.3 Object 1A02_h: Mapping parameter

VALUE DEFINITION

See /CiA301/.

OBJECT DESCRIPTION

INDEX	1A02 _h
Name	TPDO mapping
Object code	RECORD
Data type	PDO mapping
Category	Conditional: Bit 19 = 1 in object 1000 _h

ENTRY DESCRIPTION

Sub-index	00 _h
Description	number of mapped objects
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	see /CiA301/
Default value	02 _h

Sub-index	01 _h
Description	charge current requested
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	6070 00 10 _h

Sub-index	02 _h
Description	battery state of charge
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	see /CiA301/
Default value	6081 00 08 _h

7 Application object definitions

7.1 Introduction

Object description and entry description attributes are specified in /CiA301/. The *default value* attribute defines the value of an object with *access* attribute of the value 'rw' and 'wo' after power-on or application reset.

Detailed object specifications are given in the following sections.

7.2 Complex data type definition

7.2.1 Record 0080_h: BatteryPar

Sub-index 1: *Battery type*

Generic description of the battery chemistry and configuration. Refer to *appendix A* for details.

Sub-index 2: *Ah capacity*

Nominal energy capacity in Ampere-hours as provided by the battery manufacturer.

Sub-index 3: *Maximum charge current*

Maximum current in Amperes that is safely delivered to the battery without causing physical damage to the battery or its interconnecting straps or cables.

Sub-index 4: *Number of cells*

Number of battery cells that make up the battery pack.

Index	Sub-index	BatteryPar record	Data type
0080 _h	00 _h	Highest sub-index supported	Unsigned8
	01 _h	Battery type	Unsigned8
	02 _h	Ah capacity	Unsigned16
	03 _h	Maximum charge current	Unsigned16
	04 _h	Number of cells	Unsigned16

7.3 Detailed object definitions

7.3.1 Object 6000_h: Battery status

This object shall provide the status of the battery, which indicates the readiness of the battery to accept a charge or not.

VALUE DEFINITION

The status byte shall have the following format:

7	1	0
Reserved (0)	Bit 0	

7.3.3 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.

VALUE DEFINITION

Temperature shall be given in °C with resolution 0.125 °C per bit. The minimum range of values shall be -320 to +680 (i.e. -40.0 °C to +85.0 °C).

OBJECT DESCRIPTION

INDEX	6010 _h
Name	temperature
Object Code	VAR
Data Type	Integer16
Category	Mandatory

ENTRY DESCRIPTION

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

7.3.4 Object 6020_h: Battery parameters

This object shall provide the battery parameters.

VALUE DEFINITION

See clause 7.2.1.

OBJECT DESCRIPTION

INDEX	6020 _h
Name	battery parameters
Object code	RECORD
Data type	BatteryPar
Category	Mandatory

ENTRY DESCRIPTION

Sub-index	00 _h
Description	highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	04 _h
Default value	04 _h

Sub-index	01 _h
Description	battery type
Data type	Unsigned8
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

Sub-index	04 _h
Description	number of cells
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	Unsigned16
Default value	No

7.3.5 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. Character strings in the battery module shall be packed into Unsigned32 objects to allow them to be transferred using expedited SDO services.

VALUE DEFINITION

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

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

OBJECT DESCRIPTION

Index	6030 _h
Name	battery serial number
Object code	ARRAY
Data type	Unsigned32
Category	Optional

ENTRY DESCRIPTION

Sub-index	00 _h
Description	number of elements
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01 _h to 03 _h
Default value	No

Sub-index	01 _h
Description	packed ASCII characters 1 to 4
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	Unsigned32
Default value	No

Sub-index	02 _h
Description	packed ASCII characters 5 to 8
Entry category	Optional
Access	ro
PDO mapping	No
Value range	Unsigned32
Default value	No

Sub-index	03 _h
Description	packed ASCII characters 9 and 10
Entry category	Optional
Access	ro
PDO mapping	No
Value range	Unsigned32
Default value	No

7.3.6 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.

VALUE DEFINITION

Character strings in the battery module shall be packed into Unsigned32 objects to allow them to be transferred using expedited SDO services. For an example of the packing, refer to object 6030_h.

OBJECT DESCRIPTION

Index	6031 _h
Name	battery ID
Object code	ARRAY
Data type	Unsigned32
Category	Optional

ENTRY DESCRIPTION

Sub-index	00 _h
Description	number of elements
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01 _h to 05 _h
Default value	No

Sub-index	01 _h
Description	packed ASCII characters 1 to 4
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	Unsigned32
Default value	No

Sub-index	02 _h
Description	packed 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	packed ASCII characters 17 to 20
Entry category	Optional
Access	ro
PDO mapping	No
Value range	Unsigned32
Default value	No

7.3.7 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.

VALUE DEFINITION

Character strings in the battery module shall be packed into Unsigned32 objects to allow them to be transferred using expedited SDO services. For an example of the packing, refer to object 6030_h.

OBJECT DESCRIPTION

Index	6040 _h
Name	vehicle serial number
Object code	ARRAY
Data type	Unsigned32
Category	Optional

ENTRY DESCRIPTION

Sub-index	00 _h
Description	number of elements
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01 _h to 05 _h
Default value	No

Sub-index	01 _h
Description	packed ASCII characters 1 to 4
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	Unsigned32
Default value	No

Sub-index	02 _h
Description	packed 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	packed ASCII characters 17 to 20
Entry category	Optional
Access	ro
PDO mapping	No
Value range	Unsigned32
Default value	No

7.3.8 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.

VALUE DEFINITION

Character strings in the battery module shall be packed into Unsigned32 objects to allow them to be transferred using expedited SDO services. For an example of the packing, refer to object 6030_h.

OBJECT DESCRIPTION

Index	6041 _h
Name	vehicle ID
Object code	ARRAY
Data type	Unsigned32
Category	Optional

ENTRY DESCRIPTION

Sub-index	00 _h
Description	number of elements
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01 _h to 05 _h
Default value	No

Sub-index	01 _h
Description	packed ASCII characters 1 to 4
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	Unsigned32
Default value	No

Sub-index	02 _h
Description	packed 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	packed ASCII characters 17 to 20
Entry category	Optional
Access	ro
PDO mapping	No
Value range	Unsigned32
Default value	No

7.3.9 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.

VALUE DEFINITION

The resolution shall be 1 Ah per bit.

OBJECT DESCRIPTION

Index	6050 _h
Name	cumulative total ah charge
Object code	VAR
Data type	Unsigned32
Category	Optional

ENTRY DESCRIPTION

Sub-index	00 _h
Access	ro
PDO mapping	No
Value range	Unsigned32
Default value	No

7.3.10 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.

VALUE DEFINITION

The resolution shall be 0.125 Ah per bit.

OBJECT DESCRIPTION

INDEX	6051 _h
Name	ah expended since last charge
Object code	VAR
Data type	Unsigned16
Category	Optional

ENTRY DESCRIPTION

Sub-index	00 _h
Access	ro
PDO mapping	No
Value range	Unsigned16
Default value	No

7.3.11 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.

VALUE DEFINITION

The resolution shall be 0.125 Ah per bit.

OBJECT DESCRIPTION

INDEX	6052 _h
Name	ah returned during last charge
Object code	VAR
Data type	Unsigned16
Category	Mandatory: if RPDO2 is supported

ENTRY DESCRIPTION

Sub-index	00 _h
Access	rw
PDO mapping	Default if RPDO2 is supported
Value range	Unsigned16
Default value	00 _h

7.3.12 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.

VALUE DEFINITION

The resolution shall be 0.125 Ah per bit.

OBJECT DESCRIPTION

INDEX	6053 _h
Name	ah since last equalization
Object code	VAR
Data type	Unsigned16
Category	Optional

ENTRY DESCRIPTION

Sub-index	00 _h
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	00 _h

7.3.13 Object 6054_h: Date of last equalization

This object shall indicate the date of the last equalization charge.

VALUE DEFINITION

The number of minutes since midnight and the number of days since January 1, 1984 shall be given in minute/bit respectively in day/bit.

OBJECT DESCRIPTION

INDEX	6054 _h
Name	date of last equalization
Object code	ARRAY
Data type	Unsigned16
Category	Optional

ENTRY DESCRIPTION

Sub-Index	00 _h
Description	number of elements
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	02 _h
Default value	02 _h

Sub-index	01 _h
Description	number of minutes
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	00 _h

Sub-index	02 _h
Description	number of days
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	00 _h

7.3.14 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.

VALUE DEFINITION

The resolution shall be 1/1024 V per bit.

OBJECT DESCRIPTION

INDEX	6060 _h
Name	battery voltage
Object code	VAR
Data type	Unsigned32
Category	Mandatory: if TPDO2 is supported

ENTRY DESCRIPTION

Sub-Index	00 _h
Access	ro
PDO mapping	Default if TPDO2 is supported
Value range	Unsigned32
Default value	No

7.3.15 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.

VALUE DEFINITION

The resolution shall be 1/16 A per bit. FF_h shall indicate an invalid value.

OBJECT DESCRIPTION

INDEX	6070 _h
Name	charge current requested
Object code	VAR
Data type	Unsigned16
Category	Mandatory: if TPDO3 is supported

ENTRY DESCRIPTION

Sub-index	00 _h
Access	ro
PDO mapping	Default if TPDO3 is supported
Value range	Unsigned16
Default value	No

7.3.16 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.

VALUE DEFINITION

Resolution shall be 1 % per bit. FF_h shall indicate an invalid value.

OBJECT DESCRIPTION

INDEX	6080 _h
Name	charger state of charge
Object code	VAR
Data type	Unsigned8
Category	Mandatory: if RPDO2/3 is supported

ENTRY DESCRIPTION

Sub-index	00 _h
Access	rw
PDO mapping	Default if RPDO2/3 is supported
Value range	00 _h to 64 _h and FF _h
Default value	FF _h

7.3.17 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.

