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CED-20/CED-30 CANopen User Manual

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User Manual

CED-20/CED-30 (CANopen)

V1.1 October 2025

CED-20/CED-30 CANopen User Manual

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Document History

Rev.	Date	Author	Details of Change
1.0	2023-10-10	Ian Chalinder Nathan Benjafield	Initial release. Valid for CED-20/CED-30 f/w V1.0.
1.1	2025-10-22	Andrew Palmer	Add descriptions of User Parameters and Disable RPDO1 features, as added in f/w V1.1.

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1. The CED-20/CED-30 Module

Note: Unless specifically stated otherwise, any use of the term 'CED-20' in this manual gives information that is applicable to both the CED-20 and CED-30 modules.

1.1. Introduction

The CED-20 electronics module is a load cell digitiser with integral delta-sigma 24-bit analogue-to-digital converter for weighing and force measurements with strain gauge sensors used primarily in the automotive industry.

The CED-20 is tested to meet Reg 10 and has also been tested to meet the specifications set out in ISO 13766:2018 and ISO 14982:1998. The CED-20 has not been fully approved. These test specifications allow the CED-20 to be used in multiple automotive applications including earth-moving machines and agricultural vehicles.

The device features a CAN interface with support for the CANopen protocol with a number of data rates from 10 kbps up to 1 Mbps.

The CED-20 can be switched from using the CANopen protocol to using the J1939 protocol as needed to suit the application. This document details the operation and commands for the CANopen protocol only. To switch to using the J1939 protocol, see the [Bus Protocol](#) section of this manual (section 5.3.3) and refer to the CED-20/CED-30 J1939 User Manual (Flintec document 0109611) for details of its operation and command set.

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1.2. Disclaimer

No patent liability is assumed with respect to the use of the information contained herein. While every precaution has been taken in the preparation of this Manual, Flintec assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained herein.

The information herein is believed to be both accurate and reliable. Flintec, however, would be obliged to be informed if any errors occur. Flintec cannot accept any liability for direct or indirect damages resulting from the use of this manual.

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NOTICE: The contents of this manual are subject to change without notice.

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1.3. Safety Instructions



CAUTION: READ this manual BEFORE operating or servicing this equipment. FOLLOW these instructions carefully. SAVE this manual for future reference. DO NOT allow untrained personnel to operate, clean, inspect, maintain, service, or tamper with this equipment. ALWAYS DISCONNECT this equipment from the power source before cleaning or performing maintenance.

CALL Flintec for parts, information, and service.



WARNING: Only permit qualified personnel to service this equipment. Exercise care when making checks, tests and adjustments that must be made with power on. Failing to observe these precautions can result in bodily harm.



WARNING: Disconnect all power to this unit before removing the fuse or servicing.



WARNING: Before connecting/disconnecting any internal electronic components or interconnecting wiring between electronic equipment always remove power and wait at least thirty (30) seconds before any connections or disconnections are made. Failure to observe these precautions could result in damage to or destruction of the equipment or bodily harm.



CAUTION: Observe precautions for handling electrostatic sensitive devices.

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2. Specification

CED-20/CED-30	
Application	Automotive industry
CED-30 Bridge excitation	5 V _{DC}
CED-20 Bridge excitation	3.3 V _{DC}
Load cell/sensor	4-wire or 6-wire
Accuracy	Single channel 24-bit delta-sigma ADC
Minimum input sensitivity	0.02 μ V/count
Resolution (external)	\pm 1000000 counts (non-approved)
Minimum load cell impedance	75 Ω (4x350 Ω)
Maximum load cell impedance	1100 Ω
Communication protocols	CANopen and J1939
CANopen data rate	10k, 20k, 50k, 125k, 250k, 500k, 800k, 1Mbit/s
Power supply	+9 V _{DC} to +32 V _{DC}
Automotive protection voltage	\geq 38 V
Filter mode	Selectable IIR and averaging filters
Operating temperature range	-20°C to +85°C
Storage temperature	-40°C to +125°C
Regulations/standards	REG 10 (non-approved), ISO 13766:2018, ISO 14982:1998
Enclosure dimensions	CED-20 – Load cell dependent. Please view the relevant load cell datasheet for full dimensions. CED-30 – T-Adaptor: Steel/Abs: 70 x 40 x 21 mm CED-30 – Inline: 78 x 20 ϕ mm
Volume	CED-20 – Load cell dependent. Please view the relevant load cell datasheet for full dimensions. CED-30 – T-Adaptor: Steel/Abs: 58.8 cm ³ CED-30 – Inline: 24.5 cm ³
Weight	CED-20 – Load cell dependent. Please view the relevant load cell datasheet for full dimensions. CED-30 – T-Adaptor: Steel: 206g Abs: 103g CED-30 – Inline: 122 g
Enclosure mounting options	Steel bracket, 6.6mm drill holes.
IP protection rating	CED-20 – Load cell Dependent. Please view the relevant load cell datasheet for full dimensions. CED-30 – IP65

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3. Glossary of Terms and Abbreviations

The following is a list of terms and abbreviations used throughout this document, together with a brief explanation of their meaning.

Term / Abbreviation	Meaning
bps	Bits Per Second. A data rate equivalent to one binary digit per second.
CAN	Controller Area Network. A communications bus standard common in automotive and factory automation environments.
CANopen	A higher-layer communication protocol developed and supported by the CAN in Automation (CiA [®]) organization. Website: www.can-cia.org
Client-server	A communication system in which the client initiates the communication by a request to the server. The server will always send back a response to the client.
COB	Communication Object. One or more CAN messages with a specific functionality.
COB-ID	The object specifying the CAN message identifier and parameters.
Confirmed service	A confirmed service is a message (or group of messages) that requires the receiver to return an acknowledgement that the message has been successfully received. Compare with unconfirmed service .
DLC	Data Length Code. A field within a CAN bus frame stating how many bytes of data are included in the frame.
ECU	Electronic Control Unit.
EDS	Electronic Data Sheet. A text file to describe the functionality and capabilities of a given CANopen device. The EDS is presented in a standardized format and layout to be both human-readable and machine-readable.
FDC	Flintec Device Configurator. A PC application to configure and calibrate several Flintec devices. Available on Flintec's website: www.flintec.com
Heartbeat	A specific CANopen message transmitted periodically to show that a node (device) is still present on the network.
Index	A 16-bit address identifier to enable access to the CANopen object dictionary . For arrays and records, the address is extended by an 8-bit sub-index .
IP rating	Ingress Protection rating. Rates the degree of protection of an enclosure from external intrusions.

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Term / Abbreviation	Meaning
ISO	International Organization for Standardization. Standard-setting body composed of representatives from various national standards organizations.
J1939 (SAE J1939)	A higher-layer communication protocol developed and supported by the Society of Automotive Engineers. Website: www.sae.org
kbps	Kilobits per second. A data rate of 1000 binary digits per second.
LSB	Least Significant Byte. The byte in a multi-byte number which has the lowest value.
MSB	Most Significant Byte. The byte in a multi-byte number which has the highest value.
Node ID	The unique device identifier required by CAN -based higher-layer protocols to target messages to a specific recipient.
NVM	Non-Volatile Memory. A data-storage medium which retains information after the device is disconnected from its power source.
Object dictionary	A standardized listing which contains all communications and application parameters of a specific CANopen device.
PDO	Process Data Object. A communication object used for broadcasting high-priority control and status information. The PDO protocol is an unconfirmed service .
REG 10	Vehicle type approval certificate. An internationally agreed EMC standard applicable to road vehicles.
RPDO	Receive Process Data Object. A PDO that is received by a CANopen device.
RTR	Remote Transmission Protocol. Setting the RTR bit in a CAN frame requests data from the node which would normally transmit the specified CAN ID.
SDO	Service Data Object. A protocol to provide access to all entries of the object dictionary . The SDO is a client-server confirmed service .
Sub-index	An 8-bit sub-address used to access array objects or records in the object dictionary .
TPDO	Transmit Process Data Object. A PDO that is transmitted by a CANopen device.
Unconfirmed service	An unconfirmed service is a message which will not be acknowledged by the receiver(s).
USB	Universal Serial Bus. An industry standard for communications between computers and peripherals.

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4. Getting Started

You will require:

- A USB to CAN Converter for CANopen
- Load cell/scale with test weights or load cell simulator.
- +12 V_{DC} to +24 V_{DC} power supply capable of delivering approximately 100 mA.
- A suitable software such as the Flintec Device Configuration (FDC) software. Download the latest copy of the FDC from the Flintec website:
<https://www.flintec.com/uk/downloads?id=493565>

Note: The Flintec FDC application was developed with the Peak System USB-to-CAN adaptor. When using the Flintec FDC with CANopen or J1939 protocols, the Peak System adaptor should be used. Drivers and manuals for the Peak System devices are located here:
<https://www.peak-system.com/PCAN-USB.199.0.html>

4.1. Labelling

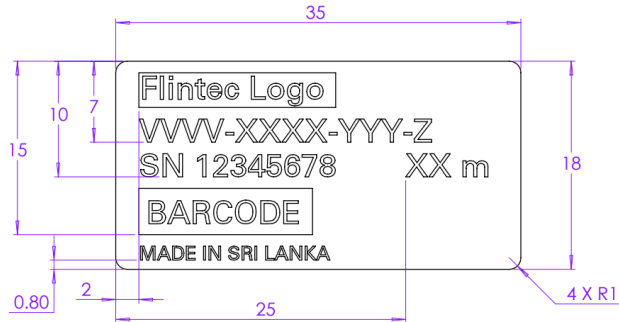
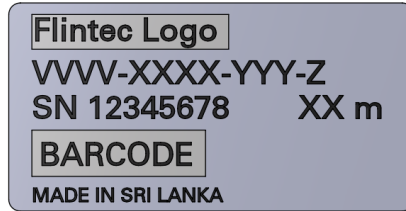
The label for the CED-20 is located on the external wall of the load cell. The label for the CED-30 will be located on the external wall of the enclosure. Enclosures and load cells all require information to distinguish between models.

