DSEControl

DSE

DEEP SEA ELECTRONICS

DSEM870 Operator Manual

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CULTURE OF QUALITY



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DSEM870 Operator Manual

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Revision History

Issue No.	Comments
1	First Release
1.1	Changed some specification items.
2.0	Changes to support DSEM870 V2 firmware.
2.1	Added Misc section.
3.0	Added features to support DSEM870 V3 firmware including Format options and new Camera Overlay support.
4.0	Added Touchscreen to cover M870-02 variant. Added WebVisu to cover M870-03 variant.
4.1	Added Tightening Torque for M10 connections. Corrected USB socket pinout Added more detail on Screen Rotation

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1 INTRODUCTION

This document details the operation and setup requirements of the DSEM870 Mobile Controller and Display, 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.deepseaelectronics.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 the product, operators and machinery.

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

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 or C programming. Contact DSE Technical Support for further details.



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 DSEM870 to control the machine it is connected to. The Application within the DSEM870 is designed and provided by the manufacturer of the complete machine.
Bootloader	The Bootloader is the program within the DSEM870 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. DSEM870 supports CODESYS V3.5
ECU	Electronic Control Unit. For example the DSEM870 device.
Firmware	The Firmware of the DSEM870 is the Operating System of the DSEM870 that reads and executes the Application program.
FSD	Full Scale Deflection. For example 0 mA to 20 mA is the Full Scale Deflection of a current sink input.
I/O	Input / Output. For example “The I/O is taken out to an external terminal strip in the user panel”.
IDE	Integrated Development Environment. For example the CODESYS V3.5 application that runs on the host PC is an IDE.
Ixyyy	An Input, where x is the connector and yyy is the input number. For example IC003 means Input 3 on Connector C.
PLC	Programmable Logic Controller. Industrial computer used primarily for the automation of electromechanical machinery.
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.
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).
Qxyyy	An Output, where x is the connector and yyy is the output number. For example QC002 means Output 2 on Connector C.

1.3 RELATED INFORMATION

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

1.3.1 TECHNICAL INFORMATION

DSE Part	Description
053-187	DSEM870 Installation Instructions
055-198	DSEM640 Datasheet
055-199	DSEM870 Datasheet
057-244	DSEM640 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 heatsink at the rear heats 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 when the connectors are not in use. Tighten to 0.8 Nm (0.6 lbf ft). Where IP protection is required when the interfaces are in use, suitable O-rings must be fitted.

- The heatsink must be wired to vehicle ground to comply with EMC guidelines. A screw connection point is provided for this purpose. A metallic screw must be used to create an electrical connection to vehicle / machine ground.

2 SPECIFICATIONS

2.1 PROCESSOR

Description	Specification
Technexion Freescale iMX6 SOLO Microcontroller	ARM A9
Speed	800 MHz

2.2 MEMORY

Description	Specification
Flash	2 GB available for application. 4 GB total.
RAM	512 Mb

2.3 DC SUPPLY

Description	Specification
Operating Voltage (Pin A7)	8 V to 32 V
Maximum Current (Full Backlight, no External Loads)	<1000 mA at 24 V
Maximum Current (Full Backlight & Heater, no External Loads)	<1500 mA at 24 V
Maximum Current (After Controlled Shutdown With Ignition off)	<5 mA at 24 V

2.3.1 FUSING

Description	Specification
DC Supply (Pin A7)	3 A Max
Ignition (15) (Pin A13)	1 A Max
High Current Outputs supply (Pin C1) Fuse as Required by Output Loads (Pins C2, C3, C4, C5)	10 A Max
Auxiliary Supply Output (Pin C13)	100 mA Max

2.4 ENVIRONMENTAL

⚠NOTE: M12 protection plugs (supplied) must be installed in both the USB and Ethernet interfaces to ensure IP67 rating when the connectors are not in use. Tighten to 0.8 Nm (0.6 lbf ft). Where IP protection is required when the interfaces are in use, suitable O-rings must be fitted.

Description	Specification
Operating Temperature	-30 ºC to +85 ºC (-22 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)

2.5 USER INTERFACE



2.5.1 CONTROLS

Description	Specification
Push Buttons	9 (10 including Rotary Encoder Push)
Rotary Encoder	1 Rotary Encoder With Integral Push Button

2.5.2 DISPLAY

Description	Specification
Size (Across Diagonal)	177.8 mm (7”)
Size (W x H)	WVGA (800 x 480)
Touchscreen (M870-02 and DSEM870-03 only)	Capacitive
Aspect Ratio	15:9
Type	Optically Bonded LED
Lifetime	> 50,000 hours
Colour	24 bit
Splash Screen Image Type	Bitmap Image (BMP) 8 bit / 24 bit colour depth 800 x 480

2.5.3 AMBIENT LIGHT LEVEL SENSOR

Description	Specification
Light Level Sensor	Measures ambient light level. This can be used to adjust display brightness based upon lighting conditions.

2.5.4 LED

The system LED is used to indicate operating status.

Description	Specification
LED Type	Tricolour (Red, Amber, Green) (see below)

Colour	Operation	State	Meaning
Off	N/A	Off	Device not powered
Green	Static	Application Stopped.	Unit powered up, Application program loaded but not running
	1 Hz flash	Application Running.	Unit powered up, Application program loaded and running
	5 Hz flash	No Application.	Unit powered up, but no Application program loaded
Amber	Static	Bootloader Mode	Bootloader functioning normally, firmware present
		Firmware Start-up	Firmware is at Start-up.
		Application Exception	Unit Stopped due a serious fault.
	1 Hz flash	Decrypting Image	Bootloader is decrypting the downloaded image
	5 Hz flash	Reading Image from USB	Bootloader is reading an image from the USB
Red	Static	Fatal Error	Fatal system / hardware fault – LED may be driven directly by microcontroller error pin or firmware is in fault condition state.
	1Hz flash	Faulty Application Running	Unit running with a serious fault, see CODESYS error flags or Web Tool

2.6 REAL TIME CLOCK

Description	Specification
Retention Type	Super Cap for up to 800 hours

2.7 INPUTS

2.7.1 DIGITAL INPUTS

2.7.1.1 DIGITAL

Description	Specification
Applicable Pins	Pins C14, C15, C16, C17
Minimum Voltage For High Level	>6 V
Maximum Voltage For Low Level	<2 V

2.7.1.2 FREQUENCY

Description	Specification
Applicable Pins	Pins C14, C15, C16, C17
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)	>2 V
Maximum Voltage For Low Level (Space)	<1.4 V

2.7.2 ANALOGUE INPUTS

Description	Specification
Applicable Pins	Pins C14, C15, C16, C17
Reference Voltage Pins	C6, C18
Reference Voltage	Programmable 5 V / 10 V ±500 mV

2.7.2.1 VOLTAGE

Description	Specification
Applicable Pins	Pins C14, C15, C16, C17
Configurable Ranges	0 V to 5 V 0 V to 10 V 0 V to 32 V
Input Resistance	>=30 kΩ
Sampling Rate	500 Hz

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

2.7.2.2 CURRENT

Description	Specification
Applicable Pins	Pins C14, C15, C16, C17
Configurable Ranges	0 mA to 20 mA 4 mA to 20 mA
Input Type	Current sink only
Input Sink Resistance	100 Ω ± 1%
Sampling Rate	500 Hz
Resolution (12 bits)	0.005 mA
Accuracy (± 1 % Full Scale Deflection)	0.2 mA

2.7.2.3 RESISTIVE

Description	Specification
Applicable Pins	Pins C14, C15, C16, C17
Measurement Range	0 Ω to 3200 Ω
Measurement Source Voltage	12 V maximum
Measurement Source Current	1 mA
Sampling Rate	500 Hz
Resolution (12 bits)	0.78 Ω
Accuracy (± 1 % Full Scale Deflection)	32 Ω

2.7.2.4 RATIOMETRIC

Description	Specification
Applicable Pins	Pins C14, C15, C16, C17
Measurement Voltage Reference	Input/Output Supply (Pin C1, C7)
Measurement Type	Ratio of input Pin to I/O Supply
Measurement Source Current	1 mA
Accuracy	± 1 % F.S.D.

2.8 OUTPUTS

2.8.1 NEGATIVE SWITCHING

Description	Specification
Applicable Pins	Pins C2, C3, C4, C5
Maximum Current	2 A
Digital Output Active Low ‘ON’ State Maximum Voltage at Rated Current	< 100 mV
Digital Output Active Low ‘OFF’ State Leakage Current	<5 µA at 24 V output supply

2.8.2 POSITIVE SWITCHING

Description	Specification
Applicable Pins	Pins C2, C3, C4, C5
Maximum Current	2 A
Digital Output Active Low ‘ON’ State Maximum Voltage at Rated Current	<100 mV
Digital Output Active Low ‘OFF’ State Leakage Current	<10 µA at 24 V output supply

2.9 COMMUNICATIONS

2.9.1 CAN

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

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).

Description	Specification
Number of CAN Interfaces	2
Supported Protocols	J1939 CAN open Raw CAN
Supported Baud Rates	10 kbit/s, 20 kbit/s, 50 kbit/s, 100 kbit/s, 125 kbit/s, 250 kbit/s, 500 kbit/s, 1 Mbit/s

2.9.2 ETHERNET

Description	Specification
Number Of Ethernet Ports	1
Supported Data Rates	10 Mbit/s / 100 Mbit/s, Duplex
Supported Protocols	MODBUS TCP CODESYS 3.5

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

2.9.3 USB

Description	Specification
Number of USB Ports	1
USB Version	2
Supported Speeds	Full Speed (12 Mbit/s)
Device Class	08 (Mass Storage)
Max Size	64 Gb
Filing System	VFAT or FAT32
Filename Structure	Filenames must be alphanumeric only (A to Z, a to z, 0 to 9) and "." (used to seperate the file extension).

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

2.9.4 CAMERA INPUTS

NOTE: M870 V3.0 and above blends the camera overlay with CODESYS visualisation and the camera display allowing all to be visible at the same time. See section entitled *Camera Overlay* elsewhere in this document.

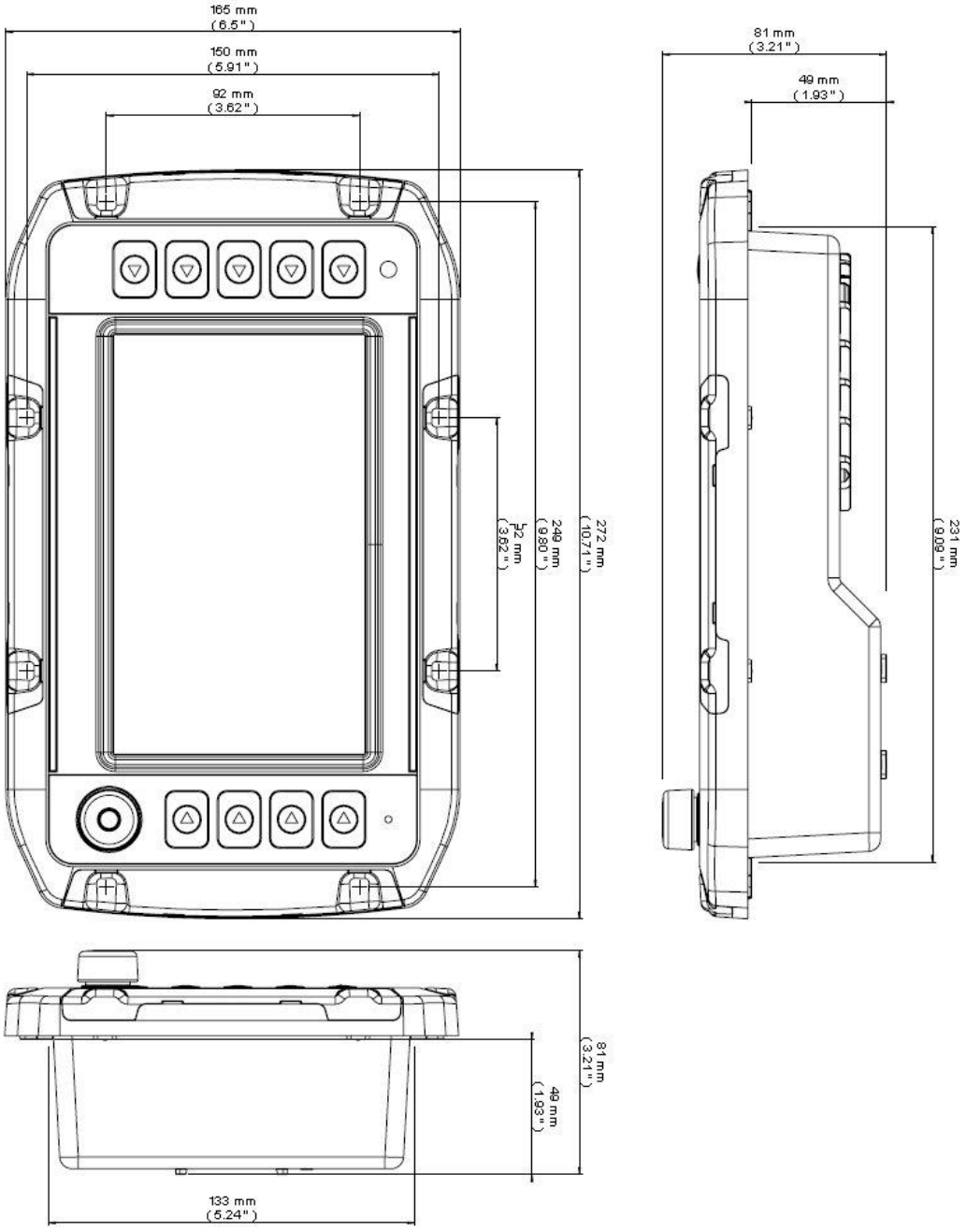
Description	Specification
Number of Camera Inputs	2
Connection Pins	A5, A11 (Camera 1) A6, A12 (Camera 2)
Camera Type	VGA
Interface Type	Analogue (Composite) Video for PAL / NTSC
Overlay Size (when utilised)	800 x 480

3 INSTALLATION

3.1 DIMENSIONS AND MOUNTING

3.1.1 DIMENSIONS

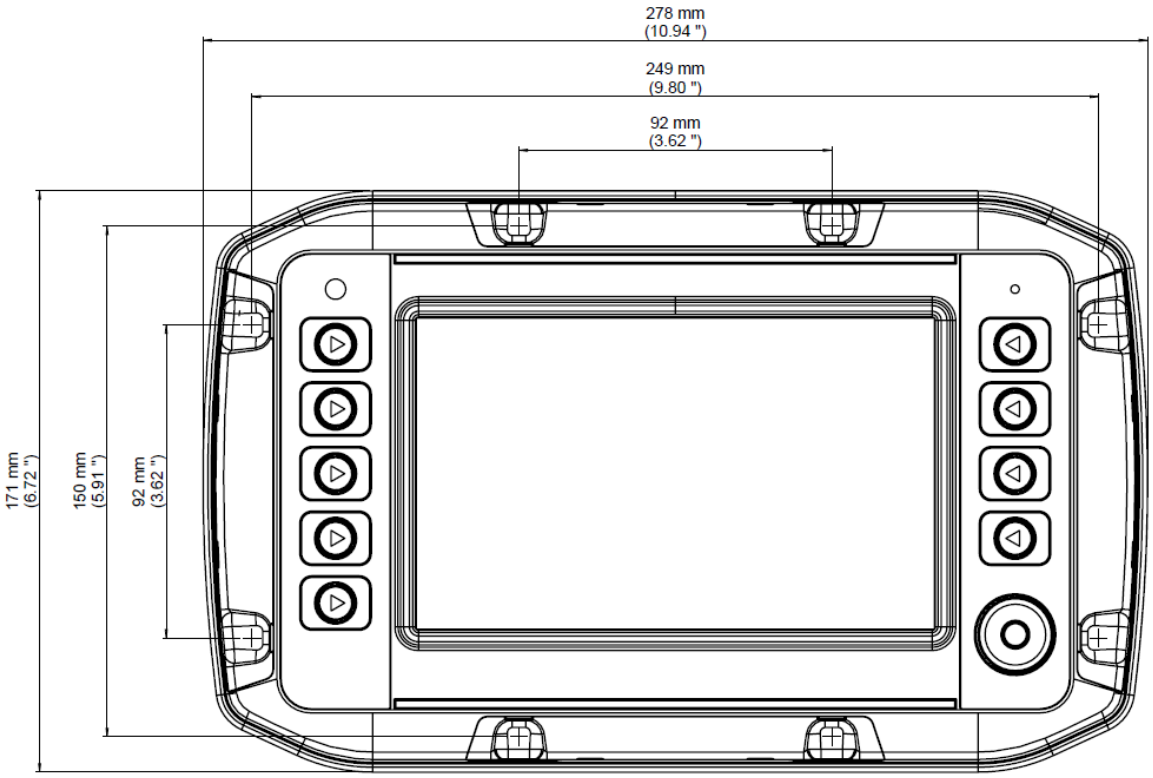
Description	Specification
Overall Dimensions (Height x Width x Depth)	272 mm x 165 mm x 81 mm (10.7 ” x 6.5 ” x 3.2 ”)
Mounting Type	8 x mounting bolts or RAM mount.
Overall Weight	<1 kg (2.2 lb)



