L201™

Fiber Optic Thermometer Instrument

2 to 8-Channel System
With Optional Rugged Connect Software

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Notice

Permanent damage may be done to the thermometer if the power supply connections are not done correctly. Only approved USB power supply modules should be used to operate this L201 thermometer.

This product does not contain any user-serviceable parts. Opening this precision instrument will void its warranty and may disturb its factory calibration. Always seek servicing from an authorized Rugged Monitoring service depot.

To assure cleanliness of the optical connector, keep the protection cap on unused connectors at all time.

Fiber optic probes and extension cables are fragile and will break if the bending radius becomes less than ~1 cm, even temporarily. Probe and extension cable breakages are not covered under the standard Rugged Monitoring warranty.

The Rugged Monitoring products are CE marking certified.

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.

1 RUGGED MONITORING WARRANTY NOTICE

Your L201™ unit is guaranteed (Parts and Workmanship) for one full year from the date of purchase. Upon written notification of any defect, Rugged Monitoring will either repair or replace any faulty product or components thereof. A Return Authorization Number (RMA) must be obtained from Rugged Monitoring Inc. or authorized distributor prior to any merchandise return.

Due to the unique nature of the fiber optic probes that are used with this Rugged Monitoring transducer system, probes and extension cables are not guaranteed.

When using any electrical appliance, basic safety precautions should be followed, including the following:
- Do not operate in wet / damp environments
- Do not operate in explosive atmospheres
- Keep product surface dry and clean.

Always make sure all electrical installations are made in accordance with local authorities' regulations and laws.

2 GETTING STARTED

Your L201™ temperature-sensing instrument allows you to take full advantage of the benefits inherent to fiber optic sensing technology. It offers accurate and reliable temperature measurements, combined with extraordinary insensitivity to EMI/RFI, high voltage insulation and disturbance free sensing due to the non-electrical nature of the sensor element used.

Not only does the L201 family of products gives access to reliable measurements, it also offers a simple user interface that makes the technology easy to use. Moreover, no special calibration is required when changing the fiber optic sensor probes.

The thermometer is packaged in a small package, which is ideally suited for laboratory and industrial applications. It can be easily converted to a portable unit by simply connecting it to a commercially available external USB power battery bank (also available from Rugged Monitoring). A 3000 mAh bank should be good for 24 hours of continuous operation.

The unit is fitted with a micro-USB connector. This interface allows for powering the unit as well as for all data transfer, to or from a Windows computer. The transfer protocol is a fast serial scheme, a standard in the industry.

This thermometer includes the latest developments in fiber optic temperature measurement technologies. Most types of GaAs-based probes now available on the market are supported, even probes manufactured by Rugged Monitoring' competitors. It will also interface with and read marginal probes, or probes with dirty connectors, and so forth. It will give you years of excellent service.

The Rugged Connect software package is an excellent complement to your thermometer. This Windows software allows the user to configure the L201 more easily than using the few keys available on the instrument itself. It should be noted that some functions are programmable only from Rugged Connect.

Temperature logging can be performed in two ways:
1- Directly in the instrument, using a user supplied micro-SD memory card (in theory, up to 2 TB);
2- With Rugged Connect. In this case, logging can be done concurrently from 6 instruments (up to 64 channels);
3- Logging rate from one sample per second;
4- Both logging methods can be used simultaneously.

A serial RS-485 communication port is available; this could be useful for Modbus communication (industrial applications).

An optional analog output module is available. It features 8 channels, and can be programmed to operate with 0-10 V, 0-5 V or 4-20 mA outputs, and the outputs are completely programmable (any analog output can be assigned to any optical channel or can be assigned to the minimum or maximum value of any combination of optical channels).

2.1   L201 product specifications

|	
Resolution	0.1 °C
Accuracy	± 1 °C
Calibrated Temperature Range	-45 ° to 200 °C (Extended calibration available on special order)
Usable Temperature Range	-80° to 250 °C (Cryogenic calibration available on special order)
Number of channels	2 to 8
Probe length	1 to 500 meters (and more)
Sensor	GaAs dielectric epoxy tipped optical fiber probes Any Rugged Monitoring probes
Response time	Typically, 0.2 to 0.5 second, per channel (Probe and setting configuration dependent) Sampling rate is ~ 5 Hz (per channel)
Probe compatibility	All Rugged Monitoring probes Most competitive GaAs probes
Unit	°C only
Data logging	On user supplied micro-SD card
Operating temperature	-40 ° to 72 °C, non-condensing
Storage temperature	-40 ° to 85 °C
Local display	Display of temperature readings as well as various user information
Analog outputs	Optional external module (4-20 mA and 0-10 V)
Serial port	RS-485 port (Modbus) – Non electrically isolated
Power	5 VDC (USB port), ~150 mA
Firmware upgradability	Through USB port
Size	182L x 125W x 69H mm
Weight	0.45 kg
Standard interface	Micro-USB connector

All technical specifications are subject to change without notice.

The following figure gives a description of the various probe configurations that are optionally available from Rugged Monitoring.
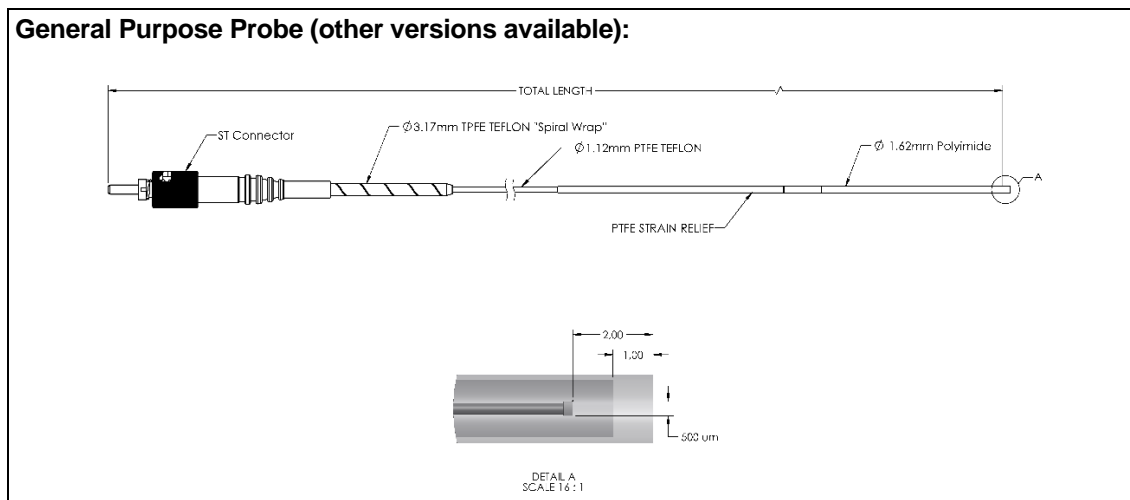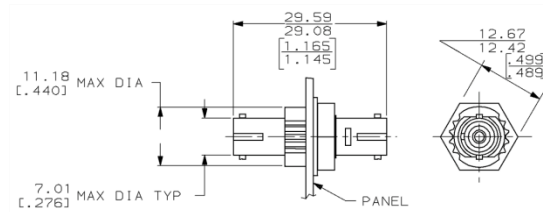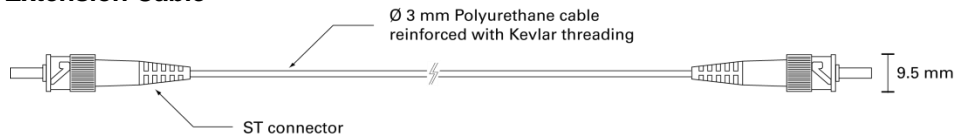
Probe for hot spot transformer (with and without disk):
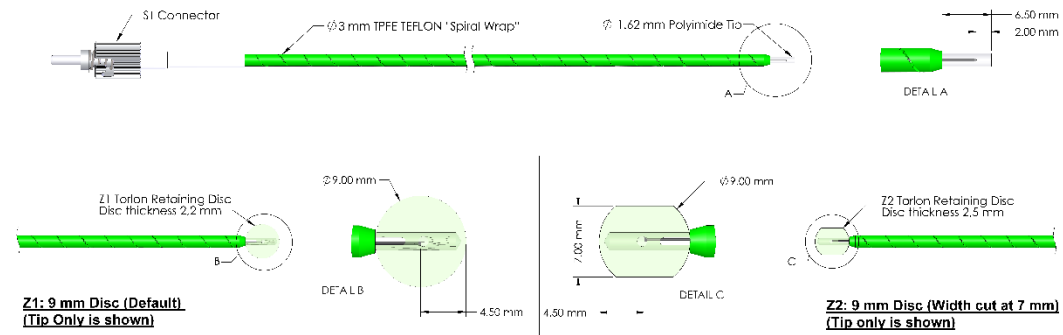
ST-ST Coupling:

ST-ST Extension Cable

Extension cable bundles are also available.

2.2   Calibration

Your L201 thermometer comes factory-calibrated. Experience has shown that re-calibration is not required over the whole product life; however, if your ISO company rules state that an annual re-calibration is required, then it is your responsibility to comply with those rules. For laboratory applications, a new calibration is standard every 12 months or whenever performance verification indicates that calibration is necessary; NIST traceable calibration certificates are available. All calibrations are performed at the factory. Contact your Rugged Monitoring Representative for further information.

3 UNPACKING

Before using your L201 thermometer, check the box content to be sure all items have been included. Your package should normally contain:

- L201 instrument
- USB cable
- User manual (this manual) (paper copy not included, supplied as a PDF document downloadable from the Internet)
- Calibration Certificate.

Options:
- USB power supply module (universal input: 100-240 VAC, 50/60 Hz; output: 5 VDC 1 A).
- Fiber optic temperature sensor probes
- Fiber optic extension cables and extension bundles
- Fiber optic couplings and feedthroughs
- Rugged Connect software package™ (downloadable from the Internet)
- LabView, Matlab, Python software interfaces (downloadable from the Internet)
- Carrying case, for L201 and accessories.

Make sure all listed items have been received and are in good condition. Note any evidence of rough handling in transit; immediately report any damage to the shipping agent. Should a part be missing or damaged, please contact your distributor immediately. Returns must be made with the original packaging, accompanied by an authorization number (RMA). Your distributor will provide you with information concerning the return of merchandise.

The carrier will not honour damage claims unless all shipping material is saved for inspection. After examining and removing contents, save packing material and carton in the event reshipment becomes necessary.

4 QUICK INTRODUCTION

The best way to familiarize yourself with your new L201 instrument is, of course, to use it! This chapter shows you to prepare your unit and do some initial measurements. The detailed instructions are given in the next Chapter.

Your new L201 comes calibrated and ready to use. This figure shows the main view of the L201, along with the top and side (where the electrical connections are available) views.
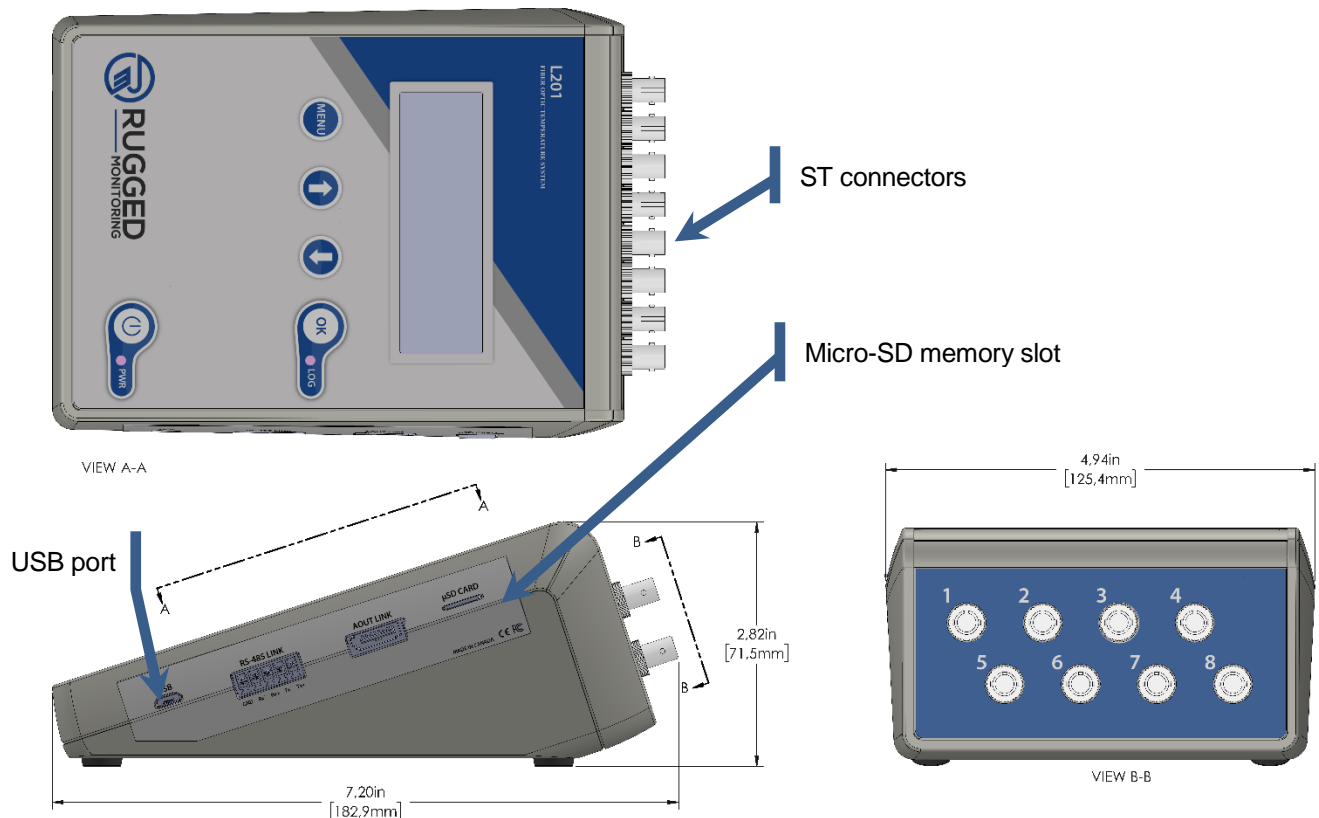

4.1 Making your first measurements

4.1.1 Installing the USB serial driver

This is only required if you intend to use the optional Rugged Connect software. The first time you connect your L201 to your PC, you should have access to Internet; this would allow for the installation of a FTDI serial driver. Normally, this driver installation will be transparent to you, if you are connected to the Internet. The driver is properly installed when you get a confirmation of its successful installation "FT230X Basic UART is set up and ready to go". In case of trouble, follow these recommendations:

1- Start the Device Manager Windows app, and select the "Ports" section, as follows:
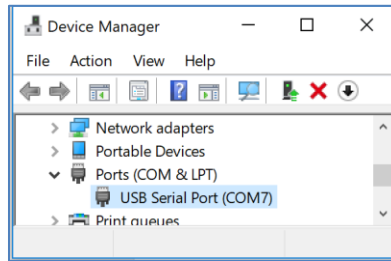
2- Right click on the "USB Serial Port" entry and select "Update driver". In the next window, select "Search automatically for updated driver software". In most cases, this will solve your driver problem.

