BC9 series

CONDUCTIVITY CONTROLLERS

OPERATION GUIDE

PREFACE

Product Warranty

This instrument has a warranty against defects in materials and workmanship for a period of 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.

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.

There are no user serviceable parts, including fuses etc., within the unit. Any attempt to dismantle the instrument will invalidate the warranty.

Disclaimer

LTH Electronics Ltd reserves the right to make changes to this manual or the instrument 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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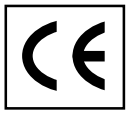
Manufacturing Standards



Electromagnetic compatibility

This instrument has been designed to comply with the standards and regulations called up by the European EMC Directive.

Safety

This instrument has been designed to comply with the standards and regulations called up by the European Low Voltage Directive using BS EN 61010-1 : 1993

Quality

This instrument has been manufactured under the following quality standard: ISO 9001:2000. 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.

CONTENTS

CONTENTS

1 INTRODUCTION

The BC9 series of electrodeless technology based conductivity controllers use ultra-low maintenance toroidal conductivity sensors to measure a broad spectrum of solution conductivity. Four measurement ranges can be selected: - 1.999 mS/cm, 19.99 mS/cm, 199.9 mS/cm & 1999 mS/cm. Note that 1.999 mS/cm = 1999 µS/cm. An optional version is available with the output scaled 0 – 5 % NaOH (sodium hydroxide).

The BC9 series conductivity controllers comprise four basic models as follows:

The BC9 has a single changeover relay, with a fully adjustable Hi or Lo control set point that can be used for a variety of dosing and bleeding applications.

The BC92 has a second relay that gives a time proportioning output that is particularly useful for corrosion inhibitor dosing. It could be used for many other similar applications. A 10% to 100% linear proportional dose can be set using a graduated potentiometer.

The BC93 has a second relay, with a fully adjustable Hi or Lo control set point that can be used for a variety of dosing and bleeding applications. It can also be configured as an alarm device, perhaps operating a safety valve or klaxon.

The BC94 has a second relay, configured as a dose alarm device, perhaps used to operate a safety valve or klaxon. The timer can be set from 1 – 60 minutes. If any single dose exceeds the set time, the dose relay and LED is de-energised, the alarm relay is energised and the alarm LED flashes. A low-tank switch input can also activate the alarm condition.

The BC92, BC93 and BC94 variants also provide an industry-standard isolated two wire 0 - 20 mA or 4 - 20 mA signal for remote monitoring. The output span can be expanded to cover 0 - 50 % of the operating range. The high level of the transmitted signal ensures excellent noise immunity, and it is not affected by a damp environment.

Calibration is by a series of single & multi-turn pots that are accessible with the front cover removed. A full calibration can be performed by the user with this handbook, the calibration loop resistors, a multi-meter and a few tools if necessary. The controls are not accessible with the front cover fitted.

Simple temperature compensation can be turned on or off. A fixed 2 % / °C slope compensation is supplied as standard.

Specifications

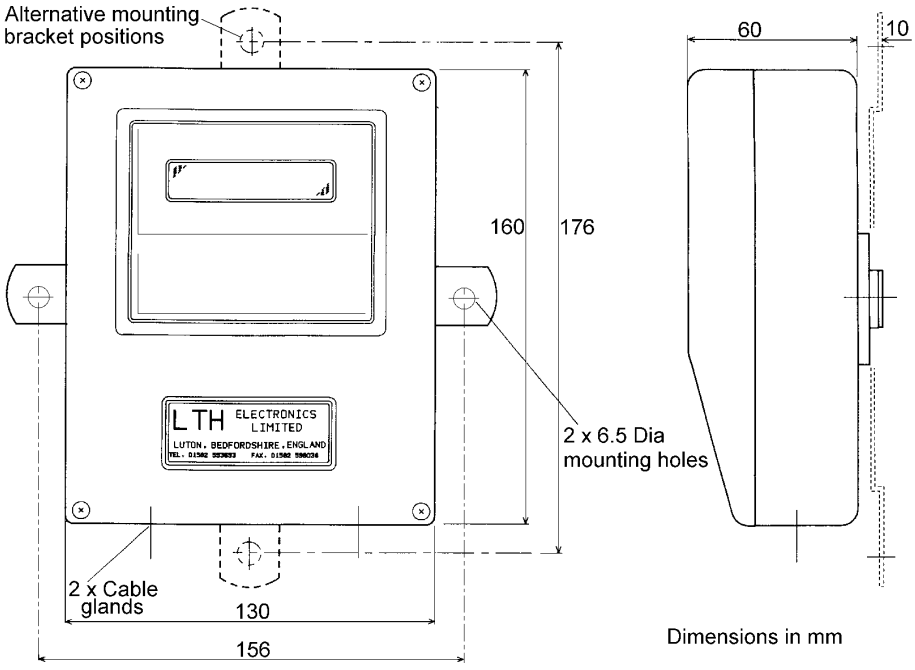
Sensor	Any LTH ECS 20 or 40 series sensor. Cable up to 30m.
Ranges of measurement	0 - 1.999, 0 - 19.99, 0 - 199.9, 0 - 1999 mS/cm, (or a 0-5 % NaOH option is available to order)
Conductivity accuracy	1% of reading ± 2 digits
Linearity	0.1% of range
Repeatability	0.1% of range
Ambient temperature	-20°C to +70°C for full specification.
Temperature variation	±0.02% of range / °C (typical)
Temp. comp'n slope	Fixed 2% / °C over 0 - 100°C. Select In or Out.
Temp. comp'n base	Fixed at 25 °C.
Display	3½ digit back-lit LCD, 20 mm character height
Operating frequency	Sensor : 33 kHz, sinusoidal
Current output (BC92, BC93, BC94)	Select 0 - 20 mA or 4 - 20 mA into 600 ohms max. Expandable to 0 - 50 % of range.
Primary control relay	Adjustable set point with volt free contacts (5A 250V AC). Hysteresis 1% fsd. Red LED = relay energised.
Secondary control relay (BC92 only)	Volt free contacts (5A 250V AC). Time proportioning action settable from 10 - 100% of Primary relay on time. Red LED indicates relay energised.
Secondary control relay (BC93 only)	Adjustable set point with volt free contacts (5A 250V AC). Hysteresis 1% fsd. Red LED = relay energised.
Secondary alarm relay (BC94 only)	Adjustable timed dose alarm with volt free contacts (5A 250V AC). A flashing red LED indicates relay energised.
EMC : Immunity	BS EN 50082-2:1995
EMC :Emissions	BS EN 50081-1:1994
LVD : Safety	BS EN 61010-1:1993
Power supply	110V or 230V AC, 50/60 Hz, user selectable, 3W max.
Housing	Flame retarding ABS plastic in pale grey
Weight	Less than 800 grams (transmitter only)
Environmental	IP66
Overall dimensions	160 x 130 x 65 mm (H, W, D) exc. mounting brackets