Overall dimensions without fascia mounting gasket

3.1.2 FASCIA MOUNTING

Description	Specification
Fascia Mounting Holes	Suitable for M5 bolts (0.3 “ holes)
Fascia Mounting Hole Centres	See Diagram Below
Panel Cut-Out	231 mm x 133 mm (9.09 “ x 5.24 “)
Fascia Mounting Bolt Material Recommendation	Steel or Stainless Steel bolts fitted with M5 bonded seal washers (also known as Dowty washers).
Fascia Mounting Bolt Tightening Torque to prevent distortion of the sealing gasket and subsequent seal failure / mechanical damage to the controller.	1.2 Nm Maximum (0.89 lbf ft Maximum)

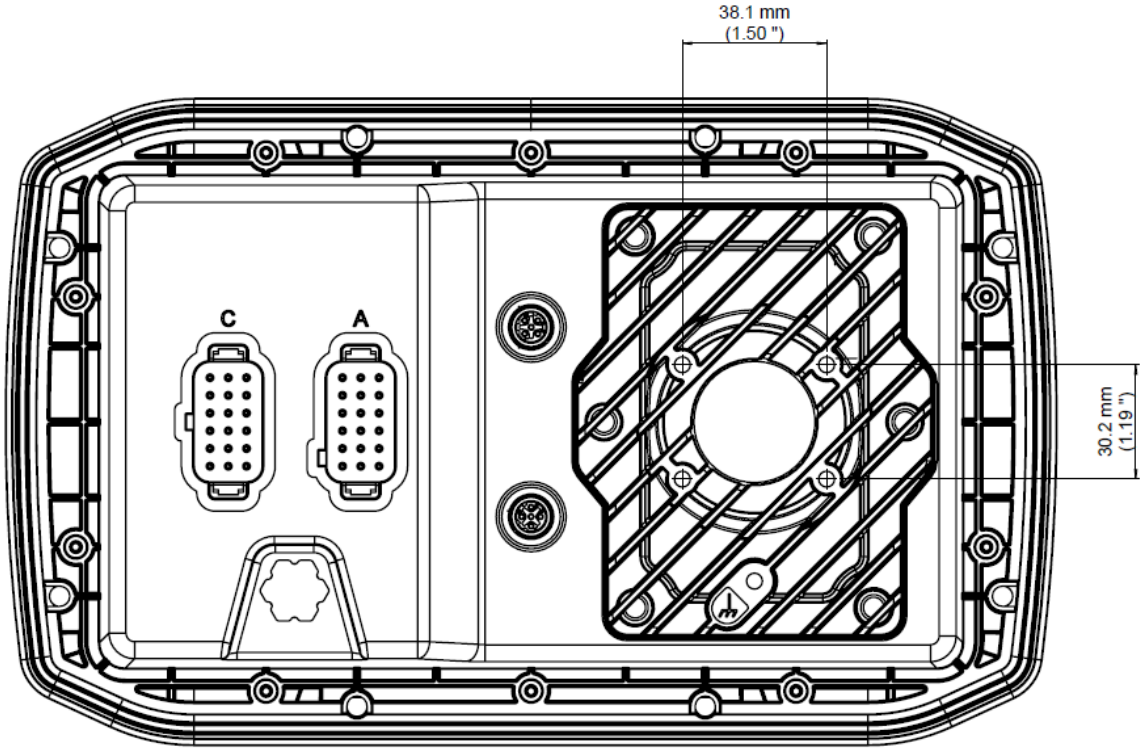


Overall dimension including fascia mount gasket.

3.1.3 RAM MOUNTING

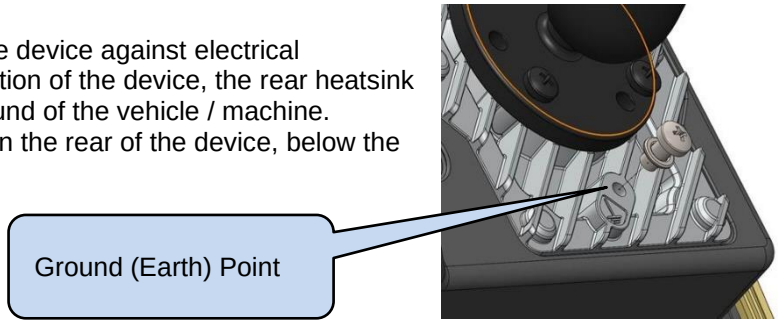
DSE870 has four holes on the rear face, suitable for fitting of a RAM type mount with the *AMPS hole pattern.* The spacing for the mounting holes is detailed in the image below.

Description	Specification
RAM Mounting Holes	Suitable for M5 bolts (0.3 “ holes)
RAM Mounting Hole Centres	31.1 mm x 30.2 mm (1.50 “ x 1.19 “)
RAM Mounting Bolt Material Recommendation	Steel or Stainless Steel
RAM Mounting Bolt Tightening Torque	4 Nm Maximum (2.95 ft. lb Maximum)



3.2 GROUNDING

To ensure the protection of the device against electrical interference and the safe function of the device, the rear heatsink must be connected to the ground of the vehicle / machine.
A suitable screw is provided on the rear of the device, below the RAM mount location.



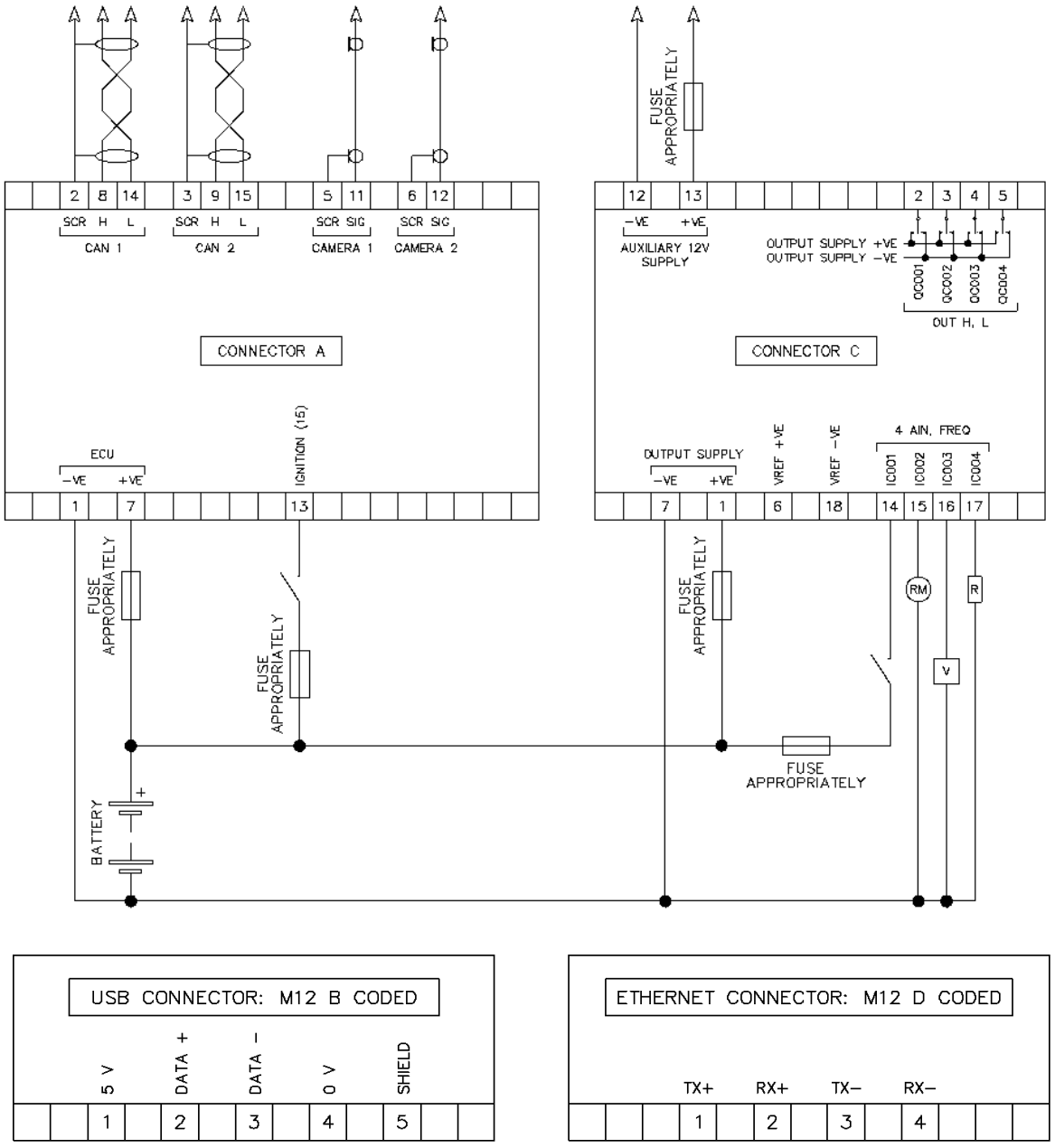
3.3 FUSING

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

Pin	Description	Comments	Recommended Fuse Size
A7	ECU Supply	Supplies M870 CPU	3 A Max
A13	Ignition (15)		1 A Max
C1	Output Supply	Supplies Outputs QC001 (Pin C2) QC002 (Pin C3) QC003 (Pin C4) QC004 (Pin C5).	10 A Max
C13	Auxiliary Supply Output (100 mA)	Used to Supply External Devices Internally Protected From Overcurrent.	100 mA Max

3.4 TYPICAL CONNECTION DIAGRAM

Terminology	Meaning
QCxxx	Output
Ix	Input
H	Output, High when active
L	Output, Low when active
AIN, FREQ	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 and frequency measuring.

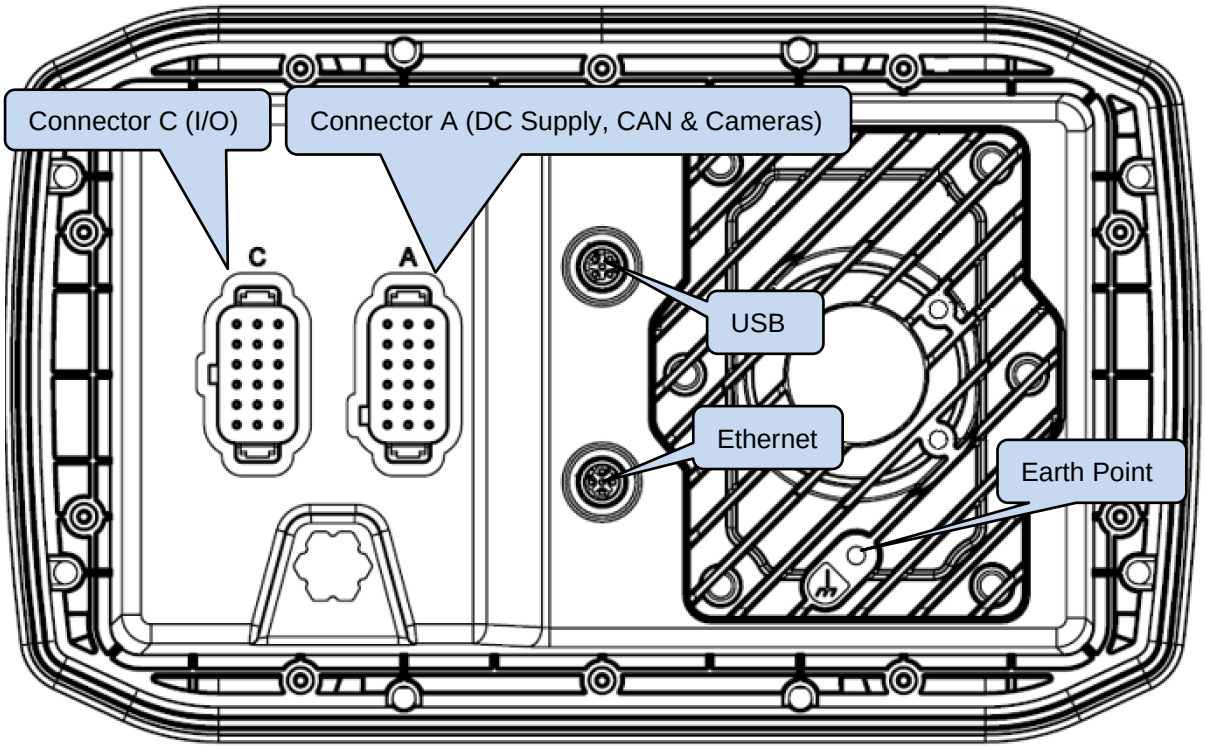


3.5 USER CONNECTIONS

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: Connectors A and C are coded differently. Do not try to force a connector into the wrong socket.

NOTE: USB and Ethernet connectors are coded differently. Do not try to force a connector into the wrong socket.



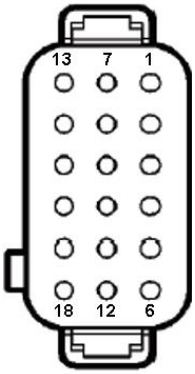
3.5.1 CONNECTOR A (DC SUPPLY, CAN AND CAMERA)

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

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).

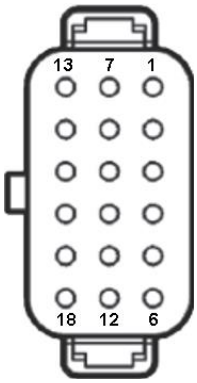
NOTE: CAN connections are NOT internally terminated. A complete CAN network must have 120 Ω terminators at each end of the network.

NOTE: Connect Camera1 and Camera2 using a single core conductor with screen (shield).

Connector A	Pin	Description	Comments
(A Coded)  	1	ECU Supply -ve	DC Supply for the M870
	2	CAN1 SCR	Screen (shield) for CAN1
	3	CAN2 SCR	Screen (shield) for CAN2
	4	No Connection	
	5	Camera 1 SCR	Screen (shield) for Camera 1
	6	Camera 2 SCR	Screen (shield) for Camera 2
	7	ECU Supply +ve	DC Supply for the M870
	8	CAN1 H	
	9	CAN2 H	
	10	No Connection	
	11	Camera 1 Signal	Analogue (Composite) video
	12	Camera 2 Signal	Analogue (Composite) video
	13	Ignition +ve (15)	Energises the ECU.
	14	CAN1 L	
	15	CAN2 L	
	16	No Connection	
	17	No Connection	
	18	No Connection	

3.5.2 CONNECTOR C (I/O)

Terminology	Meaning
QC00x	Output
IC00x	Input
H	Output, High when active.
L	Output, Low when active.
AIN, FREQ	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 and frequency measuring

Connector C	Pin	Description	Comments
(C Coded)  	1	Input/Output Supply +ve	Supplies Outputs 1 to 4 and *Ratiometric* inputs.
	2	QC001	OUT H, L. Supplied by C1.
	3	QC002	OUT H, L. Supplied by C1.
	4	QC003	OUT H, L. Supplied by C1.
	5	QC004	OUT H, L. Supplied by C1.
	6	Vref +	+ve Reference Output for AIN.
	7	Output Supply GND	-ve Connection for Output Supply (C1)
	8	No Connection	
	9	No Connection	
	10	No Connection	
	11	No Connection	
	12	Aux 12V -ve Output	Used to Supply External Devices
	13	Aux 12V +ve Output (Max 100 mA)	Used to Supply External Devices
	14	IC001	AIN, FREQ
	15	IC002	AIN, FREQ
	16	IC003	AIN, FREQ
	17	IC004	AIN, FREQ
	18	Vref GND	-ve Reference Output for AIN

4 OPERATION

4.1 SYSTEM PAGES

The System Information and System Settings pages are accessed by pressing and holding any two of the fascia buttons during the power up (application of DC power) of the DSEM870. Wait until *Entering Setup…* is displayed before releasing the buttons.

4.1.1 NAVIGATION

Within the System Pages, the following icons appear adjacent to the buttons to indicate their function.

Icon	Function	Description
	Return	Press the adjacent button to return to a previous page.
	Encoder	Rotate to cycle through the available options. Press to select (OK) the displayed option.



4.1.1.1 PAGE SELECTION

Use the rotary encoder to move through the pages. Press the rotary encoder to select the page.



