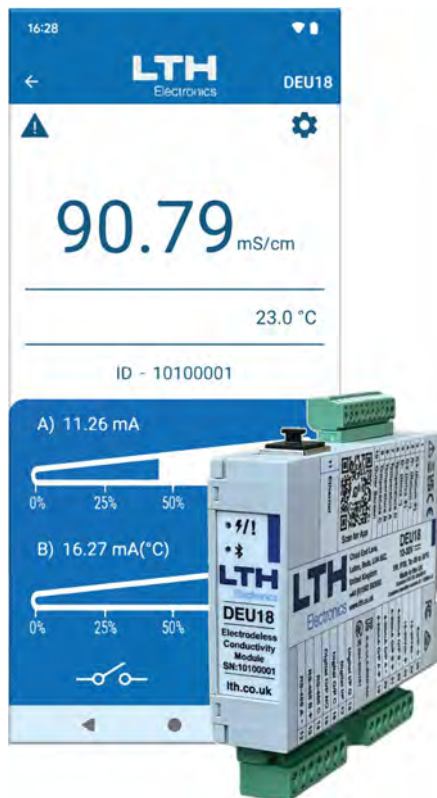


DEU18

Electrodeless Conductivity Measurement Module & LTH Discover App



Operation Guide

Preface

Product warranty

The DEU18 Electrodeless Conductivity Module has a warranty against defects in materials and workmanship for three years from the date of shipment. During this period LTH will, at its own discretion, either repair or replace products that prove to be defective. The associated software is provided 'as is' without warranty.

Limitation of warranty

The foregoing warranty does not cover damage caused by accidental misuse, abuse, neglect, misapplication or modification.

No warranty of fitness for a particular purpose is offered. The user assumes the entire risk of using the product. Any liability of LTH is limited exclusively to the replacement of defective materials or workmanship.

Disclaimer

LTH Electronics Ltd reserves the right to make changes to this manual or the module without notice, as part of our policy of continued developments and improvements.

All care has been taken to ensure accuracy of information contained in this manual. However, we cannot accept responsibility for any errors or damages resulting from errors or inaccuracies of information herein.

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Manufacturing Standards



Radio Equipment

This product has been designed to comply with the standards and regulations set down by both the United Kingdom RED Regulations S.I. 2017 No. 1206 and the European RED 2014/53/EU using EN IEC 61326-1 : 2021, ETSI EN 300 328 V2.2.2, ETSI EN 301 489-1 V2.2.3, ETSI EN 301 489-17 V3.2.4 and EN IEC 61010-1 : 2010.

Restriction of Hazardous Substances

This module has been produced to comply with the standards and regulations set down by both the United Kingdom Equipment Restriction of Hazardous Substances Regulations S.I. 2012/3032 and the European Restriction of Hazardous Substances Directive 2011/65/EU using BS EN IEC 63000 : 2018.

Quality

This module has been manufactured under the following quality standard:

ISO 9001:2015. Certificate No: FM 13843

Note: The standards referred to in the design and construction of LTH products are those prevailing at the time of product launch. As the standards are altered from time to time, we reserve the right to include design modifications that are deemed necessary to comply with the new or revised regulations.

Disposal



As per regulation S.I. 2012/3032 and directive 2012/19/EU, please observe the applicable local or national regulations concerning the disposal of waste electrical and electronic equipment.

Declaration of Conformity

UK Declaration of Conformity			Chaul End Lane Luton Bedfordshire LU4 8EZ United Kingdom
We,	LTH Electronics Ltd	declare under our sole responsibility that the produce / products	
Product identification	DEU18		
to which this declaration relates is/are in conformity with all essential requirements of the UK statutory requirements relating to:			
Radio Equipment Directive Hamonised Standards	SI 2017 No. 1206 EN IEC 61326-1 : 2021 ETSI EN 300 328 V2.2.2 ETSI EN 301 489-1 V2.2.3 ETSI EN 301 489-17 V3.2.4 EN IEC 61010-1 : 2010		
RoHS Directive Hamonised Standards / Harmonisierte Normen / Normes Harmonisées	SI 2012 No. 3032 EN 63000: 2018		
Place and date of issue / Ausstellungsort, -datum / Lieu et date d'émission	Luton, 07th May 2025  Neil Adams Managing Director		

EU Declaration of Conformity

EU-Konformitätserklärung

Déclaration UE de Conformité



Chaul End Lane
Luton
Bedfordshire
LU4 8EZ
United Kingdom

We, / Wir, die, / Nous,

LTH Electronics Ltd

declare under our sole responsibility that the produce / products
erklären in alleiniger Verantwortung, dass dieses Produkt / diese Produkte,
déclarons sous notre seule responsabilité que le produit / les produits,

Product identification /
Produktbezeichnung /
Désignation du produit

DEU18

to which this declaration relates is/are in conformity with all essential requirements of the Council Directives relating to:
auf welche(s) sich diese Erklärung bezieht, mit allen wesentlichen Anforderungen der folgenden Richtlinien des Rates
übereinstimmen:

auquel/auxquels se réfère cette déclaration est/sont conforme(s) aux exigences essentielles de la Directives du Conseil relatives à:

Radio Equipment Directive /
Funkanlagen-Richtlinie / Directive sur
les Equipements Radioélectriques

2014/53/EU

Hamonised Standards /
Harmonisierte Normen /
Normes Harmonisées

EN IEC 61326-1 : 2021
ETSI EN 300 328 V2.2.2
ETSI EN 301 489-1 V2.2.3
ETSI EN 301 489-17 V3.2.4
EN IEC 61010-1 : 2010

RoHS Directive /
RoHS-Richtlinie /
Directive RoHS

2011/65/EU

Hamonised Standards /
Harmonisierte Normen /
Normes Harmonisées

EN 63000: 2018

Place and date of issue /
Ausstellungort, -datum /
Lieu et date d'émission

Luton, 07th May 2025



Neil Adams
Managing Director

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Introduction

The DEU18 is a microprocessor-controlled electrodeless (toroidal) conductivity measurement DIN rail mounted module that can be used with LTH's range of ECS conductivity cells to measure and control a broad spectrum of solution conductivity. The module is powered from 12-30VDC.

0/4-20mA Outputs

The module features two industry standard, isolated, 0/4-20mA current outputs that features adjustable scaling, selectable on-error states and loop fault detection. Either allows the module to transmit the primary reading or observed process temperature for remote monitoring purposes.

Modbus

Additionally, the module features an optional Modbus interface via either RTU or ASCII over RS-485, or TCP/IP over Ethernet. Using the interface, the module's measurements can be read, status checked, configurations changed, and calibrations performed.

Note, by default the Modbus functionality is locked, and requires an additional purchase to unlock. This can be done at the time of ordering the module or alternatively may be ordered after purchase by supplying LTH or your local distributor the serial number of your module along with the purchase order. In return they will supply you with an 8 digit unlock code that is unique to the module.

Digital Input & Digital Output

Also present are a single digital input and a single digital output. The digital input features a dry contact input which allows the module to be remotely set to either an offline state that forces the current outputs to a pre-defined state, or to change the whole configuration of the module by switching the setup to a preconfigured state.

The digital output consists of a volt free, single pole, single throw normally open relay, which can be used to indicate the module alarm status.

Status LEDs

Finally, two status LEDs on the front of the module indicate the operation status of the of the module and the Bluetooth connection.

Bluetooth

To achieve this all within in a small foot print the module features no display. Instead, a separate mobile app, **LTH Discover** that can be downloaded from all major app stores, is used to connect to the module via Bluetooth and display the primary reading and temperature, show operational status and to provide an intuitive means to configure and calibrate the module.

If multiple modules are within range **LTH Discover** can display the measurement readings and operation status of all of them within the app's discovery screen.

DEU18 Specification

Measurement Input	ECS20 or ECS40 Series electrodeless conductivity sensor.
Connection Cable	Up to 30 meters LTH 54E/ 54H.
Ranges of Measurement	0-999.9μS/cm, 0-9.999mS/cm, 0-99.99ms/cm, 0-999.9mS/cm 0-999.9 ppm, 0-9999 ppm, 0-99.99 ppt (parts per thousand). 0 to 16.00% NaOH – Sodium Hydroxide 0 to 30.00% NaCl – Sodium Chloride 0 to 15.00% HCl – Hydrochloric Acid 0 to 25.00% H₂SO₄ – Sulphuric Acid 0 to 25.00% H₃PO₄ – Phosphoric Acid 0 to 24.00% HNO₃ – Nitric Acid 0 to 41.00 ppt Salinity Two Custom Solution Curves - Defined by a user entered 2 to 9 point curve. User defined scale: 0 to 999.9, 0 to 99.99, 0 to 999.9, and 0 to 9999. User defined units up to 7 characters.
Range Selection	Internal single or auto range.
Accuracy	± 1% of range.
Linearity	± 0.1% of range.
Repeatability	± 0.1% of range.
Ambient Temperature Variation	±0.05% of range / °C (typical)
Operator Adjustment	Anywhere within current measurement range.
Sensor Input Filter	Adjustable filter that averages the sensor input over a user selectable time (10sec – 5mins).
Temperature Sensor	Pt1000 RTD input. Up to 30 meters of cable. Temperature sensor can be mounted in the sensor or separately.
Range of Temperature Measurement	-20 °C to +150 °C (-4 °F to +302 °F) for full specification.
Temperature Accuracy	± 0.2 °C (When using 4 wire PT1000)
Operator Adjustment (Temperature)	Anywhere within range of temperature measurement.
Range of Temperature Compensation	-20 °C to +150 °C (-4 °F to +302 °F)
Temperature Compensation Type	Automatic or manual, with variable slope - 0 - 9.99 %/°C
Temperature Compensation Base	-20 °C to +150 °C (-4 °F to +302 °F)
Off-Line Facility	The current outputs are held at a user defined level.

Digital Input	Dry contact input for remote activation of user defined operations. Can be configured to operate in either normally open or normally closed modes.
Current Outputs Specification	Two current outputs as standard, selectable 0-20mA or 4-20mA into 750 ohms max, the pair of outputs are fully isolated to 2kV from the rest of the module. Expandable to 100% of any operating range and offset anywhere in that range.
Current Outputs Adjustment	3-point 0/4-20 mA for remote monitor calibration.
Digital Output	Volt free, single pole, single throw, normally open, 24v AC/DC max, 750mA max.
Digital Output Mode	Module alarm status
Modbus	If optioned, module features Modbus communication over either RS485 or Ethernet. Allowing for remote access to readings, configuration changes and calibration of the module.
	Can be specified at time of purchase or activated later using a module specific unlock code.
RS-485 Modbus Interface	RTU and ASCII protocol, 300Bps to 38400Bps baud rate, None-Odd-Even parity bits, 1-2 stop bits.
TCP/IP Over Ethernet Interface	Manual or automatic (via DHCP server support) network configuration. Port link and activity status LEDs
Bluetooth	Integrated Bluetooth radio. 25 meters max operating range.
Mobile App	Separate LTH Discover app provides an easy to use and intuitive means of commissioning, monitoring and calibrating the module from mobile devices via the Bluetooth interface.
	Available to download from major app stores, requires iOS 13.2 and later or Android 6.0 and up.
Radio Equipment Directive	SI 2017 No. 1206 & 2014/53/EU
Power Supply	12-30V DC, 4W max.
Module Housing	PA 6.6-FR (UL 94 V0)
Ingress Protection Rating	IP20.
Ambient Operating Conditions	Temperature -20 to +55°C, Relative Humidity 5 to 95%, non-condensing.
Weight	Maximum 160 grams (module only).
Dimensions	104 x 23 x 111 mm (H, W, D) including connectors.
Mounting	Compatible with 35 x 7.5mm and 35 x 15mm top hat section DIN rail (IEC 60715)

Installation – Safety & EMC

This chapter describes how to install the module and how to connect the unit to a power source and auxiliary equipment.

Although today's electronic components are very reliable, it should be anticipated in any system design that a component could fail, and it is therefore desirable to make sure a system will **fail safe**. This could include the provision of an additional monitoring device, depending upon the particular application and any consequences of a module or sensor failure.

Wiring Installation

The specified performance of the module is entirely dependent on correct installation. For this reason, the installer should thoroughly read the following instructions before attempting to make any electrical connections to the unit.

CAUTION ! : ALWAYS REMOVE THE MAIN POWER FROM THE SYSTEM BEFORE ATTEMPTING ANY ALTERATIONS TO THE WIRING. ENSURE THAT BOTH POWER INPUT LINES ARE ISOLATED. MAKE SURE THAT THE POWER CANNOT BE SWITCHED ON BY ACCIDENT WHILST THE UNIT IS BEING CONNECTED. FOR SAFETY REASONS AN EARTH CONNECTION MUST BE MADE TO THE EARTH TERMINAL OF THIS MODULE.

LOCAL WIRING AND SAFETY REGULATIONS SHOULD BE STRICTLY ADHERED TO WHEN INSTALLING THIS UNIT. SHOULD THESE REGULATIONS CONFLICT WITH THE FOLLOWING INSTRUCTIONS, CONTACT LTH ELECTRONICS OR AN AUTHORISED LOCAL DISTRIBUTOR FOR ADVICE.

To maintain the specified levels of Electro Magnetic Compatibility (EMC, susceptibility to and emission of electrical noise, transients and radio frequency signals) it is essential that the types of cables recommended within these instructions be used. If the installation instructions are followed carefully and precisely, the module will achieve and maintain the levels of EMC protection stated in the specification. Any equipment to which this unit is connected must also have the same or similar EMC control to prevent undue interference to the system.

❖ Terminations at the connectors should have any excess wire cut back so that a minimal amount of wire is left free to radiate electrical pick-up inside or close to the module housing.

N.B. The use of CE marked equipment to build a system does not necessarily mean that the completed system will comply with the European requirements for EMC.

Noise suppression

In common with other electronic circuitry, the module may be affected by high level, short duration noise spikes arising from electromagnetic interference (EMI) or radio frequency interference (RFI). To minimise the possibility of such problems occurring, the following recommendations should be followed when installing the unit in an environment where such interference could potentially occur.

The following noise generating sources can affect the module through capacitive or inductive coupling.

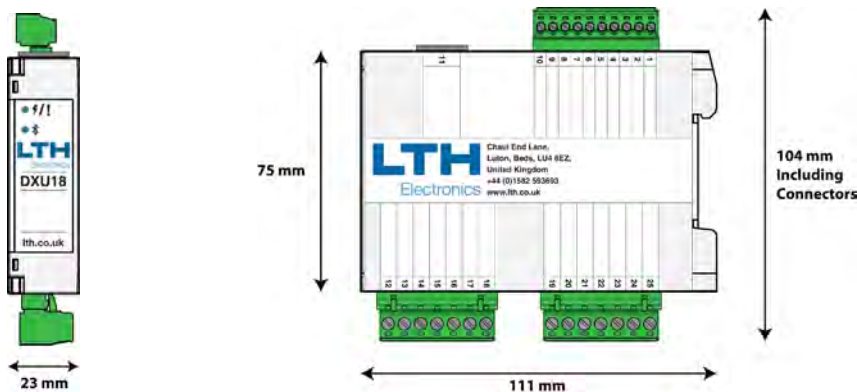
- ❖ Relay coils
- ❖ Solenoids
- ❖ AC power wires, particularly at or above 100V AC
- ❖ Current carrying cables
- ❖ Thyristor field exciters
- ❖ Radio frequency transmissions
- ❖ Contactors
- ❖ Motor starters
- ❖ Business and industrial machines
- ❖ Power tools
- ❖ High intensity discharge lights
- ❖ Silicon control rectifiers that are phase angle fired

The module is designed with a high degree of noise rejection built in to minimise the potential for interference from these sources, but it is recommended that you apply the following wiring practices as an added precaution. Cables transmitting low level signals should not be routed near contactors, motors, generators, radio transmitters, or wires carrying large currents.

If noise sources are so severe that the module's operation is impaired, or even halted, the following external modifications should be made, as appropriate:

- ❖ Fit arc suppressors across active relay or contactor contacts in the vicinity.
- ❖ Run signal cables inside steel tubing as much as is practical.
- ❖ Use the internal relays to switch external slave relays or contactors when switching heavy or reactive loads.
- ❖ Fit an in-line mains filter close to the power terminals of the module.