2 INSTALLATION

This chapter describes how to install and mount the pipe-, rail- and surface-mounting versions, and how to connect the unit to auxiliary equipment and a power source.

Surface-mounting version

The surface-mounting version is designed for fixing to a wall or other flat surface using the brackets provided.



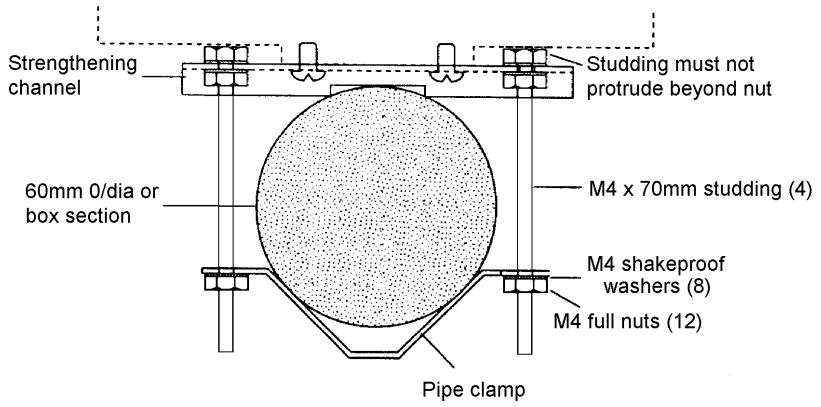
Mounting brackets and dimensions

The brackets should be attached, either horizontally or vertically, to the back of the BC9 series using the four M4 pan head screws provided.

Rail-mounting version

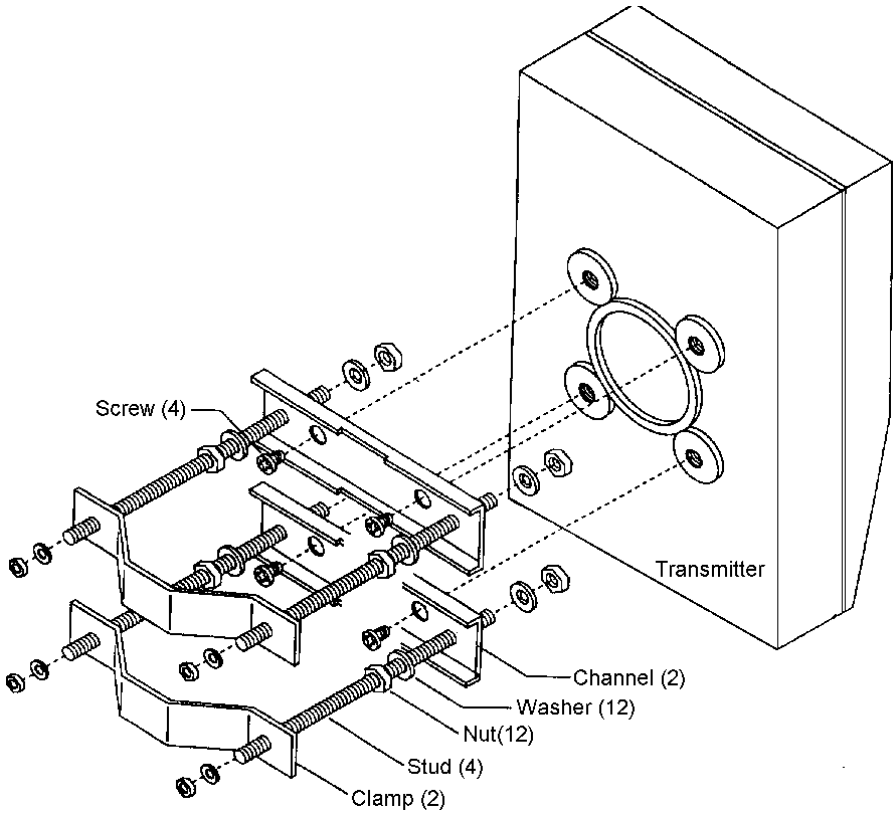
The rail- & pipe-mounting version is designed for fixing to a vertical or horizontal handrail or pipe, of 25 mm min. to 60 mm max. outside diameter. The rail-mounting kit comprises two channels, two clamps and appropriate studs, nuts and washers, as shown in the exploded view opposite.
To mount the rail-mounting version proceed as follows:

- Attach the four studs to the channels using four pairs of nuts and washers as shown in the following diagram. The studding must not protrude beyond the nut on the flat side of each channel
- Attach the two channels to the rear of the transmitter, using the four Posidrive screws provided.
- Attach to the pipe using the two clamps and fasten with nuts and washers, as above



Rail- & pipe-mounting brackets

Note: the brackets can be fitted vertically or horizontally



Exploded view of the pipe and rail fixing clamp assembly.

Note: the brackets can be fitted vertically or horizontally

Special installation instructions

Part of the method of EMC compliance is a strict limitation on the way in which all signal, supply and control cables are terminated at both the instrument and source or destination. It is essential that the types of cables which have been recommended (or direct replacements) are used. With the wrong cable fitted, incorrect readings will result.
If these installation instructions are followed carefully and precisely, the instrument will achieve and maintain the levels of EMC protection stated in the specification. The equipment to which it is connected must also have the same or similar EMC control to maintain operation without undue interference to the whole 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 the instrument housing.
- The instrument housing must be correctly re-assembled and securely fastened, to maintain a continuous electro-magnetic shield around the instrument.
- An Earth connection must be made to the Earth terminal of this instrument, both for SAFETY and to keep the EMC protective shield at Earth potential.

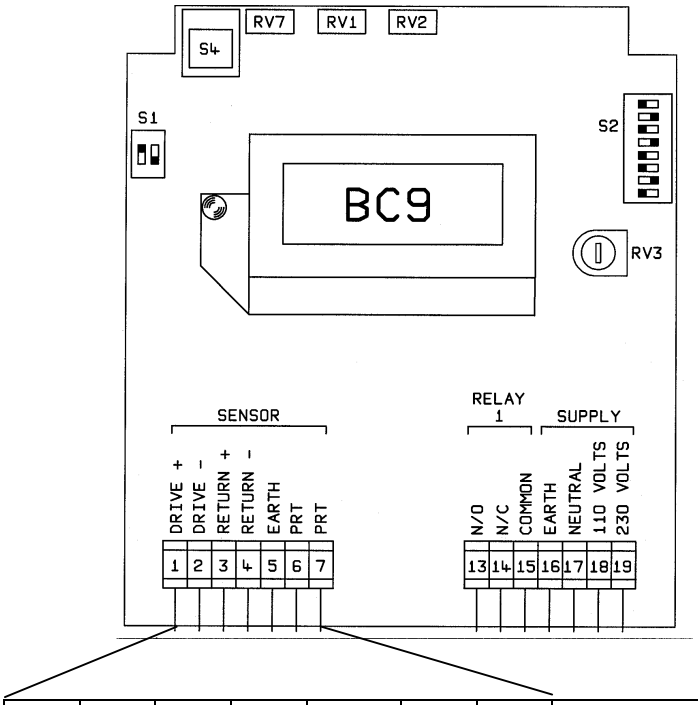
Connections and Controls

CAUTION: Before installing or making any changes to the High Voltage terminals, ensure the mains power has been switched off and cannot be switched back on by accident during wiring of the instrument.

Connections to the BC9 series are made through two groups of terminal blocks, accessible by removing the front panel. The following four diagrams of the BC9 series connections also show the position of the calibration controls which are referred to in the section on setting up the instrument.

NOTE: the BC9 is not fitted with a current output or a second relay (relay 2).

BC9 Connections and Controls
(Single Setpoint, No Current Output)



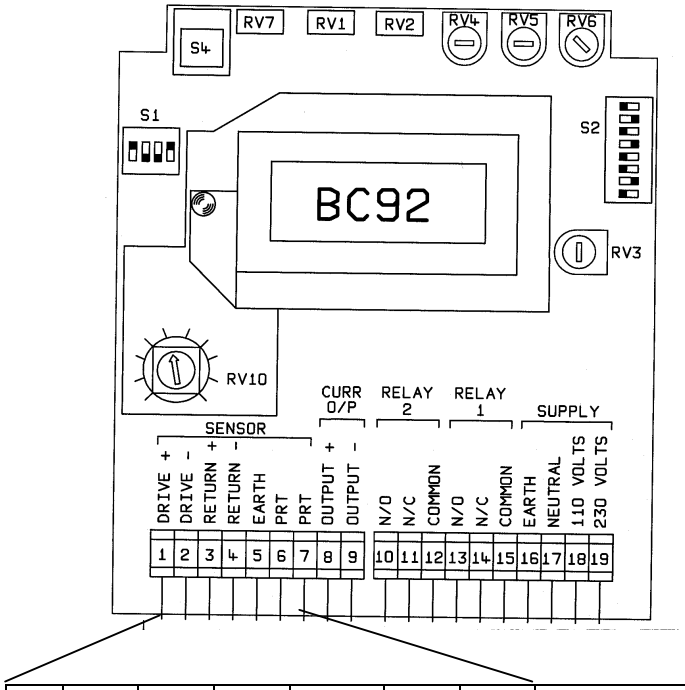
1	2	3	4	5	6	7	Sensor	Cable
Clear	Screen 2	Green	Screen 1	Green & Yellow	Blue & Yellow	Black & White	ECS 40 Series Beige Plastic	54E Cable
Clear	Screen 2	Green	Screen 1	Green & Yellow	Blue	Yellow	ECS 20 Series Blue Plastic	54H Cable

DISCONNECT the mains power to the instrument and the control relays before making changes to connections under the mains terminal safety cover.

