CiA Draft Standard Proposal 418

Device Profile for Battery Modules

This is a draft standard proposal and may be changed without notification

Version 1.0

6 October 2002

HISTORY

Date	Changes
2002-10-6	• First public release

CONTENTS

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 /1/. Programmable battery modules may use communication techniques, which conform to those described in the framework for CANopen programmable devices /2/. These specifications should be consulted in parallel to this device profile specification.

2 Normative references

/1/: CiA DS 301 V4.02, CANopen application layer and communication profile, April 2002.

/2/: CiA DSP 302 V3.1, Framework for programmable CANopen devices, May 2002.

/3/ ISO FDIS 11898-1:2002, Road vehicles - Controller area network (CAN) - Part 1: Data link layer and physical signaling

/4/ ISO FDIS 11898-2:2002, Road vehicles - Controller area network (CAN) - Part 2: High-speed medium access unit

/5/ ISO 646:1983, ISO 7-bit coded character set for information exchange

3 Definitions, acronyms and abbreviations

CAN

Controller Area Network: Data link layer protocol for serial communication as specified in ISO FDIS 11898-1:2002.

RPDO

Receive Process Data Object: Communication object of a device, which contains output data.

SDO

Service Data Object: Peer-to-peer communication with read- and write-access to the Object Dictionary of a CANopen device.

TPDO

Transmit Process Data Object: Communication object of a device, which contains input data.

4 Operating principles

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.

4.1 Physical layer

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. 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.

4.1.1 CAN transceiver

The CAN bus shall use standard high-speed differential transceivers compliant to /4/. The battery module shall support at least the 125 kbit/s default baud rate. A termination resistor of 124 Ohms 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 (see /1/). 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 /1/. Additional error codes specific to the battery module are given in the following table.

Error Code	Meaning
5010_h	temperature sensor fault

6 Pre-definitions

6.1 Introduction

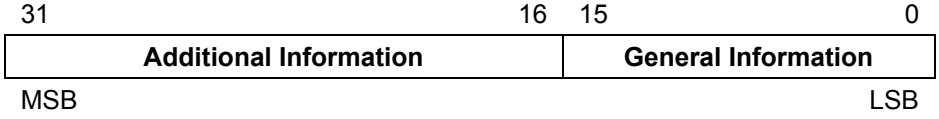
One default RPDO and one default TPDO are defined. All modules compliant to this device profile shall support these PDOs, which transmit battery status and battery temperature from the battery module, and receive charger status from the charger. Two optional RPDOs and one optional TPDO are defined as 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).

6.2 Pre-defined communication objects

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 /1/.

6.2.1 Object 1000_h: Device type

This object describes the type of battery module and its functionality.



General Information:

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). The following table 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.

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

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 definition

This RPDO shall receive asynchronously the value of the charger status byte.

Default COB-ID

31	30	29	28 ... 11	10 ... 0
0	1	0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	200_h + node-ID
MSB				LSB

Index	Sub-index	Name	Default value
1400_h	0_h	Largest sub-index supported	2_h
	1_h	COB-ID	See above
	2_h	transmission type	255_d

Index	Sub-index	Name	Default value
1600_h	0_h	Number of mapped objects	1_h
	1_h	Charger status	6001 00 08_h

6.2.4 1st TPDO definition

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).

Default COB-ID

31	30	29	28 ... 11	10 ... 0
1	0	0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	180_h + node-ID
MSB				LSB

Index	Sub-index	Name	Default value
1800_h	0_h	Largest sub-index supported	5_h
	1_h	COB-ID	See above
	2_h	Transmission type	255_d
	3_h	Inhibit timer	0
	4_h	reserved	-
	5_h	Event timer	200_d

Index	Sub-index	Name	Default value
$1A00_h$	0_h	Number of mapped objects	2_h
	1_h	Temperature	6010 00 10_h
	2_h	Battery status	6000 00 08_h

6.2.5 2nd RPDO definition

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

Default COB-ID

31	30	29	28 ... 11	10 ... 0
0	1	0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	300_h + node-ID
MSB				LSB

Index	Sub-index	Name	Default value
1401_h	0_h	Largest sub-index supported	2_h
	1_h	COB-ID	See above
	2_h	Transmission type	255_d

Index	Sub-index	Name	Default value
1601_h	0_h	Number of mapped objects	2_h
	1_h	Charger status	6001 00 08_h
	2_h	Ah returned during last charge	6052 00 10_h

6.2.6 2nd TPDO definition

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).