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4.1.1. CED-20

Load Cell Self Adhesive Label

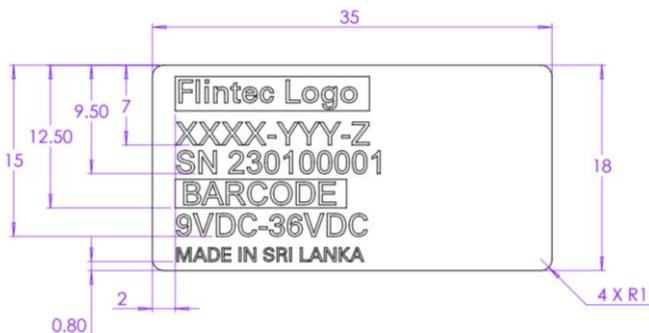
Located on the external wall of the load cell near cable gland.



4.1.2. CED-30

Enclosure Self Adhesive Label

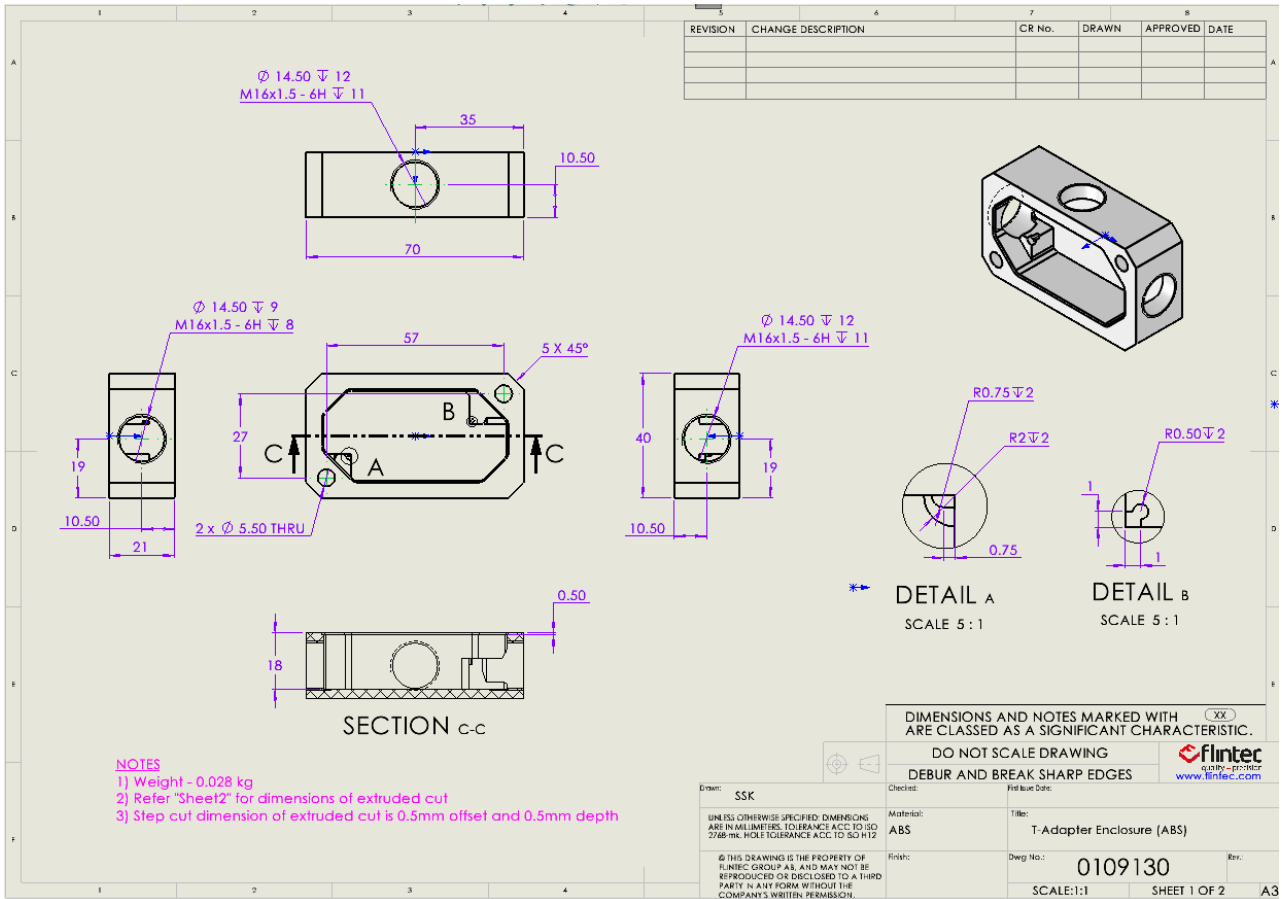
Located on the external wall of the Enclosure/T-adaptor.



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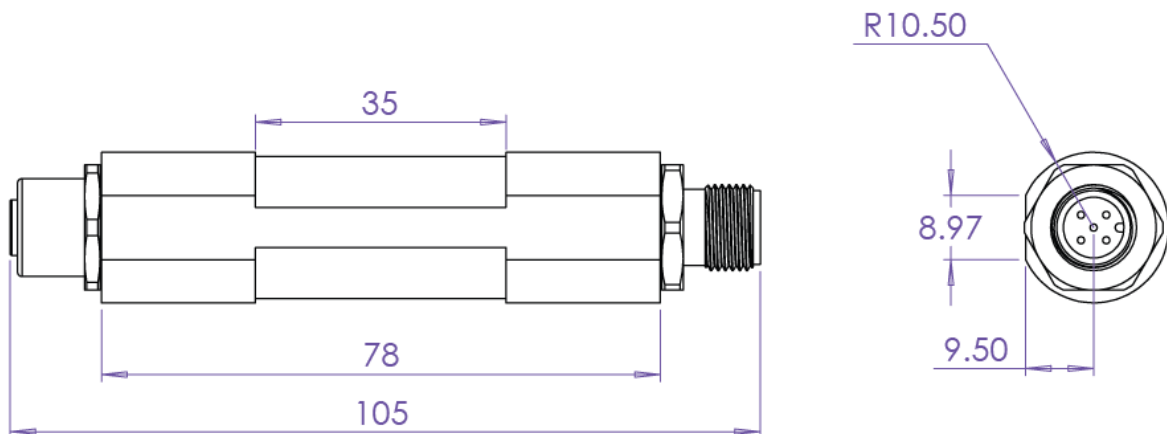
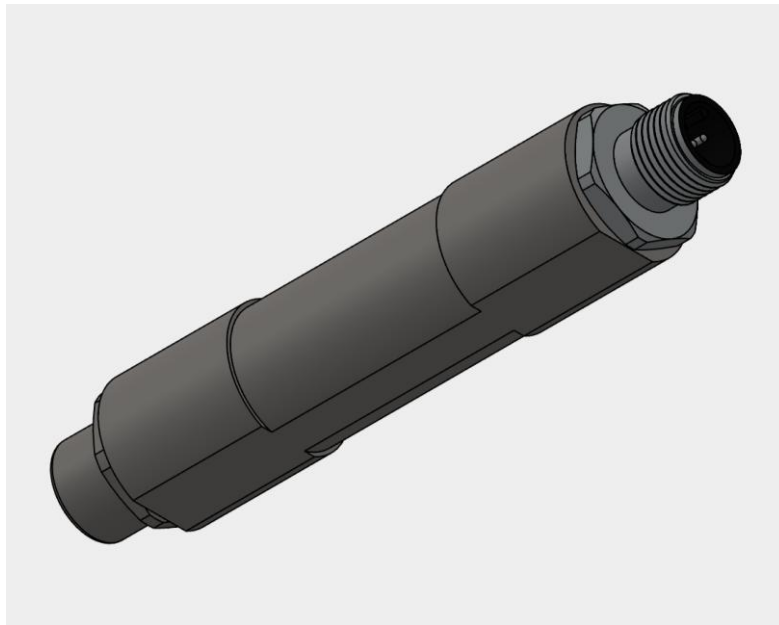
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4.2. T-adaptor Enclosure Dimensions



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4.3. In-line Enclosure Dimensions

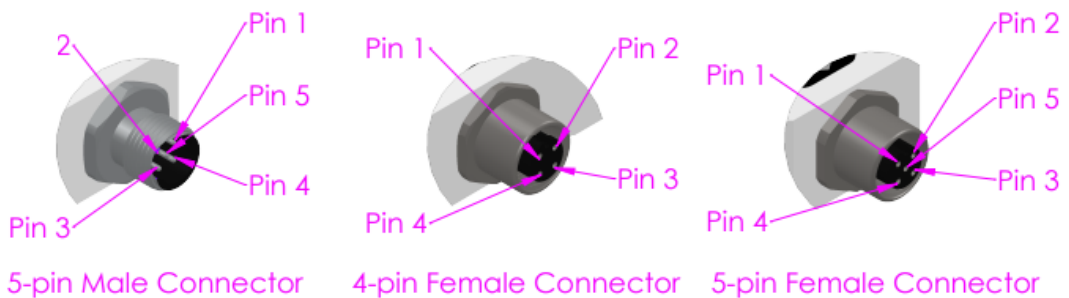
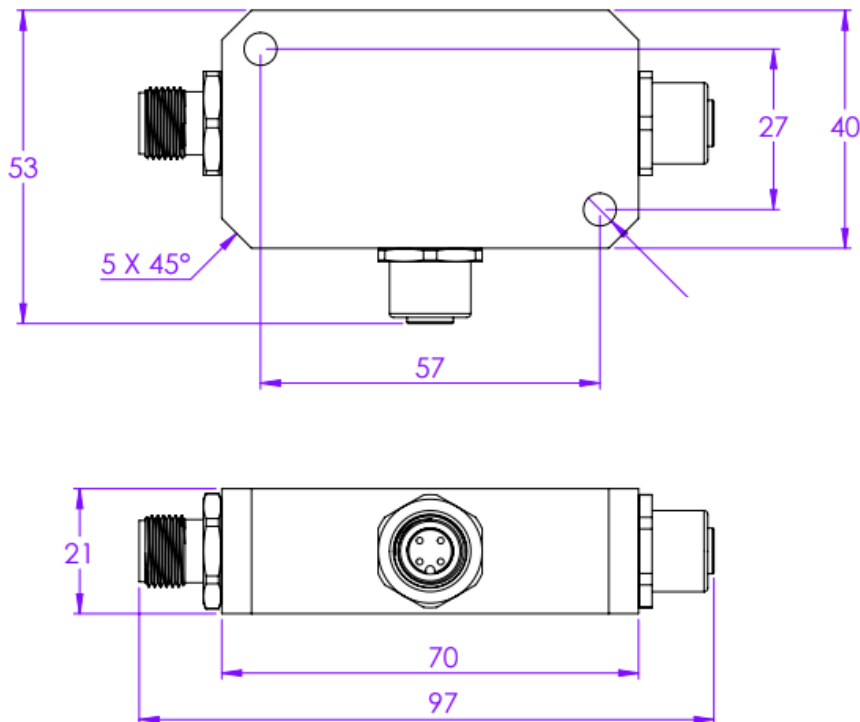


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4.4. Connections

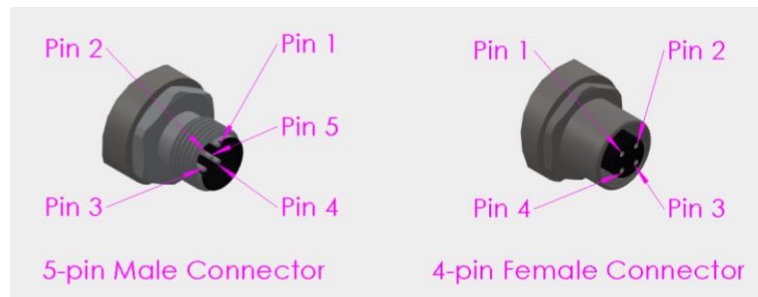
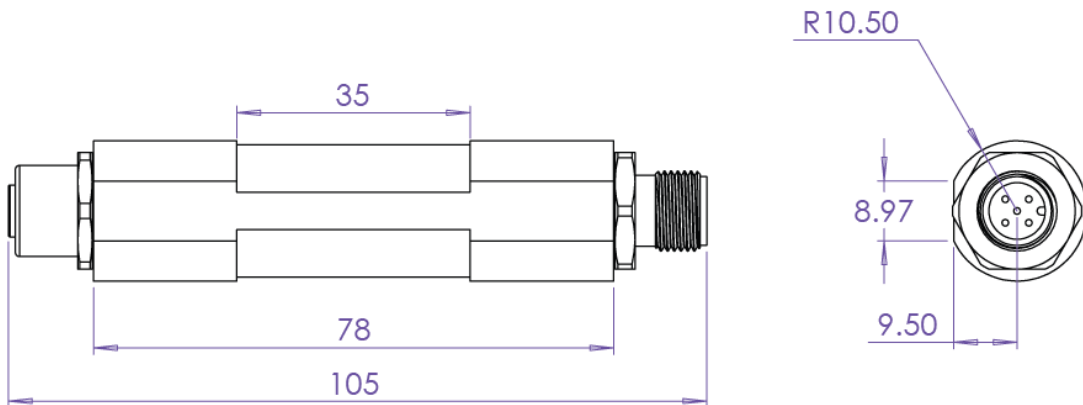
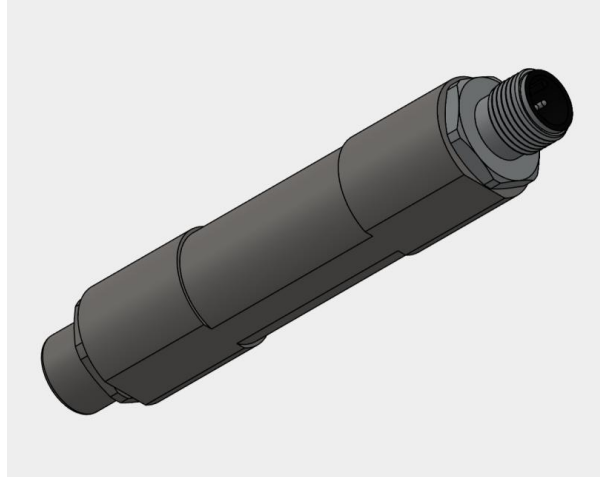
4.4.1. T-Adaptor Enclosure Connections



Pin Number	5 pin - Male	4 pin - Female	5 pin - Female
Pin 1	SHIELD	+ Excitation	SHIELD
Pin 2	+VDC	+ Signal	+VDC
Pin 3	GND	- Excitation	GND
Pin 4	CAN High	- Signal	CAN High
Pin 5	CAN Low		CAN Low

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4.4.2. In line Enclosure Connections



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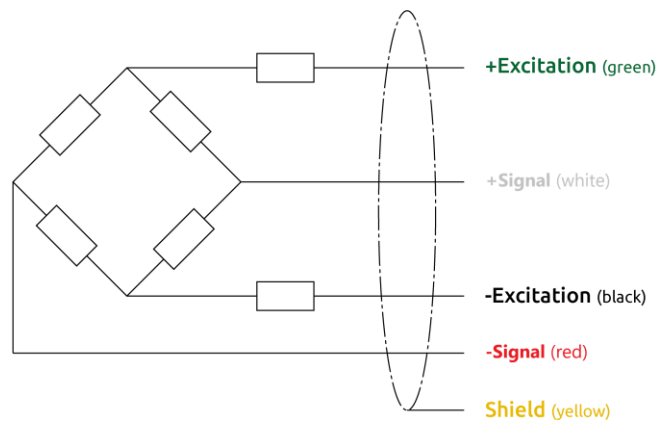
5-pin Male Connector 4-pin Female Connector

Pin Number	5 pin - Male	4 pin - Female
Pin 1	SHIELD	+ Excitation
Pin 2	+VDC	+ Signal
Pin 3	GND	- Excitation
Pin 4	CAN High	- Signal
Pin 5	CAN Low	

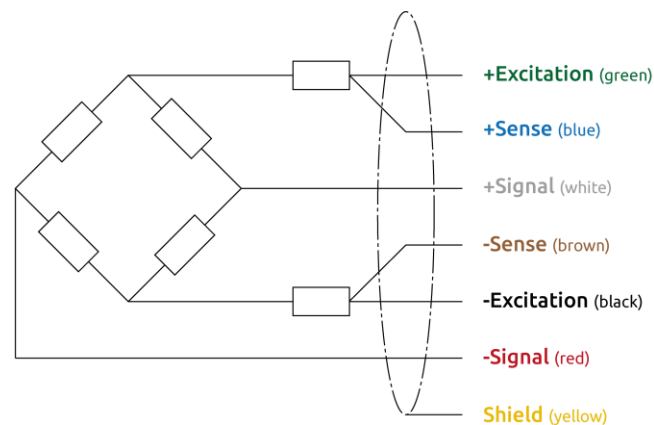
4.4.3. Load-Cell connections

If using a 6-wire load cell, connect the Excitation+ (**EXC+**) to the Sense+ (**S+**) & Excitation- (**EXC-**) to the Sense- (**S-**) for correct configuration, as shown below.

4-Wire Connection:



6-Wire Connection:



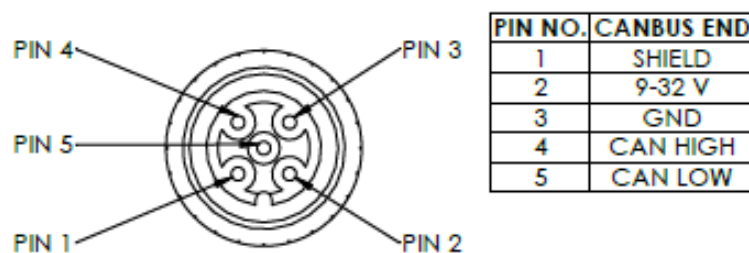
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4.4.4. Power Connections

The unit is designed to accept +12 V_{DC} or +24 V_{DC}. The PCB will accept a voltage within the range of +9 V_{DC} to +32 V_{DC} input but optimised for +12 V_{DC} or +24 V_{DC}. The power supply ground is the same potential as the communications. Only use the appropriate power and return pins for the supply, all communications pins are to be referenced to the supply ground.

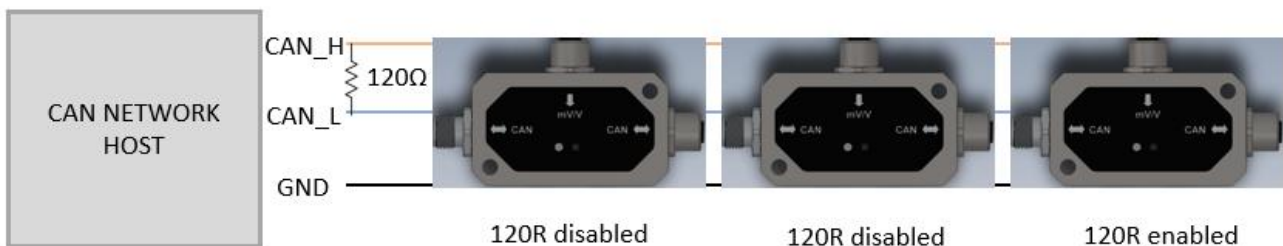
PIN CONFIGURATION CANBUS END



CED-20 CAN Bus Pins	Pin Name	Function
1	Shield	Chassis GND
2	Vin	Power supply input (+9 V to +32 V)
3	GND	Ground or -ve battery
4	CAN_H	CAN high differential +
5	CAN_L	CAN low differential -

4.4.5. CAN Bus Connection

For the CAN network to operate properly, it is necessary to enable the 120 Ω termination resistor at both the host end and at the furthest point in the network. The CED-20/CED-30 PCB has a 120 Ω resistor which can be enabled or disabled to meet this termination requirement. See the [CAN Termination Resistor](#) section of this manual (section 5.3.4) for details of how to enable/disable the 120 Ω resistor.



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4.5. General Information

The CANopen® interface conforms to the CAN 2.0B standard, using 11-bit identifiers and runs at a default speed of 500 kbps. All data is sent in little-endian format; that is, least-significant byte first.

The CED-20 conforms to the requirements for an NMT slave as defined in CiA® 302 DSP Part 2: Network Management (February 2009).

On first connection to the CANopen network, the CED-20 will send its boot-up message (a heartbeat message with a node state of 0), followed by periodic [heartbeat](#) messages (see section 4.6.2 and 5.3.5). If the node is configured to self-start, it will transition through the Pre-operational state into the Operational state. Otherwise, it will remain in the Pre-operational state, waiting for [NMT](#) messages or [SDO](#) requests (see sections 4.6.2. and 4.8)

The CED-20 implements static [PDO](#) mapping and a single, statically defined [SDO](#) server.

Throughout this manual, hexadecimal values are written using the “h” suffix (such as ‘9Ch’); all un-suffixed numbers should be considered as decimal numbers.

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4.6. Network Management and Node Addressing

4.6.1. Node ID/Address

Each node on the CANopen network must have a unique 7-bit node ID (address) in the range 1 to 127 (7Fh); node ID 0 is reserved for use by the network management (NMT) master module. See section 5.3.2 and 5.3.7.3 for information on how to set the CED-20's [node ID](#).

4.6.2. Network Management (NMT)

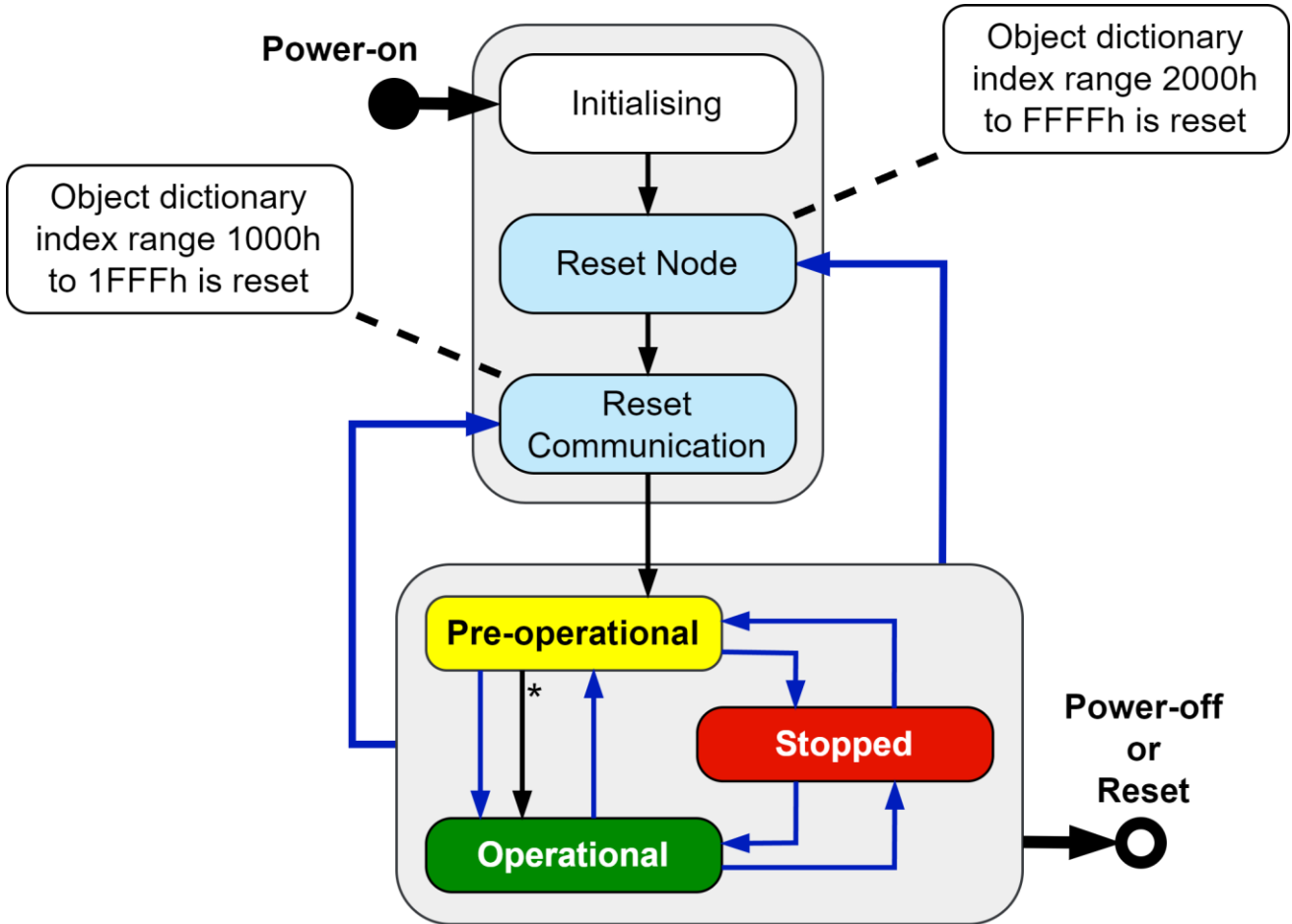
For the purposes of network management, the CED-20 supports the following dictionary objects.

Name	CAN ID / COB ID	DLC	CAN Data	
Boot-up protocol	700h + node ID	1	00h (Initialising)	
Heartbeat	700h + node ID	1	04h = Stopped 05h = Operational 7Fh (127) = Pre-operational	
NMT protocol	000h	2	00h = All nodes 01h..7Fh = Node ID	01h = Operational 02h = Stopped 80h (128) = Pre-operational 81h (129) = Reset node 82h (130) = Reset comms

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NMT protocol is used to tell slaves to change state, to indicate device bootup and error conditions. The current node state dictates how that node communicates on the network.

The cycle of states is shown below.



Black arrows show automatic transitions (* NMT self-start)

Blue arrows show manual transitions (NMT messages)

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4.7. Process Data Objects (PDOs)

Process data objects (PDOs) are messages which send real-time control and status information to and from the nodes on the CANopen network.

PDOs are unconfirmed transmissions and have a higher message priority than [service data objects \(SDOs\)](#), so will take precedence on the CAN bus.

The following sections detail the transmit PDOs ([TPDOs](#)) and receive PDOs ([RPDOs](#)) supported by the CED-20.

4.7.1. Transmit Process Data Objects (TPDOs)

Once set to the Operational state, the CED-20 will produce TPDOs on specific events, or they can be requested using a Remote Transmission Request (RTR), as described in the CANopen protocol.

When in the Operational state, a TPDO may be disabled by writing a '1' to bit-31 of its COB-ID (1800h:1 for TPDO1 and 1801h:1 for TPDO2).

The tables below detail the data content and format of the TPDOs implemented in the CED-20.

4.7.1.1. TPDO1: Net mV/V Signal

TPDO1	Content	Net mV/V signal and ECU status information.		
	COB ID	180h + Node ID		
	Trigger	On-event: ADC sample available.		
	CAN Data (DLC = 5)	Data 0	R32 or I32 (defined by the Data Output Options). mV/V value , SDO 3004h:02h.	
		Data 1		
Data 2				
Data 3				
	Data 4	UI8. ECU Status , SDO 3004h:03h.		

Note: Depending on the data rate set for the CANopen network, the higher sample rates (up to 2500 samples per second) can exceed what can be transmitted on the CAN bus. The output rate may also be affected when there are multiple nodes on the network and/or lower [communication speeds](#) are used. In these cases, lower [sample rates](#) can be used to reduce the network load (see section 5.2.1 for more information).

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4.7.1.2. TPDO2: Tare Signal

TPDO3	Content	Tare signal and ECU status information.		
	COB ID	280h + Node ID		
	Trigger	On-event: Set mV/V Tare or Reset mV/V Tare command executed.		
	CAN Data (DLC = 5)	Data 0	R32 or I32 (defined by Data Output Options). Tare signal , SDO 3004h:04h.	
		Data 1		
		Data 2		
Data 3				
	Data 4	UI8. ECU Status , SDO 3004h:03h		

4.7.2. Receive PDOs (RPDOs)

Once set to the Operational state, the CED-20 will accept the RPDO1 message to execute the functions described below.

RPDO1 can be disabled by writing a '1' to bit-31 of its COB-ID (1400h:1).

4.7.2.1. RPDO1: Set/Reset Tare

RPDO2	Content	Set and Reset mV/V Tare commands.	
	COB ID	200h + Node ID	
	CAN Data (DLC = 1)	Data 0	UI8. Set and Reset mV/V Tare (see section 5.5), SDO 3005h:01h.

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4.8. Service Data Objects (SDOs)

Service data objects (SDOs) give access to all entries in the node's [object dictionary](#), allowing reading of device-specific attributes, reading and writing of configuration parameters and execution of commands.

The SDO protocol is a confirmed service operating on a client-server basis. One SDO is made up of two CAN frames with different IDs: one for the client request and another for the server response. In this case, the CED-20 is the SDO server and supports only expedited (single-frame) responses.

SDOs operate only in the Pre-operational and Operational states.

4.8.1. The SDO Message Frame

The message frame format of an SDO is as follows.

The SDO request frame (client to server):

CAN-ID (COB-ID)	CAN Data (DLC = 8)							
	D0	D1	D2	D3	D4	D5	D6	D7
600h + node ID	Command	SDO Index	Sub-Index	Data				

The SDO response frame (server to client):

CAN-ID (COB-ID)	CAN Data (DLC = 8)							
	D0	D1	D2	D3	D4	D5	D6	D7
580h + node ID	Command	SDO Index	Sub-Index	Data				

Note: SDO requests and responses *a/ways* contain 8 data bytes (DLC=8), regardless of the type of data they contain.

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The command byte, D0, is split up further, as shown below.

Bit(s)	Symbol	Use	Meaning	
7..5	SP	Command specifier for client or server. (Only services supported by CED-20 are shown.)	Client specifier	Server specifier
			1: Initiate write 2: Initiate read 4: Abort transfer.	2: Initiate read response 3: Initiate write response 4: Abort transfer.
4	T	Toggle bit	For segmented reads only - not used by CED-20.	
3..2	N	Unused data bytes (valid only if E=S=1)	0: Four data bytes are in the transfer 1: Three data bytes are in the transfer 2: Two data bytes are in the transfer 3: One data byte is in the transfer.	
1	E	Expedited transfer	0: Segmented transfer - not used by CED-20 1: Transfer is an expedited transfer (single frame).	
0	S	Size indication	0: Data size is not indicated 1: Data size is indicated by bits 3..2.	

4.8.2. SDO Abort Codes

Since the SDO protocol is a confirmed service, all requests to the CED-20 will elicit a response. Where an SDO client request cannot be executed, an abort message will be sent. The command specifier of an SDO abort message is always 80h. The 32-bit abort code is sent in the data bytes of the SDO response frame to provide some detail as to why the request was not executed.

