T301™

Fiber Optic Thermometer Instrument

4- to 24-Channel System
With 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 power supply modules (24 to 48 VDC) should be used to operate this T301 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.

1 RUGGED MONITORING WARRANTY NOTICE

Your T301™ unit is guaranteed (Parts and Workmanship) for one full year from the date of purchase (different warranty conditions may have been negotiated for specific customers; for those cases, these conditions would supersede this standard text). 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 T301 instrument.

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 T301™ 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 T301 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 24 optical channels in a single compact and rugged enclosure.

The T301 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 cast aluminum enclosure which makes it ideally suited for transformer cabinet 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 proprietary transfer protocol is a fast binary serial scheme. Take note that the unit is powered via a different connector; the unit requires a 24 to 48 VDC power input (~20 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 is a mandatory complement to your thermometer. This Windows software allows the user to configure the T301 more easily than using the few keys available on the instrument itself. It should be noted that many 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 T301 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 T301 can be supplied with no relays or with 8 form-C relays. These relays are completely programmable, and they are not pre-assigned to any specific optical channel. A 9th relay is always present: it is a dedicated system fault relay.

An optional Ethernet module is also available; it must be ordered at the same time as the T301 unit. This option gives you these additional functions:

1- The IEC 61850 communication protocol;
2- The Modbus over Ethernet communication protocol;
3- The IEC 60870-5-104 communication protocol (on Ethernet);
4- The DNP 3.0 communication protocol (on Ethernet);

5- A webserver that allows you to communicate and configure the T301 using most commercially available browsers;
6- When a microSD memory card is ordered with your T301, mirrored logging will also be done by the Ethernet board (4 or 8 GB). This internal memory is not removable by the user;
7- It gives you the possibility to add an industry standard SFP plug-in module that will give you fiber optic communication. As both RJ45 and fiber communication can be used simultaneously, communication redundancy is achieved.

2.1 T301 product specifications

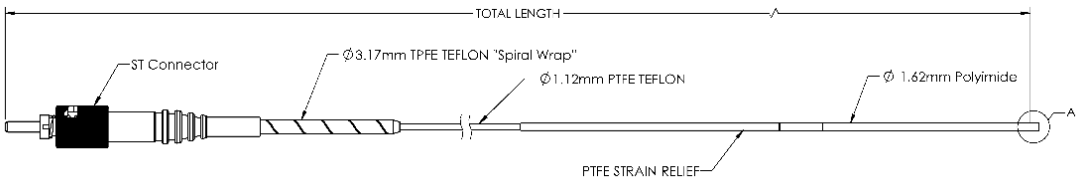
This is only a summary of the most important specifications; for complete product specifications, please refer to the marketing product brochure.

Resolution	0.1 °C
Accuracy	± 1 °C
Calibrated Temperature Range	-45 ° to 200 °C (Extended calibration available on special order)
Usable Temperature Range	-80° to 250 °C (Cryogenic calibration available on special order)
Number of channels	4 to 24
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 option	On a user-removable microSD memory card (4 or 8 GB) With the Ethernet and logging options, a non-removable microSD card is supplied in addition to the removable card (mirrored logging)
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 Display of 6 values; will scroll to display up to 24 values and error messages
Analog output option	Internal module (4-20 mA and 0-10 V), with 8 programmable outputs
Relays option	8 form-C relays, rated at 5 A
Serial port	RS-485 port (Modbus, DNP 3.0 and IEC 60870-5-101) – Ground insulated
Ethernet option	RJ45 – With advance communication protocols (IEC 61850, Modbus over Ethernet, IEC 60870-5-104 and DNP 3.0) – Webserver
Fiber optic communication	SFP module can be added to the Ethernet option
Power	24 to 48 VDC, ~20 watts
Firmware upgradability	Through USB port (and Ethernet port, if available). Both processors need to be upgraded independently from one another.
Size	267L x 187W x 72H mm
Weight	0.8 kg
Standard interface	Micro-USB connector

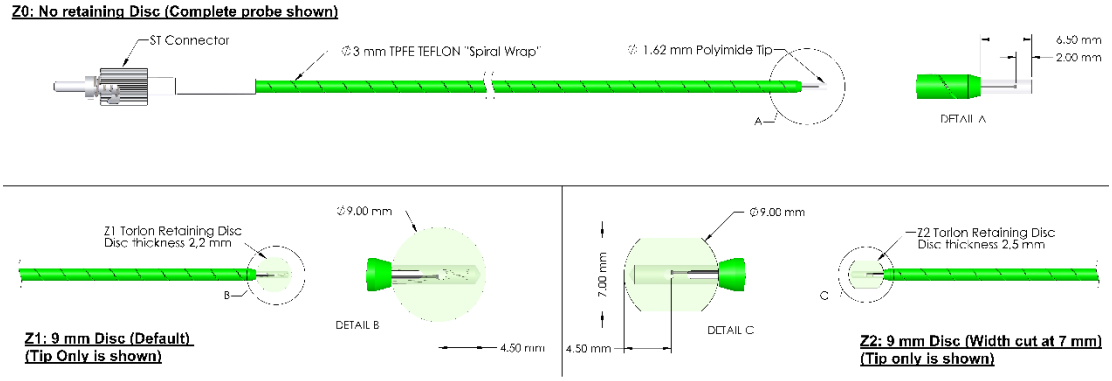
All technical specifications are subject to change without notice.

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

General Purpose Probe (other versions available):

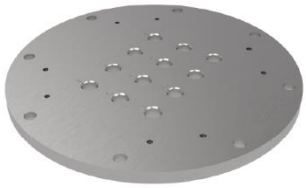


Probe for hot spot transformer (with and without disk):



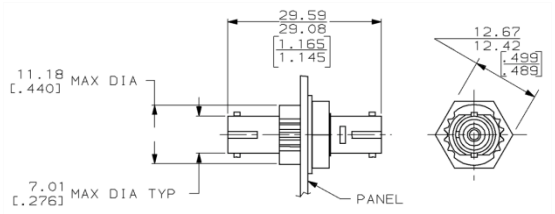
Feedthrough:

Tank Wall Plate:



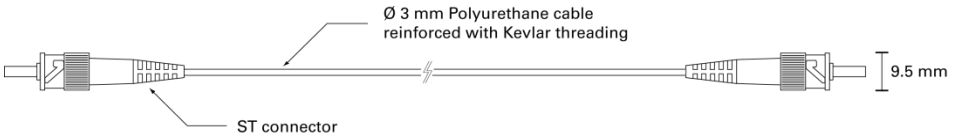
Interface Box (I-Box):

ST-ST Coupling:



Dielectric Connector:

ST-ST Extension Cable



Extension cable bundles are also available.

2.2 Calibration

Your T301 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 T301 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 T301 thermometer, check the box content to be sure all items have been included. Your package should normally contain:

- T301 instrument
- USB cable
- 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)
- Internal relays
- Internal analog output module
- Internal Gigabit Ethernet module (RJ45), with SFP optical communication option
- LabView, MATLAB, Python software interfaces (downloadable from the Internet)
- Logging memory, microSD
- Carrying case, for T301 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 PRODUCT INSTALLATION

Information: A Quick Start Guide for the T301 is available from Rugged Monitoring; contact Rugged Monitoring for a copy. This short guide (2 pages) contains all essential information to quickly get you going with the T301 instrument.

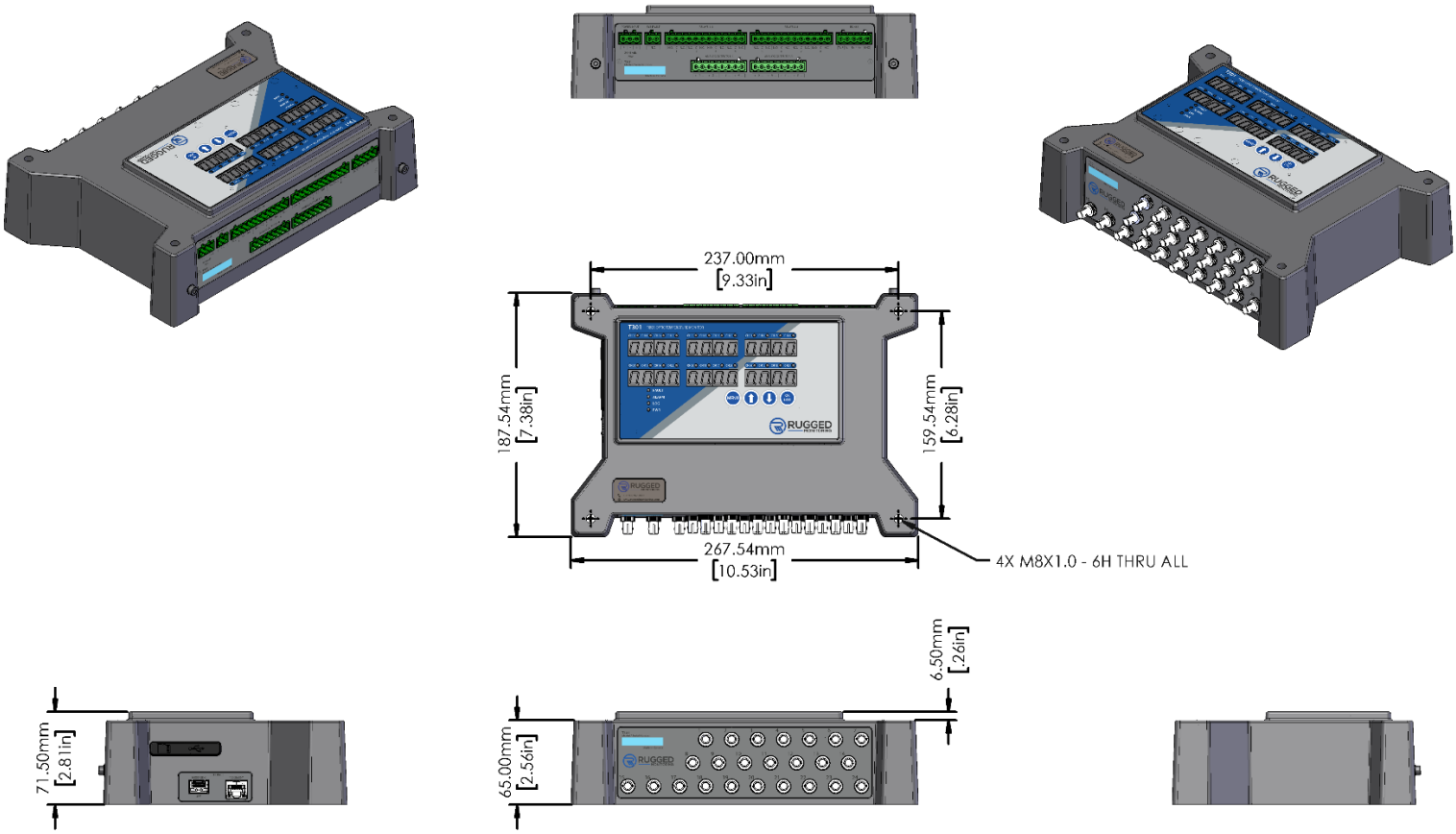
This chapter contains an overview of:

- 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 T301 either in a transformer cabinet swing panel, or to bolt it on a recessed mounting plate.

