

Measuring & Control



LLC-D3 Level Controller Hardware Manual And Technical Documentation

(Firmware version: V1.020B159)



BOSMA-CONTROLS Measuring & Control

Safety Instructions

CAUTION! Read all instructions carefully before commencing any work. Heed all warnings. Installation and use of the controller may only be carried out by adequately qualified individuals. The operator must be aware of the consequences of setting up the controller incorrectly. Factory settings do not guarantee safe operation, since the configuration parameters depend on the type of system.

If changes are made to type-approved equipment, this type approval becomes void. The equipment's inputs and outputs as well as its accessories may only be connected as shown in this guide. Bosma-Controls Products assumes no responsibility for damages that result from failing to abide by the above or by using the LLC-D3 level controller in your refrigeration systems.

Explanation of symbols: In this hardware instruction manual, the following symbol is used to indicate important safety instructions to the user. The symbol will always appear when the information is necessary. The safety instructions, and particularly the warnings, must always be read and adhered to.

CAUTION! Refers to threats to system components or a possible limitation of functionality.

In this context, the head of operations is urged to abide by all the mandatory regulations, so as to avoid accidents and do everything possible to prevent damage to people and materials in the situation in question.

Intended use and terms of use: The Bosma Model LLC-D3 level controller functions properly when combined with the original supplied Bosma Measuring Probe for the corresponding specified refrigerant(s) without any shortening/lengthening of the original supplied fixed length coax cable.

The LLC-D3 is designed to continuously measure and regulate refrigerants in industrial refrigeration systems. If you want to use the LLC-D3 level controller for a different purpose or want to make use of a special Bosma Measuring probe, prior permission must be obtained from the manufacturer.

Prevention of collateral damage: Make sure that faults are assessed and relevant precautions are formulated by qualified personnel. In this way, you will prevent collateral damage from the LLC-D3, which would result in damages to persons and materials.

Environmentally-correct behavior and disposal instructions: LLC-D3 level controller is also built according to environmentally-correct behavior. The modules can easily be disassembled to allow sorting and recycling after sorting.



The Bosma-Controls Liquid Level Controller LLC-D3 is both designed and built in Holland. More than 40 year experience in the refrigeration industry resulted in the latest design. The LLC-D3 controls the refrigerant level in high and low pressure condensers, evaporators and chillers. The LLC-D3 can only function properly in combination with the Bosma-Controls "P-" sensor with length 390mm -> 1800mm. The sensor operates according to the capacitive measuring principle being unaffected by pressure, foam, splashing and coating. As the level rise's and material begins to cover the sensing element, the capacitance within the circuit between the probe and the media (conductive applications) or the probe and the vessel wall (insulating applications) increases. The LLC-D3 Liquid level controller detects this change, displays the status on a good visible 4x20 back-light LCD-display and generates relay actuations and a proportional 4-20 mA output signal. Senses pure liquid only!

APPLICATIONS:

- High pressure liquid level control
- Low pressure liquid level control
- Modulating liquid level / defrost



Working principle (functionality)





Compatibility with the old BOSMA NCA- and LLC-221/LLC-222/LLC-223 controllers:

The LLC-D3 is backwards compatible with the old Bosma Liquid Level Controllers manufactured in the 1970's (!) and later. The coax connector of the measuring probe is of the same type and fits on the new LLC-D3.

As the wiring specification for relays can differ, please always compare and check the relay specification of the LLC-D3 with the situation in the field.

Functionality:



In normal mode the LLC-D3 displays:

- Actual Level (in this example 76.1%)
- Setpoint Levelswitches L1, L2 and L3 (in this example 25%, 53%, 92%)
- Company Name (Bosma-Controls)
- Bargraph corresponding with the actual level
- 3 x LED emitting RED or GREEN

The relay setpoints L1, L2 and L3 can be adjusted with the corresponding 3 rotating arrow-knobs and can be set at any value between 0 and 100%.



The front plate has 3 x bi-colour LED's giving GREEN or RED light. From factory the setting of the LED's and the 3 double-relay outputs is as follows:

	LED	RELAY 1,2,3 connect 1+2	RELAY 1,2,3 connect 3+4
NO POWER	OUT	OPEN	CLOSED
LOW LEVEL	RED	CLOSED	OPEN
HIGH LEVEL	GREEN	OPEN	CLOSED
ABOVE RANGE	"BLINK" R/G	OPEN	CLOSED
NO PROBE	"BLINK " R/G	OPEN	CLOSED

- "RED" indicates that the pump is running. Although not recommended the LLC-D3 unit can be ordered with different LED functionality (GREEN where now is RED)
- At no-power/above range/no probe the relays are de-activated and fall in fail-safe mode, meaning the relay is "open" (factory jumper-setting)
- Blinking LED's alternating RED/GREEN/RED etc. means that the unit and situation needs attention. Alternate blinking can mean that the measured signal is "ABOVE RANGE" which means that the displayed value is higher than 125% of the calibrated FULL value. Other possibility is a measuring probe error (no probe connected, cable damage or internal leakage/shortcut). In that case the display shows blinking: **MEASUREMENT IS NOT CORRECT, CHECK COAX-CABLE OR PROBE-RESISTANCE**