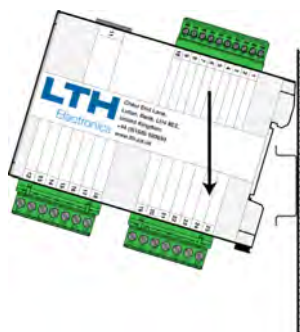
Enclosure



DEU18 Overall Dimensions

The enclosure is designed to attached to standard DIN EN 60715 / TH 35mm DIN-rail.

It should be attached to the rail by following the below guide.



Tilt the module and attach the top edge of the module's rail clip to the rail



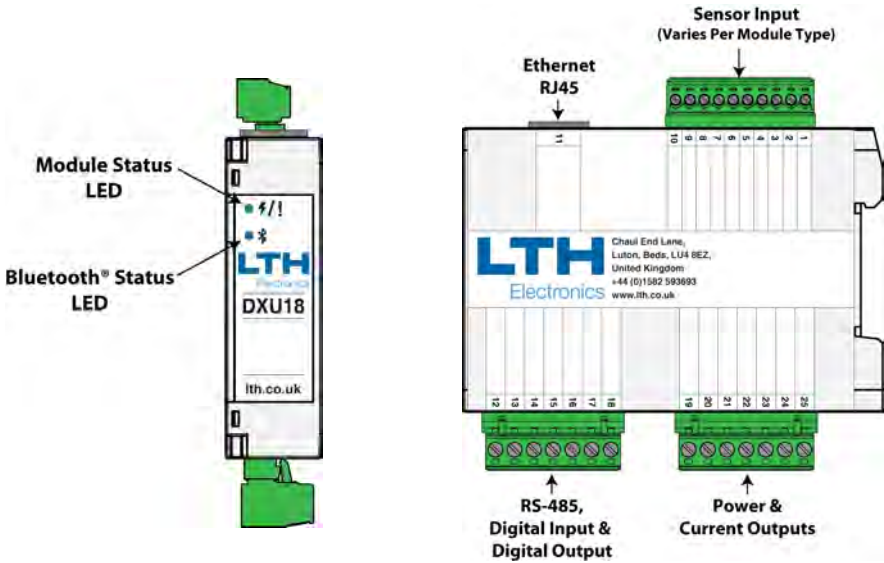
Rotate the module downwards



The spring clip in the bottom of the module's rail clip should click onto the rail

To remove the module from the rail, insert a slotted screwdriver into the module's rear rail clip and pull the clip downwards to disengage the clip from the rail, then follow the above but in reverse.

Module Overview



DEU18 Overview

Status LEDs

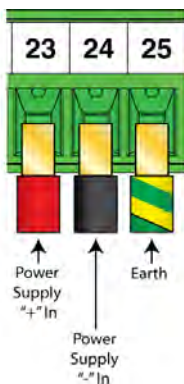
⚡/!	Module Status LED	
○	Off	Module Unpowered
●	Constant Red	Module Initialising
⏏	Flashing Green	Module Running
⏏	Flashing Red	Module Error

📶	Bluetooth® Status LED	
○	Off	Module Unpowered
⏏	Flashing Blue	Bluetooth Unconnected
●	Constant Blue	Bluetooth Connected

DEU18 LEDs

Supply Voltage Connections

Refer to the label adjacent to the power supply terminals for the input voltage limits. Exceeding these limits may damage the module.

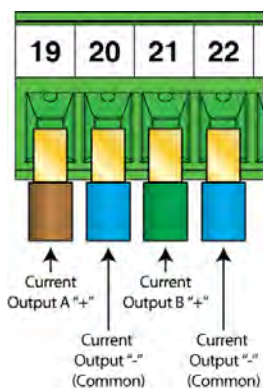


12-30V DC Power Connections

The incoming Earth connection must be connected to the Earth terminal.

Current Output Connections

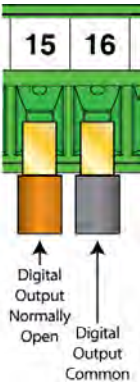
The DEU18 is supplied as standard with two current outputs, either of which can terminate into a load resistance not exceeding 750Ω and are both galvanically isolated from the rest of the module. For best noise immunity use a screened twisted pair cable, with the screen connected to Earth at one end. Use a sufficiently large cable to avoid a high resistance in the overall current loop.



Current Outputs Connection Detail

Digital Output Connections

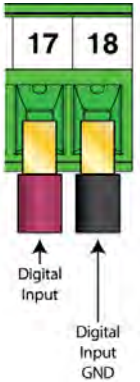
The DEU18 is supplied with a single volt free, single pole, single throw, normally open relay. Maximum switching voltage of **24v AC/DC**, maximum load **750mA**. To switch a higher voltage or load will require a slave relay.



Digital Output Connection Details

Digital Input Connections

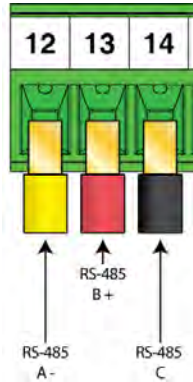
The DEU18 features a single dry contact digital input, which can be used to initiate a user configurable module operation by use of a volt free link, switch or relay. The module can be configured to initiate the appropriate action when the contact either closes or opens.



Digital Input Connection Details

Modbus Connections

The DEU18 features optional Modbus communications over either RS485 or Ethernet. Allowing for remote access to readings, configuration changes and calibration of the module. Note, the module can only be set to use either the RS485 interface or the Ethernet interface, they cannot both be used at the same time.



Modbus RS485 Connection Details

Note, the module does not feature an internal RS485 120 Ω terminating resistor.



Modbus TCP/IP Ethernet RJ45 Connection

Ethernet connection uses standard RJ45 connector and termination, remove connector dust cap before use. Integrated ethernet status LEDs – Green – Good link, Yellow – Activity on link.

Installation and Choice of Electrodeless Conductivity Sensors

The choice of the correct type of electrodeless conductivity sensor and how and where to mount the sensor, so that it has a representative sample of solution are probably the two most important considerations when installing a conductivity system.

The following criteria are of great importance during selection:

- The choice of the best method of measurement
- Use of the correct materials for temperature and corrosion resistance
- Position of sensor for robustness and service access
- Ensuring a representative, uncontaminated solution sample

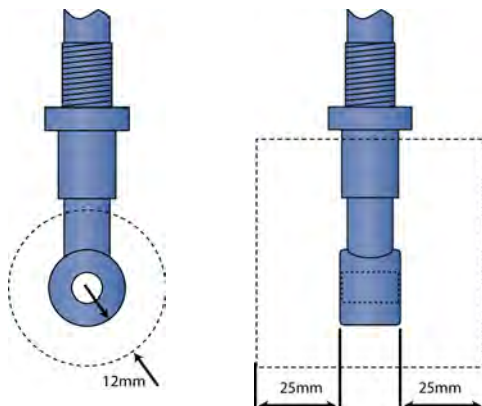
The electrodeless method of measuring conductivity has many advantages over conventional methods in particular the sensors will operate with virtually zero maintenance and provide reliable measurements over extended periods of time.

LTH provides a selection of electrodeless sensors in a variety of materials including PEEK™ a food grade material with excellent chemical resistance and high temperature performance. Contact LTH Electronics or your local distributor for more information.

To ensure correct sensor mounting the following conditions should be observed:

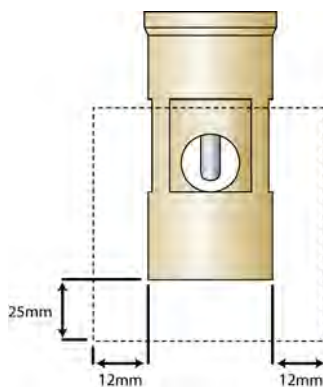
- The solution around the sensor is representative of the solution as a whole.
- For best performance line up the cross hole with direction of flow.
- A moderate flow is maintained to provide an “up to date” sample. Excessive flow rates, however, can cause cavitations and turbulence within the sensor, which will result in inaccurate readings.
- The sensor is mounted so that air bubbles do not lodge within it - displacing solutions and affecting the sample volume (air is not conductive).
- Similarly it must be in a position so that sludge and particulate matter does not collect within the sensor.

The electrodeless sensor will need a minimum clearance around it when installed or making measurements in a sample. Do not rest it on the bottom of a tank or vessel. See the following figures for details.



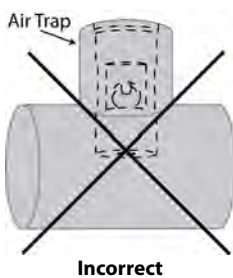
ECS20 SERIES SENSORS

Sensor Installation Clearance

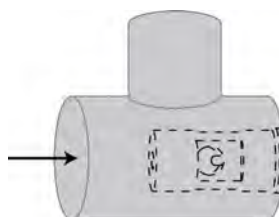


ECS40 SERIES SENSORS

Care should also be taken to ensure to position of the sensor within the flow is correct.



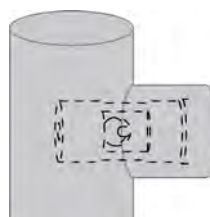
Incorrect



Best Solution

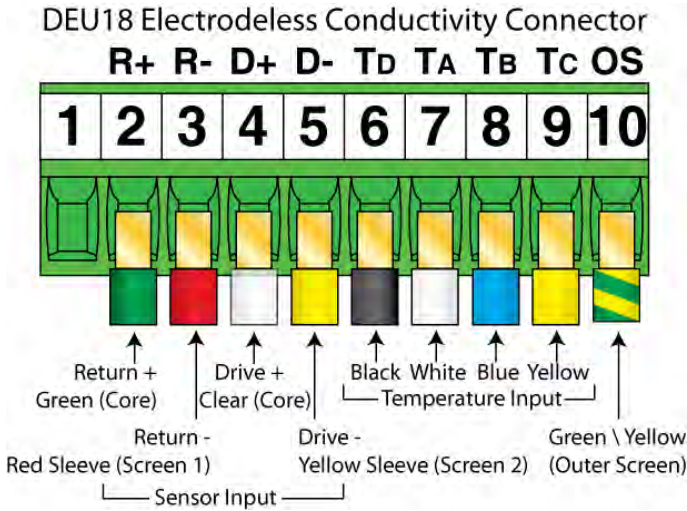


Acceptable

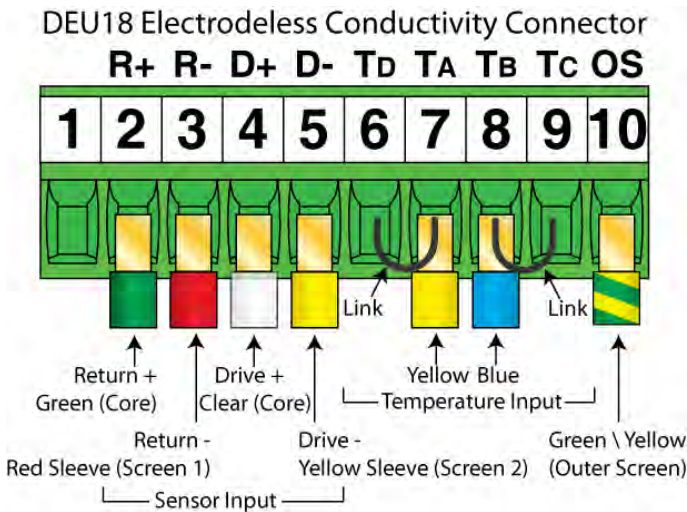


Acceptable

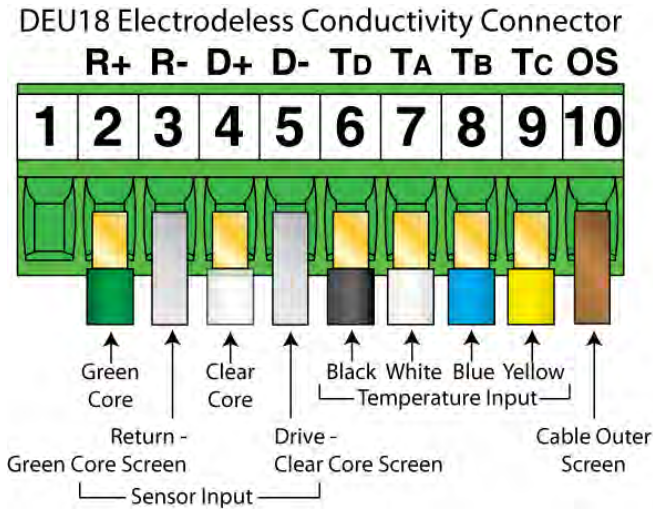
DEU18 Electrodeless Conductivity Input Connection Details



Electrodeless Conductivity 54E Cable Connection Details

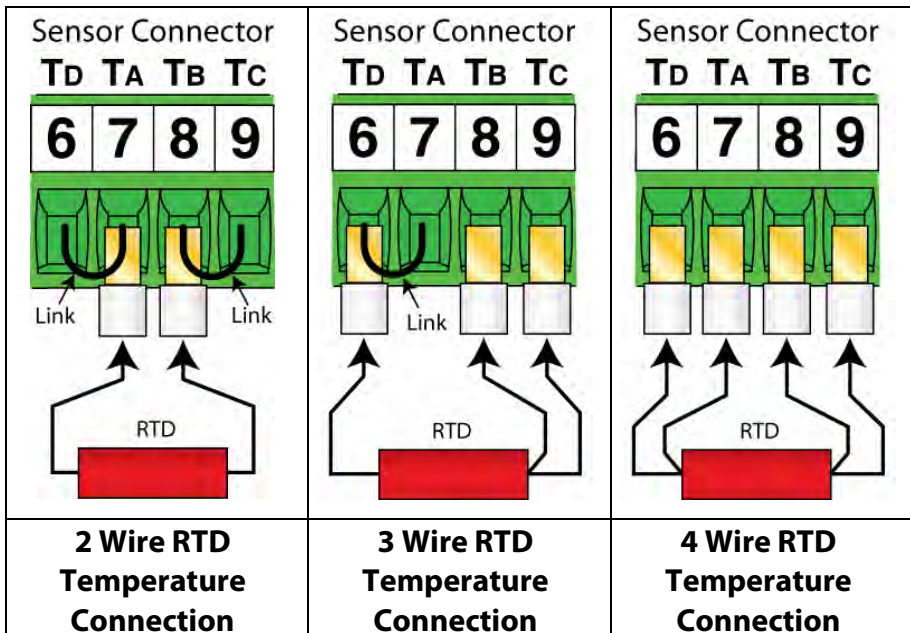


Electrodeless Conductivity 54H Cable Connection Details



Electrodeless Conductivity 54E Extension Cable Connection Details

Temperature Sensor Connections



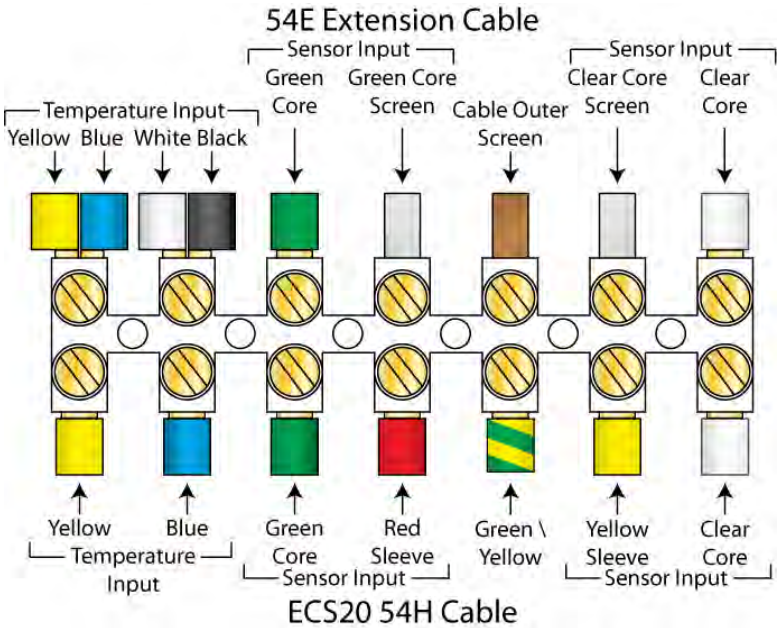
Extension Cable Arrangement

It is strongly recommended that only LTH 54E is used to extend the sensor / instrument distance. When extending the cable, a terminal block can be used to connect two lengths of cable. The user should be careful to avoid wiring the positive drive and return signals into adjacent locations on the terminal block. The preferred arrangement would be to have the positive signals as far apart as the terminal block will allow with the negatives between them and the earth between the negative signals as shown in the following diagram.