Under certain conditions (for example with Win-7), you may have to download and install the driver manually. In this case, download it from this website https://www.ftdichip.com/Drivers/VCP.htm, and install it by double clicking on the downloaded file.

For more information on how to use Rugged Connect, refer to Chapter 6.

4.1.2 Using the L201

To make your first temperature measurements, do as follows:

- Remove the dust cap on the optical connectors of the L201 (located on the top of the L201).

- Remove the dust cap on the probe connectors.

- Insert each probe connector into a sensor connector on the L201. Make sure the two mating parts are properly aligned and twist the connector clockwise to fasten it securely. **Warning**: Do not apply force on this connector!

- Turn your L201 on by pressing the ON button for at least one second. After a few seconds, a "splash" screen will display some information such as firmware version, calibration date, etc. Then the temperature is immediately displayed, for up to 8 channels.

- Place a sensor tip on a warmer surface (such as your hand): you can observe the temperature variation on the display.

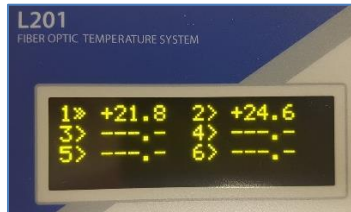- You can power it down by briefly pressing again this key.

5   L201 THERMOMETER HARDWARE REFERENCE

5.1   Display description

The display can show 4 different screen contents. You can navigate from one to the next by pressing the "Menu" key.

1- The default screen is the Temperature screen, where up to 8 temperature values are displayed, as shown here:

   a. A double arrow is displayed for any channel reading where an offset has been programmed for that channel (as shown for channel # 1 above)

2- The Percentage screen, where the power level of each sensor is given. Normally, for a healthy probe, the reading should be 100%. See section 5.4 for information on how to interpret this "%" reading.

3- The Enable screen. This allows you to enable or disable a specific channel. Normally all channels are enabled, but if you want fast refresh rates from one or a few probes, it is highly suggested to disable any unused channels[1].

4- The Setup screen. To move through the screen, you can use the "OK" button to move from one field to the next and use the 2 arrow keys to change the flashing parameter value. This can be used to configure the following parameters:

   a. Date and time
      i. **Warning**: The L201 will lose its date and time information after about 10 days if not connected to a USB power source.
   b. Logging status, information only. To enable or disable logging, press the "OK" button when you are *not* in this Setup menu.
   c. Logging rate (on microSD card). Note: Independently, Rugged Connect can also log temperatures, and it can be set to a different logging rate.
   d. AGC, ON or OFF. For best speed, this should be OFF. The ON position is recommended for installations where you are dealing with probe weaker signals, such as when using extension cables and feedthroughs (typically for transformer applications).
   e. Hold, 0 to 9. This indicates the number of "holds" since the last good reading. Normally, a value of "0" should be appropriate, unless you are using probes with weak signal, in which case it could avoid a probe from alternating from "no reading" to "reading". In other words, this represents the number of reading cycles the thermometer will do before abdicating.

The setup screen is shown here:

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[1] The L201 scans continuously all enabled channels in a sequential manner. The acquisition time for each channel is about 0.1 (fixed gain, AGC off) to 0.4 second (AGC on), which means that it takes about 1 to 4 seconds to refresh all channels. If you disable any unused channels, then the overall refresh rate will be faster.

The following parameters cannot be set from the L201 panel, you must use the Rugged Connect software to set them.

1- RS-485 serial port and Modbus parameters;
2- Analog output parameters;
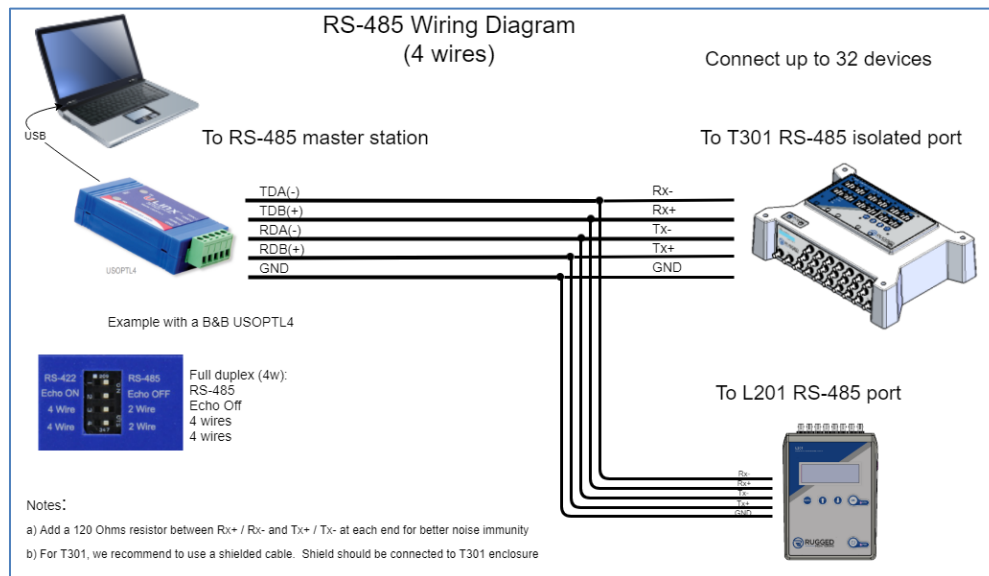3- Channel naming.

