O201™

Fiber Optic Thermometer OEM Module

4- to 8-Channel System
With Rugged Connect Software

Rugged Monitoring Québec Inc.
1415, rue Frank-Carrel, Suite 230
Québec, QC, G1N 4N7
Canada

Tel: +1-418-767-0111
support@ruggedmonitoring.com

Proprietary notice:

Part number: MAN0011R01 (May 2019)

TABLE OF CONTENTS

Notice

Permanent damage may be done to the thermometer if the power supply connections are not done correctly. Only approved power supply modules (24 to 48 VDC) should be used to operate this O201 thermometer module.

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.

1 RUGGED MONITORING WARRANTY NOTICE

Your O201™ 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.

1.1 Certifications

The following certifications and conformity tests have been done successfully on the O201 module.

Emission

Radiated Emission	FCC part 15 subpart B (2018) ; CISPR 11 (2015 + A1 2016)	
Conducted Emission	FCC part 15 subpart B (2018) ; CISPR 11 (2015 + A1 2016)	

Immunity

Conducted Immunity	IEC 61000-4-6 (2013)	10 Vrms
Radiated Electromagnetic Field Immunity	IEC 61000-4-3 (2006 + A1 2007 + A2 2010) ; IEEE C37.90.2 (2004)	Up to 20 V/m
ESD Immunity	IEC 61000-4-2 (2008); IEEE C37.90.3 (2001)	Up to ±8 kV contact, ±15 kV air
Fast Transients Immunity	IEC 61000-4-4 (2012); IEEE C37.90.1 (2012)	Up to ±4 kV
Surge Immunity	IEC 61000-4-5 (2014)	Up to ±2 kV L-L; ±4 kV L-G
Magnetic field Immunity	IEC 61000-4-8 (2009)	100 A/m continuous, 1 kA/m for 3 s
Damped Oscillatory Magnetic Field	IEC 61000-4-10 (2016)	100 A/m
Conducted Disturbances Immunity	IEC 61000-4-16 (2015)	30V 1 min, 300 V 1 s
Damped Oscillatory Wave Immunity	IEC 61000-4-18 (2006); IEEE C37.90.1 (2012)	Up to ±2.5 kV, 1 MHz
Voltage Dips and Interruptions	IEC 61000-4-29 (2000)	0%: < 10 msec
DC Voltage Ripple	IEC 60870-2-1 (1995); IEC 61000-4-17 (1999 + A1 2001 + A2 2009)	15%

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.

2 GETTING STARTED

Your O201™ 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 Rugged Monitoring 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. It offers up to 8 optical channels in a single compact and rugged din-rail mountable enclosure.

The O201 instrument is uniquely fitted with an optical integrity feature that ensures that the internal optical modules are within accuracy specifications.

The thermometer is packaged in a rugged aluminum enclosure which makes it ideally suited for OEM transformer and other industrial applications.

The unit is fitted with a micro-USB connector. This interface allows for all data transfer, to or from a Windows computer. The transfer protocol is a fast serial scheme, a standard in the industry. Take note that the unit is powered via a different connector; the unit requires a 24 to 48 VDC power input (~10 watts).

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 would be a good complement to your thermometer. This Windows software allows the user to configure the O201; 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 microSD 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 a standard feature; this could be useful for Modbus communication (industrial applications). Up to 32 instruments can be linked together when using the Modbus communication protocol. Furthermore, DNP 3.0 and IEC 60870-5-101 protocols are also standard features.

An optional analog output internal module is available; it must be ordered at the same time as the O201 unit. It features 8 channels, and can be programmed to operate with 0-10 V, 0-5 V or 4-20 mA (default) outputs; 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).

The O201 is supplied with one 8 form-C relay; it is a dedicated system fault relay.

A serial CAN port is also available; it supports the CAN bus protocol.

2.1 O201 product specifications

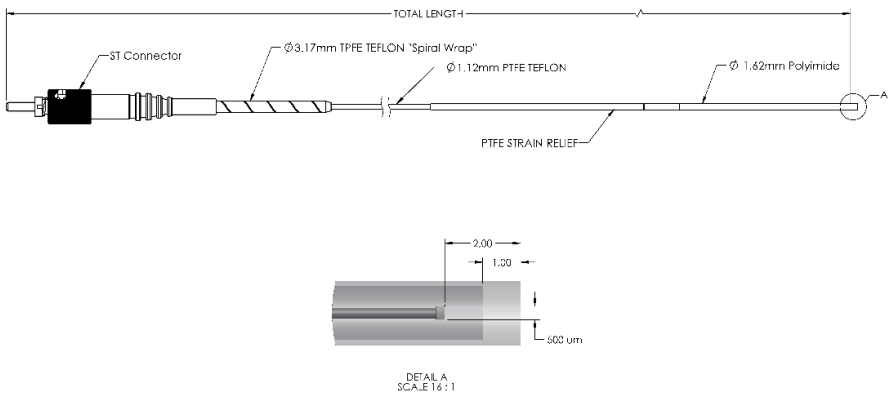
This is only a summary of the most important specifications; for complete product specifications, please refer to the marketing product brochure.

Resolution	0.1 °C
Accuracy	± 1 °C
Calibrated Temperature Range	-45 ° to 200 °C
Usable Temperature Range	-80° to 250 °C
Number of channels	4 to 8
Probe length	1 to 500 meters (and more)
Sensor	GaAs dielectric epoxy tipped optical fiber 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 a user-removable microSD memory card
Operating temperature	-40 ° to 72 °C, non-condensing
Storage temperature	-40 ° to 85 °C
Local display	One status LED per optical channel (8 in total) Information LEDs: Power on/off, logging status, serial communication activity and fault relay status
Analog output option	Not available
Relay	1 form-C relays, rated at 5 A – System fault
Serial port	RS-485 port (Modbus, DNP 3.0 and IEC 60870-5-101) – Ground insulated Canbus
Power	24 to 48 VDC, ~10 watts
Firmware upgradability	Through USB port
Size	120L x 161W x 48H mm
Weight	0.5 kg
Standard interface	Micro-USB connector

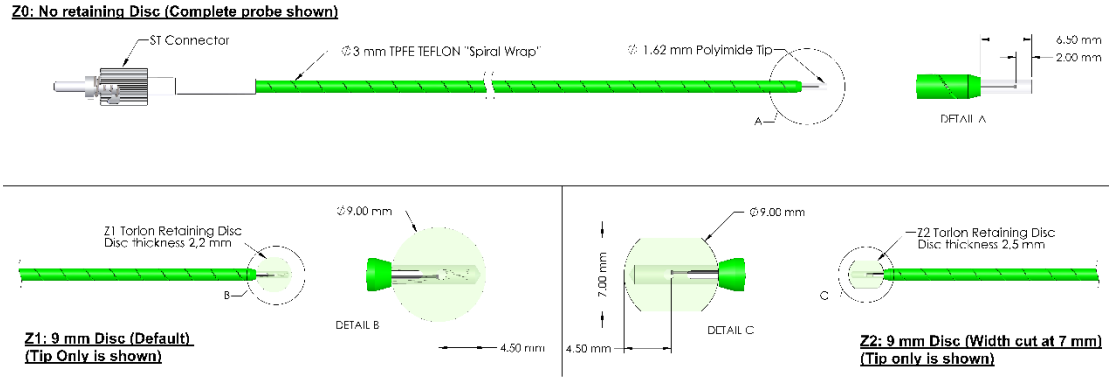
All technical specifications are subject to change without notice.

The following figure gives a description of the various probe configurations that are optionally available from Rugged Monitoring.

General Purpose Probe (other versions available):

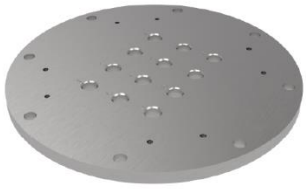


Probe for hot spot transformer (with and without disk):



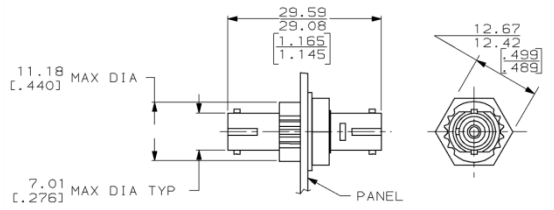
Feedthrough:

Tank Wall Plate:



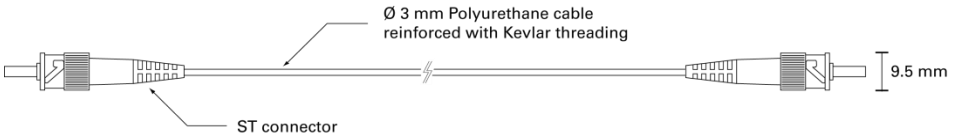
Interface Box (I-Box):

ST-ST Coupling:



Dielectric Connector:

ST-ST Extension Cable



Extension cable bundles are also available.

2.2 Calibration

Your O201 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.

2.3 Transformer applications

Transformer winding monitoring is one of the most important applications for the O201 instrument. Rugged Monitoring personnel has accumulated over 100 years of experience in this field and is considered as a world leader in this application.

3 UNPACKING

Before using your O201 thermometer, check the box content to be sure all items have been included. Your package should normally contain:

- O201 instrument
- User manual (this manual) (paper copy not included, supplied as a PDF document downloadable from the Internet). Contact Rugged Monitoring for a copy (support@ruggedmonitoring.com)
- Calibration Certificate.

Options:
- Power supply module (universal input: 100-240 VAC, 50/60 Hz; output: 24 VDC 1 A).
- Fiber optic temperature sensor probes
- Fiber optic extension cables and extension bundles
- Fiber optic couplings and feedthroughs
- Interface box
- Rugged Connect software package™ (downloadable from the Internet).