** MEASUREMENT **
** IS NOT CORRECT **
* CHECK COAX-CABLE *
OR PROBE-RESISTANCE

Setting parameters :

The LLC-D3 foresees in setting parameters for:

- Hysteresis
- Average
- Delay

HYSTERESIS can be set on a choosen value 1,2,4,6,8,10 or 20 (%) and it can prevent the relays from continues switching in the case that fluid hight is unstable and is just around the setpoint of a levelcontact. Example: if the Hysteresis value is set to 6% and switch L1 is set on 20% and we assume liquid is rising,





than the relay will be de-activated at exactly the setpoint 20%. However, as soon as the liquid level drops, the relay will activate at/below 14% (20%-6%) and will be de-activated again as soon as the rising liquid level passes level 20%.

Hysteresis is a very usefull function. From factory this factor normally is pre-set at 2%

AVERAGE can be set on 1,2,4 or 5 meaning that the displayed value is averaged every 1,2,4 or 5 measurements by respectively 1,2,4 or 5. The pre-setted value is "1"

DELAY can be set on 1,2,3,4,5 (seconds) meaning that the displayed value is refreshed every 1,2,3,4 or 5 seconds.

The delay value possibility is not meant for most applications, therefore the pre-setted value is "1"

FLOWCHART FOR PROGRAMMING HYSTERESIS, AVERAGE, DELAY:



(From normal mode press 1 x ENTER for only viewing the parameters. Waiting a few seconds lets the menu come back in normal mode.

For programming immediately press ENTER after the VIEW display comes up and as soon as HYSTERESIS appears: press ENTER again for changing the hysteresis or wait for AVERAGE or DELAY via auto-scroll to appear in the display and than press ENTER)



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WET CALIBRATION PROCEDURE:

The so called "WET" calibration procedure is a very quick, easy and practical calibration that can be done in the field with a standpipe complete empty (ZERO) and with standpipe completely filled-up "FULL". This calibration also can be done with help of an external simulator with a pre-set value for "ZERO" and/or "FULL". For more information about available simulators please contact Bosma-Controls or your agent.

Procedure for "ZERO" calibration (needed a pin or small screwdriver <3mm/length >30mm)

- Completely empty/drain the standpipe or prepare a "ZERO" simulator
- Check that is controller is under power and that the probe or ZERO simulator is connected
- Carefully push-through a pin in the ZERO-hole
- In the display appears: "ZERO PROBE CAL.", a count-down timer starts
- Before count-down is finished press the ENTER button
- In the display appears " PROCESSING DATA"
- The display goes back to the normal measuring mode
- NEW calibration for ZERO is done now!

Note: If the ENTER button is NOT pressed during the count-down, the original ZERO is kept

Procedure for "FULL" calibration (needed a pin or small screwdriver <3mm/length >30mm)

- Completely fill the standpipe or prepare a "FULL" simulator
- Check that is controller is under power and that the probe or FULL simulator is connected
- Carefully push-through a pin in the FULL-hole
- In the display appears: "FULL PROBE CAL.", a count-down timer starts
- Before count-down is finished press the ENTER button
- In the display appears " PROCESSING DATA"
- The display goes back to the normal measuring mode
- NEW calibration for FULL is done now!

Note: If the ENTER button is NOT pressed during the count-down, the original FULL is kept





FLOWCHART FOR WET CALIBRATION PROCEDURE:



Most Bosma Measuring Probes with lengths 390-1800mm and supplied with the standard white ± 5 meter coax cable all have a ZERO-value of around 350 pF. From factory this zero is set in the LLC-D3 controller and so normally it is not necessary to do a new ZERO calibration.

"FULL" however is different for every length probe and depends of the type of refrigerant.

If a standpipe can be realised that is complete filled with liquid, this could be a good moment to do a FULL calibration (if not done before).

Bosma levelsimulators, factory adjusted for "0" and for 100% of a specified liquid are available at request. With these simulators a spare LLC-D3 from stock easily can be pre-calibrated making it plug&play for the new application



Wiring connections:

Input: 100-240V-AC/50-60Hz (or optional: 9 – 36 V-DC or 12-24 V-AC/50-60Hz) Input: 1 x coax for connecting the measuring probe (left side) Output relays: 3 x double relays each no and nc (=factory setting but can be changed via jumpers positioned above the terminals) Output mA: 1 x mA galvanic isolated mA-output, load max. 600 Ohm



Connection terminals

		LED	RELAY 1,2,3	RELAY 1,2,3		S/N 1511-192
NO POWER LOW LEVEL HIGH LEVEL ABOVE RANG NO PROBE	NO POWER	OUT	OPEN	CLOSED	Relay-functionality is only valid for factory-jumper- setting Relay- functionality can be inverted by changing jumper- positions from "NO" to "NC" or vice verse.	Software V1.020B159 V Power 100-240VAC V
	LOW LEVEL	RED	CLOSED	OPEN		Relais NO NC NO 4-20mA Isolator Y) N
	HIGH LEVEL	GREEN	OPEN	CLOSED		pre-calibrated for 1000mm-5m-NH3
	ABOVE RANGE	"BLINK" R/G	OPEN	CLOSED		TESTDATE: 25.11.2015
	NO PROBE	"BLINK " R/G	OPEN	CLOSED		

Inside the cover of the terminal box is a functionality-sticker and test-data sticker







BOSMA-CONTROLS LLC-D3 cabinet dimension backside with mounting holes (mm):



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BOSMA-CONTROLS LLC-D3 cabinet dimension underside, with cable-glands entry (mm):



The LLC-D3 is compatible and is an ideal replacement for the older model Bosma LLC controllers, the relay configuration however can differ. Always check!