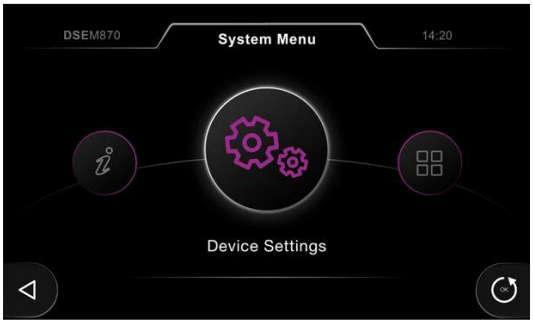
4.1.1.2 OPTION SELECTION AND EDITING

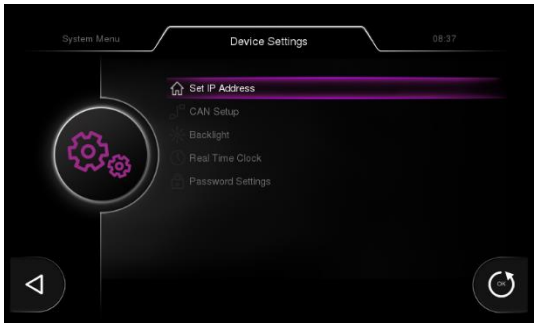
While viewing the selected page, use the rotary encoder to move through the options, Press the rotary encoder to select the option for editing.

While editing the selected parameter, use the rotary encoder to change the value, Press the rotary encoder to save the change.
Press ◄ to exit the editor.

4.1.2 DEVICE SETTINGS

This section allows access to the *Device Settings*.





4.1.2.1 SET IP ADDRESS

This section allows selection of DHCP or Static IP address.
When connecting the device to a third party network, these settings must be made after consulation with the network manager.

Turn the rotary encoder to select the item to change and press it to enter the editor.

Use the rotary encoder to select the digit.
Press to accept the change and/or move to the next digit.

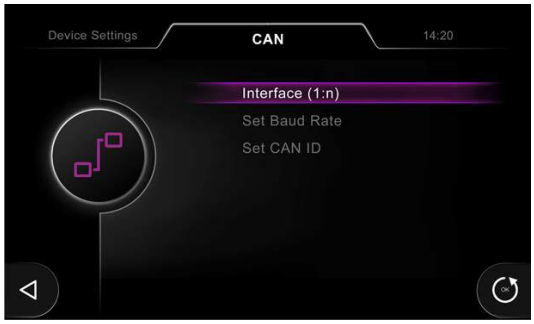


4.1.2.2 CAN

This section allows configuration of the CAN interface parameters.

Turn the rotary encoder to select the item to change and press it to enter the editor.

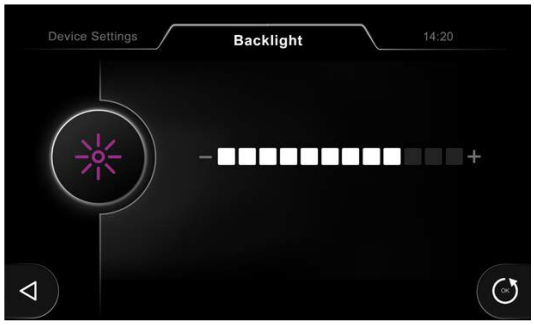
Selecting *Interface* and pressing the encoder cycles between the two CAN ports (0 & 1).



4.1.2.3 BACKLIGHT

This section allows adjustment of the LCD backlight brightness.

Use the rotary encoder to adjust the level. Press to accept the change.



4.1.2.4 REAL TIME CLOCK

Allows the setting of the Real Time Clock and Calendar.

Use the rotary encoder to select the digit. Press to accept the change and/or move to the next digit.



4.1.2.5 PASSWORD SETTINGS

NOTE: Ensure the Password (if enabled) is not lost or forgotten!

Allows the password to be enabled and changed.

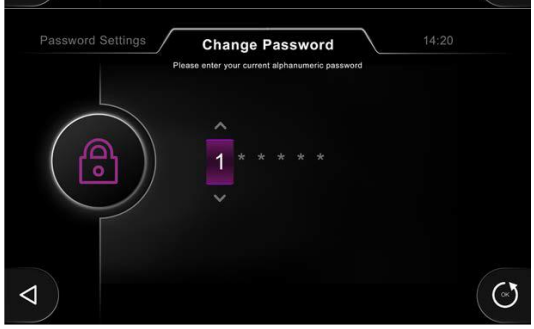
Turn the rotary encoder to select the item to change and press it to enter the editor.



Use the rotary encoder to select the digit. Press to accept the change and move to the next digit.

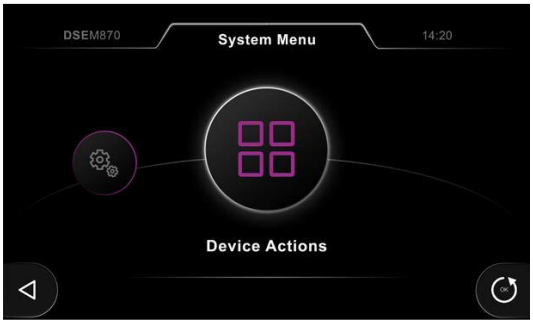


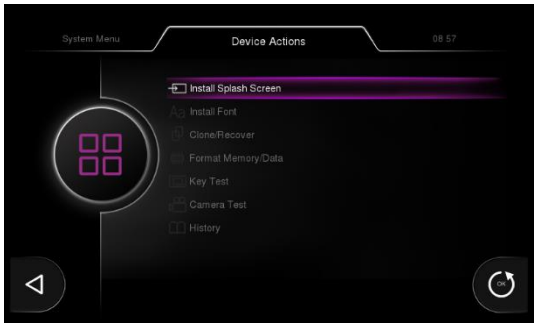
Use the rotary encoder to select the digit. Press to accept the change and move to the next digit.



4.1.3 DEVICE ACTIONS

Allows selection of device actions.

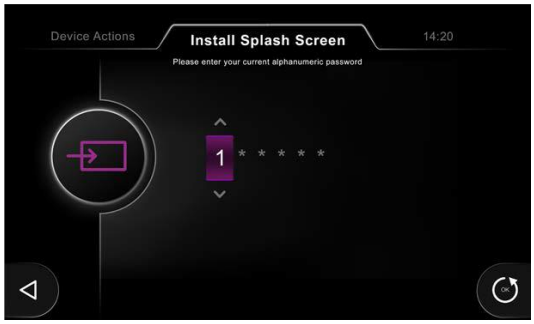




4.1.3.1 INSTALL SPLASH SCREEN

DSEM870 supports the display of a *Splash Screen* at power up and shutdown of the device. This is typically used to display the OEM logo image.

The device Password is required (when enabled) to allow Splash Screen installation.



Splash Screen Image Type:
Bitmap Image (BMP)
8 bit / 24 bit colour depth
800 x 480

Filenames must be alphanumeric only (A to Z, a to z, 0 to 9) and "." (used to seperate the file extension). Spaces are not permitted in the filename

Turn the rotary encoder to choose *Startup or* Shutdown image and then to select the required image file. Press the encoder to install the file..



4.1.3.2 INSTALL FONT

The device Password is required (when enabled) to allow font installation.

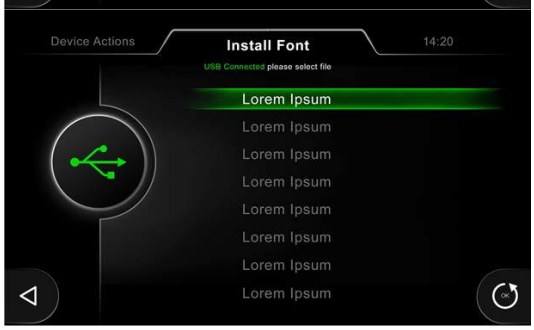


Ensure the USB device containing the font(s) is connected to the controller.

Filenames must be alphanumeric only (A to Z, a to z, 0 to 9) and "." (used to seperate the file extension).



Turn the rotary encoder to choose the required font and press it to select.



4.1.3.3 CLONE / RECOVER SELECTION

The device Password is required (when enabled) to allow Clone or Recover operations.



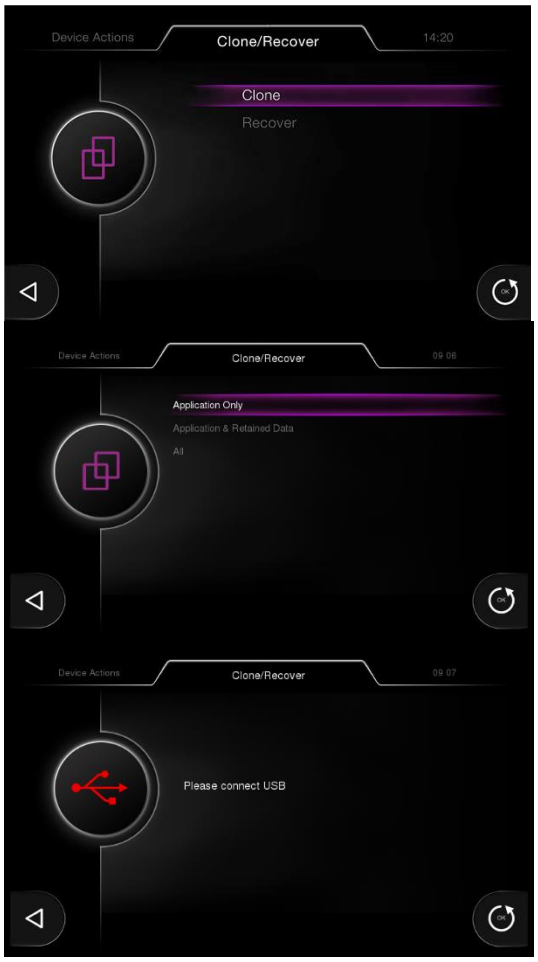
CLONE

This section is used to create a backup file of the device, selecting the elements to backup. This file may then be used to recover the device, or create *Clones*, sending the file to other devices.

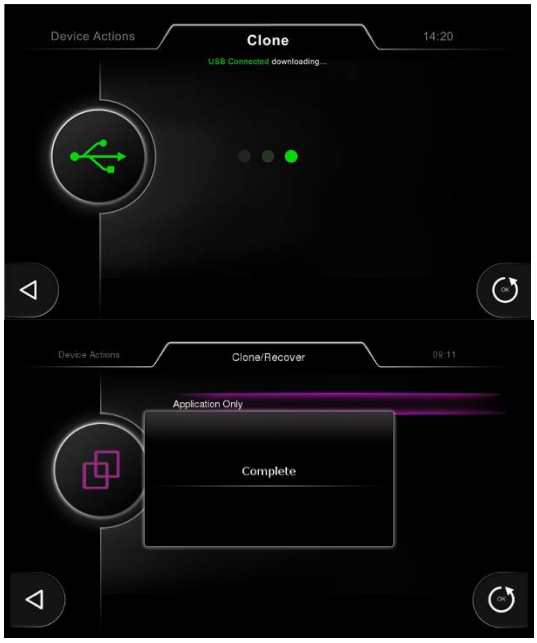
Turn the rotary encoder to choose the function and press it to access the *Clone* selector.

Turn the rotary encoder to choose the function and press it to select.

Ensure the USB device used to store the Clone file(s) is connected to the controller.



Wait while the process completes….



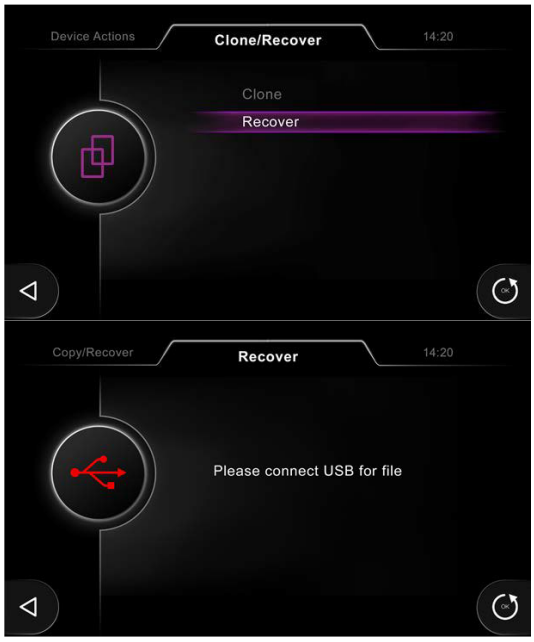
RECOVER

NOTE: The *Recover* process replaces files on the target device and may change the Application of the device.

This section is used to recover the device from a previously stored Clone (backup) file, or create copies of the device, sending the file to other devices.

Ensure the USB device containing the file(s) to Recover is connected to the controller.

Filenames must be alphanumeric only (A to Z, a to z, 0 to 9) and "." (used to seperate the file extension).

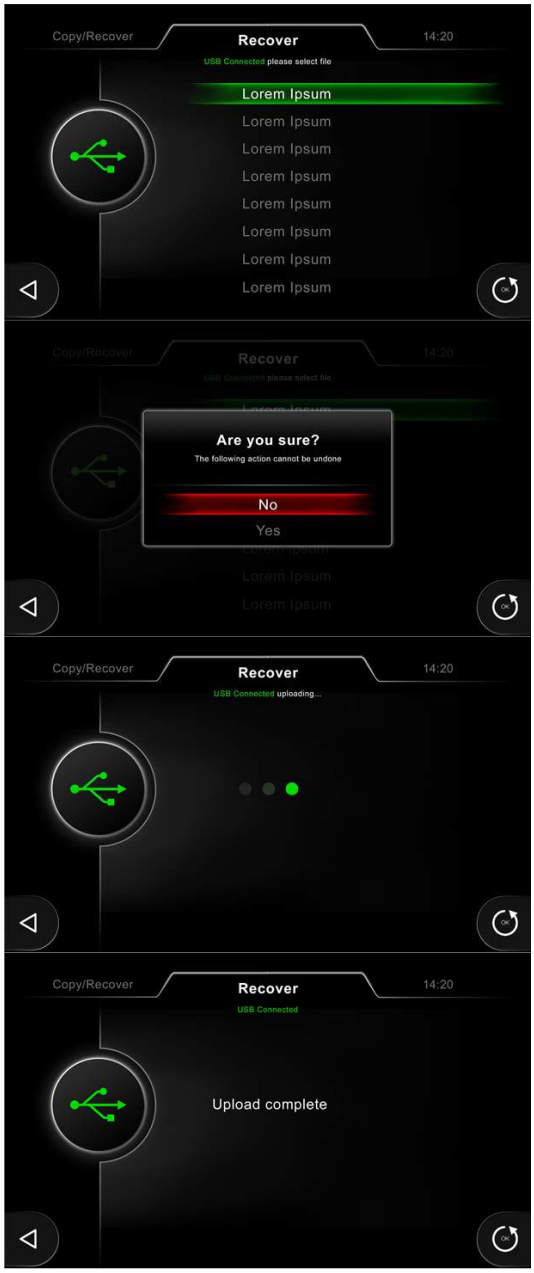


Turn the rotary encoder to choose the file to restore, and press it (*click*) to select.

Confirm that you wish to proceed with this process.

Turn the rotary encoder to choose the option, and press it to select.

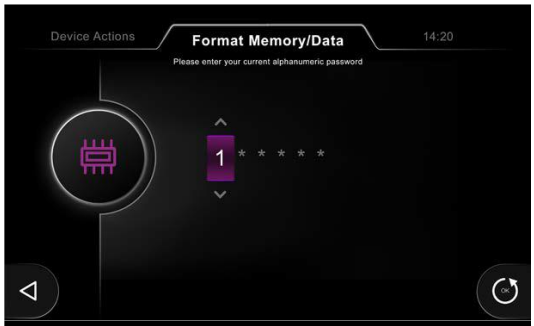
Wait while the process completes….



4.1.3.4 FORMAT MEMORY / DATA

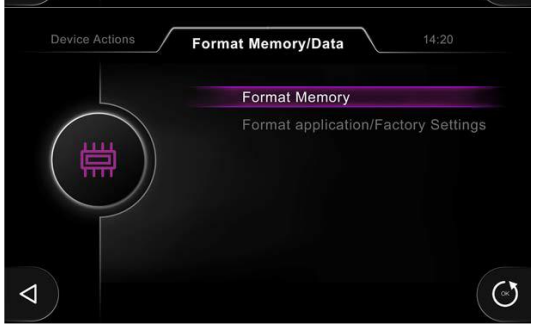
NOTE: The *Format* process deletes files on the target device and may change the operation of the device.

Enter the Password if one has been set.



Select which memory area to Format.
Turn the rotary encoder to choose the function, and press it to select.

Format Memory *:* Remove Application only.
Format Application/Factory Settings:
Removes Application and all other files including system settings. May be considered as a 'Factory Reset'.

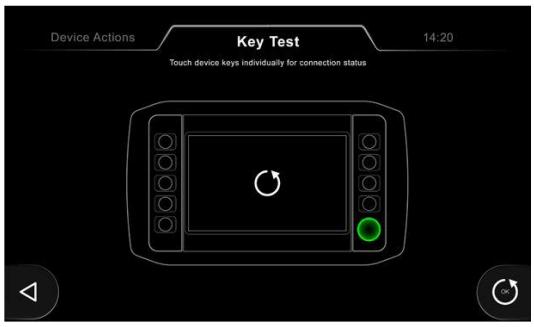


4.1.3.5 KEY TEST

This section allows the device fascia buttons and rotary encoder to be tested.