The BC9 has a single relay. It changes state when the measured conductivity falls below or rises above the setpoint. A single LED is lit when the relay is energised. It has no current output.

BC92 Connections and Controls

(Relay 1 Setpoint, Relay 2 Timer, One 4-20 Output)



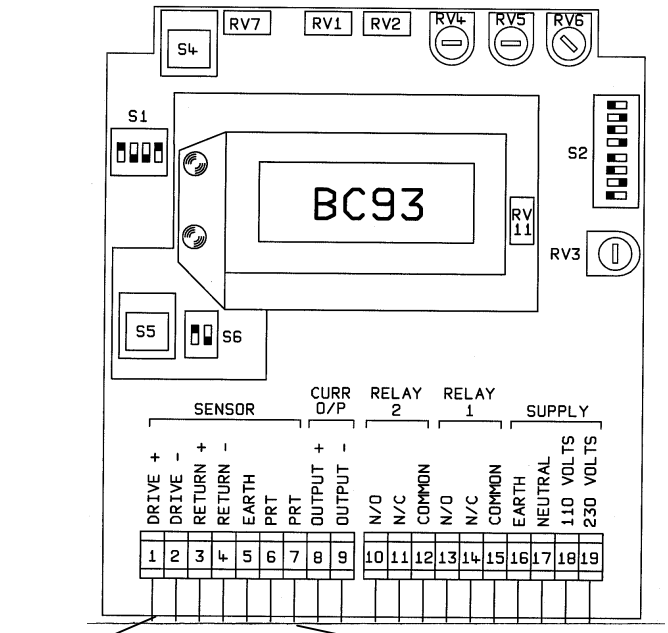
1	2	3	4	5	6	7	Sensor	Cable
Clear	Screen 2	Green	Screen 1	Green & Yellow	Blue & Yellow	Black & White	ECS 40 Series Beige Plastic	54E Cable
Clear	Screen 2	Green	Screen 1	Green & Yellow	Blue	Yellow	ECS 20 Series Blue Plastic	54H Cable

DISCONNECT the mains power to the instrument and the control relays before making changes to connections under the mains terminal safety cover.

The BC92 has two relays. Relay 1 changes state when the measured conductivity falls below or rises above the Setpoint. LED 1 is lit when Relay 1 is energised. Relay 2 is energised when Relay 1 is de-energised. It stays on for a fixed proportion of the on time of Relay 1, as set with RV10. The BC92 has a single 4-20 mA current output.

BC93 Connections and Controls

(Relay 1 Setpoint, Relay 2 Setpoint, One 4-20 Output)



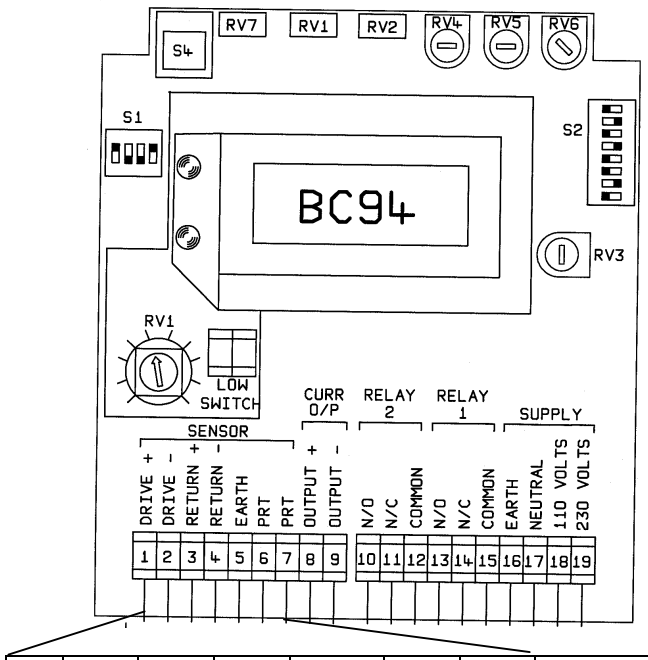
1	2	3	4	5	6	7	Sensor	Cable
Clear	Screen 2	Green	Screen 1	Green & Yellow	Blue & Yellow	Black & White	ECS 40 Series Beige Plastic	54E Cable
Clear	Screen 2	Green	Screen 1	Green & Yellow	Blue	Yellow	ECS 20 Series Blue Plastic	54H Cable

DISCONNECT the mains power to the instrument and the control relays before making changes to connections under the mains terminal safety cover.

The BC93 has two relays. Relay 1 changes state when the measured conductivity falls below or rises above Setpoint 1. LED 1 is lit when Relay 1 is energised. Relay 2 changes state when the measured conductivity falls below or rises above Setpoint 2. LED 2 is lit when the Relay 2 is energised. The BC93 has a single 4-20 mA current output.

