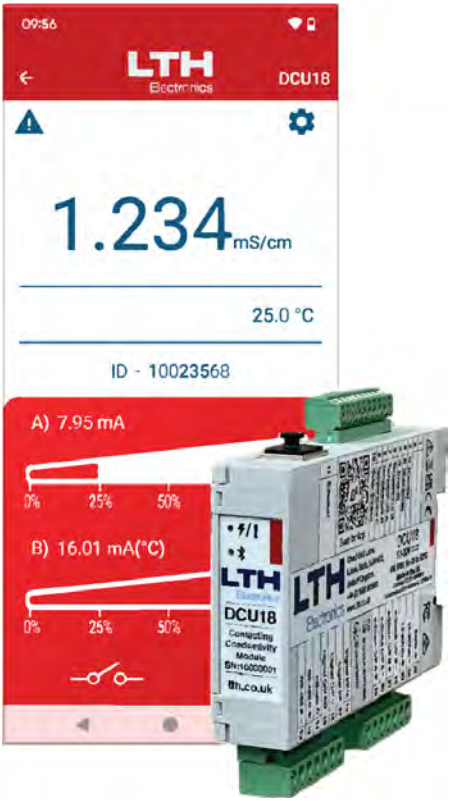
DCU18

Contacting Conductivity Measurement Module & LTH Discover App



Operation Guide

Preface

Product warranty

The DCU18 Contacting 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
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We,	**LTH Electronics Ltd** declare under our sole responsibility that the produce / products
Product identification	**DCU18**

to which this declaration relates is/are in conformity with all essential requirements of the UK statutory requirements relating to:

Radio Equipment Directive	**SI 2017 No. 1206**
Hamonised Standards	**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	**SI 2012 No. 3032**
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

EU Declaration of Conformity
EU-Konformitätserklärung
Déclaration UE de Conformité

Chaul End Lane
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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	**DCU18**

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 Équipements 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

Contents

Introduction

The DCU18 is a microprocessor-controlled contacting conductivity measurement DIN rail mounted module, which can be used with a wide range of LTH contacting 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.

DCU18 Specification

Measurement Input	Any LTH contacting conductivity cell. Other manufacturer's cells can be accommodated.
Connection Cable	Up to 30 meters LTH 54D.
Ranges of Measurement	0-9.999 µS/cm to 0-999.9 mS/cm (K= 0.01 to 10.0). 0-99.99 kΩ/cm to 0-99.99 MΩ/cm (K= 0.01 to 1.0). 0-9.999 ppm to 0-99.99 ppt. (parts per thousand). See the following range / cell constant table for further information.
Cell Constant Adjustment	Fully adjustable from 0.005 to 15.00.
Range Selection	Internal single or auto range.
Accuracy	± 0.5% 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	Pt100 / 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 fixed UPW curve plus 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)

Range & Sensor Compatibility Tables

CONDUCTIVITY RANGE	NOMINAL CELL CONSTANT			
	0.010	0.100	1.000	10.00
0 to 9.999 µS/cm	✓	✓	×	×
0 to 99.99 µS/cm	✓	✓	✓	×
0 to 999.9 µS/cm	×	✓	✓	✓
0 to 9999 µS/cm	×	×	Note 1	Note 1
0 to 9.999 mS/cm	×	×	✓	✓
0 to 99.99 mS/cm	×	×	Note 2	✓
0 to 999.9 mS/cm	×	×	×	Note 2

RESISTIVITY RANGE	NOMINAL CELL CONSTANT			
	0.010	0.100	1.000	10.00
0 to 99.99 kΩ-cm	×	✓	✓	×
0 to 999.9 kΩ-cm	✓	✓	×	×
0 to 9.999 MΩ-cm	✓	✓	×	×
0 to 99.99 MΩ-cm	✓	×	×	×

TOTAL DISSOLVED SOLIDS RANGE	NOMINAL CELL CONSTANT			
	0.010	0.100	1.000	10.00
0 to 9.999 ppm	✓	✓	×	×
0 to 99.99 ppm	✓	✓	✓	×
0 to 999.9 ppm	×	✓	✓	✓
0 to 9999 ppm	×	×	✓	✓
0 to 99.99 ppt	×	×	✓	✓

Note 1: 0 to 9999 µS/cm range only available as a fixed range option.

Note 2: Maximum measurement range will be limited by solution temperature. With the temperature compensation slope set to 2%/°C derate linearly from full scale at 25°C to 50% of scale at 100°C.

Total Dissolved Solids in ppm = µS/cm * F, where F = TDS Factor (0.50 - 0.90)

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:

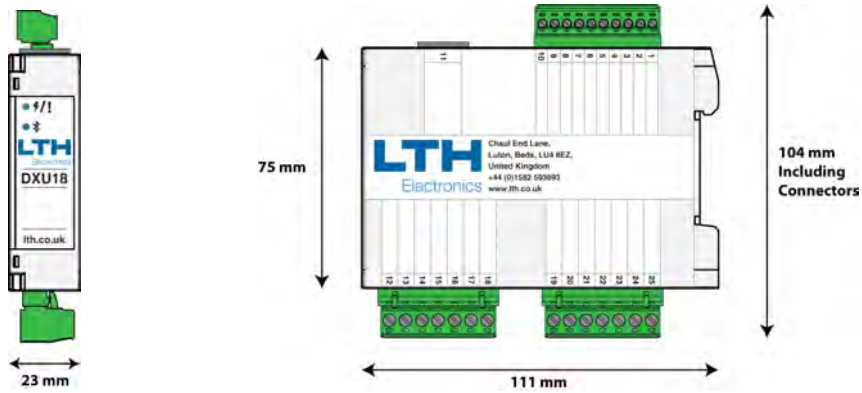
- Fit arc suppressors across active relay or contactor contacts in the vicinity.

- 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.

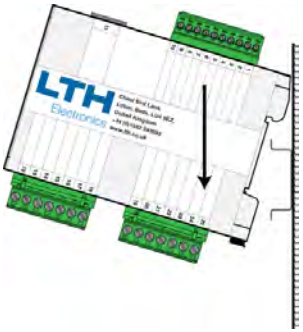
Enclosure



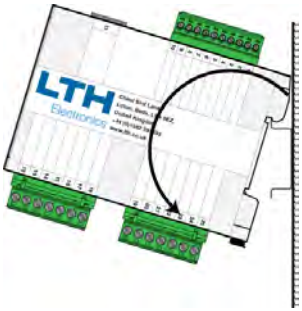
DCU18 Overall Dimensions

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

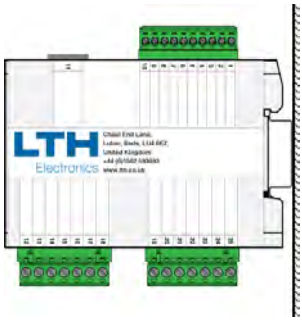
It should be attached to the rail by following the below guide.