Drive +	Drive -	Earth	Return -	Return +
---------	---------	-------	----------	----------

Recommended Extension Terminal Block Arrangement

The following diagram details the connections required to extend a 54H cable as found on the ECS20 sensors with 54E cable.



ECS20 54H Cable To 54E Extension Cable Connection Details

CAUTION! BEFORE PROCEEDING, ENSURE THAT THE INSTALLATION INSTRUCTIONS HAVE BEEN FOLLOWED CORRECTLY. FAILURE TO DO SO MAY RESULT IN AN ELECTRICALLY HAZARDOUS INSTALLATION OR IRREPARABLE DAMAGE TO THE MODULE.

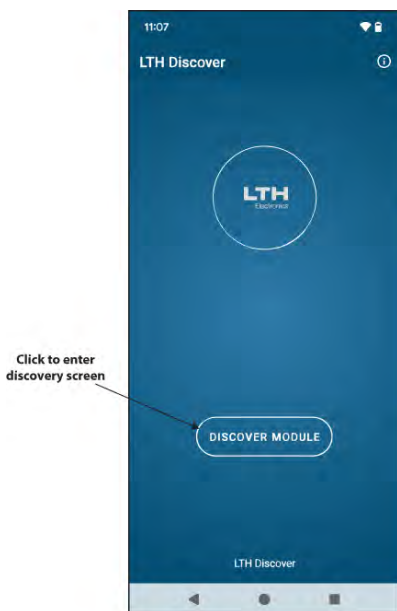
LTH Discover App

Complementing the DOU18 module is a separate mobile app, **LTH Discover** which can be downloaded from all major app stores.



LTH Discover App

The app can be used to connect to the module via Bluetooth and display the primary reading and temperature, show operational status and to provide an intuitive means to configure and calibrate the module.



Opening Screen



Discovery Screen

On opening the app press the Discover Module button to enter the discovery screen. The discovery screen shows all the modules within in range along with their current sensor and temperature readings, error status, the model type, and either the serial number or if set the module's label. Click on the desired module to connect.

Note, during connection the app will check if the module is running the latest firmware to ensure compatibility between the app and the module, if not the user is given the optional ability to update it.



Measurement Screen

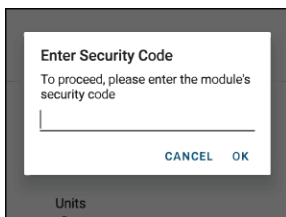
Module Setup Screen

Once connected the app shows the Measurement screen which can be used to view the primary, temperature, and raw sensor readings; module, digital input, digital output and error statuses; and current output readings. Pressing the gear icon enters the module setup screen from which the user can configure and calibrate the module. Note, if the Modbus menu is greyed out then the interface requires unlocking on the connected module, see 73 page for more details.

Security Code Access

To protect the module setup from unauthorised or accidental tampering when using the app, a security access code system is present. This is implemented via the module's menu system which operates in two modes, "locked" and "unlocked". The locked mode allows the user to observe the module's configuration but without the ability to change it. If the user wishes to change a setting, then the "Security Code" menu will appear that will prompt them to enter the security code which will then change the module's mode to "unlocked". Once unlocked, the user can change any setting without having to re-enter the security access code whilst the app remains connected to the module, however the module will automatically lock itself if the app disconnects.

The user can change the module's access code in the security code section of the configuration menu, or alternatively they can disable the module's security system permanently by changing the access code to 0000.



The default security code is 1000

Main Measurements

In addition to using the mobile app, the module's main measurements can be accessed using the Modbus interface and the registers as listed below. See Modbus section (page 75) for further details about the using the interface.

Description	Register/s	Type	Access	Option	Value
Module Type	2000	Int	Read	Electrodeless Conductivity	3

Description	Register/s	Type	Access	Option	Value
Main Reading Status	2001	Int	Read	Normal	0
				Ranging	1

Description	Register/s	Type	Access	Format	Units
Main Reading Value	2002	Float	Read	See register 2004	See register 2004

Description	Register/s	Type	Access	Option	Value
Main Reading Format and Units	2004	Int	Read	000.0 to 999.9 $\mu\text{S}/\text{cm}$	0
				0.000 to 9.999 mS/cm	1
				00.00 to 99.99 mS/cm	2
				000.0 to 999.9 mS/cm	3
				000.0 to 999.9 ppm	4
				0000 to 9999 ppm	5
				00.00 to 99.99 ppt	6
				00.00 to 16.00% NaOH	7
				00.00 to 30.00% NaCl	8
				00.00 to 15.00% HCl	9
				00.00 to 25.00% H_2SO_4	10
				00.00 to 25.00% H_3PO_4	11
				00.00 to 24.00% HNO_3	12
				0 to 41.00 ppt Salinity	13
				X.XXX Custom Solution 1	14
				XX.XX Custom Solution 1	15

				XXX.X Custom Solution 1	16
				XXXX Custom Solution 1	17
				X.XXX Custom Solution 2	18
				XX.XX Custom Solution 2	19
				XXX.X Custom Solution 2	20
				XXXX Custom Solution 2	21

Description	Register/s	Type	Access	Option	Value
Secondary Reading Status	2005	Int	Read	Disabled	0
				Enabled	1

Description	Register/s	Type	Access	Format	Units
Secondary Reading Value (Returns 0 if secondary reading is disabled)	2006	Float	Read	See register 2008	See register 2008

Description	Register/s	Type	Access	Option	Value
Secondary Reading Format and Units (Returns 0 if secondary reading is disabled)	2008	Int	Read	000.0 to 999.9 μ S/cm	0
				0.000 to 9.999 mS/cm	1
				00.00 to 99.99 mS/cm	2
				000.0 to 999.9 mS/cm	3

Description	Register/s	Type	Access	Option	Value
Temperature Status	2009	Int	Read	Disabled	0
				Enabled	1
				Manual Mode	2

Description	Register/s	Type	Access	Format	Units
Temperature Reading Value (Returns 0 if temperature is disabled)	2010	Float	Read	+/- XXX.X	See register 2012

Description	Register/s	Type	Access	Option	Value
Temperature Reading Units (Returns 0 if temperature is disabled)	2012	Int	Read	°C	0
				°F	1

Description	Register/s	Type	Access	Option	Value
Current Output A Status	2013	Int	Read	Disabled	0
				Enabled – Source Sensor	1
				Enabled – Source Temperature	2

Description	Register/s	Type	Access	Format	Units
Current Output A Value (Returns 0 if current output A is disabled)	2014	Float	Read	00.00 to 24.00	mA

Description	Register/s	Type	Access	Format	Units
Current Output A Percentage (Returns 0 if current output A is disabled)	2016	Int	Read	000 to 100	%

Description	Register/s	Type	Access	Option	Value
Current Output B Status	2017	Int	Read	Disabled	0
				Enabled – Source Sensor	1
				Enabled – Source Temperature	2

Description	Register/s	Type	Access	Format	Units
Current Output B Value (Returns 0 if current output B is disabled)	2018	Float	Read	00.00 to 24.00	mA

Description	Register/s	Type	Access	Format	Units
Current Output B Percentage (Returns 0 if current output B is disabled)	2020	Int	Read	000 to 100	%

Description	Register/s	Type	Access	Option	Value
Digital Output Status	2021	Int	Read	Disabled	0
				Inactive	1
				Active	2

Description	Register/s	Type	Access	Option	Value
Digital Input Status	2022	Int	Read	Disabled	0
				Inactive	1
				Active	2

Description	Register/s	Type	Access	Option	Value
Module Status	2023	Int	Read	Normal	0
				Offline	1
				Digital Input – Offline	4
				Digital Input - Interlock	5
				Digital Input – Flow Switch	6
				Digital Input – Tank Level	7

Description	Register/s	Type	Access	Option	Value
Module Error Status	2024	Int	Read	No Error Present	0
				Error Present	1

Description	Register/s	Type	Access	Format	Units
Custom Solution Units (Returns 0 if not using custom solution)	2025	ASCII 4 Bytes	Read	7 Characters (2 Characters per Register) Each Register Read as (Upper Byte << 8 Lower Byte << 0) Unused characters return 0	N/A

Conductivity Input Setup

The Channels Setup menu contains the configuration for the sensor's input.

The default security access code is **1000**

Sensor

Units

The module can be setup to display conductivity in Siemens/cm, TDS (Total Dissolved Solids) in ppm, or Solution.

When solution is selected the module will automatically apply the correct conversion and temperature conversion and display the concentration as “%” with an indication of the solution type selected (see range selection).

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2101	Int	Read / Write	None	Conductivity (S/cm)	0	None
				TDS (ppm)	1	None
				Solution	2	None

Sensor Type

The electrodeless conductivity input can use either the ECS20, or all of the ECS40 series sensors. Selecting the appropriate sensor will configure the instrument with the correct nominal cell constant. If the sensor type is not shown selecting custom will allow a manual cell constant to be entered.

! A Sensor loop calibration must be performed when a new sensor is attached to the module, or the sensor cable is changed; see page 44 for details.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2102	Int	Read / Write	None	ECS20	0	None
				ECS40	1	None
				Custom	2	None

Cell Constant

Allows manual entry of the sensor cell constant if custom is selected in the sensor type menu.

Register/s	Type	Access	Condition/s	Value Limits	Units
2103	Float	Read / Write	None	00.01 – 99.99	None

Range

Select the desired operating range for the input or select auto to let the instrument select the appropriate operating range.

If units have been set to solution, then the user can select what concentration to display or alternatively select one of the two custom ranges. If selected, the user can then define the custom range via the setup custom solution menu see 34 for more information.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2105	Int	Read/ Write	None	Auto	0	Sensor Units (2101) set to Conductivity (0) or TDS (1)
				000.0 to 999.9 $\mu\text{S}/\text{cm}$	1	Sensor Units (2101) set to Conductivity (0)
				0.000 to 9.999 mS/cm	2	
				00.00 to 99.99 mS/cm	3	
				000.0 to 999.9 mS/cm	4	
				000.0 to 999.9 ppm	5	Sensor Units (2101) set to TDS (1)
				0000 to 9999 ppm	6	
				00.00 to 99.99 ppt	7	
				00.00 to 16.00% NaOH	8	Sensor Units (2101) set to Solution (2)
				00.00 to 30.00% NaCl	9	
				00.00 to 15.00% HCl	10	
				00.00 to 25.00% H_2SO_4	11	
				00.00 to 25.00% H_3PO_4	12	
				00.00 to 24.00% HNO_3	13	
				0 to 41.00 ppt Salinity	14	
				Custom Solution 1	15	
				Custom Solution 2	16	

Setup Custom Solution 1 / Setup Custom Solution 2

The electrodeless conductivity input provides the user with the facility to enter two different customised conversions from conductivity to a user defined concentration, for solutions not specifically defined in the standard ranges.

To use this first set the units to "Solution", then the range to one of the two custom ranges. The "Setup Custom Solution X" menu will then appear.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
<i>App Only</i>						

Display Solution Conductivity

Allows the for calculation of the solution conductivity in addition to the calculated solution reading when Solution is set as the primary units.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2106	<i>Int</i>	<i>Read / Write</i>	<i>Sensor Units (2101) set to Solution (2)</i>	No	0	None
				Yes	1	None

TDS Factor

When TDS is selected as the operating units the module will calculate the conductivity as "ppm" using a factor which can be adjusted between 0.50 and 0.90.

Register/s	Type	Access	Condition/s	Value Limits	Units
2107	<i>Float</i>	<i>Read / Write</i>	<i>Sensor Units (2101) set to TDS (1)</i>	0.50 – 0.90	None

Temperature

Input

Select the module's temperature measurement sensor type for use with the primary measurement's automatic temperature compensation system.

If a temperature sensor is not connected to the module this menu item should be set to disabled, else temperature input error messages will be shown.

Note. Even when disabled is set a manual temperature compensation can be used.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2109	<i>Int</i>	<i>Read / Write</i>	<i>None</i>	<i>Disabled</i>	0	None
				<i>PT1000</i>	1	None

Units

Select the units for the module's temperature measurement and compensation system.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2110	Int	Read / Write	None	°C	0	None
				°F	1	None

Compensation

Enable (in) or disable (out) temperature compensation for the primary measurement.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2111	Int	Read / Write	None	In	0	None
				Out	1	None

Compensation Base

Set the temperature compensation base. See Appendix B - Temperature Coefficient for more information. Only Available if Temperature Compensation is set to in.

Register/s	Type	Access	Condition/s	Value Limits	Units
2112	Float	Read / Write	Compensation (2111) set to In (0)	-20.0 to 150.0 Units (2110) set to °C (0)	°C
				-4.0 to 302.0 Units (2110) set to °F (1)	°F

Compensation Slope

Set the temperature compensation Slope. See Appendix B - Temperature Coefficient for more information. Only Available if Temperature Compensation is set to in.

Register/s	Type	Access	Condition/s	Value Limits	Units
2114	Float	Read / Write	Compensation (2111) set to In (0)	0.00 to 9.99	%

Compensation Mode

To use temperature compensation from the temperature sensor, select "Auto", else select "Manual" to enable a fixed value entry. Only Available if Temperature Compensation is set to in.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2116	Int	Read / Write	None	Manual	0	None
				Auto	1	Input (2109) set to PT1000 (1)

Manual Input

The fixed temperature value used for manual temperature compensation.

Only available when temperature compensation mode is set to “manual”.

Register/s	Type	Access	Condition/s	Value Limits	Units
2117	Float	Read / Write	Compensation (2111) set to In (0) and Compensation Mode (2116) set to Manual (0)	-20.0 to 150.0 Units (2110) set to °C (0)	°C
				-4.0 to 302.0 Units (2110) set to °F (1)	°F

Filter

Input

When very noisy environments are encountered, this function will allow the user to filter the sensor readings by taking a running average over the time period selected (from 10 seconds to 5 minutes), alternatively to disable the filter by setting it to out.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2119	Int	Read / Write	None	Out	0	None
				10 Seconds	1	None
				20 Seconds	2	None
				40 Seconds	3	None
				1 Minute	4	None
				3 Minute	5	None
				5 Minute	6	None

Simulate

Range

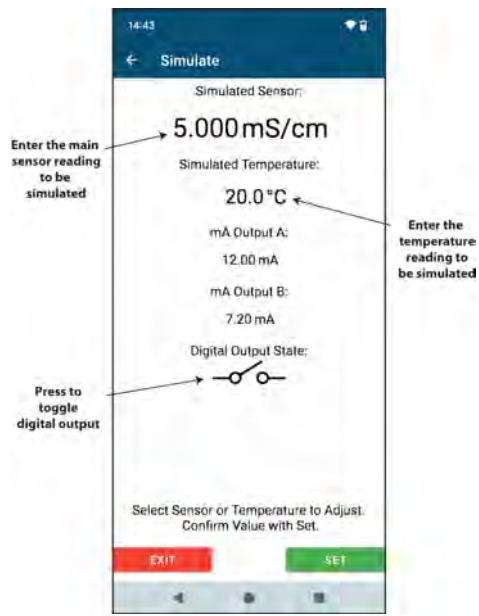
Define the operating range for the Simulate system for when the primary operating range is set to Auto.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
App Only						

Sensors

Assists the user in commissioning the module by simulating the main sensor and temperature readings which in turn drive the current outputs as per their configuration. User can also toggle the status of the digital output.