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Error Detection

SYMPTOM	PROBABLES CAUSES	CURE
No light in the display and no LCD- display and LED lamps activated	No power to the unit or the wrong voltage	 Measure the power on MAIN input terminals Check the Fuse 2AT inside LLC-D3 controller
Wrong digits/figures in display	Interference caused by strong disturbance or else	Push the small RESET button next to the coax-connector on the circuit board
Blinking message in display "**MEASUREMENT IS NOT CORRECT**"	Loose coax-connector, defective coax cable, internal probe leakage	Check probe connection if loose or not Check probe resistance with a "megger": resistance should be infinite (!) for a normal probe If possible measure the capacitance of the probe and report values to Bosma- Controls If capacitance is "0", it is possible that the coax-connector got loose from the cable
The valve or the pump do not react to the signal from the controller	Defective cable or lack of a connection to the valve or pump	Check the connection to the pump or the valve
The LCD-display bar shows too low/high level in relation to the actual level in the vessel	 The cable is defective or there is no connection to the sensor probe Calibration is not correct Sensor not calibrated for the correct refrigerant 	 Measure the signal from the sensor Calibrate the controller ZERO and FULL Check the sensor. Look at the sensor's instruction manual (oil-)deposit under in standpipe
High/low alarm occurs frequently	 1) Turbulence in liquid 2) HYSTERESIS value set too close to the desired set point 	 1) Check the system's operational state 2) Eventually insulate the standpipe against "boiling" 3) Check the HYSTERESIS value and eventually set to a higher value 4) Set the AVERAGE VALUE at a higher value
The LCD-display flickers or is unstable	 Loose connection in the power supply or the sensor EMC interference from mobile telephones, frequency converters, or other equipment that does not meet the legal requirements for EMC 	 Check for loose connections Check the equipment that is causing flickering Install insulated wire from the sensor- housing to the controller





Pressing the small reset-button at the left side of the probe-input connector can solve display issues or dysfunctioning caused by (strong) interferences



A capacitance meter with coax-connector can help to detect measuring-probe issues



Fixed-value simulator for "ZERO" or "FULL" available at request



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Technical Specification

	LLC-D3 230Vac	LLC-D3 24Vdc
Supply:		
Voltage	100 – 240Vac /50-60Hz	9 – 36 DC / (12- 24 VAC-/50-60Hz)
Power consumption	< 5 Watt	< 5 Watt
Connection	Screw terminal	Screw terminal
Wire size	<2,5 mm2	< 2,5 mm2
Installation conditions		
Surrounding temperature	045°C	045°C
Protection class	IP66/DIN 60529	IP66/DIN 60529
Relative humidity	2080%	2080%
Approvals:	CE	CE
Mechanical Specifications:		
Mounting	Wall	Wall
External size cabinet (without cable	238x227x85 mm (HxWxD)	237x227x85 mm (HxWxD)
glands)		
Weight	1,5kg	1.5kg
Enclosure material	ABS; PC (only Front), seal made of CR	ABS; PC (only Front), seal made of CR
Display:		
LCD-display	20x4 digits white / blue	20x4 digits white / blue
Alarm indication	LED's and LCD-display flashing	LED's and LCD-display flashing
Programming	From front, ENTER button and	From front, ENTER button and
	potentiometers	potentiometers
Relay position indication	3x LED green/red	3x LED green/red
Input:		
Capacity range sensor	300 – 1200pF	300 – 1200pF
Output:		
Analogue output	Isolated, 4 – 20mA/600Ω max	Isolated, 4 – 20mA/600Ω max
Relays	3 x standard DIL relays, double. Form A	3 x standard DIL relays, double. Form A
	(no) + Form B (nc), no/nc configuration	(no) + Form B (nc), no/nc configuration
Deley Flectricel en dynamos	with jumpers possible	with jumpers possible
Relay Electrical endurance	$30V-DC/1A$ typ. $5x10^{\circ}$ operations, 230V-	$30V-DC/1A$ typ. $5X10^{\circ}$ operations, 230V-
	AC/0.5A typ. 3X10 operations.	AC/0.5A typ. 3X10 operations.
	operations	operations





Declaration of conformity



Declaration of Conformity

We hereby declare that the equipment listed below complies with the requirements of: The low Voltage Directive 2006/95/EC

Type of Equipment: BOSMA-CONTROLS LIQUID LEVEL CONTROLLER MODEL: LLC-D3

Dick Vosmeer (General Manager) Signed: _

Data: November 19, 2012

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NOTES: