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CED-20/CED-30 J1939 User Manual
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User Manual

CED-20/CED-30 (J1939)

V1.1 October 2025

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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	2025-10-23	Andrew Palmer	Add description of User Parameters feature, 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 earthmoving machines and agricultural vehicles.

The device features a CAN interface with support for the J1939 protocol with a fixed data rate of 250 kbps.

The CED-20 can be switched from using the J1939 protocol to using the CANopen protocol as needed to suit the application. This document details the CED-20 operation and commands for the J1939 protocol only. To switch to using the CANopen protocol, see the [Bus Protocol](#) section of this manual (section 6.3.3) and refer to the CED-20/CED-30 CANopen User Manual (Flintec document 0109610) 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	J1939 and CANopen
J1939 data rate	250 kbits/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 (cm^3)	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 – IP67

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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
Broadcast message	Any message on the J1939 network that may be received and actioned by all devices simultaneously. Compare with P2P message .
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
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.
FDC	Flintec Device Configurator. A PC application to configure and calibrate a number of Flintec devices. Available on Flintec's website: www.flintec.com
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.
P2P message	Peer-to-peer message. A P2P message is any message on the J1939 network which is targeted at a device with a specific Node ID . Compare with Broadcast message .
PGN	Parameter Group Number. This identifies a message's function and its associated data. J1939 defines a large number of standard PGNs for a wide variety of purposes.
REG 10	Vehicle Type Approval Certificate. An internationally agreed EMC standard applicable to road vehicles.

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4. Getting Started

You will require:

- A USB to CAN Converter for J1939
- 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

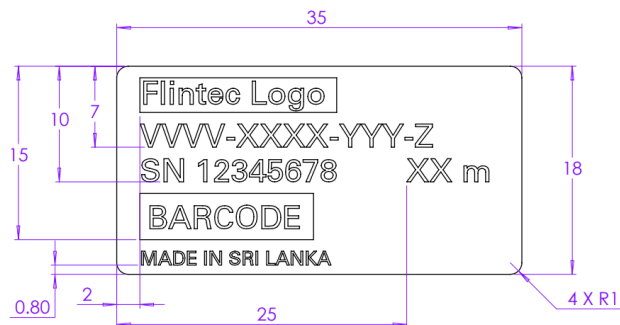
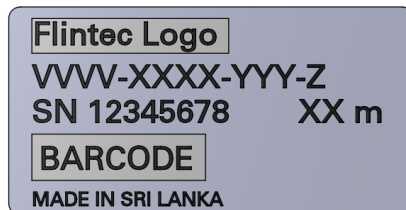
The label for the CED-20 is located on the external wall of the load cell. The label for the CED-30 will be located on the external wall of the enclosure. Enclosures and load cells all require information to distinguish between models.

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4.1.1. CED-20

Load Cell Self Adhesive Label

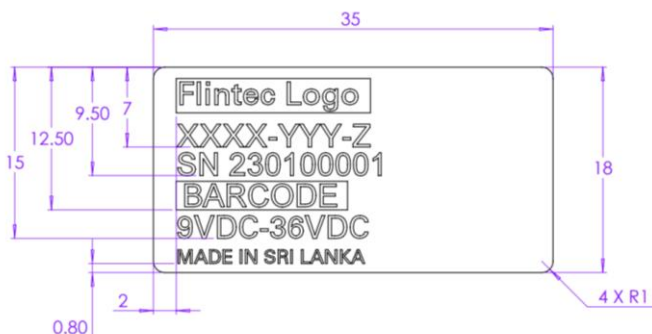
Located on the external wall of the load cell near cable gland.



4.1.2. CED-30

Enclosure Self Adhesive Label

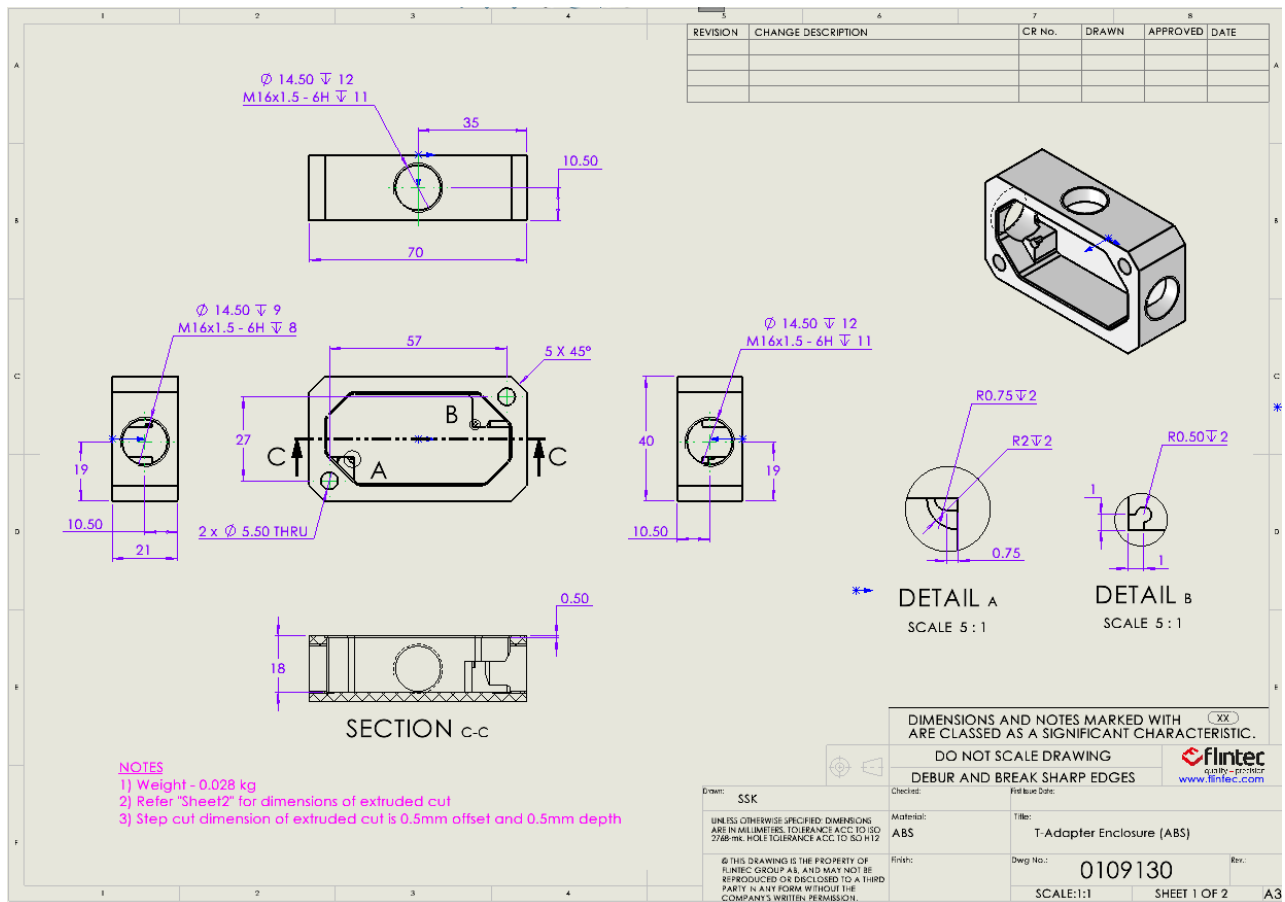
Located on the external wall of the Enclosure/T-adaptor.