The T301 instrument has the same enclosure irrespective of the total number of optical channels, up to 24. The details are shown here:

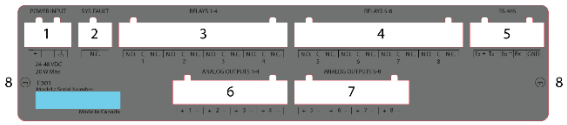


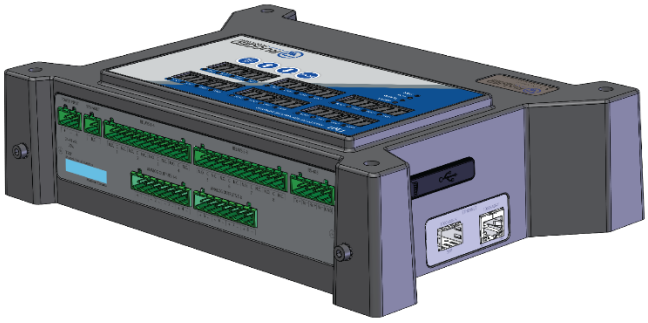
When the T301 has more than 6 optical channels, the display will scroll automatically, displaying 6 channels at a time. There is a LED on top of each display field which indicates which channel is currently being displayed. For the 24-channel version, all 24 channels will be shown after a total of 4 display cycles. In case of a system error, an additional cycle will display the error message. See section 5.1 for more information.

This drawing shows how to install a T301 instrument on a swing panel.

4.2 Electrical installation

This drawing shows all electrical connections that are possible on a fully populated T301 instrument.





1- POWER INPUT
24 to 48 VDC, 20w max
Mating connector: Phoenix #1757022

Pinout: 1-Power input +
2-Power input -
3-Earth ground

2- SYSTEM FAULT
Normally closed contact. Contact is open if system is not powered or if the firmware is not operating properly.
See relay rating for voltage and current specifications.
Mating connector: Phoenix #1757019

Pinout: 1-SF-A
2-SF-B

3- RELAYS 1-4
User configurable dry contact relays 1 to 4
Mating connector: Phoenix #1757116

Pinout: 1-RLY1 Normally Open
2-RLY1 Common
3-RLY1 Normally Closed
4-RLY2 Normally Open
5-RLY2 Common
6-RLY2 Normally Closed
7-RLY3 Normally Open
8-RLY3 Common
9-RLY3 Normally Closed
10-RLY4 Normally Open
11-RLY4 Common
12-RLY4 Normally Closed

4- RELAYS 5-8
User configurable dry contact relays 5 to 8
Mating connector: Phoenix #1757116

Pinout: 1-RLY5 Normally Open
2-RLY5 Common
3-RLY5 Normally Closed
4-RLY6 Normally Open
5-RLY6 Common
6-RLY6 Normally Closed
7-RLY7 Normally Open
8-RLY7 Common
9-RLY7 Normally Closed
10-RLY8 Normally Open
11-RLY8 Common
12-RLY8 Normally Closed

5-RS-485 SERIAL PORT
Isolated RS-485 serial port for SCADA communication.
Pin 1+3 and 2+4 should be shorted together to create a 2 wire half-duplex interface.
Shielded cable is recommended. Shield should be connected to ground at T301 end.
Mating connector: Phoenix #1757048

Pinout: 1-Tx +
2-Tx -
3-Rx +
4-Rx -
5-Ground

6- ANALOG OUTPUTS 1-4
User configurable analog output 1-4
Each output can be configured to drive a 4-20 mA current output or a 0 to 10 v voltage output
For current, impedance is 400 Ω max.
For voltage, impedance is 100 kΩ min.
Shielded cable is recommanded. Shield should be connected to ground at T301 end.
Mating connector: Phoenix #1757077

Pinout: 1-A1+
2-A1-
3-A2+
4-A2-
5-A3+
6-A3-
7-A4+
8-A4-

7- ANALOG OUTPUTS 5-8
User configurable analog output 5-8

Mating connector: Phoenix #1757077

Pinout: 1-A5+
2-A5-
3-A6+
4-A6-
5-A7+
6-A7-
7-A8+
8-A8-

8- GROUND POINTS
Both can be used for ground bonding and/or terminating cable shields.

IF ETHERNET OPTION IS PRESENT:

9- ETHERNET (Fiber)
Port 1 SFP 1000Base-X (Default: 1000Base-SX)

10- ETHERNET (Copper)
Port 1 RJ45 1000Base-T

The following connectors are to be used by features that offered as options on the T301. These are:

- Relays 1-8 (connectors # 3 and 4)
- Analog outputs 1-8 (connectors 6 and 7)
- Ethernet, Copper RJ45 (connector 10)
- Ethernet, SFP module, fiber (connector 9).

The small opening found on the right side of the instrument (as seen in the drawing above) reveals 2 features:

- A micro-USB connector, that can be used to connect to Rugged Connect software

- A microSD memory card slot, where a SD card can be inserted to allow for in-instrument temperature logging[1]. Reading the SD card content can only be done by removing the card from the instrument and reading it with a USB adapter on a PC computer. Data files can also be transferred to a PC via 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 T301 instrument; of course, data that might have been logged during the time the card was removed is lost.
    - If you have the Ethernet option AND have ordered from Rugged Monitoring a microSD memory card option, mirrored data logging will also be performed on the non-removable memory card present on the Ethernet board option. See section 8.3 for more information.

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

The relays 1-8 are completely general-purpose relays and are fully programmable by the user (with Rugged Connect). They are Form-C relays, with a common terminal, a no (no = normally open) terminal and a nc (nc = normally closed) terminal. Take note that these relays are forced to stay in their non-energized state for a few seconds after the T301 is powered up, during the processor boot-up time.

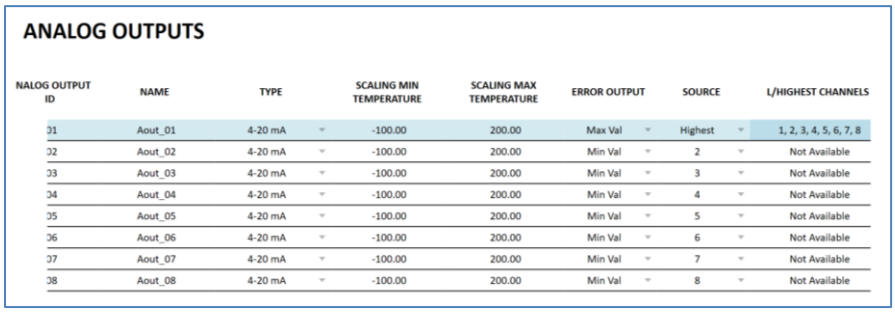
The System Fault relay is a Form-A relay (2 contacts) that is “hard-wired” and not programmable by the user. It is energized or activated when the T301 is running normally. This relay should be energized in less than one second after the T301 is powered up.

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 below. 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

[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.

4.2.2 Ethernet ports (option)

The Ethernet option is normally offered with a copper standard RJ45 connector. This option adds the following functionalities to the T301:

- Support for IEC 61850 communication protocol;
- Support for Modbus over Ethernet communication protocol;
- The IEC 60870-5-104 communication protocol (on Ethernet);
- The DNP 3.0 communication protocol (on Ethernet);
- A webserver, that can be used to program and interrogate the T301 software. It can be an alternative to the Rugged Connect software.

Ethernet fiber communication is supported by adding an SFP module. More information on SFP module can be found on Wikipedia: https://en.wikipedia.org/wiki/Small_form-factor_pluggable_transceiver.

Both Ethernet connections (RJ45 and fiber) can be used concurrently. This offers an unprecedented level of communication reliability.

4.2.3 RS-485 serial port

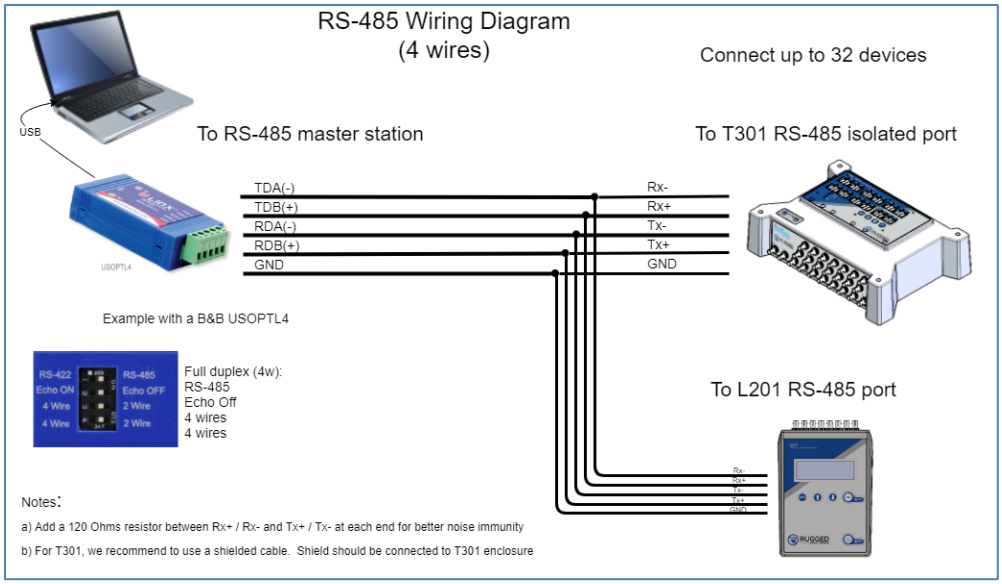
The serial RS-485 port found on the bottom of the T301 instrument is intended to be used as a slave port (Modbus, IEC 60870-5-101 or DNP 3.0). You can configure its parameters (baud rate, parity, etc.) with Rugged Connect (or webserver, if available). This port is ground insulated. The port can be configured either as a 2W configuration (half-duplex, 2 wires) or as a 4W configuration (full-duplex, 4 wires).

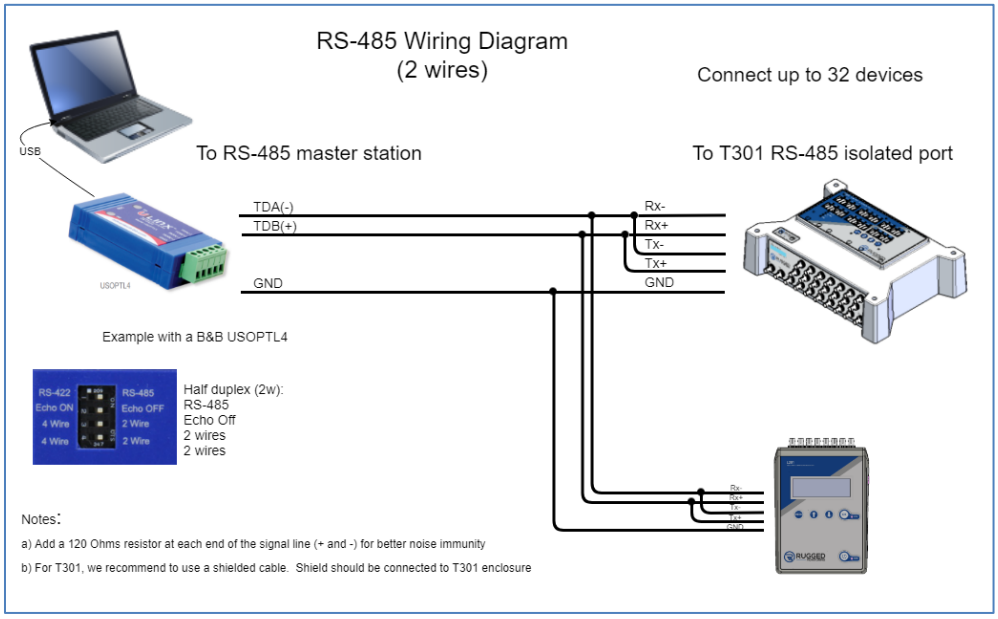
The mating connector (not included with the instrument) is Phoenix part # 1827622, or Digikey part # 277-8837-ND. Contact Rugged Monitoring for more information.