Available options depend on current output and digital output configurations.



Register/s	Type	Access	Condition/s	Option	Value	Condition/s
App Only						

Setup Custom Solution

Number of Points

Number of points – Define the number of data entry points which make up the custom curve (not including the zero point as the unit will always assume that the concentration zero is equal to the conductivity zero).

Register/s	Type	Access	Condition/s	Value Limits	Units
Solution 1: 3120 Solution 2: 3220	Int	Read / Write	None	1 - 9	None

Input Range

The conductivity range over which the custom curve will operate.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
Solution 1: 3121 Solution 2: 3221	Int	Read / Write	None	000.0 to 999.9 $\mu\text{S/cm}$	0	None
				0.000 to 9.999 mS/cm	1	
				00.00 to 99.99 mS/cm	2	
				000.0 to 999.9 mS/cm	3	

Solution Units

Enter the units the conversion will use (7 Characters maximum).

Register/s	Type	Access	Condition/s	Value Limits	Units
Solution 1: 3122 Solution 2: 3222	4 Byte ASCII	Read / Write	None	7 Characters - ASCII Codes 0x20 to 0x7E (2 Characters per Register) Each Register Read as (Upper Byte << 8 Lower Byte << 0) Unused characters set to 0	None

Solution Range

Enter the range over which the converted reading will operate.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
Solution 1: 3126 Solution 2: 3226	Int	Read / Write	None	000.0 to 9.999	0	None
				0.000 to 99.99	1	
				00.00 to 999.9	2	
				000.0 to 9999	3	

Point Conductivity

Enter the conductivity value for each point of the custom solution curve.

Register/s		Type	Access	Condition/s	Value Limits & Units
Solution 1	Solution 2	Float	Read / Write	None	As per Input Range (Solution 1: 3121 Solution 2: 3221)
Point 1: 3130	Point 1: 3230				
Point 2: 3134	Point 2: 3234				
Point 3: 3138	Point 3: 3238				
Point 4: 3142	Point 4: 3242				
Point 5: 3146	Point 5: 3246				
Point 6: 3150	Point 6: 3250				
Point 7: 3154	Point 7: 3254				
Point 8: 3158	Point 8: 3258				
Point 9: 3162	Point 9: 3262				

Point Concentration

Enter the equivalent concentration value for each point of the custom solution curve.

Register/s		Type	Access	Condition/s	Value Limits & Units
Solution 1	Solution 2	Float	Read / Write	None	As per Solution Range (Solution 1: 3126 Solution 2: 3226) & Solution Units (Solution 1: 3122 Solution 2: 3222)
Point 1: 3132	Point 1: 3232				
Point 2: 3136	Point 2: 3236				
Point 3: 3140	Point 3: 3240				
Point 4: 3144	Point 4: 3244				
Point 5: 3148	Point 5: 3248				
Point 6: 3152	Point 6: 3252				

<i>Point 7: 3156</i>	<i>Point 7: 3256</i>				
<i>Point 8: 3160</i>	<i>Point 8: 3260</i>				
<i>Point 9: 3164</i>	<i>Point 9: 3264</i>				

Calibration

Normal good practices should be observed when calibrating an electrodeless conductivity system.

Three Calibration procedures are provided with the electrodeless conductivity input:

- An initial installation loop calibration that matches the sensor, cable and instrument using loop resistors. This only needs to be performed when the system is commissioned and when a sensor or cable is changed.
- Automatic solution detection calibration, which will allow the user to calibrate the module automatically by using one of four standard LTH conductivity solutions.
- A manual solution calibration, that will allow the user to fine tune the calibration using an existing conductivity solution of the users choosing.

For best results always clean the sensor before making any adjustments.

Calibration of Conductivity Readings

Conductivity measurements are very temperature dependent so it is essential that an understanding of the complex relationship between conductivity and temperature is understood when calibrations are made. It is possible to make several different types of calibration.

Calibration with Standard Solutions

This calibration must be carried out under strictly controlled conditions due to the temperature effect on conductivity measurements and the possibility of contamination of the standard solution. The advantage of this calibration method is that the sensor and cable are an integral part of the calibration. Conductivity is a very sensitive measurement and even trace contamination of the standard solution will be detected, for example exposing the solution to air will add $1\mu\text{S}/\text{cm}$ to the standard solution due to absorption of CO_2 .

Most standards are made up from a solution of KCl dissolved in high purity water. BS EN 60746-3 provides details of the concentrations of KCl necessary to produce industry standard conductivity solutions. Ready-made solutions are available from LTH with traceable certification if required.

Standard solutions will be supplied with a conductivity value quoted at a reference temperature. This temperature is the base temperature, and the calibration should be performed at that temperature, with the temperature compensation switched out. Alternatively, the temperature compensation should be switched on and a temperature slope and base temperature equal to that of the calibration solution can be used to configure the module. For example, this would be $1.76\%/^{\circ}\text{C}$ for a KCl solution between 1000 to $10,000\mu\text{S}/\text{cm}$. For more details on calculating the slope of a different solution, refer to Appendix B - Temperature Coefficient (page 90).

Calibration by Comparison with Another Instrument

This can provide the easiest method for in-situ calibrations but has the disadvantage of only being able to check a single measurement point. As measurements are made by comparison of the readings taken in the same solution, temperature effects are less critical. However, it is essential that settings for temperature compensation are the same on both instruments.

Calibration Menu

The calibration menu provides the facility to adjust the sensor inputs to the system in which it is operating.

The default security access code is 1000

Module

Mode

Selecting off-line causes any current outputs to go to the value stated in their "Offline Mode" menu, useful for when commissioning or calibrating the module.

When the unit is placed in an off-line state "off-line" will appear in the messages section on the measurement screen.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2201	Int	Read/ Write	None	Online	0	None
				Offline	1	None

Manual Temperature Input

This setting allows a different fixed temperature value to be used when calibrating. Makes it easier to calibrate a standard solution at a different temperature to the process.

Only available when the channel temperature compensation mode has been set to manual.

Register/s	Type	Access	Condition/s	Value Limits	Units
2202	Float	Read / Write	Compensation (2111) set to In (0) and Compensation Mode (2116) set to Manual (0)	-20.0 to 150.0 Units (2110) set to °C (0)	°C
				-4.0 to 302.0 Units (2110) set to °F (1)	°F

Sensor

Loop - Calibrate

Enter the sensor loop calibration screen.

See Sensor Loop Calibration on page 44 for further details.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
App Only						

Solution Calibration Principle

Select the solution calibration mode.

See Conductivity Calibration - Manual Mode on page 44 and Conductivity Calibration – Standard Solution Detection on page 50 for further details of the sensor calibration modes.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2204	Int	Read/ Write	None	Manual	0	None
				Standard Solution Detection	1	Sensor Units (2101) set to Conductivity (0) and either Temperature Input (2019) not set to Disabled or Temperature Input (2019) set to Disabled and Temperature Compensation (2111) set to In (1)

Calibration Range

Define the calibration range when using the Manual calibration mode and the Sensor Range is set to Auto.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2205	Int	Read / Write	Mode (2204) is set to Manual (0) and Range (2105) set to Auto (0).	0 to 999.9μS/cm	0	Sensor Units (2101) set to Conductivity (0)
				0 to 9.999mS/cm	1	
				0 to 99.99mS/cm	2	
				0 to 999.9mS/cm	3	
				0 to 999.9ppm	4	Sensor Units (2101) set to TDS (1)
				0 to 9999ppm	5	
				0 to 99.99ppt	6	

Slope - Calibrate

Enter the sensor slope calibration screen.

See Conductivity Calibration - Manual Mode on page 44 for further details.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
App Only						

Solution - Calibrate

Enter the sensor solution calibration screen.

See Conductivity Calibration – Standard Solution Detection on page 50 for further details.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
<i>App Only</i>						

Slope Value

The sensor slope value currently being used. The value will change depending on the result of the sensor calibration.

Cannot be edited.

A slope value of 100% indicates that no adjustment has been made to the sensor calibration.

A slope value of greater than 100% indicates that the sensor reading has had to be increased to match the known input.

A slope value of less than 100% indicates that the sensor reading has had to be decreased to match the known input.

Register/s	Type	Access	Condition/s	Value Limits	Units
2206	<i>Float</i>	<i>Read</i>	<i>Sensor Units (2101) set to Conductivity (0) or TDS (1)</i>	<i>50.0 to 150.0</i>	<i>%</i>

Solution Offset - Calibrate

Enter the sensor solution offset calibration screen.

See Solution Offset Calibration page 54 for further details.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
<i>App Only</i>						

Offset Value

The sensor offset value currently being used. The value will change depending on the result of the solution offset calibration.

Cannot be edited.

Register/s	Type	Access	Condition/s	Value Limits & Units
2209	<i>Float</i>	<i>Read</i>	<i>Sensor Units (2101) set to Solution (2)</i>	<i>Depends on Range (2105) or Solution Range (Solution 1: 3126, Solution 2: 3226) & Solution Units (Solution 1: 3122 Solution 2: 3222) if Range (2105) is set to Custom Solution 1 (15) or Custom Solution 2 (16)</i>

Temperature

Offset - Calibrate

Enter the temperature offset calibration screen. See Temperature Calibration on page 60 for further details

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
App Only						

Offset Value

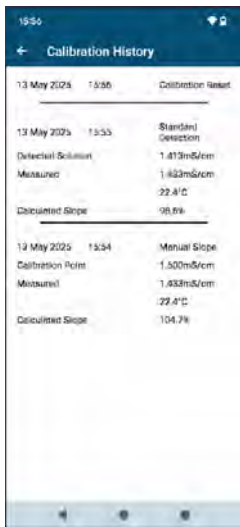
The temperature offset value currently being used. The value will change depending on the result of the temperature offset calibration. Cannot be edited

Register/s	Type	Access	Condition/s	Value Limits	Units
2211	Float	Read	Temperature Input (2108) not set to Disabled (0)	-50.0 to +50.0 Units (2110) set to °C (0)	°C
				-122.0 to +122.0 Units (2110) set to °F (1)	°F

History

Records

Shows a log of the sensor calibration. Including time and date, calibration method and results.



Time	Method	Standard	Measured	Calculated Slope
13 May 2025 15:55	Standard Detection	1.419mS/cm	1.422mS/cm	98.6%
13 May 2025 15:54	Manual Slope	1.500mS/cm	1.438mS/cm	104.7%

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
App Only						

Clear

Clear the sensor calibration history.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
App Only						

Reminder

Set

By enabling the calibration reminder, the user can configure a calibration interval, which when expired will activate an alarm and message on the measurement screen.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2215	Int	Read / Write	None	No	0	None
				Yes	1	None

Interval

Sets the interval time for the calibration alarm.

The Reminder Date will update to show the date of the next calibration alarm.

Register/s	Type	Access	Condition/s	Value Limits	Units
2216	Int	Read / Write	Reminder Set (22120 set to Yes (1))	1 to 999	Days

Date

Sets the exact date of the next calibration alarm.

The Calibration Interval will update to show the number of days to the next calibration date.

Register/s	Type	Access	Condition/s	Value Limits	Units
2217	Int	Read / Write	Reminder Set (22120 set to Yes (1))	1 to 31	Day
Register/s	Type	Access	Condition/s	Value Limits	Units
2218	Int	Read / Write	Reminder Set (22120 set to Yes (1))	1 to 12	Month
Register/s	Type	Access	Condition/s	Value Limits	Units
2219	Int	Read / Write	Reminder Set (22120 set to Yes (1))	2000 to 3000	Year

Defer Calibration Date

Turns off the alarm and increases the calibration interval by an extra 7 days.

Only appears once the calibration interval has expired.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2220	Int	Read / Write	Calibration Due Set (3208 Bit 2 = 1)	Done	0	None
				Defer	1	None

Reset**Loop Calibration**

Reset the sensor loop calibration to its default state.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2221	Int	Read / Write	None	Done	0	None
				Reset	1	None

Sensor Calibration

Reset the sensor user calibration to its default state.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2222	Int	Read / Write	None	Done	0	None
				Reset	1	None

Temperature Calibration

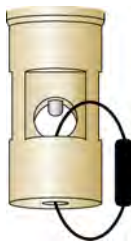
Reset the temperature user calibration to its default state.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2223	Int	Read / Write	Temperature Input (2108) not set to Disabled (0)	Done	0	None
				Reset	1	None

Sensor Loop Calibration

The sensor calibration is a one off configuration calibration, to allow for losses due to cable length and sensor output variations. It must be completed when either a sensor or sensor cable is changed. To complete the calibration the four loop resistors (Black, Glue, Green, Pink) supplied with the module must be used, once completed do not discard the resistors as they will be required for future calibration and checks. The resistors must be removed prior to installing the sensor into a pipe or tank.

Care must be taken to ensure that the loop resistor path through the sensor is as shown below.



ECS40 Series Sensor



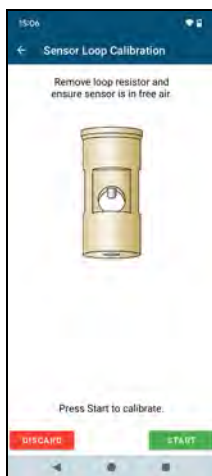
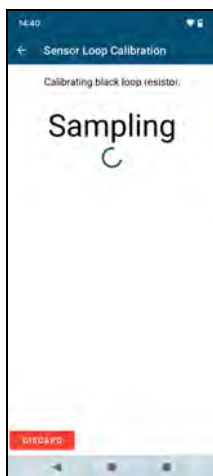
ECS20 Series Sensor

Loop Resistor Path

Calibration method using App

From the calibration menu click on Loop – Calibrate. Once in the initial screen follow the instruction and insert the black loop resistor as shown, with the sensor image matching the type of sensor being used. Once inserted click on the start button to proceed with the calibration. The module will then sample the loop resistor, if the user wishes to abandon the calibration press the discard button.

Once that has completed the module will ask for the black loop to be replaced with the blue loop. Again, once setup click start to proceed with sampling of the loop, then repeat as before for the requested for the green and pink loops. Once all four of the loops have been sampled the module will need to perform one final sample with no loops inserted. Once this is complete the app will display calibration complete. Press save to store the calibration and exit, else press restart to return to the initial calibration screen, or press discard to exit without saving.



Calibration

Calibration method using Modbus

To enter loop calibration mode first set the *Loop Calibration Status (2230)* to *Loop Calibration Mode (1)*. Place the black loop through the sensor as detailed above, then set *Loop Calibration Status (2230)* to *Begin Black Loop Calibration (2)*. The module will then begin calibration and automatically increment the *Loop Calibration Status (2230)* through *Black Loop Calibration Stage 1 Complete (3)* and *Black Loop Calibration Stage 2 Complete (4)*. Once it has completed the two stages replace the black loop with the blue loop.

Once the blue loop has been inserted set the *Loop Calibration Status (2230)* to *Begin Blue Loop Calibration (5)*. The module will begin calibration and automatically increment the *Loop Calibration Status (2230)* through *Blue Loop Calibration Stage 1 Complete (6)* and *Blue Loop Calibration Stage 2 Complete (7)*. Once it has completed the two stages now replace the blue loop with the green loop.

Now with the green loop inserted set the *Loop Calibration Status (2230)* to *Begin Green Loop Calibration (8)*. The module will begin calibration and automatically increment the *Loop Calibration Status (2230)* through *Green Loop Calibration Stage 1 Complete (9)* and *Green Loop Calibration Stage 2 Complete (10)*. Once it has completed the two stages replace the green loop with the pink loop.

Again, with the pink loop inserted set the *Loop Calibration Status (2230)* to *Begin Pink Loop Calibration (11)*. The module will begin calibration and automatically increment the *Loop Calibration Status (2230)* to *Pink Loop Calibration Complete (12)* once the calibration has been performed.

Finally with no loop resistors inserted, set the *Loop Calibration Status (2230)* to *Begin Open Sensor Calibration (13)*. The module will begin the open sensor calibration and automatically increment the *Loop Calibration Status (2230)* through *Open Sensor Calibration Stage 1 Complete (14)*, *Open Sensor Calibration Stage 2 Complete (15)*, *Open Sensor Calibration Stage 3 Complete (16)* and finally *Open Sensor Calibration Stage 4 Complete (17)*.

To save the completed loop calibration, set the *Loop Calibration Status (2230)* to *Save Loop Calibration (18)*, else set it to either to *Loop Calibration Mode (1)* to restart the process or *Loop Calibration Stopped (0)* to exit the loop calibration mode.

Note, to stop calibration at any point set *Loop Calibration Status (2230)* to *Loop Calibration Stopped (0)*.

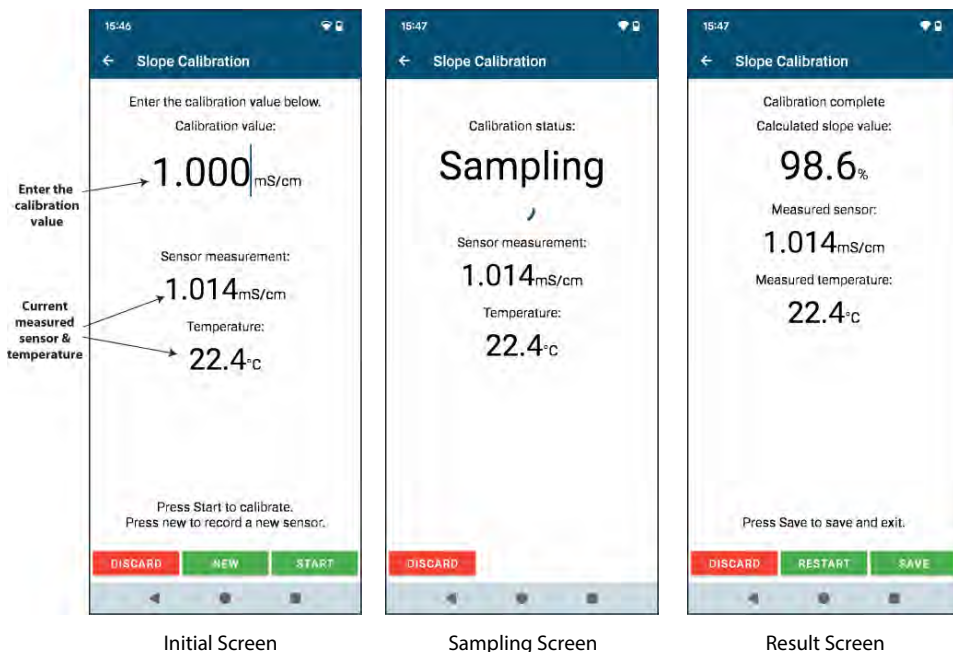
Loop Calibration Status						
Controls the loop calibration process.						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2230	Int	Read / Write	None	Loop Calibration Stopped	0	None
				Loop Calibration Mode	1	
				Begin Black Loop Calibration	2	
				Black Loop Calibration Stage 1 Complete	3	

				Black Loop Calibration Stage 2 Complete	4	
				Begin Blue Loop Calibration	5	
				Blue Loop Calibration Stage 1 Complete	6	
				Blue Loop Calibration Stage 2 Complete	7	
				Begin Green Loop Calibration	8	
				Green Loop Calibration Stage 1 Complete	9	
				Green Loop Calibration Stage 2 Complete	10	
				Begin Pink Loop Calibration	11	
				Pink Loop Calibration Complete	12	
				Begin Open Sensor Calibration	13	
				Open Sensor Calibration Stage 1 Complete	14	
				Open Sensor Calibration Stage 2 Complete	15	
				Open Sensor Calibration Stage 3 Complete	16	
				Open Sensor Calibration Stage 4 Complete	17	
				Save Loop Calibration	18	

Conductivity Calibration - Manual Mode

Calibration method using App

Set the calibration sensor mode to Manual, then optionally if using auto range set the calibration range, then click on slope – calibrate. Once in the initial screen enter the calibration value the user is simulating, and press start to begin calibration. The module will then begin sampling the sensor, if the user wishes to abandon the calibration press the discard button. Once completed it will automatically move on the result screen to show the newly calculated slope value, and the measured sensor and temperature values at the time of calibration. If the user is happy with the result press save, else press restart to return to the initial screen, or press discard to exit.



Calibration method using Modbus

First set the *Calibration Sensor Mode (2204)* to Manual (0), then optionally if using auto range set the *Calibration Range (2205)* as required, next set the *Manual Sensor Calibration Status (2250)* to Calibration Mode (1) and write the calibration value the user is simulating to *Calibration Value (2251)*.

Now to begin sampling the reading set *Manual Sensor Calibration Status (2250)* to Begin Calibration (2). Once the sampling is complete *Manual Sensor Calibration Status (2250)* will automatically change to Calibration Process Completed (3).

The newly calculated slope can be read from *Calculated Slope Value (2254)* along with the *Measured Sensor Value (2256)* and *Measured Temperature Value (2259)*. If these are acceptable set *Manual Sensor Calibration Status (2250)* to Save Calibration (4) if not set *Manual Sensor Calibration Status (2250)* to either Calibration Mode (1) to restart the process or Calibration Stopped (0) to exit the calibration mode.

Note, to stop calibration at any point set *Manual Sensor Calibration Status (2250)* to Calibration Stopped (0).

Manual Sensor Calibration Status						
Controls the calibration process.						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2250	Int	Read / Write	None	Calibration Stopped	0	None
				Set Module to Calibration Mode	1	
				Begin Calibration	2	
				Calibration Process Completed	3	
				Save Calibration	4	

Calibration Value						
The calibration value the user is simulating.						
Register/s	Type	Access	Condition/s	Value Limits & Units		
2251	Float	Write	Calibration Mode (2204) set to Manual (0)	As per Calibration Value Range (2253)		

Calibration Value Range and Units						
The calibration value range and units will be equal to either the sensor range from the channel menu or if sensor range is set to auto the range and units will be equal to the sensor calibration range.						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2253	Int	Read	Calibration Mode (2204) set to Manual (0)	0 to 999.9μS/cm	0	None
				0 to 9.999mS/cm	1	
				0 to 99.99mS/cm	2	
				0 to 999.9mS/cm	3	
				0 to 999.9ppm	4	
				0 to 9999ppm	5	
				0 to 99.99ppt	6	

Calculated Slope Value

The result of the calibration, note this is not applied to the module until the calibration state is set to save.

Register/s	Type	Access	Condition/s	Value Limits	Units
2254	Float	Read	None	XXX.X	%

Measured Sensor Value

The sensor reading at the time of calibration.

Register/s	Type	Access	Condition/s	Value Limits & Units
2256	Float	Read	None	As per Measured Sensor Range (2258)

Measured Sensor Range and Units

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2258	Int	Read	None	0 to 999.9μS/cm	0	None
				0 to 9.999mS/cm	1	
				0 to 99.99mS/cm	2	
				0 to 999.9mS/cm	3	
				0 to 999.9ppm	4	
				0 to 9999ppm	5	
				0 to 99.99ppt	6	

Measured Temperature Value

The temperature reading at the time of calibration.

Register/s	Type	Access	Condition/s	Value Limits	Units
2259	Float	Read	None	+/- XXX.X	See register 2012

Conductivity Calibration – Standard Solution Detection

A form of automatic calibration where the module can detect from one of four standard LTH solutions being used to calibrate the sensor, then by using the temperature measured at calibration and built-in look-up tables the module can automatically calculate what the solution should measure. Using this along with the actual measured solution value the module can calculate the new sensor slope value.

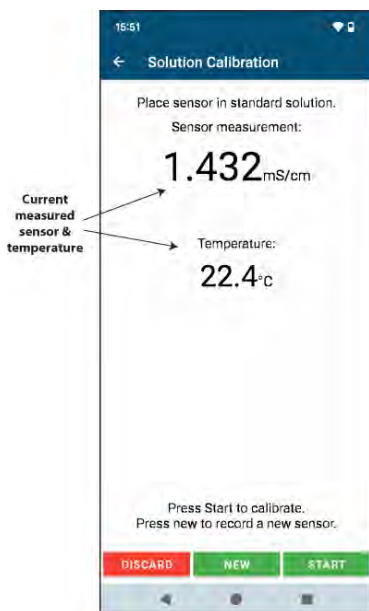
Note, this method is only available when using conductivity and when either the temperature sensor is not set to disabled, or there is a manual temperature input.

For list of supported standard solutions see Appendix C - Table of conductivity variation with temperature of LTH standard solutions on page 91.

Calibration method using App

Set the calibration sensor mode to Standard Solution Detection, then click on solution – calibrate. Once in the initial screen place the sensor in the standard solution and wait for the reading to stabilise, then press start to begin a calibration. The module will then begin sampling the sensor, if the user wishes to abandon the calibration press the discard button.

Once completed the app will display the detected solution, if correct press next to calculate the new sensor slope value. Finally, the app will show the newly calculated slope value, and the measured sensor and temperature values at the time of calibration. If the user is happy with the result press save, else press restart to return to the initial screen, or press discard to exit.



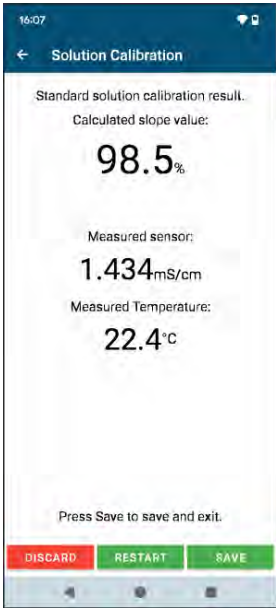
Initial Screen



Sampling Screen



Detected Solution Screen



Result Screen

Calibration method using Modbus

First set the *Calibration Sensor Mode (2204)* to *Standard Solution Detection (1)*, next set the *Sensor Solution Detection Calibration Status (2232)* to *Calibration Mode (1)*, place the sensor in the standard solution and wait for the reading to stabilise, then set *Sensor Solution Detection Calibration Status (2232)* to *Begin Calibration (2)*.

Once the sampling is complete *Sensor Solution Detection Calibration Status (2232)* will automatically change to *Calibration Process Completed (3)*.

The newly calculated slope can be read from *Calculated Slope Value (2234)* along with the *Detected Solution (2233)*, *Measured Sensor Value (2236)* and *Measure Temperature Value (2239)*. If these are acceptable set *Sensor Solution Detection Calibration Status (2232)* to *Save Calibration (4)* if not set *Sensor Solution Detection Calibration Status (2232)* to either *Calibration Mode (1)* to restart the process or *Calibration Stopped (0)* to exit the calibration mode.

Note, to stop calibration at any point set *Sensor Solution Detection Calibration Status (2232)* to *Calibration Stopped (0)*.

Sensor Solution Detection Calibration Status						
Controls the calibration process.						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2232	Int	Read / Write	None	Calibration Stopped	0	None
				Set Module to Calibration Mode	1	None

				<i>Begin Calibration</i>	2	<i>None</i>
				<i>Calibration Process Completed</i>	3	<i>None</i>
				<i>Save Calibration</i>	4	<i>None</i>

Detected Solution

The standard solution value the module believes is being used.

<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Option</i>	<i>Value</i>	<i>Condition/s</i>
2233	Int	Read	None	147 μ S/cm	0	None
				1.413 mS/cm	1	None
				12.88 mS/cm	2	None
				111.8 mS/cm	3	None

Calculated Slope Value

The result of the calibration, note this is not applied to the module until the calibration state is set to save.

<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Value Limits</i>	<i>Units</i>
2234	Float	Read	None	XXX.X	%

Measured Sensor Value

The sensor reading at the time of calibration.

<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Value Limits & Units</i>
2236	Float	Read	None	As per Measured Sensor Range (2238)

Measured Sensor Range and Units

<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Option</i>	<i>Value</i>	<i>Condition/s</i>
2238	Int	Read	None	0 to 999.9 μ S/cm	0	None
				0 to 9.999mS/cm	1	
				0 to 99.99mS/cm	2	
				0 to 999.9mS/cm	3	

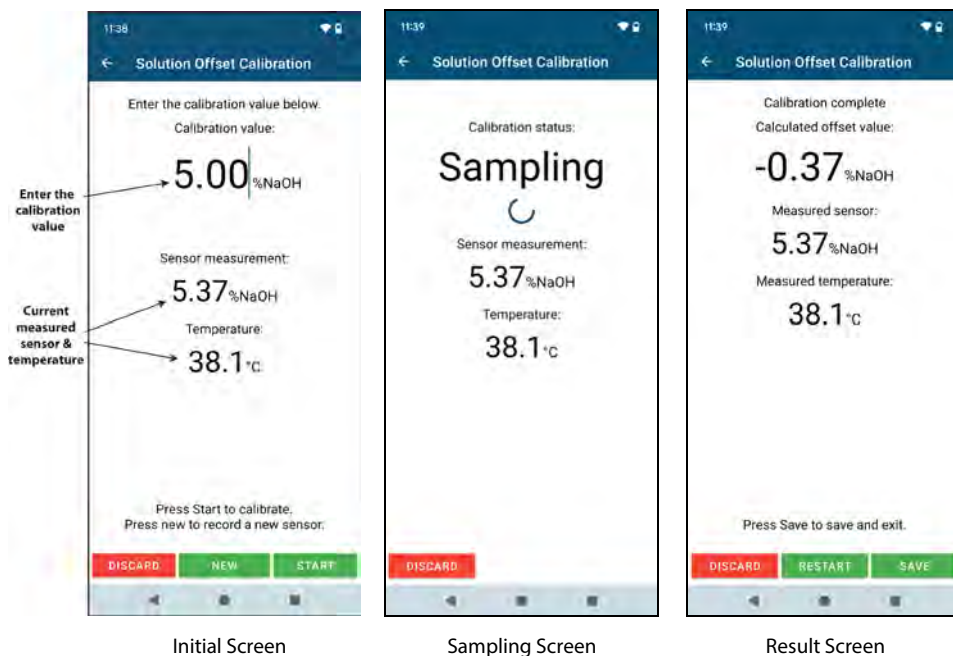
Measured Temperature Value The temperature reading at the time of calibration.					
<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Value Limits</i>	<i>Units</i>
2239	Float	Read	None	+/- XXX.X	See register 2012

Solution Offset Calibration

Only available when channel units are set to solution.

Calibration method using App

Click on solution offset – calibrate. Once in the initial screen enter the solution calibration value the user is simulating, and press start to begin calibration. The module will then begin sampling the sensor, if the user wishes to abandon the calibration press the discard button. Once completed it will automatically move on to the result screen to show the newly calculated solution offset value, and the measured solution and temperature value at the time of calibration. If the user is happy with the result press save, else press restart to return to the initial screen, or press discard to exit.



Calibration method using Modbus

First set the *Solution Offset Calibration Status* (2261) to *Calibration Mode* (1) and write the solution calibration value the user is simulating to *Calibration Value* (2262).

Now to begin sampling the solution reading set *Solution Offset Calibration Status* (2261) to *Begin Calibration* (2). Once the sampling is complete *Solution Offset Calibration Status* (2261) will automatically change to *Calibration Process Completed* (3).

The newly calculated solution offset can be read from *Calculated Offset Value* (2269) along with the *Measured Sensor Value* (2277) and *Measured Temperature Value* (2284). If these are acceptable set *Solution Offset Calibration Status* (2261) to *Save Calibration* (4) if not set *Solution Offset Calibration Status* (2261) to either *Calibration Mode* (1) to restart the process or *Calibration Stopped* (0) to exit the calibration mode.

Note, to stop calibration at any point set *Solution Offset Calibration Status* (2261) to *Calibration Stopped* (0).

Solution Offset Calibration Status

Controls the calibration process.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2261	Int	Read / Write	None	Calibration Stopped	0	None
				Set Module to Calibration Mode	1	
				Begin Calibration	2	
				Calibration Process Completed	3	
				Save Calibration	4	

Calibration Value

The calibration value the user is simulating.