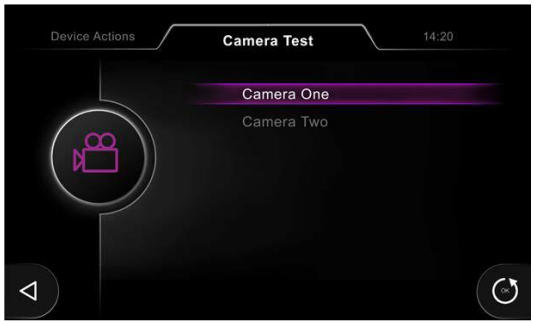
Press the keys and rotate the encoder to receive feedback of their operation.

To exit the Keytest, release all buttons for five seconds.



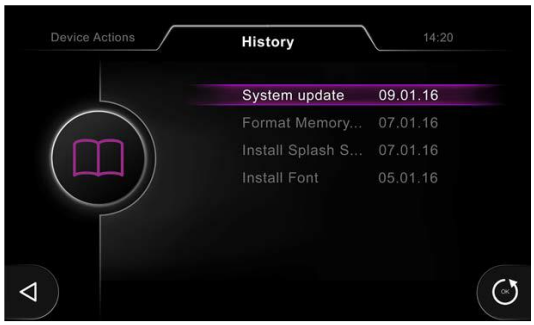
4.1.3.6 CAMERA TEST

Select the camera using the rotary encoder and press the encoder to view the selected camera.



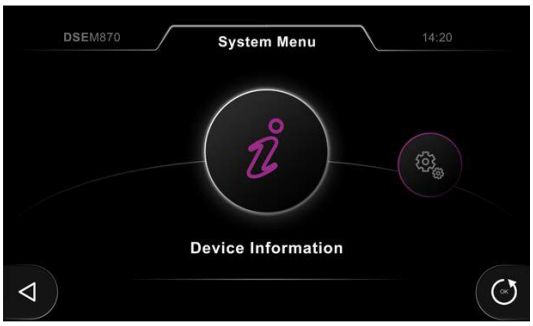
4.1.3.7 HISTORY

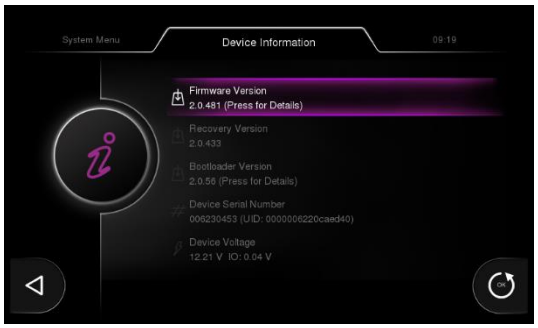
Used to display a log of the date of certain actions.



4.1.4 DEVICE INFORMATION

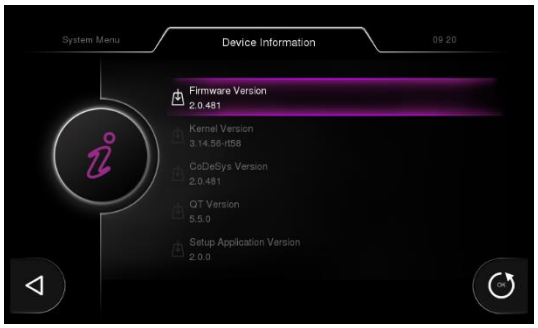
This section shows the *Device Information*.





4.1.4.1 FIRMWARE VERSION

Shows all details of the device versions.



4.2 FIRMWARE UPDATE

The Firmware Update is performed as follows:

- Remove DC Supply from the DSEM870.
- Press and hold any three buttons. Reapply DC power until the DSEM870 indicates that it is *Entering Flash / Recovery.* Now release the buttons.
- When prompted, connect the USB memory stick containing the firmware update file(s). You must do this within 60 seconds. Failure to do so results in the DSEM870 restarting into normal operation mode.
- Update occurs automatically when the memory stick is inserted.
- On completion, press any button when prompted to restart the device and apply the new firmware.

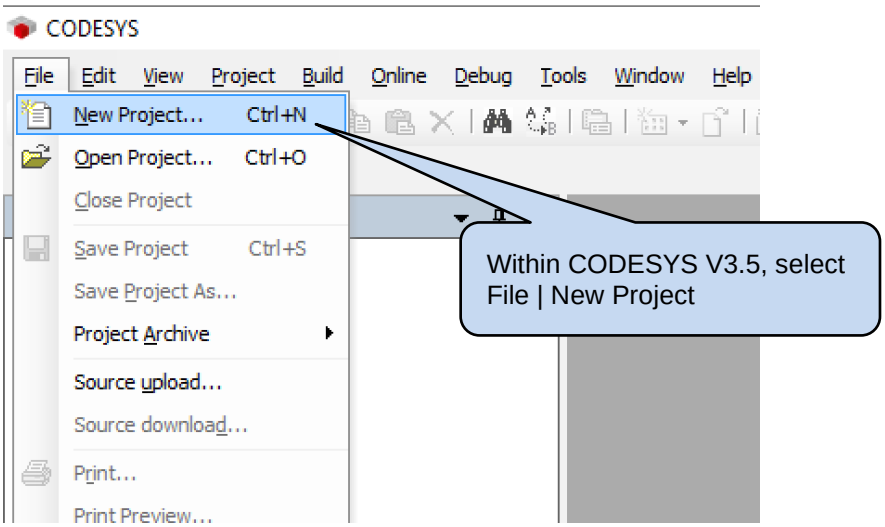
5 CONNECTING TO CODESYS

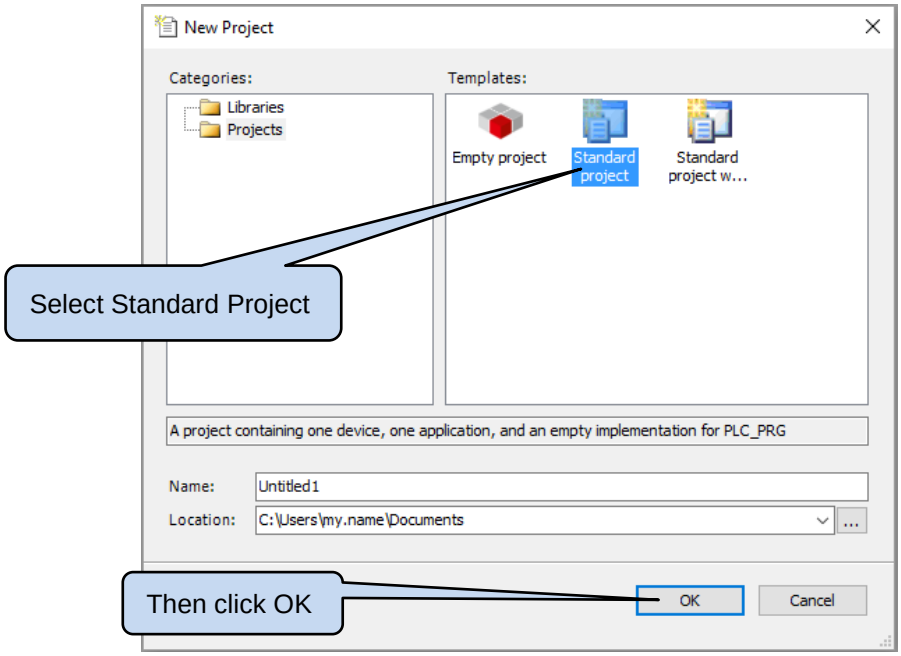
NOTE: DSEM835 supports CODESYS version 3.5.12.0. Ensure Compiler version, Visualisation version and the versions of any 3S libraries used in the project are no later than version 3.5.12.0. Contact support@deepsealectronics.com if assistance is required.

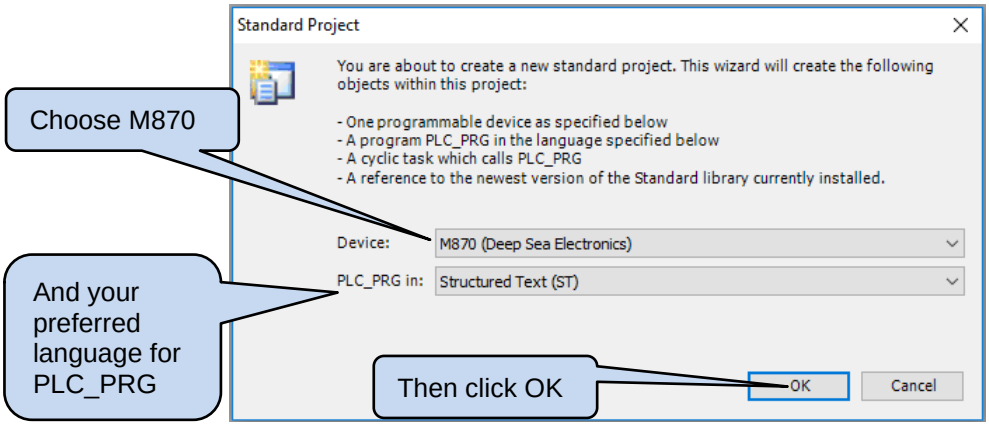
DSEM870 communicates with, and is programmed by, the CODESYS V3.5 Integrated Development Environment (IDE).

5.1 START NEW PROJECT

To begin, start a new project as shown.



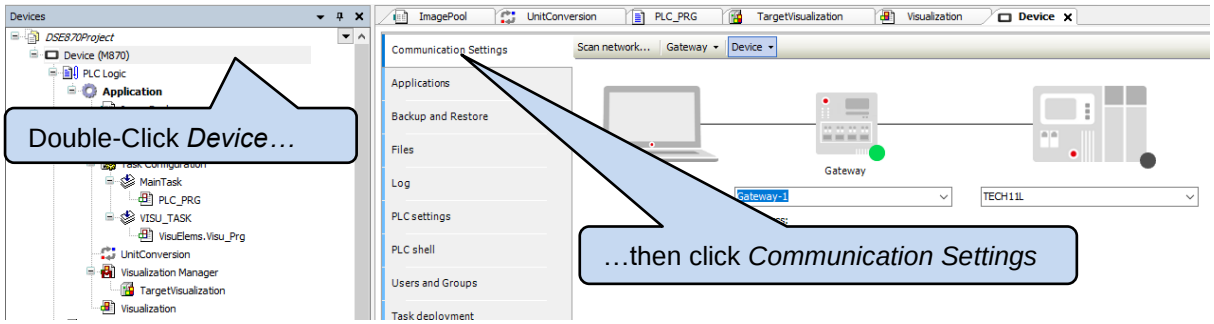


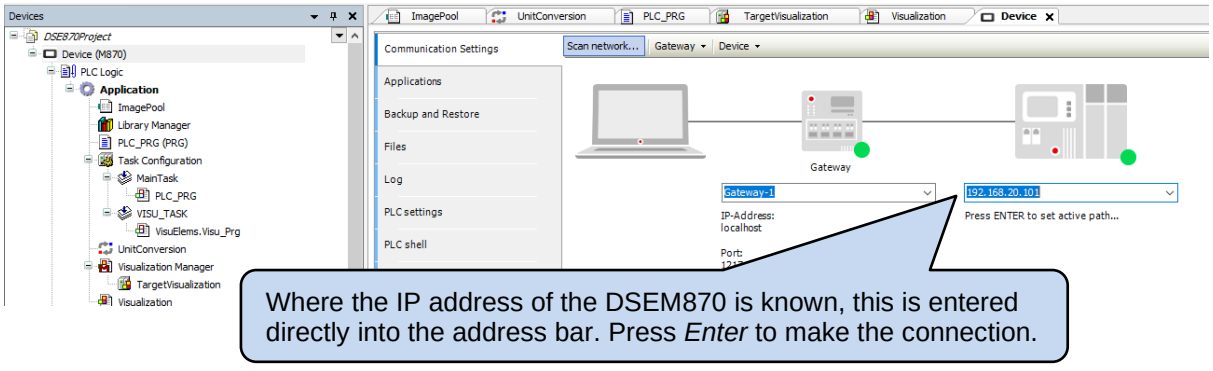


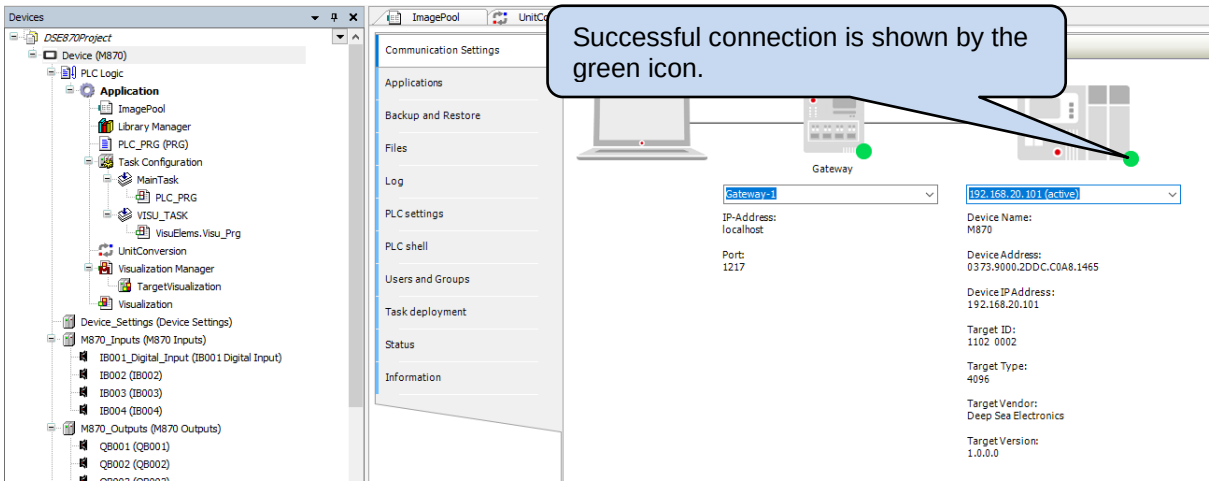
5.2 ETHERNET TCP

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

With the DSEM870 connected to the same Ethernet network as the PC, Select *Device* | *Communication Settings* in the CODESYS V3.5 IDE.