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).

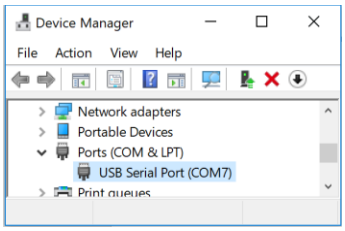




4.3 Installing the USB serial driver

This is only required if you intend to use the Rugged Connect software. The first time you connect your T301 to your PC, you should have access to the Internet; this would allow for an automatic installation of the 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.

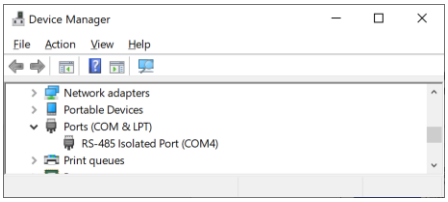
4.4 Testing your serial connection

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.

ModScan can also be sued to test Modbus over Ethernet; refer to section 7.3 for more information.

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):

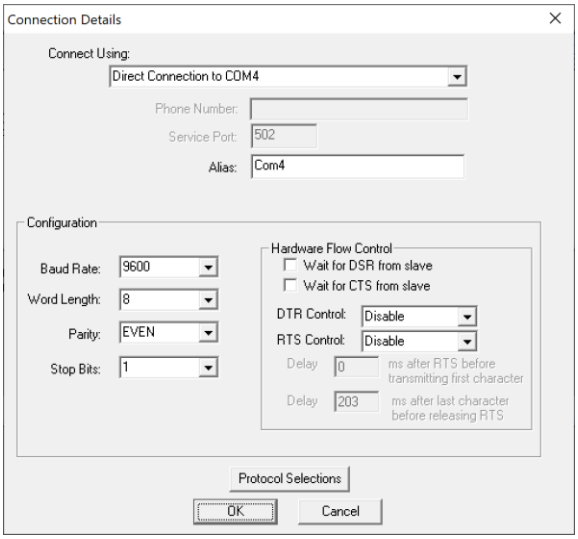


Please note that the Ports entry in the list (as shown above) will appear only if a serial port is detected by your Windows operating system. The above example confirms that the serial port is COM4; take note of this information as you will need it to connect to ModScan.

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 T301 will need 2 different serial COM port for communication:

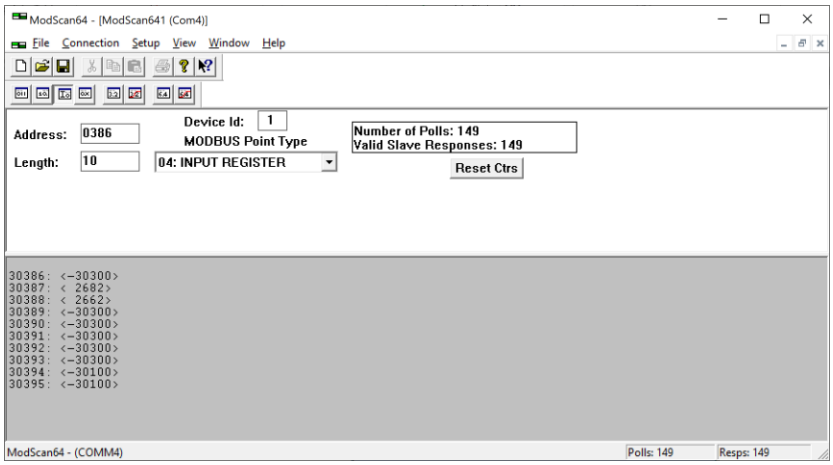
- One for USB communication (for Rugged Connect)
- One for RS-485 communication (for Modbus, or another serial protocol).

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 9 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, or you can also set it up using the front panel keys (press the Menu key 5 times, and then the OK button 4 times).
- Modbus register type. The temperature values are “Input Register” type register.
- 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 table on chapter 10 for IEC 60870-5 data structure.

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 table on chapter 11 for DNP 3.0 data structure.

4.5 Using the T301 for the first time

To make your first temperature measurements, do as follows:

- Remove the dust cap on the optical connectors of the T301 (located on the bottom of the T301).
- Remove the dust cap on the probe connectors.
- Insert each probe connector into a sensor connector on the T301. 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 T301 (24 to 48 VDC); it will turn on within a second or so. Then, a “splash” screen will display some information such as firmware version, calibration date, etc. Then the temperatures are immediately displayed, scrolling 6 channels at a time.
- Place a sensor tip on a warmer surface (such as your hand): you can observe the temperature variations on the display.

5 T301 THERMOMETER HARDWARE REFERENCE

5.1 Display and keypad description

The display can show 7 different menu screens. You can navigate from one to the next by pressing the “Menu” key. 4 keys are available to navigate through the various menu screens, as follows:

- MENU key. This allows for cycling through the menus or to return from sub-menu back to its parent menu.
- UP / DOWN arrow keys. Use these to change the value of configuration parameters, when that parameter is blinking.
- OK key. To be used to enter a specific menu, cycle through screens or cycle through configurable parameters.

Description of the 7 menu screens:

1- Temperature Menu. The default screen is the Temperature screen, where up to 6 temperature values are displayed. For instrument that have more than 6 channels, the display will automatically scroll, to display the next 6 channels, until all channels have been displayed (up to 4 scroll cycle, for 24 channels). A LED above each display window indicates which channel is being displayed.
   a. In case of a system error, an additional cycle will be added so the error message is continuously displayed; see next section
2- Info Menu. The system information menu is given in 4 steps:
   a. 1st screen: Model number and number of channels
   b. 2nd screen: Firmware version and unit serial number
   c. 3rd screen: Instrument calibration date
   d. 4th screen: Instrument self-tests results.
3- Setup Menu. The following parameters can be read and set:
   a. Date
      i. **Warning**: The T301 will lose its date and time information after about 10 days if not connected to a power source (24 to 48 VDC).
   b. Time. The T301 does not support time zone;
   c. 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;
   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. Logging enabled or disabled. Recommendation: this setting should always be set to “enabled”; then, if a microSD card in inserted in the instrument, logging will automatically start;
   f. Logging rate (on microSD card). Note: Independently, Rugged Connect can also log temperatures, and it can be set to a different logging rate.
4- Channels Menu. 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[2].
5- Signal Menu. This gives power level of each sensor is given, in percentage. Normally, for a healthy probe, the reading should be 100%. See section 5.4 for information on how to interpret this “%” reading.
6- Serial Port Menu. From here, you can configure the RS-485 serial port:
   a. Protocol selection (Modbus, DNP3, 60870)
   b. Baud rate

[2] The T301 scans continuously all enabled channels in a sequential manner. The acquisition time for each channel is about 0.1 (fixed gain, AGC off) to 0.2 to as much as 0.8 second (AGC on), which means that it takes about 5 to as much as 12 seconds to refresh all 24 channels. If you disable any unused channels, then the overall refresh rate would be faster.

c. Parity
d. Address. For the Modbus protocol, that would be the node address for this T301 instrument.

7- Ethernet Menu. Here you can read and set your Ethernet IP addresses (RJ45 and SFP). This menu is only available when the Ethernet option is present in your T301 instrument.
8- Alarms Menu. From here, you can reset all latched alarms. All alarms are reset all together; you cannot reset only one.

Take note that most parameters must be set using:

- The Rugged Connect software
- The Webserver, if you have the Ethernet card option installed on this T301 instrument.

5.2 System error

In the case when a system error is detected by the T301 internal processor, this will be displayed as an additional cycle with the temperature display. This is shown here:

The displayed error code is a hexadecimal number that can display multiple errors at the same time (individual error codes are added to form a single number code). The possible error codes are:

Code	Description
0001	Memory cannot be read
0002	Corrupted memory, fatal error
0004	Corrupted memory, default parameters to be used
0008	Invalid optical calibration
0010	Optical error with module # 1
0020	Optical error with module # 2

Optical errors (codes 0010 and 0020) can be generated at power on if an accuracy criterium is not met when 2 internal sensors are compared together (one sensor is optical, one is electronic).

5.3 How to access the logged data

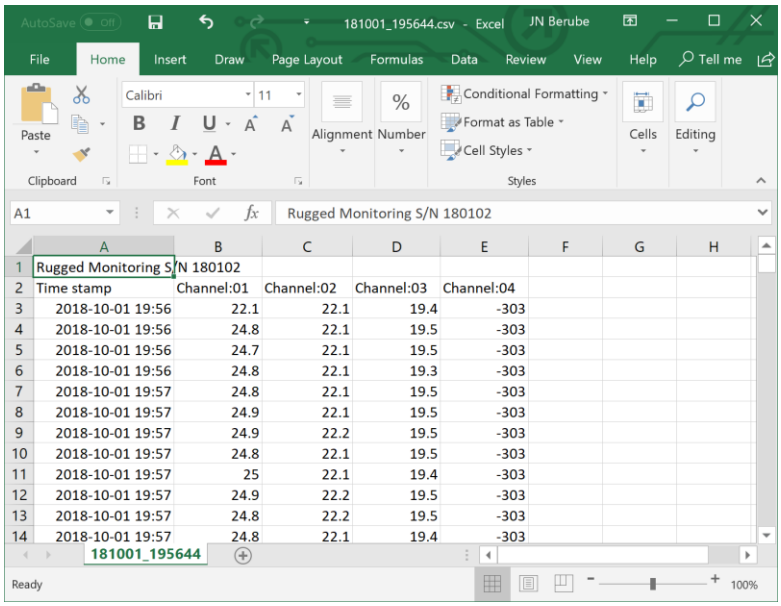
To log temperature data, a microSD card must be inserted in the card slot. This card must be formatted in FAT or exFAT, and up to 2 TB (in theory) is supported. When removing the card, it is strongly suggested to stop the logging process by pressing the “OK” button. Each time a new log is started, a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

To read the logged data, you can use one of the 3 following means:

1- You can remove the card from the T301 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.
2- Data files can be downloaded to a PC using Rugged Connect software. See section 6.4 for more details.
3- If your system was ordered with the Ethernet option and a microSD card, then you have received 2 microSD cards, and temperature logging will be performed on both (same logging rate). You can use one of the 2 above mentioned methods to download temperature logged on the removable microSD card. The temperature stored in the non-removable microSD card managed by the Ethernet option can be downloaded using the webserver. See chapter 8 for more details.

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.