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 PRODUCT INSTALLATION

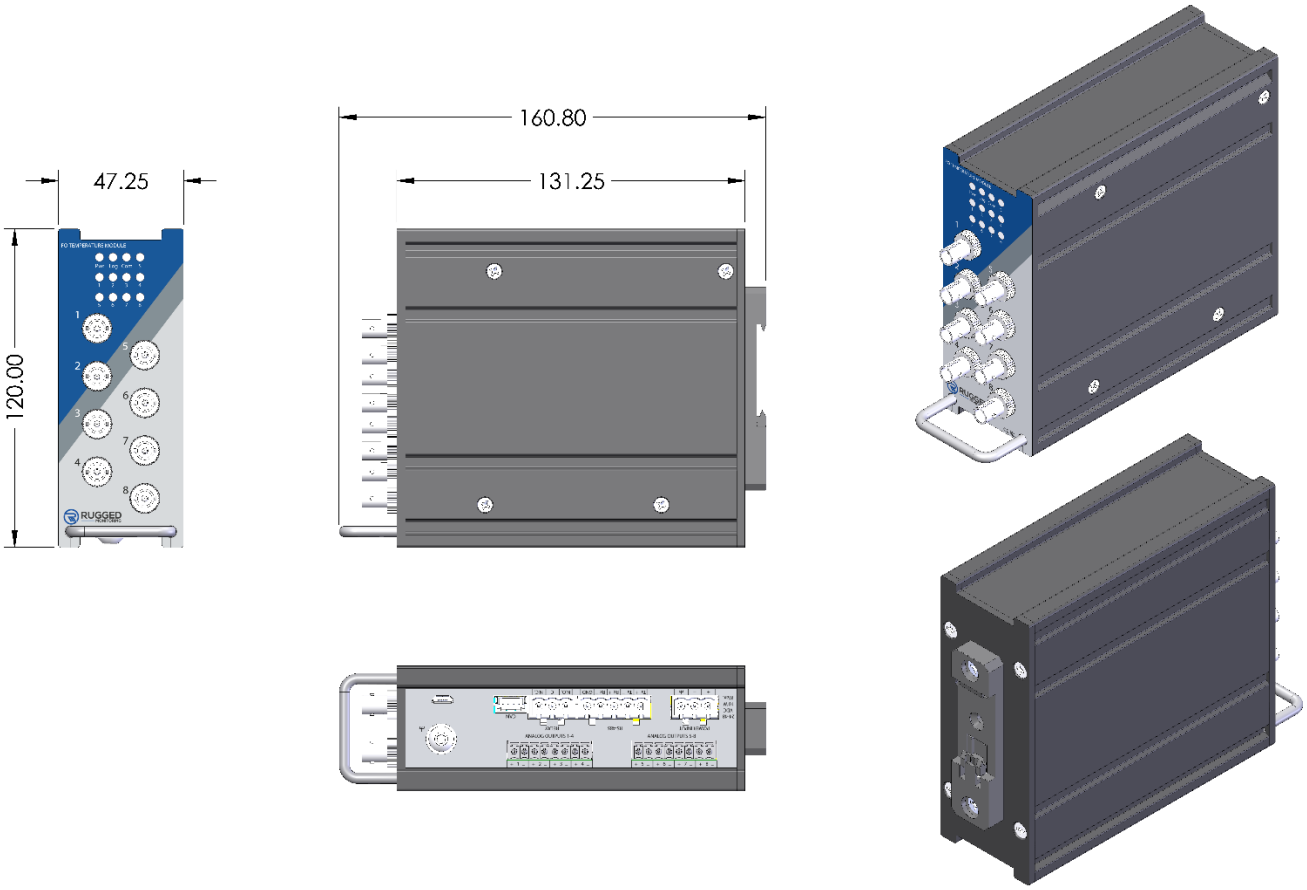
This chapter contains an overview of:

- Mechanical installation
- Electrical wiring
- Fiber optic sensor connection
- Installation of USB driver (required to use the Rugged Connect software)
- Making your first measurements.

4.1 Mechanical Installation

The following drawings give all mechanical information that would be necessary to install the O201 in your enclosure.

The O201 instrument has the same enclosure irrespective of the total number of optical channels, up to 8. The module is din-rail mountable (35 mm). The details are shown here:



There is one LED for each optical channel. This LED can take 3 colors, as follows:

- OFF, if no temperature can be read from this channel (e.g., no probe)
- Green, temperature is read normally
- Red, a temperature can be read but its power level is lower than 65%. See section 5.3 for more information on how to interpret this percentage value.

It should be mentioned that there is a microSD card slot at the back of the module, near the din-rail mechanism. If the module is mounted on a din rail, then you will have to remove it to access the microSD card.

4.2 Electrical installation

This drawing shows all electrical connections that are possible on a fully populated O201 module.

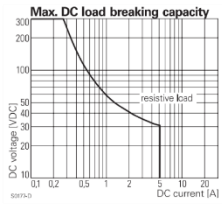
1- POWER INPUT
24 to 48 vdc, 10w max
Mating connector: Phoenix #1757022
Pinout: 1 Power input +
2 Power input -
3 Earth ground

2- RS-485
Isolated RS-485 serial port for SCADA communication
Pin 1+3 and 2+4 can be shorted together to create a 2 wires half-duplex interface
Shielded cable is recommanded. Shield should be connected to earth (enclosure).

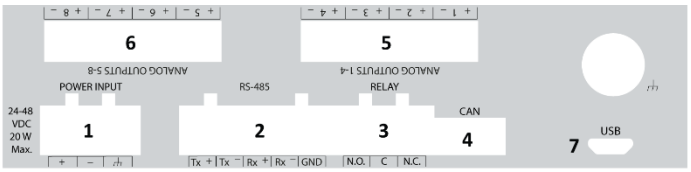
Mating connector: Phoenix # 1757048
Pinout: 1 Tx +
2 Tx -
3 Rx +
4 Rx -
5 Ground

3- FAULT RELAY
Form C contacts. Coil is not energized if system is not powered or if the firmware is not operating properly.
See relays rating for voltage and current specifications.
Mating connector: Phoenix #1757022
Pinout: 1 NO
2 COM
3 NC

Relays rating 5A, 250VAC



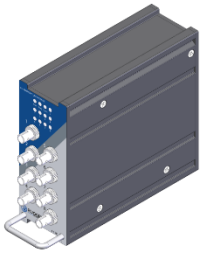
4- CAN
CAN 2.0B, 1Mbit/s bus rate
Mating connector: Molex # 5023510400
Pinout: 1 *Not Connected*
2 CAN_L
3 CAN_H
4 CAN_GND

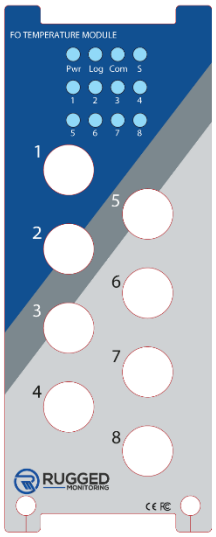


5- Analog Output 1 to 4 (optionnal)
User configurable analogue output 1-4
Each output can be configured to driver a 4-20 mA current output or a 0 to 10 v voltage output
For current, impedance is 400 Ohms max.
For voltage, impedance is 100 k Ohms min.
Shielded cable is recommanded.
Shield should be connected to earth (enclosure).
Mating connector: Phoenix # 1803633
Pinout: 1 A1+
2 A1-
3 A2+
4 A2-
5 A3+
6 A3-
7 A4+

6- Analog Output 5 to 8 (optionnal)
User configurable analogue output 5-8
Mating connector: Phoenix # 1803633
Pinout: 1 A5+
2 A5-
3 A6+
4 A6-
5 A7+
6 A7-
7 A8+
8 A8-

7- USB
micro usb for PC configuration using Rugged Connect





LED	COLOR	MEANING
PWR	Green	System powered
LOG	Blue	System is logging
Com	Red	RS-485 / CAN data emitted
	Green	RS-485 / CAN data received
S	Red	System in fault
CH *	Off	Channel has no signal
	Red	Channel has low signal
	Green	Channel has good signal (>65%)

** There is one dedicated CH led per channel, 1 to 8*

A microSD memory card slot is in the back of the module (not shown above); a SD card can be inserted to allow for in-instrument temperature logging[1]. Reading the SD card content can be done by removing the card from the instrument and reading it with a USB adapter on a PC computer. Files can also be transferred to a PC using Rugged Connect. Although it is preferable to stop the logging process before removing the card, it is also safe to simply remove the card, then transfer its content to a PC (as an Excel compatible data file), and finally by reinstalling the card in the O201 instrument; of course, data that might have been logged during the time the card is absent is lost.

Take note that the microSD card is available from the back of the module; if the module is mounted on a din rail, the module will have to be removed to gain access to the microSD card.

Phoenix mating connectors are supplied with the unit, when the options are present.

[1] It is highly recommended to get your microSD memory cards from Rugged Monitoring, even if they are relatively expensive. The Rugged Monitoring cards feature a wide temperature range and are ruggedized, for demanding industrial applications.

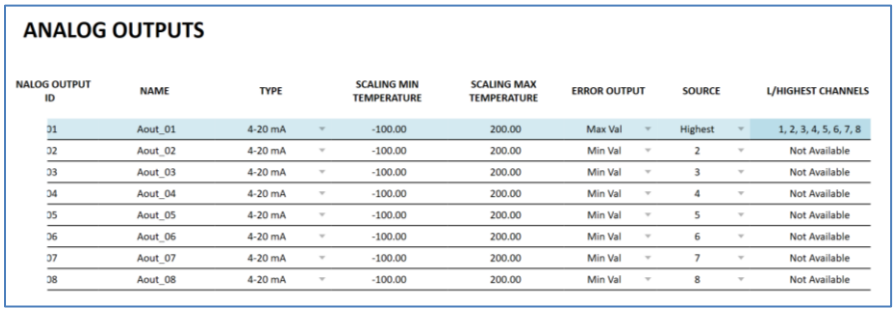
The System Fault relay is a Form-C relay (3 contacts) that is “hard-wired” and not programmable by the user. It is energized or activated when the O201 is running normally. This relay should be energized in less than one second after the O201 is powered up.

4.2.1 Analog outputs

The optional internal analog output option is easy to use; it is also very flexible. To configure it, you will need to run the Rugged Connect software; see section 6.3.4. 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 insulated (no ground loops).
- All outputs are completely programmable:
    - They are 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 is called “span”)
    - With “Error Style”, you can define the behavior of the output if no temperature is read for that output. The most common setting is “Max Val” as this will simulate a high temperature in case of error.

The following figure shows the Analog Outputs tab, from Rugged Connect. You are referred to chapter 6 (Rugged Connect) for clarifications on how to set the various parameters.



ANALOG OUTPUTS

NALOG OUTPUT ID	NAME	TYPE	SCALING MIN TEMPERATURE	SCALING MAX TEMPERATURE	ERROR OUTPUT	SOURCE	L/HIGHEST CHANNELS
01	Aout_01	4-20 mA	-100.00	200.00	Max Val	Highest	1, 2, 3, 4, 5, 6, 7, 8
02	Aout_02	4-20 mA	-100.00	200.00	Min Val	2	Not Available
03	Aout_03	4-20 mA	-100.00	200.00	Min Val	3	Not Available
04	Aout_04	4-20 mA	-100.00	200.00	Min Val	4	Not Available
05	Aout_05	4-20 mA	-100.00	200.00	Min Val	5	Not Available
06	Aout_06	4-20 mA	-100.00	200.00	Min Val	6	Not Available
07	Aout_07	4-20 mA	-100.00	200.00	Min Val	7	Not Available
08	Aout_08	4-20 mA	-100.00	200.00	Min Val	8	Not Available

4.2.2 RS-485 serial port

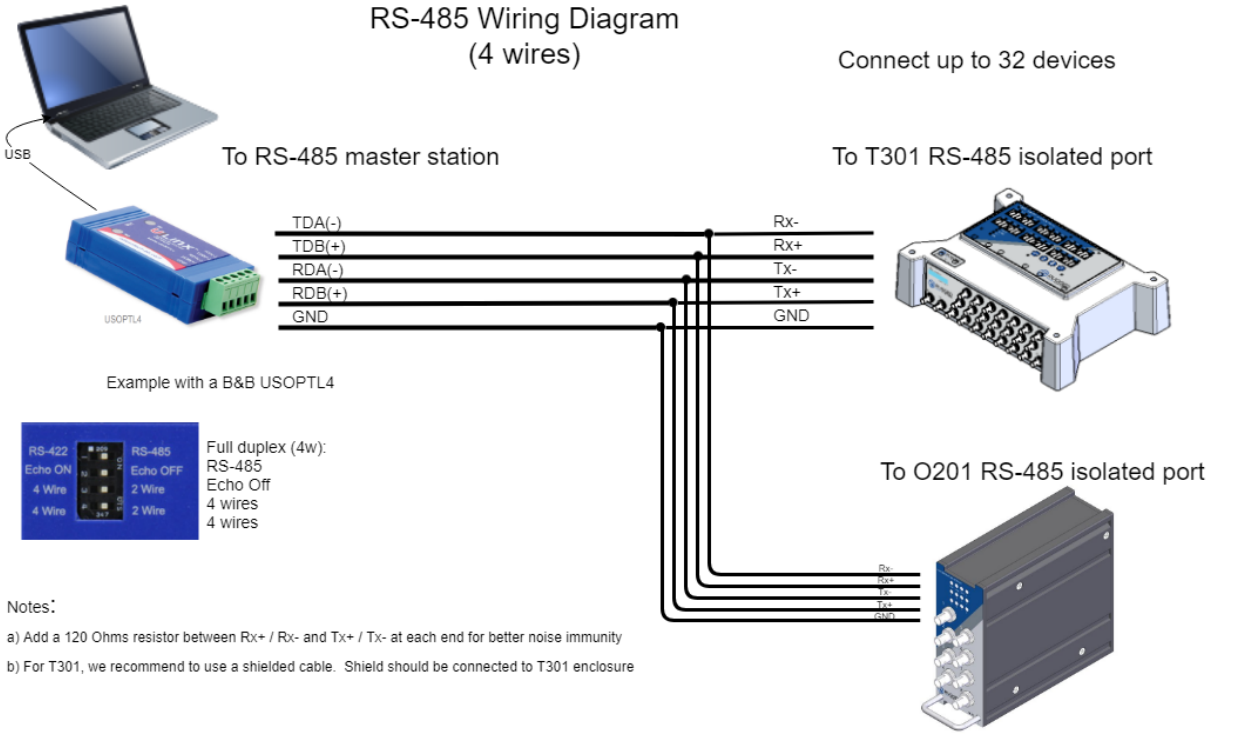
The serial RS-485 port found on the bottom of the O201 instrument is intended to be used as a slave port (Modbus, IEC 60870-5-101 or DNP 3.0). You can configure its parameters (baud rate, parity, etc.) with Rugged Connect (or webserver, if available). This port is ground insulated The port can be configured either as a 2W configuration (half-duplex, 2 wires) or as a 4W configuration (full-duplex, 4 wires).

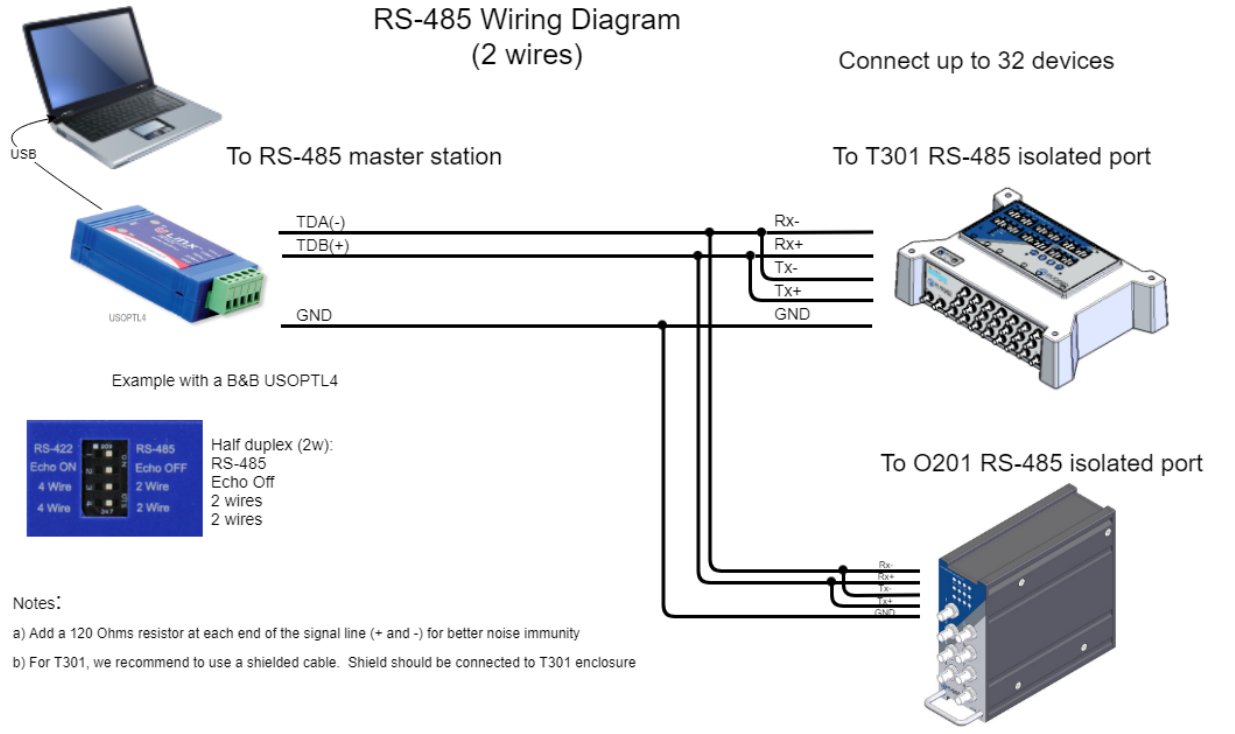
The mating connector (not included with the instrument) is Phoenix part # 1827622, or Digikey part # 277-8837-ND. Contact Rugged Monitoring for more information.

Recommendation: 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).

Recommendation: It is strongly suggested to install two termination resistors (120 Ω), one at each end of the communication cable; this is especially important when working with a long cable and at high baud rate.

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

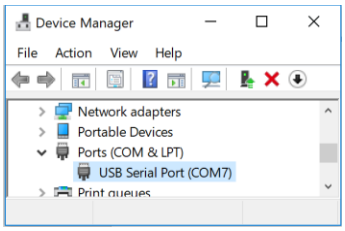




4.3 Installing the USB serial driver

This is only required if you intend to use the Rugged Connect software. The first time you connect your O201 to your PC, you should have access to the Internet; this would allow for the installation of a FTDI serial driver. Normally, this driver installation is 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.

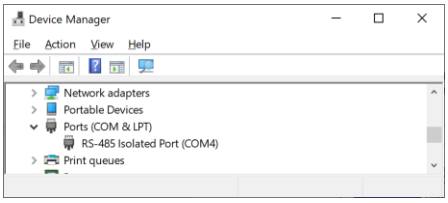
For more information on how to use Rugged Connect, refer to Chapter 6.

4.4 Testing your serial connection

4.4.1 Testing your Modbus connection

ModScan can be a very useful tool to exercise your RS-485 serial Modbus connection. Please note that using ModScan is only a suggestion; there exists other solutions in the market and you are free to use them as you wish. You can download it from here: https://www.win-tech.com/html/demos.htm; it can be used free of charge for up to 30 days, after which you will need to buy it from WinTech.

You will need to know the COMx port number for your serial port. The easiest way to do this is to invoke Device Manager on your PC, as shown here (which is COM4 for this example):

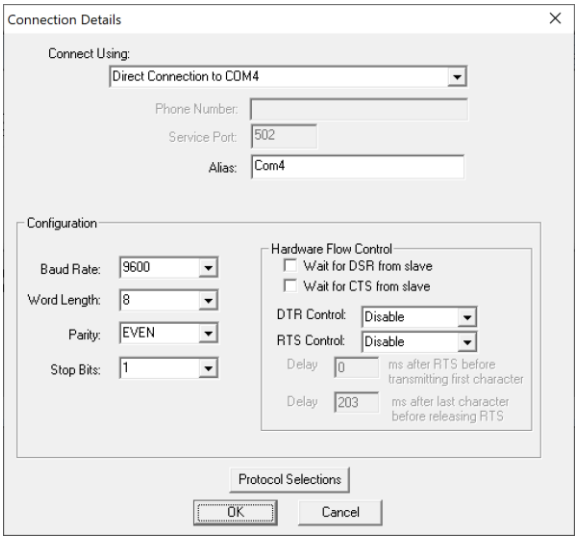


Please note that the Ports entry in the list (as shown above) will appear only if a serial port is detected by your Windows operating system. The above example confirms that the serial port is COM4; take note of this information as you will need it to connect to ModScan.

Take note that you will probably have to load a serial driven which is different that the one described in section 4.3 above. This means that your O201 will need 2 different serial COM port for communication:

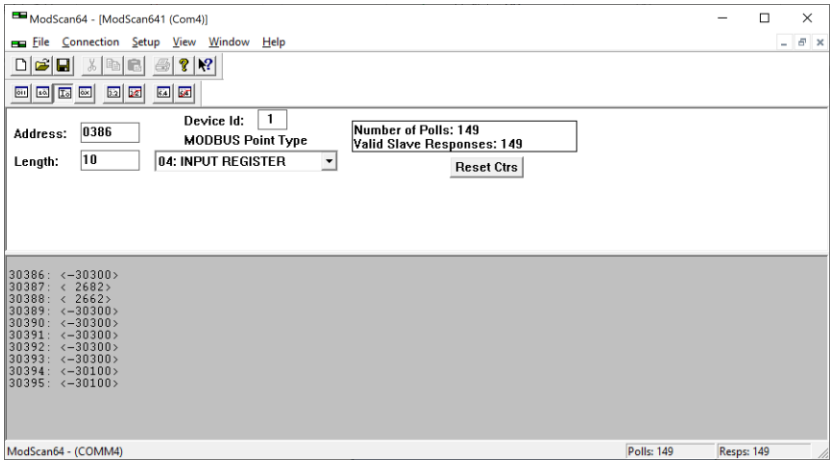
- One for USB communication
- One for Modbus communication.

Select Connection from the top tool bar of ModScan and then Connect, to get this setup window:



The following window appears. In this example, we are displaying 8 temperature values (see figure below); to do this, make sure these parameters are set correctly:

- Address. The address for temperature Channel # 1 is hex 0181 (see Chapter 7 for a complete Modbus register description), or dec 385. As ModScan counts register starting at 1 (not 0), then you need to add 1 to 385. Thus, the starting address is 386, in this example here.
- Length. As we want to read 8 channels, this should be 8.
- Device Id. This is the instrument identification (node address); it should be a number between 1 and 247. It must match the id that you have given to an instrument; use Rugged Connect to set this id.
- Modbus register type. The temperature values are “Input Register” type registers.
- Note that displayed temperature values are multiplied by 100, as shown in the figure. A value of -302 means that this channel is disabled and -303 means that no probe was detected for that channel. Note also that only 2 probes (channels 2 & 3) were connected here.



4.4.2 Testing your IEC 60870-5-101 connection

As an alternative to Modbus, you can use IEC 60870-5 protocol for data exchange over the RS-485 port. Refer to the T301 user guide for more information and for the data map for the IEC 60870-5 protocol.

4.4.3 Testing your DNP 3.0 connection

As an alternative to Modbus, you can use DNP 3.0 protocol for data exchange over the RS-485 port. Refer to the T301 user guide for more information and for the data map for the DNP 3.0 protocol.

4.5 CAN port and CAN bus protocol description

Information on CAN and CAN bus can be found in chapter 8.

4.6 Using the O201 for the first time

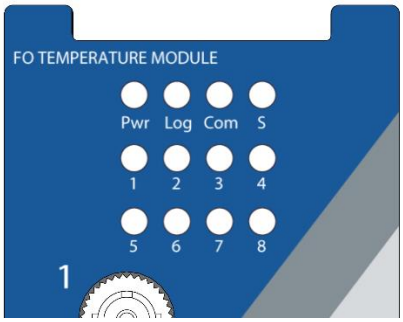
To make your first temperature measurements, do as follows:

- Remove the dust cap on the optical connectors of the O201.
- Remove the dust cap on the probe connectors.
- Insert each probe connector into a sensor connector on the O201. 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!
- Apply power to the O201 (24 to 48 VDC); it will turn on within a second or so. Within a few seconds, the LEDS corresponding to the optical channels where there is a probe will turn green.
- To get the temperature values, you will need the Rugged Connect software; refer to chapter 6.

5 O201 THERMOMETER HARDWARE REFERENCE

5.1 Display description

The visible feedback that the O201 can give you is quite limited, as it is intended to be used as an OEM module which will be installed in a higher-level system. To get more information and for configuring your O201 instrument, you will need to use the Rugged Connect software, which is described in the next chapter.



The O201 features a total of 12 LEDs, as shown above and as follows:

- Each optical channel (total of 8) is linked to one LED, that can take one of three states:
  - OFF, if no probe is detected (power level of 0%)
  - Green, if a good probe is detected (power level above 65%)
  - Red, if a probe exhibiting a weak optical signal (less than 65% power level) is detected.
- Pwr: Power ON / OFF
- Log: Logging status; blue if logging
- Com : TX/RX RS-485 communication port status. This LED will briefly flash red if data is transmitted or green if data is received
- S: On if system fault relay is active.

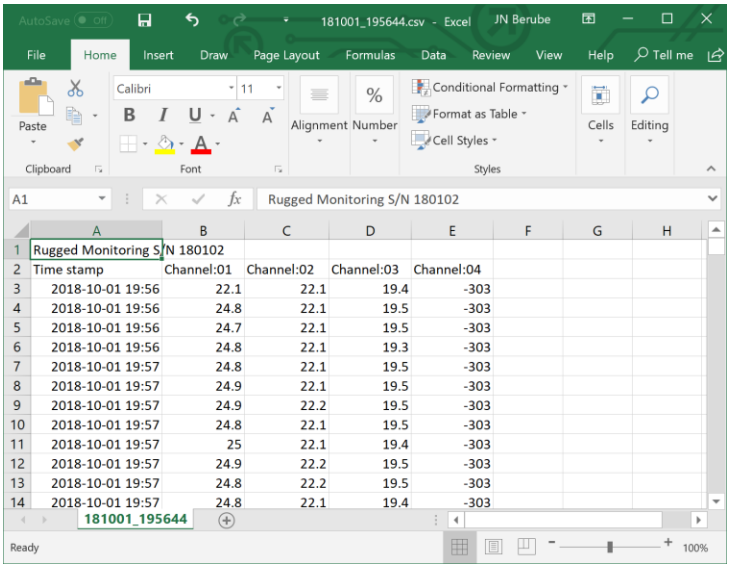
5.2 How to access the logged data

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 powering down the instrument (this is not mandatory but would be safer). Each time a new log is started, a new file is generated with a set file name (YYMMDD_HHMMSS.csv).

To read the logged data, one must remove the card from the O201 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. It is also possible to transfer the data files to a PC using the Rugged Connect software.

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.



When a file reaches 65,000 entries (lines), it will be closed and a new file will be created, with a name that reflects the date and time which is current at the time of its creation.

5.3 Interpretation of "%" results

The O201 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 many ways:

1- From the instrument panel, it is possible to see if the power level is below or above 65%; the channel LED will be red if the signal is below 65% and green if above 65%.
2- With Rugged Connect, by selecting the "Temperature Table View mode" (DATA tab). See section 6.2.
3- It can also be read using the serial protocol (e.g., Modbus).

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; for transformer applications, it is always recommended to have the AGC turned on.

Based on experience and with a feedthrough and extension cable, a power value of 65% or more is considered as being satisfactory. When testing a probe alone, power value should be 100%.

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

6 RUGGED CONNECT SOFTWARE DESCRIPTION

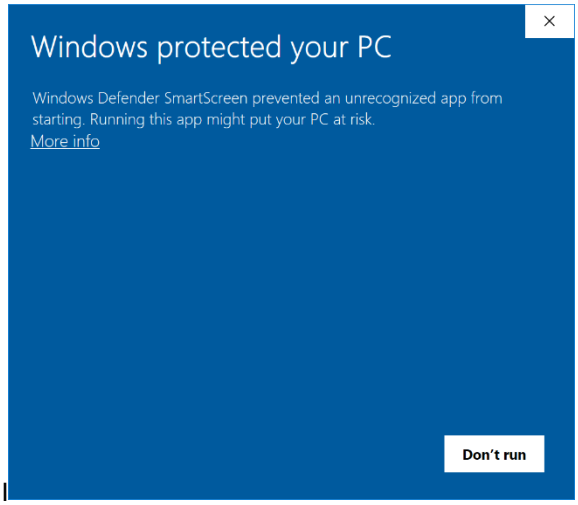
Rugged Connect (RC) is particularly interesting for O201 users as it provides a convenient complement to how instrument parameters are controlled and how temperature data is acquired. It offers a friendlier procedure to load various parameters, such as optical channel and relay parameters that would otherwise require being set by hand using the instrument panel. The goals and purposes of this software packages are as follows:

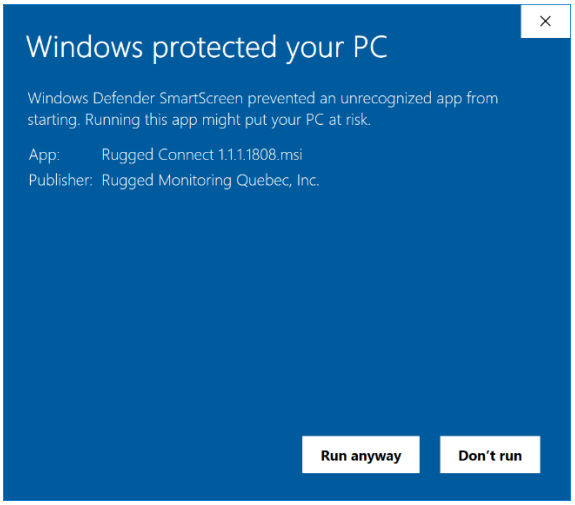
- Display temperature information, for up to a total of 64 channels, from up to 6 compatible instruments (O201, L201 and T301, and others to be released in the future)
    - Can provide results in graphical form
    - Can log temperatures to a Windows file, independently from the logging feature found 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, at https://www.ruggedmonitoring.com/downloads; you will need to request access on line. You can also write an email to support@ruggedmonitoring.com). Simply run this setup program (no unzipping is required). Windows-10 users: 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”.





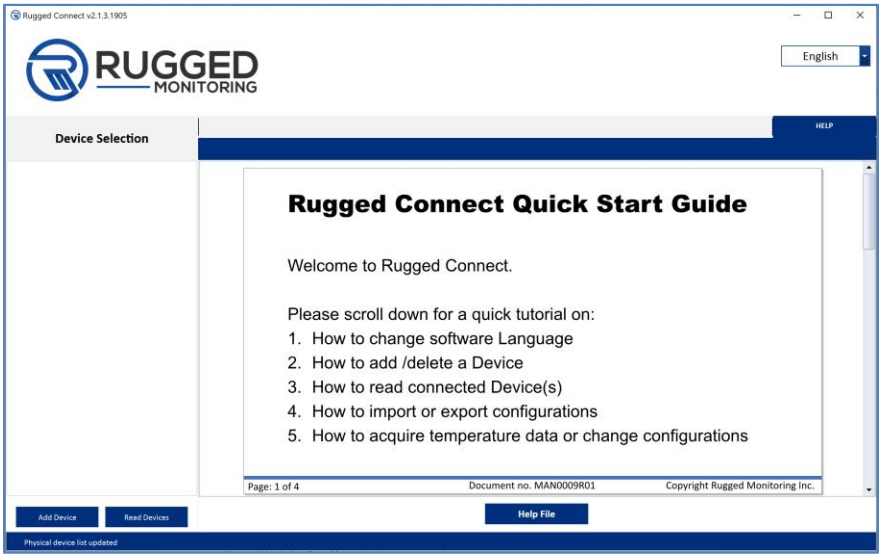
When you connect the O201 for the first time to your computer, a driver will be installed; this procedure is described at the beginning of Chapter 4.3 above and is not repeated here.

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

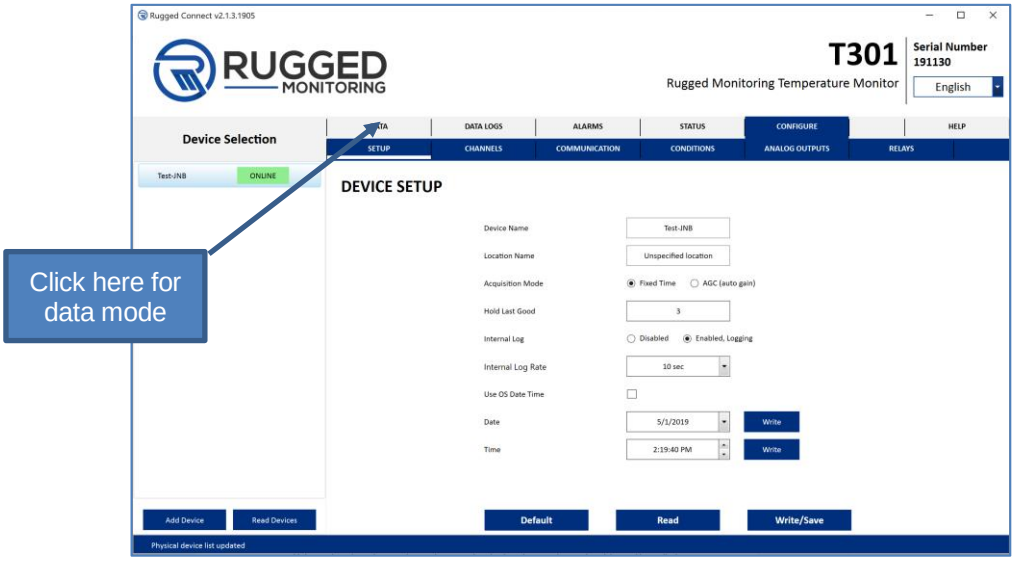
Warning: To reinstall the software, or install a new version, you will need to first uninstall the older version. This must be done by using the “Programs and Features”, found in Windows Control Panel.

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[2]:



You get this window if one O201 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 into a single file

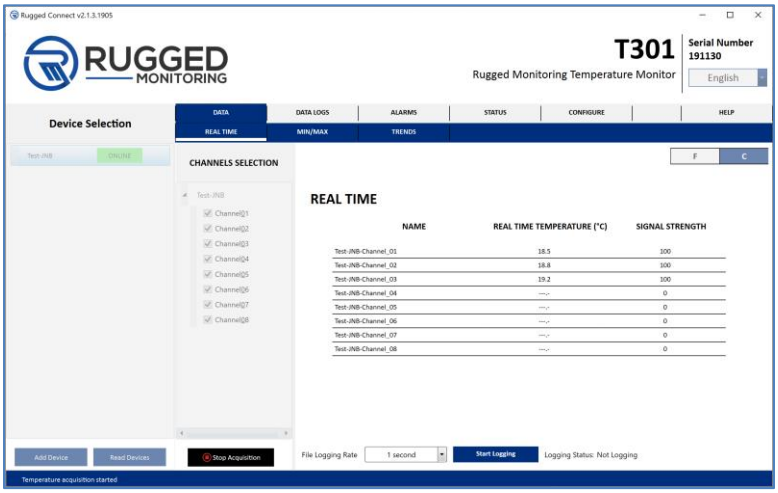
- Configuration mode; here you can configure your selected instrument (only one at a time).

These 2 modes of operation are explained below.

[2] Most screenshots presented in this chapter show the T301 logo; however, these screenshots are also applicable to the O201 product. Please ignore these logos, if you are using a O201 module.

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):

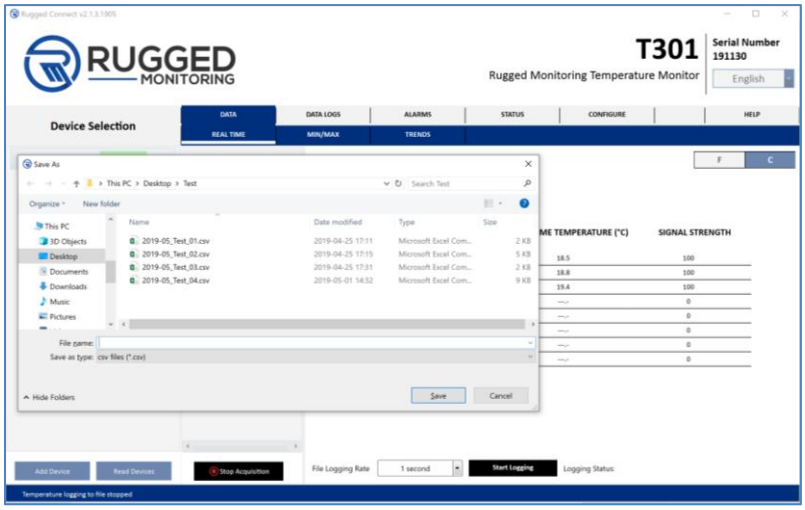


Warning: When you enter in configuration mode, all temperature acquisition is stopped; this means that logging to a PC file or graphing will be interrupted.

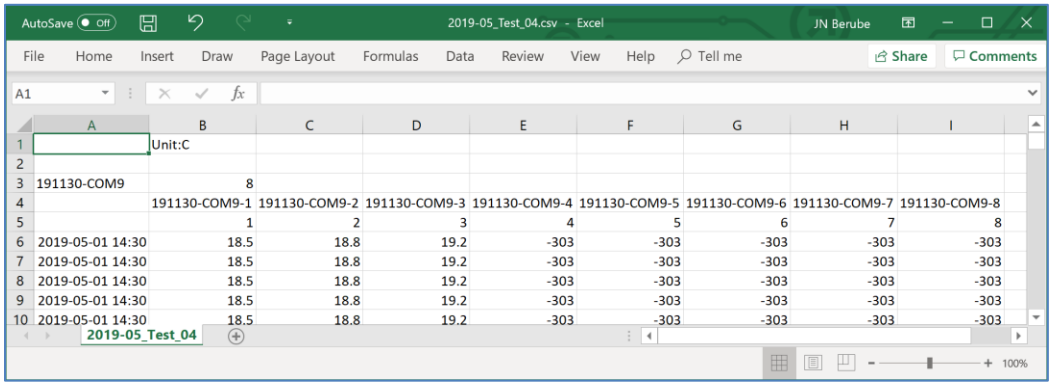
This window shows all temperatures in number format (°C or °F). If select from the menu either MIN/MAX or TRENDS, you can see the same data presented in different ways including in graphical form.

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:

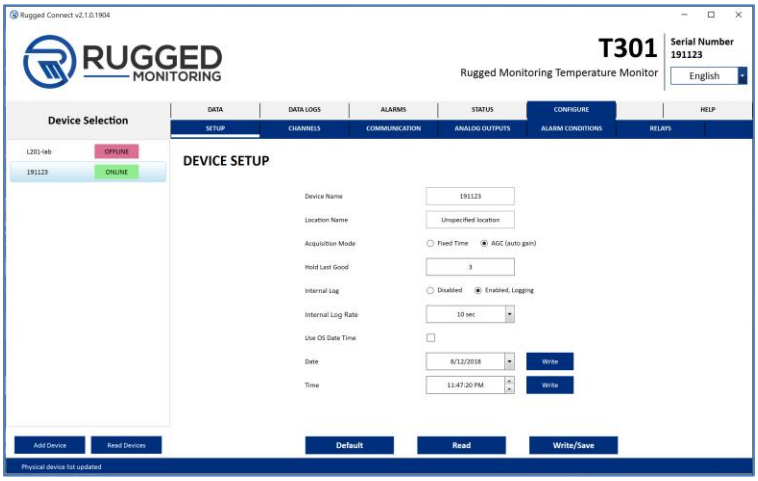


The file is a .csv that can easily be read by Excel, as shown here:



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.

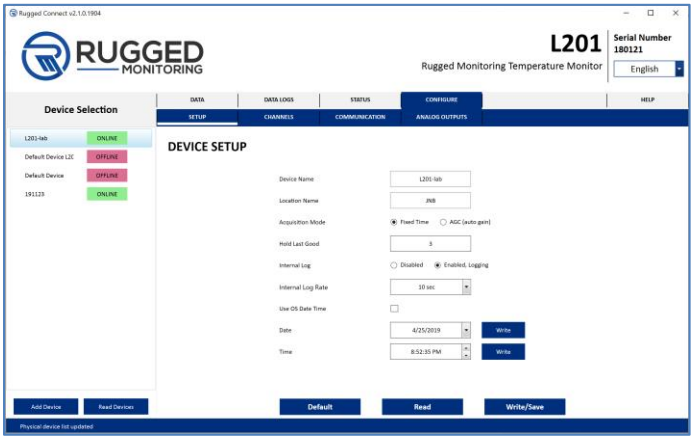
As part of configuring your instrument, you can select other tabs, to configure other parameters, such as the analog outputs (if this option is available on your instrument). The most important are described here; for the other parameters, they should be easy to understand.