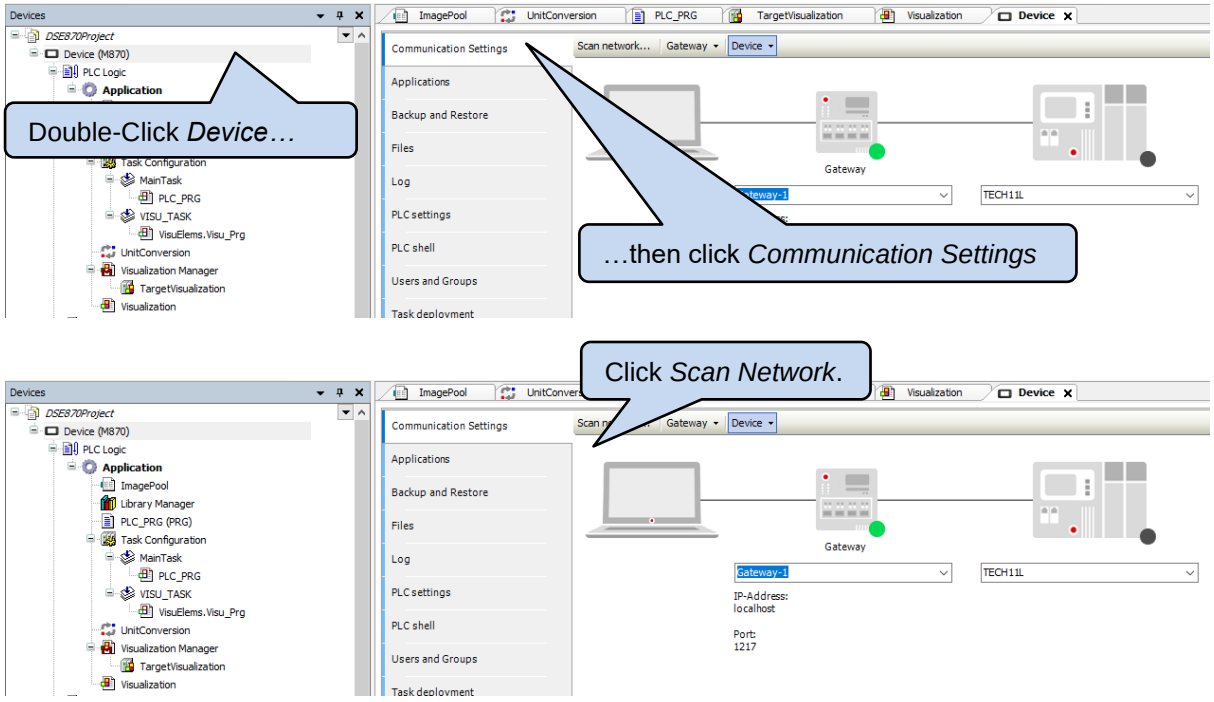




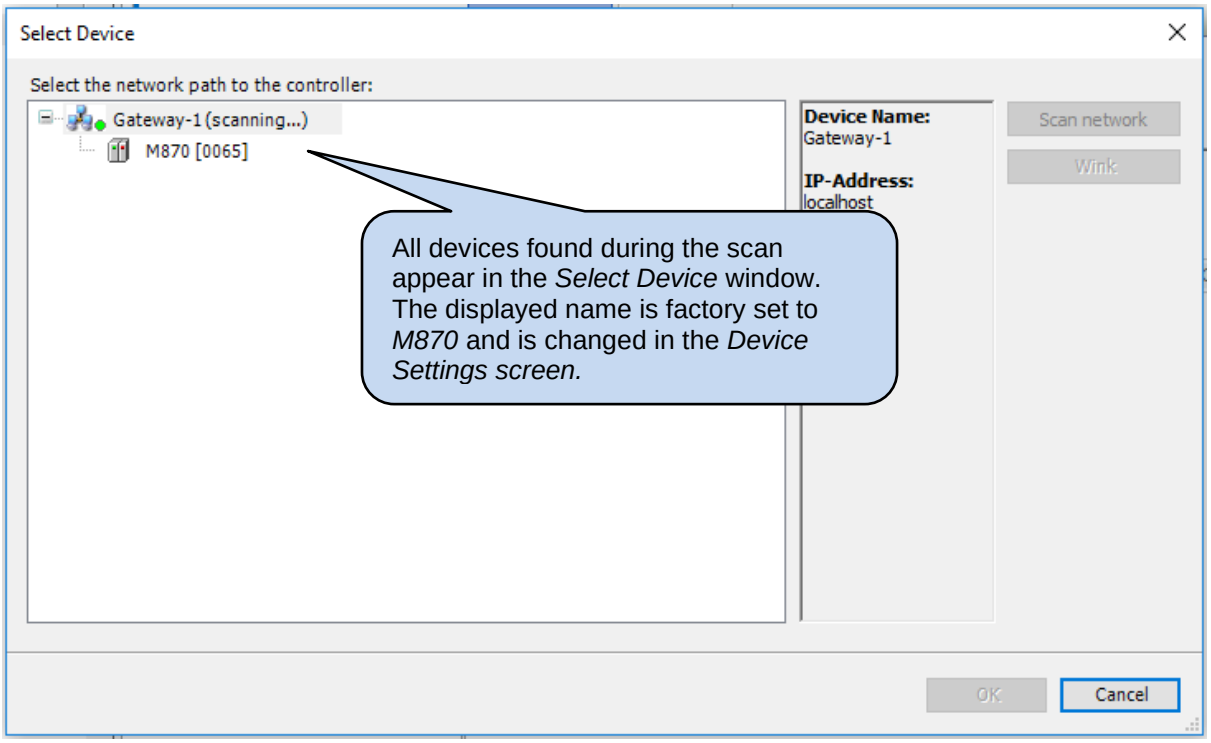
5.3 ETHERNET UDP

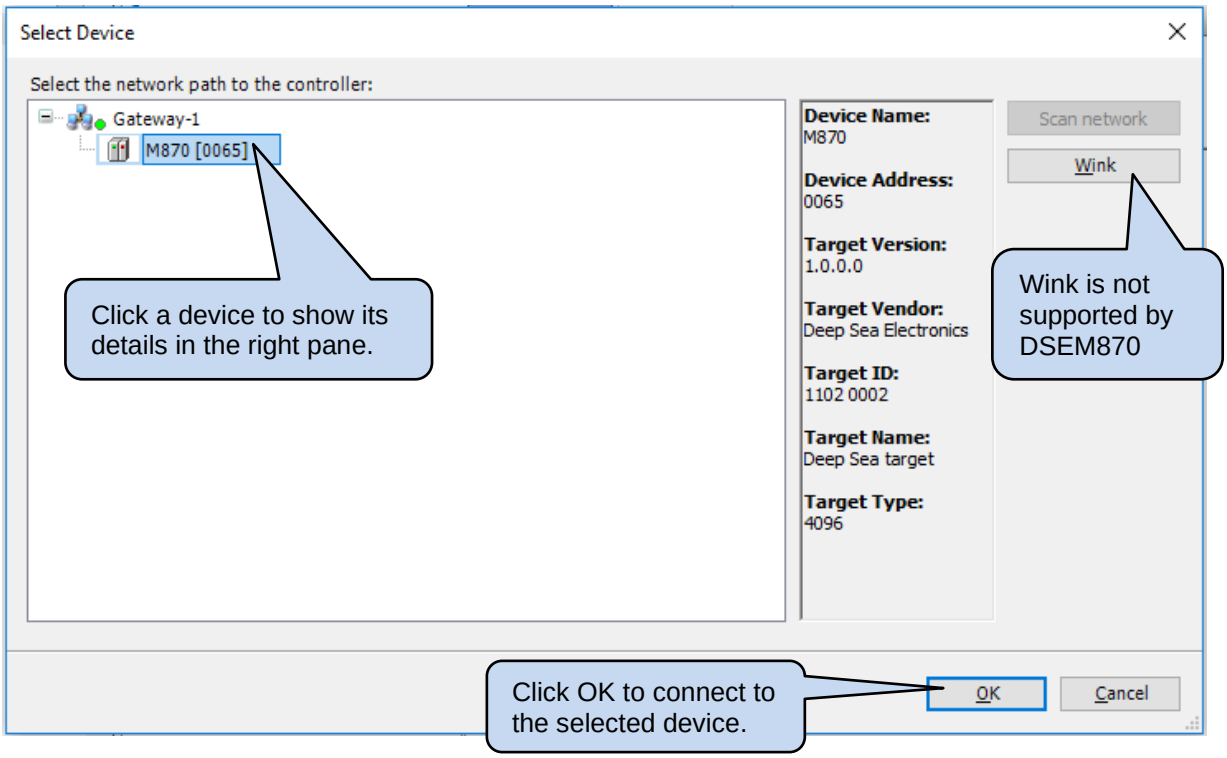
NOTE: If the IP address of the device is known, connection may also be achieved manually as detailed in the section entitled *Ethernet TCP* elsewhere in this document.

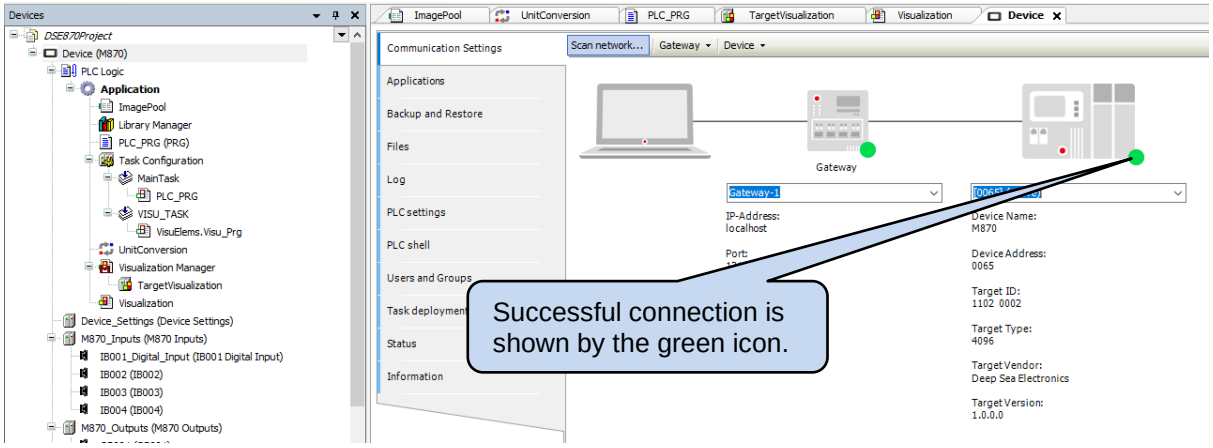
With the DSEM870 connected to the same Ethernet network as the PC, Select *Device* | *Communication Settings* in the CODESYS V3.5 IDE.



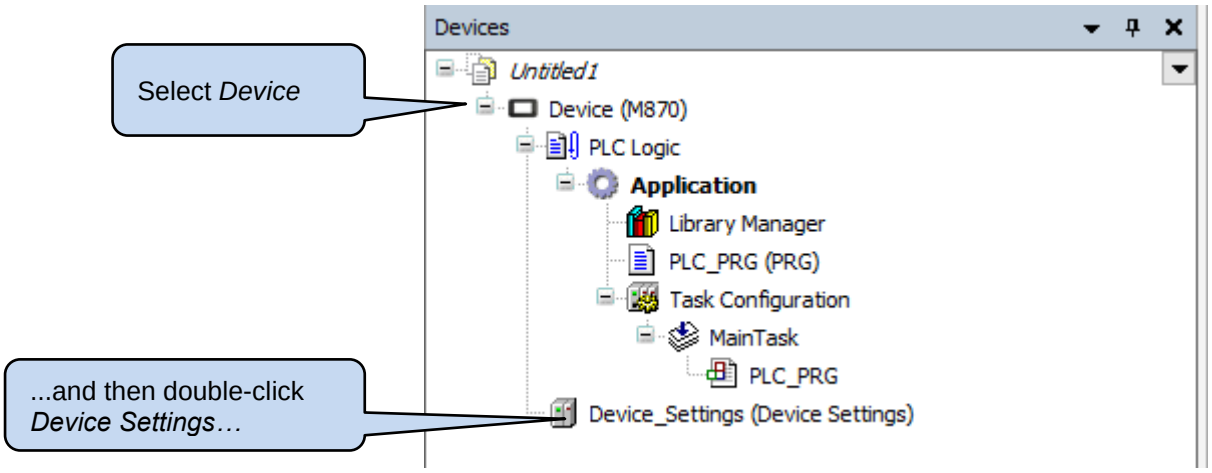
NOTE: A device in *Setup* mode is not discoverable by the Scan.







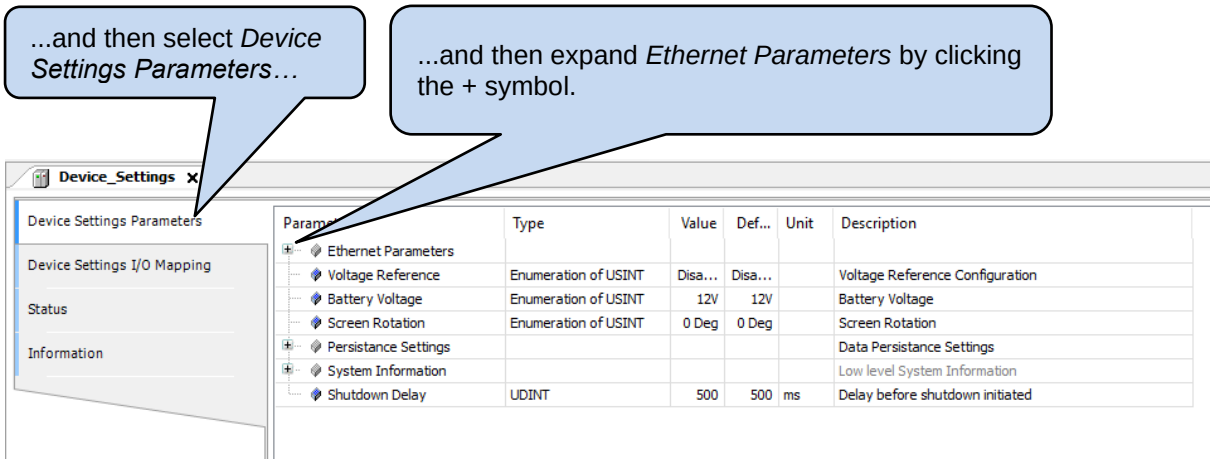
5.4 CONFIGURE SETTINGS AND MONITOR THE DEVICE

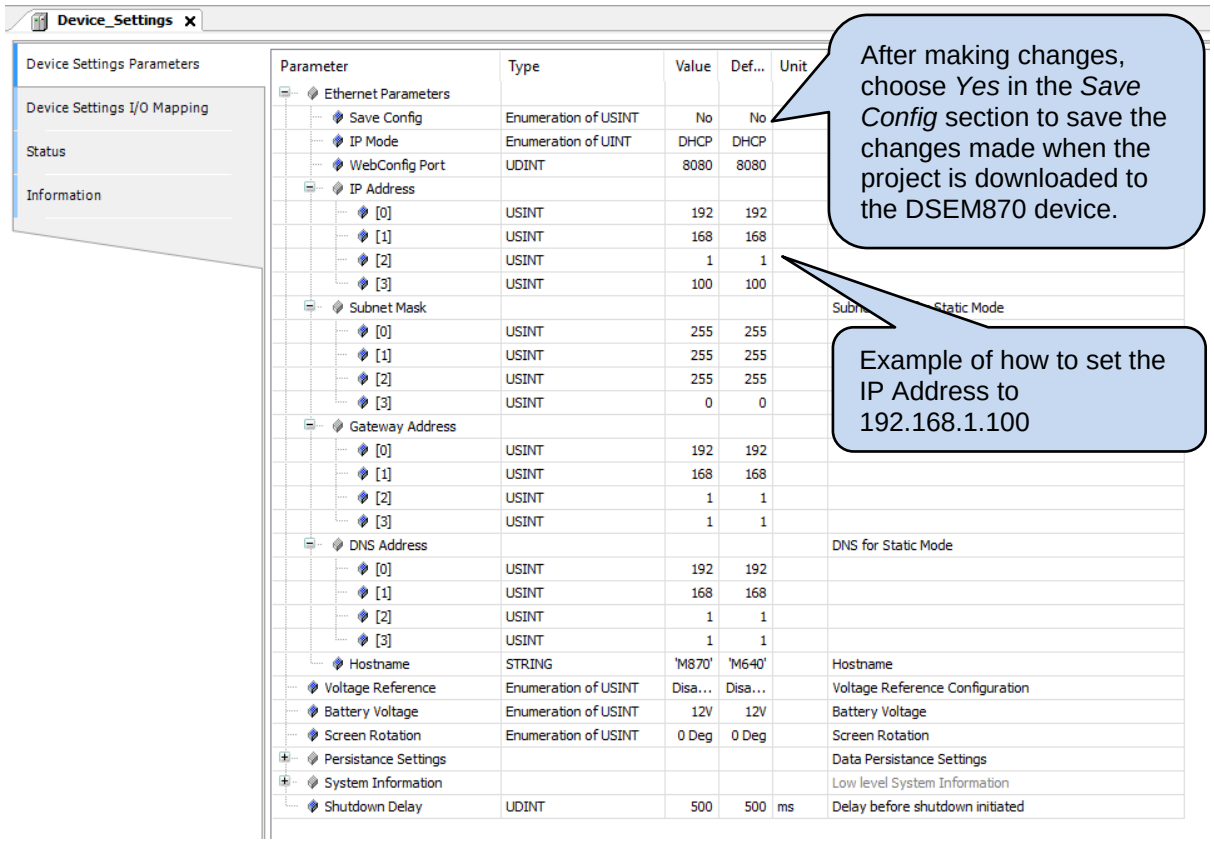


See the following subsections for details of the Device Settings pages.

5.4.1 DEVICE SETTINGS PARAMETERS

NOTE: After changing the setting of *Screen Rotation, DSEM870 must be power cycled for the change to take effect.*

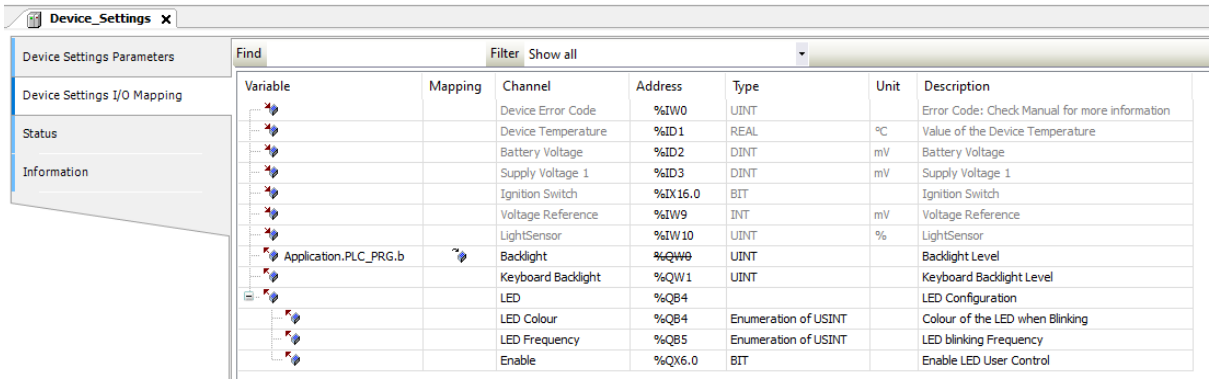




Parameter	Description
New Ethernet Configuration	**NOTE: After making changes, choose *Yes* in the *Save Config* section to save the changes made when the project is downloaded to the DSEM870 device.** Allows configuration of the device ethernet port.
Voltage Reference	Enables the *VREF* output. This is an auxiliary output supply used for example to supply external input sensors. ***Disabled:*** The outputs is OFF. ***5V:*** The output gives 5 V dc. ***10V:*** The output gives 10 V dc.
Screen Rotation	**NOTE: After changing the setting of *Screen Rotation, DSEM870 must be power cycled for the change to take effect.*** **NOTE: For Screen Rotation ROT_90 and ROT_270 (portrait mode) the Visualisation must be created accordingly to fit to the full screen size as detailed below. CODESYS does not automatically adjust the Visualisation Size upon changes to the Screen Rotation setting.** Sets the device screen rotation. ***ROT_0:*** Visualisation is not adjusted, to suit the 'normal' device orientation with the Encoder at the BOTTOM RIGHT of the display. (Landscape 800 px X 480 px)  ***ROT_90:*** Visualisation is rotated 90° clockwise to suit the device orientation with the Encoder at the TOP RIGHT of the display. (Portrait 480 px X 800 px).  ***ROT_180:*** Visualisation is rotated 180° suit the device orientation with the Encoder at the TOP LEFT of the display. (Landscape 800 px X 480 px).  ***ROT_270:*** Visualisation is rotated 270° clockwise to suit the device orientation with the Encoder at the BOTTOM LEFT of the display. (Portrait 480 px X 800 px). 