	A	B	C	D	E
1	Rugged Monitoring S/N 180102				
2	Time stamp	Channel:01	Channel:02	Channel:03	Channel:04
3	2018-10-01 19:56	22.1	22.1	19.4	-303
4	2018-10-01 19:56	24.8	22.1	19.5	-303
5	2018-10-01 19:56	24.7	22.1	19.5	-303
6	2018-10-01 19:56	24.8	22.1	19.3	-303
7	2018-10-01 19:57	24.8	22.1	19.5	-303
8	2018-10-01 19:57	24.9	22.1	19.5	-303
9	2018-10-01 19:57	24.9	22.2	19.5	-303
10	2018-10-01 19:57	24.8	22.1	19.5	-303
11	2018-10-01 19:57	25	22.1	19.4	-303
12	2018-10-01 19:57	24.9	22.2	19.5	-303
13	2018-10-01 19:57	24.8	22.2	19.5	-303
14	2018-10-01 19:57	24.8	22.1	19.4	-303

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.

5.4 Interpretation of "%" results

The T301 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, by clicking the "Menu" button 4 times, until you reach the "Signal" menu.
2- With Rugged Connect, by selecting the "Temperature Table" tab. See section 6.2.
3- With the webserver, if this option is available on this T301 (with the Ethernet module option).
4- It can also be read using the Modbus and IEC 61850 protocols, and some other protocols.

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

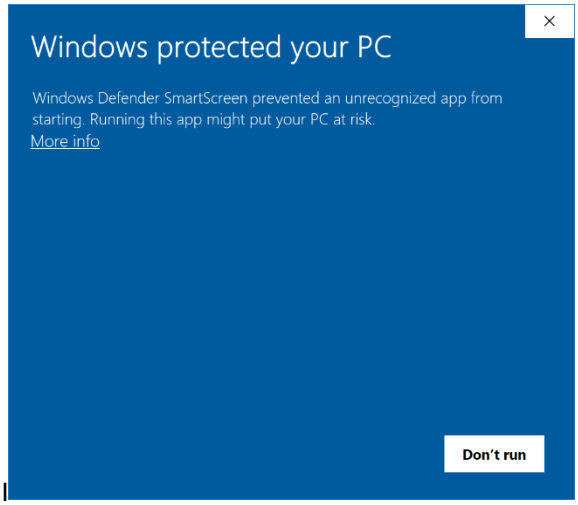
Rugged Connect (RC) is particularly interesting for T301 users as it provides a convenient complement to how instrument parameters are controlled and how temperature data is acquired. It offers a friendlier procedure to load various parameters, such as optical channel and relay parameters that would otherwise require being set by hand using the instrument panel. The goals and purposes of this software packages are as follows:

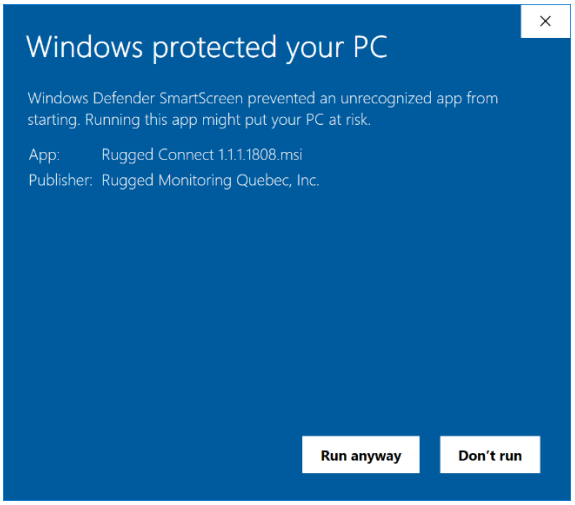
- Display temperature information, for up to a total of 64 channels, from up to 6 compatible instruments (L201 and T301)
    - Can provide results in graphical form
    - Can log temperatures to a Windows file, independently from the logging feature found on the instrument itself
- Initialize and manage 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”.





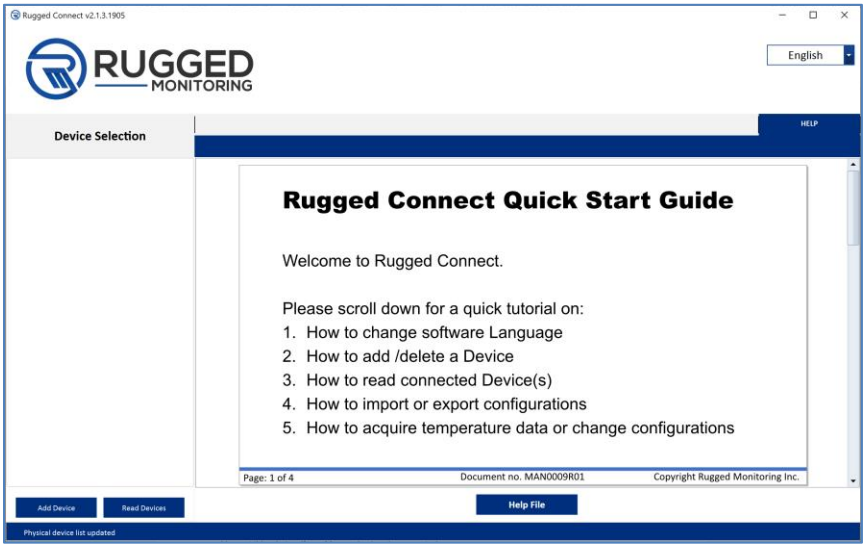
When you connect the T301 for the first time to your computer, a driver will be installed; this procedure is described at the beginning of Chapter 4.3 above and is not repeated here.

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

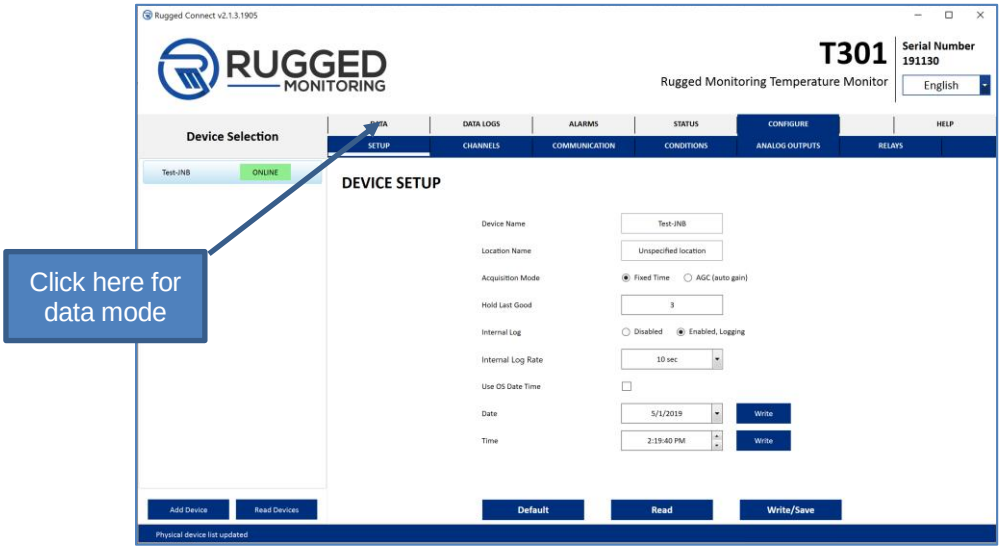
Warning: To reinstall the software, or install a new version, you will need to first uninstall the older version. This must be done by using the “Programs and Features”, found in Windows Control Panel.

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[3]:



You get this window if one T301 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

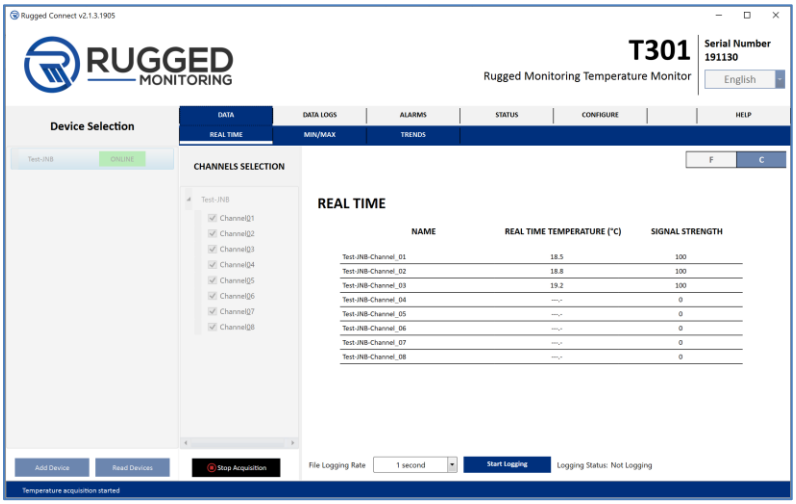
- Configuration mode; here you can configure your selected instrument (only one at a time).

These 2 modes of operation are explained below.

[3] Most screenshots presented in this chapter show the L201 logo; however, these screenshots are also applicable to the T301 product. Please ignore these logos, if you are using the T301 instrument.

6.2 Data mode (temperature acquisition)

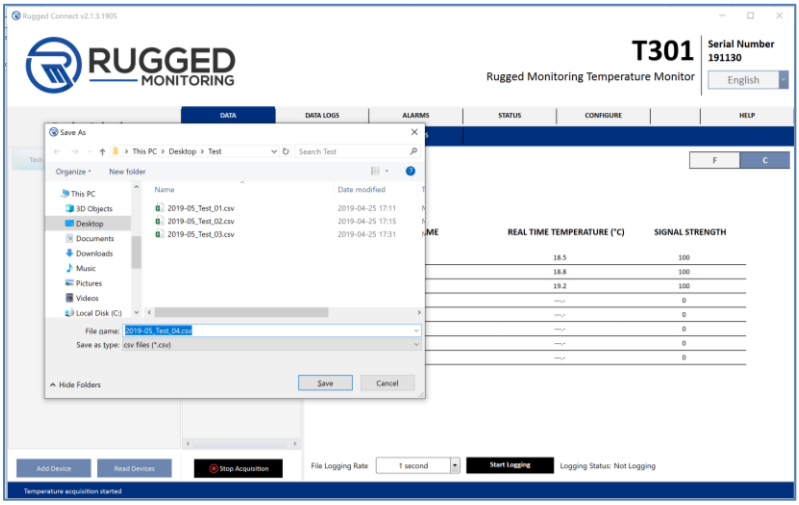
By clicking on DATA (from the top menu bar, at left) as shown above, your instrument will be in data mode whereby it will continuously acquire temperature data from all connected instruments. This is shown here (6-channel single instrument, with only 3 probes):



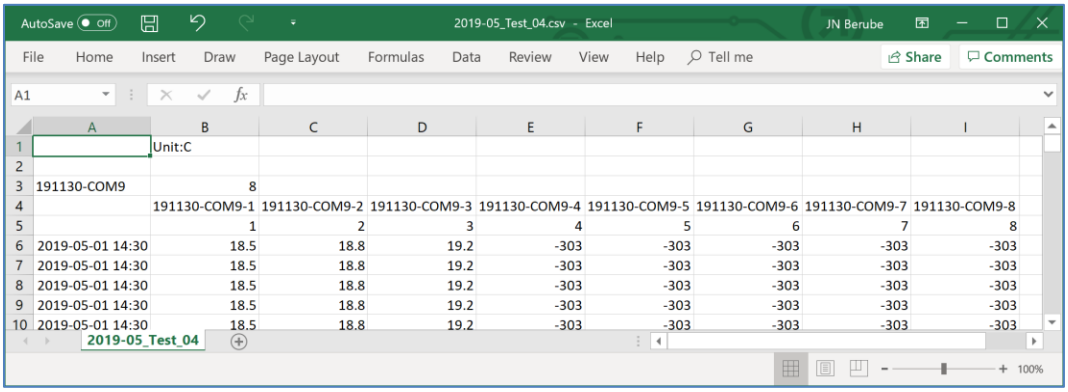
This window shows all temperatures in number format (°C or °F); signal strength (%) is also given for each channel. If select from the menu either MIN/MAX or TRENDS, you can see the same data presented in different ways including in graphical form.