Register/s	Type	Access	Condition/s	Value Limits & Units
2262	Float	Write	Channel Units (2101) set to Solution (2)	As per Calibration Value Range (2264)

Calibration Value Range and Units

The calibration value range and units.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2264	Int	Read	Channel Units (2101) set to Solution (2)	00.00 to 16.00% NaOH	7	None
				00.00 to 30.00% NaCl	8	
				00.00 to 15.00% HCl	9	
				00.00 to 25.00% H ₂ SO ₄	10	
				00.00 to 25.00% H ₃ PO ₄	11	
				00.00 to 24.00% HNO ₃	12	
				0 to 41.00 ppt Salinity	13	

				X.XXX Custom Solution 1	14	
				XX.XX Custom Solution 1	15	
				XXX.X Custom Solution 1	16	
				XXXX Custom Solution 1	17	
				X.XXX Custom Solution 2	18	
				XX.XX Custom Solution 2	19	
				XXX.X Custom Solution 2	20	
				XXXX Custom Solution 2	21	

Custom Solution Units

If using custom solution, lists the units of the currently selected solution.

Register/s	Type	Access	Condition/s	Value Limits	Units
2265	4 Byte ASCII	Read	Channel Units (2101) set to Solution (2) and Channel Range (2105) set to either Custom Solution 1 (15) or Custom Solution 2 (16)	7 Characters - ASCII Codes 0x20 to 0x7E (2 Characters per Register) Each Register Read as (Upper Byte << 8 Lower Byte << 0) Unused characters set to 0	None

Calculated Offset Value

The result of the calibration, note this is not applied to the module until the calibration state is set to save.

Register/s	Type	Access	Condition/s	Value Limits & Units
2269	Float	Read	None	As per Calculated Offset Range (2271)

Calculated Offset Range and Units The offset value range and units.						
<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Option</i>	<i>Value</i>	<i>Condition/s</i>
2271	Int	Read	Channel Units (2101) set to Solution (2)	+/- XX.XX % NaOH	7	None
				+/- XX.XX % NaCl	8	
				+/- XX.XX % HCl	9	
				+/- XX.XX % H ₂ SO ₄	10	
				+/- XX.XX % H ₃ PO ₄	11	
				+/- XX.XX % HNO ₃	12	
				+/- XX.XX ppt Salinity	13	
				+/- X.XXX Custom Solution 1	14	
				+/- XX.XX Custom Solution 1	15	
				+/- XXX.X Custom Solution 1	16	
				+/- XXXX Custom Solution 1	17	
				+/- X.XXX Custom Solution 2	18	
				+/- XX.XX Custom Solution 2	19	
				+/- XXX.X Custom Solution 2	20	
				+/- XXXX Custom Solution 2	21	

Calculated Offset Custom Solution Units

If using custom solution, lists the units of the currently selected solution.

Register/s	Type	Access	Condition/s	Value Limits	Units
2272	4 Byte ASCII	Read	Channel Units (2101) set to Solution (2) and Channel Range (2105) set to either Custom Solution 1 (15) or Custom Solution 2 (16)	7 Characters - ASCII Codes 0x20 to 0x7E (2 Characters per Register) Each Register Read as (Upper Byte << 8 Lower Byte << 0) Unused characters set to 0	None

Measured Sensor Value

The sensor reading at the time of calibration.

Register/s	Type	Access	Condition/s	Value Limits & Units
2277	Float	Read	None	As per Measured Sensor Range (2279)

Measured Sensor Range and Units

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2279	Int	Read	Channel Units (2101) set to Solution (2)	00.00 to 16.00% NaOH	7	None
				00.00 to 30.00% NaCl	8	
				00.00 to 15.00% HCl	9	
				00.00 to 25.00% H ₂ SO ₄	10	
				00.00 to 25.00% H ₃ PO ₄	11	
				00.00 to 24.00% HNO ₃	12	
				0 to 41.00 ppt Salinity	13	
				X.XXX Custom Solution 1	14	
				XX.XX Custom Solution 1	15	

				XXX.X Custom Solution 1	16	
				XXXX Custom Solution 1	17	
				X.XXX Custom Solution 2	18	
				XX.XX Custom Solution 2	19	
				XXX.X Custom Solution 2	20	
				XXXX Custom Solution 2	21	

Measured Sensor Custom Solution Units

Register/s	Type	Access	Condition/s	Value Limits	Units
2280	4 Byte ASCII	Read	Channel Units (2101) set to Solution (2) and Channel Range (2105) set to either Custom Solution 1 (15) or Custom Solution 2 (16)	7 Characters - ASCII Codes 0x20 to 0x7E (2 Characters per Register) Each Register Read as (Upper Byte << 8 Lower Byte << 0) Unused characters set to 0	None

Measured Temperature Value

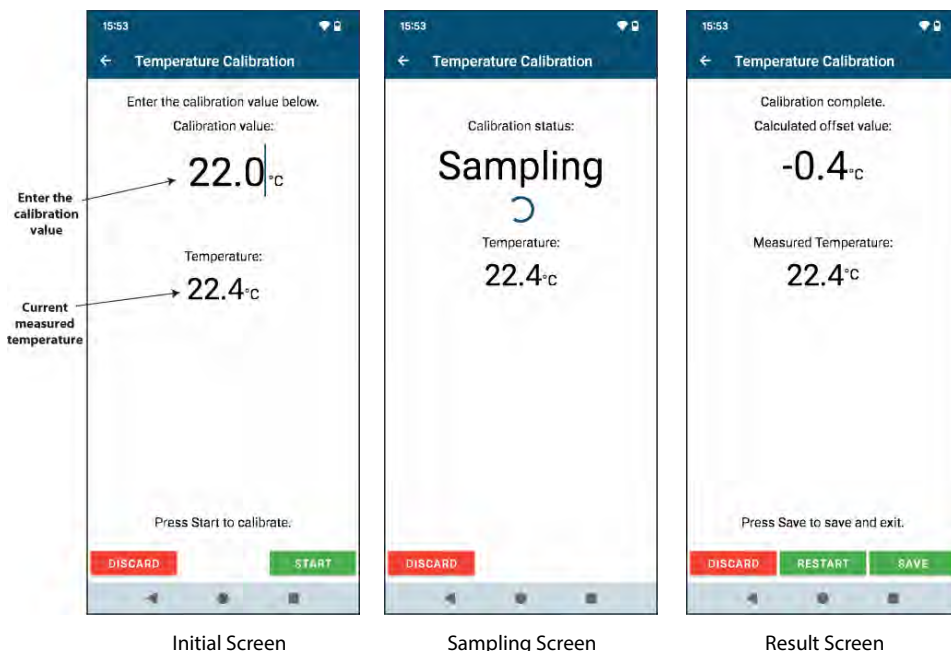
The temperature reading at the time of calibration.

Register/s	Type	Access	Condition/s	Value Limits	Units
2284	Float	Read	None	+/- XXX.X	See register 2012

Temperature Calibration

Calibration method using App

Click on temperature offset – calibrate. Once in the initial screen enter the temperature calibration value the user is simulating, and press start to begin calibration. The module will then begin sampling the temperature sensor, if the user wishes to abandon the calibration press the discard button. Once completed it will automatically move on the result screen to show the newly calculated temperature offset value, and the measured temperature value at the time of calibration. If the user is happy with the result press save, else press restart to return to the initial screen, or press discard to exit.



Calibration method using Modbus

First set the *Temperature Calibration Status* (2286) to *Calibration Mode* (1) and write the temperature calibration value the user is simulating to *Temperature Calibration Value* (2287).

Now to begin sampling the temperature reading set *Temperature Calibration Status* (2286) to *Begin Calibration* (2). Once the sampling is complete *Temperature Calibration Status* (2286) will automatically change to *Calibration Process Completed* (3).

The newly calculated temperature offset can be read from *Calculated Temperature Offset Value* (2289) along with the *Measured Temperature Value* (2291). If these are acceptable set *Temperature Calibration Status* (2286) to *Save Calibration* (4) if not set *Temperature Calibration Status* (2286) to either *Calibration Mode* (1) to restart the process or *Calibration Stopped* (0) to exit the calibration mode.

Note, to stop calibration at any point set *Temperature Calibration Status* (2286) to *Calibration Stopped* (0).

Temperature Calibration Status

Controls the temperature calibration process.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2286	Int	Read / Write	None	Calibration Stopped	0	None
				Set Module to Calibration Mode	1	None
				Begin Calibration	2	None
				Calibration Process Completed	3	None
				Save Calibration	4	None

Temperature Calibration Value

The temperature calibration value the user is simulating.

Register/s	Type	Access	Condition/s	Value Limits	Units
2287	Float	Write	None	-20.0 to 150.0 Units (2110) set to °C (0)	°C
				-4.0 to 302.0 Units (2110) set to °F (1)	°F

Calculated Temperature Offset Value

The result of the temperature offset calibration.

Register/s	Type	Access	Condition/s	Value Limits	Units
2289	Float	Read	None	+/- XXX.X	See reg. 2012

Measured Temperature Value

The temperature reading at the time of calibration.

Register/s	Type	Access	Condition/s	Value Limits	Units
2291	Float	Read	None	-20.0 to 150.0 Units (2110) set to °C (0)	°C
				-4.0 to 302.0 Units (2110) set to °F (1)	°F

Digital Output

The DEU18 is equipped with a single volt free, single pole, single throw, normally open relay, which can be used to indicate the module alarm status.

Operation

Mode

Select the operation mode of the Digital Output.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2401	Int	Read / Write	None	Disabled	0	None
				Alarm	1	None

Polarity

Configure whether the digital output opens or closes when active.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2402	Int	Read / Write	Mode (2401) not set to Disabled (0)	Normally Open	0	None
				Normally Closed	1	None

Alarm

Source

The digital output will energise when one of the following sources are active.

- Sensor Error– When a sensor related error is detected.
- Calibration – When a calibration is in progress.
- Offline – When the module is taken offline.
- Any Error – When any error is detected.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2403	Int	Read / Write	Mode (2401) set to Alarm (1)	Sensor Error	0	None
				Calibration Mode	1	None
				Offline Mode	2	None
				Any Error	3	None

mA Outputs

The DEU18 is fitted with two current outputs, either which can be used for the transmission of the primary variable or temperature. The current output menu contains all the necessary setup functions to configure the current output sources. The app will display the status of the current output on the measurement screen, where --mA indicates that the output is disabled.

Output

Mode

Enable the current output by selecting its output mode, either 0 – 20mA or 4 – 20mA.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A:2501 B:2601	Int	Read / Write	None	Disabled	0	None
				0 – 20mA	1	None
				4 – 20mA	2	None

Source

Select the source for the current output. Note, the temperature option is only available if the Temperature Input option in the Channel Menu is set to either PT1000 or PT100.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A:2502 B:2602	Int	Read / Write	Output Mode (A:2501, B:2601) Not set to Disabled (0)	Sensor	0	None
				Temperature	1	Temperature Input (2108) set to either PT100 (1) or PT1000 (2)

Scaling

Range

The current output's operating range.

This is only available if sensor range in the channel menu has been set to Auto. Else the output operates over the selected range of the channel.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A:2503 B:2603	Int	Read / Write	Output Mode (A:2501, B:2601)	0 to 999.9µS/cm	0	Sensor Units (2101) set to Conductivity (0)
				0 to 9.999mS/cm	1	

			B:2601) Not set to Disabled (0) and Source (A:2502 B:2602) set to Sensor (0) and Sensor Range (2105) set to Auto (0).	0 to 99.99mS/cm	2	Sensor Units (2101) set to TDS (1)
				0 to 999.9mS/cm	3	
				0 to 999.9ppm	4	
				0 to 9999ppm	5	
				0 to 99.99ppt	6	

Zero (0mA)

Enter the desired sensor value to be represented by 0mA (depends on current output mode). An inverse relationship can be achieved by setting the Zero greater than the Span.

If the sensor reading falls outside this or the span value an error will be activated.

Register/s	Type	Access	Condition/s	Value Limits & Units	
A:2504 B:2604	Float	Read / Write	Output Mode (A:2501, B:2601) set to 0 – 20mA (1)	If Source (A:2502, B:2602) set to Sensor (0)	As per either Sensor Range (2105) or Scaling Range (A:2503, B:2603) if Sensor Range is set to Auto
				If Source (A:2502, B:2602) set to Temperature (1) And Units (2110) set to °C (0)	-20.0 to 150.0°C
				If Source (A:2502, B:2602) set to Temperature (1) And Units (2110) set to °F (1)	-4.0 to 302.0°F

Zero (4mA)

Enter the desired sensor value to be represented by 4mA (depends on current output mode). An inverse relationship can be achieved by setting the Zero greater than the Span.

If the sensor reading falls outside this or the span value an error will be activated.

Register/s	Type	Access	Condition/s	Value Limits & Units	
A:2506 B:2606	Float	Read / Write	Output Mode (A:2501, B:2601) set to 4 – 20mA (2)	If Source (A:2502, B:2602) set to Sensor (0)	As per either Sensor Range (2105) or Scaling Range (A:2503, B:2603) if Sensor Range is set to Auto
				If Source (A:2502, B:2602) set to Temperature (1) And Units (2110) set to °C (0)	-20.0 to 150.0°C
				If Source (A:2502, B:2602) set to Temperature (1) And Units (2110) set to °F (1)	-4.0 to 302.0°F

Span (20mA)

Enter the desired sensor value to be represented by 20mA. An inverse relationship can be achieved by setting the Span less than the Zero.

If the sensor reading falls outside this or the zero value an error will be activated.

Register/s	Type	Access	Condition/s	Value Limits & Units	
A:2508 B:2608	Float	Read / Write	Output Mode (A:2501, B:2601) Not set to Disabled (0)	If Source (A:2502, B:2602) set to Sensor (0)	As per either Sensor Range (2105) or Scaling Range (A:2503, B:2603) if Sensor Range is set to Auto
				If Source (A:2502, B:2602) set to Temperature (1) And Units (2110) set to °C (0)	-20.0 to 150.0°C
				If Source (A:2502, B:2602) set to Temperature (1) And Units (2110) set to °F (1)	-4.0 to 302.0°F

Action

On Error

The current outputs can be programmed to output 0mA, 4mA, 22mA or hold their value when an error is detected on the input source (i.e. Sensor Fault, Temperature Fault), to provide remote warning of error conditions or to ensure fail safe operation.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A:2510 B:2610	Int	Read / Write	Output Mode (A:2501, B:2601) Not set to Disabled (0)	No Action	0	None
				Drive to 0mA	1	None
				Drive to 4mA	2	None
				Drive to 22mA	3	None
				Hold Level	4	None

Offline Mode

The current outputs can be programmed to output 0mA, 4mA, 22mA or hold their value when the module is put in an offline state.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A:2511 B:2611	Int	Read / Write	Output Mode (A:2501, B:2601) Not set to Disabled (0)	No Action	0	None
				Drive to 0mA	1	None
				Drive to 4mA	2	None
				Drive to 22mA	3	None
				Hold Level	4	None

Calibrate

Output

Permits the user to adjust the current output, to calibrate any equipment that may be being used to monitor the current output signal.

App Method

On entering the calibration function module will set the current output to a fixed value as per shown in the calibration menu. Enter the value as measured by the external meter in the displayed field then press next to proceed to the next point.

Repeat as before until both points have been calibrated. Next proceed to the check section where the current output will be set to a mid-point between to allow for calibration verification.

If the calibration is successful select Save, else select Restart to repeat the calibration or Discard to exit.

Modbus Method

4-20mA Mode Example

Set Current Output Calibration Status register (A:2530, B:2630) to 2 (Start 4mA Calibration), then write the measured current output value to the Calibration 4mA Value register (A:2533, B2633).

Next set the Current Output Calibration Status register to 3 (Start 20mA Calibration), then write the measured current output value to the Calibration 20mA Value register (A:2535, B2635).

Next set the Current Output Calibration Status register to 5 (Check Calibration 12mA). If satisfied with the calibration check value set the Current Output Calibration Status register to 6, else set the register to 0.

0-20mA Mode Example

Follow the above example but use Start 0mA Calibration state (1), instead of Start 4mA Calibration state (2), Calibration 0mA Value register (A:2531, B2631) instead of Calibration 4mA Value register and Check Calibration 10mA state (4) instead of Check Calibration 12mA state (5).