5.4.2 DEVICE SETTINGS I/O MAPPING

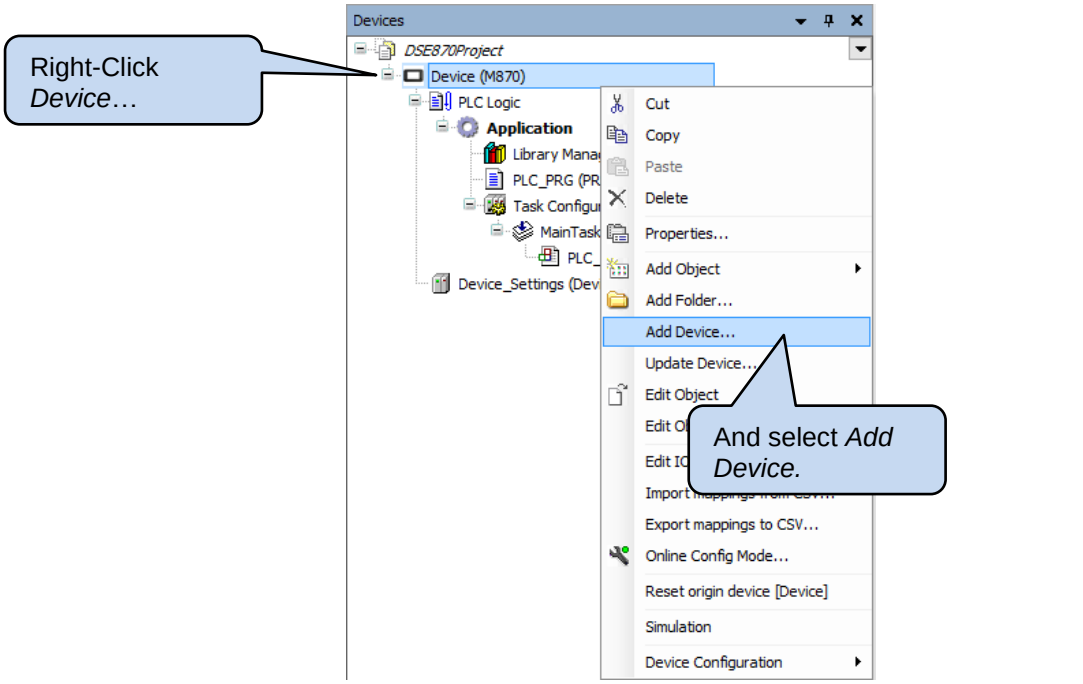
This page is used to monitor the device, and if required, to map the monitored values to program variables.

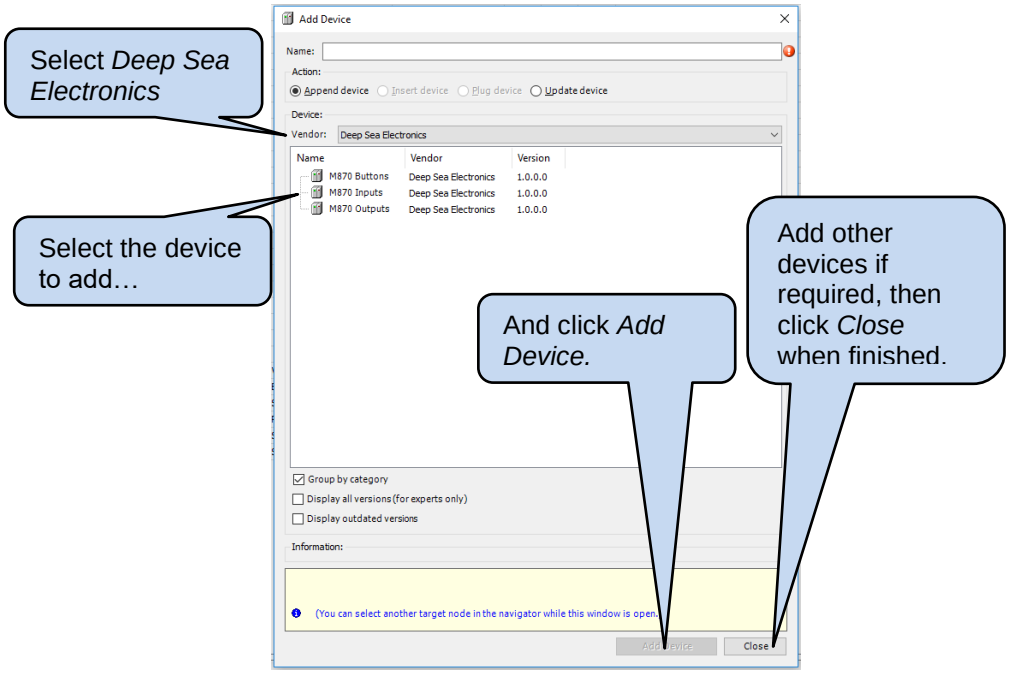


Parameter	Description
Device Error Code	A bitfield to allow the error code to be mapped to a variable. This enables the application to decode and display internal errors. See Section Entitled *M870 CODESYS ERROR CODES* elsewhere in this document for more details.
Device Temperature	The actual temperature (°C) as measured within the device. Typical temperatures are more than 25°C above ambient temperature and vary depending upon device usage.
Battery Voltage	The voltage measured at the *ECU Power* terminals, PINs A1 (-ve) and A7 (+ve).
Supply Voltage 1	The voltage measured at the *Supply Voltage 1* terminals, PINs C1 (-ve) and C7 (+ve). This voltage is used to supply the device outputs on PINS C2, C3, C4 and C5 when configured as *Active High*.
Ignition Switch	Contains the state of the *Ignition Switch* on PIN A13. Upon ignition removal the variable changes from TRUE to FALSE. A short time later the device completes the shutdown process and the application is shutdown.
Voltage Reference	Provides the voltage of the *VREF* output on PINS C6 (-ve) and C18 (+ve). This output is used as an auxiliary DC supply for example to power input sensor devices.
Light Sensor	Gives indication of the amount of ambient light detected by the devices light sensor. This may be used for example to vary *Backlight* according to local conditions. (0 = Dark, 100 = Maximum Brightness)
Backlight	Sets the percentage of the display LCD Backlight. (0 = minimum, 100 = maximum). Setting *Backlight* to the value 255 enables *Automatic Backlight Control* whereby brightness automatically increases as ambient light levels increase.
Keyboard Backlight	Sets the percentage of the Keyboard surround Backlight.

LED	Allows configuration of the System LED. Internal system errors take over control of the LED and indicate the fault in *Device Error Code*. ***LED Colour:*** Use enum DSE.LEDColour_t to select one of RED, AMBER, GREEN, BLUE, MAGENTA, CYAN, WHITE ***LED Frequency:*** Use enum DSE.LEDFrequency to select one of Off, ONE_HZ, TWO_HZ, THREE_HZ, FOUR_HZ, FIVE_HZ, SIX_HZ, SEVEN_HZ, EIGHT_HZ, NINE_HZ, TEN_HZ, ON

5.5 ADD INPUTS, OUTPUTS AND BUTTONS TO THE PROJECT





5.5.1 BUTTONS AND ROTARY ENCODER

NOTE: F10 is not fitted to DSEM870. In its place is fitted the Encoder Button (F11) and Rotary Encoder (F12).

5.5.1.1 BUTTON LOCATION



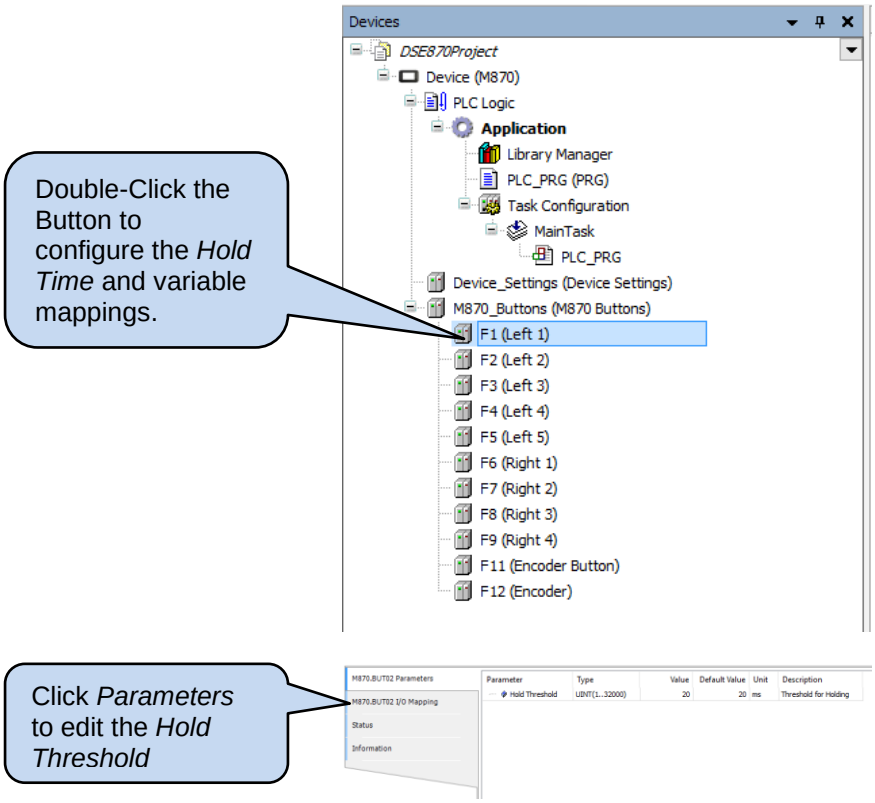
5.5.1.2 BUTTON POSITION ON THE VISUALISATION

To aid positioning of icons on the visualisation, the vertical position of the centre of each button is as follows.

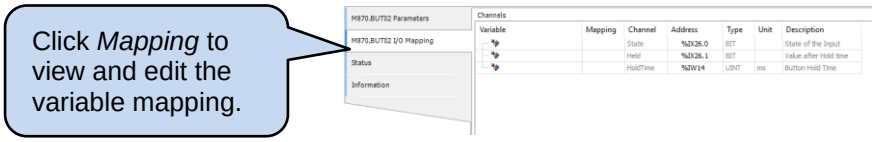
Button	Pixel Position From Top of Display
F1 & F6 (centre)	30
F2 & F7 (centre)	130
F3 & F8 (centre)	230
F4 & F9 (centre)	330
F5 (centre)	430
F11 & F12 (top)	430

5.5.1.3 BUTTON SETTINGS (F1 TO F11)

NOTE: F10 is not fitted to DSEM870. In its place is fitted the Encoder Button (F11) and Rotary Encoder (F12).



Parameter	Description
Hold Threshold	Amount of time (in milliseconds) that the button must be pressed before it is considered 'held down'.

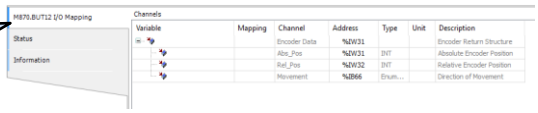


Parameter	Description
State	Indicates if the button is pressed (1) or not pressed (0).
Held	Indicates if the button has been held for longer than the duration of the *Hold Threshold* (1) or not (0).
Hold Time	The amount of time (in milliseconds) that the button has been pressed for (zero if not currently pressed).

5.5.1.4 ROTARY ENCODER (F12)

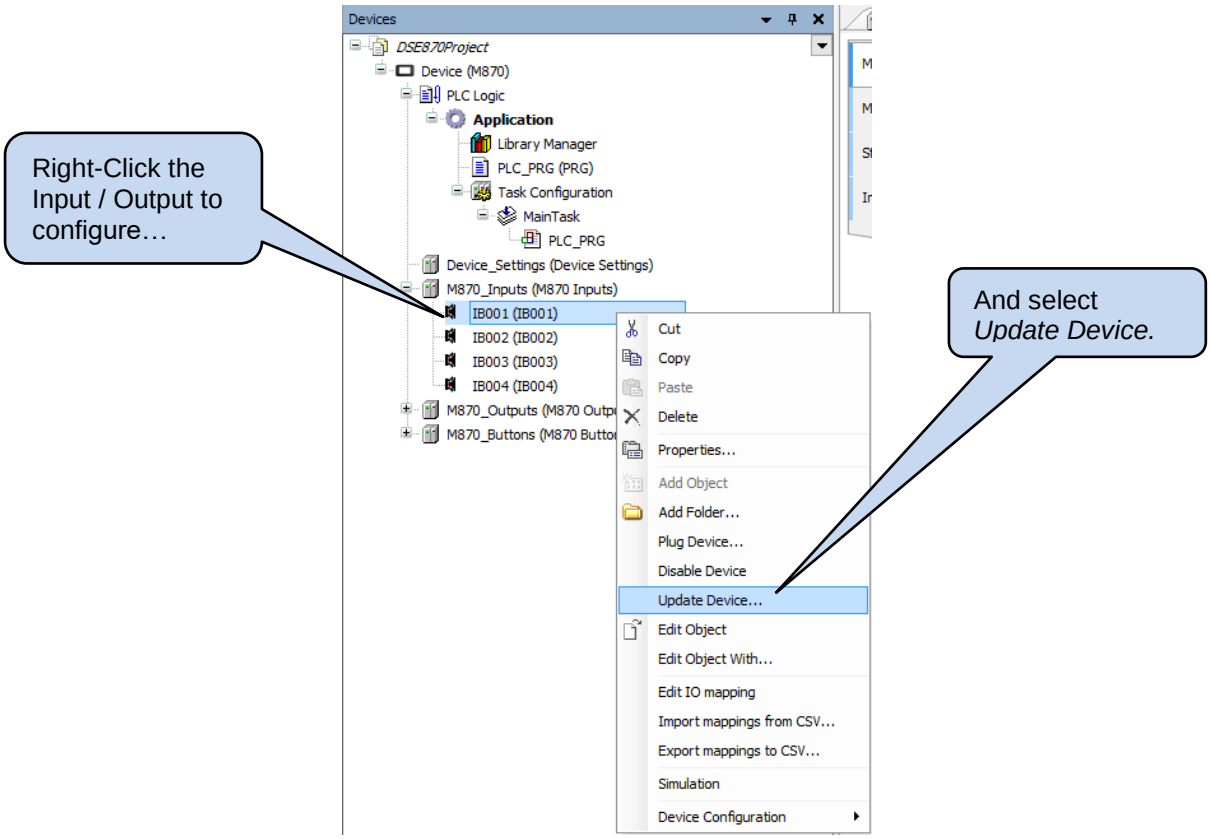
The rotary encoder may be turned to make selections and adjust values.

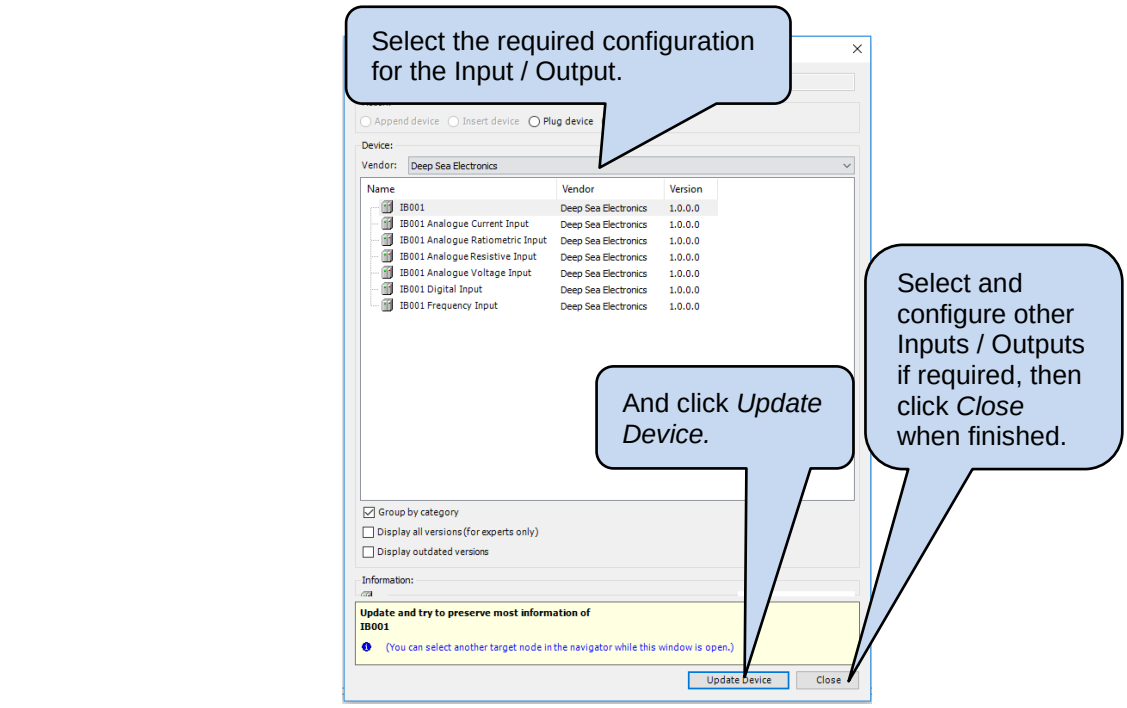
Click *Mapping* to view and edit the variable mapping.



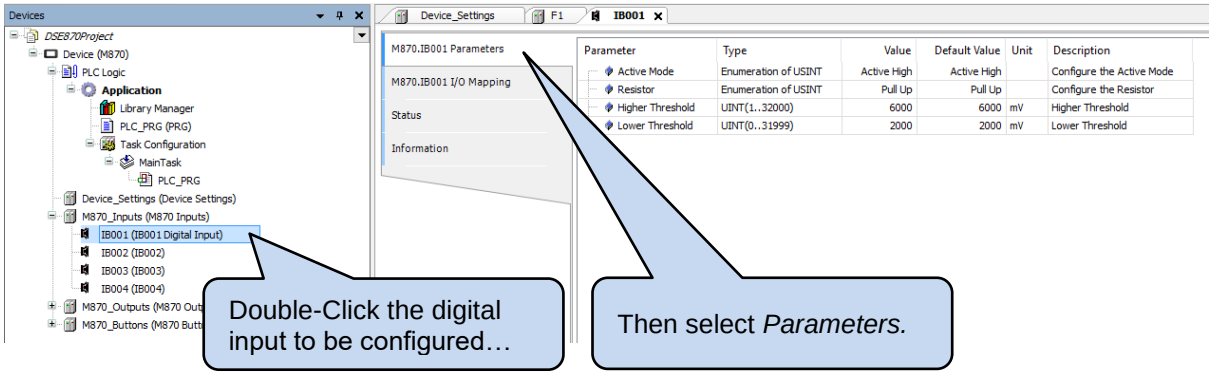
Parameter	Description
Abs_Pos	The absolute position of the encoder. Increases with Clockwise rotation, Decreases with Anti-Clockwise rotation.
Rel_Pos	The relative position of the encoder. Increases with Clockwise rotation, Decreases with Anti-Clockwise rotation.
Movement (M870 V3)	***0:*** Indicates that the rotary encoder is not being rotated. ***1:*** Indicates that the rotary encoder is being rotated Anti-Clockwise. ***2:*** Indicates that the rotary encoder is being rotated Clockwise.
Movement (M870 V1, V2)	***0:*** Indicates that the rotary encoder is not being rotated. ***1:*** Indicates that the rotary encoder is being rotated Clockwise. ***2:*** Indicates that the rotary encoder is being rotated Anti-Clockwise.

5.5.2 INPUTS AND OUTPUTS





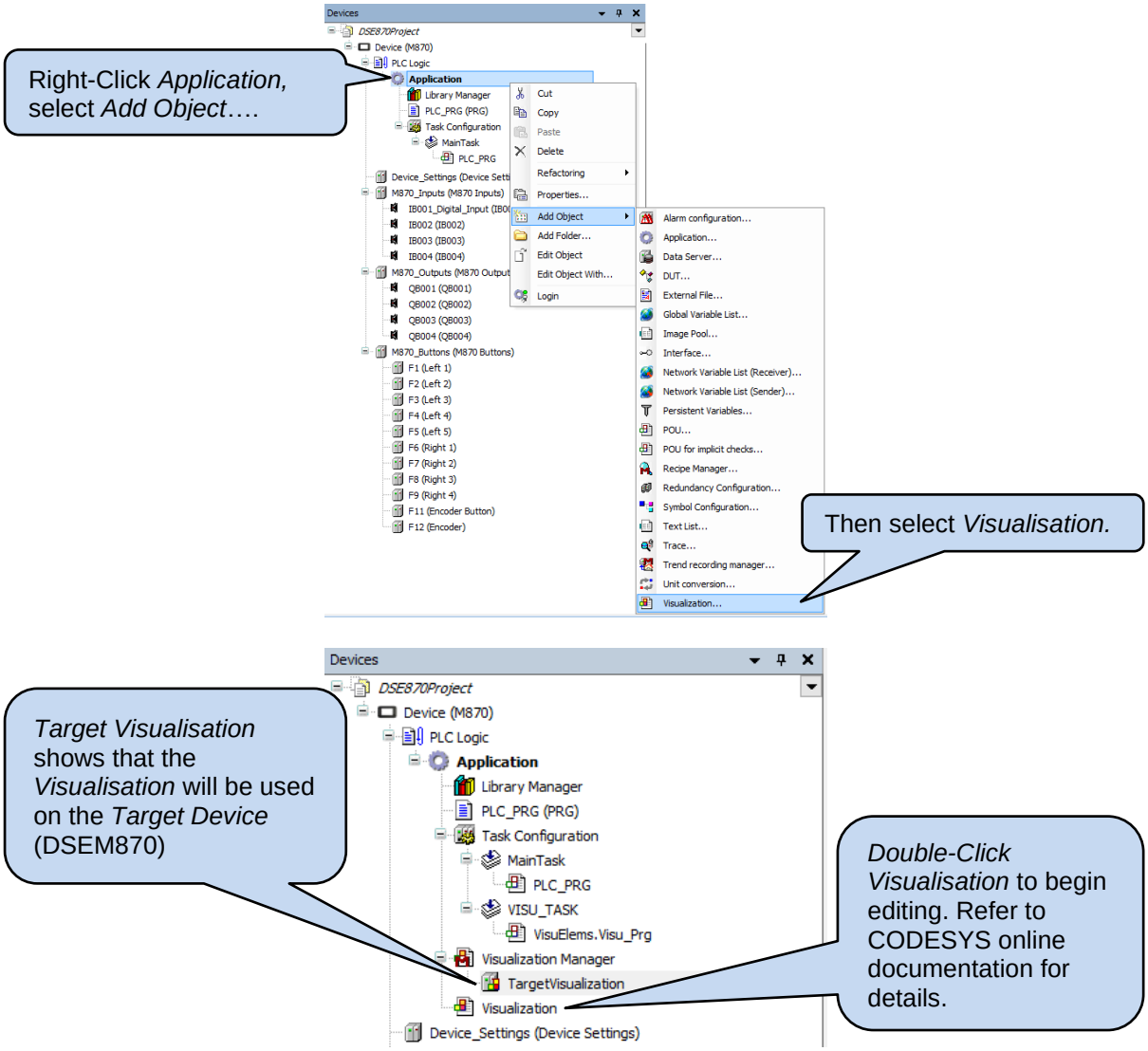
5.5.3 DIGITAL INPUT PARAMETER CONFIGURATION



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 input is detected as being active when above this threshold with respect to the negative supply rail.
Lower Threshold	For *Active Low* inputs, the input is detected as being active when below this threshold with respect to the negative supply rail.

5.6 USING THE DISPLAY VISUALISATION IN THE PROJECT

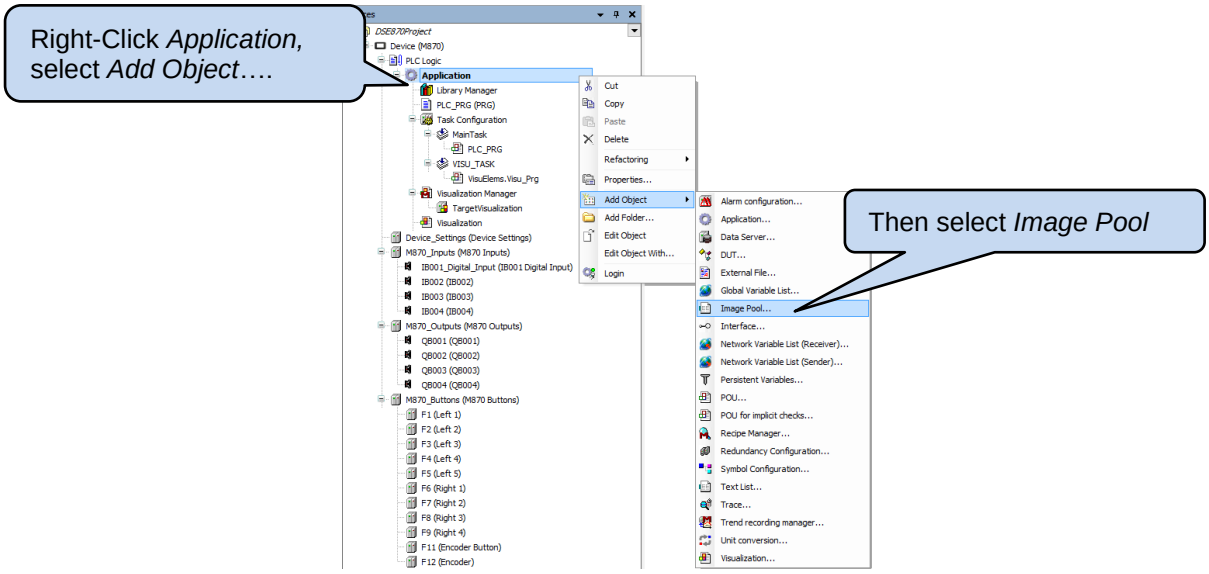
CODESYS 3.5 includes the facility to design and manipulate the LCD of the device. While the operation of the CODESYS environment is detailed within the CODESYS online document, this section provides a quick-start guide to using the *Visualisation* component of CODESYS 3.5.



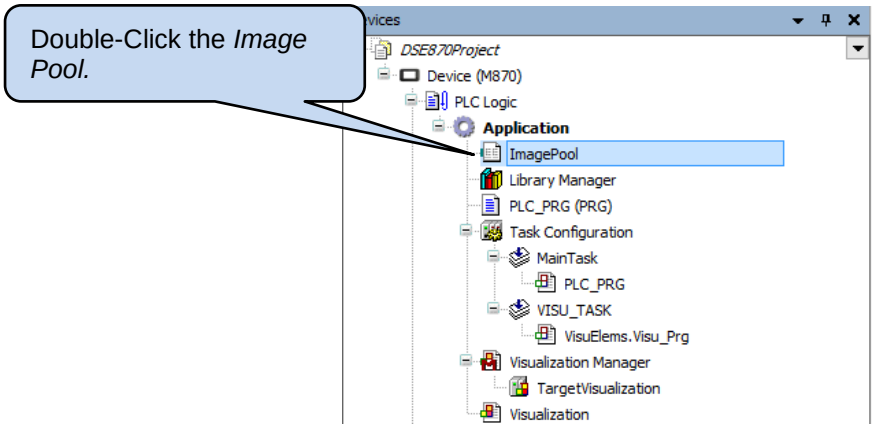
5.6.1 USING CUSTOM IMAGES ON THE DISPLAY

Many applications require custom images to be placed on the M870 display. This is controlled using an *Image Pool* within CODESYS. The Image Pool acts as a container for the images, which are then selected for display.

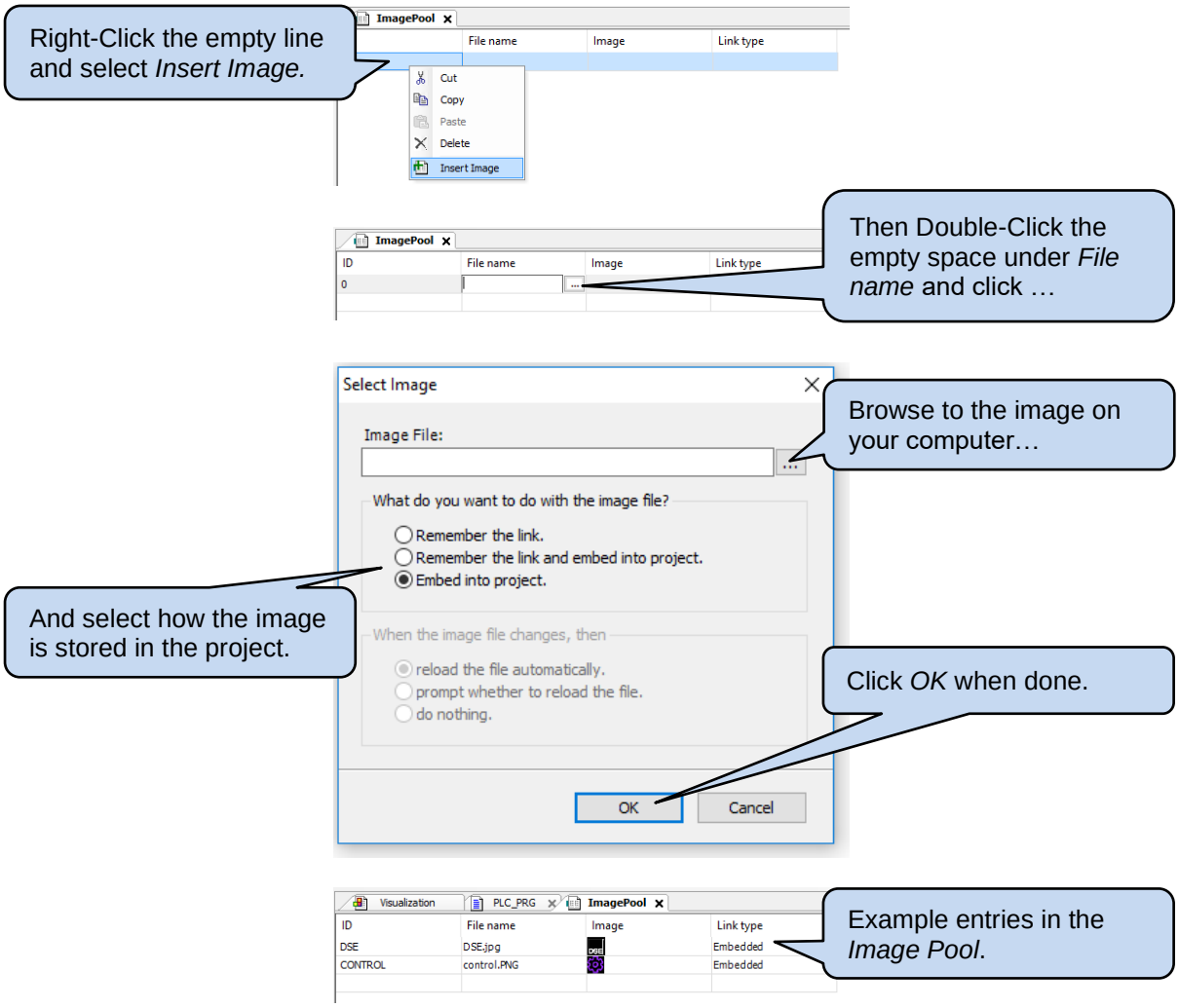
5.6.1.1 ADDING AN IMAGE POOL



5.6.1.2 ADDING IMAGES TO THE IMAGE POOL

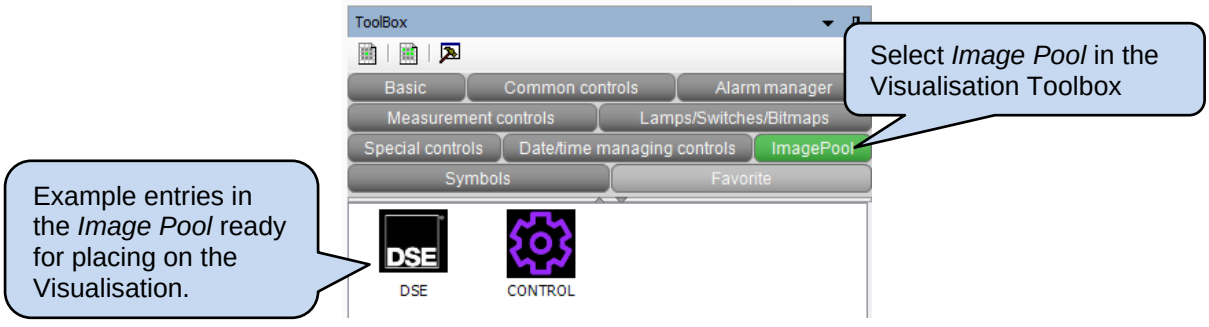


Continued overleaf…



5.6.1.3 USING THE IMAGE POOL ON THE DISPLAY

Entries within the Image Pool are automatically detected by the CODESYS Visualisation Toolbox and are available for placing on the Visualisation.



5.6.2 UTILISING THE TOUCHSCREEN AND WEBVISU

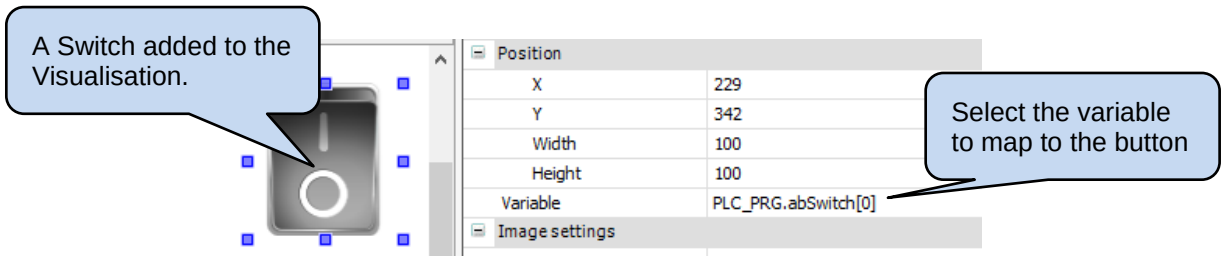
NOTE: Touchscreen functionality is available only on DSEM870-02 and DSEM870-03. WebVisu functionality is available only on DSEM870-03.

The capacitive touchscreen of DSEM870-02 mimics the operation of a mouse within the CODESYS environment. The following examples show how to utilise this functionality within the Visualisation.

5.6.2.1 SWITCHES, SLIDERS, COMBO BOXES, RADIO BUTTONS

Many CODESYS visualisation elements require no additional coding or settings to enable them for use with the Touchscreen. These include Switches, Sliders, Comboboxes and Radio Buttons. Simply add them to the Visualisation and map a variable to them. Touch them on the screen or click on the Webvisu to operate them.

Example:
Add a switch to the Visualisation. Usually these are found in the *Toolbox* under *Lamps/Switches/Bitmaps*.



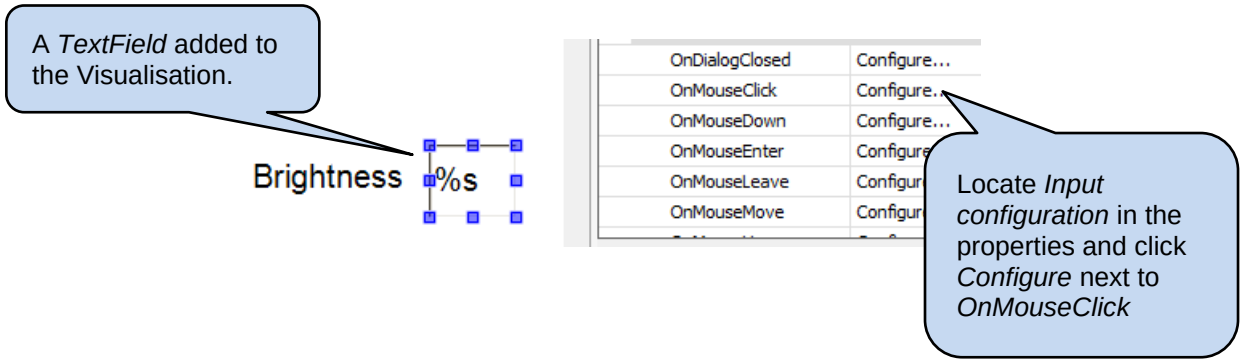
During the execution of the application, simply touch the switch on the screen or click on the WebVisu to operate it.

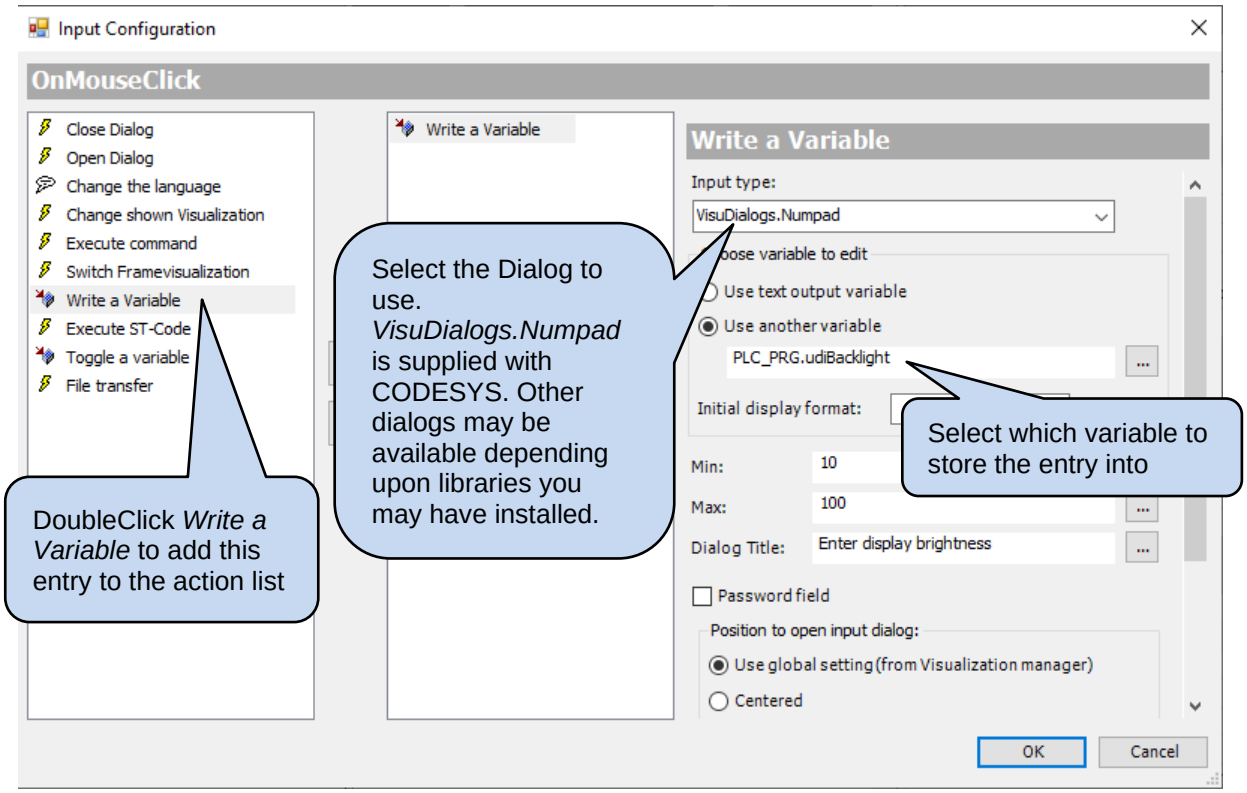
5.6.2.2 NUMBER AND TEXT ENTRY

NOTE: DSE_VISU library includes additional Dialogs for number and text entry, including UK keyboard layout.

Number entry via the M870 Touchscreen requires the use of a *Virtual Numpad.*
Text entry via the M870 Touchscreen requires the used of a Virtual Keypad.

CODESYS include a simple number pad and a German layout keypad as a *Dialog* and are utilised as follows.



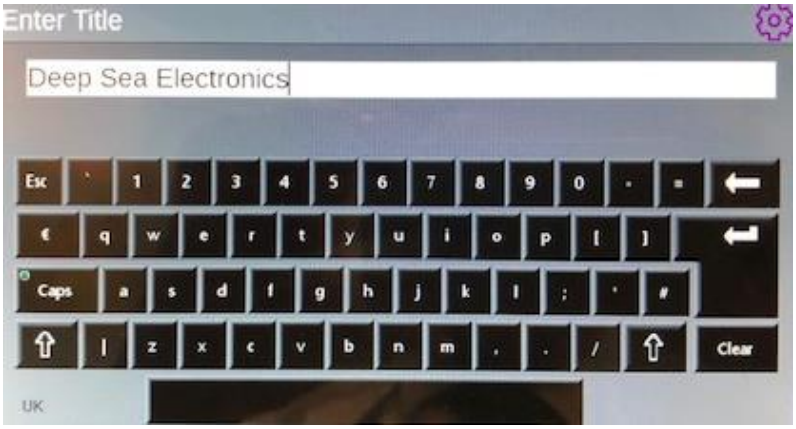


Example:

Upon touching the screen on the Visualisation element, CODESYS displays the selected Dialog.
Enter the value required.
ESC: Exit without saving the value.

OK or : Exit and update the variable with the text or value entered.

Should the value be outside the configured range, this is indicated, and the dialog remains on screen to allow the correction to be made.



Virtual Keypad



Virtual Numpad

5.6.3 WEBVISU

NOTE: WebVisu functionality is available only on DSEM870-03.

DSEM870-03 includes CODESYS WebVisu functionality. DSEM870 includes an integral webpage server, whereby a full copy of the project visualisation is available for viewing and control by an external device supported by a web browser.

Example:
Connect a PC to ethernet. Ensure the PC can “route” through to the DSEM870. You may need to consult your IT department to set up the network to allow this.
On the web browser, point it to port 8080 of the DSEM870. For example, if the DSEM870 IP address is 192.168.1.100 then point the web browser to `http://192.168.1.100:8080`.

5.7 USING THE CAMERA OVERLAY

NOTE: M870 V3.0 and above blends the camera overlay with CODESYS visualisation and the camera display allowing all to be visible at the same time.

Type *M870CameraOverlaySettings*, contains options to Enable/Disable the overlay and control the transparency.

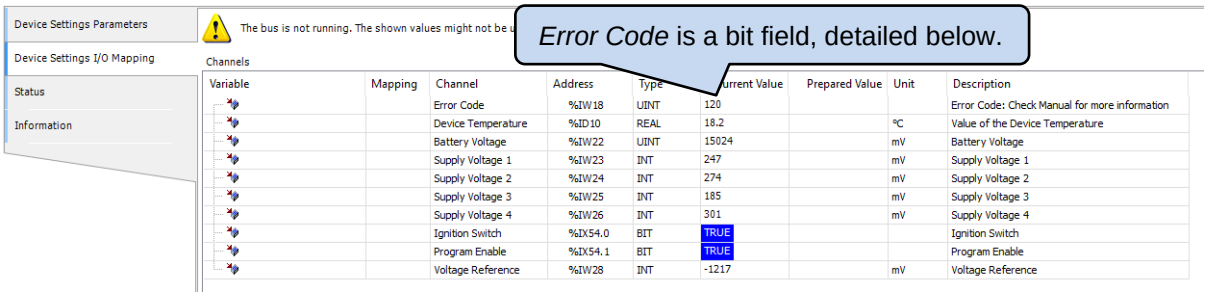
5.8 M870CAMERAOVERLAYSETTINGS

Structure used for M870 camera overlay display.

Variable	Type	Description
Enable	BOOL	Turns overlay ON / OFF ☐: Camera is not displayed. ☑: Camera is displayed according to the settings of *Transparency* and *FileName* below.
Transparency	UDINT	**NOTE: This parameter is NOT applicable if *FileName* is specified.** Specifies the transparency of the overlay over the camera display. ***0:*** Overlay is not visible, Camera Only. ***1 to 254:*** Overlay is 'more visible' the higher the value. ***128:*** Overlay and Camera are equally visible. ***255:*** Camera is not visible.
FileName	STRING	**NOTE: Leave this parameter empty if an overlay image is not required. In this case, use *Transparency* to control the blending of Camera and Visualisation.** **NOTE: Ensure FileName is correct when used. If FileName does not exist, no *Alpha Channel* data is available and the camera appears at 0 % visibility (behind the CODESYS visualisation) and hence not visible.** Overlay Image Filename (png, jpg, bmp). The image should be sized to match the size of the camera display within the application. *Transparency* setting is not used, and the overlay image transparency is taken from the *Alpha Channel* value contained within the image. Some PC 'Paint' applications may call this *Transparency* or use similar wording.

6 M870 CODESYS ERROR CODES

DSEM870 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	Bit 4	3	2	LSB 1
Digital	Invalid Parameter	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Error
Frequency	Invalid Parameter	Reserved	Reserved	Reserved	Reserved	Freq Over Range	Reserved	Error

6.4 DIGITAL OUTPUTS

Output Configuration	MSB 8	7	6	5	Bit 4	3	2	LSB 1
Digital	Invalid Parameter	Reserved	Reserved	Reserved	Reserved	Over Current	Wire Break (Config)	Error

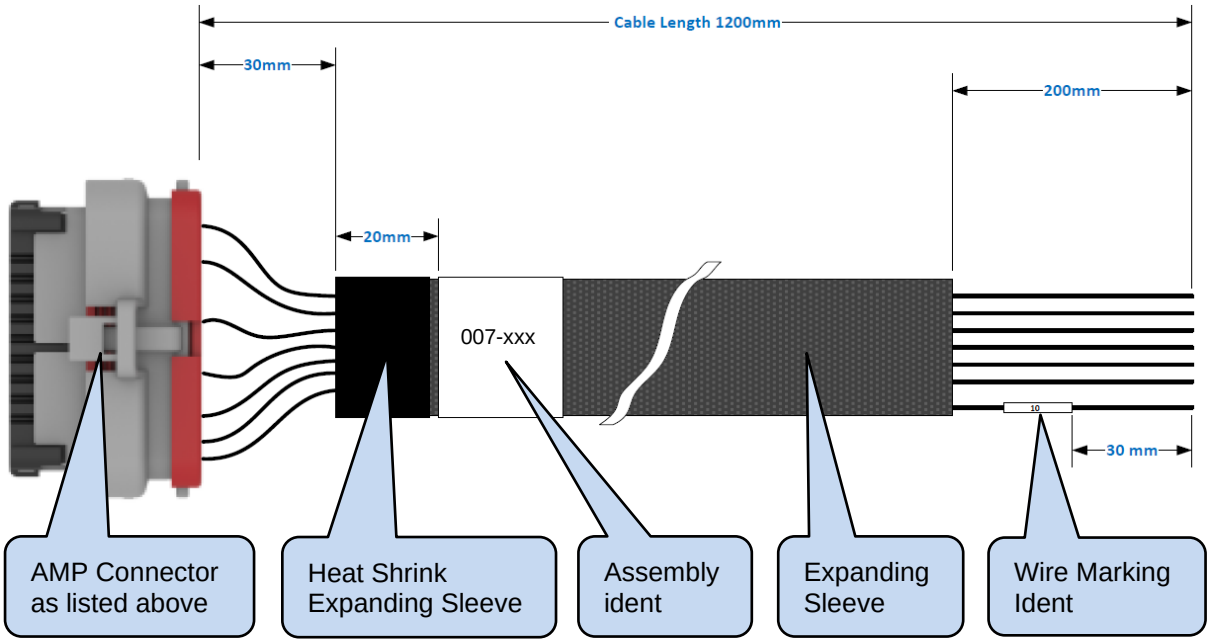
7 CABLES, CONNECTORS, HARNESSES AND SPARE PARTS

Description	DSE Part	Manufacturer Part	Manufacturer
M870 Connector Kit (Set of 2)	007-850	DT16-18SA-K004 DT16-18SC-K004	TE / Deutsch
Connector Pin Crimp (0.5 mm² to 1.0 mm²)	N/A	0462-201-16	TE
Connector Pin Crimp (2 mm²)		0462-209-16	TE
M870 Connector Harness Kit (Set of 2)	016-167	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
Belden 9841 (CAN Cable)	016-030	9841	Belden
Panel Mounting Sealing Gasket	020-579	N/A	DSE
Pin Blank Inserts (Seals unused connector pins)	N/A	114017	TE

7.1 M870 CONNECTOR HARNESS KIT (016-167)

DSE Part 016-167 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 B
Assembly Ident	007-850	007-851
AMP Connector	DT16-18SA-K004	DT16-18SC-K004
No of Connections	18	18
Wire size	0.5 mm² (AWG 20)	0.5 mm² (AWG 20)
Wire Colour	Black	Black
Wire Idents	1 to 18	1 to 18
Connector Pin Crimp (0.5 mm² to 1.0 mm²)	0462-201-16	0462-201-16
Connector Pin Crimp (2 mm²)	0462-209-16	0462-209-16



8 MAINTENANCE AND WARRANTY

The device 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).

9 DISPOSAL

9.1 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

10 MISC

This product includes copyrighted third-party software licensed under the terms of the GNU General Public License. A copy of the corresponding source code for all included third-party software is available on request, please contact DSE Technical Support for additional information.

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