Default COB-ID

31	30	29	28 ... 11	10 ... 0
1	0	0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	280_h + node-ID
MSB				LSB

Index	Sub-index	Name	Default value
1801_h	0_h	Largest sub-index supported	5_h
	1_h	COB-ID	See above
	2_h	Transmission type	255_d
	3_h	Inhibit timer	0
	4_h	reserved	-
	5_h	Event timer	200_d

Index	Sub-index	Name	Default value
$1A01_h$	0_h	Number of mapped objects	3_h
	1_h	Temperature	6010 00 10_h
	2_h	Battery status	6000 00 08_h
	3_h	Battery voltage	6060 00 20_h

6.2.7 3rd RPDO definition

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.

Default COB-ID

31	30	29	28 ... 11	10 ... 0
0	1	0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	400_h + node-ID

MSB LSB

Index	Sub-index	Name	Default value
1402_h	0_h	Largest sub-index supported	2_h
	1_h	COB-ID	See above
	2_h	Transmission type	255_d

Index	Sub-index	Name	Default value
1602_h	0_h	Number of mapped objects	3_h
	1_h	Charger status	6001 00 08_h
	2_h	Ah returned during last charge	6052 00 10_h
	3_h	Chargers state of charge	6080 00 08_h

6.2.8 3rd TPDO definition

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).

Default COB-ID

31	30	29	28 ... 11	10 ... 0
1	0	0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	380_h + node-ID

MSB LSB

Index	Sub-index	Name	Default value
1802h	0_h	Largest sub-index supported	5_h
	1_h	COB-ID	See above
	2_h	Transmission type	255_d
	3_h	Inhibit timer	0
	4_h	reserved	-
	5_h	Event timer	200_d

Index	Sub-index	Name	Default value
$1A02_h$	0_h	Number of mapped objects	2_h
	1_h	Charge current requested	6070 00 10_h
	2_h	Battery state of charge	6081 00 08_h

7 Object dictionary

7.1 Introduction

Battery module specific mandatory and optional objects are listed in the following table. Detailed object specifications are given in the following sections.

Index	Object	Name	Type	Access	M/O
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
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	M[1]
6070_h	VAR	Charge current requested	Unsigned16	ro	M[1]
6080_h	VAR	Charger state of charge	Unsigned8	rw	M[1]
6081_h	VAR	Battery state of charge	Unsigned8	ro	M[1]
6090_h	VAR	Water level status	Unsigned8	ro	O

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

7.2 Detailed specification of object entries

7.2.1 Introduction

OBJECT DESCRIPTION and ENTRY DESCRIPTION attributes are specified in /1/. 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.

7.2.2 Complex data type definition

7.2.2.1 Record 0080h: BatteryPar

Index	Sub-Index	BatteryPar Record	Data Type
0080_h	0_h	Number of parameters	Unsigned8
	1_h	Battery type	Unsigned8
	2_h	Ah capacity	Unsigned16
	3_h	Maximum charge current	Unsigned16
	4_h	Number of cells	Unsigned16

7.2.3 Detailed specification of object entries

7.2.3.2 Object 6000_h: Battery status

This object shall indicate readiness of the battery to accept a charge—i.e., ready or not-ready.