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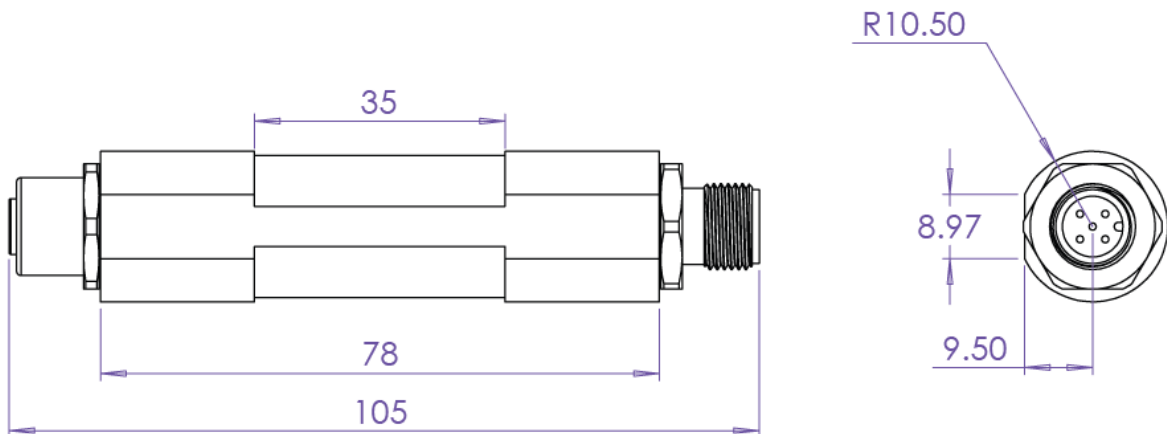
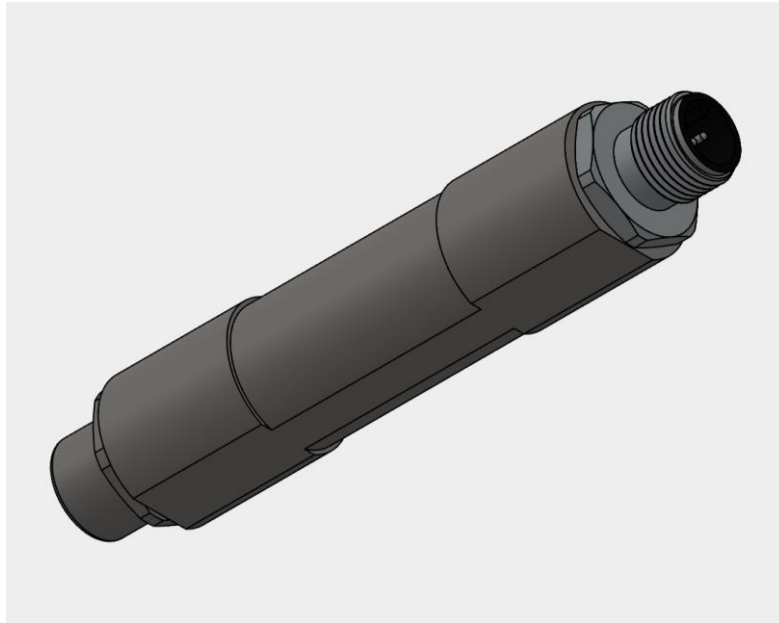
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4.2. T-adaptor Enclosure Dimensions



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4.3. In-line Enclosure Dimensions