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). ..

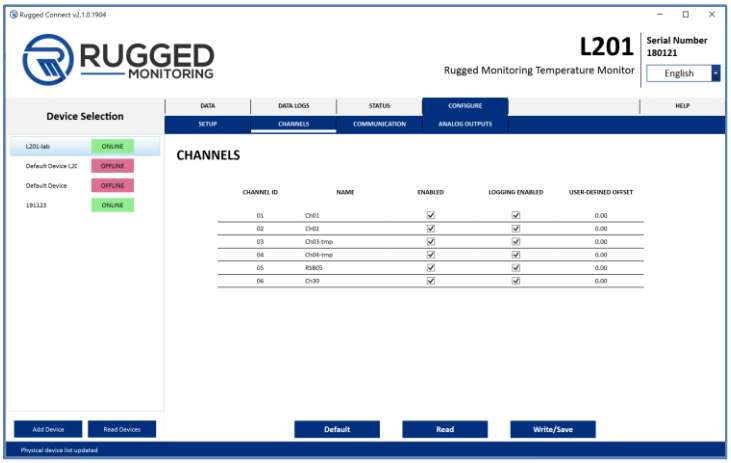
2- Hold Last Good. This indicates the number of “holds” since the last good reading. Normally, a value of “0” should be appropriate, unless you are using probes with weak signal, in which case it could avoid a probe from alternating from “no reading” to “reading”. In other words, this represents the 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 O201 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.

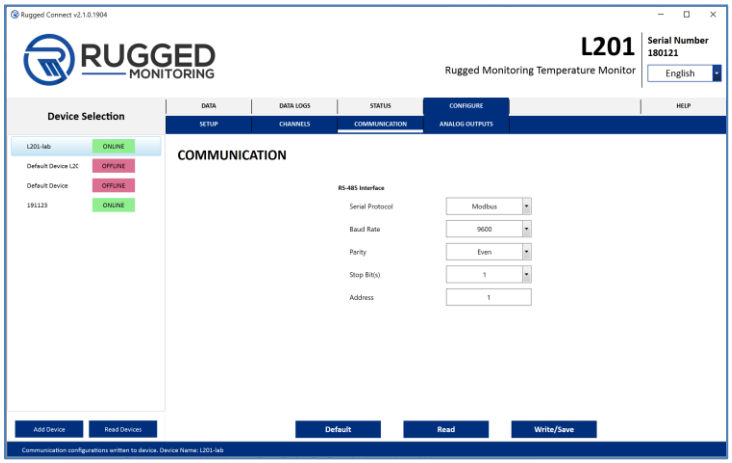


6.3.3 COMMUNICATION tab

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 of 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.

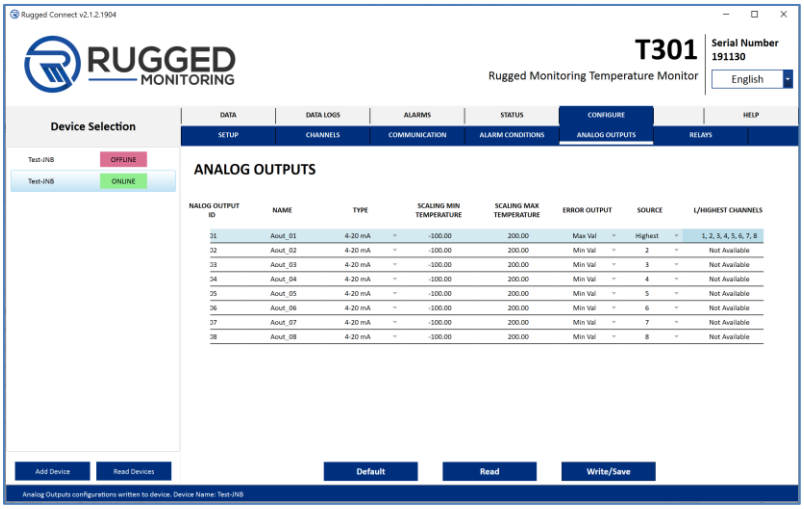
Once you have selected a protocol, you can change the baud rate, parity, stop bits and node address to communicate with your master device.



6.3.4 ANALOG OUTPUTS tab

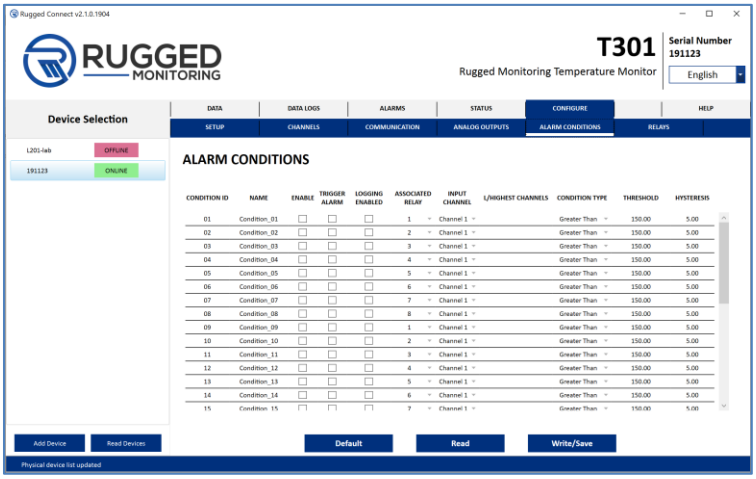
This tab allows for setting the behavior of the 8 analog outputs normally found on the O201 (this option may not be present on your specific instrument). The outputs are highly flexible and completely programmable; for example, you can assign many optical channels to a single output, and this output will give the highest temperature of all channels.

The setting of the various parameters is explained in detail in section 4.2.1 and are thus not repeated here.



6.3.5 CONDITIONS tab

Although the O201 instrument does not have physical relays to activate alarms or fans, etc., it is still possible for it to generate “soft” alarms that can be read via Rugged Connect, or Modbus, or other available communication protocols. The ALARM CONDITIONS window is shown here, and explanations are given below.



There are lots of concepts presented in this table; here is some information that should help configuring your conditions. Please note that “condition” is a generic name than does not mean necessarily an actual alarm; for example, turning on a cooling fan is considered as a condition. Sometimes, “conditions” can also be called “events” or “alarms”. Conditions can be configured so they can generate a real user alarm or simply activate a relay which has no importance to the user (such as turning on a fan). It is strongly recommended that you read this section carefully before attempting to configure your alarms.

Activated conditions can also be logged in the instrument microSD memory card, for later analysis. See section 6.3.5.1 below for more information.

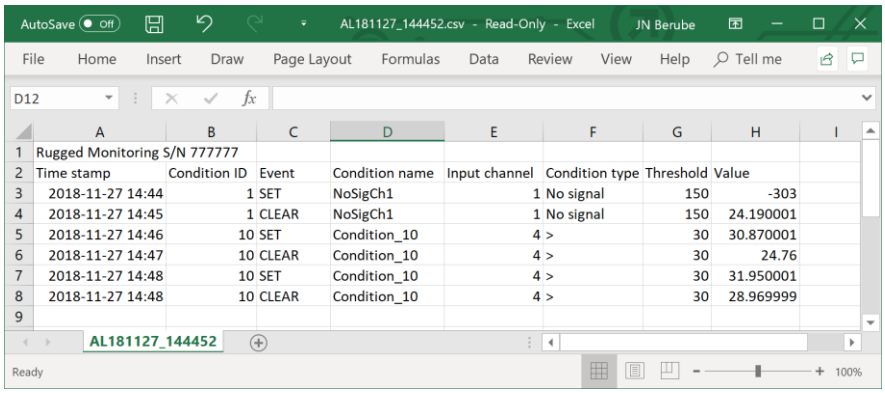
Detailed explanations of each column:

1- CONDITION ID. Sequential identification numbers. Cannot be changed by the user. There is a total of 32 conditions.
2- NAME. You can name a condition with a name of your liking, such as “Fan bank 1”.
3- ENABLE. By clicking this box, this condition is enabled; otherwise, it is disabled.
4- TRIGGER ALARM. By clicking this box, this condition will generate an alarm when the condition is true.
5- LOGGING ENABLED. Conditions can be optionally logged in a condition event file. Click this box to enable logging. For a description of this event file, see section 6.3.5.1.
6- ASSOCIATED RELAY. This specifies which relay will be activated if this condition becomes active. For “soft” alarms, you should select “none”, in which case an alarm can be generated but no relays will be activated as a result of this alarm. Take note that multiple conditions can be assigned to the same relay; this relay will be activated if at least one condition is active (logical “OR” function).
7- INPUT CHANNEL. This specifies the optical channel that is associated to this condition. If you select “highest” or “lowest”, then multiple optical channels can be associated to this condition; the selection of these channels can be done in the next column, L/HIGHEST CHANNELS.
8- L/HIGHEST CHANNELS. This channel selection field is usable only if you have selected “highest” or “lowest” in the previous column. Here you can select the channels that have an input to this condition.
    a. There is an exception as follows: If you select “highest” or “lowest in the INPUT CHANNEL field and “No signal” as the condition type (next field below), then here you can select the channels for which you would like to generate an alarm in case of a no-signal situation.
9- CONDITION TYPE. This can take three values:
    a. No signal. This is useful if the condition is to generate an alarm if a channel loses its optical signal.
    b. Less Than. This will trigger an alarm if the temperature becomes lower than the set threshold (see next column).
    c. Greater Than. This will trigger an alarm if the temperature becomes higher than the set threshold (see next column). This should be the most used type.
10- THRESHOLD. This is the temperature threshold value used in evaluating the real-time condition.

11- HYSTERESIS. This is the number of degrees (°C) by which a temperature must change in order to remove this alarm condition. Although a value of “0” can be used, it is not suggested especially if this condition is to control a physical relay, as this could make unnecessary relay contact tripping. A value of “5” generally considered as a good choice.

6.3.5.1 Condition event file

The condition event file is like a temperature data file; it is a tab-delimited .csv file that is easily readable by Excel. Its file name is automatically generated based on the date and time of its creation, with the “CE” letters forced as the first letters of its name, as shown here. It can contain up to 65,000 entries, and when this number of entries is reached, this file is closed, and a new file is created.



