DEEP SEA ELECTRONICS PLC
DSEM640 & DSEM643 Operator Manual

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DSEM640 & DSEM643 Operator Manual

Revision History

Issue No.	Comments
1	First Issue 06/07/16
2	Corrected comments for pins on connectors B and C. Corrected Program Enable pin instructions. Added failure codes. Additional detail throughout.
3	Added DSEM643.

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Section	**Page**

1 INTRODUCTION

This document details the operation and setup requirements of the DSEM640 and DSEM643, part of the DSEControl® range of products.

The manual forms part of the product and should be kept for the entire life of the product. If the product is passed or supplied to another party, ensure that this document is passed to them for reference purposes.
This is not a *controlled document.* DSE do not automatically inform on updates. Any future updates of this document are included on the DSE website at www.deepseaplc.com

Observe the operating instructions. Non-observance of the instructions, operation not in accordance with use as prescribed below, wrong installation or incorrect handling seriously affects the safety of operators and machinery.

A robust metal case designed for chassis mounting houses the module. Connections are via locking plug and sockets.

DSEM640 and DSEM643 have identical functionality, with DSEM643 having a lower I/O (Input/Output) count, half that of the DSEM640. This is achieved by omitting Connector B on DSEM643. This allows cost savings to be made where the application is less demanding.

The controller is supplied with no application program. The equipment manufacturer is responsible for creating and managing the application program and installing it in the controller. This is achieved using CODESYS V3.5. Contact DSE Technical Support for further details.

DSEM640   DSEM643

1.1 CLARIFICATION OF NOTATION

Clarification of notation used within this publication.

⚠NOTE:	**Highlights an essential element of a procedure to ensure correctness.**
⚠CAUTION!	**Indicates a procedure or practice, which, if not strictly observed, could result in damage or destruction of equipment.**
☣WARNING!	**Indicates a procedure or practice, which could result in injury to personnel or loss of life if not followed correctly.**

1.2 GLOSSARY OF TERMS

Term	Description
Application	The application is the program that allows the device to control the machine it is connected to. The Application within the device is designed and provided by the manufacturer of the complete machine.
Bootloader	The Bootloader is the program within the device responsible for loading the Operating System.
CAN	Control Area Network. A high-speed data transmission system used extensively within the Automotive and Off-Highway industries.
CODESYS (Previously stylised as CoDeSys)	Integrated Development Environment for programming controller applications according to the international industrial standard IEC 61131-3. device supports CODESYS V3.5
ECM	Engine Control Module. For example the Engines own Electronic Control Unit or CAN ECU.
ECU	Electronic Control Unit. For example the device device. Engine Control Unit. For example the Engines own Electronic Control Unit or CAN ECU.
Firmware	The Firmware of the device is the Operating System of the device that reads and executes the Application program.
Floating	Refers to a signal line with a high impedance connection (or open circuit) to a supply line.
FSD	Full Scale Deflection. For example 0 mA to 20 mA is the Full Scale Deflection of a current sink input.
IDE	Integrated Development Environment. For example the CODESYS V3.5 application that runs on the host PC is an IDE.
I/O	Input / Output. For example "The I/O is taken out to an external terminal strip in the user panel".
Ixyyy	An Input, where x is the connector and yyy is the input number. For example IC005 means Input 5 on Connector C.

Continued Overleaf…

Term	Description
Off-Highway	An industrial vehicle used primarily "off road". For example construction and farm machinery. A wider interpretation includes on road access platforms, emergency vehicles and other industrial machinery, used either on the road, or off road.
Pin	A male or female pin connection in a housing (plug or socket).
PLC	Programmable Logic Controller. Industrial computer used primarily for the automation of electromechanical machinery.
Pull-Up or Pull-Down	A resistor used to bias a signal line towards a positive (Pull-Up) or negative (Pull-Down) supply.
PWM PWMi	A digital signal is used to represent an analogue value by using Pulse Width Modulation. The mark-space ratio of a square wave changes to represent the value. Used for many control applications including proportional valves. PWM = Voltage control. PWMi = Current control.
Qxyyy	An Output, where x is the connector and yyy is the output number. For example QB022 means Output 22 on Connector B.

1.3 RELATED INFORMATION

This document refers to, and is referred by the following DSE publications which are obtained from the DSE website: www.deepseaplc.com or by contacting DSE technical support: support@deepseaplc.com.

1.3.1 TECHNICAL INFORMATION

DSE Part	Description
055-198	DSEM640 Datasheet
055-236	DSEM643 Datasheet
053-186	DSEM640 & DSEM643 Installation Instructions

1.3.2 ADDITIONAL INFORMATION

The following information relates to optional equipment compatible with the DSEM640 & DSEM643.

DSE Part	Description
057-261	DSEM040 Development Kit Operator Manual

1.4   SAFETY INSTRUCTIONS

1.4.1   GENERAL

- These instructions are for authorised persons according to the EMC and low-voltage directives. The device must be installed, connected and put into operation by a qualified electrician.

- It is not permissible to open the controller or to modify or repair the controller. Modification or repairs to the wiring could result in dangerous malfunctions. Repairs to the controller must be performed by DSE. Contact your original equipment supplier in the case of malfunction.

- When the device is unpowered, ensure that no connection pins are connected to a voltage source. Thus, when the supply is switched off, the supply for the electronics, the power outputs and the external sensor supply must be switched off together.

- The controller will heat up beyond normal ambient temperature during operation. To avoid danger caused by high temperatures, protect against contact.

- The customer is responsible for performing risk analysis of the mobile working machine and determining the possible safety related functions. The user is responsible for the safe function of the application programs created. If necessary, they must additionally carry out an approval test by corresponding supervisory and test organisations according to the national regulations.

- All connectors must be unplugged from the electronics during electrical welding and painting operations.

1.4.2   INSTALLATION NOTES

- Follow the instructions of the connector manufacturer, specifically with respect to preventing water from entering the device. See Section entitled *Cables, Connectors, Harnesses and Spare Parts* for details of DSE Part Numbers.

- To maintain IP67 rating where connectors have unused pins, ensure the use of a suitable Blanking Insert. In the case of a completely unused connector, the plug must be inserted, fully populated with Pin Blanking Inserts. See Section entitled *Cables, Connectors, Harnesses and Spare Parts* for details.

- M12 protection plugs supplied must be installed in both the USB and Ethernet interfaces to ensure IP67 rating.

- The case must be wired to vehicle ground in order to comply with EMC guidelines. Metallic screws must be used to create an electrical connection to vehicle / machine ground.

2 SPECIFICATIONS

2.1 DC SUPPLY

Description	Specification
Operating Voltage (Connector A, Pin 4)	8 V to 32 V
Maximum Current (no external loads)	300 mA at 24 V
Maximum Current (ignition off)	5 mA at 24 V

2.1.1 FUSING

⚠ **NOTE: Maximum total current of the device is 32 A. This includes the device current consumption plus the current supplied to the outputs. Each Output supply is rated Max 16 A.**
Output Supply 1 + Output Supply 2 must not exceed 16 A.
Output Supply 3 + Output Supply 4 must not exceed 16 A.

Description	Specification
DC Supply (Connector A, Pin 4)	3 A
High Current Outputs supply Fuse as required by connected loads (Connector A, Pins 1, 8, 16, 23)	16 A Max for each Output Supply.

2.2 ENVIRONMENTAL

Description	Specification
Operating Temperature	-40 ºC to +85 ºC (-40 ºF to 185 ºF)
Storage Temperature	-40 ºC to +85 ºC (-40 ºF to 185 ºF)
Degrees of Protection Provided by Enclosure (with all mating connectors fitted)	IP67 (NEMA 6)

2.3   INPUTS

2.3.1.1   IGNITION

Ignition is used to energise / deenergise the device. The pin must be switched from the same supply as ECU.

Description	Specification
Ignition. Same supply as ECU (Connector A, Pin 4)	Connector A, Pin 3
Input Voltage for OFF	0 V
Input Voltage for ON	4 V DC to 32 V DC

2.3.1.2   PROGRAM ENABLE

> ⚠ **NOTE: Ensure to remove the *Program Enable* Pin once you've finished. Powering up with *Program Enable* active results in the device entering *Bootloader* mode, hence the application is not active.**

Description	Specification
Program Enable	Connector A, Pin 6
Program Enable pin pull-down resistance	33 kΩ
Minimum voltage for active (Program Enable)	6 V
Maximum voltage for inactive	2 V

Program Enable pin has two functions as listed below.

1. To configure (program) the device or activate *Debug Mode* via CODESYS V3:
    - Power down the device.
    - Disconnect *Program Enable* pin.
    - Apply DC power to the device.
    - Wait a few seconds.
    - Connect *Program Enable* pin to battery positive.
    - Program the device (ie using CODESYS V3).

2. To use the *DSEServicetool* software to update firmware or download the application program to the device:
    - Power down the device.
    - Connect *Program Enable* pin to battery positive.
    - Apply DC power to the device.
    - Use *Service Tool* software as desired.

2.3.2 DIGITAL INPUTS

2.3.2.1 DIGITAL

⚠️**NOTE: Connector B is not fitted to DSEM643.**

Description	Specification
Applicable Inputs (Connector B and C)	Pins 6, 9, 14, 15, 16, 22, 28, 31
Minimum voltage for High Level	6 V
Maximum voltage for Low Level	2 V
Internal Pull Up Resistance (when configured)	2.2 kΩ to internal 12 V reference
Internal Pull Down Resistance (when configured)	13 kΩ to internal 0 V reference
Impedance of input when set to *Float*	30 kΩ

2.3.2.2 FREQUENCY

⚠️**NOTE: Connector B is not fitted to DSEM643.**

Description	Specification
Applicable Inputs (Connector B and C)	Pins 6, 9, 14, 15, 16, 22, 28, 31
Frequency Range	5 Hz to 30 kHz
Resolution	100 Hz at Maximum Frequency
Accuracy	400 Hz at Maximum Frequency
Minimum voltage for High Level (Mark)	6 V
Maximum voltage for Low Level (Space)	2 V

2.3.2.3 PHASE

⚠️**NOTE: Connector B is not fitted to DSEM643.**

Description	Specification
Applicable Inputs (Connector B and C)	Pins 6, 9, 14, 15, 16, 22, 28, 31
Frequency Range	5 Hz to 30 kHz
Resolution	1º
Accuracy	1º
Minimum voltage for High Level (Mark)	6 V
Maximum voltage for Low Level (Space)	2 V

2.3.2.4 PULSE COUNTER

⚠️**NOTE: Connector B is not fitted to DSEM643.**

Description	Specification
Applicable Inputs (Connector B and C)	Pins 6, 9, 14, 15, 16, 22, 28, 31
Frequency Range	5 Hz to 30 kHz
Counter Range	2^{24} (16777215)
Direction	Up / Down
Resolution	1 count