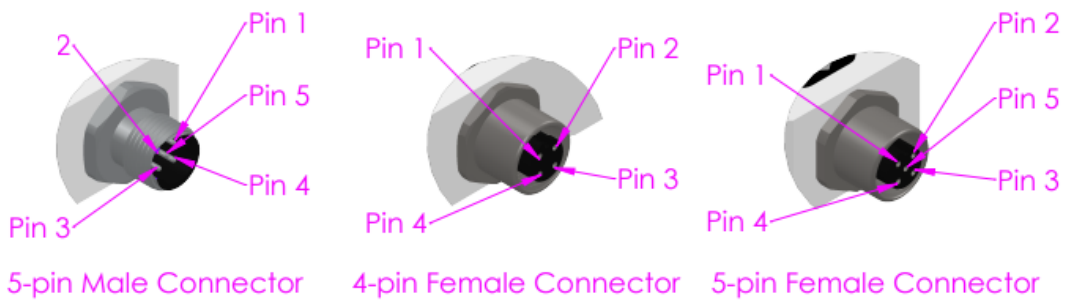
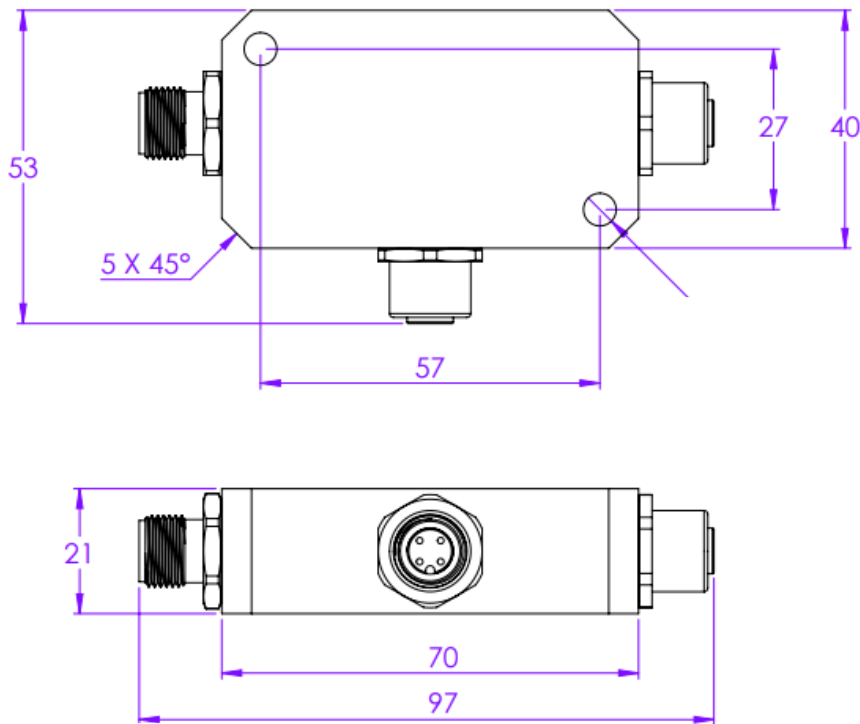


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4.4. Connections

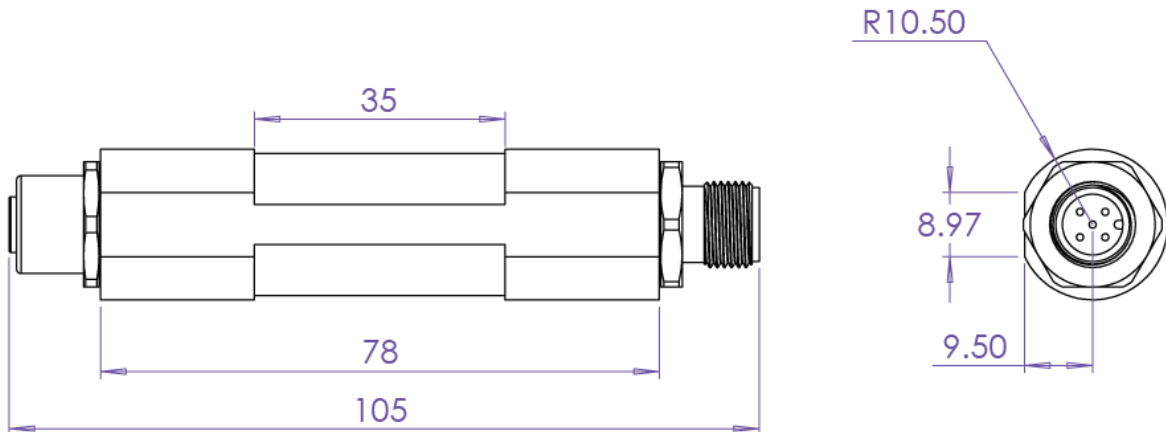
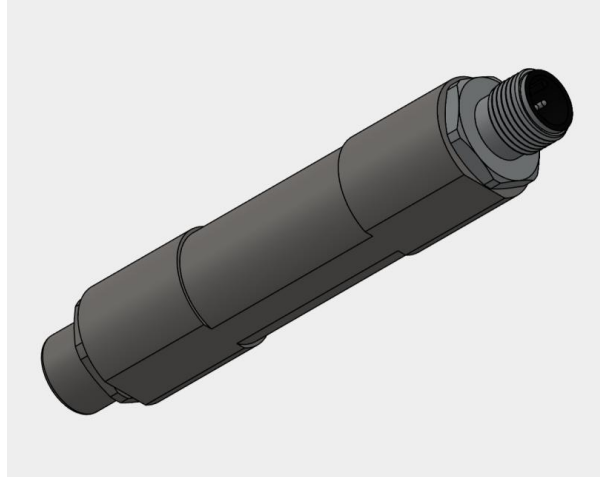
4.4.1. T-Adaptor Enclosure Connections



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

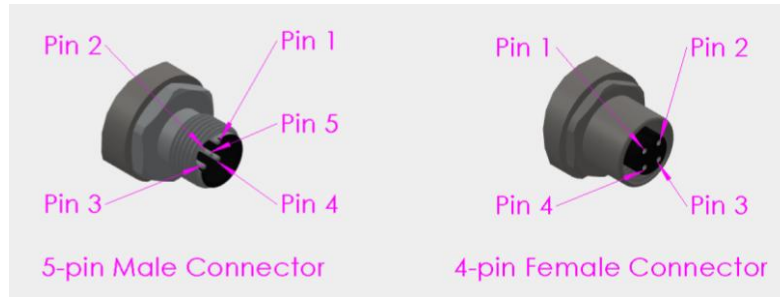
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4.4.2. In line Enclosure Connections