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



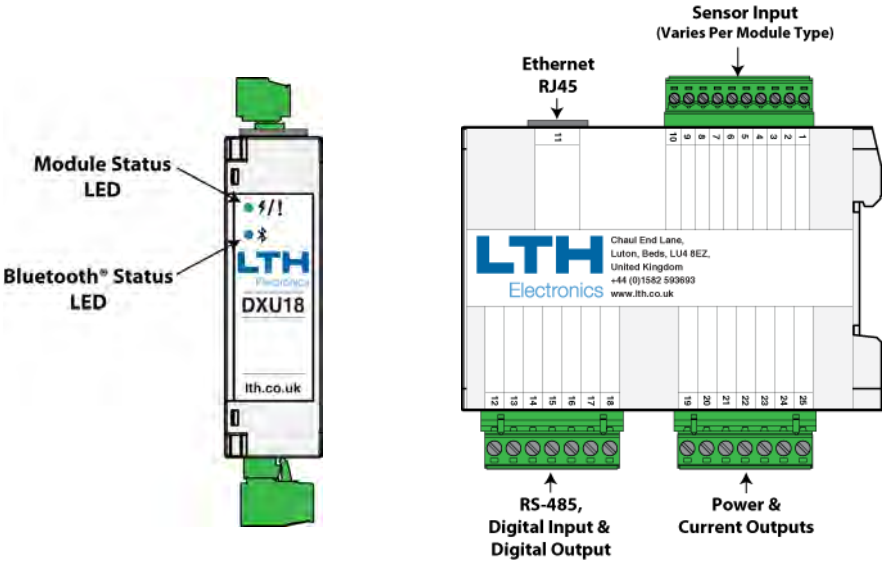
Rotate the module downwards



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



DCU18 Overview

Status LEDs

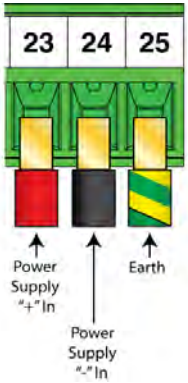
ϟ/!	Module Status LED	
○	Off	Module Unpowered
●	Constant Red	Module Initialising
≋	Flashing Green	Module Running
≋	Flashing Red	Module Error

ᛒ	Bluetooth® Status LED	
○	Off	Module Unpowered
≋	Flashing Blue	Bluetooth Unconnected
●	Constant Blue	Bluetooth Connected

DCU18 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.

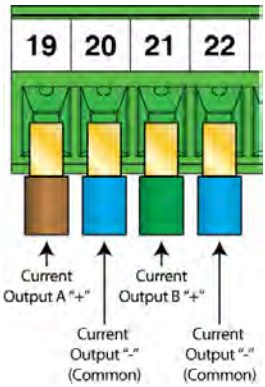


12-30V DC
Power Connections

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

Current Output Connections

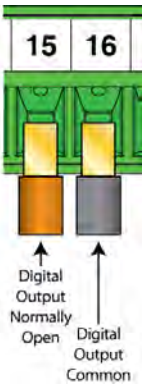
The DCU18 is supplied as standard with two current outputs, either of which can terminate into a load resistance not exceeding 750Ω and are both galvanically isolated from the rest of the module. For best noise immunity use a screened twisted pair cable, with the screen connected to Earth at one end. Use a sufficiently large cable to avoid a high resistance in the overall current loop.



Current Outputs
Connection Detail

Digital Output Connections

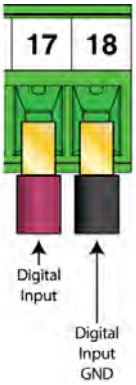
The DCU18 is supplied with a single volt free, single pole, single throw, normally open relay. Maximum switching voltage of **24v AC/DC**, maximum load **750mA**. To switch a higher voltage or load will require a slave relay.



Digital Output Connection Details

Digital Input Connections

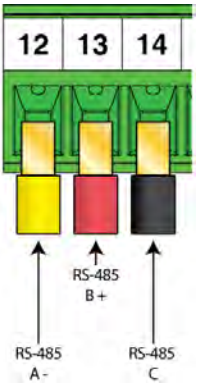
The DCU18 features a single dry contact digital input, which can be used to initiate a user configurable module operation by use of a volt free link, switch or relay. The module can be configured to initiate the appropriate action when the contact either closes or opens.



Digital Input Connection Details

Modbus Connections

The DCU18 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 120Ω 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 Contacting Conductivity Sensors

The choice of the correct type of conductivity sensor, how and where to mount it, 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
- Selection of the correct (optimum) cell constant
- Use of the correct materials for corrosion resistance
- Position of sensor for robustness and service access
- Ensuring a representative, uncontaminated solution sample

The following tips might be useful. The range of measurement will determine the cell constant. The epoxy resin castings are extremely resistant to most acids and alkalis. Many sensors have stainless steel bosses, and these should be avoided in the presence of chlorides, e.g. HCl.

There is also a growing tendency to passivate new water systems during commissioning, it is imperative that any sensors are removed from the pipework prior to this because it forms a non-conductive coating on the surface of the electrodes.

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

- The solution between the cell electrodes or around the sensor is representative of the solution.
- 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.
- Contacting conductivity cells can suffer problems associated with direct electrical contact with the solution where large electrical currents may be flowing, for example in electroplating tanks.

It is not uncommon for a cell to require cleaning on a weekly or daily basis, due to the nature of chemicals used and the presence of scale in hard water areas, experience will determine the correct maintenance periods.

Care and Maintenance of Contacting Conductivity Sensors

Conductivity measuring systems are designed to be trouble free in use and reliable measurements can be expected during their operating life. However, some maintenance is required. In particular, the cell and cable connections should be checked for security and freedom from corrosion. The sensor will also require periodic cleaning, depending on the quality of the water passing through it and the type of sensor employed. A dirty sensor will always give a low conductivity reading.

The area of the cell which is sensitive to fouling is the electrode surfaces which must fully "wet" to ensure accurate measurements. Moulded cells are often used in applications where a high level of contamination may be expected.

Some of these contaminants do not contribute directly to the measured conductivity, e.g. organics, rust and suspended solids, but may form deposits on the electrode surface. In general, these may be cleaned with the bristle brush provided and a weak detergent solution mixed with scouring powder.

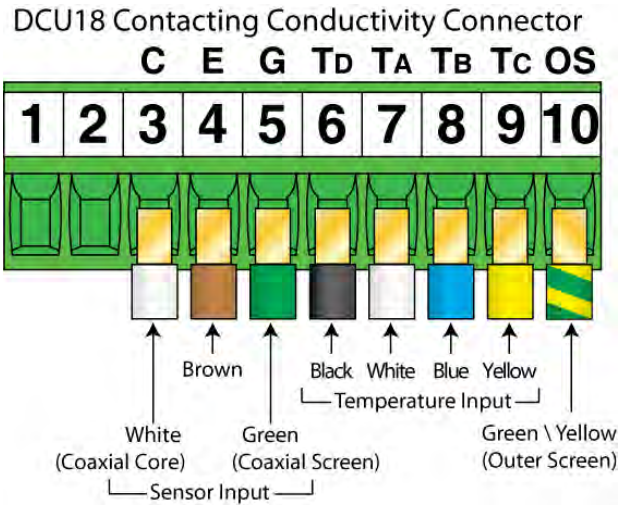
Problems may occur in hard water areas where the gradual formation of scale will reduce the active area of the electrodes. Simple brush cleaning alone will not remove a hard deposit from the electrode surface. If scaling is suspected the cell should be removed from the system and treated with a 10% solution of hydrochloric or formic acid. The presence of bubbles will indicate that scale is being dissolved. Cleaning is completed when bubbles cease and usually takes 2-3 minutes. The cell must be thoroughly rinsed to remove all traces of acid before it is replaced in the system.

Note: Follow the supplier's data sheet when handling acids and dispose of as instructed by your local authority regulations.

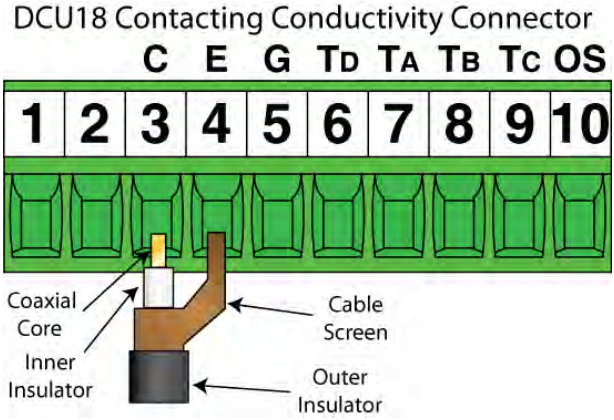
Cells with stainless steel electrodes are generally used in applications where a low conductivity is combined with a low level of organic contamination and cleaning is rarely necessary. Errors in measurements can often be traced to faulty connections or incorrect setting on the module. However, if contamination is suspected the cell should be removed from the system and cleaned if necessary.