2.3.2.5   ENCODER

⚠️**NOTE: Connector B is not fitted to DSEM643.**

Description	Specification
Applicable Inputs (Connector B and C)	Pins 6, 9, 14, 15, 16, 22, 28, 31
Frequency Range	5 Hz to 30 kHz
Counter Range	2^{24} (16777215)
Direction	Up / Down
Resolution	1 count

2.3.3   ANALOGUE INPUTS

2.3.3.1   VOLTAGE

⚠️**NOTE: Connector B is not fitted to DSEM643.**

Description	Specification
Applicable Inputs (Connector B and C)	Pins 7, 8, 17, 18, 19, 20, 29, 30
Configurable Ranges	0 V to 5 V 0 V to 10 V 0 V to 32 V
Input Resistance	30 kΩ
Sampling Rate	1 kHz

Voltage Measurement resolution and accuracy

Configured Range	Resolution (12 bits)	Accuracy (±1%) FSD
0 V to 5 V	0.001 V	±0.05 V
0 V to 10 V	0.01 V	±0.1 V
0 V to 32 V	0.3 V	±0.32 V

2.3.3.2   CURRENT

⚠️**NOTE: Connector B is not fitted to DSEM643.**

Description	Specification
Applicable Inputs (Connector B and C)	Pins 7, 8, 17, 18, 19, 20, 29, 30
Configurable Ranges	0 mA to 20 mA 4 mA to 20 mA
Input Type	Current sink only
Input Sink Resistance	100 Ω
Sampling Rate	1 kHz
Resolution (12 bits)	0.005 mA
Accuracy (± 1 % Full Scale Deflection)	0.2 mA

2.3.3.3 RESISTIVE

> ⚠ **NOTE: Connector B is not fitted to DSEM643.**

Description	Specification
Applicable Inputs (Connector B and C)	Pins 7, 8, 17, 18, 19, 20, 29, 30
Measurement Range	0 Ω to 3400 Ω
Measurement source voltage	12 V
Measurement source current	1 mA
Sampling Rate	1 kHz
Resolution (12 bits)	0.78 Ω
Accuracy (± 1 % Full Scale Deflection)	32 Ω

2.3.3.4 RATIOMETRIC

> ⚠ **NOTE: Connector B is not fitted to DSEM643.**

Description	Specification
Applicable Inputs (Connector B and C)	Pins 7, 8, 17, 18, 19, 20, 29, 30
Measurement voltage reference	Supply (Pin 4)
Measurement	Ratio of input Pin to Supply (Pin 4)
Measurement source current	1 mA
Accuracy (± 1 % Full Scale Deflection)	0.36 V (based upon maximum supply voltage of 36 V)

2.4 OUTPUTS

⚠️**NOTE: Maximum total current of the device is 32 A. This includes the device current consumption plus the current supplied to the outputs. Each Output supply is rated Max 16 A.**

2.4.1 NEGATIVE SWITCHING

⚠️**NOTE: Connector B is not fitted to DSEM643.**

Description	Specification
2 A Switching Current Applicable Inputs (Connector B and C)	Pins 1, 12, 13, 23, 24
4 A Switching Current Applicable Inputs (Connector B and C)	Pins 12, 13, 25
Maximum voltage for output ON	2 V
Maximum current for output OFF	10 mA at 24 V output supply

2.4.2 POSITIVE SWITCHING

⚠️**NOTE: Connector B is not fitted to DSEM643.**

Description	Specification
2 A Switching Current Applicable Inputs (Connector B and C)	Pins 1, 2, 3, 5, 11, 12, 13, 23, 24, 26, 32, 34, 35
4 A Switching Current Applicable Inputs (Connector B and C)	Pins 2, 4, 10, 12, 13, 23, 25, 27, 35
Minimum voltage for output ON	Output supply -2 V
Maximum current for output OFF	10 mA at 24 V output supply

2.4.3   PWM

> ⚠ **NOTE: Connector B is not fitted to DSEM643.**

Description	Specification
Applicable Inputs (Connector B and C)	Pins 1, 2, 3, 12, 13, 23, 24, 34, 35
Peak Current Rating (output ceases if rating is exceeded)	5 A
Frequency Range	20 Hz to 250 Hz
Frequency Resolution	0.1 Hz
Pulse Ratio Range	0 % to 100 %
Pulse Ratio Resolution	1 %
Accuracy	±1 % Full Scale Deflection
Minimum Load Impedance	3 Ω at 12 V 6 Ω at 24 V

2.4.3.1   PWMI CURRENT RESOLUTION

Configured Range	Current Resolution
0 A to 2 A	1 mA
0 A to 4 A	2 mA

2.5   COMMUNICATIONS

2.5.1   CAN

⚠️**NOTE: CAN connections are NOT internally terminated. A complete CAN network must have 120 Ω terminators at each end of the network.**

Description	Specification
Number of CAN interfaces	4
Supported Protocols	J1939 CAN open Raw CAN
Supported Baud Rates	50 kbit/s, 120 kbit/s, 250 kbit/s, 500 kbit/s, 800 kbit/s, 1 Mbit/s

2.5.2   ETHERNET

⚠️**NOTE: When fitted with the supplied 'blanking plug' and integral O'ring, the Ethernet socket is sealed against the environment to IP67 (NEMA 6). Ensure suitable protection is provided when removing this plug and connecting an Ethernet cable. A suitable O'ring is available from DSE, part number 011-137.**

Description	Specification
Number of Ethernet ports	1
Supported data rates	10 Mbits / 100 Mbits, Full Duplex
Supported Protocols	MODBUS TCP CODESYS 3.5

M12 'D' Coded – 4 Pin Female	Pin	Description
	1	Tx+
	2	RC+
	3	TX-
	4	RC-

2.5.3   USB

> ⚠️**NOTE: When fitted with the supplied 'blanking plug' and integral O'ring, the USB socket is sealed against the environment to IP67 (NEMA 6). Ensure suitable protection is provided when removing this plug and connecting a USB cable. A suitable O'ring is available from DSE, part number 011-137.**

Description	Specification
Number of Ethernet Ports	1
USB Version	2
Supported Speeds	Full Speed (12 Mbit/s)
Device Class	08 (Mass Storage)
Filing System	FAT32

M12 'B' Coded – 5 Pin Female	Pin	Description
	1	5 V
	2	Data+
	3	Data-
	4	0 V
	5	Shield

2.6 APPLICABLE STANDARDS

| Category	Description	Standard
CE marking	Electromagnetic compatibility (EMC) noise immunity Electromagnetic compatibility (EMC) emission standard Safety of information technology equipment, general requirements	EN 61000-6-2 EN 61000-6-4 BS EN 60950-1: 2006 + A2: 2013
E11	EMC requirements for vehicles Noise immunity with 100 V/m	UN/ECE-R10.05 ISO 11452-2
Electrical tests	Pulse 1, severity level: III; function state C Pulse 2a, severity level: III; function state A Pulse 2b, severity level: III; function state C Pulse 3a, severity level: III; function state A Pulse 3b, severity level: III; function state A Pulse 4, severity level: III; function state A Pulse 5a, severity level: III; function state C	ISO 7637-2 (2004)
Climatic tests	Damp heat, cyclic upper temperature 55 ˚C Damp heat, steady state test temperature 40 ˚C / 93% RH Test duration: 21 days Salt spray test severity level 3 (vehicle)	EN 60068-2-30 EN 60068-2-78 EN 60068-2-52
Mechanical tests	Test VII; vibration, random mounting location: vehicle body. Vibration, sinusoidal 10...500 Hz; 0.73 mm / 10 g: 10 cycles / axis. bumps 30 g / 6 ms; 24,000 shocks	ISO 16750-3 EN 60068-2-6 ISO 16750-3

3 INSTALLATION

3.1 DIMENSIONS AND MOUNTING

3.1.1 DIMENSIONS

Description	Specification
Overall Dimensions (Height X Width X Depth)	240 mm X 190 mm X 49 mm (9.45 " X 7.48 " X 1.46 ")
Mounting Holes	Suitable for M6 bolts (¼" holes)
Mounting Hole Centres	218 mm X 169 mm (8.58 " X 6.65 ")
Mounting Bolt Material Recommendation	Steel or Stainless Steel
Mounting Bolt Tightening Torque	8 Nm ±2 Nm
Overall Weight	1.58 kg
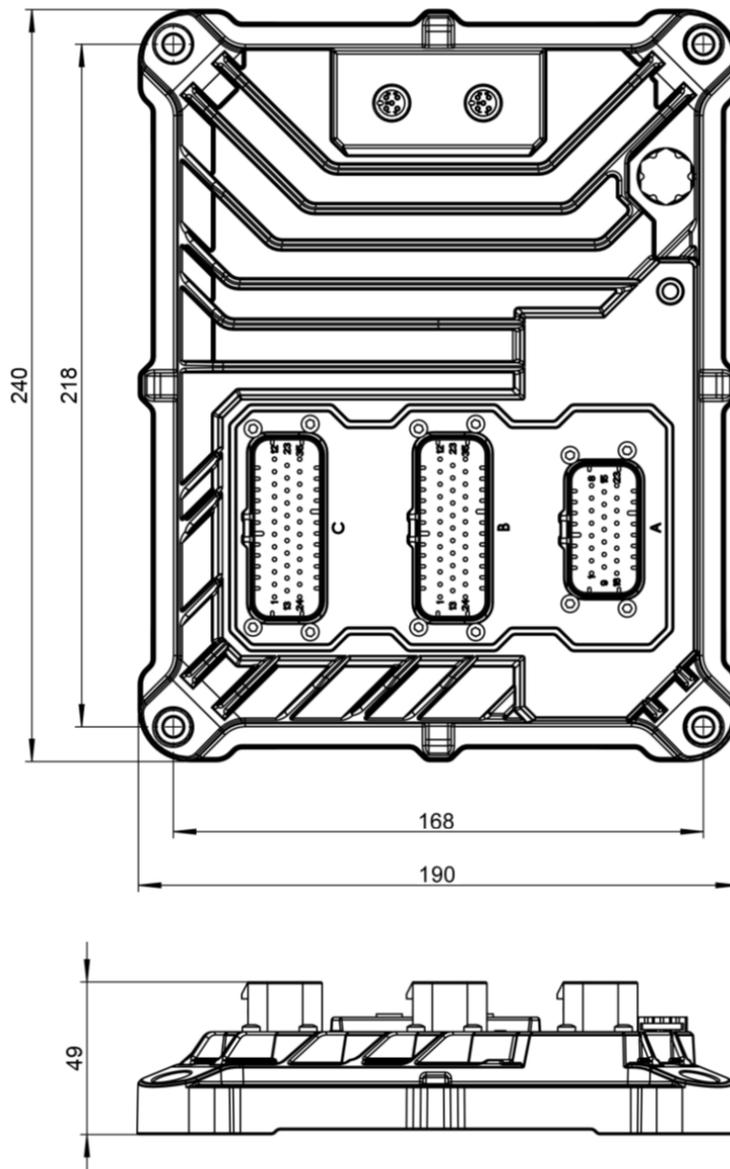
3.1.2 MOUNTING