VALUE DEFINITION

Resolution shall be 1 % per bit.

OBJECT DESCRIPTION

INDEX	6081 _h
Name	battery state of charge
Object code	VAR
Data type	Unsigned8
Category	Mandatory: if TPDO3 is supported

ENTRY DESCRIPTION

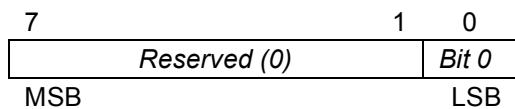
Sub-index	00 _h
Access	ro
PDO mapping	Default if TPDO3 is supported
Value range	00 _h to 64 _h and FF _h
Default value	No

7.3.18 Object 6090_h: Water level status

This object shall indicate the need for additional water in a flooded battery-i.e., full or low.

VALUE DEFINITION

The status byte shall have the following format:



Bit 0: 0 = low

1 = full

OBJECT DESCRIPTION

INDEX	6090 _h
Name	water level status
Object code	VAR
Data type	Unsigned8
Category	Optional

ENTRY DESCRIPTION

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

Appendix A (normative): Battery type parameter

The battery type parameter (object 6020_n sub-index 1) shall be given in following format:

cccc wxyz

where cccc gives the chemistry, and wxyz describes the sub-types.

A.1 Lead acid (PbA)

cccc 0001

w 0 for flooded
1 for maintenance free

A.1.1 Flooded

x reserved
y 0 for normal
1 for high gravity
z 0 for flat plates
1 for tubular

A.1.2 Maintenance free

x reserved
yz 00 for AGM
01 for gel
10 for hybrid
11 not used

eg. flooded, normal gravity, flat plate PbA: 00010000

A.2 Nickel cadmium

cccc 0010

w 0 for vented
1 for sealed

x reserved
y reserved
z 0 for pocket plate
1 for sintered plate

A.3 Nickel zinc (NiZn)

cccc 0011

wxyz reserved

A.4 Nickel iron (NiFe)

cccc 0101
wxyz reserved

A.5 Silver oxide

cccc 0110
wx reserved
yz 00 for AgZn
01 for AgCd
10 for AgFe
11 not used

A.6 Nickel hydrogen (NiH₂)

cccc 0111
wxyz reserved

A.7 Nickel metal hydride (NiMH)

cccc 1000
wxyz reserved

A.8 Zinc/Alkaline/Manganese dioxide

cccc 1001
wxyz reserved

A.9 Lithium ion (LiI)

cccc 1010
wxyz reserved

A.10 Zinc bromine

cccc 1011
wxyz reserved

A.11 Metal air

cccc 1100
wxyz reserved

A.12 Lithium/Iron sulfide

cccc 1101

wxyz reserved

A.13 Sodium beta

cccc 1110

wxyz reserved

Appendix B (normative): Pilot signal

The *figure 1* 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.

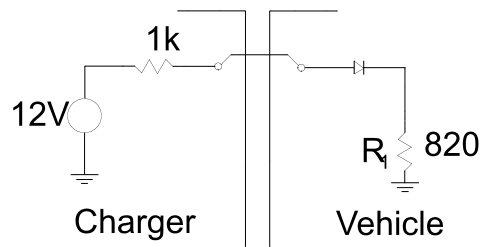


Figure 1: Connection between charger and vehicle battery

Appendix C (informative): Overview on application objects

Battery module specific mandatory and optional application objects are listed in:

Table 3: Overview on application objects

Index	Object code	Name	Data type	Access	Category
6000 _h	VAR	Battery status	Unsigned8	ro	M
6001 _h	VAR	Charger status	Unsigned8	rw	M
6010 _h	VAR	Temperature	Integer16	ro	M
6020 _h	RECORD	Battery parameters	BatteryPar (80 _h)	ro	M
6030 _h	ARRAY	Battery serial number	Unsigned32	ro	O
6031 _h	ARRAY	Battery ID	Unsigned32	ro	O
6040 _h	ARRAY	Vehicle serial number	Unsigned32	ro	O
6041 _h	ARRAY	Vehicle ID	Unsigned32	ro	O
6050 _h	VAR	Cumulative total Ah charge	Unsigned32	ro	O
6051 _h	VAR	Ah expended since last charge	Unsigned16	ro	O
6052 _h	VAR	Ah returned during last charge	Unsigned16	rw	C ¹
6053 _h	VAR	Ah since last equalization	Unsigned16	rw	O
6054 _h	ARRAY	Date of last equalization	Unsigned16	rw	O
6060 _h	VAR	Battery voltage	Unsigned32	ro	C ¹
6070 _h	VAR	Charge current requested	Unsigned16	ro	C ¹
6080 _h	VAR	Charger state of charge	Unsigned8	rw	C ¹
6081 _h	VAR	Battery state of charge	Unsigned8	ro	C ¹
6090 _h	VAR	Water level status	Unsigned8	ro	O

¹ Mandatory, if PDOs are implemented that maps this object by default