Handling of the cell electrodes will leave residues of oils and greases which will affect the wetting of the surfaces, leading to inaccurate readings. After touching the electrodes, wash them with a weak detergent solution and rinse thoroughly. After rinsing check that the surfaces 'wet' properly, that is, they maintain a complete film of water for approximately 10 seconds.

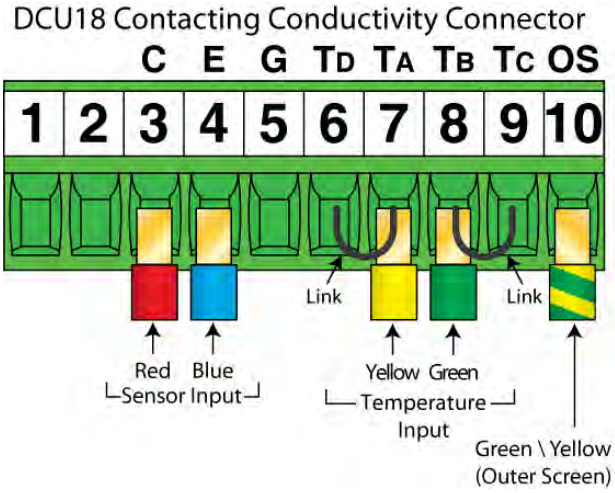
DCU18 Contacting Conductivity Input Connection Details



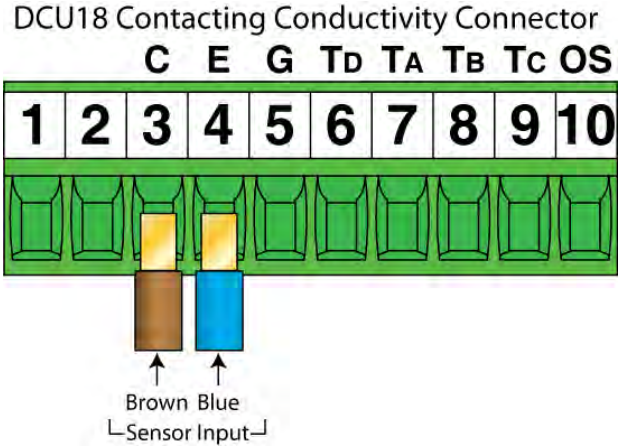
Contacting Conductivity 54D Cable Connection Details



Contacting Conductivity Coax Cable
(CMC8/01 & CMC8/10)
Connection Details

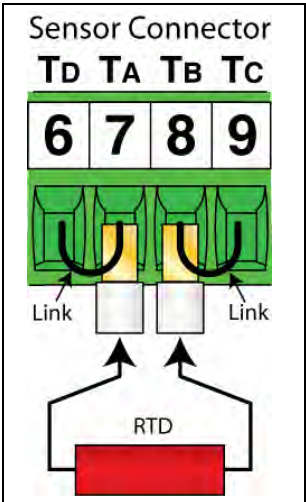
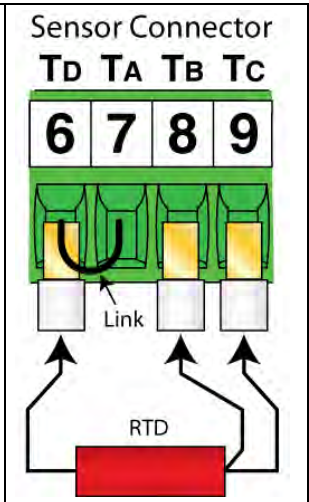
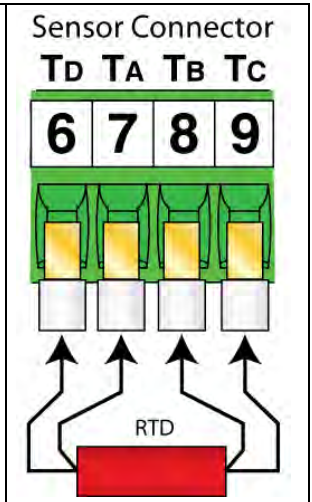