The table below lists all SDO abort codes supported by the CED-20.

Code	Description
05040001h	Invalid bit combination in the command specifier byte.
06010001h	Attempt to read a write-only object.
06010002h	Attempt to write a read-only object.
06020000h	The object does not exist in the object dictionary (the SDO index is invalid).
06070010h	The data length for an SDO write is incorrect.
06090011h	The sub-index does not exist for the given object.
06090030h	The value for an SDO write is out of range.
08000000h	General error (e.g., the request does not have 8 bytes or there is non-zero data in a read request).
08000022h	The conditions are not correct to execute the request at this time (e.g., the CED-20 is not in administrator mode).

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4.9. Emergency Messages and the Emergency Object (EMCY)

On detection of certain errors in the CED-20 or on the CANopen bus itself, the CED-20 will send an unsolicited message containing details of the detected error; this is the Emergency Object (EMCY).

The EMCY message has the following format:

EMCY	COB-ID	80h + Node ID		
	Trigger	On-event: On detection of a new error <i>type</i> .		
	CAN Data (DLC = 8)	Data 0	UI16.	
		Data 1	Error code (see the table of supported error codes below)	
		Data 2	UI8. Error register, SDO 1001h:00h .	
		Data 3	Vendor-specific data	
		Data 4		
		Data 5		
		Data 6		
Data 7				

The following table shows all error codes which can be transmitted by the CED-20 EMCY object.

Code	Description
0000h	Error reset - transmitted when all errors are cleared.
5001h	An error has been detected in the A/D converter.
5002h	An open circuit has been detected in one of the load cell connections.
5003h	The load cell excitation voltage is too low.
8110h	A CAN over-run error has occurred – a message has been lost.
8120h	The CED-20's CAN controller has entered the Error Passive state.
8140h	The CED-20's CAN controller has recovered from a Bus Off condition.
8150h	A COB-ID collision has been detected – another device on the CAN bus has the same node ID as the CED-20.
8210h	An RPDO1 message has been received with an incorrect data length.
FF01h	A non-recoverable fault has been detected in the factory settings memory. The CED-20 should be returned to the factory.
FF02h	An error has been detected in the configuration data memory. The CED-20 can be recovered by reconfiguring all user parameters.

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4.10. The Object Dictionary

The following subsections detail the object dictionary entries needed for access to the CED-20 data.

The table below shows the abbreviations used for the various data types found in the object dictionary.

Abbreviation	Data Type	Range
UI8	Unsigned 8-bit integer	0 to 255
UI16	Unsigned 16-bit integer	0 to 65535
UI32	Unsigned 32-bit integer	0 to 4294967295
I32	Signed 32-bit integer	-2147483648 to 2147483647
R32	32-bit floating point number conforming to IEEE 754.	$\cong \pm 3.4 \times 10^{38}$

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4.10.1. Communication Segment

Index	Sub-Index	Name	Type	Access	Default Value	Information
1000h	0	Device type	UI32	RO	0	Non-standard device profile.
1001h	0	Error register	UI8	RO	0	Supported bits: Bit 0: Generic error Bit 4: Communication error Bit 7: Manufacturer-specific error
1003h	Pre-defined error field					
	0	Number of errors	UI8	RW	0	Reads the number of errors. Write 0 to erase error history.
	1 to 8	Standard error field	UI32	RO	-	A list of the most recent errors (EMCY objects sent).
1010h	Store parameters					
	0	Number of entries	UI8	RO	4	
	1	Save all parameters	UI32	RW	1	Save Setup Parameters (see section 5.6.3).
	2	Dummy	UI32	RO	0	The CED-20 does not support this entry.
	3	Dummy	UI32	RO	0	The CED-20 does not support entries 6000h – 9FFFh.
	4	Reserved for Flintec use	UI32	RW	-	Do not write to this entry.
1011h	Restore Default Parameters					
	0	Number of entries	UI8	RO	1	
	1	Restore all defaults	UI32	RW	1	Restore Factory Defaults (see section 5.6.4).
1014h	0	Emergency COB-ID	UI32	RO	80h + node ID	CAN ID of the EMCY message.

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Index	Sub-Index	Name	Type	Access	Default Value	Information
1017h	0	Producer heartbeat time	UI16	RW	0	Heartbeat cycle time in milliseconds (see section 5.3.5).
1018h	Identity object					
	0	Number of entries	UI8	RO	4	
	1	Vendor ID	UI32	RO	044Ah	
	2	Product code	UI32	RO	112328 (CED-20) 112325 (CED-30)	Application firmware part number (see section 5.1.1).
	3	Revision number	UI32	RO	Version specific	Application firmware version (see section 5.1.2).
	4	Serial number	UI32	RO	-	Device-specific serial number (see section 5.1.3).
1026h	OS Prompt					
	0	Number of entries	UI8	RO	2	
	1	StdIn	UI8	WO	-	Reserved for Flintec use.
	2	StdOut	UI8	RO	-	Reserved for Flintec use.
1400h	RPDO1 communication parameter					
	0	Number of entries	UI8	RO	2	
	1	COB-ID of RPDO1	UI32	RW	200h + node ID	Set bit 31 to disable RPDO1.
	2	Transmission type	UI8	RO	FFh	Transmission type is asynchronous.

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1600h	RPDO1 mapping					
	0	Number of entries	UI8	Const	1	
	1	Mapping entry 1	UI32	Const	30050108h	Mapped to the mV/V Tare commands (see section 5.5).
1800h	TPDO1 communication parameter					
	0	Number of entries	UI8	RO	2	
	1	COB-ID of TPDO1	UI32	RW	180h + node ID	Set bit 31 to disable TPDO1.
	2	Transmission type	UI8	RO	FEh	Transmission type is manufacturer specific.
1801h	TPDO2 communication parameter					
	0	Number of entries	UI8	RO	2	
	1	COB-ID of TPDO2	UI32	RW	280h + node ID	Set bit 31 to disable TPDO2.
	2	Transmission type	UI8	RO	FEh	Transmission type is manufacturer specific.
1A00h	TPDO1 mapping					
	0	Number of entries	UI8	Const	2	
	1	Mapping entry 1	UI32	Const	30040220h	Mapped to Read Filtered mV/V Signal (see section 5.4.2).
	2	Mapping entry 2	UI32	Const	30040308h	Mapped to ECU Status (see section 5.4.3).
1A01h	TPDO2 mapping					
	0	Number of entries	UI8	Const	2	
	1	Mapping entry 1	UI32	Const	30040420h	Mapped to Read Tare Signal (Section 5.4.4).
	2	Mapping entry 2	UI32	Const	30040308h	Mapped to ECU Status (see section 5.4.3).
1F80h	0	NMT start-up	UI32	RW	4 (no self-start)	NMT self-start capability (see section 5.3.6).

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4.10.2. Manufacturer Segment

4.10.2.1. Device Identification (Index 3000h)

Index	Sub-Index	Name	Type	Access	Default Value	Information
3000h	0	Number of entries	UI8	RO	4	
	1	Bootloader part number	UI32	RO	-	Bootloader firmware part number (see section 5.1.4).
	2	Bootloader f/w version	UI32	RO	-	Bootloader firmware version (see section 5.1.5).

4.10.2.2. General Parameters (Index 3002h)

Index	Sub-Index	Name	Type	Access	Default Value	Information
3002h	0	Number of entries	UI8	RO	3	
	1	ADC sample rate	I32	RW	50 (Hz)	ADC sample rate (see section 5.2.1).
	2	Filter type	I32	RW	2	ADC digital filter type (see section 5.2.2).
	3	Warm-up time	I32	RW	0	Time for system stabilization (see section 5.2.3).

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4.10.2.3. Communication Parameters (Index 3003h)

Index	Sub-Index	Name	Type	Access	Default Value	Information
3003h	0	Number of entries	UI8	RO	4	
	1	Baud rate	I32	RW	500000 (bps)	CAN bus speed (see section 5.3.1).
	2	Node ID	I32	RW	1	CANopen network address/ID (see section 5.3.2).
	3	Bus protocol	I32	RW	-	Switch between CANopen & J1939 (see section 5.3.3).
	4	R120 status	I32	RW	1 (enabled)	CAN termination resistor status (see section 5.3.4).

4.10.2.4. Data Access (Index 3004h)

Index	Sub-Index	Name	Type	Access	Default Value	Information
3004h	0	Number of entries	UI8	RO	5	
	1	Data output options	UI8	RW	0 (I32 format)	Integer or floating-point output format (see section 5.4.1)
	2	Filtered mV/V signal	R32 / I32	RO	-	Latest filtered load cell signal level (see section 5.4.2).
	3	ECU status	UI8	RO	-	ECU status flags (see section 5.4.3).
	4	mV/V tare signal	R32 / I32	RO	-	Load cell signal tare value (see section 5.4.4).
	5	Filtered ADC sample	I32	RO	-	Latest filtered ADC output (see section 5.4.5).

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4.10.2.5. mV/V Tare Control (Index 3005h)

Index	Sub-Index	Name	Type	Access	Default Value	Information
3005h	0	Number of entries	UI8	RO	1	
	1	Set and Reset mV/V Tare	UI8	WO	-	Commands to set/reset the mV/V tare (see section 5.5).

4.10.2.6. Miscellaneous (Index 3007h)

Index	Sub-Index	Name	Type	Access	Default Value	Information
3007h	0	Number of entries	UI8	RO	3	
	1	System reset	I32	WO	-	System reset / warm start (see section 5.6.1).
	2	Write passcode register	I32	WO	-	Entry to administrator mode (see section 5.6.2).
	3	Reserved	I32	WO	-	Reserved for Flintec use.

4.10.2.7. User Parameters (Index 3008h)

Index	Sub-Index	Name	Type	Access	Default Value	Information
3008h	0	Number of entries	UI8	RO	4	
	1	User Parameter 1	I32	RW	0	
	2	User Parameter 2	I32	RW	0	

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Index	Sub-Index	Name	Type	Access	Default Value	Information
	3	User Parameter 3	I32	RW	0	
	4	User Parameter 4	I32	RW	0	

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5. Command Descriptions

The following sections give a definitive list of the user commands supported by the SDOs making up the CED-20 [object dictionary](#).