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:

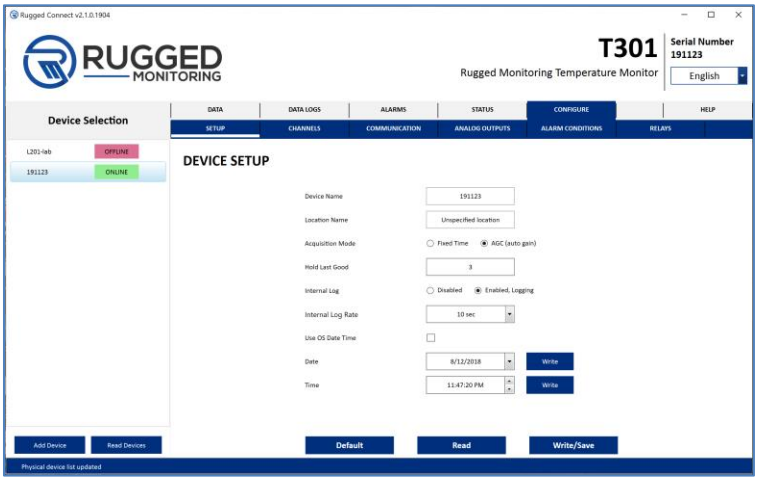


The file format is a .csv tab-delimited file that can easily be read by Excel, as shown here:



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:



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.

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 Data mode where all temperatures from all connected instruments can be displayed.

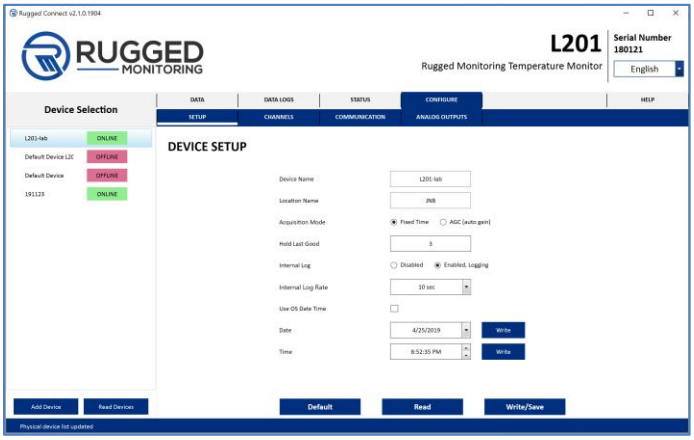
As part of configuring your instrument, you can select other tabs, to configure other parameters, such as the analog outputs (if this option is available on your instrument). The most important are described here; for the other parameters, they should be easy to understand.

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 mode is recommended for installations where you are dealing with probes that may have weaker signals, such as when using extension cables and feedthroughs (typically for transformer applications). ..

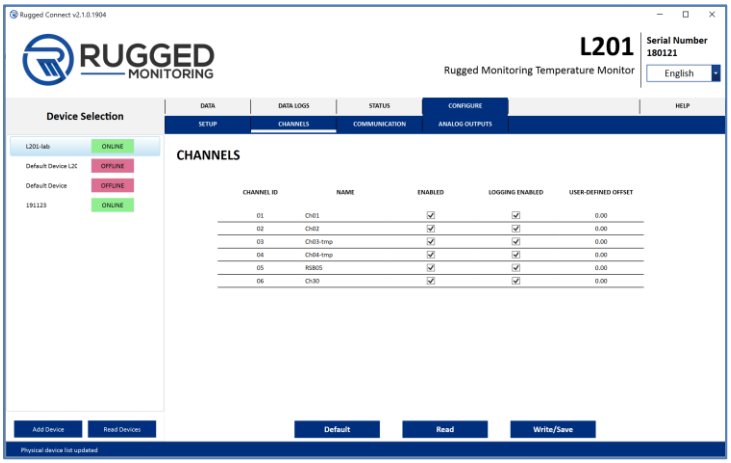
2- Hold Last Good. This indicates the number of “holds” since the last good reading. Normally, a value of “0” should be appropriate, unless you are using probes with weak signal, in which case it could avoid a probe from alternating from “no reading” to “reading”. In other words, this represents the 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 T301 will lose its date and time information after about 10 days if not connected to a 24-48 VDC 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.

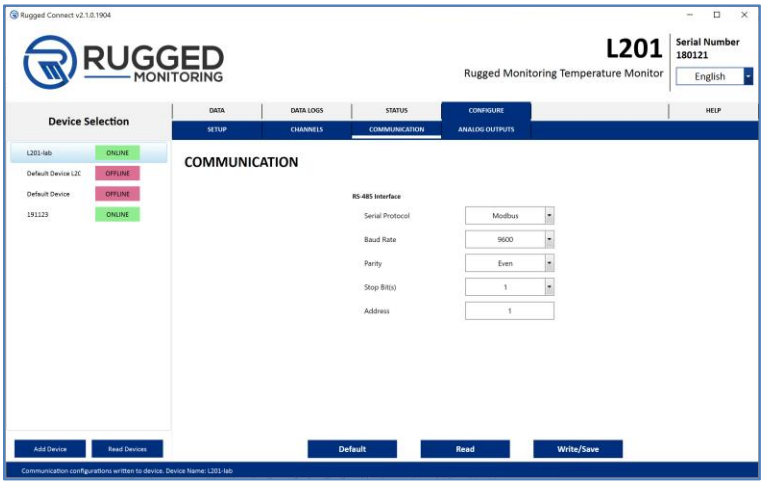


6.3.3 COMMUNICATION tab

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 9 includes a description of the Modbus registers.
3- IEC 60870-5-101. Chapter 10 gives all required information about the data structure for IEC 60870.
4- DNP 3.0. See chapter 11 for detailed information about this protocol.

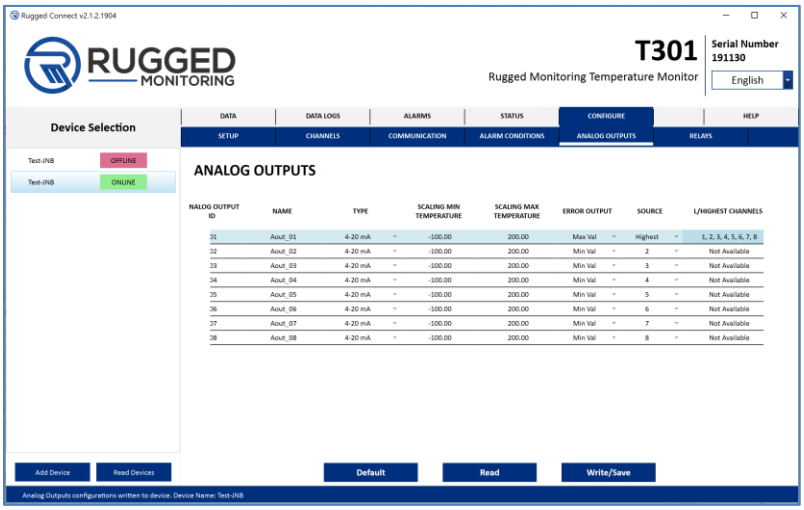
Once you have selected a protocol, you can change the baud rate, parity, stop bits and node address to communicate with your master device.



6.3.4 ANALOG OUTPUTS tab

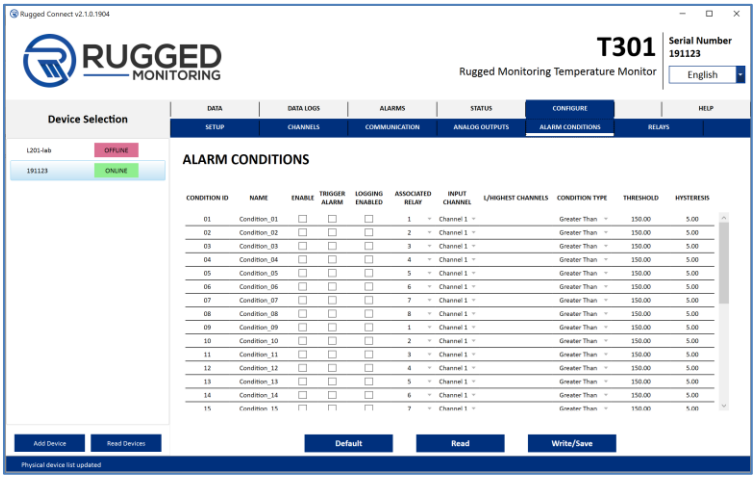
This tab allows for setting the behavior of the 8 analog outputs normally found on a T301 (this option may not be present on your specific instrument). The outputs are highly flexible and completely programmable; for example, you can assign many optical channels to a single output, and this output will 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 T301 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 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).

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.

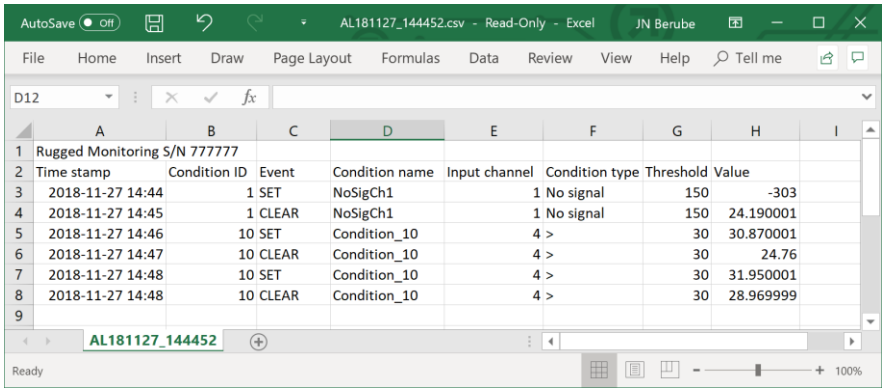
Detailed explanations of each column:

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:

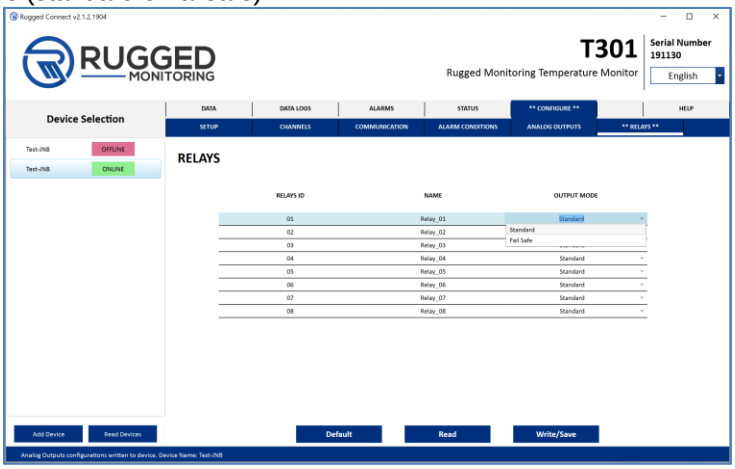
1- An activated condition will generate 2 entries in the file: first, when the condition becomes active and, second, when this condition disappears.
2- Value. Temperature value at time of condition trigger.

6.3.6 RELAYS tab

This tab is useful for doing these 2 things:

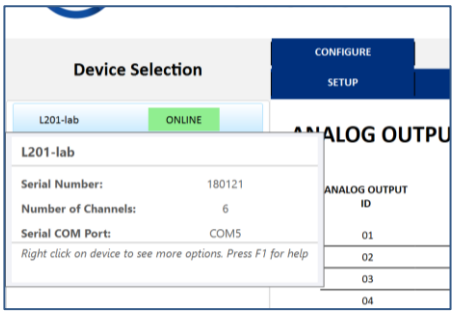
1- You can give names to the eight relays
2- You can set to relays to operate in failsafe mode. If you intend to use some relays in failsafe mode, this information should be useful for you:
   a. When the T301 is turned on, it will take 1 to 2 seconds before the failsafe relays are activated
   b. If you intend to use the relays in failsafe mode, your electrical design must be done in consequence. Logically speaking, your design will be different depending on the mode you want to use (standard or failsafe).

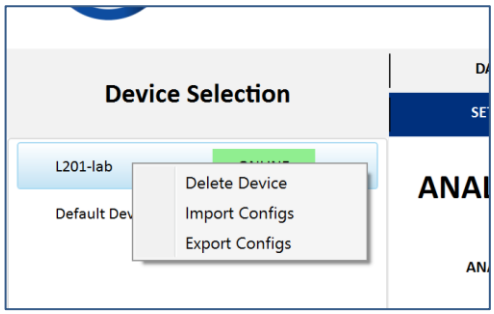
3-



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: :



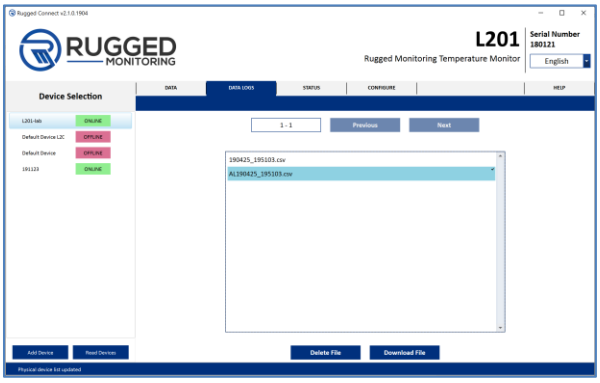


From here, you can click on Import or Export Configs. The Export function can be useful if you intend to configure multiple instruments with the same configuration.

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 Alarm management

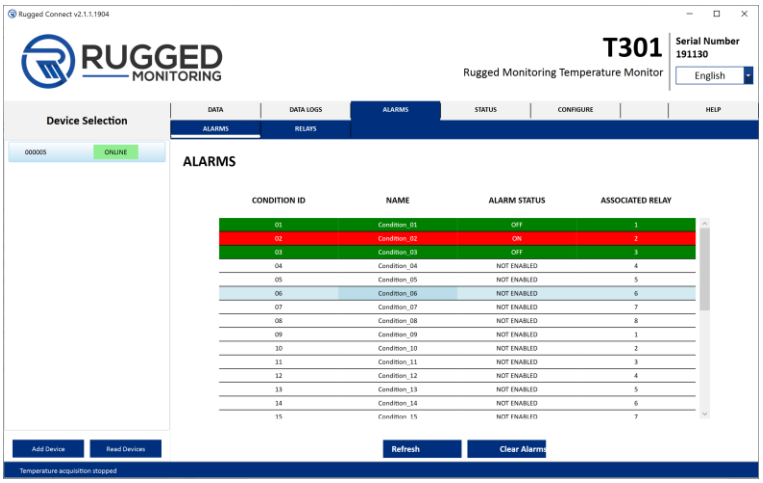
Rugged Connect includes a few windows that gives the user information about the presence of any active alarms. You need to select the ALARMS tab and then ALARMS again. You get the alarm information as follows (there is one line for each of the 32 conditions):

- The line is shown in green if no alarm is latched for this condition
- The line is red if an alarm is present for this condition.

Alarms are latched in the T301 instrument. To clear them, you can either:

- Click the Clear Alarms button found at the bottom of this window. This will only clear the alarms in Rugged Connect
- You can also select the ALARM menu on the instrument front panel (click a few times on the MENU button until you see ALARM on the display, then click OK twice to reset any pending alarms. This will also turn off the alarm LED on the front panel. Take note that the alarm active mode can immediately come back if the condition that cause an alarm is not resolved.

Both actions will clear ALL alarms that are active (one cannot clear a single alarm condition).

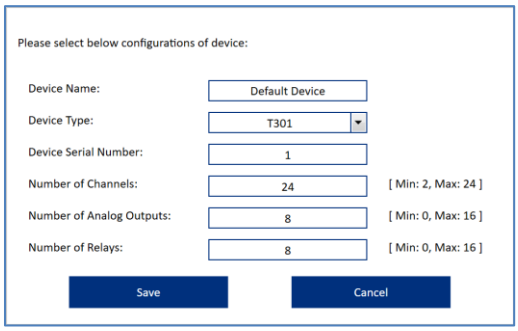


The status of the relays (if you have this option)

6.6 Offline configurations

Rugged Connect allows you to create offline configurations, i.e. configurations for instruments that are not connected to your PC (these can also be called virtual configurations). 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”.

6.7 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)
- Upgrade firmware code file (from Rugged Monitoring).
- To force the T301 in upgrade mode, you must power it off, and then turn it on again while holding down the 2 arrow keys (on the front panel).

Information: This procedure will only upgrade the base T301 processor system. If you have the Ethernet option installed, then this option will need to be upgraded using the RMAdmin utility; see section 7.2 for more information.

7 ETHERNET COMMUNICATION PROTOCOLS

When the Ethernet option is included with your T301 instrument, the following capabilities are added to your T301:

- IEC 61850 communication protocol
- DNP 3.0, IEC 60870-5 and Modbus over Ethernet communication protocols
- Webserver (see new Chapter).

7.1 Connecting to the Ethernet port

One of the first thing you will need to do is to connect your PC to your T301 Ethernet port. This can be done in two ways:

1- Using a static IP address. In this situation you must configure both your T301 and your PC Ethernet interface to work with a fixed IP address scheme. This would be a private network. For more information about IP addresses, contact your local network administrator; Wikipedia can also be a good source of information, see https://en.wikipedia.org/wiki/IP_address.

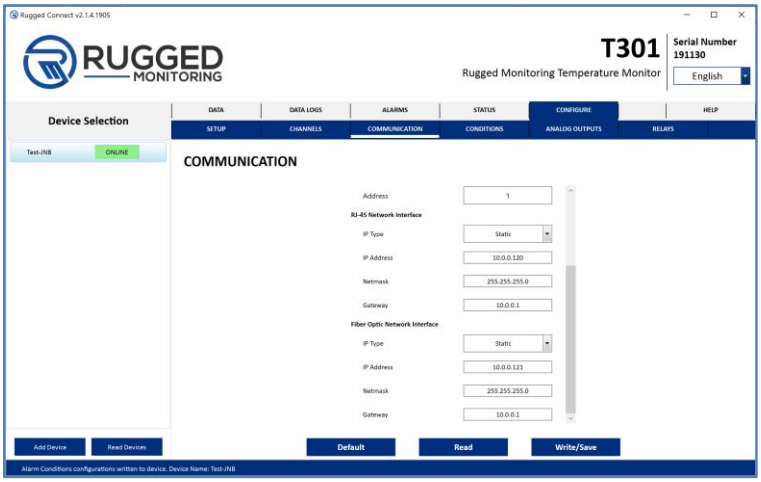
2- Using a dynamic IP address. You should select this type of communication when you want to connect your T301 to your laboratory or office network. These networks have a DHCP server that would automatically allocate an IP address to your T301 when you turn it on.

7.1.1 Fixed IP address

We cover the case of network connection using a fixed IP address first; this is the most complicated of the 2, but it would also be the most common situation as usually users would connect to their T301 through a direct connection between an Ethernet port on their PC, and not through an office open network.

The procedure described here can be applied to both Ethernet interface found on your T301 (RJ45 and fiber); however, only the RJ45 procedure is given here, as the second one is essentially similar.

The easiest way to know and change the value of your IP addresses is by using Rugged Connect; select the CONFIGURE function from the menu bar and then COMMUNICATION; you get the following information.

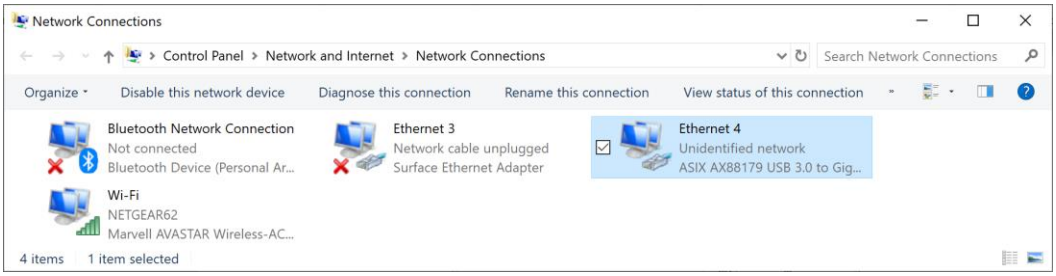


Here you can set the IP address, and related parameters; by default, the IP address is 10.0.0.120. We strongly suggest you select an address in the range of 10.0.0.xxx, Netmask 255.255.255.0 and Gateway 10.0.0.1. You can do this both for the RJ45 port and the fiber SFP port (assuming you have this option available).

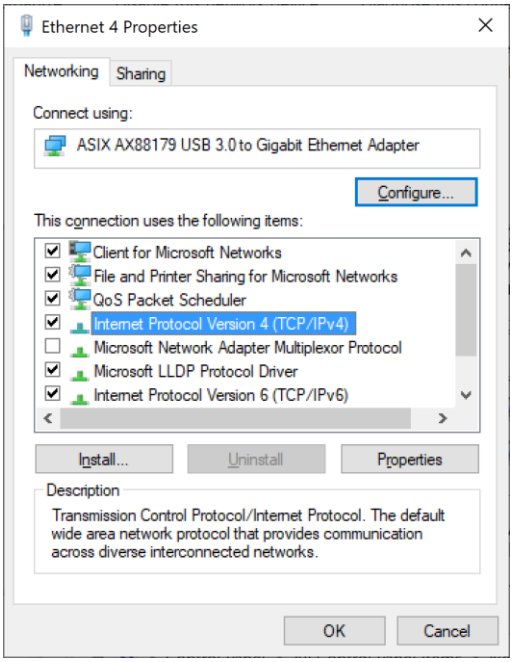
If you change any parameters, do not forget to click the Write/Save button, so they are saved in your instrument. With this version of Rugged Connect, you will need to power down the T301 for a few seconds and then to power it on again, to ensure the new parameters become active. Consider that the booting time of the Ethernet board is about 15 seconds.