	A	B	C	D	E	F	G	H	I
1	Rugged Monitoring S/N 777777								
2	Time stamp	Condition ID	Event	Condition name	Input channel	Condition type	Threshold	Value	
3	2018-11-27 14:44	1	SET	NoSigCh1	1	No signal	150	-303	
4	2018-11-27 14:45	1	CLEAR	NoSigCh1	1	No signal	150	24.190001	
5	2018-11-27 14:46	10	SET	Condition_10	4	>	30	30.870001	
6	2018-11-27 14:47	10	CLEAR	Condition_10	4	>	30	24.76	
7	2018-11-27 14:48	10	SET	Condition_10	4	>	30	31.950001	
8	2018-11-27 14:48	10	CLEAR	Condition_10	4	>	30	28.969999	
9									

Some remarks regarding the content of this file:

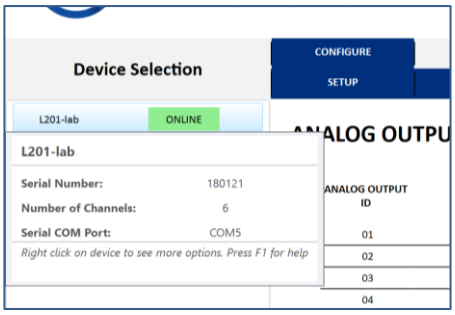
1- An activated condition will generate 2 entries in the file: first, when the condition becomes active and, second, when this condition disappears.
2- Alarm ID. This identifies the condition ID that has generated this alarm.
3- Alarm name is the condition name, as set in ALARM CONDITIONS tab, above.
4- Value. Temperature value at time of condition trigger

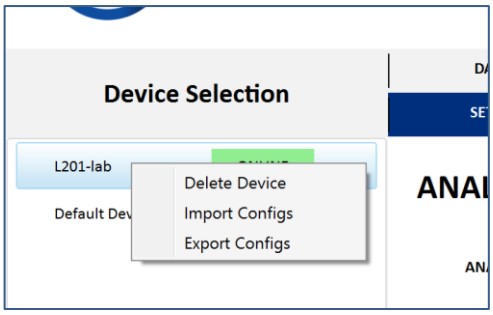
6.3.6 RELAYS tab

This tab is not applicable to the O201 product, as no physical relays are available for this product.

6.3.7 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: :



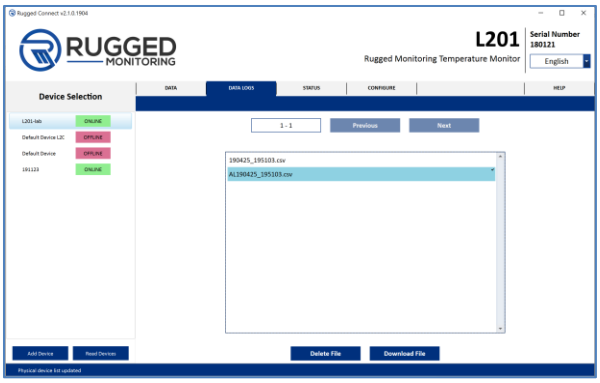


From here, you can click on Import or Export Configs. The Export function can be useful if you intend to configure multiple instruments with the same configuration.

6.4 Downloading data files

You can download data from you instrument by clicking on the DATA LOGS tab. Data files can be temperature or alarm event files. Select a file and click the Download File button.

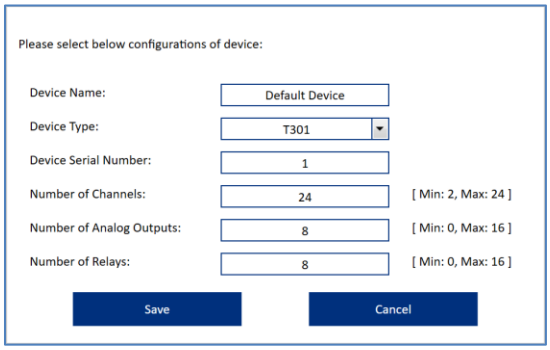
From the same window, one can also delete files stored in the instrument microSD.



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. It might be a good idea to call these virtual configurations by project number or name; when they will be uploaded to a real instrument later on, then its name will change to the instrument actual serial number.

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”.

6.6 Firmware upgrade

Future version of Rugged Connect will feature a function to upgrade any instrument internal firmware. For the time being, if an upgrade is required on your instrument, please contact Rugged Monitoring to get:

- Upgrade software tool (https://www.st.com/en/development-tools/flasher-stm32.html)
- Get the firmware code file from Rugged Monitoring, as explained above.
- To force the instrument to be in “upgrade” mode, you will need to do the following:
  - Remove the 24V power from the instrument. Make sure the instrument is OFF
  - Connect the instrument to a PC using the micro-USB connector

    - Run the ST utility. Wait until the transfer is done.
    - Disconnect the cable from the micro-USB connector
    - Reconnect the 24 VDC power. The upgrade is now complete.

- If an upgrade is required, Rugged Monitoring will send you a complete detailed procedure.

7 MODBUS REGISTER TABLE

This chapter gives a description of the Modbus registers included in the O201 instrument. If you want to connect to the O201 using the serial RS-485 port, you will need this information.

Rugged Monitoring **Modbus map register**

Version: 1.6

2 **Function code:** **0x03** **Read Holding Registers** **Read only**

2.1 System Info **Factory_struct**

Reg Address	Name	Description	16 bits	Encoding
0x0000	Device	Type of Device	Unsigned	Define: 1 = L201; 2 = T301; 3 to 7 = OEM
0x0001	Model	Device Model	Unsigned	Reserved
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	SerialNumberH	Unique ID Serial Number MSW	Unsigned	MSW of the 32 bits variable
0x0007	SerialNumberL	Unique ID Serial Number LSW	Unsigned	LSW of the 32 bits variable
0x0008	NbAout	Number of Analog Outputs	Unsigned	0 means option is not present, 8 = 8 analog output available
0x0009	NbRelay	Number of Relays	Unsigned	0 means option is not present, 8 = 8 relays available

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 = Fixed Time; 2 = AGC on
0x0011	TempAveraging	Averaging	Unsigned	50 to 100; 100 = 100% of last value (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; 1 = Enable Not Logging; 2 = Logging
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 MSW	Unsigned	MSW of the 32 bits variable
0x0019	TimeInSecL	Device Internal Time in second LSW	Unsigned	LSW of the 32 bits variable

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 [e.g. 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	…	*Same as Channel 01 structure*
0x0130-0x013F	…	Channel 03	…	*Same as Channel 01 structure*
0x0140-0x014F	…	Channel 04	…	*Same as Channel 01 structure*
0x0150-0x015F	…	Channel 05	…	*Same as Channel 01 structure*

0x0160-0x016F	…	Channel 06	**…**	*Same as Channel 01 structure*
0x0170-0x017F	…	Channel 07	**…**	*Same as Channel 01 structure*
0x0180-0x018F	…	Channel 08	**…**	*Same as Channel 01 structure*

2.4 Analog Output **Aout_struct**

Reg Address	Name	Description	16 bits	Encoding
0x0300	A01_Type	Analog 01 Type of output	Unsigned	Define: 0 = 4-20 mA; 1 = 0-10 V; 2 = 0-20 mA; 3 = 0-5 V
0x0301	A01_ErrStyle	Analog 01 Output if no valid signal	Unsigned	Define: 0 = min value; 1 = max value; 2 = Toggle 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 [e.g. 20000 for 200.00]
0x0304	A01_Tlow	Analog 01 Low value temperature	Signed	Low temperature x 100 [e.g. -10000 for -100.00]
0x0305	A01_EvalChEnH	Enabled channel for highest and lowest (one hot) MSW	Unsigned	MSW of the 32 bits variable (1 bit per channel)
0x0306	A01_EvalChEnL	Enabled channel for highest and lowest (one hot) LSW	Unsigned	LSW of the 32 bits variable (1 bit per channel)
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 = 4-20 mA; 1 = 0-10 V; 2 = 0-20 mA; 3 = 0-5 V
0x0371	A08_ErrStyle	Analog 08 Output if no valid signal	Unsigned	Define: 0 = min value; 1 = max value; 2 = Toggle 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 [e.g. 20000 for 200.00]
0x0374	A08_Tlow	Analog 08 Low value temperature	Signed	Low temperature x 100 [e.g. -10000 for -100.00]
0x0375	A08_EvalChEnH	Enabled channel for highest and lowest (one hot) MSW	Unsigned	MSW of the 32 bits variable (1 bit per channel)
0x0376	A08_EvalChEnL	Enabled channel for highest and lowest (one hot) LSW	Unsigned	LSW of the 32 bits variable (1 bit per channel)
0x0377-0x037E	A08_Name	Analog 08 Name	Unsigned	16 bytes long string
0x037F	*A08_Reserved*	*Reserved for Future use*	*Unsigned*	*Set to 0x0000*

2.6 Conditions **Alarm_struct**

Reg Address	Name	Description	16 bits	Encoding
0x0500	AL01_Enable	Condition 01 Enable/Disable	Unsigned	0 = Disable; Enable otherwise
0x0501	AL01_RLY	Condition 01 Associated relay (0 based)	Unsigned	0 to 7 for relay 1 to 8
0x0502	AL01_InChannelNb	Condition 01 Input channel number	Signed	-2 = lowest; -1 = highest; 0 = reserved; 1 = channel 1 etc.
0x0503	AL01_ConditionType	Condition 01 Condition type	Unsigned	0 = No signal; 1 = Less than; 2 = Greater than
0x0504	AL01_AlarmEn	Condition 01 General Condition	Unsigned	0 = Disable; Enable otherwise
0x0505	AL01_LogEn	Condition 01 Log event	Unsigned	0 = Disable; Enable otherwise
0x0506	AL01_Threshold	Condition 01 Temperature threshold (Celsius)	Signed	Temperature x 100 [e.g. 15000 for 150.00]
0x0507	AL01_Hysteresis	Condition 01 hysteresis (Celsius)	Signed	Temperature x 100 [e.g. 500 for 5.00]
0x0508	AL01_EvalChEnH	Enabled channel for highest and lowest (one hot) MSW	Unsigned	MSW of the 32 bits variable (1 bit per channel)
0x0509	AL01_EvalChEnL	Enabled channel for highest and lowest (one hot) LSW	Unsigned	LSW of the 32 bits variable (1 bit per channel)
0x050A-0x0515	AL01_ConditionName	Condition string name	Unsigned	24 bytes long string

0x0516-0x051F	*AL01_Reserved*	*Reserved for Future use*	*Unsigned*	*Set to 0x0000*
0x0520-0x053F	…	Condition 02	…	*Same as Condition 01 structure*
0x0540-0x055F	…	Condition 03	…	*Same as Condition 01 structure*
0x0560-0x057F	…	Condition 04	…	*Same as Condition 01 structure*
0x0580-0x059F	…	Condition 05	…	*Same as Condition 01 structure*
0x05A0-0x05BF	…	Condition 06	…	*Same as Condition 01 structure*
0x05C0-0x05DF	…	Condition 07	…	*Same as Condition 01 structure*
0x05E0-0x05FF	…	Condition 08	…	*Same as Condition 01 structure*
0x0600-0x061F	…	Condition 09	…	*Same as Condition 01 structure*
0x0620-0x063F	…	Condition 10	…	*Same as Condition 01 structure*
0x0640-0x065F	…	Condition 11	…	*Same as Condition 01 structure*
0x0660-0x067F	…	Condition 12	…	*Same as Condition 01 structure*
0x0680-0x069F	…	Condition 13	…	*Same as Condition 01 structure*
0x06A0-0x06BF	…	Condition 14	…	*Same as Condition 01 structure*
0x06C0-0x06DF	…	Condition 15	…	*Same as Condition 01 structure*
0x06E0-0x06FF	…	Condition 16	…	*Same as Condition 01 structure*
0x0700-0x071F	…	Condition 17	…	*Same as Condition 01 structure*
0x0720-0x073F	…	Condition 18	…	*Same as Condition 01 structure*
0x0740-0x075F	…	Condition 19	…	*Same as Condition 01 structure*
0x0760-0x077F	…	Condition 20	…	*Same as Condition 01 structure*
0x0780-0x079F	…	Condition 21	…	*Same as Condition 01 structure*
0x07A0-0x07BF	…	Condition 22	…	*Same as Condition 01 structure*
0x07C0-0x07DF	…	Condition 23	…	*Same as Condition 01 structure*
0x07E0-0x07FF	…	Condition 24	…	*Same as Condition 01 structure*
0x0800-0x081F	…	Condition 25	…	*Same as Condition 01 structure*
0x0820-0x083F	…	Condition 26	…	*Same as Condition 01 structure*
0x0840-0x085F	…	Condition 27	…	*Same as Condition 01 structure*
0x0860-0x087F	…	Condition 28	…	*Same as Condition 01 structure*
0x0880-0x089F	…	Condition 29	…	*Same as Condition 01 structure*
0x08A0-0x08BF	…	Condition 30	…	*Same as Condition 01 structure*
0x08C0-0x08DF	…	Condition 31	…	*Same as Condition 01 structure*
0x08E0	AL32_Enable	Condition 32 Enable / Disable	Unsigned	0 = Disable; Enable otherwise
0x08E1	AL32_RLY	Condition 32 Associated relay (0 based)	Unsigned	0 to 7 for relay 1 to 8
0x08E2	AL32_InChannelNb	Condition 32 Input channel number	Signed	-2 = lowest; -1 = highest; 0 = reserved; 1 = channel 1 etc.
0x08E3	AL32_ConditionType	Condition 32 Condition type	Unsigned	0 = No signal; 1 = Less than; 2 = Greater than
0x08E4	AL32_AlarmEn	Condition 32 General Condition	Unsigned	0 = Disable; Enable otherwise
0x08E5	AL32_LogEn	Condition 32 Log event	Unsigned	0 = Disable; Enable otherwise
0x08E6	AL32_Threshold	Condition 32 Temperature threshold (Celsius)	Signed	Temperature x 100 [e.g. 15000 for 150.00]
0x08E7	AL32_Hysteresis	Condition 32 hysteresis (Celsius)	Signed	Temperature x 100 [e.g. 500 for 5.00]
0x08E8	AL32_EvalChEnH	Enabled channel for highest and lowest (one hot) MSW	Unsigned	MSW of the 32 bits variable (1 bit per channel)
0x08E9	AL32_EvalChEnL	Enabled channel for highest and lowest (one hot) LSW	Unsigned	LSW of the 32 bits variable (1 bit per channel)
0x08EA-0x08F5	AL32_ConditionName	Condition string name	Unsigned	24 bytes long string
0x08F6-0x08FF	*AL32_Reserved*	*Reserved for Future use*	*Unsigned*	*Set to 0x0000*

2.7 Alarms status

Reg Address	Name	Description	16 bits	Encoding
0x0900	AlarmLatchH	Alarm latch MSW (a write resets all latched alarms)	Unsigned	MSW of the 32 bits variable (1 bit per alarm)

0x0901	AlarmLatchL	Alarm latch LSW (a write resets all latched alarms)	Unsigned	LSW of the 32 bits variable (1 bit per alarm)
0x0902-0x090F	*RFU*	*Reserved for Future use*	*Unsigned*	*Set to 0x0000*

2.9 Device String ID

Reg Address	Name	Description	16 bits	Encoding
0x0B00	DeviceName	Device string name	Unsigned	31 bytes long string
0x0B20	LocationName	Device location string name	Unsigned	31 bytes long string
0x0B40-0x0BFF	*RFU*	*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 [e.g. 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 [e.g. 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	...

8 CAN BUS PROTOCOL

This chapter gives a description of the CAN bus registers included in the O201 instrument. If you want to connect to the O201 using the serial RS-485 port, you will need this information.

8.1 CAN bus general information

- Device can be configured to send data only when triggered with a read message.
- Device can be configured to periodically send specific values. Two groups of periodic values can be configured.
- Channels can be individually disabled from any CAN transmission.

CAN MESSAGE

CAN 2.0 A (Base) : 11 bits.
CAN 2.0 B (Extended) : 11 + 18 bits = 29 bits.
First 10 / 28 bits are user configurable.
Last bit is fixed: device transmits with bit value 0 and listens for messages with bit value 1.
For example, with address defined as 0x04567124:
Base: device transmits message ID 0x0124.
Base: device listens for message IDs 0x0125.
Extended: device transmits message ID 0x04567124.
Extended: device listens for message IDs 0x04567125.

DATA COMPOSITION

Data length is fixed at 6 bytes (DLC = 6).
First byte specifies value address.
Second byte specifies array ID (e.g. channel, alarm, relay), if relevant, encoded in the 7 MSB bits.
Requests with invalid values are ignored.
When listening, second byte (last bit) also specifies if the message is a request to read (0) or write (1).
Payload is always encoded in 4 bytes (32 bits). Unused bits are sign-extended (transmit) or ignored (listen).
Payload is ignored when receiving a read request.

	DB0	DB1	DB2	DB3	DB4	DB5
Transmit	ADDR	ID	Payload	Payload	Payload	Payload
Listen	ADDR	ID + R/W	Payload	Payload	Payload	Payload

PERIODIC TRANSMISSION

The first 16 values addresses can be configured for periodic transmission.
A periodic transmission group will transmit one value at each configured period.
Transmission period is set on multiples of 0.1 s.
For example, if temperatures are to be periodically transmitted each 0.5 s, and 8 channels are enabled, all temperatures will have been transmitted in 4 s.
Channels can be individually omitted from CAN periodic transmission. This setting is common to both groups. This setting has no effect on individual read/write commands.
Channels or alarms that are disabled by the user are not included in periodic transmission, but remain accessible with individual read/write commands.

8.2 CAN Register table

DATA REGISTERS

Data bytes								Type	Values
DB0		DB1 (7MSB)	DB1 (LSB)	DB2	DB3	DB4	DB5		
ADDR (DEC / HEX)		ID	R(0)/W(1)	Payload (encoded on 32 bits, MSB first)					
0	**00**	[1..24]	R	Temperature				INT 16	
1	**01**	[1..24]	R	Status				UINT 8	
2	**02**	[1..24]	R	SigStr				UINT 8	
3	**03**	[1..24]	R	Amplitude				UINT 8	
4	**04**	[1..24]	R	Gain				UINT 8	
5	**05**	[1..24]	R/W	Enable				UINT 8	0 : inactive / 1 : active.
6	**06**	[1..24]	R/W	Offset				INT 16	Scaled * 100 (e.g. value of +1234 means +12.34C)
7	**07**	[1..32]	R/W	Alarms				UINT 8	0 : inactive / 1 : latched. A write to that address will reset all latched alarms.
8	**08**	[1..8]	R	Relay status				UINT 8	0 : inactive / 1 : active.
9	**09**			*Reserved (periodic able)*					
…	…			*Reserved (periodic able)*					
15	**0F**			*Reserved (periodic able)*					
16	10			*Reserved*					
…	…			*Reserved*					
235	EB			*Reserved*					
236	EC	0	R	MajorVersion				UINT 8	
237	ED	0	R	MinorVersion				UINT 8	
238	EE	0	R	GenError				UINT 32	
239	EF	0	R	CalibError				UINT 32	
240	F0			*Reserved*					
241	F1	0	R	InternalTemp				INT 16	
242	F2	0	R	Device				UINT 8	
243	F3	0	R	Model				UINT 8	
244	F4	0	R	NbChannel				UINT 8	
245	F5	0	R	CalibYY				UINT 8	
246	F6	0	R	CalibMM				UINT 8	
247	F7	0	R	CalibDD				UINT 8	
248	F8	0	R	SerialNumber				UINT 32	
249	F9			*Reserved*					
250	FA	0	R/W	AcquisitionMode				UINT 8	
251	FB	0	R/W	TempAveraging				UINT 8	
252	FC	0	R/W	HoldLastGood				UINT 8	
253	FD	0	R/W	LogEn				UINT 8	0 : disabled / 1 : enabled
254	FE	0	R/W	LogRate				UINT 8	
255	FF			*Reserved*					

Notes:

- Values with addresses 0 to 15 can be selected for periodic transmission.
- 'R' indicated that value is read only, R/W that value is available for read or write operations.

9 INDEX

Rugged Monitoring Québec Inc.
1415, rue Frank-Carrel, Suite 230
Québec City, QC
CANADA G1N 4N7

Tel: 418-767-0111

www.ruggedmonitoring.com
support@ruggedmonitoring.com

Printed in Canada