Unless stated otherwise, all data parameters and SDO results are transmitted as 32-bit signed integers in little-endian format.

5.1. Device Identification Commands

5.1.1. Read Firmware Part Number (Index 1018h, Sub-Index 02h)

Reading SDO 1018h:02h returns the application firmware part number.

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	18h 10h	02h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	18h 10h	02h	C8h B6h 01h 00h

The data in the above response returns the application firmware part number 112328 (CED-20).
The CED-30 module will return a part number of 112325.

5.1.2. Read Application Firmware Version (Index 1018h, Sub-Index 03h)

SDO 1018h:03h returns the application firmware version number in the following format:

- Data byte 4: Minor firmware version (LSB)
- Data byte 5: Minor firmware version (MSB)
- Data byte 6: Major firmware version (LSB)
- Data byte 7: Major firmware version (MSB).

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	18h 10h	03h	00h 00h 00h 00h

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CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	18h 10h	03h	00h 00h 01h 00h

The data in the above response returns application firmware V1.0.

5.1.3. Read Serial Number (Index 1018h, Sub-Index 04h)

Reading SDO 1018h:04h returns the device-specific serial number as a 32-bit unsigned integer.

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	18h 10h	04h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	18h 10h	04h	87h 53h 1Fh 00h

The data in the above response returns the serial number 2052999.

5.1.4. Read Bootloader Firmware Part Number (Index 3000h, Sub-Index 01h)

Reading SDO 3000h:01h returns the bootloader part number.

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	00h 30h	01h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	00h 30h	01h	88h ADh 01h 00h

The data in the above response returns the bootloader part number 109960.

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5.1.5. Read Bootloader Firmware Version (Index 3000h, Sub-Index 02h)

Reading SDO 3000h:02h returns the bootloader firmware version number in the following format:

- Data byte 4: Bootloader firmware version (minor)
- Data byte 5: Bootloader firmware version (major)
- Data byte 6: Bootloader compatibility number (LSB)
- Data byte 7: Bootloader compatibility number (MSB)

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	00h 30h	02h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	00h 30h	02h	01h 02h F1h 1Fh

The data in the above response returns bootloader firmware V2.1, compatibility number 8177.

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5.2. General Parameters

5.2.1. ADC Sample Rate (Index 3002h, Sub-Index 01h)

SDO 3002h:01h reads and sets the A/D converter sample rate.

Note: The IIR filters have a fixed sample rate and cannot be changed. If the currently selected filter has a fixed sample rate, writing a new value with this command will have no effect. See section 5.2.2 below for details of [filter types](#).

The permitted values for ADC sample rate are from 5 to 2500 samples/second.

The factory default value is 50 samples/second.

5.2.1.1. Read ADC Sample Rate

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	02h 30h	01h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	02h 30h	01h	7Dh 00h 00h 00h

The data in the above response returns a sample rate of 125 samples/second.

5.2.1.2. Write ADC Sample Rate

To set the ADC sample rate at 250 samples/second:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	23h	02h 30h	01h	FAh 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	02h 30h	01h	00h 00h 00h 00h

5.2.2. Filter Type (Index 3002h, Sub-Index 02h)

SDO 3002h:02h reads and sets the ADC filter type parameter, according to the 32-bit parameter sent with the command.

The permitted values of the filter type parameter are as follows.

Value	Filter Type
00h	No filtering
01h	8-sample moving average
02h	16-sample moving average
03h	32-sample moving average
04h	64-sample moving average
20h	IIR filter, 40 SPS, 0.2 Hz cut-off
21h	IIR filter, 40 SPS, 0.5 Hz cut-off
22h	IIR filter, 40 SPS, 1 Hz cut-off
23h	IIR filter, 40 SPS, 2 Hz cut-off
24h	IIR filter, 40 SPS, 5 Hz cut-off
25h	IIR filter, 40 SPS, 10 Hz cut-off
26h	IIR filter, 600 SPS, 0.25 Hz cut-off
27h	IIR filter, 600 SPS, 0.5 Hz cut-off
28h	IIR filter, 600 SPS, 1 Hz cut-off
29h	IIR filter, 600 SPS, 2 Hz cut-off
2Ah	IIR filter, 600 SPS, 3 Hz cut-off
2Bh	IIR filter, 600 SPS, 4 Hz cut-off
2Ch	IIR filter, 600 SPS, 8 Hz cut-off
2Dh	IIR filter, 600 SPS, 18 Hz cut-off

The factory default value is 2 (16-sample moving average).

Note: The IIR filters above each have a fixed sample rate, but the moving average filters have a configurable sample rate. See section 5.2.1.2 above for details of how to set the [ADC sample rate](#) for the moving average filters.

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5.2.2.1. Read Filter Type

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	02h 30h	02h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	02h 30h	02h	03h 00h 00h 00h

The result returned in the above response shows that the 32-sample moving average filter is currently in use.

5.2.2.2. Write Filter Type

To set the ADC digital filter to use a 600 SPS, IIR filter with 1 Hz cut-off:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	23h	02h 30h	02h	28h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	02h 30h	02h	00h 00h 00h 00h

5.2.3. Warm-Up Time (Index 3002h, Sub-Index 03h)

SDO 3002h:03h reads and sets the system warm-up time.

The system warm-up time is the time, measured from power-on or [system reset](#), during which the mV/V signal level will be reported as the under-range value of -10^9 , to avoid false readings while the system is stabilising.

The permitted values for warm-up time are from 0 to 3600 seconds.

The factory default value is 0 seconds.

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5.2.3.1. Read Warm-Up Time

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	02h 30h	03h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	02h 30h	03h	0Fh 00h 00h 00h

The data in the above response returns a warm-up time of 15 seconds.

5.2.3.2. Write Warm-Up Time

To set a system warm-up time of 30 seconds:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	23h	02h 30h	03h	1Eh 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	02h 30h	03h	00h 00h 00h 00h

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5.3. Communications

5.3.1. Baud Rate (Index 3003h, Sub-Index 01h)

SDO 3003h:01h reads and sets the CAN bus speed (baud rate) in bits per second.

The permitted values for baud rate are 10000, 20000, 50000, 125000, 250000, 500000, 800000 and 1000000 bps.

The factory default value is 500000 bps.

When set (and written to NVM by the [Save Setup Parameters](#) command), the new baud rate will be enabled after the next power cycle or [system reset](#).

The CAN bus speed may also be changed using the [LSS protocol](#), as detailed in section 5.3.7.

5.3.1.1. Read Baud Rate

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	03h 30h	01h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	03h 30h	01h	20h A1h 07h 00h

The data in the above response returns a CAN bus speed of 500000 bps.

5.3.1.2. Write Baud Rate

To set a CAN bus speed of 1 Mbps:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	23h	03h 30h	01h	40h 42h 0Fh 00h

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CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	03h 30h	01h	00h 00h 00h 00h

5.3.2. Node ID (Index 3003h, Sub-Index 02h)

SDO 3003h:02h reads and sets the device address used on the CANopen bus.

The permitted values for node ID are 01h to 7Fh.

The factory default value is 01h.

When set (and written to NVM by the [Save Setup Parameters](#) command), the new node ID will be active after the next power cycle or [system reset](#).

The node ID may also be changed using the [LSS protocol](#), as detailed in section 5.3.7.

5.3.2.1. Read Node ID

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	03h 30h	02h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	03h 30h	02h	33h 00h 00h 00h

The data in the above response returns a node ID of 33h.

5.3.2.2. Write Node ID

To set a node ID of 0Fh:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	23h	03h 30h	02h	0Fh 00h 00h 00h

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CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	03h 30h	02h	00h 00h 00h 00h

5.3.3. Bus Protocol (Index 3003h, Sub-Index 03h)

SDO 3003h:03h reads and sets the CAN Bus Protocol parameter, allowing the CED-20 to switch between CANopen and J1939.

The permitted values for the Bus Protocol parameter are 12Dh (CANopen) and 793h (J1939).

When set (and written to NVM by the [Save Setup Parameters](#) command), the new bus protocol will be enabled after the next power cycle or [system reset](#).

The CED-20 must be in [administrator mode](#) to write this parameter.

The [Restore Factory Defaults](#) command will not change the value of this parameter.

5.3.3.1. Read Bus Protocol

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	03h 30h	03h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	03h 30h	03h	2Dh 01h 00h 00h

The result returned in the above response shows that the CED-20 will use the CANopen protocol after the next power cycle.

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5.3.3.2. Write Bus Protocol

To set the CED-20 to use the J1939 protocol after the next power cycle:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	23h	03h 30h	03h	93h 07h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	03h 30h	03h	00h 00h 00h 00h

5.3.4. CAN Termination Resistor Status (Index 3003h, Sub-Index 04h)

SDO 3003h:04h reads and sets the status of the 120Ω CAN termination resistor.

A CAN bus network should have a terminating resistor between CAN High and CAN Low at the two physical endpoints of the CAN network. Each CED-20 PCB has a 120Ω resistor which can be enabled or disabled to achieve this termination requirement.

The permitted values for the termination resistor status are 0 (disabled) and 1 (enabled).

The factory default value is 1 (enabled).

5.3.4.1. Read CAN Termination Resistor Status

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	03h 30h	04h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	03h 30h	04h	00h 00h 00h 00h

The data in the above response indicates that the CAN termination resistor is disabled.

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5.3.4.2. Write CAN Termination Resistor Status

To enable the CAN termination resistor:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	23h	03h 30h	04h	01h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	03h 30h	04h	00h 00h 00h 00h

5.3.5. Producer Heartbeat Time (Index 1017h, Sub-Index 00h)

The CED-20 implements the heartbeat protocol as a means of monitoring the CANopen network and ensuring the availability of all heartbeat producers. The heartbeat message (when enabled) is transmitted in the Per-operational, Operational and Stopped states.

Node-guarding is not supported by the CED-20.

SDO 1017h:00h reads or sets the period (in milliseconds) between successive heartbeat messages. Data is sent / received as a 16-bit unsigned integer.

The permitted values for the producer heartbeat time are 0 (disabled) to 65535 (ms).

The factory default value is 0 (disabled).

5.3.5.1. Read Producer Heartbeat Time

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	17h 10h	00h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	4Bh	17h 10h	00h	FAh 00h 00h 00h

The result returned in the above response shows a producer heartbeat time of 250 milliseconds.

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5.3.5.2. Write Producer Heartbeat Time

To disable the transmission of the heartbeat message:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	2Bh	17h 10h	00h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	17h 10h	00h	00h 00h 00h 00h

5.3.6. Self-Start / NMT Start-Up (Index 1F80h, Sub-Index 00h)

In the CANopen standard, dictionary object 1F80h:00h controls several aspects of a node's start-up behaviour. However, the CED-20 supports only the NMT Master Start flag, which determines whether the node will automatically switch to the Operational state as part of its start-up sequence.

An automatic transition to the Operational state will see [TPDO1 \(Net mV/V Signal Status\)](#) periodically transmitted at power-on without the need to send an NMT message to achieve this.

The permitted values for the NMT Start-up are:

00h: The node automatically switches to the Operational state at start-up.

04h: The node does *not* switch to the Operational state; it stays in the Pre-operational state.

The factory default value is 4 (self-start is disabled).

5.3.6.1. Read Self-Start / NMT Start-Up

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	80h 1Fh	00h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	80h 1Fh	00h	04h 00h 00h 00h

The result returned in the above response shows the node does *not* self-start.

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5.3.6.2. Write Self-Start / NMT Start-Up

To enable the node's self-start capability:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	23h	80h 1Fh	00h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	80h 1Fh	00h	00h 00h 00h 00h

5.3.7. Layer Setting Services (LSS)

As well as using the [SDOs](#) described above, the CED-20 also supports the CANopen Layer Setting Services (LSS) as a means of configuring the [node ID](#) and [baud rate](#).

Unlike when using the [SDO](#) service, the current node ID of the CED-20 is not used in the protocol, so the LSS protocol can be used if the node ID is not known or two nodes on the bus share the same ID. The following layer setting services are supported by the CED-20:

Service Code	Service Name
04h	Switch state global
11h	Configure node ID
13h	Configure bit timing
15h	Activate bit timing
17h	Store configuration
40h	Switch state selective, select vendor ID
41h	Switch state selective, select product code
42h	Switch state selective, select revision number
43h	Switch state selective, select serial number
5Ah	Inquire vendor ID
5Bh	Inquire product code
5Ch	Inquire revision number
5Dh	Inquire serial number
5Eh	Inquire node ID

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In order to change the [node ID](#) or [baud rate](#) of the CED-20, the specific device must first be selected for configuration. This can be done in one of two ways, as shown below.

5.3.7.1. Switch State Global

Using the Switch State Global service, all devices on the CANopen bus will be selected using a single command.

The permitted modes for the switch state global command are:

- 00h: Waiting – nodes in the waiting state will not be configured using LSS messages
- 01h: Configuration – nodes in the configuration state can be configured using LSS messages.

To select all devices on the CANopen bus for configuration:

Controller Sends 'Switch State Global':			
CAN ID	CAN Data (DLC = 8)		
	Command	Mode	Reserved
7E5h	04h	01h	00h 00h 00h 00h 00h 00h

The switch state global service is unconfirmed; there will be no response from any node receiving the message.

5.3.7.2. Switch State Selective

Using the Switch State Selective service, a specific node can be selected for configuration. To select a specific node, four messages must be sent, each identifying a different attribute of the node to be selected. Only when *all four* attributes of the node have been selected, will the node be in the configuration state.

The attributes to be matched and their CED-20 values are shown below.

LSS Attribute	CED-20 Value	CED-20 Attribute
Vendor ID	044Ah	Flintec vendor ID (044Ah)
Product code	112328 (CED-20) 112325 (CED-30)	Application f/w part number
Revision number	Device-dependent	Application firmware version
Serial number	Device-dependent	Serial number

The switch state selective service is a confirmed service, but a response will only be sent when the node enters the configuration state (i.e., *all four* attributes are matched).

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To select the CED-20 with serial number 202101999 and version 1.0:

Controller Sends 'Select Vendor ID':			
CAN ID	CAN Data (DLC = 8)		
	Command	Vendor ID	Reserved
7E5h	40h	4Ah 04h 00h 00h	00h 00h 00h

Controller Sends 'Select Product Code':			
CAN ID	CAN Data (DLC = 8)		
	Command	Product Code	Reserved
7E5h	41h	C8h B6h 01h 00h	00h 00h 00h

Controller Sends 'Select Revision Number':			
CAN ID	CAN Data (DLC = 8)		
	Command	Revision Number	Reserved
7E5h	42h	00h 00h 01h 00h	00h 00h 00h

Controller Sends 'Select Serial Number':			
CAN ID	CAN Data (DLC = 8)		
	Command	Serial Number	Reserved
7E5h	43h	EFh D4h 0Bh 0Ch	00h 00h 00h

When *all four* attributes are matched:

CED-20 Responds:			
CAN ID	CAN Data (DLC = 8)		
	Command	Reserved	
7E4h	44h	00h 00h 00h 00h 00h 00h 00h	

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5.3.7.3. Configure Node ID

When a device has been selected for configuration, the Configure Node ID service can be used together with the [NMT Reset Communications](#) message and the LSS Store Configuration service.

The permitted values for node ID are 01h to 7Fh.

The message sequence needed to configure the selected device with node ID 3Bh is as follows.

Controller Sends 'Configure Node ID':			
CAN ID	CAN Data (DLC = 8)		
	Command	New Node ID	Reserved
7E5h	11h	3Bh	00h 00h 00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Error Code	Spec-Error	Reserved
7E4h	11h	00h	00h	00h 00h 00h 00h 00h

Controller Sends 'Reset Communications':		
CAN ID	CAN Data (DLC = 2)	
	Command	Node ID
000h	82h	00h (all nodes)

CED-20 Responds:	
CAN ID	CAN Data (DLC = 1)
73Bh (= 700h + new node ID)	00h

Controller Sends 'Store Configuration':		
CAN ID	CAN Data (DLC = 8)	
	Command	Reserved
7E5h	17h	00h 00h 00h 00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Error Code	Spec-Error	Reserved
7E4h	17h	00h	00h	00h 00h 00h 00h 00h

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5.3.7.4. Configure Bit Timing

When a device has been selected for configuration, the Configure Bit Timing service can be used together with the LSS Activate Bit Timing service and the LSS Store Configuration service to set a new CAN bus speed.

Bit timing / bus speed is determined by means of a table selector and a table index. The CED-20 uses a manufacturer-specific bit timing table (table selector 80h) with indices defined as follows.

Table Index	CAN Bus Speed
0	1000000 bits/s (1 Mbps)
1	800000 bits/s (800 kbps)
2	500000 bits/s (500 kbps)
3	250000 bits/s (250 kbps)
4	125000 bits/s (125 kbps)
5	Reserved, do not use.
6	50000 bits/s (50 kbps)
7	20000 bits/s (20 kbps)
8	10000 bits/s (10 kbps)

The message sequence needed to configure the selected device with a bus speed of 125 kbps is as follows.

Controller Sends 'Configure Bit Timing':				
CAN ID	CAN Data (DLC = 8)			
	Command	Table Selector	Table Index	Reserved
7E5h	13h	80h	04h	00h 00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Error Code	Spec-Error	Reserved
7E4h	13h	00h	00h	00h 00h 00h 00h 00h

Controller Sends 'Activate Bit Timing':			
CAN ID	CAN Data (DLC = 8)		
	Command	Switch Delay	Reserved
7E5h	15h	32h 00h	00h 00h 00h 00h 00h

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Note: Switch delay is the time delay (UI16) in milliseconds which the slave nodes will wait before accepting the new bit rate. There is second delay of the same period before the slave sends messages.
This is an unconfirmed service; no response is sent.

Controller Sends 'Store Configuration':		
CAN ID	CAN Data (DLC = 8)	
	Command	Reserved
7E5h	17h	00h 00h 00h 00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Error Code	Spec-Error	Reserved
7E4h	17h	00h	00h	00h 00h 00h 00h 00h

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5.4. Data Access Commands

5.4.1. Data Output Options (Index 3004h, Sub-Index 01h)

SDO 3004h:01h reads and sets the Data Output Options parameter.

The Data Output Options parameter determines the format of all mV/V data output.

This parameter is sent and received as an 8-bit unsigned integer.

The permitted values for the Data Output Options parameter are derived from the table below.

Bit #	Value	Meaning
7..1		Unused, always 0.
0	01h	IEEE 754 flag. 0: All mV/V data is sent as a 32-bit signed integer (multiplied by 10000 for increased precision). 1: All mV/V data is sent as a 32-bit floating-point number in IEEE 754 format.

The factory default value is 0 (mV/V data is sent 32-bit integer format).

5.4.1.1. Read Data Output Options

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	04h 30h	01h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	4Fh	04h 30h	01h	00h 00h 00h 00h

The result returned in the above response shows that all mV/V data will be transmitted in 32-bit integer format.

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5.4.1.2. Write Data Output Options

To set all mV/V data output to be transmitted in IEEE 754 format:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	2Fh	04h 30h	01h	01h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	04h 30h	01h	00h 00h 00h 00h

5.4.2. Read Filtered mV/V Signal (Index 3004h, Sub-Index 02h)

Reading SDO 3004h:02h returns the latest value of the load cell signal in mV/V, after any selected [filtering](#) has been applied. The value returned is the net value, with any [mV/V tare](#) signal already subtracted.

The mV/V signal value is returned as a 32-bit integer or a 32-floating-point number, as determined by the IEEE 754 Flag setting in the [Data Output Options](#) parameter.

The overweight rogue value of 10^9 will be returned if the signal level is above the absolute limit of +3.3 mV/V.

The underweight rogue value of -10^9 will be returned under any of the following conditions:

- The [warm-up time](#) defined in section 5.2.3 has not yet expired.
- The mV/V signal level is below the absolute limit of -3.3 mV/V.
- Any fault flags in the [ECU Status](#) byte are set (see section 5.4.3).

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	04h 30h	02h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	04h 30h	02h	4Ch 2Bh 00h 00h

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The result returned in the above response shows a signal level of 11084 (\equiv 1.1084 mV/V). In this example, the result is in integer format (multiplied by 10000) since the IEEE 754 flag in the [data output options](#) parameter is cleared.

5.4.3. Read ECU Status (Index 3004h, Sub-Index 03h)

Reading SDO 3004h:03h returns the status of the CED-20. The 8-bit unsigned integer returned represents a set of bit-mapped flags to indicate whether certain conditions are active. The values of each of these flags is as follows.

Bit #	Value	Condition
7	80h	Critical fault (non-recoverable, the CED-20 must be returned to Flintec).
6	40h	Load cell fault (open circuit or low excitation voltage).
5	20h	ECU configuration fault (recoverable by configuring all parameters).
4	10h	Copy of the IEEE 754 flag in the Data Output Options parameter.
3	08h	The mV/V signal is above the maximum limit of +3.3 mV/V.
2	04h	The mV/V signal is below the minimum limit of -3.3 mV/V.
1	02h	The mV/V net/tare function is active.
0	01h	Warm-up is active (i.e., the warm-up time has not yet expired).

To read the ECU status:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	04h 30h	03h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	4Fh	04h 30h	03h	12h 00h 00h 00h

The result returned in the above response shows that the mV/V output is in IEEE 754 format and tare is active.

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5.4.4. Read mV/V Tare Signal (Index 3004h, Sub-Index 04h)

Reading SDO 3004h:04h returns the current tare signal level, measured in mV/V. If the [mV/V net/tare function](#) is not currently active, a value of zero will be returned.

The tare signal level is returned as a 32-bit integer or a 32-floating-point number, as determined by the IEEE 754 Flag setting in the [Data Output Options](#) parameter.

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	04h 30h	04h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	04h 30h	04h	71h 1Bh 4Dh 3Eh

The result returned in the above response shows a tare signal of 0.2003 mV/V. In this example, the result is in IEEE 754 format since the IEE 754 flag in the [Data Output Options](#) parameter is set.

5.4.5. Read Filtered ADC Sample (Index 3004h, Sub-Index 05h)

Reading SDO 3004h:05h returns value of the last-calculated ADC signal after any selected [filtering](#) has been applied (as detailed in section 5.2.2).

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	04h 30h	05h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	04h 30h	05h	9Dh 7Bh 9Ch 00h

The result returned in the above response shows a filtered ADC sample value of 10255261 counts.

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5.5. Set and Reset mV/V Tare (Index 3005h, Sub-Index 01h)

Writing to SDO 3005h:01h controls the CED-20's taring operation depending on the value of the 8-bit unsigned integer parameter sent with the command.

Each bit in the parameter represents a specific command which will be executed only if that bit is set. The bits assignments are as shown below.

Bit #	Bit Value	Function
7..2		Unused, always 0.
1	02h	Reset mV/V tare (section 5.5.2)
0	01h	Set mV/V tare (section 5.5.1)

Note: All set bits in the data byte will execute the corresponding function, starting from the least-significant bit (bit 0). Thus, if the '[Reset mV/V Tare](#)' bit *and* the '[Set mV/V Tare](#)' bit are both set (parameter value is 03h), the [Set mV/V Tare](#) command will be executed first, immediately followed by the [Reset mV/V Tare](#) command.

Dictionary object 3005h:01h is mapped to [RPDO1](#) for use as an unconfirmed service when in the Operational state. See section 4.7.2.1 for more information.

5.5.1. Set mV/V Tare

Writing the value 01h to SDO 3005h:01h sets the tare signal to the current mV/V signal level and activates the net/tare function. All subsequent [mV/V readings](#) transmitted by the CED-20 will be offset from this value.

The Set mV/V Tare command will be rejected if any of the following conditions are true:

- The [mV/V signal](#) level is outside the absolute maximum range of ± 3.3 mV/V.
- The [warm-up time](#) defined in section 5.2.3 has not yet expired.
- Any fault flags in the [ECU Status](#) byte are set (see section 5.4.3).

When the Set mV/V Tare command is executed, the 'mV/V net/tare function active' flag in the [ECU Status](#) byte will be set and the [TPDO2 \(Tare Signal\)](#) message will be broadcast (when in the Operational state).

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To set a new mV/V tare value:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	2Fh	05h 30h	01h	01h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	05h 30h	01h	00h 00h 00h 00h

5.5.2. Reset mV/V Tare

Writing the value 02h to SDO 3005h:01h resets the mV/V tare signal to zero and deactivates the mV/V net/tare function. All subsequent [mV/V readings](#) transmitted by the CED-20 will be the true signal level from the load cell.

When the Reset mV/V Tare command is executed, the 'mV/V net/tare function active' flag in the [ECU Status](#) byte will be cleared and the [TPDO2 \(Tare Signal\)](#) message will be broadcast (when in the Operational state).

To reset the mV/V tare value:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	2Fh	05h 30h	01h	02h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	05h 30h	01h	00h 00h 00h 00h

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5.6. Miscellaneous Commands

5.6.1. System Reset (Index 3007h, Sub-Index 01h)

Writing any value to SDO 3007h:01h instructs the CED-20 to perform a full firmware reset (warm start).

When successfully executed, the response will be returned *before* the device is reset. Initialisation after reset can take up to 250 ms. During initialisation, any messages transmitted on the CAN bus may not be received by the CED-20.

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	23h	07h 30h	01h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	07h 30h	01h	00h 00h 00h 00h

5.6.2. Write Passcode Register (Index 3007h, Sub-Index 02h)

SDO 3007h:02h writes a 32-bit integer into the passcode register. The contents of this register must match the system passcode (default value 9A52Fh) to put the CED-20 into **either** administrator mode or OEM mode (allowing changes to restricted parameters and access to restricted functions).

If the CED-20 is *not* in administrator mode or OEM mode when an incorrect code is entered, an error will be returned, and this command will become unavailable for around 5 seconds.

The CED-20 will exit administrator mode or OEM mode if any of the following occur:

- The contents of the passcode register are *changed* when already in administrator mode (a success response will be returned in this case).
- No administrator commands are executed for around 10 minutes.
- A power cycle or [system reset](#) is performed.

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To write the passcode register, putting the CED-20 into administrator mode:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	23h	07h 30h	02h	2Fh A5h 09h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	07h 30h	02h	00h 00h 00h 00h

5.6.3. Save Setup Parameters (Index 1010h, Sub-Index 01h)

When the value 65766173h is written to SDO 1010h:01h, any changes in setup parameters are saved to non-volatile memory. Until committing to NVM, any unsaved parameter changes will be lost if a power cycle or [system reset](#) occurs.

The following setup parameters are saved using this command: [RPDO1 disable bit](#), [TPDO1 disable bit](#), [TPDO2 disable bit](#), [ADC sample rate](#), [filter type](#), [warm-up time](#), [baud rate](#), [node ID](#), [bus protocol](#), [CAN termination resistor status](#), [producer heartbeat time](#), [NMT start-up](#), [data output options](#), and [user parameters 1-4](#).

Note: The data transfer to non-volatile memory may take up to 75 ms to complete. A successful response to this request signifies only that the request was valid, and that the memory transfer has begun. Any further communication sent to the CED-20 within 75 ms of this command may be lost, as all CPU activity is halted during the memory transfer process.

To save setup parameters to non-volatile memory:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	23h	10h 10h	01h	73h 61h 76h 65h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	10h 10h	01h	00h 00h 00h 00h

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5.6.4. Restore Factory Defaults (Index 1011h, Sub-Index 01h)

Writing value 64616F6Ch to SDO 1011h:01h over-writes all setup parameters (except for the [bus protocol](#) parameter) with pre-defined factory default values.

When this command has been successfully executed, the restored parameters will be automatically written to non-volatile memory, without the need to send the [Save Setup Parameters](#) message.

Note: The data transfer to non-volatile memory may take up to 75 ms to complete. A successful response to this request signifies only that the request was valid, and that the memory transfer has begun. Any further communication sent to the CED-20 within 75 ms of this command may be lost, as all CPU activity is halted during the memory transfer process.

The CED-20 must be in [administrator mode](#) to accept this command.

The parameters changed and their restored default values are as follows.

Parameter	Index	Sub-Index	Default Value
Producer heartbeat time	1017h	00h	0 (Heartbeat is disabled.)
RPDO1 COB-ID	1400h	01h	200h + node ID (RPDO1 enabled)
TPDO1 COB-ID	1800h	01h	180h + node ID (TPDO1 enabled)
TPDO2 COB-ID	1801h	01h	280h + node ID (TPDO2 enabled)
NMT start-up	1F80h	00h	04h (Self-start is disabled.)
ADC sample rate	3002h	01h	50 samples/second.
Filter type	3002h	03h	2 (16-entry running average.)
Warm-up time	3001h	06h	0 seconds
Baud rate	3003h	01h	500000 bps.
Node ID	3003h	02h	1
CAN termination resistor status	3003h	03h	1 (Resistor is enabled.)
Data output options	3004h	01h	0 (mV/V data in integer format.)
User Parameters 1-4	3008h	01h – 04h	0

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To restore factory default values:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	23h	11h 10h	01h	6Ch 6Fh 61h 64h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	11h 10h	01h	00h 00h 00h 00h

5.6.5. Read/Write User Parameters 1-4 (Index 3008h, Sub-Indexes 01h – 04h)

The user parameters are for storing arbitrary user data, and are not used by the firmware.

Reading from an SDO in the range 3008h:01h to 3008h:04h returns the value of the corresponding user parameter 1 to 4 recorded in the device. Writing to an SDO in the range 3008h:01h to 3008h:04h will over-write the existing value for the corresponding user parameter 1 – 4 recorded in the device with the supplied value.

Note: After writing any new values, a [Save Setup Parameters](#) command must be issued to store all of the new values in non-volatile memory.

The CED-20 must be in [administrator mode](#) to use this command.

The below example writes a new user parameter 3 value of -16180, with CED-20 responding successfully to the request:

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	23h	08h 30h	03h	CCh C0h FFh FFh

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	60h	08h 30h	03h	00h 00h 00h 00h

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The below example attempts to read user parameter 3 (with a value of -16180 returned):

Controller Sends:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Parameters
600h + node ID	40h	08h 30h	03h	00h 00h 00h 00h

CED-20 Responds:				
CAN ID	CAN Data (DLC = 8)			
	Command	Index	Sub-Index	Result
580h + node ID	43h	08h 30h	03h	CCh C0h FFh FFh