BC94 Connections and Controls

(Relay 1 Setpoint, Relay 2 Alarm, One 4-20 Output)



1	2	3	4	5	6	7	Sensor	Cable
Clear	Screen 2	Green	Screen 1	Green & Yellow	Blue & Yellow	Black & White	ECS 40 Series Beige Plastic	54E Cable
Clear	Screen 2	Green	Screen 1	Green & Yellow	Blue	Yellow	ECS 20 Series Blue Plastic	54H Cable

DISCONNECT the mains power to the instrument and the control relays before making changes to connections under the mains terminal safety cover.

The BC94 has two relays. Relay 1 changes state when the conductivity falls below or rises above the Setpoint. LED 1 is lit when Relay 1 is energised. Relay 2 is energised and LED 2 flashes when one of the alarm conditions occur. Relay 1 & LED 1 are de-energised in alarm conditions. The BC94 remains in alarm condition until reset. To cancel the alarm, ensure any tank low condition is cancelled. The tank switch must be open. Fill the tank with chemical to achieve this. Then either reset the instrument by momentarily turning the power off, or manually dose the system until a normal conductivity level is achieved. Both of these methods require operator intervention. This has been deliberately designed in as a safety feature. The BC94 has a single 4-20 mA current output.

All connections

This applies to all cables and cable glands for all installations.
After each cable has been connected up, pull most of the cable slack back through the cable gland to prevent any unwanted RF energy being radiated inside the housing. Make sure you do not tension the cable within the instrument. Tighten the cable gland onto the cable so that it grips sufficiently to seal and to prevent the cable from being pulled back through the gland.

Supply voltage connections

Remove the plastic mains cover as follows. Squeeze the top of the mounting post with fine pliers or similar and then lift the mains cover clear of the terminals.
Feed the mains supply cable through the outer right hand cable gland. Do not use individual strands of wire if it is necessary to achieve an IP66 level of environmental seal. Connect the power supply to terminals 16,17 & either 18 or 19 as required.
Replace the plastic mains cover and skip the next paragraph if relays are not required.

Relay connections

For typical external wiring configurations, refer to the Appendices at the back of this guide.

Remove the plastic mains cover (unless already removed above) as follows. Squeeze the top of the mounting post with fine pliers or similar and then lift the mains cover away from the terminals.

The relay contacts are not powered from the instrument itself. They must be connected in series with a supply, a load and a 5 Amp fuse. A contact arc suppressor may be required to prevent excessive electrical noise, depending upon the load. To switch more than 5 Amps will require a slave relay.

Feed the relay cable through the inner right hand cable gland. Do not use individual strands of wire if it is necessary to achieve an IP66 level of environmental seal. Connect relay 1 to terminals 13,14 & 15 as required and connect relay 2 to terminals 10, 11 & 12 [BC92, BC93 and BC94 only] if required.

Pull most of the cable slack back through the cable gland to prevent any unwanted RF being radiated inside the housing. Make sure you do not tension the cable within the instrument. Tighten the cable gland onto the cable so that it grips sufficiently to seal and to prevent the cable from being pulled back through the gland.

Replace the plastic mains cover.

Current output connections

[BC92, BC93 and BC94 only]

Feed the current output cable through the inner left-hand cable gland [the smallest cable gland on the instrument]. Do not use individual strands of wire if it is necessary to achieve an IP66 level of environmental seal. Connect the current output to terminals 8 & 9 using a standard 2 core screened cable. Connect the screen to Earth at one end only.

Pull most of the cable slack back through the cable gland to prevent any unwanted RF being radiated inside the housing. Make sure you do not tension the cable within the instrument. Tighten the cable gland onto the cable so that it grips sufficiently to seal and to prevent the cable from being pulled back through the gland.

Sensor input connections

Cable connection details are shown in the diagrams near the start of this section.

Feed the ECS sensor cable through the outer left-hand cable gland [the largest cable gland on the instrument]. Do not use any other type of cable than those recommended by LTH to extend the sensor / instrument distance. Connect the conductivity sensor to terminals 1, 2, 3 & 4 and the outer cable screen to terminal 5. If the conductivity cell is fitted with a Pt1000 RTD, connect it to terminals 6 & 7. None of the three cable screens should be connected together at any time.

Low tank level switch connections

(BC94 only)

A normally open float switch can be wired to the top PCB connector terminals of the BC94 to give an alarm condition. A small current flows through the switch contacts when closed. Operating current is about 10 milliamps, and open circuit voltage is about 12V DC. Therefore a relatively long cable of small diameter can be used.

Noise suppression

In common with other electronic circuitry, the BC9 series 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.

Potential noise sources

The following noise generating sources can affect the BC9 series 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 BC9 series 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.

Recommended wiring practices

- All the wiring should conform to local codes and practices.
- Cables transmitting low level signals should not be routed near contactors, motors, generators, radio transmitters or wires carrying large currents.

Reducing interference

If noise sources are so severe that the instrument'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 earthed steel trunking as much as 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 instrument.

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3 OPERATION & SETUP

Introduction

This chapter explains the best and quickest set-up method for this equipment. Carefully follow the procedures below systematically to ensure optimum performance from your instrument. Remember that a little extra time spent getting this right can make a lot of difference in terms of efficiency savings, maintenance calls, faulty installations and so on.

Note 1: for operators familiar with the setting up of this type of instrument, use the summary tables in Appendix A in conjunction with the component layout diagrams in Section 2.

Note 2: For identification of components refer to the control diagrams on pages 11 (BC9), 12 (BC92), 13 (BC93), 14 (BC94).

Setting up your controller

To set up a BC9 series controller ensure that the instrument and sensor have been installed in accordance with all the requirements of Section 2. Configure the option switches according to the following tables.

IMPORTANT: READ THE FOLLOWING TABLE KEY

The switch tables below have been designed for ease of installation with minimum chance of incorrect settings. Each switch table has a specific function. Each function should be carefully considered and the switches set accordingly. Think about the following example...

Switch 2			Display.....
#5	#6	#7	
On / Closed	Off / Open	Off / Open	Set.....

Switch 2 is the component number of a group of switches.

#5, #6 etc. is the **Nth** switch in that group of switches.

The right hand column details the function and options for the switch group.

If in doubt contact LTH Electronics or your local distributor for technical support. When the switches have been configured, adjustment of the calibration potentiometers should be carried out in the correct sequence as shown at the end of this Section.

Unscrew and remove the instrument housing cover.

Select the operating range

Four operating ranges are available in the BC9 series of instruments. These are: 1.999 mS/cm, 19.99 mS/cm, 199.9 mS/cm and 1999 mS/cm. Note that 1.999 mS/cm = 1999 µS/cm.

For %NaOH range versions, see supplementary information in APPENDIX D

The range is selected by changing the position of the PCB mounted switches (Sw 1#1 & Sw 1#2) as shown in the table below

Switch 1		Operating and Display Range
#1	#2	
Off / Open	Off / Open	Display Range = 1999 mS/cm
Off / Open	On / Closed	Display Range = 199.9 mS/cm
On / Closed	Off / Open	Display Range = 19.99 mS/cm
On / Closed	On / Closed	Display Range = 1.999 mS/cm

Set the display decimal point

Note: the decimal point position on the display depends on the operating range as selected previously. Use *only one* of Sw 2#5, Sw 2#6 & Sw 2#7 to turn on the required decimal point.

Switch 2			Display Decimal Point Position
#5	#6	#7	
On / Closed	Off / Open	Off / Open	Set decimal point = 1XX.X
Off / Open	On / Closed	Off / Open	Set decimal point = 1X.XX
Off / Open	Off / Open	On / Closed	Set decimal point = 1.XXX

Set temperature compensation mode

Note: during sensor calibration with a loop resistor, the temperature compensation must be switched out. Upon completion of the sensor calibration, it can be switched in again as required.

Switch 2		Temperature Compensation In or Out
#1	**#2**	
Off / Open	**On / Closed**	**Set temperature compensation IN**
On / Closed	**Off / Open**	**Set temperature compensation OUT**
Off / Open	*Off / Open*	*Illegal set-up for temperature compensation*
On / Closed	*On / Closed*	*Illegal set-up for temperature compensation*

Calibrating the system

Before calibration, ensure that all option switches above are set correctly.

NOTE 2: power up for at least 10 minutes prior to calibration for the circuits to reach their working temperature.

Select the Calibration Resistor

The BC9 series can be operated on one of 4 standard ranges using 2 different types of sensor (plus a special 0 - 5 % NaOH range). To reduce the number of calibration resistors to a minimum, the following three tables contain the details of the loop resistors, the span values, and the current output values that are necessary for setting up all ranges and all sensors.

Two calibration loop sets are available for the BC9 series. Originally, there were 2.5, 25, 250, 2K5 (ohm) resistors. Since the introduction of the ECS40 range of sensors, the loop resistor set has been changed to 3, 30, 300, 3K0 (ohm) resistors. Check you are using the correct loop resistor / sensor / table combination on the next page..

Note: if the wrong table is used to select the calibration point, a scaling error of 20 % will result. If in doubt as to which type of sensor has been installed, contact LTH Electronics or your local distributor with the sensor serial number.

Calibration Resistor Tables

Note1: Table 1 = old value loop resistors, Tables 2 & 3 = new value loop resistors
Note2: Sensor constants… ECS20 = 4.5, ECS40 = 5.55
Note3: For NaOH ranged controllers, see APPENDIX D at the back of this guide.

ECS 20 series (blue coloured plastic) sensor calibration (Identified by the 54H sensor cable or ECS2x on the sensor label)						
Display Range	**Loop Type**	**Part No.**	**Loop Resistor**	**Display Value**	**0-20 mA Output**	**4-20 mA Output**
1999 mS/cm	Pink & Black	6062	2.5 Ω	1800 mS/cm	18.00 mA	18.40 mA
199.9 mS/cm	Red & Black	6061	25 Ω	180.0 mS/cm	18.00 mA	18.40 mA
19.99 mS/cm	Yellow & Blk	6060	250 Ω	18.00 mS/cm	18.00 mA	18.40 mA
1.999 mS/cm	Grey & Blue	6059	2500 Ω	1.800 mS/cm	18.00 mA	18.40 mA

ECS 20 series (blue coloured plastic) sensor calibration (Identified by the 54H sensor cable or ECS2x on the sensor label)						
Display Range	**Loop Type**	**Part No.**	**Loop Resistor**	**Display Value**	**0-20 mA Output**	**4-20 mA Output**
1999 mS/cm	Grey/ Black	6073	3.0 Ω	1500 mS/cm	15.00 mA	16.00 mA
199.9 mS/cm	Violet/ Red	6072	30 Ω	150.0 mS/cm	15.00 mA	16.00 mA
19.99 mS/cm	Yellow/ Green	6071	300 Ω	15.00 mS/cm	15.00 mA	16.00 mA
1.999 mS/cm	Red/ Green	6070	3000 Ω	1.500 mS/cm	15.00 mA	16.00 mA

ECS 40 series (beige coloured plastic) sensor calibration (Identified by the 54E sensor cable or ECS4x on the sensor label)						
Display Range	**Loop Type**	**Part No.**	**Loop Resistor**	**Display Value**	**0-20 mA Output**	**4-20 mA Output**
1999 mS/cm	Grey/ Black	6073	3.0 Ω	1850 mS/cm	18.50 mA	18.80 mA
199.9 mS/cm	Violet/ Red	6072	30 Ω	185.0 mS/cm	18.50 mA	18.80 mA
19.99 mS/cm	Yellow/ Green	6071	300 Ω	18.50 mS/cm	18.50 mA	18.80 mA
1.999 mS/cm	Red/ Green	6070	3000 Ω	1.850 mS/cm	18.50 mA	18.80 mA

Calibrate the display

- Unscrew and remove the instrument housing cover
- Set the Temp.Comp. control OFF (Sw 2#1 On / Closed, Sw 2#2 Off / Open)
- Ensure the sensor is in air with no conductive material around it, (product, loop resistors, surfaces).
- Adjust the Set Display Zero control (RV1) until the display reads 000 .
- Pass the chosen calibration loop resistor (see Calibration Resistor Tables on previous page) through the sensor and connect the two ends together.
- Adjust the Set Display Span control (RV2) until the display reads the calibration value listed in the Calibration Resistor Tables on previous page.
- Remove the loop resistor and check that the display falls to 000 .
- Repeat until the Zero and Span are both correct.
- If required, set Temp.Comp. ON (Sw 2#1 Off / Open, Sw 2#2 On / Closed)

Set current output mode

(BC92, BC93 & BC94 Only)

Switch 1		**Current Output Reference Current**
#3	**#4**	
Off / Open	**On / Closed**	**Set current output range 4 - 20 mA**
On / Closed	**Off / Open**	**Set current output range 0 - 20 mA**
Off / Open	*Off / Open*	*Illegal set-up for current output*
On / Closed	*On / Closed*	*Illegal set-up for current output*

Calibrate the current output

(BC92, BC93 and BC94 Only)

If a high level of current output accuracy is required, or if using current expansion, add a current milliammeter in series with the output or use another method to monitor the output current.

- Set the Temp.Comp. control OFF (Sw 2#1 On / Closed, Sw 2#2 Off / Open)
- Ensure the display has been calibrated as detailed above.
- Set the current output expansion to OFF (Sw 2#8 Off / Open)
- Ensure the sensor is in air with no conductive material around it, (product, loop resistors, surfaces, etc.).
- Check that the display reads 000.
- Adjust the Set current Zero = 0 mA (RV4) or 4 mA (RV5) as required. The 0mA control should be backed off until the current drops to virtually zero... it will always fall short of zero by a few microamps.
- Pass the chosen calibration loop resistor (see Calibration Resistor Tables on previous page) through the sensor and connect the two ends together.
- Adjust the Set current Span control (RV6) until the current output equals the current calibration value listed in the calibration tables above.
- Remove the loop resistor and check that the current falls to 0 or 4 mA .

- Repeat until the current output zero and span are both correct.
- Further small adjustments can be made with RV4, RV5, RV6 if it is necessary to set specific values on an external monitoring system.
- If required, set Temp.Comp. ON (Sw 2#1 Off / Open, Sw 2#2 On / Closed)

Upon completion of calibration

- If required, set temperature compensation ON (Sw 2#1 Off / Open, Sw 2#2 On / Closed)
- If required, set the Current output expansion to ON (Sw 2#8 Off / Open) **(BC92, BC93 and BC94 Only)**

Select current output expansion

(BC92, BC93, BC94 only)

Note: the current output can be re-scaled to cover 0 - 50% of the displayed range, that is 20 mA output at the following conductivities: 1.000 mS/cm, 10.00 mS/cm, 100.0 mS/cm, 1000 mS/cm.

Switch 2	Current Output Scale Expansion
#8	
Off / Open	Set o/p = 20 mA at 100 % of display range
On / Closed	Set o/p = 20 mA at 50 % of display range

Set point 1 operating mode

Note: The relays supplied with the BC9 series are of the changeover type. The choice of wiring configuration to be made here is whether the relay is to be used to dose chemicals (increase the conductivity) or to bleed a system (decrease the conductivity). In either case the relay wiring selected should permit the system to fail in a safe way (usually to de-energise the load) if the power fails. The set point 1 LED indicates that the relay is in an energised state.

Note the BC94 is fixed to energise if conductivity is less than the setpoint.