3.1.2.1 ORIENTATION

Install the controller in such a way to allow any condensation that may form to flow out.
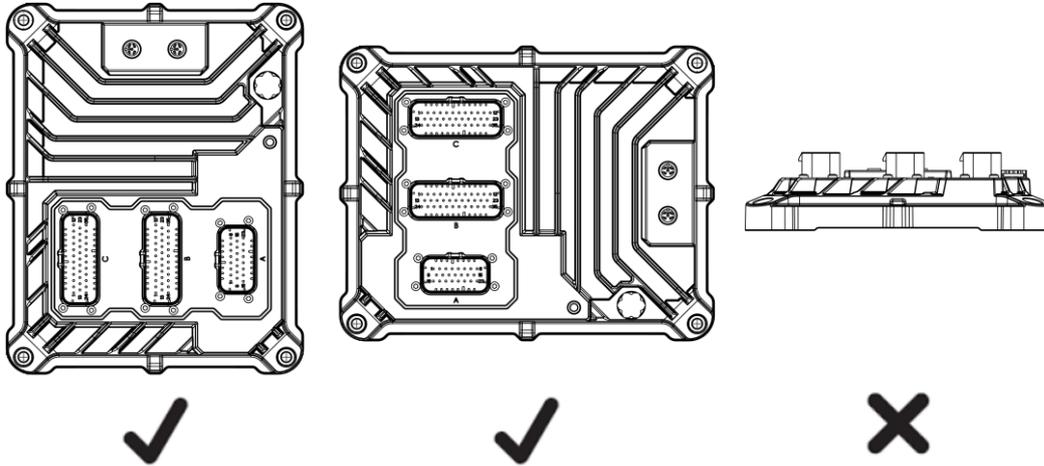
3.1.2.2 SURFACE

The controller must be mounted on a flat surface.

Use compensating elements if there is no flat mounting surface available.
For steel surfaces, ensure that it is protected against corrosion.
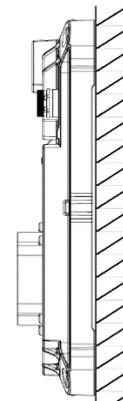
3.1.2.3 FIXING

4 x M6 Screws (one in each corner of the controller)
Screw material: steel or stainless steel
Tightening torque: 8 Nm ±2 Nm

3.1.2.4 GROUNDING

To ensure the protection of the device against electrical interference and the safe function of the device, the housing must be connected to the ground of the vehicle / machine.

3.2 FUSING

The individual electric circuits must be protected in order to protect the whole system. Select appropriate fuses to protect the outputs being supplied.

⚠️**NOTE: Output Supplies must be connected (even if the outputs are not used in the project) to ensure *Output Supply Under Voltage* alarms are not raised by the device.**

⚠️**NOTE: Maximum total current of the device is 32 A. This includes the device current consumption plus the current supplied to the outputs. Each Output supply is rated Max 16 A. Output Supply 1 + Output Supply 2 must not exceed 16 A. Output Supply 3 + Output Supply 4 must not exceed 16 A.**

⚠️**NOTE: Connector B is not fitted to DSEM643.**

| Pin	Description	Comments	Recommended Fuse Size
1	Output Supply 1 Not fitted to DSEM643	Supplies Outputs QB002 (B35), QB003 (B13), QB005 (B1), QB008 (B34), QB009 (B27), QB012 (B33), QB013 (B26), QB016 (B32), QB017 (B25), QB018 (B24)	16 A Max
3	Ignition (15)	Supplied by a switch connected to Pin A4 (ECU+) of the same ECU device.	1 A Max
4	ECU Supply	Supplies device ECU	3 A Max
8	Output Supply 2 Not fitted to DSEM643	Supplies Outputs QB001 (B2), QB004 (B12), QB006 (B23), QB007 (B3), QB010 (B4), QB011 (B10), QB014 (B5), QB015 (B11)	16 A Max
16	Output Supply 3	Supplies Outputs QC002 (C35), QC008 (C34), QC009 (C27), QC012 (C33), QC013 (C26), QC016 (C32), QC017 (C25), QC018 (C24)	16 A Max
23	Output Supply 4	Supplies Outputs QC001 (C2), QC003 (C13), QC004 (C12), QC005 (C1), QC006 (C23), QC007 (C3), QC010 (C4), QC011 (C10), QC014 (C5), QC015 (C11)	16 A Max
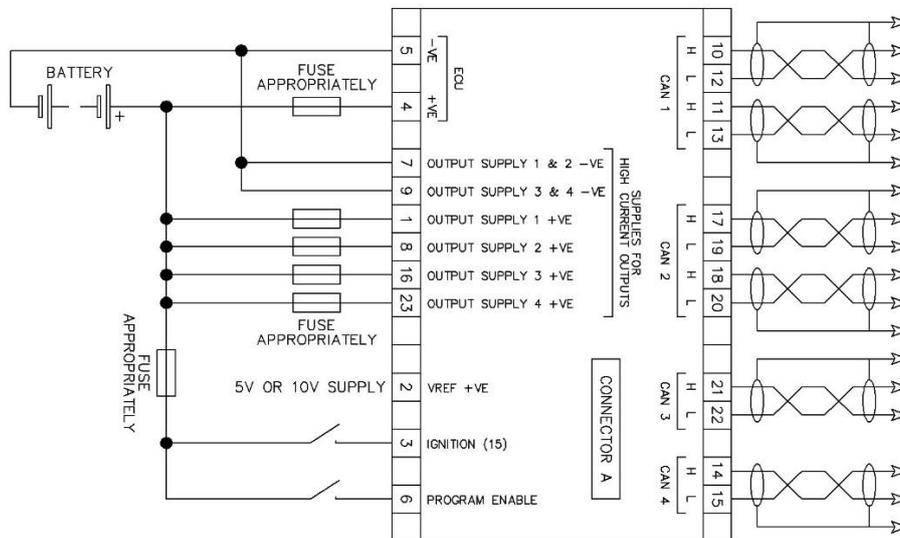
3.3   TYPICAL CONNECTION DIAGRAM

⚠NOTE: Connector B is not fitted to DSEM643. *Output Supply 1 & 2* (Connector A, Pins 7 & 9) are not fitted to DSEM643.
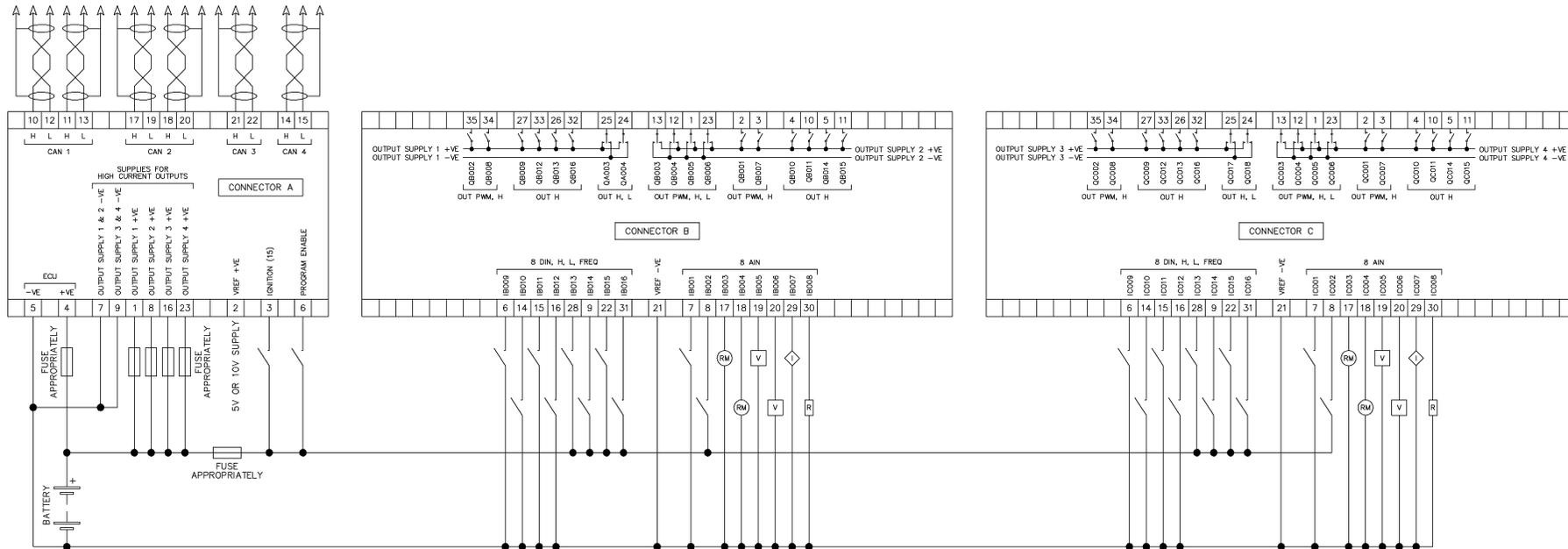
3.4   USER CONNECTIONS

⚠️**NOTE: If a prewired connection cable is used, remove the cores with unused signal inputs and outputs. Unused cores, in particular core loops, lead to interference coupling that can influence the connected controller.**

⚠️**NOTE: When fitted with the supplied 'blanking plug' and integral O'ring, the Ethernet and USB sockets are sealed against the environment to IP67 (NEMA 6). Ensure suitable protection is provided when removing these plugs and connecting a cable. A suitable O'ring is available from DSE, part number 011-137.**

⚠️**NOTE: Connector B is not fitted to DSEM643.**

DSEM640   DSEM643

USB

Ethernet

Connector C (I/O)

Connector B (I/O)

Connector A (DC Supply and CAN)

Connector C (I/O)