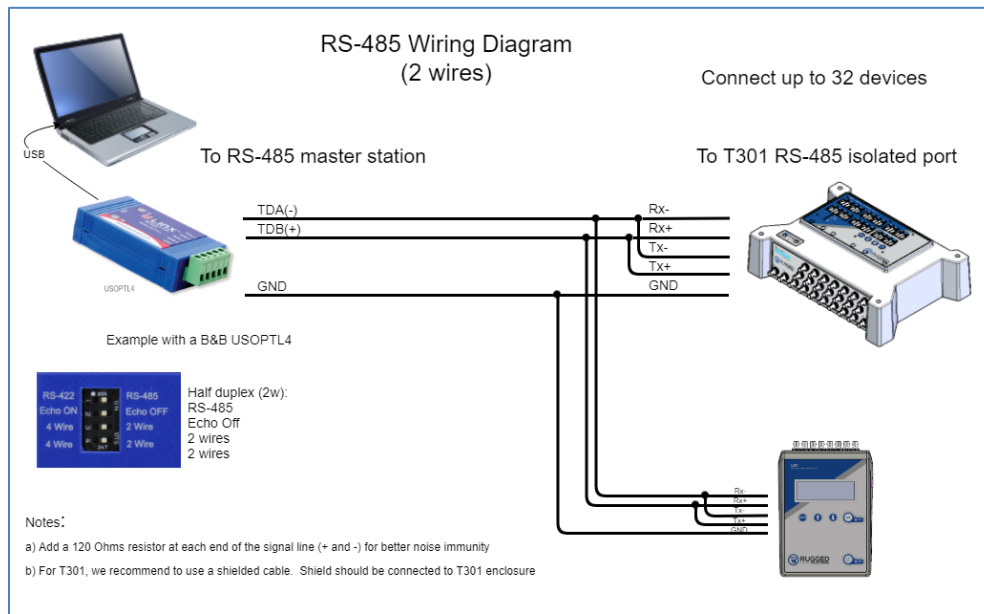## 5.2 Modbus port configuration

The serial RS-485 port found on the side of the L201 instrument is intended to be used as a Modbus slave port. You can configure its parameters (baud rate, parity, etc.) with Rugged Connect. When using this port, be careful with grounding, as this port is non-insulated. The port can be configured either as a 2W configuration (half-duplex, 2 wires) or as a 4W configuration (full-duplex, 4 wires).

The mating connector (not included with the instrument) is Phoenix part # 1827622, or Digikey part # 277-8837-ND. Contact Rugged Monitoring for more information.

Recommendation: As this port is not electrically insulated inside the L201, it is strongly suggested to use an insulated interface to connect the Modbus communication to a PC computer. Rugged Monitoring recommends the use of Model USOPTL4, available from B&B Electronics (web site: http://www.bb-elec.com/USOPTL4).

The following drawings show examples of typical wirings for a Modbus communication scheme (4W and 2W).

RS-485 Wiring Diagram
(2 wires)

Connect up to 32 devices

To RS-485 master station

To T301 RS-485 isolated port

Example with a B&B USOPTL4

Half duplex (2w):
RS-485
Echo Off
2 wires
2 wires

Notes:

a) Add a 120 Ohms resistor at each end of the signal line (+ and -) for better noise immunity

b) For T301, we recommend to use a shielded cable. Shield should be connected to T301 enclosure

5.3   *How to access the logged data*

To log temperature data, a microSD card must be inserted in the card slot. This card must be formatted in FAT or exFAT, and up to 2 TB (in theory) is supported. When removing the card, it is strongly suggested to stop the logging process by pressing the "OK" button. Each time a new log is started, a new file is generated with a set file name (YYMMDD_HHMMSS.csv), with tab delimitation; the date and time used are those current when the file is generated.

To read the logged data, you have two possibilities:

- You must remove the card from the L201 and to read it with a PC using an appropriate microSD card reader. You should configure your Excel application, so Excel is automatically invoked when you open a .csv file.

- Data files stored in the microSD card can be downloaded using the Rugged Connect software. See Section 6.4 for more information. Please note that the file that is currently being open for data logging cannot be downloaded; you must first stop the acquisition and then do the download.

Information: -302 means that this channel is disabled and -303 means that no probe was detected for that channel.

Here is an example of a .csv file.

5.4   Analog output module

The optional analog output module is easy to use; it is also very flexible. To configure it, you will need to run the Rugged Connect software; see next chapter. Here are some features, with some comments:

- Voltage outputs. You can select 0-5 V or 0-10 V. Please note that this requires a ground connection, so be careful with ground loops, which can easily fool the voltage values.
- Current outputs. 4-20 mA is the industry norm. This is a better choice for industrial applications, as it is ground isolated (no ground loops).
- Any output is completely programmable:
  - It is not hard-assigned to any specific optical channel
  - One output can reflect the temperature values of many optical channels (e.g., minimum or maximum temperature read from many channels)
  - For each output, you can define the low and high temperatures (the difference between these two would be the "span"
  - With "Error Style", you can define the behavior of the output if no temperature is read for that output.
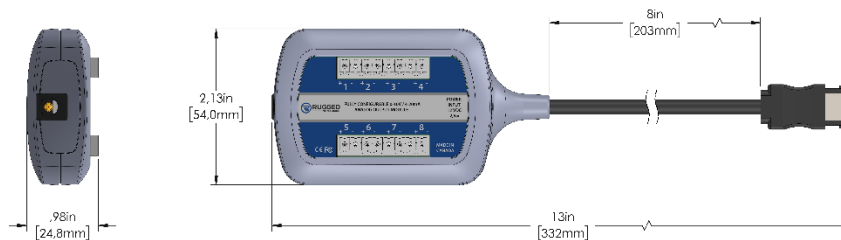
The following figure shows the Analog Outputs tab, from Rugged Connect. You are referred to the next chapter (Rugged Connect) for clarifications on how to set the various parameters.

ANALOG OUTPUT ID	NAME	TYPE	SCALING MIN TEMPERATURE	SCALING MAX TEMPERATURE	ERROR OUTPUT	SOURCE	L/HIGHEST CHANNELS
01	A1	4-20 mA	-100.00	200.00	Min Val	Highest	1, 2, 3, 4, 5, 6
02	A2	4-20 mA	-100.00	200.00	Min Val	Channel 2	
03	A3	4-20 mA	-100.00	200.00	Min Val	Channel 3	
04	Aout_04	4-20 mA	-100.00	200.00	Min Val	Channel 4	
05	Aout_05	0-10 V	0.00	100.00	Max Val	Channel 5	
06	Aout_06	0-10 V	0.00	100.00	Max Val	Channel 6	
07	Aout_07	0-10 V	0.00	100.00	Toggle Val	Channel 1	
08	Aout_08	0-10 V	0.00	100.00	Toggle Val	Channel 2	

5.5   Interpretation of "%" results

The L201 system is fitted with an algorithm that gives an evaluation about probe signal strength or signal quality index. This is expressed as a percentage value, with 100% being the highest score, and 0% meaning no signal (no probe or broken probe). The % reading of probes can be obtained in two ways:
1- Form the instrument panel, by clicking the "Menu" button once.
2- With Rugged Connect, by selecting the DATA tab. See section 6.2.

Dirty connectors will contribute to lower probe strength; always assure that all fiber connections are clean before evaluating probe performance.

For installations where extension cables and/or feedthroughs, it is highly recommended to turn on the "AGC" auto-gain feature. You can control the AGC setting either from the instrument panel or from Rugged Connect. Note: In Rugged Connect, the "no-AGC" mode is called "Fixed time", in the General tab. Be advised that having the AGC feature on will slow the acquisition time; thus, for fast acquisition it is recommended to turn off the AGC feature.

Based on experience, a power value of 65% or more is considered as being satisfactory.

Warning: These values are approximate and may change slightly from instrument to instrument.

6 RUGGED CONNECT SOFTWARE DESCRIPTION

Rugged Connect (RC) is particularly interesting for L201 users as it provides a convenient complement to how instrument parameters are controlled and how temperature data is acquired. It offers a friendlier procedure to load various parameters, such as optical channel parameters that would otherwise require being set by hand using the instrument panel. The goals and purposes of this software packages are as follows:

- Display temperature information, for up to a total of 64 channels, from up to 6 compatible instruments (L201 and T301 and other that will become compatible in the future)
  - o Can provide results in graphical form
  - o Can log temperatures to a Windows file, independently from the logging feature found on the instrument itself
- Initialize and manage the optical channel and associated control parameters
- You can work with "virtual" instruments, i.e., you can develop instrument configurations without having a physical instrument connected to your PC
- It allows for transferring configurations between instruments
- And more.

6.1   Installation and initial operation

6.1.1 Software installation

Get a copy of Rugged Connect from Rugged Monitoring (from the web or write an email to support@ruggedmonitoring.com). Unzip the file to a suitable location in your PC and run setup. If you get this left window, below, you need to click on "More info". Then, in the next window (shown at right), you need to click "Run anyway".
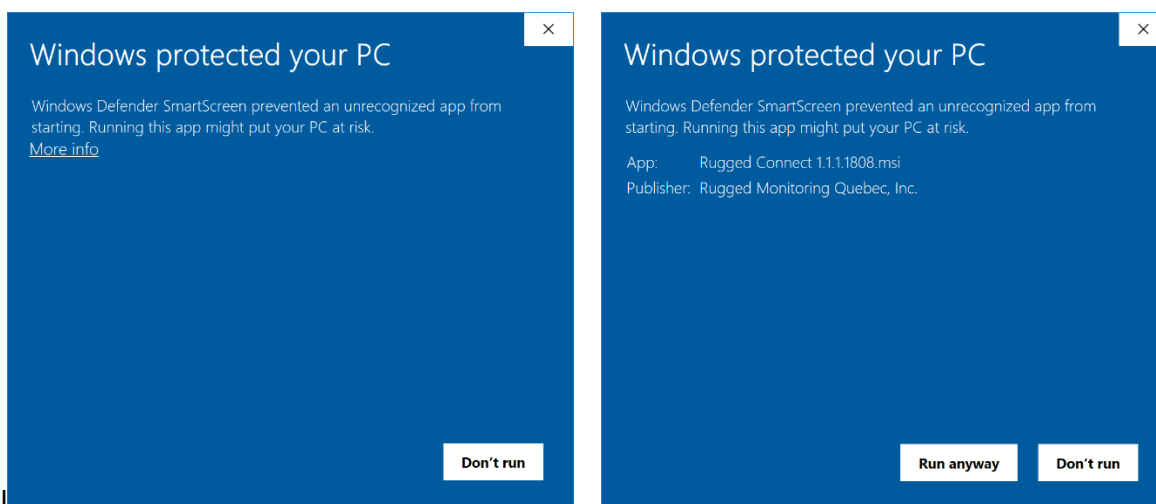
When you connect the L201 for the first time to your computer, a driver will be installed; this procedure is described at the beginning of Chapter 4.1.1 above and is not repeated here.

The current version of Rugged Connect has been fully tested with Windows-10.

Warning: To reinstall the software, or install a new version, you will need to first uninstall the older version. This must be done by using the "Programs and Features", found in Windows Control Panel.
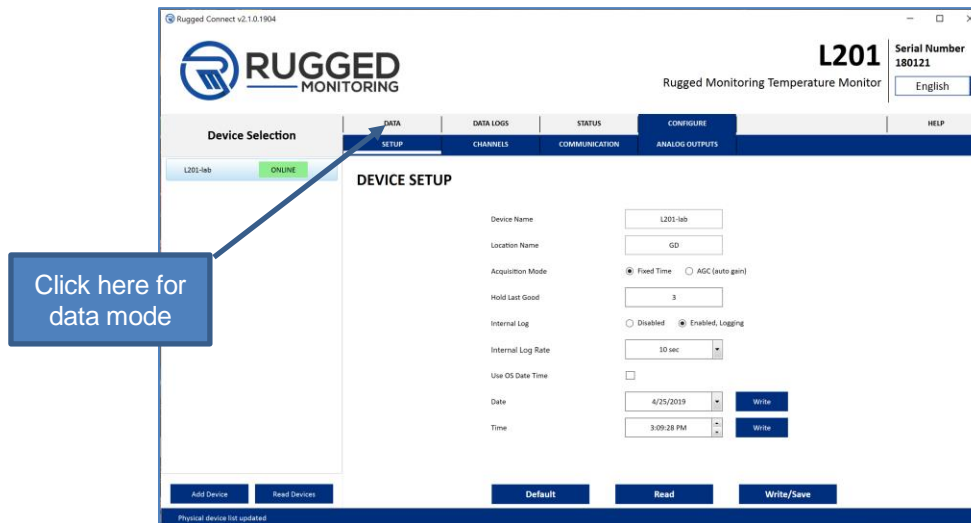
Connect your instruments (up to 6) to your PC. Each instrument must have its own USB port; you can use a USB hub if necessary.

Upon running Rugged Connect, this window will open as follows, if no instruments are connected:
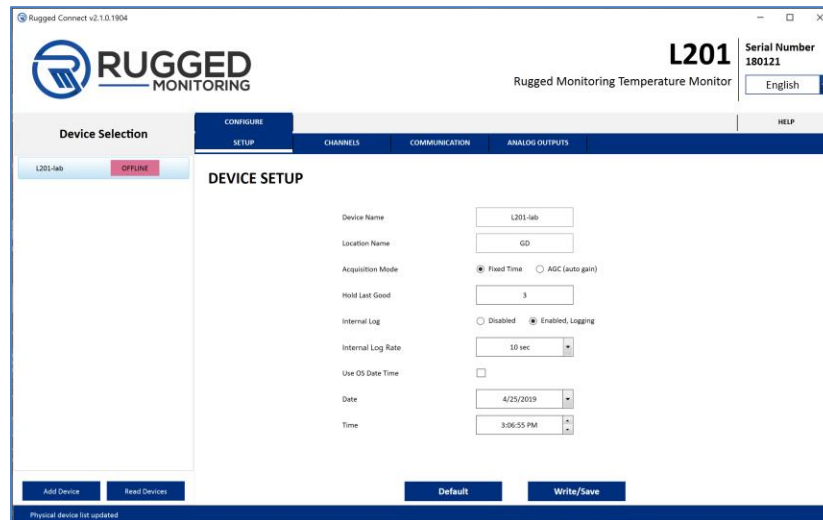
You get this window if one L201 is already connected:

The instrument can basically operate in two modes of operation:

- Data mode, where temperature values can be displayed in number or trend form. This will show temperatures for up to 6 connected instruments. If you do data logging, all temperatures from all instruments will be logged in a single file

- Configuration mode; here you can configure your selected instrument (only one at a time).

These 2 modes of operation are explained below.

6.2 Data mode (temperature acquisition)

By clicking on DATA (from the top menu bar, at left) as shown above, your instrument will be in data mode whereby it will continuously acquire temperature data from all connected instruments. This is shown here (6 channel instrument, with only 2 probes):
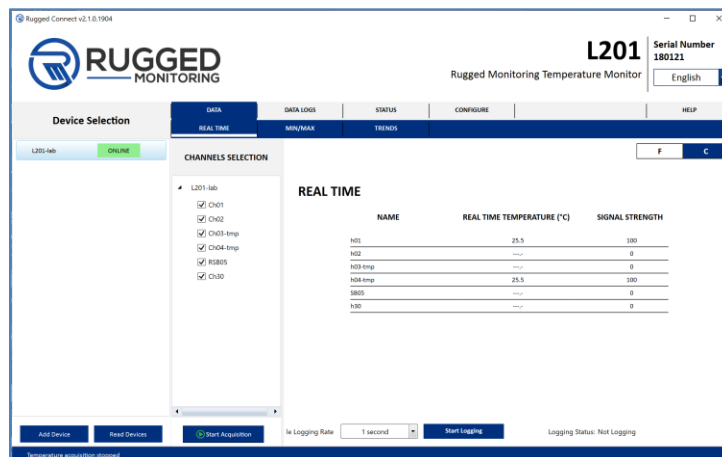
This window shows all temperatures in number format (^oC or ^oF). If select from the menu either MIN/MAX or TRENDS, you can see the same data presented in different ways including in graphical form.

6.2.1 Logging data to a PC file

The data mode allows also to log data to a PC file. Click the Start Logging button at the bottom of the window, and an open file dialog will open, as shown here:
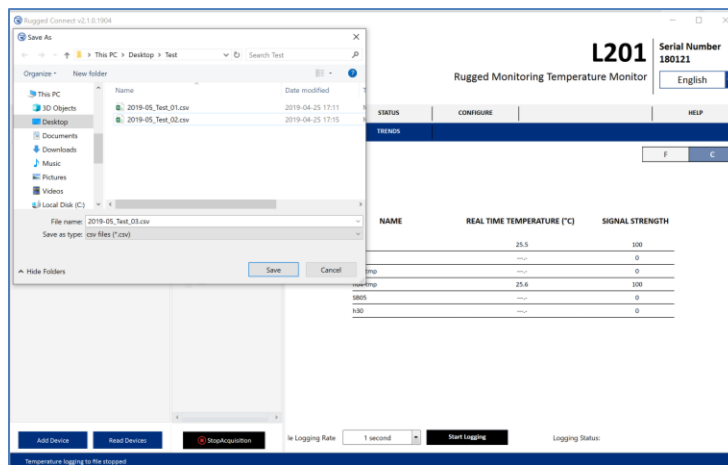
The file is a .csv that can easily be read by Excel, as shown here:

6.3 Device configuration mode

Click on the instrument serial number of the instrument you wish to configure (the list of instruments is in the left pane of this window). Then click on CONFIGURE from the menu bar; you will get:

After a few seconds, this Configuration window is populated, and you can change any parameters you want (some fields, in light grey, are for information only and are not changeable); do not forget to click the "Write/Save", button, to save your new parameters to the instrument.

Please note that this window works with only one instrument at a time, by opposition to the Display window where all temperatures from all connected instruments can be displayed.

As part of configuring your instrument, you can select other tabs, to configure other parameters, such as the analog outputs (if this option is available on your instrument). The most important are described here; for the others, you are invited to click on the various buttons and learn what they can do for you.

6.3.1 SETUP tab

As shown in the window below, here you can set:
1- Acquisition Mode (AGC). For best speed, this should be Fixed. The AGC position is recommended for installations where you are dealing with probe weaker signals, such as when using extension cables and feedthroughs (typically for transformer applications).

2- Hold Last Good. This indicates the number of "holds" since the last good reading. Normally, a value of "0" should be appropriate, unless you are using probes with weak signal, in which case it could avoid a probe from alternating from "no reading" to "reading". In other words, this represents the number of reading cycles the thermometer will do before abdicating.
3- Internal logging and logging rate. You need a microSD card in your instrument to be able to log into your instrument.
4- Date and time update. You can update the time/date of your instrument here. The L201 will lose its date and time information after about 10 days if not connected to a USB power source.
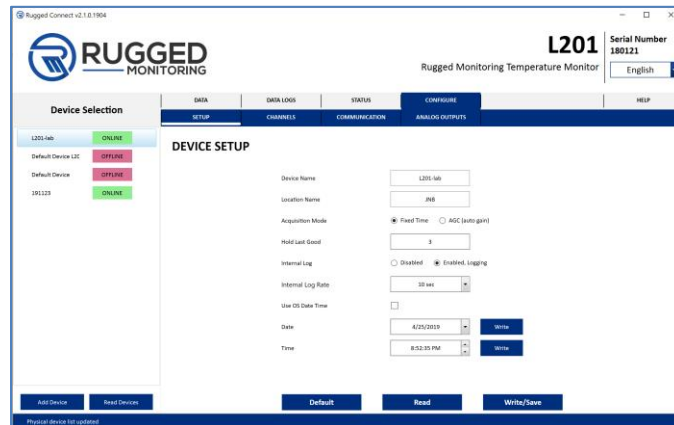
6.3.2 CHANNELS tab

Here, you can do the following:
- Give alphanumeric names to optical channels
- Enable and disable optical channels
- Enabling and disabling logging on the microSD card, independently for each channel
- Finally, you can force an offset for each channel. Please note that forcing an offset on a channel will defeat the instrument calibration.
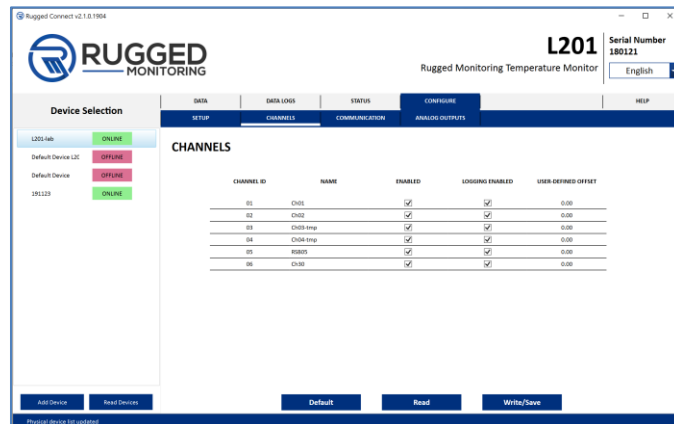

6.3.3 COMMUNICATION tab

Here you can select which protocol you want to enable on the serial RS-485 port. Currently, 4 choices are available:
1- None.
2- Modbus. Chapter 7 includes a description od the Modbus registers.
3- IEC 60870-5-101. See Smart Protocol user guide for more information.
4- DNP 3.0. See Smart Protocol user guide for more information.

Once you have selected a protocol, you can change the baud rate, parity, stop bits and node address to communicate with your master device.
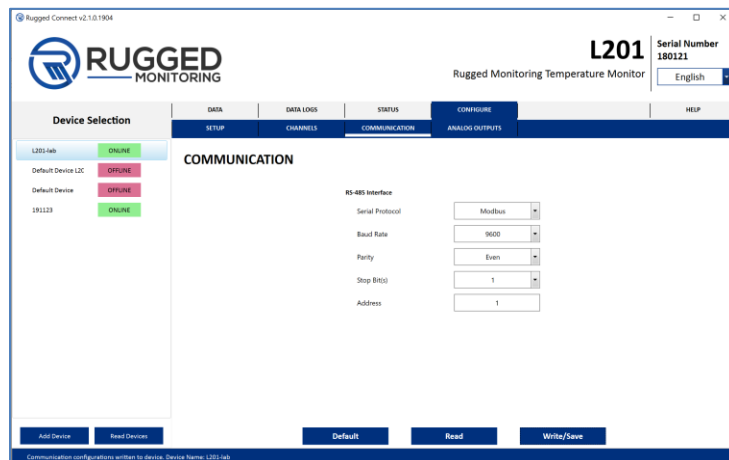

6.3.4 ANALOG OUTPUTS tab

Analog output parameters can be set here. Refer to section 5.4 for more information for hints on how to set these outputs. Take note that the analog output module is an option on the L201, so this setting will be only useful if that option is present on your L201.
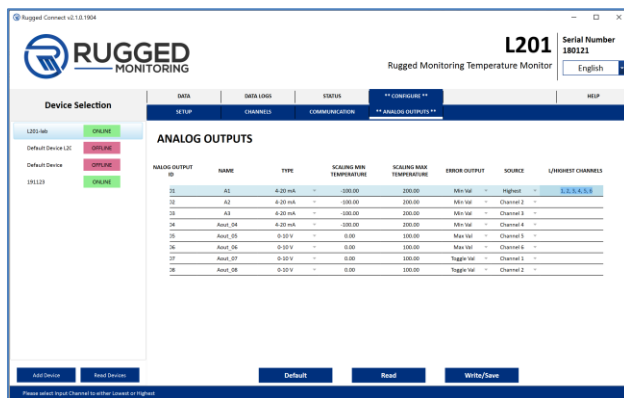
6.3.5 Importing / Exporting Instrument Configurations

Importing and exporting configurations are easy to do. If you place your mouse over the instrument name in the left pane, you will get the information shown here, and then by right clicking, you will get what is shown at right:
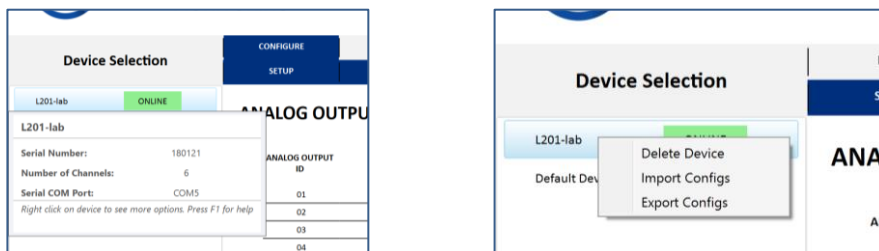

From here, you can click on Import or Export Configs. The Export function can be useful if you intend to configure multiple instruments with the same configuration.

6.4   Downloading data files

You can download data from you instrument by clicking on the DATA LOGS tab. Select a file and click the Download File button.

From the same window, one can also delete files stored in the instrument microSD.
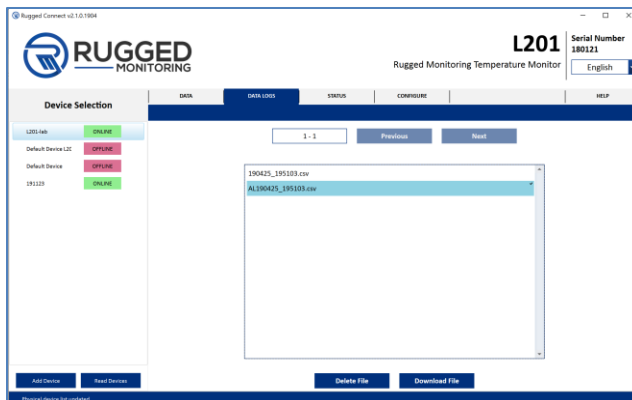
6.5   Virtual configurations

Rugged Connect allows you to create virtual configurations, i.e. configurations for instruments that are not connected to your PC. You can then save this configuration file, which could be later uploaded to a real instrument.

Click on the "Add Device" button found at the bottom left of the window. The following small window will open:

Fill the text boxes with values that your new instrument should have and click "Save". From this point, you can continue to configure it as if this instrument was a real one. When you are done with your configuration, do not forget to click on "Write/Save".

7 MODBUS REGISTER TABLE

This chapter gives a description of the Modbus registers included in the L201 instrument. If you want to connect to the L201 using the serial RS-485 port, you will need this information.

Rugged Monitoring		Modbus map register	
Ref: MODBUS Application Protocol Specification V1.1b3		Modbus.org	
Function code: 0x03		Read Holding Registers	Read only

2

2.1 System Info — Factory_struct

Reg Address	Name	Description	16 bits	Encoding
0x0000	Device	Type of Device	Unsigned	Define: 0=Undefined; 1=L201; 2=T301
0x0001	Model	Device Model	Unsigned	Define
0x0002	NbChannel	Number of Channels	Unsigned	1 to 32 for 1 to 32 channels
0x0003	CalibYY	Calibration Year	Unsigned	18 for 2018
0x0004	CalibMM	Calibration Month	Unsigned	1 to 12
0x0005	CalibDD	Calibration Day	Unsigned	1 to 31
0x0006	SerialNumber	Serial Number	Unsigned	Unique

2.2 User Config — User_config_struct

Reg Address	Name	Description	16 bits	Encoding
0x0010	AcquisitionMode	Acquisition Auto Gain Mode	Unsigned	Define: 0=Reserved; 1=Fix Time; 2=AIG
0x0011	TempAveraging	Averaging	Unsigned	50 to 100; 100 = 100% of last val (no avg) = default
0x0012	HoldLastGood	Hold Last Good value for x scan	Unsigned	0 to 9; Default = 3
0x0013	LogEn	Internal Logging Enable	Unsigned	0 = Disable; Enable otherwise
0x0014	LogRate	Internal Logging Rate	Unsigned	Defines
0x0015	Date_yy	Device Internal Year (date)	Unsigned	18 for 2018
0x0016	Date_mm	Device Internal Month (date)	Unsigned	1 to 12
0x0017	Date_dd	Device Internal Day (date)	Unsigned	1 to 31
0x0018	TimeInSecH	Device Internal Time in second MSB	Unsigned	32bits variable MSB
0x0019	TimeInSecL	Device Internal Time in second LSB	Unsigned	32bits variable LSB

2.3 Channel Config — User_channel_struct

Reg Address	Name	Description	16 bits	Encoding
0x0110	CH01_Enable	Channel 01 Enable to scan	Unsigned	0 = Disable; Enable otherwise
0x0111	CH01_Offset	Channel 01 Temperature Offset	Signed	Temperature Offset x 100 [eg 125 for 1.25c]
0x0112-0x011D	CH01_Name	Channel 01 Name	Unsigned	24 bytes long string
0x011E-0x011F	*CH01_Reserved*	*Reserved for Future use*	*Unsigned*	*Set to 0x0000*
0x0120-0x012F	…	Channel 02	…	…
0x0130-0x013F	…	Channel 03	…	…
0x0140-0x014F	…	Channel 04	…	…
0x0150-0x015F	…	Channel 05	…	…
0x0160-0x016F	…	Channel 06	…	…
0x0170-0x017F	…	Channel 07	…	…
0x0180-0x018F	…	Channel 08	…	…