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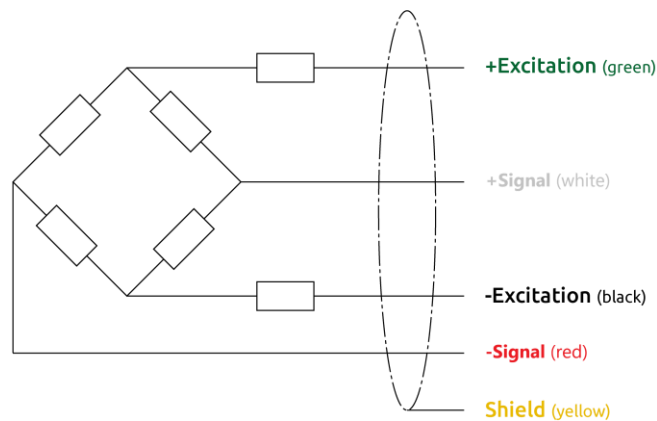


Pin Number	5 pin - Male	4 pin - Female
Pin 1	SHIELD	+ Excitation
Pin 2	+VDC	+ Signal
Pin 3	GND	- Excitation
Pin 4	CAN High	- Signal
Pin 5	CAN Low	

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.

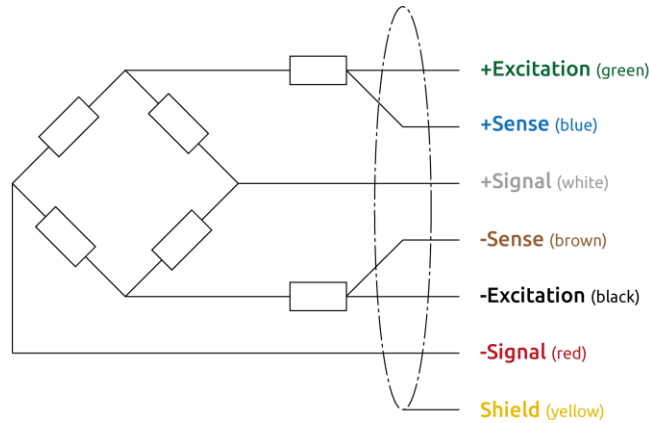
4-Wire Connection:



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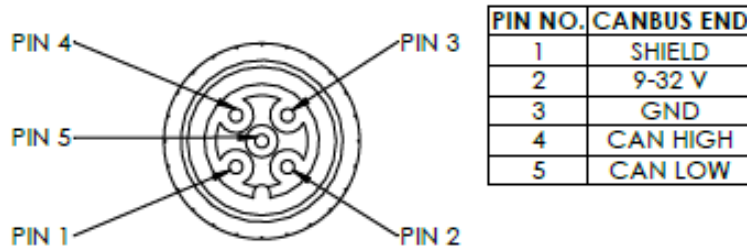
6-Wire Connection:



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 -

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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 6.3.1) for details of how to enable/disable the 120 Ω resistor.



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5. The J1939 Interface

5.1. General Information

The J1939 interface conforms to the CAN 2.0B standard, using 29-bit extended identifiers and runs at a fixed speed of 250 kbps. All data is sent in little-endian format; that is, least-significant byte first.

The CED-20 conforms to the requirements for an arbitrary address capable node as defined in the SAE International® J1939™ Network Management specification (J1939-81, March 2017). On first connection to the J1939 network, the CED-20 will negotiate a **node address** in accordance with the J1939 address claim process. A claimed address is stored in non-volatile memory (so will survive a power cycle) and will continue to be used until a higher-priority device claims that address, in which case a new address will then be negotiated.

Throughout this manual, hexadecimal values are written using the “0x” prefix (such as ‘0x9C’); all un-prefixed numbers should be considered as decimal numbers.

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5.2. Network Management and Node Addressing

For the purposes of network management and node address management, the CED-20 will support the Parameter Group Numbers (PGNs) shown in the following sections. The PGNs given in these sections conform to those described in the SAE J1939 Network Management specification.

5.2.1. Node ID/Address

Each node (device) on the J1939 network must have a unique 8-bit node ID (address) in the range 0 to 253 (0xFD); node ID 255 (0xFF) is reserved as a broadcast address to send messages to all nodes simultaneously and ID 254 (0xFE) is the “null” address used by devices that have not yet successfully claimed an address. See section 6.3.2 for information on how to [set the ECU node ID](#).

The node’s ID is always included as part of the CAN ID when transmitting a message. This is referred to as the source address.

The node’s ID *may* be part of the CAN ID when it is being specifically targeted by a request message from another device. This is referred to as the destination address.

5.2.2. Request for PGN (PGN 59904 [0xEA00])

All supported PGNs (address management and functional) can be requested using PGN 59904. For example, to request the [mV/V tare signal message](#), PGN 65282 (0xFF02) from device 0x8C:

Controller 0xF9 sends:		CED-20 0x8C responds:	
CAN ID	CAN Data (DLC=3)	CAN ID	Data (DLC = 5)
	Requested PGN		PGN Data
0x18EA8CF9	0x02 0xFF 0x00	0x18FF028C	0x1C 0x07 0x00 0x00 0x01

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5.2.3. Address Claimed (PGN 60928 [0xEE00])

When power is supplied to the CED-20, PGN 60928 will be sent as part of the address claim process. The J1939 standard defines a 64-bit NAME (which should be unique on the network) that will be sent in the data bytes of this PGN. For the CED-20, the 64-bit NAME parameter will contain the following data:

Field	Length	Value
Arbitrary address capable	1 bit	1 (Capable)
Industry group	3 bits	0 (Global, applies to all)
Vehicle system instance	4 bits	0 (First and only instance)
Vehicle system ID	7 bits	0 (Non-specific system)
Reserved	1 bit	0
Function ID	8 bits	139 (On-board axel group scale)
Function instance	5 bits	0 (First and only instance)
ECU instance	3 bits	Programmable. See section 6.1.4
Manufacturer code	11 bits	1031 (Flintec UK Ltd.)
Identity number	21 bits	21 least-significant digits of the serial number . See section 6.1.1.