Connector A (DC Supply and CAN)
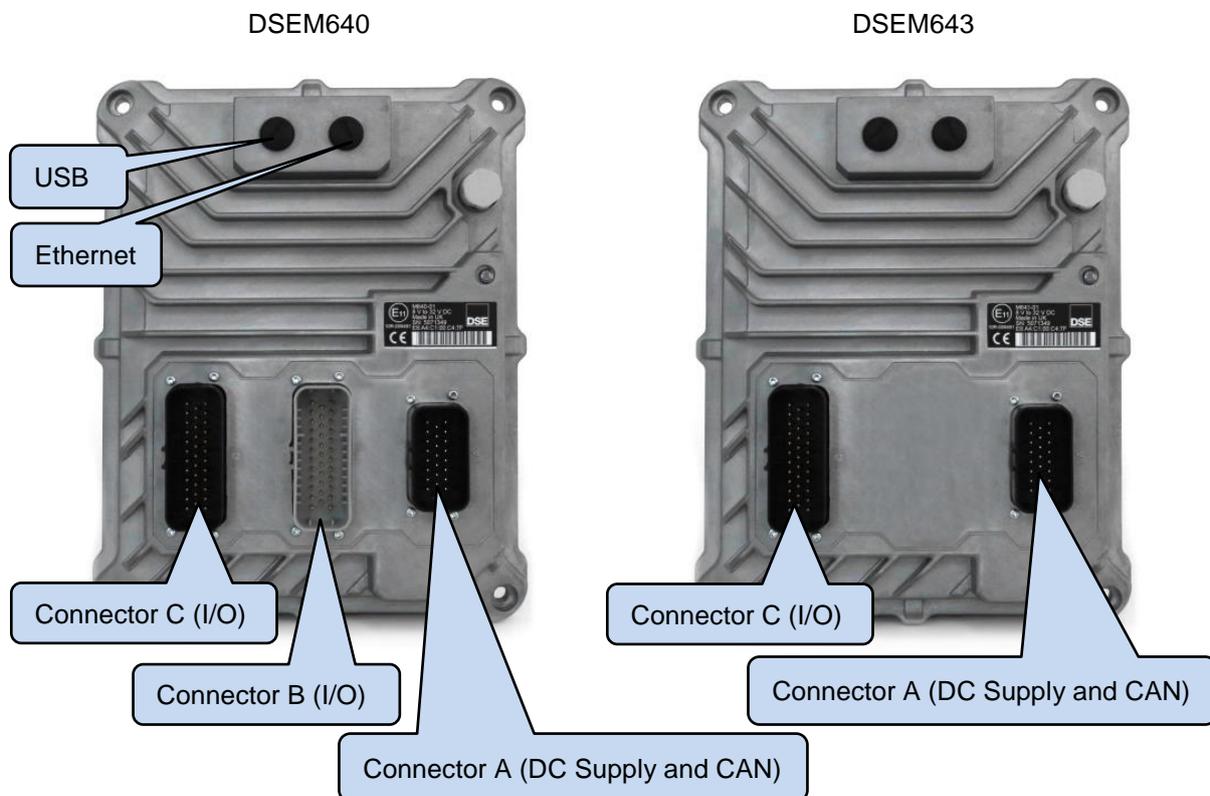
3.4.1   CONNECTOR A (DC SUPPLY AND CAN)

> **NOTE: For details of fuse requirements, refer to section entitled *Fusing* elsewhere in this document.**

> **NOTE: Maximum total current of the device is 32 A. This includes the device current consumption plus the current supplied to the outputs. Each Output supply is rated Max 16 A.**
> **Output Supply 1 + Output Supply 2 must not exceed 16 A.**
> **Output Supply 3 + Output Supply 4 must not exceed 16 A.**

> **NOTE: Screened 120 Ω impedance cable specified for use with CAN must be used for the CAN links.**
> **DSE stock and supply Belden cable 9841 which is a high quality 120 Ω impedance cable suitable for CAN use (DSE part number 016-030).**

> **NOTE: CAN connections are NOT internally terminated. A complete CAN network must have 120 Ω terminators at each end of the network.**

> **NOTE: Output Supplies must be connected (even if the outputs are not used in the project) to ensure *Output Supply Under Voltage* alarms are not raised by the device.**

Connections listed overleaf.

NOTE: Connector B is not fitted to DSEM643. Output Supply 3 and Output Supply 4 are used to provide power to DSEM643 outputs on Connector C.

Connector A	Pin	Description	Comments
	1	Output Supply 1 +ve Not fitted to DSEM643	Used to supply QB002 (B35), QB003 (B13), QB005 (B1), QB008 (B34), QB009 (B27), QB012 (B33), QB013 (B26), QB016 (B32), QB017 (B25), QB018 (B24)
	2	Vref +ve	
	3	Ignition +ve (15)	Supplied by a switch connected to Pin A4 (ECU+) of the same ECU device.
	4	ECU Supply +ve	DC Supply for the device ECU
	5	ECU Supply -ve	DC Supply for the device ECU
	6	Program Enable	Connect to +ve to enable
	7	Output Supply 1 & 2 -ve Not fitted to DSEM643	
	8	Output Supply 2 +ve Not fitted to DSEM643	Used to supply QB001 (B2), QB004 (B12), QB006 (B23), QB007 (B3), QB010 (B4), QB011 (B10), QB014 (B5), QB015 (B11)
	9	Output Supply 3 & 4 -ve	
	10	CAN1 H	Internally connected
	11	CAN1 H	
	12	CAN1 L	Internally connected
	13	CAN1 L	
	14	CAN4 H	
	15	CAN4 L	
	16	Output Supply 3 +ve	Used to supply QC002 (C35), QC008 (C34), QC009 (C27), QC012 (C33), QC013 (C26), QC016 (C32), QC017 (C25), QC018 (C24)
	17	CAN2 H	Internally connected
	18	CAN2 H	
	19	CAN2 L	Internally connected
	20	CAN2 L	
	21	CAN3 H	
	22	CAN3 L	
	23	Output Supply 4 +ve	Used to supply QC001 (C2), QC003 (C13), QC004 (C12), QC005 (C1), QC006 (C23), QC007 (C3), QC010 (C4), QC011 (C10), QC014 (C5), QC015 (C11)
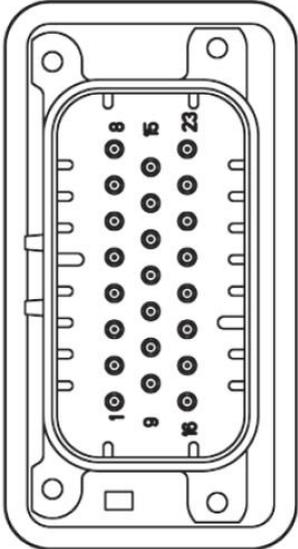
3.4.2 CONNECTOR B (I/O)

⚠NOTE: Connector B is not fitted to DSEM643.

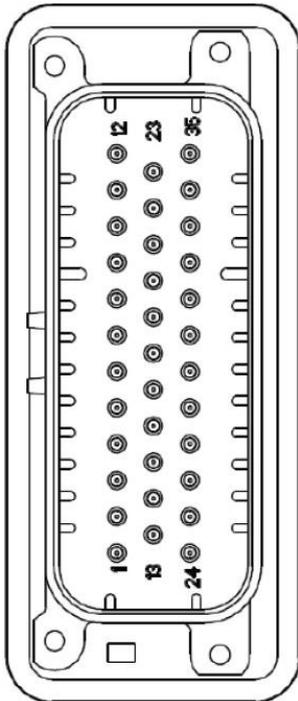| Terminology	Meaning
QBxxx	Output
IBxxx	Input
H	Output, High when active.
L	Output, Low when active.
PWM	Pulse Width Modulation (voltage or current)
DIN	Digital Input configurable to accept signals as positive digital, negative digital or frequency sensing.
AIN	Input configurable to accept signals as positive digital, negative digital, 0 V to 5 V, 0 V to 10 V, 0 V to 32 V, 0 mA to 20 mA, 4 mA to 20 mA, ratiometric or resistive.
Supply	Designates the 'Output Supply' on Connector A, used to supply the Output

Connector B	Pin	Description	Comments	Supply
	1	QB005	OUT H, L, PWM (2 A).	1 (A1)
	2	QB001	OUT H, PWM (2 A / 4 A)	2 (A8)
	3	QB007	OUT H, PWM (2 A)	2 (A8)
	4	QB010	OUT H (4 A)	2 (A8)
	5	QB014	OUT H (2 A)	2 (A8)
	6	IB009	DIN	
	7	IB001	AIN	
	8	IB002	AIN	
	9	IB014	DIN	
	10	QB011	OUT H (4 A)	2 (A8)
	11	QB015	OUT H (2 A)	2 (A8)
	12	QB004	OUT H, L, PWM (2 A / 4 A)	2 (A8)
	13	QB003	OUT H, L, PWM (2 A / 4 A)	1 (A1)
	14	IB010	DIN	
	15	IB011	DIN	
	16	IB012	DIN	
	17	IB003	AIN	
	18	IB004	AIN	
	19	IB005	AIN	
	20	IB006	AIN	
	21	Vref -ve	Negative for Vref (A2).	
	22	IB015	DIN	
	23	QB006	OUT H, L, PWM (2A)	2 (A8)
	24	QB018	OUT H, L (2A)	1 (A1)
	25	QB017	OUT H, L (4A)	1 (A1)
	26	QB013	OUT H (2A)	1 (A1)
	27	QB009	OUT H (4A)	1 (A1)
	28	IB013	DIN	
	29	IB007	AIN	
	30	IB008	AIN	
	31	IB016	DIN	
	32	QB016	OUT H (2A)	1 (A1)
	33	QB012	OUT H (4A)	1 (A1)
	34	QB008	OUT H, PWM (2 A)	1 (A1)
	35	QB002	OUT H, PWM (2 A / 4 A)	1 (A1)
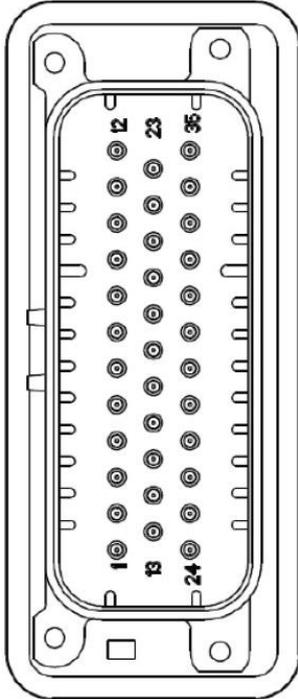
3.4.3   CONNECTOR C (I/O)

Terminology	Meaning
QCxxx	Output
ICxxx	Input
H	Output, High when active.
L	Output, Low when active.
PWM	Pulse Width Modulation (voltage or current)
DIN	Digital Input configurable to accept signals as positive digital, negative digital or frequency sensing.
AIN	Input configurable to accept signals as positive digital, negative digital, 0 V to 5 V, 0 V to 10 V, 0 V to 32 V, 0 mA to 20 mA, 4 mA to 20 mA, ratiometric or resistive.
FREQ	Input used for Frequency Measurement
Supply	Designates the 'Output Supply' on Connector A, used to supply the Output

Connector C	Pin	Description	Comments	Supply
	1	QC005	OUT H, L, PWM (2 A).	4 (A23)
	2	QC001	OUT H, PWM (2 A / 4 A)	4 (A23)
	3	QC007	OUT H, PWM (2 A)	4 (A23)
	4	QC010	OUT H (4 A)	4 (A23)
	5	QC014	OUT H (2 A)	4 (A23)
	6	IC009	DIN	
	7	IC001	AIN	
	8	IC002	AIN	
	9	IC014	DIN	
	10	QC011	OUT H (4 A)	4 (A23)
	11	QC015	OUT H (2 A)	4 (A23)
	12	QC004	OUT H, L, PWM (2 A / 4 A)	4 (A23)
	13	QC003	OUT H, L, PWM (2 A / 4 A)	4 (A23)
	14	IC010	DIN	
	15	IC011	DIN	
	16	IC012	DIN	
	17	IC003	AIN	
	18	IC004	AIN	
	19	IC005	AIN	
	20	IC006	AIN	
	21	Vref -ve	Negative for Vref (A2).	
	22	IC015	DIN	
	23	QC006	OUT H, L, PWM (2A)	4 (A23)
	24	QC018	OUT H, L (2A)	3 (A16)
	25	QC017	OUT H, L (4A)	3 (A16)
	26	QC013	OUT H (2A)	3 (A16)
	27	QC009	OUT H (4A)	3 (A16)
	28	IC013	DIN	
	29	IC007	AIN	
	30	IC008	AIN	
	31	IC016	DIN	
	32	QC016	OUT H (2A)	3 (A16)
	33	QC012	OUT H (4A)	3 (A16)
	34	QC008	OUT H, PWM (2 A)	3 (A16)
	35	QC002	OUT H, PWM (2 A / 4 A)	3 (A16)

4 INDICATIONS

⚠ **NOTE: Connector B is not fitted to DSEM643.**

One Multi Colour LED is provided to give indication of the device operating status.

Status LED
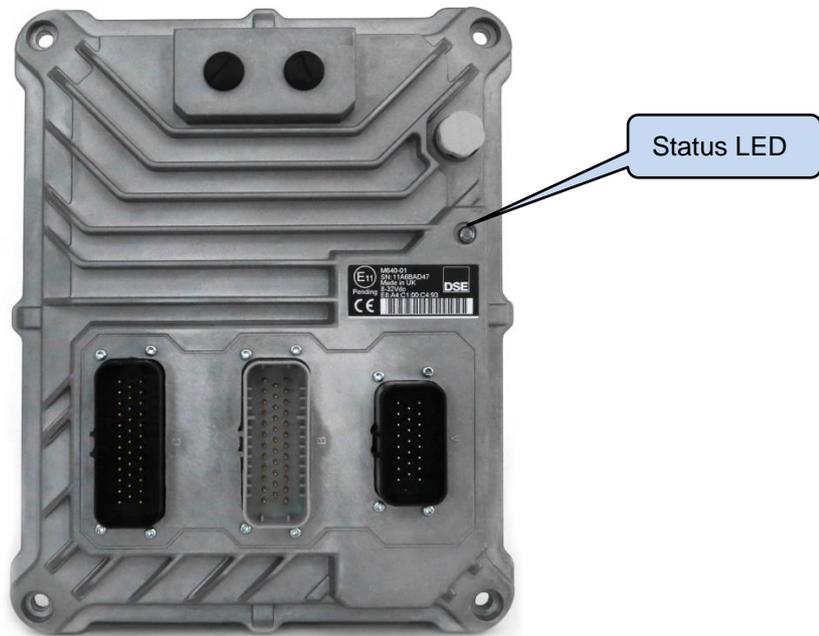
Colour	Operation	Description	State
Off	N/A	N/A	Powered down
Green	Steady	Unit powered up Application program loaded Not running	Ignition ON
	1 Hz flash	Unit powered up Application program loaded Running	Ignition ON
	5 Hz flash	Unit powered up No application program loaded.	Ignition ON
Amber	Static	Application exception Bootloader functioning normally Firmware present Program Pin enabled	Bootloader
	1 Hz flash	Firmware update in progress Reading downloaded image.	Bootloader
	5 Hz flash	Bootloader functioning normally No firmware present	Bootloader
Red	Static	Fatal system / hardware fault	Fault Condition
	1 Hz flash	Unit running with a fault, see CODESYS error flags or DSES*ervicetool*.	Fault Condition

5   USE WITH CODESYS

The device communicates with, and is programmed by, the CODESYS V3 Integrated Development Environment (IDE).

5.1   CONNECTING TO CODESYS

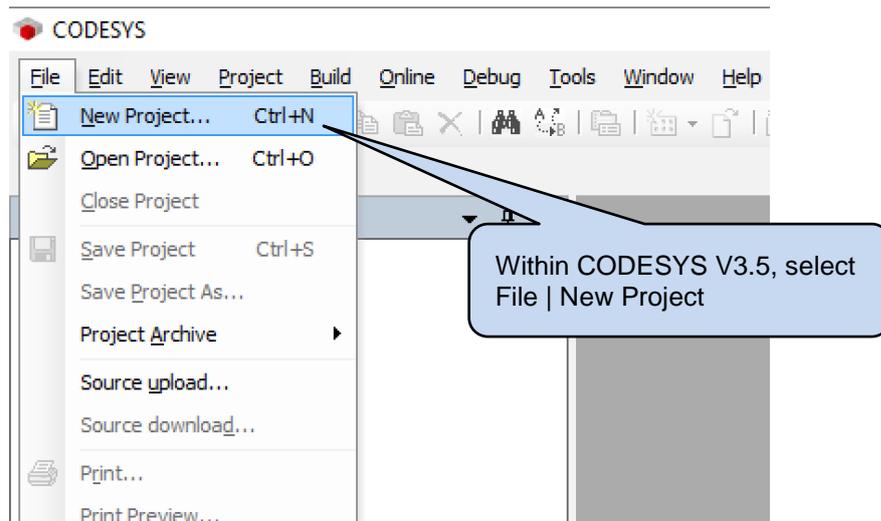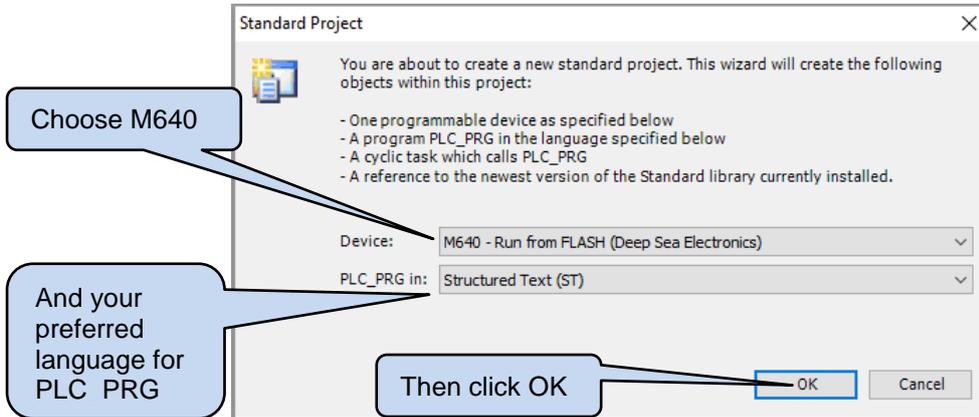### 5.1.1   PROGRAM PIN

To configure (program) the device via CODESYS V3 or activate *Debug Mode*, the *Program Pin* must be enabled as follows:

- Power down the device.
- Disconnect Program Enable pin.
- Apply DC power to the device.
- Wait a few seconds.
- Connect *Program Enable* (Connector A, Pin 6) to battery positive.

5.1.2   START NEW PROJECT

To begin, start a new project as shown.

New Project ✕

Categories:

- 📁 Libraries
- 📁 Projects

Templates:

Empty project   Standard project   Standard project w...

Select Standard Project

A project containing one device, one application, and an empty implementation for PLC_PRG

Name: Untitled1

Location: C:\Users\my.name\Documents

Then click OK

OK   Cancel

Standard Project ✕

You are about to create a new standard project. This wizard will create the following objects within this project:

- One programmable device as specified below
- A program PLC_PRG in the language specified below
- A cyclic task which calls PLC_PRG
- A reference to the newest version of the Standard library currently installed.

Choose M640

Device: M640 - Run from FLASH (Deep Sea Electronics)

And your preferred language for PLC PRG

PLC_PRG in: Structured Text (ST)

Then click OK

OK   Cancel

5.1.3 ETHERNET TCP

⚠**NOTE: If the IP address of the device is not known, see the section entitled *Ethernet UDP* elsewhere in this document.**

With the device connected to the same Ethernet network as the PC, Select *Device | Communication Settings* in the CODESYS V3 IDE.

Double-Click *Device…*

…then click *Communication Settings*

Where the IP address of the device is known, this is entered directly into the address bar. Press *Enter* to make the connection.