Contacting Conductivity Cable
(CMC8/001)
Connection Details

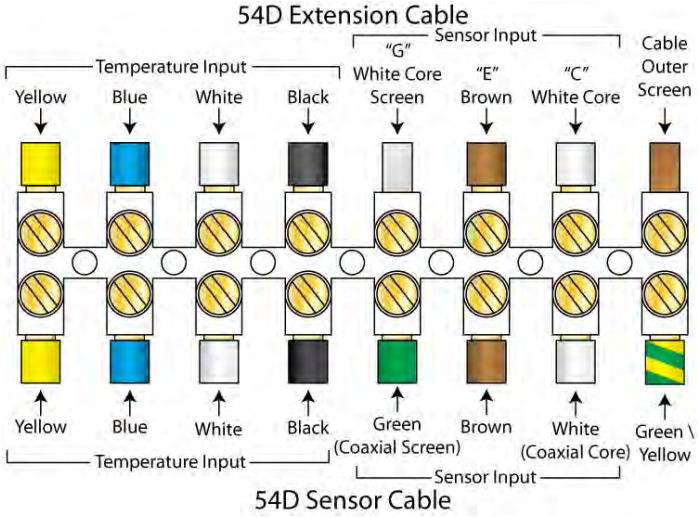


Contacting Conductivity Cable
(CMC7)
Connection Details

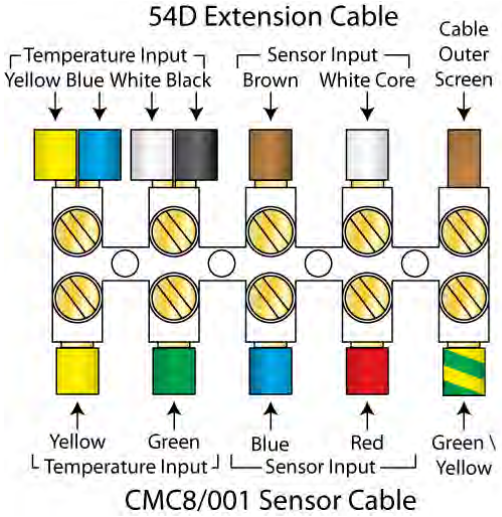
Temperature Sensor Connections

		
2 Wire RTD Temperature Connection	**3 Wire RTD Temperature Connection**	**4 Wire RTD Temperature Connection**

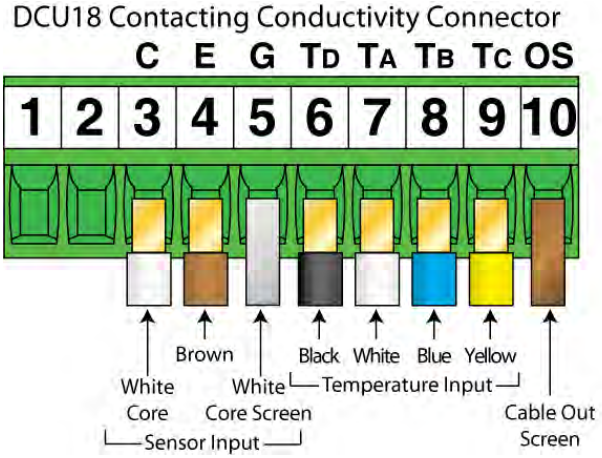
Extension Cable Connections



54D Sensor Cable to 54D Extension Cable Connection Details



CMC8/001 Cable to 54D Extension Cable Connection Details



54D 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

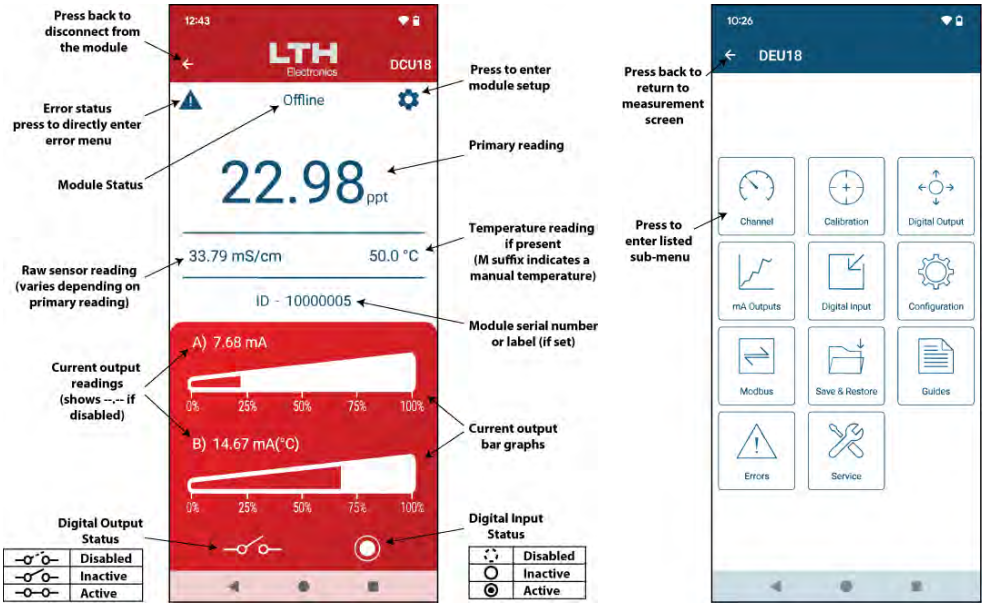
The app can be used to connect to the module via Bluetooth and display the primary reading and temperature, show operational status and to provide an intuitive means to configure and calibrate the module.

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

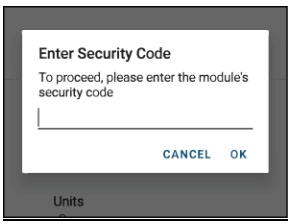
Module Setup Screen

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 65 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 <u>1000</u>

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 67) for further details about the using the interface.

Description	Register/s	Type	Access	Option	Value
Module Type	2000	Int	Read	Contacting Conductivity	2

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	0.000 to 9.999 µS/cm	0
				00.00 to 99.99 µS/cm	1
				000.0 to 999.9 µS/cm	2
				0.000 to 9.999 mS/cm	3
				00.00 to 99.99 mS/cm	4
				000.0 to 999.9 mS/cm	5
				00.00 to 99.99 kΩ.cm	6
				000.0 to 999.9 kΩ.cm	7
				0.000 to 9.999 MΩ.cm	8
				00.00 to 99.99 MΩ.cm	9
				0.000 to 9.999 ppm	10
				00.00 to 99.99 ppm	11
				000.0 to 999.9 ppm	12
				0000 to 9999 ppm	13
				00.00 to 99.99 ppt	14

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	0.000 to 9.999 µS/cm	0
				00.00 to 99.99 µS/cm	1
				000.0 to 999.9 µS/cm	2
				0.000 to 9.999 mS/cm	3
				00.00 to 99.99 mS/cm	4
				000.0 to 999.9 mS/cm	5

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*

Contacting 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, resistivity in Ohms/cm or TDS (Total Dissolved Solids) in ppm.

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

Cell Constant

The sensor input is designed to use any one of LTH contacting conductivity sensors. This menu item enables the user to enter the cell constant which should be marked on the sensor.

Register/s	*Type*	*Access*	*Condition/s*	*Value Limits*	*Units*
2102	*Float*	*Read / Write*	*None*	*0.00500 – 14.99999*	*None*

Range

Select the desired operating range for the input or select auto to let the module select the appropriate operating range. Available options depend upon the cell constant selected and units selected.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
2104	*Int*	*Read/ Write*	*None*	*Auto*	*0*	*None*
				0 to 9.999µS/cm	*1*	*Sensor Units (2101) set to Conductivity (0) and Cell Constant (2102) > 0.00499 and <0.50000*
				0 to 99.99µS/cm	*2*	*Sensor Units (2101) set to Conductivity (0) and Cell Constant (2102) > 0.00499 and <5.00000*

				0 to 999.9µS/cm	*3*	*Sensor Units (2101) set to Conductivity (0) and Cell Constant (2102) > 0.04999 and <15.00000*
				0 to 9.999mS/cm	*4*	*Sensor Units (2101) set to Conductivity (0) and Cell Constant (2102) > 0.49999 and <15.00000*
				0 to 99.99mS/cm	*5*	
				0 to 999.9mS/cm	*6*	
				0 to 99.99kΩ.cm	*7*	*Sensor Units (2101) set to Resistivity (1) and Cell Constant (2102) > 0.04999 and <5.00000*
				0 to 999.9kΩ.cm	*8*	*Sensor Units (2101) set to Resistivity (1) and Cell Constant (2102) > 0.00499 and <0.50000*
				0 to 9.999MΩ.cm	*9*	
				0 to 99.99MΩ.cm	*10*	
				0 to 9.999ppm	*11*	*Sensor Units (2101) set to TDS (2) and Cell Constant (2102) > 0.00499 and <0.50000*
				0 to 99.99ppm	*12*	*Sensor Units (2101) set to TDS (2) and Cell Constant (2102) > 0.00499 and <5.00000*
				0 to 999.9ppm	*13*	*Sensor Units (2101) set to TDS (2) and Cell Constant (2102) > 0.04999 and <15.00000*
				0 to 9999ppm	*14*	*Sensor Units (2101) set to TDS (2) and Cell Constant (2102) > 0.49999 and <15.00000*
				0 to 99.99ppt	*15*	

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***
2105	*Float*	*Read / Write*	*Sensor Units (2101) set to TDS (2)*	*0.50 – 0.90*	*None*

Calculate Secondary Reading

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

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
2107	*Int*	*Read / Write*	*Sensor Units (2101) set to TDS (2)*	*No*	*0*	*None*
				Conductivity (S/cm)	*1*	*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*
2108	*Int*	*Read / Write*	*None*	*Disabled*	*0*	*None*
				PT100	*1*	*None*
				PT1000	*2*	*None*

Units

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

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
2109	*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*
2110	*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*
2111	*Float*	*Read / Write*	*Compensation (2110) set to In (0)*	*-20.0 to 150.0 Units (2109) set to °C (0)*	*°C*
				-4.0 to 302.0 Units (2109) 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*
2113	*Float*	*Read / Write*	*Compensation (2110) 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*
2115	*Int*	*Read / Write*	*None*	*Manual*	*0*	*None*
				Auto	*1*	*Input (2108) set to PT100 (1) or PT1000 (2)*

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*
2116	*Float*	*Read / Write*	*Compensation (2110) set to In (0) and Compensation Mode (2115) set to Manual (0)*	*-20.0 to 150.0 Units (2109) set to °C (0)*	*°C*
				-4.0 to 302.0 Units (2109) set to °F (1)	*°F*

Cable

Length Compensation

At high conductivities the series resistance in the cell connection cable can have a significant effect on the conductivity measurement. By entering the cable length, the module can estimate the extra series resistance and subtract it from the calculated conductivity measurement.

This will greatly reduce the error, however, to achieve even greater accuracy the user can do the following.

Attach a 10Ω resistor to the cable at the sensor end and set the cable length to zero. Observe the module reading (in mS/cm) and use that reading to determine the cable length using the following formula: Cable Length= {[(1/Reading)-10]/0.07168}

Register/s	*Type*	*Access*	*Condition/s*	*Value Limits*	*Units*
2118	*Float*	*Read / Write*	*None*	*0.0 to 999.9*	*m*

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*
2120	*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

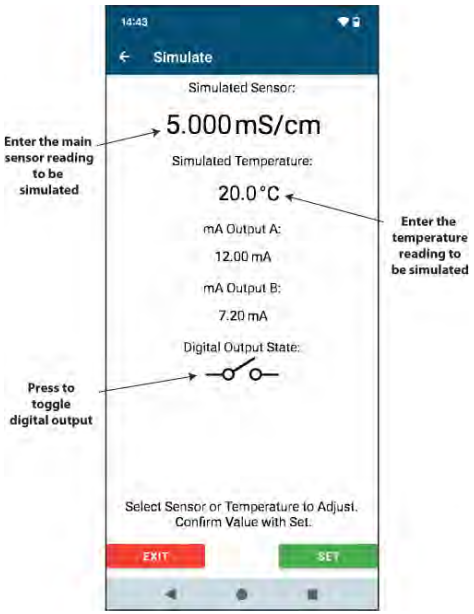
Define the operating range for the Simulate system for when the primary operating range is set to Auto.

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						

Calibration

Best Practice for Fine Tuning Contacting Conductivity Input

The DCU18 provides a facility for the operator to fine tune the calibration of the conductivity or resistivity measurement, the temperature measurement and the current outputs. The amount of adjustment is quite small because the factory calibration is accurate and with modern electronics, drift is very low. If it is found that during a calibration there is insufficient adjustment then it is probable that there is a problem with either the calibration procedure, or a fault with the module, sensor or cabling. The most common causes of inaccurate conductivity readings are contaminated electrode surfaces and air trapped within the cell; both of these will always give a low conductivity (high resistivity) reading. Refer to the Care and Maintenance of Contacting Conductivity Sensors section for more information.

Calibration of Conductivity or Resistivity 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.

Resistance calibration of the module only

This is the most accurate method of calibrating the module, but it will not consider any variations due to the cell constant variation or coatings of contaminants. Calibration is at a single point only so a value close to the normal operating conditions is preferable. The resistance should be connected between the C and E terminals. (See the table of values on page 84). It is recommended that any extended lengths of cell cable are left in during this calibration, as cable resistance will have some effect on the overall calibration accuracy. This is increasingly significant at high values of conductivity (low resistivity).

The temperature compensation must be switched out when making these adjustments and the relevant cell constant noted. The resistance accuracy will determine the overall accuracy of the calibration. A non-inductive resistance must be used below 100 ohms.

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 1µS/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%/°C for a KCl solution between 1000 to 10,000µS/cm. For more details on calculating the slope of a different solution, refer to Appendix B - Temperature Coefficient (page 83).

Calibration by Comparison with Another Module
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 modules.

Calibration of the Cell Constant
LTH conductivity cells are supplied with a nominal cell constant value, e.g. 0.1, 1.0. The actual cell constant could be up to ±2% from this value. It is possible for LTH to measure the actual cell constant of each cell and provide traceable certification. The user can then program this value into the module eliminating the errors contributed by manufacturing variations in the cell geometry. Use the cell constant menu in the channel setup menu to enter the specified cell constant.

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 (2110) set to In (0) and Compensation Mode (2115) set to Manual (0)*	*-20.0 to 150.0 Units (2109) set to °C (0)*	*°C*
				-4.0 to 302.0 Units (2109) set to °F (1)	*°F*

Sensor

Mode

Select the calibration mode.

See Conductivity Calibration - Manual Mode on page 44 and Conductivity Calibration – Standard Solution Detection on page 48 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 (2018) not set to Disabled or Temperature Input (2018) set to Disabled and Temperature Compensation (2110) set to In (1)*

Calibration Range

Define the calibration range when using the Manual calibration mode and the Senor 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 (2104) set to Auto (0).*	*0 to 9.999µS/cm*	*0*	*Sensor Units (2101) set to Conductivity (0) and Cell Constant (2102) > 0.00499 and <0.50000*
				0 to 99.99µS/cm	*1*	*Sensor Units (2101) set to Conductivity (0) and Cell Constant (2102) > 0.00499 and <5.00000*
				0 to 999.9µS/cm	*2*	*Sensor Units (2101) set to Conductivity (0) and Cell Constant (2102) > 0.04999 and <15.00000*
				0 to 9.999mS/cm	*3*	*Sensor Units (2101) set to Conductivity (0) and Cell Constant (2102) > 0.49999 and <15.00000*
				0 to 99.99mS/cm	*4*	
				0 to 999.9mS/cm	*5*	

				0 to 99.99kΩ.cm	*6*	*Sensor Units (2101) set to Resistivity (1) and Cell Constant (2102) > 0.04999 and <5.00000*
				0 to 999.9kΩ.cm	*7*	*Sensor Units (2101) set to Resistivity (1) and Cell Constant (2102) > 0.00499 and <0.50000*
				0 to 9.999MΩ.cm	*8*	
				0 to 99.99MΩ.cm	*9*	
				0 to 9.999ppm	*10*	*Sensor Units (2101) set to TDS (2) and Cell Constant (2102) > 0.00499 and <0.50000*
				0 to 99.99ppm	*11*	*Sensor Units (2101) set to TDS (2) and Cell Constant (2102) > 0.00499 and <5.00000*
				0 to 999.9ppm	*12*	*Sensor Units (2101) set to TDS (2) and Cell Constant (2102) > 0.04999 and <15.00000*
				0 to 9999ppm	*13*	*Sensor Units (2101) set to TDS (2) and Cell Constant (2102) > 0.49999 and <15.00000*
				0 to 99.99ppt	*14*	

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 48 for further details.

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

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	*Float*	*Read*	*None*	*50.0 to 150.0*	*%*

Temperature

Offset - Calibrate

Enter the temperature offset calibration screen.

See Temperature Calibration on page 52 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.

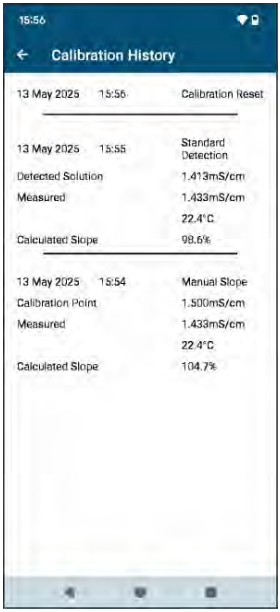
Cannot be edited

Register/s	*Type*	*Access*	*Condition/s*	*Value Limits*	*Units*
2208	*Float*	*Read*	*Temperature Input (2108) not set to Disabled (0)*	*-50.0 to +50.0 Units (2109) set to °C (0)*	*°C*
				-122.0 to +122.0 Units (2109) set to °F (1)	*°F*

History

Records

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



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*
2212	*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*
2213	*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*
2214	*Int*	*Read / Write*	*Reminder Set (22120 set to Yes (1)*	*1 to 31*	*Day*
Register/s	***Type***	***Access***	***Condition/s***	***Value Limits***	***Units***
2215	*Int*	*Read / Write*	*Reminder Set (22120 set to Yes (1)*	*1 to 12*	*Month*
Register/s	***Type***	***Access***	***Condition/s***	***Value Limits***	***Units***
2216	*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*
2212	*Int*	*Read / Write*	*Calibration Due Set (3208 Bit 2 = 1)*	*Done*	*0*	*None*
				Defer	*1*	*None*

Reset

Sensor Calibration

Reset the sensor user calibration to its default state.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
2218	*Int*	*Read / Write*	*None*	*Done*	*0*	*None*
				Reset	*1*	*None*