Example: For a CED-20 with node ID 0x86, [ECU Instance](#) number 0 and [serial number](#) 2052999, the following CAN frame will be received when PGN 60928 is transmitted:

CAN-ID (hex)	PGN	Source (hex)	Data
18EEFF86	60928	86	87 53 FF 80 00 8B 00 80 <input type="checkbox"/> NAMEOfControllerApplication = 9223524871135253383 IdentityNumber = 2052999 ManufacturerCode = Flintec UK Ltd. ECUInstance = 0 FunctionInstance = 0 Function = 139 VehicleSystem = 0 VehicleSystemInstance = 0 IndustryGroup = Global, applies to all ArbitraryAddressCapable = CA is capable

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5.3. Broadcast Messages

The CED-20 supports two broadcast messages: the [load cell signal](#) message and the [mV/V tare signal](#) message. Broadcast messages do not contain a destination address, so may be received by all nodes on the J1939 network.

The sections below describe the supported broadcast messages in detail.

5.3.1. The Load Cell Signal Message (PGN 65281 [0xFF01])

The proprietary (manufacturer-defined) broadcast message PGN 65281 (0xFF01) sends the latest (net) mV/V signal level from the load cell.

Both the data format and the message trigger can be configured by the [data output options](#) parameter described in section 6.4.1.

The message frame is as follows.

CAN ID:	0x18FF0100 + Node ID
PGN:	65281
SAE J1939 acronym:	PropB_01
Message trigger:	On-event or on-request (determined by the data output options)
DLC:	5
Data type:	32-bit integer or 32-bit IEE 754 (defined by the data output options).
Data byte 0:	Load cell signal data, byte 0 (LSB)
Data byte 1:	Load cell signal data, byte 1
Data byte 2:	Load cell signal data, byte 2
Data byte 3:	Load cell signal data, byte 3 (MSB)
Data byte 4:	ECU status (see section 6.4.2)

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5.3.2. The mV/V Tare Signal Message (PGN 65282 [0xFF02])

The proprietary (manufacturer-defined) broadcast message PGN 65282 (0xFF02) sends the latest mV/V tare value.

Both the data format and the message trigger can be configured by the [data output options](#) parameter described in section 6.4.1.

The message frame is as follows.

CAN ID:	0x18FF0200 + Node ID
PGN:	65282
SAE J1939 acronym:	PropB_02
Message trigger:	On-event or on-request (determined by the data output options)
DLC:	5
Data type:	32-bit integer or 32-bit IEE 754 (defined by the data output options).
Data byte 0:	Tare signal data, byte 0 (LSB)
Data byte 1:	Tare signal data, byte 1
Data byte 2:	Tare signal data, byte 2
Data byte 3:	Tare signal data, byte 3 (MSB)
Data byte 4:	ECU status (see section 6.4.2)

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5.4. Peer-To-Peer Messages

J1939 peer-to-peer (P2P) messaging allows a CAN data frame to be targeted at a specific node on the network rather than being broadcast to all devices simultaneously. This is achieved by including the destination address as part of the CAN ID field. A given node will ignore all P2P messages in which the destination address does not match its own node ID.

CED-20 P2P messages include configuration messages, diagnostic messages and function-execution messages, and all use the proprietary (manufacturer-defined) P2P PGN 239 (0xEF).

Note: The J1939 specification does allow the use of the global destination address, 0xFF, to be used as the destination address in a P2P message, but this is discouraged. Given that PGN 239 is manufacturer-defined, the commands described in the following sections of this document are intended only for CED-20 devices. Other devices receiving these commands could interpret them in an unintended way, possibly causing harmful results.

5.4.1. Peer-To-Peer Requests

Each CED-20 P2P message has a unique command ID which, together with any command parameters, is contained in the data field of the message. The structure of a P2P request message is shown below:

CAN ID Field	Data Field	
0x18EF<dest.><source>	Command ID (8 bits)	Command parameters (0 to 56 bits)

In the CAN ID field above, “<dest.>” and “<source>” are the 8-bit node addresses of the message receiver and message sender respectively.

5.4.2. Peer-To-Peer Responses

Every CED-20 P2P request will elicit a response from the CED-20 whose node ID matches the destination address of the request. As with the request, the response also uses PGN 239 (0xEF). The data bytes of the response message include a response code, the command ID of the request and any returned result(s). The structure of a P2P response message is shown below:

CAN ID Field	Data Field		
0x18EF<dest.><source>	Response code (8 bits)	Command ID (8 bits)	Result data (0 to 48 bits)

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The response code will have one of the following values:

Response Code	Meaning
0xFF	Positive response (success)
0xFE	Negative response – invalid command ID
0xFD	Negative response – parameter(s) out of range
0xFC	Negative response – incorrect message length
0xFB	Negative response – conditions are not correct to execute the request at this time (e.g., the CED-20 is not in administrator mode).

Example:

A request by node 0xF9 to read the firmware part number from node 0x8C will be as follows.

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x01	-	0x18EFF98C	0xFF	0x01	0xC8 0xB6 0x01 0x00

In the above messages, the data bytes have the following meanings:

Request byte 0: Command ID 0x01 is “[Read Firmware Part Number](#)” (section 6.1.2)

Response byte 0: 0xFF indicates a positive response (success).

Response byte 1: 0x01 is the command ID of the request.

Resp. bytes 2-5: 0xC8 0xB6 0x01 0x00 is the firmware part number in 32-bit little-endian format (part number 112328 is 0x0001B6C8).

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5.4.3. Command Summary

The table below gives a summary of the P2P commands available in the CED-20. An “(A)” entry beside the description denotes that the CED-20 must be in [administrator mode](#) to *write* the parameter or access the operation (i.e., the correct value has been written to the [passcode register](#), as detailed in section 6.6.2).

Command ID	Description
0x00	Read serial number (section 6.1.1)
0x01	Read firmware part number (section 6.1.2)
0x02	Read firmware version (section 6.1.3)
0x03, 0x04	ECU instance number (section 6.1.4)
0x08	Restore factory defaults (section 6.6.1) (A)
0x0B – 0x0E	Reserved for Flintec use.
0x11	Write passcode register (section 6.6.2)
0x12	Save setup parameters (section 6.6.3)
0x17, 0x18	Warm-up time (section 6.2.1)
0x30, 0x31	ADC sample rate (section 6.2.2)
0x34, 0x35	Filter type (section 6.2.3)
0x38, 0x39	CAN termination resistor status (section 6.3.1)
0x3A, 0x3B	Last claimed address (section 6.3.2)
0x3E, 0x3F	Bus protocol (section 6.3.3) (A)
0x40, 0x41	Data output options (section 6.4.1)
0x42	Read ECU status (section 6.4.2)
0x45	Read mV/V tare signal (section 6.4.3)
0x48	Read filtered ADC sample (section 6.4.4)
0x49	Read filtered mV/V signal (section 6.4.5)
0x54	Set mV/V tare (section 6.5.1)
0x55	Reset mV/V tare (section 6.5.2)
0xD0 – 0xD3	Read user parameters 1 – 4 (section 6.6.5.1)
0xD4 – 0xD7	Write user parameters 1 – 4 (section 6.6.5.2) (A)
0xE0 – 0xE6	Reserved for Flintec use.
0xF0	Reserved for Flintec use.
0xF1	Read bootloader firmware version (section 6.1.5)

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Command ID	Description
0xF2	Read bootloader part number (section 6.1.6)
0xF3	System reset (section 6.6.4)

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6. Command Descriptions

The following sections describe the set of P2P commands that are available in the CED-20. As well as the command identifiers, this section defines the length, content and format of any expected parameters.

In the following sections, all multi-byte data is sent in little-endian format (least significant byte first). Unless stated otherwise, all request parameters and response data are sent as 32-bit signed integers using 2's complement representation.

6.1. Device Identification Commands

6.1.1. Read Serial Number (0x00)

Command 0x00 returns the device-specific serial number as a 32-bit unsigned integer.

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x00		0x18EFF98C	0xFF	0x00	0x87 0x53 0x1F 0x00

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

6.1.2. Read Firmware Part Number (0x01)

Command 0x01 returns the application firmware part number.

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x01		0x18EFF98C	0xFF	0x01	0xC8 0xB6 0x01 0x00

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.

6.1.3. Read Firmware Version (0x02)

Command 0x02 returns the application firmware version number in the following format:

- Data byte 2: Minor firmware version (LSB)
- Data byte 3: Minor firmware version (MSB)

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Data byte 4: Major firmware version (LSB)

Data byte 5: Major firmware version (MSB).

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x02		0x18EFF98C	0xFF	0x02	0x00 0x00 0x01 0x00

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

6.1.4. ECU Instance Number

Commands 0x03 and 0x04 read and set the ECU instance number. This is used as part of the NAME parameter in the J1939 [address-claim](#) process. If there is more than one CED-20 on a single J1939 network, each should be assigned a unique ECU instance number for easier identification.

The permitted values for the ECU instance number are from 0 to 7.

The factory default value is 0.

6.1.4.1. Read ECU Instance Number (0x03)

Controller 0xF9 broadcasts:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x03		0x18EFF98C	0xFF	0x03	0x01 0x00 0x00 0x00

The result returned in the above response shows an ECU instance of 1.

6.1.4.2. Write ECU Instance Number (0x04)

To set the ECU instance number to 2:

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 5)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x04	0x02 0x00 0x00 0x00	0x18EFF98C	0xFF	0x04	

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6.1.5. Read Bootloader Firmware Version (0xF1)

Command 0xF1 returns the bootloader firmware version number in the following format:

Data byte 2: Bootloader firmware version (minor)

Data byte 3: Bootloader firmware version (major)

Data byte 4: Bootloader compatibility number (LSB)

Data byte 5: Bootloader compatibility number (MSB)

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0xF1		0x18EFF98C	0xFF	0xF1	0x00 0x01 0xF1 0x1F

The data in the above response returns bootloader firmware V1.0, compatibility number 8177.

6.1.6. Read Bootloader Part Number (0xF2)

Command 0xF2 returns the bootloader part number.

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0xF2		0x18EFF98C	0xFF	0xF2	0x88 0xAD 0x01 0x00

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

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6.2. General Parameters

6.2.1. Warm-Up Time

Commands 0x17 and 0x18 read and set 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.

6.2.1.1. Read Warm-Up Time (0x17)

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x17		0x18EFF98C	0xFF	0x17	0x0F 0x00 0x00 0x00

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

6.2.1.2. Write Warm-Up Time (0x18)

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

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 5)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x18	0x1E 0x00 0x00 0x00	0x18EFF98C	0xFF	0x18	

6.2.2. ADC Sample Rate

Commands 0x30 & 0x31 read and set 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 6.2.3 for details of [filter types](#).

The permitted values for ADC sample rate are from 5 to 1600 samples/second.

The factory default value is 50 samples/second.