Successful connection is shown by the green icon.
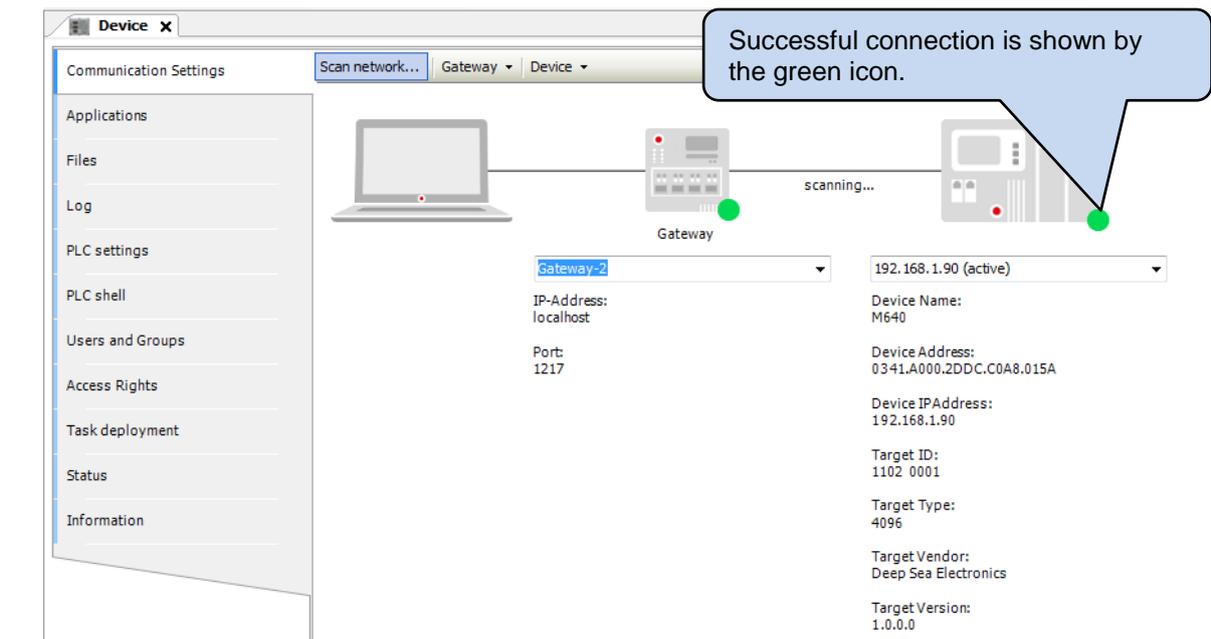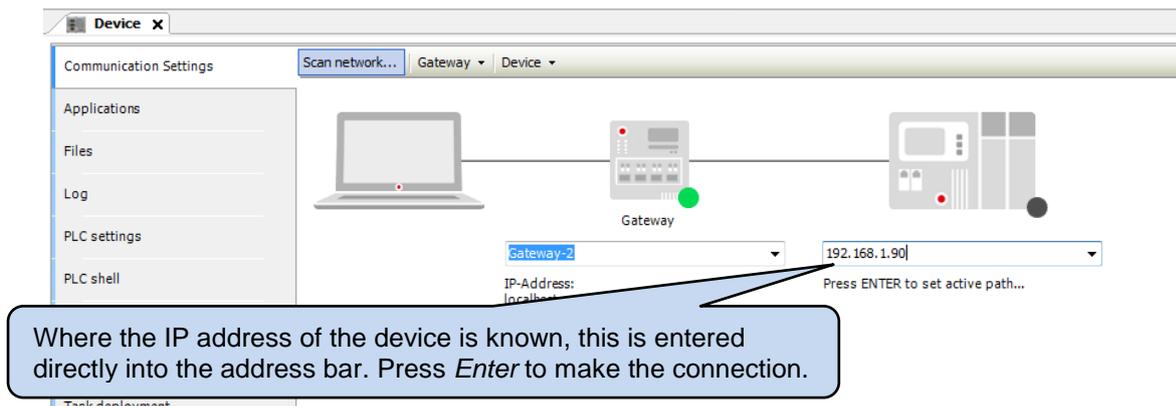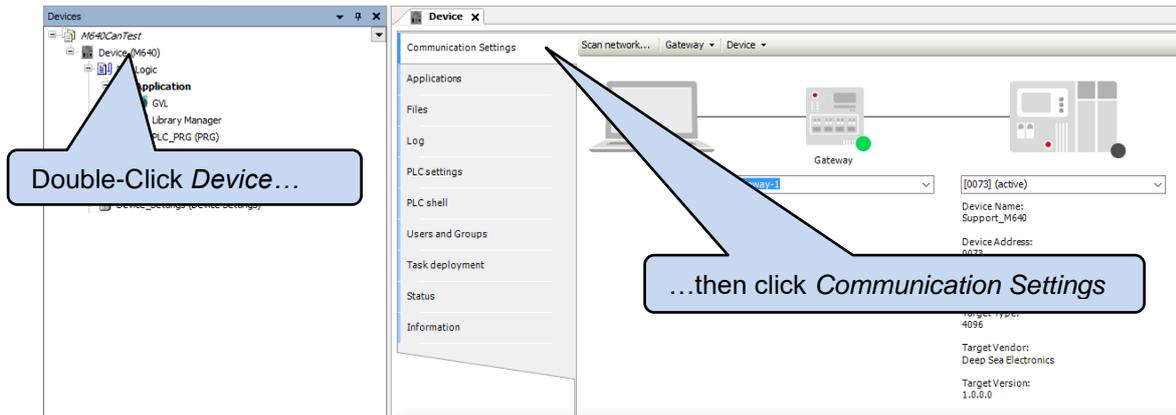
5.1.4   ETHERNET UDP

⚠️**NOTE: If the IP address of the device is known, connection may also be achieved manually as detailed in the section entitled *Ethernet TCP* elsewhere in this document.**

With the device connected to the same Ethernet network as the PC, Select *Device | Communication Settings* in the CODESYS V3 IDE.

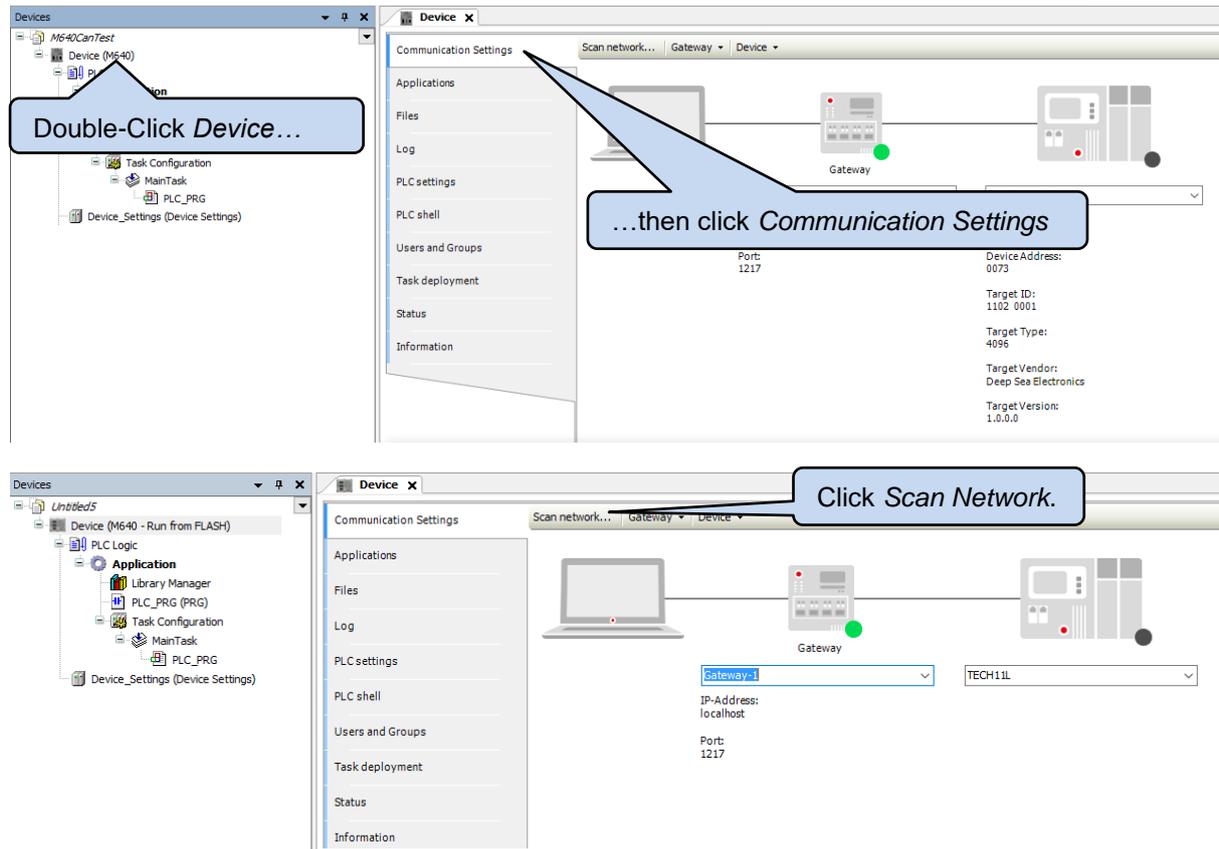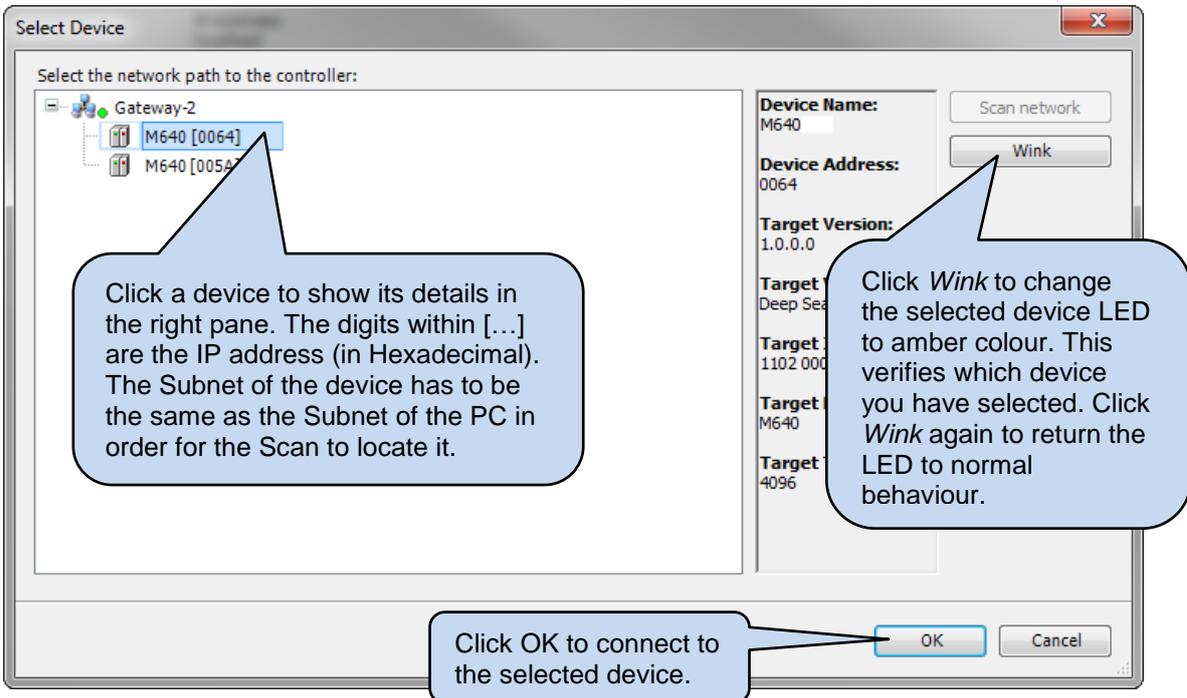> ⚠ **NOTE: A device in *Bootloader* mode is not discoverable by the Scan.**
> **The Subnet of the device has to be the same as the Subnet of the PC in order for the Scan to locate it.**

All devices found during the scan appear in the *Select Device* window. The displayed name is factory set and is changed in the *Device Settings screen.*

Click a device to show its details in the right pane. The digits within […] are the IP address (in Hexadecimal). The Subnet of the device has to be the same as the Subnet of the PC in order for the Scan to locate it.

Click *Wink* to change the selected device LED to amber colour. This verifies which device you have selected. Click *Wink* again to return the LED to normal behaviour.

Click OK to connect to the selected device.

Successful connection is shown by the green icon.

