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CALEX LCT-485 Network Interface for ExTemp Infrared Temperature Sensor User Guide

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INTRODUCTION

The LCT-485 is an RS-485 network interface module for the ExTemp infrared temperature sensor.
This unit, when connected on the safe side of an Intrinsically Safe isolator or barrier, allows the measured temperature to be read from the ExTemp sensor via the open Modbus RTU protocol. The sensor's configuration parameters may also be examined and changed.

Each LCT-485 unit allows communication with one ExTemp sensor. The chosen isolator or barrier must be compatible with the transmission of digital data superimposed over an analogue 4-20 mA signal. This allows the LCT-485 to communicate digitally with the ExTemp.

The LCT-485 is a Slave device; up to 224 devices may be connected to a third-party Modbus Master.

IMPORTANT INFORMATION FOR USE:

The LCT-485 is not suitable for use in a hazardous area. It MUST ONLY be connected in the safe area, and protected by a suitable Intrinsically Safe isolator or barrier.
Do not attempt to repair a faulty unit. Contact the vendor to arrange a return.

MODEL NUMBERS LCT-485
RS-485 network interface module for ExTemp sensor

SPECIFICATIONS

- Mounting DIN rail (35 mm)

- Communications Isolated RS-485 Modbus RTU Slave

- Dimensions 114(d) x 18(w) x 107(h) mm approx

- Connections Screw terminals for RS-485, power, and sensor loop (suitable for conductors 0.2 to 2.5 mm²)

- Supply voltage 24 V DC (6 V DC min / 28 V DC max)

- Max current draw 50 mA

- Baud rate 1200 bps to 57600 bps, detected automatically

- Bit format Parity: Odd / Even / None

- Stop bits: 1 or 2

- Ambient temperature -20°C to 70°C

- Loop resistor 270 Ω, built-in

- EMC Conformity BS EN 61326-1:2013, BS EN 61326-2-3:2013

- Max. No. of Devices Up to 224 x LCT-485 Slave devices per Modbus Master

- Reply Delay (at 9600 baud) ExTemp registers: 1 s max LCT-485 registers: 30 ms (single register) 50 ms (whole address space)

PREPARATION FOR INSTALLATION

Ambient Temperature
This network interface is designed to operate in ambient temperatures from -20°C to 70°C.
Electrical Interference
To minimise electromagnetic interference or 'noise', the network interface should be mounted away from motors, generators and such like.
Wiring
Check the distances between the Intrinsically Safe isolator or barrier, the Modbus Master, and the LCT-485 network interface. The LCT-485 conforms to industrial standards for electromagnetic compatibility with up to 30 m cable attached on the RS-485 side, and 30 m cable on the 4-20 mA side.

Power Supply
Be sure to use a 24 V DC power supply.

MECHANICAL INSTALLATION
Mounting
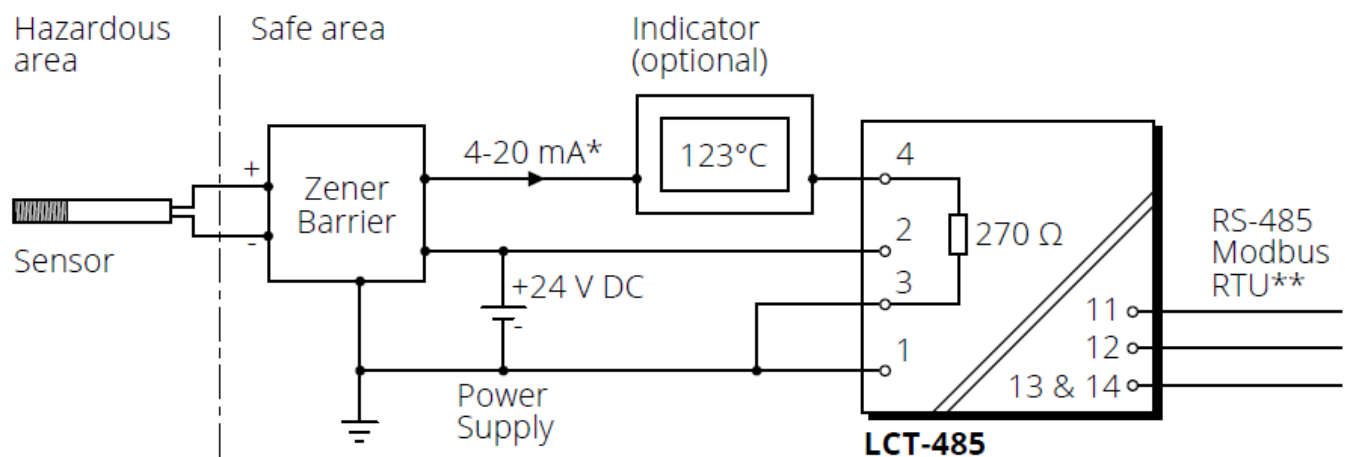The LCT-485 is designed to be attached to a 35 mm DIN rail via the included clip.

ELECTRICAL INSTALLATION

The LCT-485 is not certified for use in hazardous areas. It must only be connected on the safe side of the Intrinsically Safe isolator or barrier.
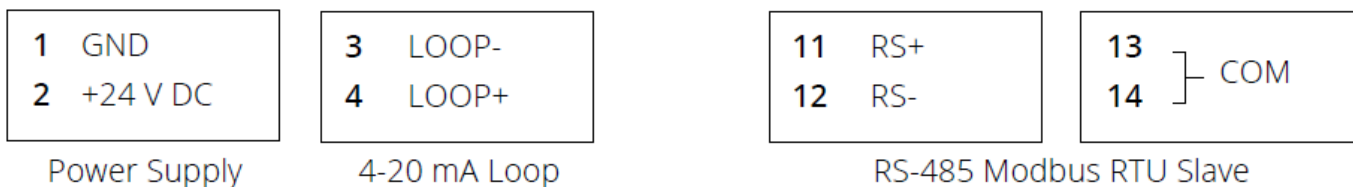
Connections with Intrinsically Safe Isolator
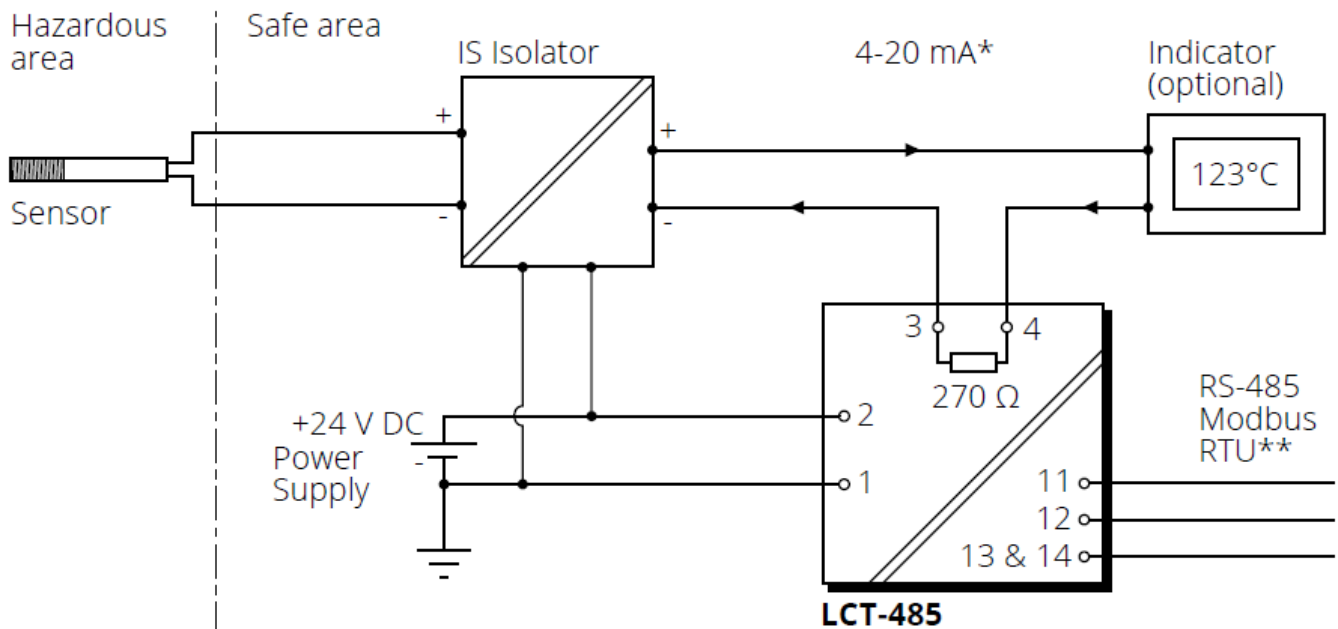
Connections with Zener Barrier

- Max. cable length 30 m
- Max. cable length 30 m (use of RS-485 Modbus repeater allows longer cable on the Master side)

Screw Terminals

1	GND		3	LOOP-		11	RS+		13	
2	+24 V DC		4	LOOP+		12	RS-		14	COM

Power Supply | 4-20 mA Loop | RS-485 Modbus RTU Slave

Intrinsically Safe Isolator or Barrier

LCT-485 must not be connected directly to the ExTemp sensor. It must only be used in conjunction with either an Intrinsically Safe isolator or zener barrier.
The isolator or barrier must be capable of simultaneously passing an analogue 4-20 mAsignal with a superimposed digital signal such as Frequency Shift Keying (FSK).
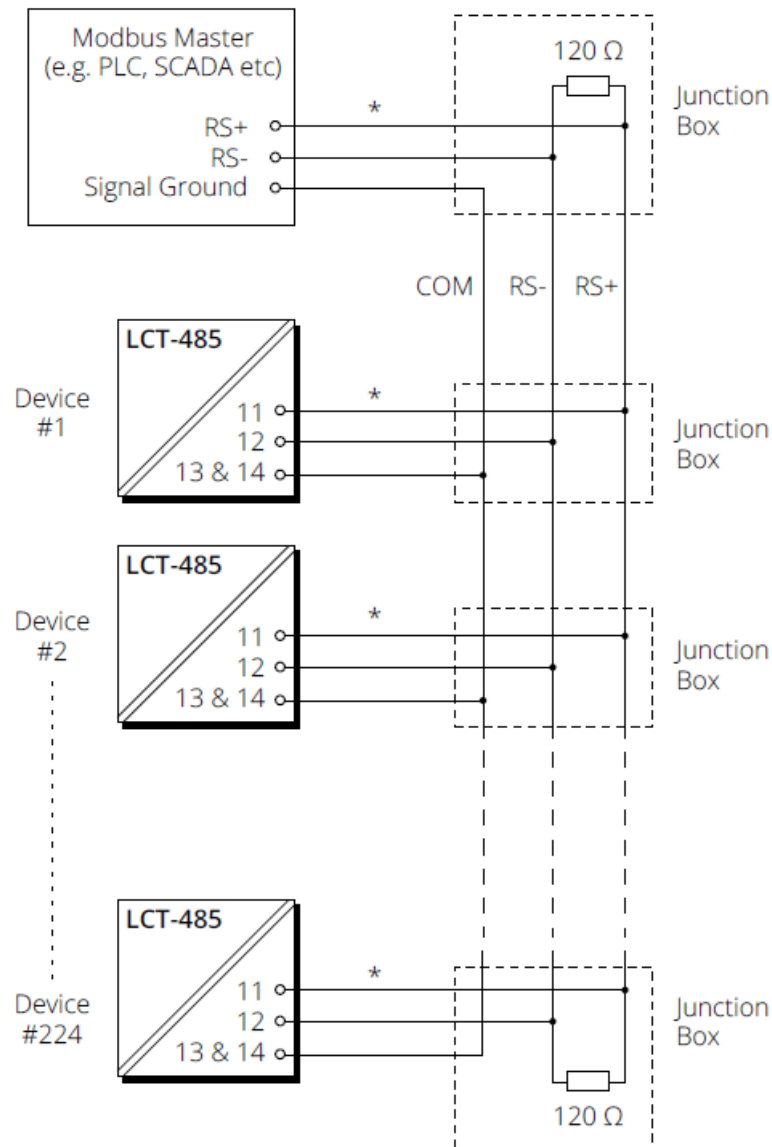
Suitable models include:

- Isolator model MTL5541
- Barrier model MTL7706+

  These are manufactured by Measurement Technology Ltd (www.mtl-inst.com).

Connections – RS-485 Modbus Network
All the below connections are on the safe side of the Intrinsically Safe isolator or barrier.

Ensure the distance between each device and the network bus is as short as possible.
Notes
The LCT-485 conforms to industrial standards for electromagnetic compatibility with up to 30 m of RS-485 cable attached. If the network must be run over a longer distance, the use of RS-485 repeaters is recommended.
Ensure all connections are correct before applying power.

OPERATION

Once the sensor is in position, a suitable Intrinsically Safe isolator or barrier must be connected and configured. When the appropriate power and cable connections are secure, the system is ready for continuous operation by completing the following simple steps:

1. Turn on the power supply
2. Turn on the indicator (if fitted)
3. Send a test message to confirm communications with LCT-485 are good (we recommend reading from address 0xD0, Modbus Slave address)
4. Send a test message to confirm communications with ExTemp sensor are good (we recommend reading from address 0x08, Filtered Object Temperature)
5. Read or monitor the temperature

MODBUS OVER SERIAL LINE (RS-485)

Interface	
Baud rate	1200 bps to 57600 bps, detected automatically
Format (Bits)	8 data, odd/even/no parity, 1 or 2 stop bits
Reply delay (at 9600 baud)	ExTemp registers: 1 s max LCT-485 registers:
	30 ms (single register)
	50 ms (whole address space)

Supported Functions	
Read register (R)	0x03, 0x04
Write single register (W)	0x06
Write multiple register (W)	0x10

LIST OF MODBUS REGISTERS (EXTEMP REGISTERS)

Address	R/W	Description	Default value	Min. value	Max. value
0x00 (0)	–	[RESERVED]	–	–	–
0x01 (1)	R	Sensor ID (length: 2 words): Bits 0..19 – Serial number Bits 20..23 – Sensor field of view (0=2:1, 1=15:1, 2=30:1) Bits 24..27 – Sensor type (A= ExTemp) Bits 28..31 – Reserved	–	–	–
0x03 (3)	R	Unfiltered object temperature	–	–	–
0x04 (4)	R	Sensor temperature	–	–	–
0x05 (5)	R	Maximum hold temperature	–	–	–
0x06 (6)	R	Minimum hold temperature	–	–	–
0x07 (7)	R	Average temperature	–	–	–
0x08 (8)	R	Filtered object temperature	–	–	–
0x09 (9)	–	[RESERVED]	–	–	–
0x0A (10)	R/W	Emissivity setting (1 LSB = 0.0001)	9500	2000	10000
0x0B (11)	R/W	Reflected temperature	0	–	–
0x0C (12)	R/W	Sensor status: Bits 0..1 – Reserved Bit 2 – Hold processing on (1) / off (0) Bit 3 – Hold peaks (1) / valleys (0) Bits 4..6 – Reserved Bit 7 – Reflected energy compensation on (1) / off (0) Bits 8..15 – Reserved	3	–	–
0x0D (13)	R/W	Average period (1 LSB = 250 ms)	1	0	240
0x0E (14)	R/W	Hold period (1 LSB = 250 ms)	1	0	4800
0x0F (15)	R/W	Temperature at 4mA	0	-200	9000
0x10 (16)	R/W	Temperature at 20mA	5000	800	10000
0x11 (17) to 0xCF (207)	–	[RESERVED]	–	–	-0

LIST OF MODBUS REGISTERS (LCT-485 REGISTERS)

Address	R/W	Description	Default value	Min. value	Max. value
0xD0 (208)	R/W	Modbus slave address*	1	1	247
0xD1 (209)	R/W	Baud rate*	9600	400	60000
0xD2 (210)	R/W	Parity (0 = none, 1 = odd, 2 = even)*	0	0	2
0xD3 (211)	R/W	Stop bits (1 = 1 stop bit, 2 = 2 stop bits)*	0	0	1
0xD4 (212)	R/W	Automatic bus configuration (ABC) mode (0 = off, 1 = on, 2 = on using nearest known baud rate**)	1	0	2
0xD5 (213)	–	[RESERVED]	–	–	–
0xD6 (214)	R/W	Function register (1=reload, 0x5555=factory reset) Cleared automatically	0	0	65535

If changed, the new value will only take effect after power is cycled, or after "1" is written to Function Register 0xD6 Mode "2": after detecting the baud rate, the LCT-485 then selects the nearest "known" baud rate from the following common values: 1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400,57600 (see "Automatic Bus Configuration Mode" below)

Notes

1. All temperatures are in tenths of degrees C
2. All write operations are saved to non-volatile memory
3. For further information please refer to **http://www.modbus.org/specs.php**
4. Use address 255 to communicate with any connected LCT-485 unit sensor (ensure only one LCT-485 unit is connected)
5. Use address 0 to broadcast to all connected LCT-485 units (no response expected)

AUTOMATIC BUS CONFIGURATION (ABC) MODE
The LCT-485 can automatically detect the correct baud rate, parity and stop bit settings used by the Modbus Master. This mode is enabled by default. To use ABC mode:

1. Configure the Modbus Master to repeatedly send Read messages to the LCT-485. Ensure the timeout period of the Modbus Master is no shorter than the LCT-485 unit's reply delay (1 second). Ensure the Modbus Master will continue to try to send messages after many timeouts.
2. The LCT-485 will listen for messages from the Modbus Master. At first it will use the chosen settings for baud rate, stop bits and parity. If none of these settings have been configured, the default values will be used.
3. After several failed messages, if the chosen settings do not work, the LCT-485 will automatically measure and set the baud rate. It will then try all the possible combinations of stop bit and parity settings until it finds the correct values.

4. The LCT-485 will detect when good communications with the Modbus Master have been established, and ABC mode will then be completed. The automatically-detected values will be stored in the LCT-485's Modbus registers. ABC mode will not begin again until the power is cycled.

5. It is possible to change the baud rate, parity and stop bit settings by writing to the Modbus registers. The LCT-485 will use the new settings after the power is cycled, or after "1" is written to Function Register 0xD6.

RECOVERY MODE
In the event that the settings for parity, stop bits and baud rate are lost or unknown, and ABC mode is "0" (Off), communications can be restored as follows:
Configure the Modbus Master to repeatedly send Read messages using 9600 baud, no parity, 1 stop bit. After several messages, the LCT-485 will temporarily revert to these settings until the power is cycled. This will allow the original correct settings to be read from the LCT-485. These recovery settings are not stored, and they do not overwrite the existing settings.

IMPORTANT

- The LCT-485 is not suitable for use in a hazardous area. It MUST ONLY be connected in the safe area, and protected by a suitable Intrinsically Safe isolator or barrier.
- Do not operate this unit near strong electromagnetic fields (e.g. around generators or induction heaters). Electromagnetic interference can cause measurement errors.
- Wires must be connected only to the appropriate terminals.
- Do not open the LCT-485 housing. This will damage the unit and invalidate the warranty.

MAINTENANCE
Our customer service representatives are available for application assistance, calibration, repair, and solutions to specific problems. Contact our Service Department before returning any equipment. In many cases, problems can be solved over the telephone. If the device is not performing as it should, try to match the symptom below to the problem. If the table does not help, contact us for further advice.

TROUBLESHOOTING

Symptom	Probable Cause	Solution
No communications	No power to the device	Check the power supply and wiring
	Incorrect Modbus Slave address	Check the Modbus Slave address on the label on the side of the unit. Check if the Modbus Slave address has been changed.

To read the Slave Address via Modbus:

With only one LCT-485 unit connected to the Modbus Master, read from register 0xD0 using Slave address 255 (this will produce a response from any Slave address) |
No (or intermittent) communications	Modbus Slave address conflict	Ensure each unit on the network has a unique Modbus Slave address
	RS-485 network layout incorrect	Ensure each RS-485 device is attached with as short a cable as possible to the main network bus
	No termination resistors	Ensure there is a 120 Ω termination resistor connected between the RS-485 + and – lines at the Modbus Master, and another at the end of the bus at the farthest device

GUARANTEE

Calex guarantees each instrument it manufactures to be free from defect in material and workmanship under normal use and service for the period of two years from the date of purchase. This guarantee extends only to the original buyer according to the Calex Terms and Conditions of Sale.

Documents / Resources

LCT-485
RS-485 Network Interface
for ExTemp Infrared Temperature Sensor
Operator's Guide	**CALEX LCT-485 Network Interface for ExTemp Infrared Temperature Sensor** [pdf] User Guide
LCT-485 Network Interface for ExTemp Infrared Temperature Sensor, LCT-485, Network Interface for ExTemp Infrared Temperature Sensor

References

- **M Modbus Specifications and Implementation Guides**
- **ETN Safety | Analysis and testing | Protection | Warning | Eaton**