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A:2530 B:2630	Int	Read / Write	Output Mode (A:2501, B:2601) Not set to Disabled (0)	Stop Calibration	0	None
				Start 0mA Calibration	1	Output Mode (A:2501, B:2601) set to 0 – 20mA (1)
				Start 4mA Calibration	2	Output Mode (A:2501, B:2601) set to 4 – 20mA (2)
				Start 20mA Calibration	3	None
				Check Calibration 10mA	4	Output Mode (A:2501, B:2601) set to 0 – 20mA (1)
				Check Calibration 12mA	5	Output Mode (A:2501, B:2601) set to 4 – 20mA (2)
				Save Calibration	6	None

Calibration 0mA Value					
Register/s	Type	Access	Condition/s	Value Limits	Units
A:2531 B:2631	Float	Write	Output Mode (A:2501, B:2601) set to 0 – 20mA (1)	0.000 to 2.000	mA
Calibration 4mA Value					
Register/s	Type	Access	Condition/s	Value Limits	Units
A:2533 B:2633	Float	Write	Output Mode (A:2501, B:2601) set to 4 – 20mA (2)	2.000 to 6.000	mA
Calibration 20mA Value					
Register/s	Type	Access	Condition/s	Value Limits	Units
A:2535 B:2635	Float	Write	Output Mode (A:2501, B:2601) Not set to Disabled (0)	18.000 to 22.000	mA

Reset						
Used to reset any user calibration applied to the 0/4-20mA Current Output						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A:2512 B:2612	Int	Read / Write	Output Mode (A:2501, B:2601) Not set to Disabled (0)	Done	0	None
				Reset Calibration (Clears to 0 once complete)	1	None

Digital Input

The DEU18 is fitted with a single digital input. The digital input menu contains all the necessary setup functions to configure the digital input sources. This input is intended to be switched using a volt free link, switch or relay. The user can select whether closing or opening the contact initiates the configured action.

Operation

Function						
The digital input can be configured to operate in the following ways:						
❖ Offline ❖ Interlock ❖ Flow Switch ❖ Tank Level ❖ Switch Setup						
Offline, Interlock, Flow Switch and Tank Level – When active will take the module “offline”. This causes any digital outputs to de-energise, the 0/4-20mA output to change to its set offline state and the selected function message to appear on the measurement screen.						
Switch Setup – When active the module will load the configuration that has been stored in one of the two internal save stores. The original configuration is restored upon the digital input going inactive.						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2701	Int	Read / Write	None	Disabled	0	None
				Offline	1	None
				Interlock	2	None
				Flow Switch	3	None
				Tank Level	4	None
				Switch Setup	5	Save Store A Present (3102 = 1) or Save Store B Present (3111 = 1)

Store						
Select which store to load when using Switch Setup.						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2702	Int	Read / Write	Function (2701) set to Switch Setup (5)	Store A	0	Save Store A Present (3102 = 1)
				Store B	1	Save Store B Present (3111 = 1)

Polarity Configure whether the digital input activates on the closing of circuit (normal) or the opening of the circuit (reverse).						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2703	Int	Read / Write	Function (2701) not set to Disabled (0)	Normally Open	0	None
				Normally Closed	1	None

Configuration

The configuration menu enables the user to configure the basic operating parameters of the module.

Time & Date

Current					
The module's current internal Time and Date.					
Hour					
Register/s	Type	Access	Condition/s	Value Limits	Units
2801	Int	Read / Write	None	0-23	Hour
Minute					
Register/s	Type	Access	Condition/s	Value Limits	Units
2802	Int	Read / Write	None	0-59	Minute
Day					
Register/s	Type	Access	Condition/s	Value Limits	Units
2803	Int	Read / Write	None	1-31	Day
Month					
Register/s	Type	Access	Condition/s	Value Limits	Units
2804	Int	Read / Write	None	1-12	Month
Year					
Register/s	Type	Access	Condition/s	Value Limits	Units
2805	Int	Read / Write	None	2000-3000	Year

Update						
Set the module's time as to the time on the device running the app.						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
App Only						

Security Code

Change Code

Sets the security access code used by the LTH Discover app to prohibit changes to the module's configuration by unauthorised personnel.

Note, if set to 0000 the security code is permanently disabled unless changed back to another number.

Register/s	Type	Access	Condition/s	Value Limits	
App Only					

Hardware

User Label

Set's the module's user label as displayed instead of the serial number in the Bluetooth discovery screen and measurement screen.

Note, leave blank to revert back to using the module's serial number.

Register/s	Type	Access	Condition/s	Value Limits	Units
2807	ASCII 4 Bytes	Read / Write	None	8 Characters - ASCII Codes 0x20 to 0x7E (2 Characters per Register) Each Register Read as (Upper Byte << 8 Lower Byte << 0) Unused characters set to 0	None

Model

The module's model Type

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2812	Int	Read	None	DEU18	2	None

Serial Number

The module's Serial Number

Register/s	Type	Access	Condition/s	Value Limits	Units
2813	Long	Read	None	8 Digits	None

Configuration

MAC Address The module's Ethernet port MAC Address Hexadecimal format with each register holding 4 digits, Register read as (Upper Byte << 8 Lower Byte << 0)					
Register/s	Type	Access	Condition/s	Value Limits	Units
2815	3 Byte Hex	Read	None	XX-XX-XX-XX-XX-XX	None

Unlock

Modbus The DXU18 series features optional functions which when purchased will expand the module's capabilities. By default, the Modbus function of the DXU18 is locked. it can be unlocked by LTH or your local distributor at the time of order. Alternatively, the Modbus function may be ordered after purchase by supplying LTH or your local distributor the serial number of your module along with the purchase order. In return they will supply you with an 8 digit unlock code that is unique to the module and the required function to be unlocked.					
Register/s	Type	Access	Condition/s	Value Limits	Units
App Only					

Firmware

Module Firmware Version The module's main firmware version number.					
Register/s	Type	Access	Condition/s	Value Limits	Units
2821	Long	Read	None	Format: AA.BB.CC Read as: AA << 16 BB << 8 CC << 0	None
Measurement Firmware Version The module's measurement section firmware version number.					
Register/s	Type	Access	Condition/s	Value Limits	Units
2823	Long	Read	None	Format: AA.BB.CC Read as: AA << 16 BB << 8 CC << 0	None

Bluetooth Firmware Version

The module's Bluetooth section firmware version number.

Register/s	Type	Access	Condition/s	Value Limits	Units
2825	Long	Read	None	Format: AA.BB.CC Read as: AA << 16 BB << 8 CC << 0	None

Update Module Firmware

Update the Module's main firmware.

When selected the app gives the user the option of using either the firmware bundled with the LTH Discover app or alternatively using a different version of firmware that LTH may have provided separately by browsing to the firmware "*.bin" file location on the phone. Note, when using iOS, the file must be located in the LTH Discover folder as found in the On My iPhone folder.

Note, Updating the firmware may take up to 5 minutes to complete, during which the device uploading the firmware must remain connected to the module via Bluetooth by staying within range of the module and with the LTH Discover app open.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
App Only						

Modbus

The DEU18 features an optional Modbus interface via either RTU or ASCII over RS-485 or RCP/IP over Ethernet. Using the interface the module's measurements can be read, status checked, configurations changed, and calibrations performed.

Note, by default the Modbus functionality is locked, and requires an additional purchase to unlock. This can be done at the time of ordering the module or alternatively may be ordered after purchase by supplying LTH or your local distributor the serial number of your module along with the purchase order. In return they will supply you with an 8 digit unlock code that is unique to the module.

Supported Modbus Function Codes

Function Code	Type	Function
3	Read Holding Register	Reads one or more registers. 1 to a maximum of 125 consecutive registers (1 register = 2 bytes) can be read with a telegram.
6	Write Single Register	Write a single register with a new value. ! Note. Registers whose address space consume more than one register i.e. Floats, cannot be set using this function code.
16	Write Multiple Registers	Writes several registers with a new value. A maximum of 120 consecutive registers can be written with a single telegram.

! Maximum number of writes - If a non-volatile parameter is modified via the Modbus this change is saved in the internal module storage. The number of writes to the storage is technically restricted to a maximum of 1 million. Attention must be paid to this limit since, if exceeded, it results in data loss and module failure. For this reason, avoid constantly writing module parameters via the Modbus.

Response Times - The time it takes the module to respond to a request telegram from the Modbus master is typically 25 to 50 milliseconds. It may take longer for a command to be executed in the module. Thus, the data is not updated until the command has been executed. Write commands especially are affected by this.

Data types - the following data types are supported by the module:

- **FLOAT** – Floating point numbers IEE 754, Data length 4 bytes (2 registers)

Byte 3	Byte 2	Byte 1	Byte 0
SEEEEEEE	EMMMMMMM	MMMMMMMM	MMMMMMMM

S = Sign, E = Exponent, M = Mantissa

- **INT** – Integer (16 bits), Data length 2 bytes (1 register)

Byte 1	Byte 0
Most Significant Bit (MSB)	Least Significant Bit (LSB)

- **LONG** – Long Integer (32 bits), Data length 4 bytes (2 registers)

Byte 3	Byte 2	Byte 1	Byte 0
Most Significant Bit (MSB)	...	...	Least Significant Bit (LSB)

Byte Transmission Sequence – The bytes are transmitted in the following data order:

Type	1 st	2 nd	3 rd	4 th
FLOAT (Big Endian)	Byte 3 (SEEEEEEE)	Byte 2 (EMMMMMMM)	Byte 1 (MMMMMMMM)	Byte 0 (MMMMMMMM)
INT	Byte 1 (MSB)	Byte 0 (LSB)		
LONG (Big Endian)	Byte 3 (MSB)	Byte 2	Byte 1	Byte 0 (LSB)

Operation

Mode

Set the operation mode of the Modbus interface, note the RS485 and Ethernet interfaces cannot both be used at the same time.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2901	Int	Read / Write	None	Disabled	0	None
				RS485 RTU	1	None
				RS485 ASCII	2	None
				Ethernet TCP/IP	3	None

Slave Address

Set the slave address of the Module when using the RS485 interface.

Register/s	Type	Access	Condition/s	Value Limits	Units
2902	Int	Read / Write	Mode (2901) set to either RS485 RTU (1) or RS485 ASCII (2)	1-255	None

Interface

Baud Rate

Set the RS485 interface baud rate.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2903	Int	Read / Write	Mode (2901) set to either RS485 RTU (1) or RS485 ASCII (2)	300	0	None
				600	1	None
				1200	2	None
				2400	3	None
				4800	4	None
				9600	5	None

				19200	6	None
				31250	7	None
				38400	8	None

Parity Set the parity format of the RS485 interface.						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2904	Int	Read / Write	Mode (2901) set to either RS485 RTU (1) or RS485 ASCII (2)	None	0	None
				Odd	1	None
				Even	2	None

Stop Bits Set the number of stop bits used by the RS485 interface.						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2905	Int	Read / Write	Mode (2901) set to either RS485 RTU (1) or RS485 ASCII (2)	1	0	None
				2	1	None

Use DHCP If available on the connected network use the DHCP server to automatically configure the TCP/IP interface. Note, if required the module's MAC address can be found in the configuration menu.						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
2906	Int	Read / Write	Mode (2901) set to Ethernet TCP/IP (3)	No	0	None
				Yes	1	None

TCP/IP Address If not using DHCP, specify the Module's own TCP/IP address. If using DHCP this menu will display the DHCP assigned Gateway Address.						
Register/s	Type	Access	Condition/s	Value Limits		Units
2907 (DHCP Disabled)	Long	Read / Write	Mode (2901) set to Ethernet TCP/IP (3) and Use DHCP (2906) set to No (0)	Format: AAA.BBB.CCC.DDD Equal to:		None

2909 (DHCP Enabled)		Read	Mode (2901) set to Ethernet TCP/IP (3) and Use DHCP (2906) set to Yes (1)	AAA << 0 BBB << 8 CCC << 16 DDD << 24 Each element 0-255	
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Gateway Address

If not using DHCP, specify the Gateway Address on the IP network the module is connected to. Note, if no Gateway is present the Address can be set to 0.0.0.0.

If using DHCP this menu will display the DHCP assigned Gateway Address.

Register/s	Type	Access	Condition/s	Value Limits	Units
2911 (DHCP Disabled)	Long	Read / Write	Mode (2901) set to Ethernet TCP/IP (3) and Use DHCP (2906) set to No (0)	Format: AAA.BBB.CCC.DDD Equal to: AAA << 0 BBB << 8 CCC << 16 DDD << 24 Each element 0-255	None
2913 (DHCP Enabled)		Read	Mode (2901) set to Ethernet TCP/IP (3) and Use DHCP (2906) set to Yes (1)		

Subnet Mask

If not using DHCP, specify the Subnet Mask of the IP network the module is connected to.

If using DHCP this menu will display the DHCP assigned Subnet Mask.

Register/s	Type	Access	Condition/s	Value Limits	Units
2915 (DHCP Disabled)	Long	Read / Write	Mode (2901) set to Ethernet TCP/IP (3) and Use DHCP (2906) set to No (0)	Format: AAA.BBB.CCC.DDD Equal to: AAA << 0 BBB << 8 CCC << 16 DDD << 24 Each element 0-255	None
2917 (DHCP Enabled)		Read	Mode (2901) set to Ethernet TCP/IP (3) and Use DHCP (2906) set to Yes (1)		

Port Number

Specify the TCP port the Modbus communication utilises.

Unless already in use by a different process, recommend leaving as the Modbus standard port of 502.

Register/s	Type	Access	Condition/s	Value Limits	Units
2919	Int	Read / Write	Mode (2901) set to Ethernet TCP/IP (3)	1-65535	None

Save, Restore & Reset

The DEU18 features the ability to save and restore the current configuration of the module to one of two stores "A and B". In addition, using the LTH Discover app the user can save the configuration of the module to the phone which can then be used to setup additional modules or emailed to LTH or your local distributor to help with support issues.

The save and restore menu also features the ability to reset the whole module back to its factory settings.

Stores

Save

Save the configuration of the module to one of the internal module stores A or B.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A:3101 B:3110	Int	Read / Write	None	Done	0	None
				Perform Save	1	None
				Note, returns to 0 once complete		

Save Present

Indicates if either of the internal module stores A or B has an existing save stored in them.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A:3102 B:3111	Int	Read	None	No save present	0	None
				Save Present	1	None

Store Time and Date

The time and date of the internal module store. Returns 0 if no store present.

Hour

Register/s	Type	Access	Condition/s	Value Limits	Units
A:3103 B:3112	Int	Read	None	0-23	Hour

Minute

Register/s	Type	Access	Condition/s	Value Limits	Units
A:3104 B:3113	Int	Read	None	0-59	Minute

Day					
Register/s	Type	Access	Condition/s	Value Limits	Units
A:3105 B:3114	Int	Read	None	1-31	Day
Month					
Register/s	Type	Access	Condition/s	Value Limits	Units
A:3106 B:3115	Int	Read	None	1-12	Month
Year					
Register/s	Type	Access	Condition/s	Value Limits	Units
A:3107 B:3116	Int	Read	None	2000-3000	Year

Restore						
Restore the module configuration from one of the internal module stores.						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A:3108 B:3117	Int	Read	None	Done	0	None
				Perform Restore	1	None
				Note, returns to 0 once complete		

Delete						
Delete the module configuration from one of the internal module stores.						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A:3109 B:3118	Int	Read	None	Done	0	None
				Perform Delete	1	None
				Note, returns to 0 once complete		

Phone – Upload to Module						
Upload a module configuration saved as a .json file from the phone to the module.						
Note, when using iOS, the file must be located in the <i>LTH Discover</i> folder as found in the <i>On My iPhone</i> folder.						
Register/s	Type	Access	Condition/s	Option	Value	Condition/s
App Only						

Phone – Download from Module

Download the module configuration as a .json file from the module to the phone.

Note, when using iOS, the downloaded file will be located in the *LTH Discover* folder as found in the *On My iPhone* folder.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
App Only						

Default

Module

Reset the module to back to its factory settings.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
3100	Int	Read / Write	None	Done	0	None
				Perform Reset <i>Note, returns to 0 once complete</i>	1	None

Errors

The DEU18 features an extensive error system that constantly monitors the condition of the base module, the sensor inputs, and the current outputs. When an error occurs, the module will indicate via the status LED on the enclosure front. Additionally, if configured the current outputs will change to their error state, and the digital output will energise.

When using the *LTH Discover* app, a full break down of currently active errors can be seen in the Error menu which is accessible via the main menu or by clicking on the error icon, if present, in the top left of the measurement screen. Whilst in the error menu, clicking on any of the active errors brings up a detailed description of the error and suggested remedies for the issue.

Additional guidance to fixing faults can be found in the Fault Finding section from page 93.

Module Errors

E01: Read/Write Error

Try switching the module off and then on again. If the message persists, consult with your supplier, as this module may require to be returned for repair.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
3200 Bit 1	Int	Read	None	Error Not Present	0	None
				Error Present	1	None

E02: Data Error

The module configuration has for some reason become corrupted. Try switching the module off and then on again. If the message persists use the Default Module function in the Save/Restore menu or consult with your supplier, as this module may require to be returned for repair.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
3200 Bit 2	Int	Read	None	Error Not Present	0	None
				Error Present	1	None

E03: Storage Error

The save setup configuration has for some reason become corrupted. Try switching the module off and then on again. If the message persists use the delete setup function in the Save/Restore menu or consult with your supplier, as this module may require to be returned for repair.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
3200 Bit 3	Int	Read	None	Error Not Present	0	None
				Error Present	1	None

E04: Factory Error

The factory configuration has for some reason become corrupted. Try switching the module off and then on again. If the message persists, consult with your supplier, as this module may require to be returned for repair.

<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Option</i>	<i>Value</i>	<i>Condition/s</i>
3200 Bit 4	Int	Read	None	Error Not Present	0	None
				Error Present	1	None

E05: User Cal Error

The module's user calibration has for some reason become corrupted. Try switching the module off and then on again. If the message persists use the Default module function in the Save/Restore menu or consult with your supplier, as this module may require to be returned for repair.

<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Option</i>	<i>Value</i>	<i>Condition/s</i>
3200 Bit 5	Int	Read	None	Error Not Present	0	None
				Error Present	1	None

Sensor Input Errors

E23: Sensor Over Range

The sensor reading is greater than the configured operating range, check channel settings, sensor condition and connections. If the message persists, please consult with your supplier.

<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Option</i>	<i>Value</i>	<i>Condition/s</i>
3202 Bit 3	Int	Read	None	Error Not Present	0	None
				Error Present	1	None

E24: Sensor Under Range

The sensor reading is less than the configured operating range, check channel settings, sensor condition and connections. If the message persists, please consult with your supplier.

<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Option</i>	<i>Value</i>	<i>Condition/s</i>
3202 Bit 4	Int	Read	None	Error Not Present	0	None
				Error Present	1	None

E31: Temperature Over Range

The temperature reading is greater than the configured operating range, check channel settings, sensor condition and connections. If the message persists, please consult with your supplier.

<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Option</i>	<i>Value</i>	<i>Condition/s</i>
3203 Bit 1	Int	Read	None	Error Not Present	0	None
				Error Present	1	None

E32: Temperature Under Range

The temperature reading is less than the configured operating range, check channel settings, sensor condition and connections. If the message persists, please consult with your supplier.

<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Option</i>	<i>Value</i>	<i>Condition/s</i>
3203 Bit 2	Int	Read	None	Error Not Present	0	None
				Error Present	1	None

Current Output Errors

E61: Output A Hardware**E71: Output B Hardware**

The current output circuit has detected an error in the current output loop; this is most commonly due to either a broken loop or too large a load resistor.

<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Option</i>	<i>Value</i>	<i>Condition/s</i>
A: 3206 Bit 1 B: 3207 Bit 1	Int	Read	None	Error Not Present	0	None
				Error Present	1	None

E62: Source < Output A Zero**E72: Source < Output B Zero**

The source's input level is less than that set for the current output zero.

<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Option</i>	<i>Value</i>	<i>Condition/s</i>
A: 3206 Bit 2 B: 3207 Bit 2	Int	Read	None	Error Not Present	0	None
				Error Present	1	None

E63: Source > Output A Span**E73: Source > Output B Span**

The source's input level is greater than that set for the current output span.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A: 3206 Bit 3 B: 3207 Bit 3	Int	Read	None	Error Not Present	0	None
				Error Present	1	None

E64: Source > Output A Zero**E74: Source > Output B Zero**

The source's input level is greater than that set for the current output zero.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A: 3206 Bit 4 B: 3207 Bit 4	Int	Read	None	Error Not Present	0	None
				Error Present	1	None

E65: Source < Output A Span**E75: Source < Output B Span**

The source's input level is less than that set for the current output span.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A: 3206 Bit 5 B: 3207 Bit 5	Int	Read	None	Error Not Present	0	None
				Error Present	1	None

Service Messages

M81: Service Due

The Planned Service interval for this module has expired. Please contact LTH Electronics at the details below:

LTH Electronics Ltd
 Chaul End Lane, Luton, Beds
 LU4 8EZ
 Tel. 0044 (0) 1582 593693, Email: sales@lth.co.uk

NB. LTH overseas users should contact their LTH distributor – See www.lth.co.uk for details.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
A: 3208 Bit 1	Int	Read	None	Message Not Present	0	None
				Message Present	1	None

M82: Calibration Due The time since the last calibration was performed has exceeded the time set in the calibration menu.						
<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Option</i>	<i>Value</i>	<i>Condition/s</i>
A: 3208 Bit 2	Int	Read	None	Message Not Present	0	None
				Message Present	1	None

Service

The DEU18 features a service reminder system that will inform the user when the module is due its service.

Reminder

Enabled

Set's whether the service reminder is enabled or not.

Requires service security code prior to use.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
App Only						

Interval

Specify the number of days between servicing.

Requires service security code prior to use.

Register/s	Type	Access	Condition/s	Value Limits	Units
App Only					

Date

The date of the next service reminder.

Requires service security code prior to use.

Register/s	Type	Access	Condition/s	Value Limits	Units
App Only					

Update

Set the next service date to the current date plus the number of interval days.

Requires service security code prior to use.

Register/s	Type	Access	Condition/s	Option	Value	Condition/s
App Only						

Defer

Once the service alarm has occurred, allows the user to temporarily disable the alarm for 7 days whilst they arrange for a service visit.

<i>Register/s</i>	<i>Type</i>	<i>Access</i>	<i>Condition/s</i>	<i>Option</i>	<i>Value</i>	<i>Condition/s</i>
<i>App Only</i>						

Appendix A – Solution Conversion

The following table provides some of the data points which have been used in the instrument to make the conversion between conductivity and solution concentration.

Temperature Compensated Conductivity (mS/cm @ 25°C)							
% wt / vol	NaOH	NaCl	HCl	H ₂ SO ₄	H ₃ PO ₄	HNO ₃	Salinity
1	56.00	17.61	102.0	48.99	10.29	66.67	19.04
5	226.8	72.86	426.4	212.3	33.48	268.5	90.00
10	355.9	128.5	694.4	398.4	61.11	483.3	172.3
20	-----	206.4	-----	661.7	116.4	734.1	324.3

Note: Salinity range is displayed by the instrument in parts per thousand concentration (p.p.t.), which is the concentration in % shown above, multiplied by 100.

Temperature Compensation Slope (% / °C)							
% / °C	NaOH	NaCl	HCl	H ₂ SO ₄	H ₃ PO ₄	HNO ₃	Salinity
-----	1.79	1.90	1.27	1.03	0.86	1.19	1.92

Appendix B - Temperature Coefficient

Calculating the temperature coefficient of a solution

If the temperature coefficient of the solution being monitored is not known, the DEU18 can be used to determine that coefficient. You should set the conductivity input channel to a suitable range and the temperature coefficient to 0.0%.

The following measurements should be made as near to the normal operating point as practical, between 5°C and 70°C for the highest accuracy. Immerse the measuring cell in at least 500 ml of the solution to be evaluated, allow sufficient time to stabilise, approximately one or two minutes, and then record both the temperature and conductivity readings. Raise the solution temperature by at least 10°C and again record the temperature and conductivity readings. Using the following equation, the temperature compensation slope can be calculated in percentage terms:

$$\alpha = \frac{(G_x - G_y) \times 100\%}{G_y(T_x - 25) - G_x(T_y - 25)} \quad (\text{base temperature } 25^\circ\text{C})$$

Note: If base temperature is set to 20°C, then replace 25 with 20 in the above equation.

Term	Description
G_x	Conductivity in $\mu\text{S/cm}$ at temperature T_x
G_y	Conductivity in $\mu\text{S/cm}$ at temperature T_y

Note: One of these measurements can be made at ambient temperature.

Set the temperature compensation slope to the calculated value. The temperature compensation is now set up for normal operation.

If it is difficult or impossible to evaluate the temperature compensation slope using this method, a 2.0 % / °C setting will generally give a good first approximation until the true value can be determined by independent means.

Temperature Data

The table below lists approximate resistance values of temperature sensors that may be used with the DEU18.

Temperature (°C)	Pt1000 RTD
0	1000.0 Ω
10	1039.0 Ω
20	1077.9 Ω
25	1097.3 Ω
30	1116.7 Ω
40	1155.4 Ω
50	1194.0 Ω
60	1232.4 Ω
70	1270.7 Ω
80	1308.9 Ω
90	1347.0 Ω
100	1385.0 Ω

Appendix C - Table of conductivity variation with temperature of LTH standard solutions

°C	147µS/cm	1.413mS/cm	12.88mS/cm	111.8mS/cm
	µS/cm	mS/cm	mS/cm	mS/cm
5	92.7	0.894	8.22	70.9
10	105.6	1.007	9.33	80.7
15	118.5	1.139	10.44	90.8
16	121.4	1.167	10.68	92.8
17	124.2	1.194	10.93	94.9
18	127.1	1.221	11.17	97.0
19	129.9	1.249	11.42	99.0
20	132.8	1.276	11.66	101.1
21	135.6	1.304	11.91	103.2
22	138.5	1.331	12.15	105.3
23	141.3	1.358	12.40	107.5
24	144.2	1.386	12.64	109.6
25	147.0	1.413	12.88	111.8
30	161.2	1.550	14.11	122.6
35	177.0	1.694	15.39	133.7
40	191.5	1.833	16.68	145.1
45	207.4	1.989	18.02	156.7
50	222.9	2.139	19.34	168.6

Appendix D – Radio Declarations

United States (FCC)

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Canada (ISED)

This device complies with Industry Canada license exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Transmitter Antenna (from Section 7.1.2 RSS-Gen, Issue 3, December 2010): User manuals for transmitters shall display the following notice in a conspicuous location: Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Fault Finding

NOTE: THERE ARE NO USER SERVICEABLE PARTS INSIDE THE UNIT

The DEU18 has been designed to include a wide range of self-diagnostic test, some of which are performed at switch on, and some on a continuous basis. This guide aims to provide a route to diagnosing and correcting any faults that may occur during normal operation. The table shown in the Errors section on page 82 gives a list that the DEU18 generates, along with their probable causes. If the fault has not been cleared after these checks have been made contact LTH. Please have as much of the following information available as possible in any communication with LTH, to enable quick diagnosis and correction of the problem.

- Serial number of the module.
- The approximate date of purchase.
- Details of the program settings and application.
- Electrical environment and supply details.
- Circumstances under which the fault occurred.
- The nature of the fault or faults.
- Any error messages that are displayed.
- The sensor type, cable length and type.
- Current output configuration.
- Digital Output configuration.
- Digital Input configuration.

It is often worthwhile to check the measurement by an independent method, for example using a handheld meter.

The Module Appears Dead

Check that power is available to the unit. Using a voltmeter, set to DC, check the power supply voltage at the connector. The design of the DEU18 allows the unit to accept from 12 to 30V DC. Check that the power cable is securely and correctly attached. There are no user serviceable fuses fitted within this unit.

The Access Code Does Not Work

It is probable that the access code has either been changed or the operator does not recall the code correctly. Contact LTH or your local distributor should this problem arise.

The Sensor Reading Is Constantly Over-range or Under-range

- Ensure that the sensor and temperature inputs are correctly connected (see Installation and Choice of Electrodeless Conductivity Sensors, page 17) and that the sensor is not faulty or damaged.
- Check that the correct range, sensor type has been entered within the Channel Setup menu if in doubt set to Auto Range (see page 28).
- Check the temperature compensation state (see Channel Setup page 30) If the compensation is set to "Manual" check that the fixed temperature is at the correct level. If the compensation is "Automatic" check that the temperature reading on the main display is correct.
- Check that the sensor is "seeing" a representative sample, trapped air will give a low reading.
- Ensure the input is correctly connected and the sensor is not faulty or damaged.
- Check the sensor and its cable for possible short circuits. Consider the fact that the conductivity may be higher than the range of the instrument.
- Check the Pt1000 RTD temperature sensor connections.
- Check that any in-line junction boxes and extension cables have been fitted and wired up correctly.

The display reads zero

- Check for open circuit sensor (conductivity or TDS modes)
- Check for damage to the connecting cable.
- Check that all input connections are secure.
- Check the sensor is wired up correctly.
- Check the sensor is immersed in the correct solution.

The Sensor Reading Is Incorrect

- Low reading due to incomplete immersion.
- There may be some trapped matter within the sensor bore.
- High conductivity readings caused by a short circuit or leakage of liquid contamination into the sensor moulding.
- Low conductivity can be caused by accumulation of trapped air or gas coming out of solution. Check that no "air traps" exist in the sensor installation.
- High conductivity readings caused by leakage of solution into the sensor. This usually indicates that the sensor material has been fractured and the sensor must be replaced.
- First check that the temperature resistance is correct, otherwise the temperature compensation circuit will cause false or erratic readings. Temporarily switching out the temperature compensation can help to show if this is the cause of the problem.
- If another electrodeless sensor is available, this can be used to determine whether the fault lies with the instrument or the sensor.
- Check that the sensor cable is not damaged or broken and that the outer screen does not make contact with any other terminals or metal work.
- Check that the sensor cable is sufficiently distant from power cables or electrical noise sources.
- Check that the correct sensor type has been installed.
- Check that the correct range has been selected.
- Check that the correct sensor loop resistor calibration values have been used.
- Check that the calibration procedure has been followed precisely.
- Check that the temperature compensation has been set up as required.
- Check that the sensor cable does not exceed the maximum specified length (sensor 5m + extension 25m).

The Temperature Reading Is Incorrect

- Check that the temperature sensor is correctly attached. (See Temperature Sensor Connections, page 20)
- Check that the temperature sensor type is correctly selected in the Channel Setup menu.
- Where practical check the temperature sensor resistance against the table in Temperature Data, page 90.

Current Output is Incorrect or Noisy

- Check that the maximum load for the current loop has not been exceeded. (750 Ω).
- Check that the terminals have been wired correctly.
- Check that the cable screen is attached to Earth at one end and that the cable does not pass too close to a power cable.
- Check that the current output has been configured properly.

Guarantee and Service

Products manufactured by LTH Electronics Ltd are guaranteed against faulty workmanship and materials for a period of three years from the date of despatch, except for finished goods not of LTH manufacture, which are subject to a separate agreement.

All sensors made by LTH Electronics Ltd are thoroughly tested to their published specification before despatch. As LTH have no control over the conditions in which their sensors are used, no further guarantee is given, although any complaints concerning their operation will be carefully investigated.

Goods for attention under guarantee (unless otherwise agreed) must be returned to the factory carriage paid and, if accepted for free repair, will be returned to the customer's address free of charge. Arrangements can also be made for repair on site; in which case a charge may be made for the engineer's time and expenses.

If any services other than those covered by the guarantee are required, please contact LTH direct.

N.B. Overseas users should contact their LTH nominated representative. Special arrangements will be made in individual cases for goods returned from overseas.



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