5.2 CONFIGURE SETTINGS AND MONITOR THE DEVICE

Select *Device…*

...and then double-click *Device Settings…*
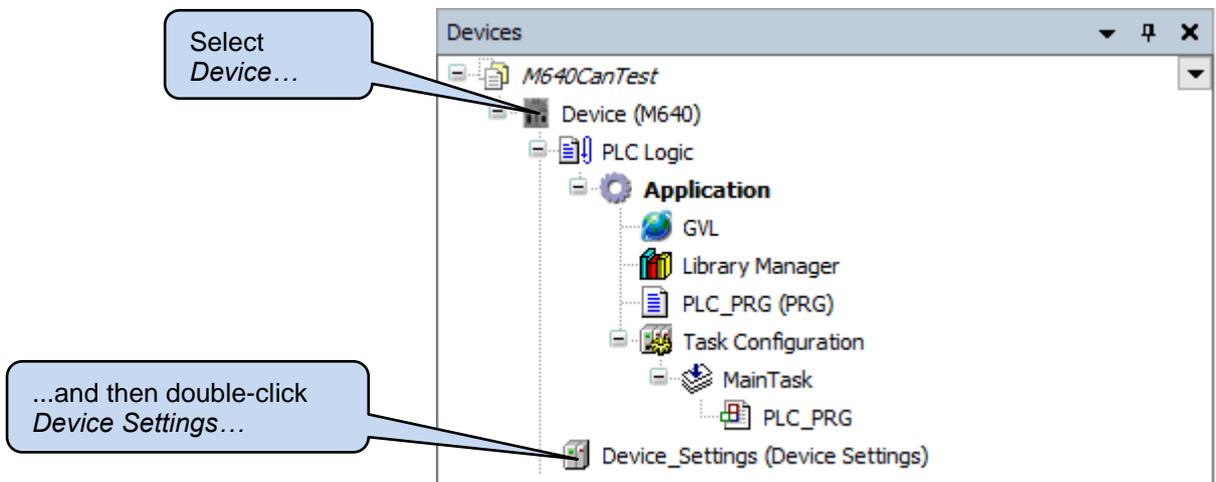
See the following subsections for details of the Device Settings pages.

5.2.1 DEVICE SETTINGS PARAMETERS

...and then select *Device Settings Parameters…*

...and then expand *Ethernet Parameters* by clicking the + symbol.

Parameter	Type	Unit	Description
Debug Mode	Enumeration of USINT		
Ethernet Parameters			
Voltage Reference	Enumeration of USINT		Voltage Reference Configuration
Battery Voltage	Enumeration of USINT		Battery Voltage
Wirebreak Condition	DINT	mA	Output must draw minimum this current when active, otherwise will flag an error
Output Overcurrent Alarm Delay	UINT	ms	Delay (in steps of 100ms) of the Output Over Current Alarm Trip (MAX 5000 ms)

Device Settings Parameters
Device Settings I/O Mapping
Status
Information

Parameter	Type	Value	Default Value	Unit	Description
Debug Mode	Enumeration of USINT	Keep Current	Keep Current		
Ethernet Parameters					
Save Config	Enumeration of USINT	No	No		Save Config
IP Mode	Enumeration of UINT	DHCP	DHCP		
WebConfig Port	UDINT	8080	8080		
IP Address					Static IP Address
[0]	USINT	192	192		
[1]	USINT	168			
[2]	USINT	1	1		
[3]	USINT	100	100		
Subnet Mask					Subnet Mask for Static Mode
[0]	USINT	255	255		
[1]	USINT	255	255		
[2]	USINT	255	255		
[3]	USINT	0	0		
Gateway Address					Gateway Address for Static Mode
[0]	USINT	192	192		
[1]	USINT	168	168		
[2]	USINT	1	1		
[3]	USINT	1	1		
DNS Address					DNS for Static Mode
[0]	USINT	192	192		
[1]	USINT	168	168		
[2]	USINT	1	1		
[3]	USINT	1	1		
Hostname	STRING	'M640'	'M640'		
Voltage Reference	Enumeration of USINT	Disabled	Disabled		Voltage Reference Configuration
Battery Voltage	Enumeration of USINT	12V	12V		Battery Voltage
Wirebreak Condition	DINT	50	50	mA	Output must draw minimum this current when active, otherwise will flag an error
Output Overcurrent Alarm Delay	UINT	200	200	ms	Delay (in steps of 100ms) of the Output Over Current Alarm Trip (MAX 5000...

Example of how set the IP Address to 192.168.1.100

⚠**NOTE: After debugging is completed, ensure to disable *Debug Mode*. Energising the device with *Debug Mode* enable when CODESYS is not connected, results in the application NOT running.**

After making changes, choose *Yes* in the *Save Config* section to save the changes made when the project is downloaded to the device.

Parameter	Type	Value	Defaul
Debug Mode	Enumeration of USINT	Keep Current	
Ethernet Parameters			
Save Config	Enumeration of USINT	No	
IP Mode	Enumeration of UINT	No / Yes	DHCP
WebConfig Port	UDINT		8080
IP Address			
[0]	USINT	192	
[1]	USINT	168	
[2]	USINT	1	
[3]	USINT	100	

After making changes, choose *Yes* in the *Save Config* section to save the changes made when the project is downloaded to the device.

5.2.2   DEVICE SETTINGS I/O MAPPING

This page is used to monitor the device, and if required, to map the monitored values to program variables.

Error Code is a bit field, detailed in the section entitled *DSEM640 & DSEM643 CODESYS Error Codes* elsewhere in this document.

Variable	Mapping	Channel		Type	Unit	Description
		Error Code	%IW0	Enumeration of UINT		Error Code: Check Manual for more information
		Device Temperature	%ID1	REAL	°C	Value of the Device Temperature
		Battery Voltage	%ID2	DINT	mV	Battery Voltage
		Supply Voltage 1	%ID3	DINT	mV	Supply Voltage 1
		Supply Voltage 2	%ID4	DINT	mV	Supply Voltage 2
		Supply Voltage 3	%ID5	DINT	mV	Supply Voltage 3
		Supply Voltage 4	%ID6	DINT	mV	Supply Voltage 4
		Ignition Switch	%IX28.0	BIT		Ignition Switch
		Program Enable	%IX28.1	BIT		Program Enable
		Voltage Reference	%ID8	DINT	mV	Voltage Reference

Device Settings Parameters
Device Settings I/O Mapping
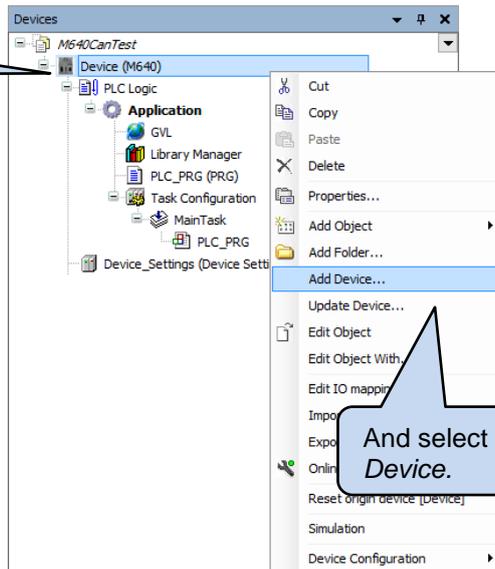*Status*
Information

5.3   ADD INPUTS AND OUTPUTS TO THE PROJECT

Inputs and *Outputs* devices
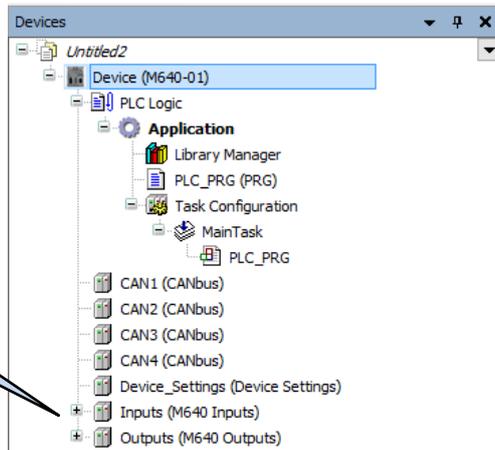
If the input and/or output devices are not already included in the project file:

Right-Click *Device…*

And select *Add Device.*

Add Device ✕

Name: ⚠

Action:
◉ Append device ○ Insert device ○ Plug device ○ Update device

Device:
Vendor: Deep Sea Electronics ▼

Name	Vendor	Version
M640 Inputs	Deep Sea Electronics	1.0.0.0
M640 Outputs	Deep Sea Electronics	1.0.0.0

Select the device to add…

And click *Add Device.*

Add other devices if required, then click *Close* when finished.

☑ Group by category
☐ Display all versions (for experts only)
☐ Display outdated versions

Information:

ⓘ (You can select another target node in the navigator while this window is open.)

Add Device   Close

Devices
- *Untitled2*
  - Device (M640-01)
    - PLC Logic
      - Application
        - Library Manage
        - PLC_PRG (PRG)
        - Task Configura
          - MainTask
            - PLC_PR
    - CAN1 (CANbus)
    - CAN2 (CANbus)
    - CAN3 (CANbus)
    - CAN4 (CANbus)
    - Device_Settings (Device
    - Inputs (M640 Inputs)
      - Connector_B_Pin_7
      - Connector_B_Pin_8 (IB002)

Browse ▶
Properties...
Add Object
Add Folder...
Plug Device...
Disable Device
Update Device...
Edit Object
Edit Object With...
Edit IO mapping
Import mappings from CSV...
Export mappings to CSV...
Simulation

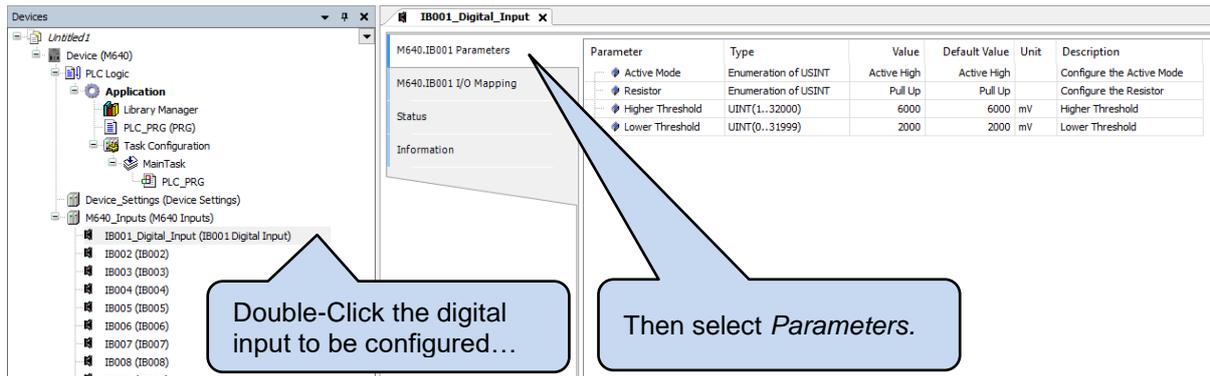Right-Click the Input / Output to configure…

And select *Update Device.*

Select the required configuration for the Input / Output (available choices depend upon which Input / Output is selected. See section entitled *User Connections* elsewhere in this document for details).
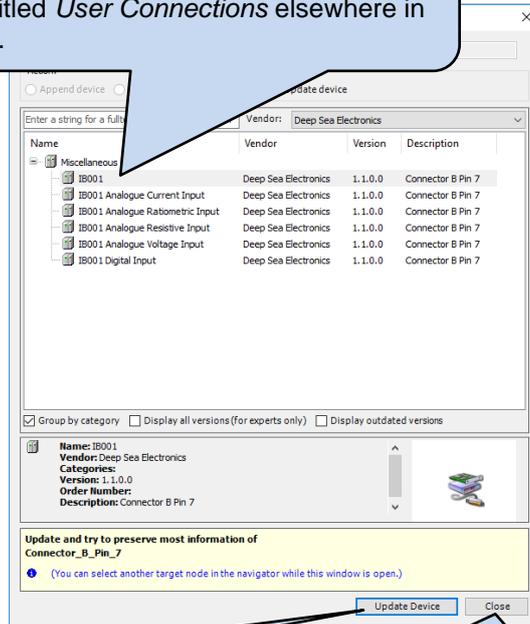
And click *Update Device.*

Select and configure other Inputs / Outputs if required, then click *Close* when finished.
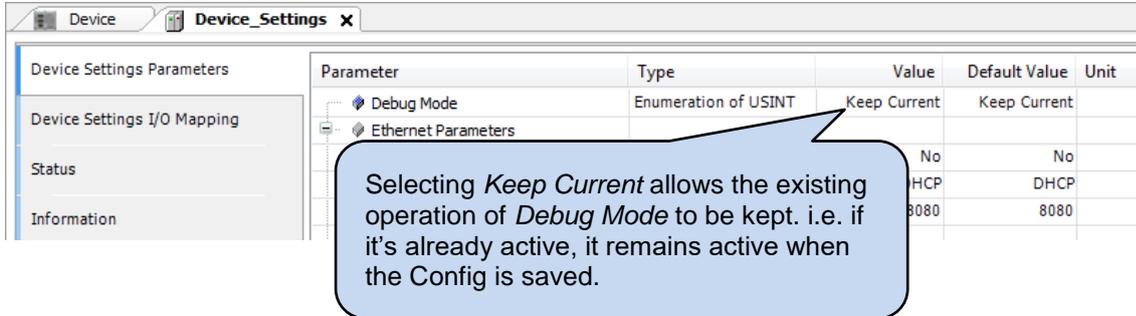
5.3.1 DIGITAL INPUT PARAMETER CONFIGURATION

Parameter	Description
Active Mode	*Active High*: The input connects to the positive supply rail when activated. *Active Low*: The input connects to the negative supply rail when activated.
Resistor	*Float*: The input is floating when no connection is made. Commonly used with PNP (Sourcing) type switched sensors. *Pull Up*: An internal pull up resistor biases the input to the positive supply rail when no connection is made. Commonly used with NPN (Sinking) type switched sensors and volt-free contacts. *Pull Down*: An internal pull down resistor biases the input to the negative supply rail when no connection is made. Commonly used with volt-free contacts.
Higher Threshold	For *Active High* inputs, the inputs is detected as being active when above this threshold with respect to the negative supply rail.
Lower Threshold	For *Active Low* inputs, the inputs is detected as being active when below this threshold with respect to the negative supply rail.

5.4   DEBUG MODE SETTING

Debug Mode is switchable by activating the *Program Enable* pin when the device is powered. However, keeping the pin active during a power cycle places the device into *Bootloader* mode. During debugging of a project, repeated enabling and disabling of the *Program Enable* pin can become tiresome. An alternative is to use the *Device Settings* to enable and disable *Debug Mode*.

Selecting *Keep Current* allows the existing operation of *Debug Mode* to be kept. i.e. if it's already active, it remains active when the Config is saved.

6 DSEM640 & DSEM643 CODESYS ERROR CODES

The device returns error codes to CODESYS when appropriate. Individual bits are set within the returned value to indicate one or more error conditions. This can be mapped to a variable if required and is available to view within CODESYS under the *Device Settings I/O Mapping* as shown below.

Examples:

A *Device* error value of 120 (01111000 in binary) indicates that all four *Output Supplies* are *Under Voltage.*

A *Device* error value of 2 (00000010 in binary) indicates *Over Temperature.*

6.1 DEVICE

MSB			Bit				LSB
8	7	6	5	4	3	2	1
Output Reference Outside Limits	Under Voltage Output Supply 4	Under Voltage Output Supply 3	Under Voltage Output Supply 2	Under Voltage Output Supply 1	Under Voltage Supply	Over Temperature	Error

6.2 ANALOGUE INPUTS

Input Configuration	MSB			Bit				LSB
	8	7	6	5	4	3	2	1
Digital	Invalid Parameter	Reserved	Reserved	Invalid Threshold	Reserved	Reserved	Reserved	Error
Voltage	Invalid Parameter	Reserved	Reserved	Reserved	Reserved	Over Range	Inverted Input (<10 mV)	Error
Current	Invalid Parameter	Reserved	Reserved	Reserved	Reserved	Over Range	Wire Break (<4 mA)	Error
Resistance	Invalid Parameter	Reserved	Reserved	Reserved	Reserved	Over Range	Reserved	Error
Ratiometric	Invalid Parameter	Reserved	Invalid Reference	Reserved	Reserved	Over Range	Reserved	Error

6.3 DIGITAL INPUTS

Input Configuration	MSB 8	7	6	5	4	3	2	LSB 1
				Bit				
Digital	Invalid Parameter	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Error
Frequency	Invalid Parameter	Reserved	Reserved	Reserved	Reserved	Freq Over Range	Reserved	Error
Phase	Invalid Parameter	Reserved	Invalid Phase Reference	Reserved	Reserved	Freq Over Range	Invalid Phase Reading	Error
Counter	Invalid Parameter	Reserved	Reserved	Invalid Direction	Reserved	Reserved	Reserved	Error
Encoder	Invalid Parameter	Reserved	Invalid Phase Reference	Reserved	Reserved	Reserved	Reserved	Error

6.4 DIGITAL OUTPUTS

Output Configuration	MSB 8	7	6	5	4	3	2	LSB 1
				Bit				
Digital	Invalid Parameter	Reserved	Reserved	Reserved	Reserved	Over Current	Wire Break (Config)	Error
PWM	Invalid Parameter	Reserved	Reserved	Invalid Duty Cycle	Invalid Frequency	Over Current	Wire Break (Config)	Error
PWMi	Invalid Parameter	Invalid Dither	Invalid Current Target	Reserved	Invalid Frequency	Over Current	Wire Break (Config)	Error

7 CABLES, CONNECTORS, HARNESSES AND SPARE PARTS

Description	DSE Part	Manufacturer Part	Manufacturer
DSEM640 Connector Kit (Set of 3)	007-035	770680-1 776164-4 776164-1	TE Connectivity
DSEM643 Connector Kit (Set of 2)	007-1020	770680-1 776164-1	TE Connectivity
Connector Pin Crimp	N/A	770854-1	TE Connectivity
DSEM640 Connector Harness Kit (Set of 3)	007-036	N/A	DSE
DSEM643 Connector Harness Kit (Set of 2)	016-174	N/A	DSE
M12 to Ethernet Cable	016-160	VS-M12MS-IP20-93R-L1/2	Phoenix
M12 to USB Cable	016-161	N/A	DSE
M12 Sealing O-Ring	011-137	N/A	DSE
Belden 9841	016-030	9841	Belden
Pin Blank Inserts (Seals unused connector pins)	N/A	114017	TE Connectivity

7.1 DSEM640 CONNECTOR HARNESS KIT (007-036)

DSE Part 007-036 consists of three cables as listed below. Connectors are fitted at one end, with cable marking to identify the wires at the other end.

	Connector A	Connector B	Connector C
Assembly Ident	007-036 (a)	007-036 (b)	007-036 (c)
AMP Connector	770680-1	776164-4	776164-1
No of Connections	23	35	35
Wire size	0.5 mm^2 (AWG 20)	0.5 mm^2 (AWG 20)	0.5 mm^2 (AWG 20)
Wire Colour	Black	Black	Black
Wire Idents	1 to 23	1 to 35	1 to 35
Pin Crimp Part No	770854-1	770854-1	770854-1
Cable Length	1200 mm (47 ")	1200 mm (47 ")	1200 mm (47 ")

7.2 DSEM643 CONNECTOR HARNESS KIT (016-174)

DSE Part 016-174 consists of two cables as listed below. Connectors are fitted at one end, with cable marking to identify the wires at the other end.

	Connector A	Connector C
Assembly Ident	007-036 (a)	007-036 (c)
AMP Connector	770680-1	776164-1
No of Connections	23	35
Wire size	0.5 mm^2 (AWG 20)	0.5 mm^2 (AWG 20)
Wire Colour	Black	Black
Wire Idents	1 to 23	1 to 35
Pin Crimp Part No	770854-1	770854-1
Cable Length	1200 mm (47 ")	1200 mm (47 ")

8 FIRMWARE UPDATE

⚠️**NOTE: A firmware update ERASES THE APPLICATION code.**

Firmware update files when available are obtained from www.deepseaplc.com and are applied as follows:

- Rename the firmware package to be "update.pkg" and place in the root folder on a **clean** (blank) USB memory stick.
- Remove DC Supply from the device.
- Apply Program Enable pin.
- Apply DC Supply to the device. A solid amber LED shows that the device has entered bootloader mode.
- Connect the memory stick to the device USB connection using the M12 to USB-A adaptor.
- After approximately 20 seconds, the LED flashes amber (2Hz) while the update file is read.
- Once read, the update file is uncompressed. The LED flashes amber at a slower rate (1 Hz) during this process. The time this occurs depends upon the size of the update file (approximately 100 seconds for a 1.25 MB file).
- After decompressing, the LED lights solid amber for approximately four seconds while the firmware update is applied to the memory, then illuminates green for a short time.
- When update is complete, the LED extinguishes.
- Remove DC Supply from the device.
- Remove the USB memory stick.
- The update is complete.

9 MAINTENANCE AND WARRANTY

The controller is *Fit and Forget*. As such, there are no user serviceable parts within the controller. In the case of malfunction, you should contact your original equipment manufacturer (OEM).

DSE Provides limited warranty to the equipment purchaser at the point of sale. For full details of any applicable warranty, refer to the original equipment supplier (OEM).

10 DISPOSAL

10.1 WEEE (WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT)

If you use electrical and electronic equipment you must store, collect, treat, recycle and dispose of WEEE separately from your other waste

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