Temperature Calibration

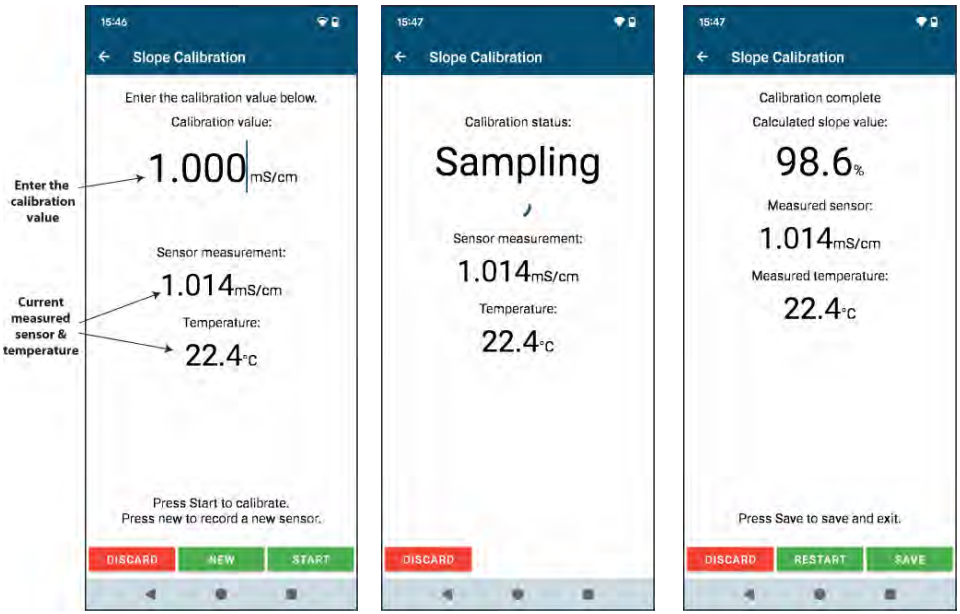
Reset the temperature user calibration to its default state.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
2219	*Int*	*Read / Write*	*Temperature Input (2108) not set to Disabled (0)*	*Done*	*0*	*None*
				Reset	*1*	*None*

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.



Initial Screen | Sampling Screen | Result Screen

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 *Sensor Calibration Status (2230)* to *Calibration Mode (1)* and write the calibration value the user is simulating to *Calibration Value (2240)*.

Now to begin sampling the reading set *Calibration Status (2230)* to *Begin Calibration (2)*. Once the sampling is complete *Sensor Calibration Status (2230)* will automatically change to *Calibration Process Completed (3)*.

The newly calculated slope can be read from *Calculated Slope Value (2233)* along with the *Measured Sensor Value (2235)* and *Measured Temperature Value (2238)*. If these are acceptable set *Calibration Status (2230)* to *Save Calibration (4)* if not set *Calibration Status (2230)* 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 *Calibration Status (2230)* to *Calibration Stopped* (*0)*.

Sensor Calibration Status

Controls the calibration process.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
2230	*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*
2240	*Float*	*Write*	*Calibration Mode (2204) set to Manual (0)*	*As per Calibration Value Range (2242)*

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*
2242	*Int*	*Read*	*Calibration Mode (2204) set to Manual (0)*	*0 to 9.999µS/cm*	*0*	*None*
				0 to 99.99µS/cm	*1*	
				0 to 999.9µS/cm	*2*	
				0 to 9.999mS/cm	*3*	
				0 to 99.99mS/cm	*4*	
				0 to 999.9mS/cm	*5*	
				0 to 99.99kΩ.cm	*6*	
				0 to 999.9kΩ.cm	*7*	
				0 to 9.999MΩ.cm	*8*	
				0 to 99.99MΩ.cm	*9*	
				0 to 9.999ppm	*10*	

				0 to 99.99ppm	*11*	
				0 to 999.9ppm	*12*	
				0 to 9999ppm	*13*	
				0 to 99.99ppt	*14*	

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***
2233	*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***
2235	*Float*	*Read*	*None*	*As per Measured Sensor Range (2237)*

Measured Sensor Range and Units

Register/s	***Type***	***Access***	***Condition/s***	***Option***	***Value***	***Condition/s***
2237	*Int*	*Read*	*None*	*0 to 9.999µS/cm*	*0*	*None*
				0 to 99.99µS/cm	*1*	
				0 to 999.9µS/cm	*2*	
				0 to 9.999mS/cm	*3*	
				0 to 99.99mS/cm	*4*	
				0 to 999.9mS/cm	*5*	
				0 to 99.99kΩ.cm	*6*	
				0 to 999.9kΩ.cm	*7*	
				0 to 9.999MΩ.cm	*8*	
				0 to 99.99MΩ.cm	*9*	
				0 to 9.999ppm	*10*	
				0 to 99.99ppm	*11*	
				0 to 999.9ppm	*12*	

				0 to 9999ppm	*13*	
				0 to 99.99ppt	*14*	

Measured Temperature Value

The temperature reading at the time of calibration.

Register/s	***Type***	***Access***	***Condition/s***	***Value Limits***	***Units***
2238	*Float*	*Read*	*None*	*+/- XXX.X*	*See register 2012*

Conductivity Calibration – Standard Solution Detection

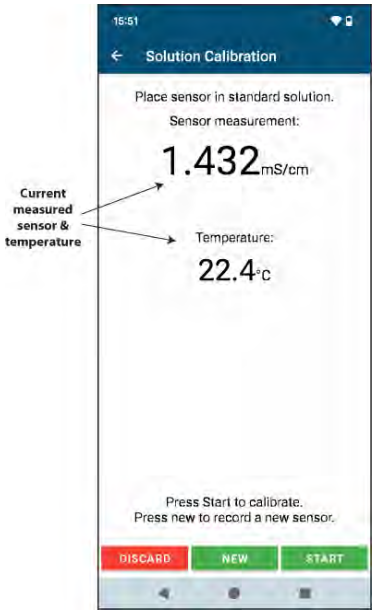
A form of automatic calibration where the module can detect from one of four standard LTH solutions being used to calibrate the sensor, then by using the temperature measured at calibration and built-in look-up tables the module can automatically calculate what the solution should measure. Using this 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 D - Table of conductivity variation with temperature of LTH standard solutions on page 85.

Calibration method using App

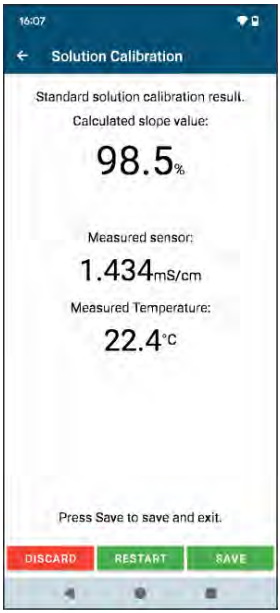
Set the calibration sensor mode to Standard Solution Detection, then click on solution – calibrate. Once in the initial screen place the sensor in the standard solution and wait for the reading to stabilise, then press start to begin a calibration. The module will then begin sampling the senor, if the 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 Calibration Status (2230)* to *Calibration Mode (1)*. place the sensor in the standard solution and wait for the reading to stabilise, then set *Sensor Calibration Status (2230)* to *Begin Calibration (2)*.

Once the sampling is complete *Sensor Calibration Status (2230)* will automatically change to *Calibration Process Completed (3)*.

The newly calculated slope can be read from *Calculated Slope Value (2233)* along with the *Detected Solution* (2232), *Measured Sensor Value (2235)* and *Measure Temperature Value (2238)*. If these are acceptable set *Calibration Status (2230)* to *Save Calibration (4)* if not set *Calibration Status (2230)* 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 *Calibration Status (2230)* to *Calibration Stopped* (*0)*.

Sensor Calibration Status

Controls the calibration process.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
2230	*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*

Detected Solution

The standard solution value the module believes is being used.

Register/s	***Type***	***Access***	***Condition/s***	***Option***	***Value***	***Condition/s***
2232	*Int*	*Read*	*None*	*147 µS/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.