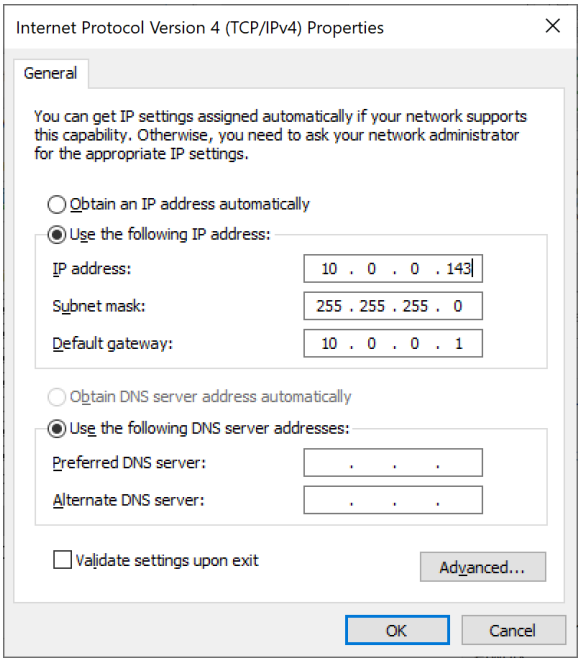
See Wikipedia https://en.wikipedia.org/wiki/Private_network, for a discussion on IP address selection.

The second step of this procedure consists in setting up your PC to work with an Ethernet port, to configure it to use a fixed IP address, as PCs are normally configured to work with DHCP servers. To start this, you need to open this window (from "Setting", then "Network and Internet", then "Network and Sharing Center", and finally "Change adapter settings"):



Next right click when your mouse is highlighting the Ethernet interface you want to use for communication with your T301, and then select "Properties". The following window appears; highlight "Internet Protocol Version 4 (TCP/IPv4)":



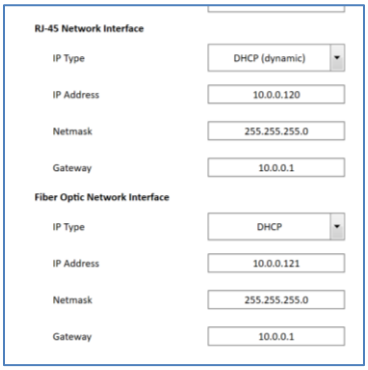


Click the "Properties" button, and the window shown at right above will appear. Here you should enter the IP address, subnet mask and Default gateway values: the values given above are good values to start with. Note that the IP address for your PC MUST be different than all addresses selected for all T301 that you intend to connect. Close all windows.

You are done. To test your communication, try to connect to the webserver, described in chapter 8.

7.1.2 Dynamic IP address (with DHCP server)

To configure your T301 to work with a dynamic IP address (also referred to the use of a DHCP server, see https://en.wikipedia.org/wiki/Dynamic_Host_Configuration_Protocol for more information), you need to select DHCP in the COMMUNICATION menu of Rugged Connect (shown below). Click Write/Save to update the T301 internal information. Wait a few seconds, and then you should power off the T301 for a few seconds and then turn it on again and wait about 15 seconds. Consider that the booting time of the Ethernet board is about 15 seconds.

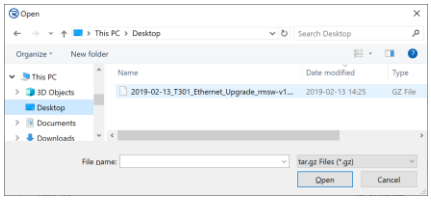


After about 15 seconds, you can read (click Read) to confirm that your new parameters are active and also most important, you can now know your new IP address. You can also know the new IP address from the instrument front panel: click the MENU button 6 times, to go to the Ethernet menu, and then click OK; the IP address will be displayed.

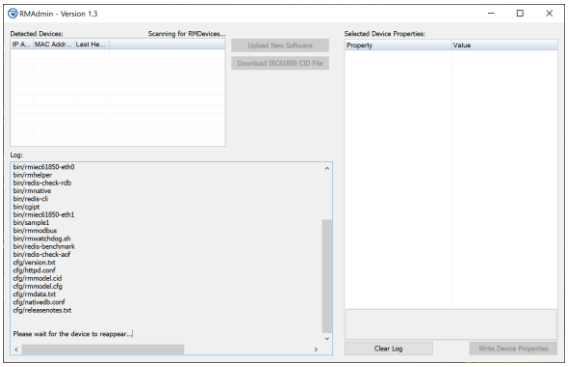
You are done. To test your communication, try to connect to the webserver, described in chapter 8.

7.2 Upgrading Ethernet option firmware

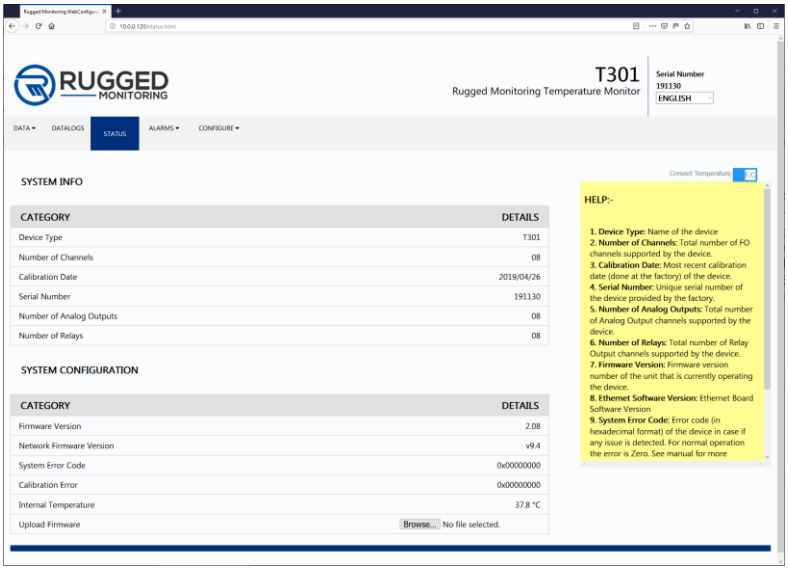
If a firmware upgrade for the Ethernet option is required, this must be done separately from the base T301 system; see section 6.7. The 2 upgrades are independent from each other. For the upgrade of the base firmware, refer to section 6.7. You will need to get a firmware file before proceeding to the upgrade; contact Rugged Monitoring Support to get this file; you will also need the RMAdmin utility, available from Rugged Monitoring as well. Then, you can upload this firmware file using the Upgrade New Software button found on the RMAdmin utility. Once you have selected your upgrade file, click Open.



The upgrade process will take at least 2 minutes. Be patient, and do not interrupt the process. If it fails, it is very likely that the instrument will need to return to Rugged Monitoring. During the upgrade process, you will get this window; when you get this, the upgrade is still progressing… wait a bit more, until RMAdmin finds your T301 again.



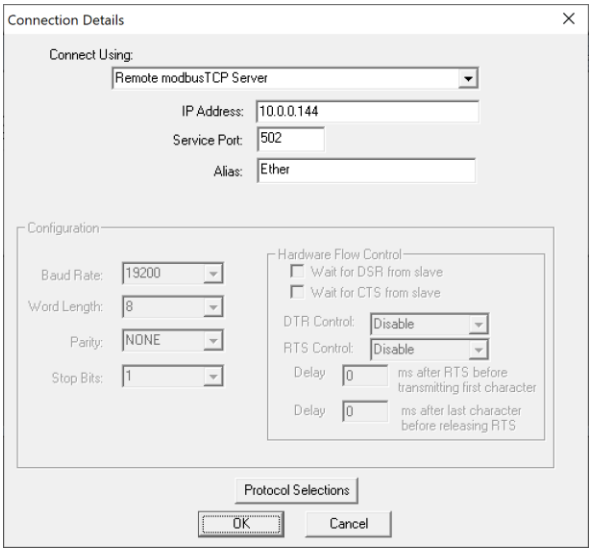
In a future release of the webserver, it will be possible to upgrade the Ethernet board firmware via the webserver; contact Rugged Monitoring for more information. The upgrade should be available from this web page, shown below.



7.3 How to use ModScan to exercise your Modbus connection

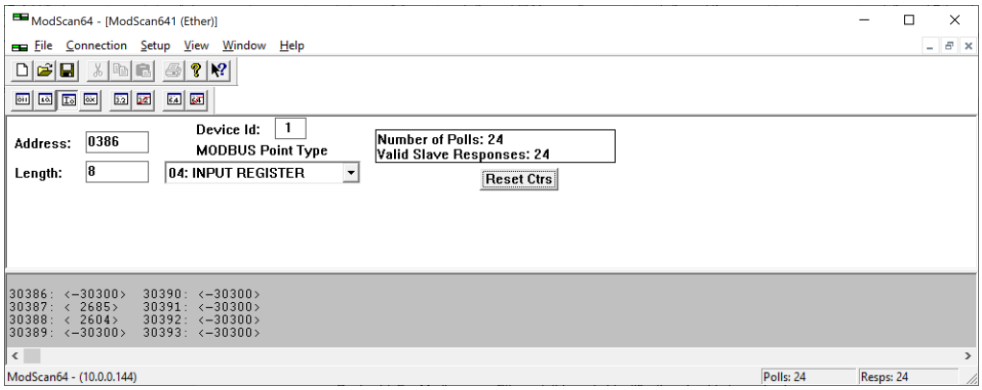
ModScan can be a very useful tool to exercise your Ethernet Modbus connection. Please note that using ModScan is only a suggestion; there exists other solutions in the market and you are free to use them as you wish. You can download it from here: https://www.win-tech.com/html/demos.htm; it can be used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

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



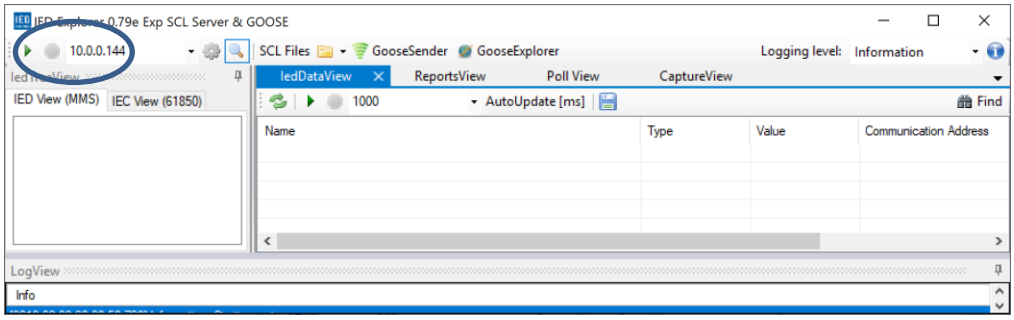
The following window appears. In this example, we are displaying 8 temperature values; to do this, make sure these parameters are set correctly:

- Address. The address for temperature Channel # 1 is hex 0181 (see Chapter 9 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. For Modbus over Ethernet, this node identification should always be 1.
- Modbus register type. The temperature values are “Input Register” type register.
- 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 that only channels 2 and 3 had probes corrected in this example.