VALUE DESCRIPTION

The status byte shall have the following format:

7	1	0
reserved (=0)		0/1
MSB		LSB

Bit 0 = 1 ready
Bit 0 = 0 not ready

OBJECT DESCRIPTION

Index	6000_h
Name	Battery status
Object Code	VAR
Data Type	Unsigned8
Category	Mandatory

ENTRY DESCRIPTION

Sub-index	0_h
Access	ro
PDO Mapping	Default
Value Range	0_h to 1_h
Default Value	No

7.2.3.3 Object 6001_h: Charger status

This object shall indicate readiness of the charger to deliver a charge to the battery—i.e., ready or not-ready

VALUE DESCRIPTION

The status byte has the following format:

7	1	0
reserved (=0)		0/1
MSB		LSB

Bit 0 = 1 ready
Bit 0 = 0 not ready

OBJECT DESCRIPTION

Index	6001_h
Name	Charger status
Object Code	VAR
Data Type	Unsigned8
Category	Mandatory

ENTRY DESCRIPTION

Sub-Index	0_h
Access	rw
PDO Mapping	Default
Value Range	0_h to 1_h
Default Value	0_h

7.2.3.4 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.

VALUE DESCRIPTION

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	0_h
Access	ro
PDO Mapping	Default
Value Range	$FEC0_h$ to $02A8_h$
Default Value	No

7.2.3.5 Object 6020_h: Battery parameters

This object shall provide the battery parameters.

VALUE DESCRIPTION

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 can be 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.

OBJECT DESCRIPTION

Index	6020_h
Name	Battery parameters
Object Code	RECORD
Data Type	BatteryPar
Category	Mandatory

ENTRY DESCRIPTION

Sub-Index	0_h
Description	Number of parameters
Data Type	Unsigned8
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	4_h
Default Value	4_h

Sub-Index	1_h
Description	Battery type
Data Type	Unsigned8
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	Unsigned8
Default Value	No

Sub-Index	2_h
Description	Ah capacity
Data Type	Unsigned16
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	Unsigned16
Default Value	No

Sub-Index	3_h
Description	Maximum charge current
Data Type	Unsigned16
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	Unsigned16
Default Value	No

Sub-Index	4_h
Description	Number of cells
Data Type	Unsigned16
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	Unsigned16
Default Value	No

7.2.3.6 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.

VALUE DESCRIPTION

Character strings in the battery module shall be packed into Unsigned32 objects to allow them to be transferred using expedited SDO services. For example, the character string “BATTERY" (ASCII representation /5/: 42 41 54 54 45 52 59) is packed as follows:

Sub-index 0: 2
Sub-index 1: 54544142
Sub-index 2: 00595245

OBJECT DESCRIPTION

Index	6030_h
Name	Battery serial number
Object Code	ARRAY
Data Type	Unsigned32
Category	Optional

ENTRY DESCRIPTION

Sub-Index	0_h
Description	Number of elements
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	1_h to 3_h
Default Value	No

Sub-Index	1_h
Description	Packed ASCII characters 1 to 4
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	Unsigned32
Default Value	No

Sub-Index	2_h
Description	Packed ASCII characters 5 to 8
Entry Category	Optional
Access	ro
PDO Mapping	No
Value Range	Unsigned32
Default Value	No

Sub-Index	3_h
Description	Packed ASCII characters 9 and 10
Entry Category	Optional
Access	ro
PDO Mapping	No
Value Range	Unsigned32
Default Value	No

7.2.3.7 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.

VALUE DESCRIPTION

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	0
Description	Number of elements
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	1_h to 5_h
Default Value	No

Sub-Index	1_h
Description	Packed ASCII characters 1 to 4
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	Unsigned32
Default Value	No

Sub-Index	2_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	5_h
Description	Packed ASCII characters 17 to 20
Entry Category	Optional
Access	ro
PDO Mapping	No
Value Range	Unsigned32
Default Value	No

7.2.3.8 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.

VALUE DESCRIPTION

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	0
Description	Number of elements
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	1_h to 5_h
Default Value	No

Sub-Index	1_h
Description	Packed ASCII characters 1 to 4
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	Unsigned32
Default Value	No

Sub-Index	2_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	5_h
Description	Packed ASCII characters 17 to 20
Entry Category	Optional
Access	ro
PDO Mapping	No
Value Range	Unsigned32
Default Value	No

7.2.3.9 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.