Register/s	***Type***	***Access***	***Condition/s***	***Value Limits***	***Units***
2233	*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***
2235	*Float*	*Read*	*None*	*As per Measured Sensor Range (2237)*

Measured Sensor Range and Units

Register/s	***Type***	***Access***	***Condition/s***	***Option***	***Value***	***Condition/s***
2237	*Int*	*Read*	*None*	*0 to 9.999µS/cm*	*0*	*None*
				0 to 99.99µS/cm	*1*	
				0 to 999.9µS/cm	*2*	
				0 to 9.999mS/cm	*3*	

				0 to 99.99mS/cm	*4*	
				0 to 999.9mS/cm	*5*	
				0 to 99.99kΩ.cm	*6*	
				0 to 999.9kΩ.cm	*7*	
				0 to 9.999MΩ.cm	*8*	
				0 to 99.99MΩ.cm	*9*	
				0 to 9.999ppm	*10*	
				0 to 99.99ppm	*11*	
				0 to 999.9ppm	*12*	
				0 to 9999ppm	*13*	
				0 to 99.99ppt	*14*	

Measured Temperature Value

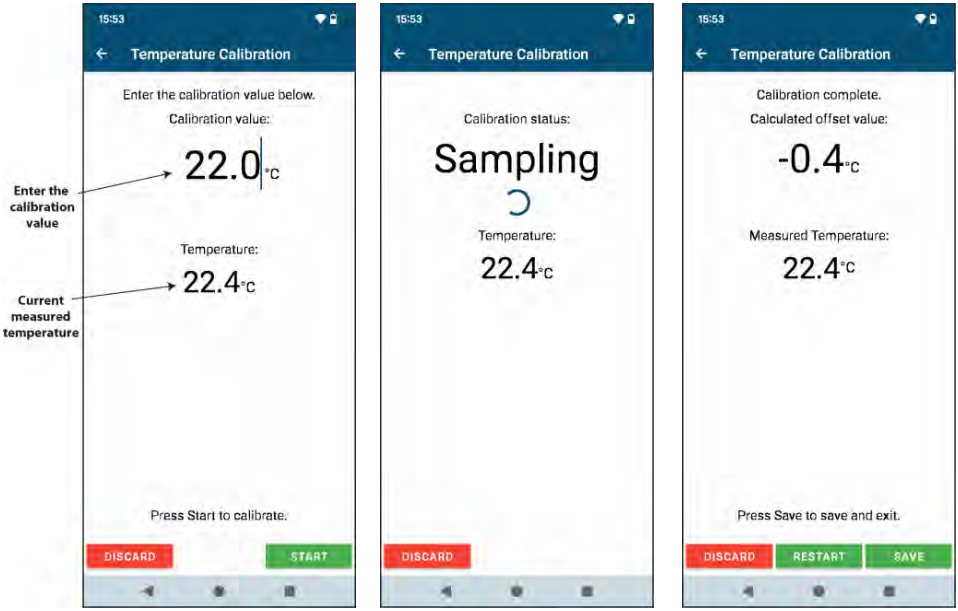
The temperature reading at the time of calibration.

Register/s	***Type***	***Access***	***Condition/s***	***Value Limits***	***Units***
2238	*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.



Initial Screen | Sampling Screen | Result Screen

Calibration method using Modbus

First set the *Temperature Calibration Status (2245)* to *Calibration Mode (1)* and write the temperature calibration value the user is simulating to *Temperature Calibration Value (2243)*.

Now to begin sampling the temperature reading set *Temperature Calibration Status (2245)* to *Begin Calibration (2)*. Once the sampling is complete *Temperature Calibration Status (2245)* will automatically change to *Calibration Process Completed (3)*.

The newly calculated temperature offset can be read from *Calculated Temperature Offset Value (2246)* along with the *Measured Temperature Value (2248)*. If these are acceptable set *Temperature Calibration Status (2245)* to *Save Calibration (4)* if not set *Temperature Calibration Status (2245)* 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 (2245)* to *Calibration Stopped* (*0)*.

Temperature Calibration Status

Controls the temperature calibration process.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
2245	*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*
2243	*Float*	*Write*	*None*	*-20.0 to 150.0 Units (2109) set to °C (0)*	*°C*
				-4.0 to 302.0 Units (2109) 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*
2246	*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*
2248	*Float*	*Read*	*None*	*-20.0 to 150.0 Units (2109) set to °C (0)*	*°C*
				-4.0 to 302.0 Units (2109) set to °F (1)	*°F*

Digital Output

The DCU18 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 DCU18 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) Not set to*	*0 to 9.999µS/cm*	*0*	*Sensor Units (2101) set to Conductivity (0) and Cell Constant (2102) > 0.00499 and <0.50000*

			Disabled (0) and Source (A:2502 B:2602) set to Sensor (0) and Sensor Range (2104) set to Auto (0).	*0 to 99.99µS/cm*	*1*	*Sensor Units (2101) set to Conductivity (0) and Cell Constant (2102) > 0.00499 and <5.00000*
				0 to 999.9µS/cm	*2*	*Sensor Units (2101) set to Conductivity (0) and Cell Constant (2102) > 0.04999 and <15.00000*
				0 to 9.999mS/cm	*3*	*Sensor Units (2101) set to Conductivity (0) and Cell Constant (2102) > 0.49999 and <15.00000*
				0 to 99.99mS/cm	*4*	
				0 to 999.9mS/cm	*5*	
				0 to 99.99kΩ.cm	*6*	*Sensor Units (2101) set to Resistivity (1) and Cell Constant (2102) > 0.04999 and <5.00000*
				0 to 999.9kΩ.cm	*7*	*Sensor Units (2101) set to Resistivity (1) and Cell Constant (2102) > 0.00499 and <0.50000*
				0 to 9.999MΩ.cm	*8*	
				0 to 99.99MΩ.cm	*9*	
				0 to 9.999ppm	*10*	*Sensor Units (2101) set to TDS (2) and Cell Constant (2102) > 0.00499 and <0.50000*
				0 to 99.99ppm	*11*	*Sensor Units (2101) set to TDS (2) and Cell Constant (2102) > 0.00499 and <5.00000*
				0 to 999.9ppm	*12*	*Sensor Units (2101) set to TDS (2) and Cell Constant (2102) > 0.04999 and <15.00000*
				0 to 9999ppm	*13*	*Sensor Units (2101) set to TDS (2) and Cell Constant (2102) > 0.49999 and <15.00000*
				0 to 99.99ppt	*14*	

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 (2104) 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 (2109) set to °C (0)	*-20.0 to 150.0°C*
				If Source (A:2502, B:2602) set to Temperature (1) And Units (2109) 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 (2104) 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 (2109) set to °C (0)	*-20.0 to 150.0°C*

				If Source (A:2502, B:2602) set to Temperature (1) And Units (2109) 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 (2104) 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 (2109) set to °C (0)	*-20.0 to 150.0°C*
				If Source (A:2502, B:2602) set to Temperature (1) And Units (2109) 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 DCU18 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*	*DCU18*	*1*	*None*

Serial Number

The module's Serial Number

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

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 DCU18 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	Sequence			
	1st	2nd	3rd	4th
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*	

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 DCU18 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 distributer 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 *Note, returns to 0 once complete*	*1*	*None*

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 *Note, returns to 0 once complete*	*1*	*None*

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 *Note, returns to 0 once complete*	*1*	*None*

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 *LTH Discover* folder as found in the *On My iPhone* 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 *Note, returns to 0 once complete*	*1*	*None*

Errors

The DCU18 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 87.

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.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
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.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
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.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
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.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
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.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
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.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
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.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
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.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
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.

Register/s	*Type*	*Access*	*Condition/s*	*Option*	*Value*	*Condition/s*
A: 3208 Bit 2	*Int*	*Read*	*None*	*Message Not Present*	*0*	*None*
				Message Present	*1*	*None*

Service

The DCU18 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.