Switch 2		**Select set point 1 Mode Hi or Lo**
#3	**#4**	
Off / Open	**On / Closed**	**Energised if conductivity is greater than set point (HI)**
On / Closed	**Off / Open**	**Energised if conductivity is less than set point (LO)**
Off / Open	*Off / Open*	*Illegal set-up for Relay 1 set point*
On / Closed	*On / Closed*	*Illegal set-up for Relay 1 set point*

Setting the set point for Relay 1

(All versions)

Note: Refer to Appendix B for an example of how Relay 1 can be used.

- The set point 1 LED is lit when the relay is energised.
- A single momentary acting push button switch (Sw 4) which, when held down, displays the Conductivity set point for Relay 1 on the digital display.
- To change the set point hold down the set point monitor switch (Sw 4) and adjust RV7 until the display shows the desired set point value.
- Relay action and set point hysteresis can be checked by slowly adjusting the set point control RV7 above and below the conductivity value.
- If the Set point action is incorrect, change both Sw2#3 and Sw2#4 over, then repeat this section.

Set point 2 operating mode

(BC93 Only)

Note: The controls for this set point are on the auxiliary circuit board mounted between the display and the main board. The relays supplied with the BC9 series are of the changeover type. The wiring configuration depends on the relay operation. Is it to be used to dose chemicals (increase the conductivity) or to bleed a system (decrease the conductivity). or to sound an alarm which indicates abnormal (fault) conditions. In either case the relay wiring selected should permit the system to fail in a safe way (usually to de-energise the load) if the power fails.. The set point 2 LED indicates that the relay is in an energised state.

Switch 6		Select set point 2 Mode Hi or Lo
#1	**#2**	
Off / Open	**On / Closed**	**Energised if conductivity above set pt 2 (HI)**
On / Closed	**Off / Open**	**Energised if conductivity below set pt 2 (LO)**
Off / Open	*Off / Open*	*Illegal set-up for Relay 2 set point*
On / Closed	*On / Closed*	*Illegal set-up for Relay 2 set point*

Setting the dose (feed) ratio for Relay 2

(BC92 only)

- The set point 2 LED is lit when the relay is energised.
- Set the required **k** (timer ratio) factor with RV10.

Using the equation $\mathbf{t_2 = kt_1}$, it can be seen that at **k** = 0.1, Relay 2 will be on for 10 % of the time that Relay 1 is on. At **k** = 1.0, Relay 2 will be on for 100 % of the time that Relay 1 is on.

Setting the set point for Relay 2

(BC93 only)

- The set point 2 LED is lit when the relay is energised.
- A single momentary push button switch on the top PCB (Sw 5) which, when held down, displays the Conductivity set point for Relay 2 on the display.
- To change the set point hold down the set point switch (Sw 5) and adjust RV11 on the top PCB until the display shows the desired set point value.
- Relay action and set point hysteresis can be checked by slowly adjusting the set point control RV11 above and below the conductivity value.
- If the Set point action is incorrect, change both Sw6#1 and Sw6#2 over, then repeat this section.

Setting up the dose alarm for Relay 2

(BC94 only)

The graduated potentiometer on the top PCB sets the time allowed for any one dose before the alarm is triggered. Adjust this time to be the maximum you want to allow (including a safety margin) before the alarm condition is activated.
A normally open float switch can also be wired to the top PCB connector terminals of the BC94 to give an additional alarm condition (for wiring details, see section 2 INSTALLATION,)
To summarise:

- The set point 2 LED flashes and the alarm relay is energised when the alarm is activated by the alarm timer or tank low switch.
- The Dose relay is de-energised in the alarm condition.
- Set the required alarm time of 1 to 60 minutes with RV1 on the top PCB.
- Alarm is activated if a single dose operation exceeds the time set on the alarm time control.
- Alarm will be activated if the tank low switch is closed.
- Relay 2 will be on until the alarm is cancelled.
- Relay 1 will not be re-energised until the alarm condition is cancelled

To cancel the alarm condition, ensure any tank low condition is cancelled. To achieve this, the tank switch must be open. Fill the tank with the required amount of chemical to achieve this. Then either reset the instrument by turning the power off for about 5 seconds, or manually dose the system until a normal conductivity condition is achieved. Both of these methods require operator intervention. This has been deliberately designed in as a safety feature.

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4 FAULT FINDING

Introduction

Note: There are no user serviceable parts inside the instrument.

Fault finding hints are included in this section. If the fault has not been cleared after these checks have been carried out, contact LTH. Please have as much of the following information available as possible in any communication with LTH, to enable a quick repair or diagnosis of the problem to be made:

- Serial number of the instrument.
- The approximate date of purchase.
- Details of the application.
- Electrical environment and supply details.
- Circumstances under which failure occurred.
- The nature of the fault or faults.
- Relay and current o/p loads, cables and lengths.
- The sensor type, cable length and serial number.

Note: most faults are due to incorrect wiring or sensor mounting. It is essential that the conductivity sensor is measuring a representative sample and that all connections are correct.

It is often worthwhile to check the measurement by an independent method, for example, by use of a portable conductivity meter or by titration.

Faults

Instrument appears dead

- Check that power is available to the unit. Using an AC voltmeter, check the mains supply voltage at the connector.

The reading is over range or under range

- Ensure that the input is correctly connected and that the sensor is not faulty or damaged.
- Check that the correct range and set up have been selected on the instrument.
- Check the sensor and its cable for possible short circuits. The conductivity may be higher than the range of the instrument.
- Check the Pt1000 RTD temperature sensor connections.