VALUE DESCRIPTION

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	0_h
Description	Number of elements
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	1_h to 5_h
Default Value	No

Sub-Index	1_h
Description	Packed ASCII characters 1 to 4
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	Unsigned32
Default Value	No

Sub-Index	2_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	5_h
Description	Packed ASCII characters 17 to 20
Entry Category	Optional
Access	ro
PDO Mapping	No
Value Range	Unsigned32
Default Value	No

7.2.3.10 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.

VALUE DESCRIPTION
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	0_h
Access	ro
PDO Mapping	No
Value Range	Unsigned32
Default Value	No

7.2.3.11 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.

VALUE DESCRIPTION
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	0_h
Access	ro
PDO Mapping	No
Value Range	Unsigned16
Default Value	No

7.2.3.12 Object 6052_h: Ah returned during last charge

This object shall provide 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 DESCRIPTION
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	0_h
Access	rw
PDO Mapping	Default if RPDO2 is supported
Value Range	Unsigned16
Default Value	0_h

7.2.3.13 Object 6053_h: Ah since last equalization

This object shall provide 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 DESCRIPTION

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	0_h
Access	rw
PDO Mapping	No
Value Range	Unsigned16
Default Value	0_h

7.2.3.14 Object 6054_h: Date of last equalization

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

VALUE DESCRIPTION

The number of minutes since midnight and the number of days since 1 January 1984 are 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	0_h
Description	Number of elements
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	2_h
Default Value	2_h

Sub-Index	1_h
Description	Number of minutes
Entry Category	Mandatory
Access	rw
PDO Mapping	No
Value Range	Unsigned16
Default Value	0_h

Sub-Index	2_h
Description	Number of days
Entry Category	Mandatory
Access	rw
PDO Mapping	No
Value Range	Unsigned16
Default Value	0_h

7.2.3.15 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.

VALUE DESCRIPTION

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	0_h
Access	ro
PDO Mapping	Default if TPDO2 is supported
Value Range	Unsigned32
Default Value	0_h

7.2.3.16 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.

VALUE DESCRIPTION

The resolution shall be 1/16 A per bit. FF_h means 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	0_h
Access	ro
PDO Mapping	Default if TPDO3 is supported
Value Range	Unsigned16
Default Value	No

7.2.3.17 Object 6080_h: Charger state of charge

This object shall provide 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 DESCRIPTION

Resolution shall be 1 % per bit. FF_h means 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	0_h
Access	rw
PDO Mapping	Default if RPDO2/3 is supported
Value Range	0_h to 64_h and FF_h
Default Value	FF_h

7.2.3.18 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.

VALUE DESCRIPTION
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	0_h
Access	ro
PDO Mapping	Default if TPDO3 is supported
Value Range	0_h to 64_h and FF_h
Default Value	No

7.2.3.19 Object 6090_h: Water level status

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

VALUE DESCRIPTION
The status byte has the following format:

7	1	0
reserved (=0)		0/1
MSB		LSB

Bit 0 = 1 full

Bit 0 = 0 low

OBJECT DESCRIPTION

Index	6090_h
Name	Water level status
Object Code	VAR
Data Type	Unsigned8
Category	Optional

ENTRY DESCRIPTION

Sub-Index	0_h
Access	ro
PDO Mapping	No
Value Range	0_h to 1_h
Default Value	No

8 Appendix A (normative): Battery type parameter

The battery type parameter (object 6020_h 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

9 Appendix B (normative): Pilot signal

The diagram below 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.

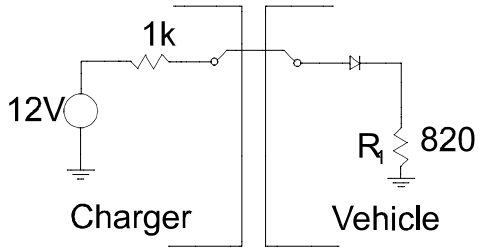


Fig. 1: Connection between charger and vehicle battery