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

Appendix A - Ultra Pure Water

UPW cell positioning, flow rate and sampling

This summary of ASTM D5391-93, combined with LTH application notes applies to ultra-pure water applications only. These applications are very specific in nature and require great care to avoid errors in measurement.

Pure water conductivity or resistivity must be measured with a cell and temperature sensor in a flowing, closed system to prevent trace contamination from wetted surfaces and from the atmosphere. Specialised temperature compensation can be used to correct the measurement to a reference temperature of 20 or 25°C taking into account the temperature effects on the ionisation of water, the contaminates and interactions between the two.

The cell constant for the precision cell has been determined with a secondary standard cell that has a cell constant determined by ASTM D1125.

Conductivity or resistivity can be used for detecting trace amounts of ionic contaminants in water. It is the primary means of monitoring the performance of demineralisation and other high purity water treatment operations.

It is used to detect ionic contamination in boiler waters, microelectronics rinse waters, pharmaceutical process waters and to monitor and control the level of boiler and power plant cycle treatment chemicals.

Exposure of the sample to atmosphere will cause changes in the conductivity or resistivity due to loss or gain of dissolved gases. CO_2 can reach an equilibrium concentration in water of about 1 mg/l and add up to 1 µS/cm to the conductivity due to the formation of carbonic acid. This process is quite fast, depending upon conditions.

Cell, flow chamber and sample line surfaces will slowly leach trace ionic contaminates, evidenced by increasing conductivity readings with very low or zero flow rate. There must be sufficient flow to keep these contaminates from accumulating to the point where they can significantly affect the measurement. The large and convoluted surface of platinised cells precludes their use for high purity measurements for this reason.

Samples containing dissolved gases must have sufficient flow through the cell so that bubbles cannot accumulate and occupy sample volume within the cell, causing low conductivity (high resistivity) readings.

High purity conductivity measurement must not be made on a sample downstream of pH sensors due to the possible contamination of the sample with traces of reference electrolyte salts. Use a dedicated sample line or place the conductivity cell up stream from the pH sensors.

Conductivity cells mounted downstream from ion exchangers are vulnerable to catching ion exchange resin particles between the cell electrodes.

Resin particles are sufficiently conductive to short circuit the cell and cause high off scale conductivity or extremely low resistivity readings.

Resin retainers must be effective, and the cell must be installed so that it is accessible for cleaning. If this is a problem with the CMC26/001/PT43 cell use the CMC34/001/PT43 which has wider spaced electrodes of greater than 1.5 mm. This has been found to be less likely to trap such particles.

Conductivity cells if subjected to de-mineraliser regeneration reagents require excessive rinse time to obtain satisfactory results, therefore, locate the cell where it will be isolated during regeneration. The cell should not be used to measure high ionic content samples of greater than 20 µS/cm (less than 0.05 MΩ.cm) since it can retain ionic contaminates and require excessive rinse down time for valid measurements.

The module incorporates an electronic guard to minimise the effect of cable capacitance and a 4-wire temperature measurement system to allow accurate measurements. LTH 54D or similar cable must be used to ensure correct operation.

The cell must be located in an active flowing part of the piping. Stagnant areas or dead legs must be avoided to ensure a representative sample and prevent any bubbles from adhering to the cell surfaces.

Sample lines must be designed to maintain sample integrity. Do not expose the sample to atmosphere to prevent absorption or loss of gases, particularly $C0_2$ which will affect conductivity.

The sample should be continuous at a stable flow rate of at least 100 ml/min and should be maintained to enable sample line wetted surfaces to reach equilibrium with sample conditions. Do not make measurements following changes to sample flow rate for the period of time required to recover from transient effects on the particular sampling system.

Appendix B - Temperature Coefficient

Calculating the temperature coefficient of a solution
If the temperature coefficient of the solution being monitored is not known, the DCU18 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:

$$\alpha = \frac{(Gx-Gy) \times 100\%}{Gy(Tx-25) - Gx(Ty-25)}$$ (base temperature 25°C)

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

Term	Description
Gx	Conductivity in µS/cm at temperature Tx
Gy	Conductivity in µS/cm at temperature Ty

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 DCU18.

Temperature (°C)	Pt1000 RTD	Pt100 RTD
0	1000.0Ω	100.0Ω
10	1039.0Ω	103.9Ω
20	1077.9Ω	107.8Ω
25	1097.3Ω	109.7Ω
30	1116.7Ω	111.7Ω
40	1155.4Ω	115.5Ω
50	1194.0Ω	119.4Ω
60	1232.4Ω	123.2Ω
70	1270.7Ω	127.1Ω
80	1308.9Ω	130.9Ω
90	1347.0Ω	134.7Ω
100	1385.0Ω	138.5Ω

Appendix C - Table of calibration resistance values

Conductivity Display Reading	Nominal cell constant K=0.01	Nominal cell constant K=0.10	Nominal cell constant K=1.00	Nominal cell constant K=10.0	Resistivity Display reading
0.050 µS/cm	200K				20.00 MΩ-cm
0.100 µS/cm	100K				10.00 MΩ-cm
0.200 µS/cm	50K				5.000 MΩ-cm
0.500 µS/cm	20K				2.000 MΩ-cm
1.000 µS/cm	10K	100K			1.000 MΩ-cm
2.000 µS/cm	5K	50K			500.0 KΩ-cm
5.000 µS/cm	2K	20K			200.0 KΩ-cm
10.00 µS/cm	1K	10K	100K		100.0 KΩ-cm
20.00 µS/cm	500R	5K	50K		50.00 KΩ-cm
50.00 µS/cm	200R	2K	20K		20.00 KΩ-cm
100.0 µS/cm	100R	1K	10K	100K	10.00 KΩ-cm
200.0 µS/cm		500R	5K	50K	
500.0 µS/cm		200R	2K	20K	
1000 µS/cm		100R	1K	10K	
2.000 mS/cm			500R	5K	
5.000 mS/cm			200R	2K	
10.00 mS/cm			100R	1K	
20.00 mS/cm			50R	500R	
50.00 mS/cm			20R	200R	
100.0 mS/cm			10R	100R	
200.0 mS/cm				50R	
500.0 mS/cm				20R	
1000 mS/cm				10R	

This list of calibration resistance values will allow the user to check or modify the calibration of the module. Temperature compensation **MUST** be turned off during the test or adjustment.

Appendix D - 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 E – 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 DCU18 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 74 gives a list that the DCU18 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 DCU18 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 Contacting Conductivity Sensors, page 18) and that the sensor is not faulty or damaged.
- Check that the correct Range and Cell Constant has been selected within the Channel Setup menu if in doubt set to the range to “Auto” (see Contacting Conductivity Input Setup, page 30.)
- Check the temperature compensation state (see Channel Setup page 32). If the compensation mode is set to “Manual” check that the fixed temperature is at the correct level. If the compensation mode is set to “Auto” check that the temperature reading is correct.
- Check the sensor using a hand-held meter.
- 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 module.
- Check the Pt100 / 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 short circuit sensor (resistivity mode)
- Check for damage to the connecting cable.
- Check that all input connections are secure.
- Check the sensor is wired up correctly.
- Check that the sensor bore is not blocked or completely filled with air.
- Check the sensor is immersed in the correct solution.

The Sensor Reading Is Incorrect

- Low reading due to incomplete immersion or contamination of the electrodes.
- 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.
- The sensor should be checked, when dry, with an ohmmeter. Disconnect it at the module and check the resistance between the E and C terminals. It should be greater than 50 MΩ between E & C. Check the leakage from E & C in turn to the terminated screens (inner and outer). Again, 50 MΩ should be the minimum isolation resistance between them all.
- 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 conductivity sensor is available, this can be used to determine whether the fault lies with the module 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 inner screen (G) does not contact any other terminals or metalwork at the sensor end. It should not be grounded.
- 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 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 21)
- 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 83.

Current Output is Incorrect or Noisy

- Check that the maximum load for the current loop has not been exceeded. (750Ω).
- 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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