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6.2.2.1. Read ADC Sample Rate (0x30)

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x30		0x18EFF98C	0xFF	0x30	0x7D 0x00 0x00 0x00

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

6.2.2.2. Write ADC Sample Rate (0x31)

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

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 5)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x31	0xFA 0x00 0x00 0x00	0x18EFF98C	0xFF	0x31	

6.2.3. Filter Type

Commands 0x34 and 0x35 read and set 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
0x00	No filtering
0x01	8-sample moving average
0x02	16-sample moving average
0x03	32-sample moving average
0x04	64-sample moving average
0x20	IIR filter, 40 SPS, 0.2 Hz cut-off
0x21	IIR filter, 40 SPS, 0.5 Hz cut-off
0x22	IIR filter, 40 SPS, 1 Hz cut-off
0x23	IIR filter, 40 SPS, 2 Hz cut-off
0x24	IIR filter, 40 SPS, 5 Hz cut-off

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Value	Filter Type
0x25	IIR filter, 40 SPS, 10 Hz cut-off
0x26	IIR filter, 600 SPS, 0.25 Hz cut-off
0x27	IIR filter, 600 SPS, 0.5 Hz cut-off
0x28	IIR filter, 600 SPS, 1 Hz cut-off
0x29	IIR filter, 600 SPS, 2 Hz cut-off
0x2A	IIR filter, 600 SPS, 3 Hz cut-off
0x2B	IIR filter, 600 SPS, 4 Hz cut-off
0x2C	IIR filter, 600 SPS, 8 Hz cut-off
0x2D	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 6.2.2 for details of how to set the [ADC sample rate](#) for the moving average filters.

6.2.3.1. Read Filter Type (0x34)

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x34		0x18EFF98C	0xFF	0x34	0x03 0x00 0x00 0x00

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

6.2.3.2. Write Filter Type (0x35)

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

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 5)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x35	0x28 0x00 0x00 0x00	0x18EFF98C	0xFF	0x35	

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6.3. Communications

6.3.1. CAN Termination Resistor Status

Commands 0x38 and 0x39 read and set 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).

6.3.1.1. Read CAN Termination Resistor Status (0x38)

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x38		0x18EFF98C	0xFF	0x38	0x00 0x00 0x00 0x00

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

6.3.1.2. Write CAN Termination Resistor Status (0x39)

To enable the CAN termination resistor:

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 5)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x39	0x01 0x00 0x00 0x00	0x18EFF98C	0xFF	0x39	

6.3.2. Last Claimed Address

Commands 0x3A and 0x3B read and set the last J1939 node address successfully claimed by the CED-20.

Writing a node address to the CED-20 is not mandatory as the ECU will negotiate an address when it is powered-up or [reset](#). Any address successfully claimed is stored in non-volatile memory and will be used as the first address claimed in all future power-on sessions.

If a *specific* node address is wanted, it can be written using this command and will take effect after the next power cycle or [system reset](#). However, any address written using this command is only a

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preferred address – this will be the first address *attempted* to be claimed by the CED-20 but may be overwritten by another (higher priority) device using the same address. Should this happen, the CED-20 will then attempt to negotiate another address and, when successful, will store this new address in its non-volatile memory.

The permitted values for last claimed address are 0 to 253 (0xFD). Any address in this range *can* be written, but the SAE J1939 standard recommends that arbitrary address-capable nodes (such as CED-20) use only addresses in the range 128 (0x80) to 247 (0xF7).

The factory default value is 128 (0x80).

6.3.2.1. Read Last Claimed Address (0x3A)

Controller 0xF9 broadcasts:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EFFFF9	0x3A		0x18EFF98C	0xFF	0x3A	0x8C 0x00 0x00 0x00

The result returned in the above response shows a node address of 140 (0x8C).

Note: The broadcast address of 0xFF (255) has been used here rather than a specific destination address, as this command is useful if the node address is not yet known.

6.3.2.2. Write Last Claimed Address (0x3B)

To set the last claimed address to 202 (0xCA):

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 5)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x3B	0xCA 0x00 0x00 0x00	0x18EFF98C	0xFF	0x3B	

Note: The source address of the response is still the original node address (0x8C) since the new address (0xCA) will not be *claimed* until after the next power cycle or [system reset](#).

6.3.3. Bus Protocol

Commands 0x3E and 0x3F read and set the CAN bus protocol parameter, allowing the CED-20 to switch between J1939 and CANopen.

The permitted values for the bus protocol parameter are 0x12D (CANopen) and 0x793 (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.

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Note: After switching to the CANopen protocol and performing a power cycle/reset, the CED-20 will start up in CANopen mode, running at a bus speed of 250 kbps. The CAN bus speed cannot be changed whilst still running the J1939 protocol.

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.

6.3.3.1. Read Bus Protocol (0x3E)

Controller 0xF9 broadcasts:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x3E		0x18EFF98C	0xFF	0x3E	0x93 0x07 0x00 0x00

The result returned in the above response shows that the CED-20 will use the J1939 protocol after the next power cycle.

6.3.3.2. Write Bus Protocol (0x3F)

To set the CED-20 to use the CANopen protocol (after the next power cycle):

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 5)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x3F	0x2D 0x01 0x00 0x00	0x18EFF98C	0xFF	0x3F	

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6.4. Data Access Commands

6.4.1. Data Output Options

Commands 0x40 and 0x41 read and set the data output options parameter.

The data output options parameter determines the format of all mV/V data output and the event triggers for the [load cell signal message](#) (5.3.1) and the [mV/V tare signal message](#) (5.3.2).

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

The permitted values for the data output options are derived from the table below.

Bit #	Value	Meaning
7..2		Unused, always 0.
1	0x02	Send-on-request flag. 0: The load cell signal message will be sent each time a new ADC sample is received. The mV/V tare signal message will be sent each time the Set mV/V Tare or Reset mV/V Tare command is executed. 1: The load cell signal message & the mV/V tare signal message will be sent only when requested using PGN 59904 (as described in section 5.2.2).
0	0x01	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 (event-triggered transmission of data in 32-bit integer format).

6.4.1.1. Read Data Output Options (0x40)

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 3)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x40		0x18EFF98C	0xFF	0x40	0x01

The result returned in the above response shows that mV/V data will be transmitted in IEEE 754 format.

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6.4.1.2. Write Data Output Options (0x41)

To set the data output options to transmit the mV/V signal in integer format by [PGN request](#):

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 2)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x41	0x02	0x18EFF98C	0xFF	0x41	

6.4.2. Read ECU Status (0x42)

Command 0x42 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 bit-mapped flags is as follows.

Bit #	Value	Condition
7	0x80	Critical fault (non-recoverable, the CED-20 must be returned to Flintec).
6	0x40	Load cell fault (open circuit or low excitation voltage).
5	0x20	ECU configuration fault (recoverable by configuring all parameters).
4	0x10	Copy of the IEEE 754 flag in the data output options parameter.
3	0x08	The mV/V signal is above the maximum limit of +3.3 mV/V.
2	0x04	The mV/V signal is below the minimum limit of -3.3 mV/V.
1	0x02	The mV/V net/tare function is active.
0	0x01	Warm-up period is active (i.e., the warm-up time has not yet expired).

To read the ECU status:

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 3)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x42		0x18EFF98C	0xFF	0x42	0x12

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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6.4.3. Read mV/V Tare Signal (0x45)

Command 0x45 returns the current tare signal level 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 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x45		0x18EFF98C	0xFF	0x45	0x71 0x1B 0x4D 0x3E

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.

6.4.4. Read Filtered ADC Sample (0x48)

Command 0x48 returns the value of the last-calculated ADC signal after any selected [filtering](#) has been applied.

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x48		0x18EFF98C	0xFF	0x48	0x9D 0x7B 0x9C 0x00

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

6.4.5. Read Filtered mV/V Signal (0x49)

Command 0x49 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 6.2.1 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 6.4.2).

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Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x49		0x18EFF98C	0xFF	0x49	0x4C 0x2B 0x00 0x00

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 IEE 754 flag in the [data output options](#) parameter is cleared.

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6.5. Set and Reset mV/V Tare

6.5.1. Set mV/V Tare (0x54)

Command 0x54 activates the net/tare function by storing the current mV/V signal level as the tare signal. All subsequent [mV/V readings](#) transmitted by the CED-20 will be the net signal level, 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 6.2.1 has not yet expired.
- Any fault flags in the [ECU status](#) byte are set (see section 6.4.2).

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 [mV/V tare signal message](#) will be broadcast (if enabled).

To set a new mV/V tare value:

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x54		0x18EFF98C	0xFF	0x54	

6.5.2. Reset mV/V Tare (0x55)

Command 0x55 resets the mV/V tare signal to zero and deactivates the 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 [mV/V tare signal message](#) will be broadcast (if enabled).

To reset the mV/V tare signal level:

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x55		0x18EFF98C	0xFF	0x55	

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6.6. Miscellaneous Commands

6.6.1. Restore Factory Defaults (0x08)

Command 0x08 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	Commands	Default Value
ECU instance number	0x03, 0x04	0
Warm-up time	0x17, 0x18	0 seconds.
ADC sample rate	0x30, 0x31	50 samples/second.
Filter type	0x34, 0x35	2 (16-entry running average.)
CAN termination resistor status	0x38, 0x39	1 (CAN termination resistor is enabled.)
Last claimed address	0x3A, 0x3B	0x80 (128)
Data output options	0x40, 0x41	0 (Integer format output, event-triggered).
User Parameters 1 - 4	0xD0 – 0xD7	0

To restore factory default values:

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x08		0x18EFF98C	0xFF	0x08	

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6.6.2. Write Passcode Register (0x11)

Command 0x11 writes a 32-bit integer into the passcode register. The contents of this register must match the system passcode (value 0x9A52F) to put the CED-20 into administrator mode (allowing changes to restricted parameters and access to restricted functions).

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

The CED-20 will exit administrator 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.

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

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 5)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x11	0x2F 0xA5 0x09 0x00	0x18EFF98C	0xFF	0x11	

6.6.3. Save Setup Parameters (0x12)

When a change is made to a setup parameter, the new value is not committed to non-volatile memory until this command is successfully executed. 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: [ECU instance number](#), [warm-up time](#), [ADC sample rate](#), [filter type](#), [CAN termination resistor status](#), [last claimed address](#), [bus protocol](#), [data output options](#), and [user parameters](#).

This command must be sent with a parameter value of 1 or an error will be returned.

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.

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To save setup parameters to non-volatile memory:

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 5)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0x12	0x01 0x00 0x00 0x00	0x18EFF98C	0xFF	0x12	

6.6.4. System Reset (0xF3)

Command 0xF3 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 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0xF3		0x18EFF98C	0xFF	0xF3	

6.6.5. User Parameters

The user parameters are for storing arbitrary user data, and are not used by the firmware. The default value for each is 0, and the full range of signed 32-bit integer values are permitted.

6.6.5.1. Read User Parameters (0xD0 – 0xD3)

Commands 0xD0 to 0xD3 return the value of the corresponding user parameter 1 to 4 recorded in the device.

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 1)		CAN ID	Data (DLC = 6)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0xD2		0x18EFF98C	0xFF	0xD2	0xCC 0xC0 0xFF 0xFF

The result returned in the above response shows a value of -16180 being returned for user parameter 3.

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6.6.5.2. Write User Parameters (0xD4 – 0xD7)

Commands 0xD4 to 0xD7 over-write the existing value of the corresponding user parameter 1 to 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.

To set the value of user parameter 3 to -16180:

Controller 0xF9 sends:			CED-20 0x8C responds:			
CAN ID	CAN Data (DLC = 5)		CAN ID	Data (DLC = 2)		
	Cmd.	Parameters		Resp.	Cmd.	Result
0x18EF8CF9	0xD6	0xCC 0xC0 0xFF 0xFF	0x18EFF98C	0xFF	0xD6	