2.4 Analog Output **Aout_struct**

Reg Address	Name	Description	16 bits	Encoding
0x0300	A01_Type	Analog 01 Type of output	Unsigned	Define: 0=4-20mA; 1=0-10v; 2=0-20mA; 3=0-5v
0x0301	A01_ErrStyle	Analog 01 Output if no valid signal	Unsigned	Define: 0=min val; 1=max val; 2=Toogle max/min 1Hz
0x0302	A01_InChannelNb	Analog 01 Input channel number	Signed	-2=lowest; -1=highest; 0=reserved; 1= channel 1 etc
0x0303	A01_Thigh	Analog 01 High value temperature	Signed	High temperature x 100 [eg 20000 for 200.00]
0x0304	A01_Tlow	Analog 01 Low value temperature	Signed	Low temperature x 100 [eg -10000 for -100.00]
0x0305	A01_EvalChEnH	Enabled channel for highest and lowest (one hot) MSB	Unsigned	32bits variable MSB
0x0306	A01_EvalChEnL	Enabled channel for highest and lowest (one hot) LSB	Unsigned	32bits variable LSB
0x0307-0x030E	A01_Name	Analog 01 Name	Unsigned	16 bytes long string
0x030F	*A01_Reserved*	*Reserved for Future use*	*Unsigned*	*Set to 0x0000*
0x0310-0x031F	…	Analog 02	…	…
0x0320-0x032F	…	Analog 03	…	…
0x0330-0x033F	…	Analog 04	…	…
0x0340-0x034F	…	Analog 05	…	…
0x0350-0x035F	…	Analog 06	…	…
0x0360-0x036F	…	Analog 07	…	…
0x0370	A08_Type	Analog 08 Type of output	Unsigned	Define: 0=4-20mA; 1=0-10v; 2=0-20mA; 3=0-5v
0x0371	A08_ErrStyle	Analog 08 Output if no valid signal	Unsigned	Define: 0=min val; 1=max val; 2=Toogle max/min 1Hz
0x0372	A08_InChannelNb	Analog 08 Input channel number	Signed	-2=lowest; -1=highest; 0=reserved; 1= channel 1 etc
0x0373	A08_Thigh	Analog 08 High value temperature	Signed	High temperature x 100 [eg 20000 for 200.00]
0x0374	A08_Tlow	Analog 08 Low value temperature	Signed	Low temperature x 100 [eg -10000 for -100.00]
0x0375	A08_EvalChEnH	Enabled channel for higest and lowest (one hot) MSB	Unsigned	32bits variable MSB
0x0376	A08_EvalChEnL	Enabled channel for higest and lowest (one hot) LSB	Unsigned	32bits variable LSB
0x0377-0x037E	A08_Name	Analog 08 Name	Unsigned	16 bytes long string
0x037F	*A08_Reserved*	*Reserved for Future use*	*Unsigned*	*Set to 0x0000*

3 **Function code:** **0x04** **Read Inputs Registers** **Read only**

3.1 Data System Info **rData_SysInfo_struct**

Reg Address	Name	Description	16 bits	Encoding
0x0000	MajorVersion	Firmware Major Version	Unsigned	0 to 99
0x0001	MinorVersion	Firmware Revision	Unsigned	0 to 99
0x0002	GenError	System error code	Unsigned	Internal use
0x0003	CalibError	Calibration CRC err (1 bit per channel)	Unsigned	Internal use
0x0004	InternalTemp	Internal temp x 100	Signed	Internal Temperature x 100 [eg 3846 for 38.46]

3.2 Temperature Data **rData_Temp_struct**

Reg Address	Name	Description	16 bits	Encoding
0x0101	CH01_Status	Channel 01 Current status	Unsigned	Error code: 0=Valid; 2=Disabled; 3=No Signal
0x0102	CH02_Status	Channel 02 Current status	Unsigned	…
0x0103	CH03_Status	Channel 03 Current status	Unsigned	…
0x0104	CH04_Status	Channel 04 Current status	Unsigned	…

0x0105	CH05_Status	Channel 05 Current status	Unsigned	…
0x0106	CH06_Status	Channel 06 Current status	Unsigned	…
0x0107	CH07_Status	Channel 07 Current status	Unsigned	…
0x0108	CH08_Status	Channel 08 Current status	Unsigned	…
0x0121	CH01_Gain	Channel 01 Current Gain	Unsigned	0 to 15
0x0122	CH02_Gain	Channel 02 Current Gain	Unsigned	…
0x0123	CH03_Gain	Channel 03 Current Gain	Unsigned	…
0x0124	CH04_Gain	Channel 04 Current Gain	Unsigned	…
0x0125	CH05_Gain	Channel 05 Current Gain	Unsigned	…
0x0126	CH06_Gain	Channel 06 Current Gain	Unsigned	…
0x0127	CH07_Gain	Channel 07 Current Gain	Unsigned	…
0x0128	CH08_Gain	Channel 08 Current Gain	Unsigned	…
0x0141	CH01_SigStr	Channel 01 Current Signal Strength (100% - 0%)	Unsigned	0 to 100 for 0% to 100% (make sure signal is valid [status])
0x0142	CH02_SigStr	Channel 02 Current Signal Strength (100% - 0%)	Unsigned	…
0x0143	CH03_SigStr	Channel 03 Current Signal Strength (100% - 0%)	Unsigned	…
0x0144	CH04_SigStr	Channel 04 Current Signal Strength (100% - 0%)	Unsigned	…
0x0145	CH05_SigStr	Channel 05 Current Signal Strength (100% - 0%)	Unsigned	…
0x0146	CH06_SigStr	Channel 06 Current Signal Strength (100% - 0%)	Unsigned	…
0x0147	CH07_SigStr	Channel 07 Current Signal Strength (100% - 0%)	Unsigned	…
0x0148	CH08_SigStr	Channel 08 Current Signal Strength (100% - 0%)	Unsigned	…
0x0161	CH01_Amplitude	Channel 01 Current Amplitude	Signed	Signal amplitude (internal use)
0x0162	CH02_Amplitude	Channel 02 Current Amplitude	Unsigned	…
0x0163	CH03_Amplitude	Channel 03 Current Amplitude	Unsigned	…
0x0164	CH04_Amplitude	Channel 04 Current Amplitude	Unsigned	…
0x0165	CH05_Amplitude	Channel 05 Current Amplitude	Unsigned	…
0x0166	CH06_Amplitude	Channel 06 Current Amplitude	Unsigned	…
0x0167	CH07_Amplitude	Channel 07 Current Amplitude	Unsigned	…
0x0168	CH08_Amplitude	Channel 08 Current Amplitude	Unsigned	…
0x0181	CH01_Temperature	Channel 01 Current Temperature	Unsigned	Temperature x 100 [eg 12345 for 123.45]
0x0182	CH02_Temperature	Channel 02 Current Temperature	Unsigned	…
0x0183	CH03_Temperature	Channel 03 Current Temperature	Unsigned	…
0x0184	CH04_Temperature	Channel 04 Current Temperature	Unsigned	…
0x0185	CH05_Temperature	Channel 05 Current Temperature	Unsigned	…
0x0186	CH06_Temperature	Channel 06 Current Temperature	Unsigned	…
0x0187	CH07_Temperature	Channel 07 Current Temperature	Unsigned	…
0x0188	CH08_Temperature	Channel 08 Current Temperature	Unsigned	…

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