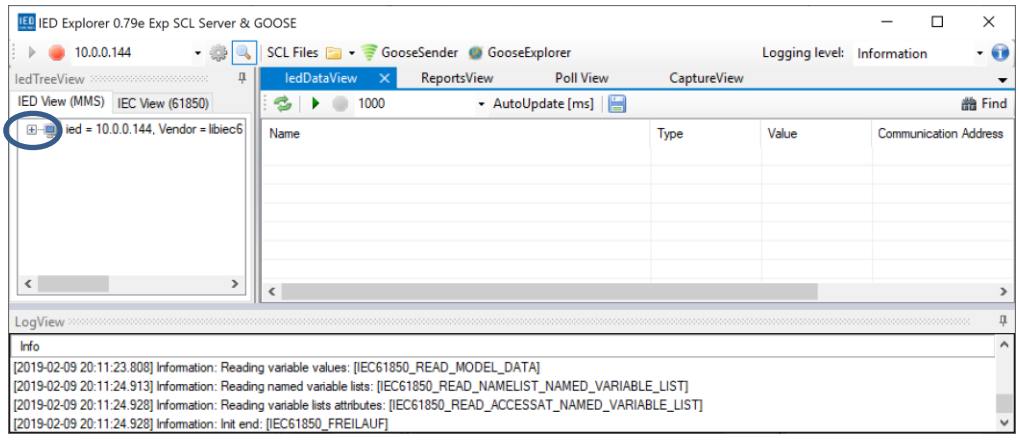


7.4 Using the IED Explorer tool (freeware)

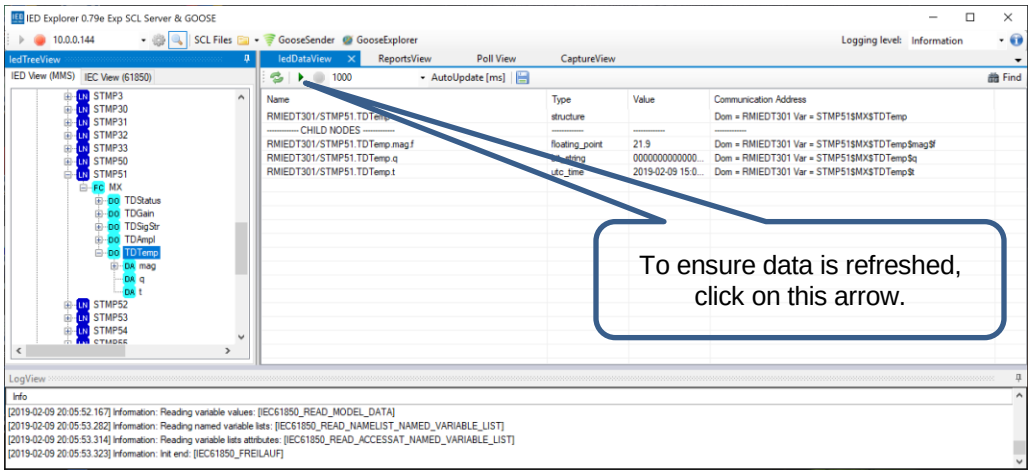
IED Explorer can be a very useful tool to exercise your Ethernet IEC 61850 protocol. Please note that using IED Explorer is only a suggestion; there exists other solutions in the market and you are free to use them as you wish. You can download a free copy from here: https://sourceforge.net/projects/iedexplorer/. At time of this writing, it is version 0.79e. When you try to install it in Win-10, and if you get the same warning as when installing Rugged Connect, please follow the same recommendations as outlined in section 6.1. IED Explorer does not require any installation, as it is a portable program. You get the following window:



In the text box found near the top-left corner, enter the IP address of your instrument (10.0.0.144, in this example), and click the arrow found just to the left of this text box, as shown in the above window. This will start the connection process to your instrument, and you should get this updated window:



You can view the parameter values by expanding the list, by clicking on the "+" sign found in the left pane; then you can scroll down to parameters that you want to see, such as the temperature values read by your T301 instrument. The CID file will give you information about the data structure of your system; instructions on how to download this file are given in section 8.2. The parameter name for accessing the temperature value for optical channel # 2 is STMP51, this is illustrated in the screenshot found below. Take note that you also have access to other parameters associated to channel # 1, such as its signal strength.



The IED Explorer tool is an incomplete tool, just it can still be very useful for the following functions:

- Inspect MMS variables in the tree structure

- Read values
- Create or delete variable lists
- Activate and read un/buffered reports
- Read directories and files (e.g. for COMTRADE protection event records)
- Capture MMS packets.

8 WEBSERVER (WITH ETHERNET OPTION)

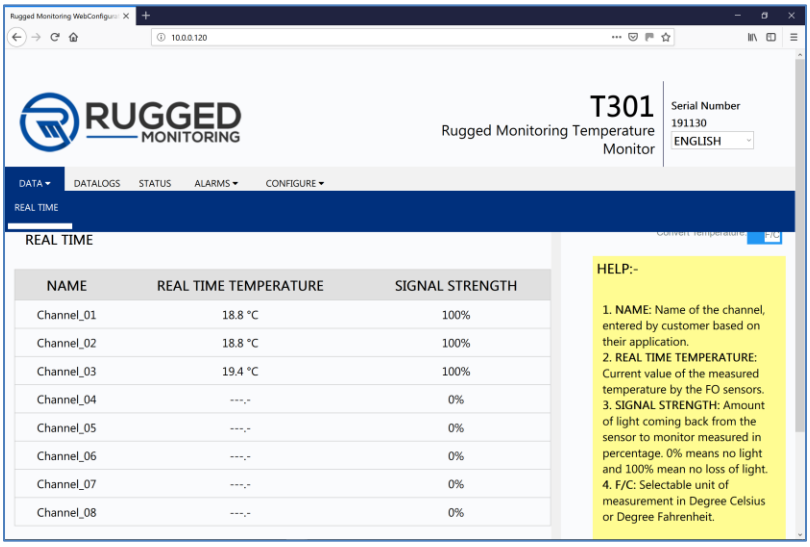
If your T301 instrument is fitted with the ethernet option, you have access to a built-in webserver; this is in addition to the smart protocols also available using the Ethernet port (IEC 61850, Modbus over Ethernet, IEC 60870-5-104 and DNP 3.0). The webserver allows you to communicate with the T301 using most commercially available internet browsers.

If your T301 is also fitted with a fiber optic SFP plug-in module, you will be able to communicate with either Ethernet port (fiber or RJ45). These 2 ports are redundant and can be used simultaneously, with 2 browsers.

8.1 Connecting your PC to the webserver

First, you must connect your PC to the T301. This requires that you define an IP address (or 2 IP addresses, if you are using both Ethernet connections) for the T301. You can find the current IP addresses of your instrument by running the Rugged Connect application, as described in section 7.1 above; the keypad (see section 5.1) allows you also to change this address to your liking.

Once you know your IP address, simply enter it in your favorite browser, such as Google Chrome, Firefox or Internet Explorer (the examples given in this manual were done with Firefox). Enter your instrument IP address into the URL address bar (typically 10.0.0.120), as shown here:



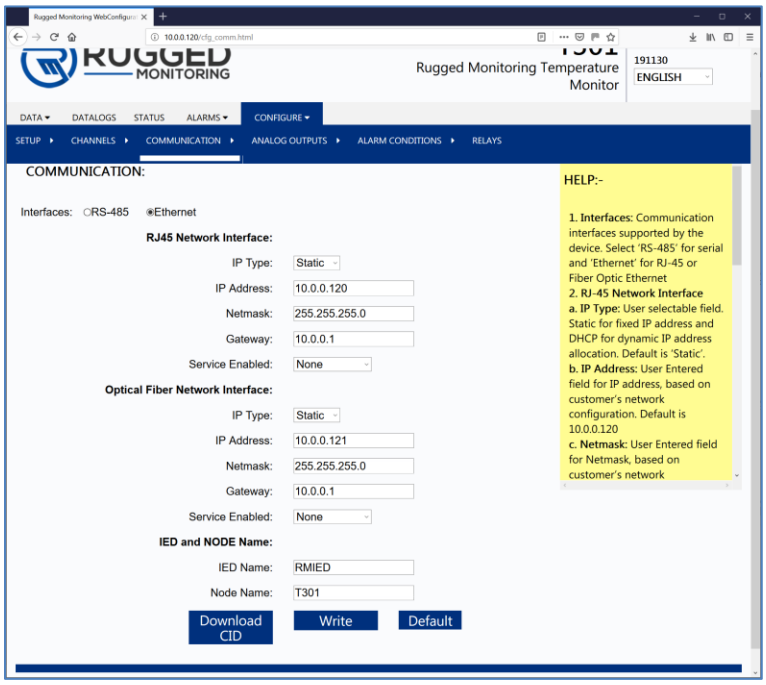
On this first page, you can see the temperature values and their corresponding signal strength (%). If you have used Rugged Connect, you will immediately notice that the T301 webserver is very similar to Rugged Connect.

The presentation structure of the information given by the webserver is essentially like the structure of the Rugged Connect software (see chapter 6). It is not repeated here, except for features that are unique to the webserver. These are:

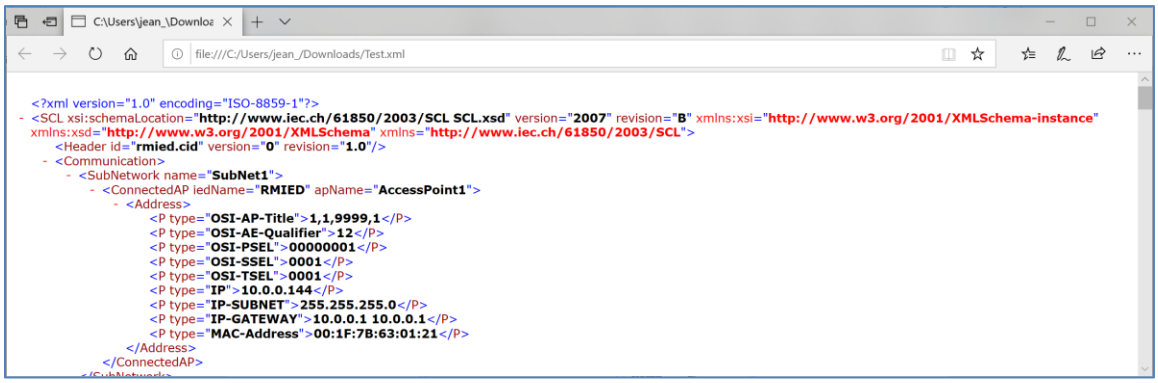
- CID file download; see section 8.2.
- Firmware upgrade; see section7.2.
- Realtime graphing is not available with the webserver.
- Data logging is performed in the non-removable internal memory card (option must be ordered at the same time as system, as it cannot be installed by the user). When downloading data from the web, data will be downloaded from that internal memory. See section 8.3 for more information.

8.2 Downloading the IEC 61850 CID file

You can download the CID file using the webserver. Select the CONFIGURE menu, and then COMMUNICATION. The DOWNLOAD CID file button is at the bottom of this web page, as shown here.



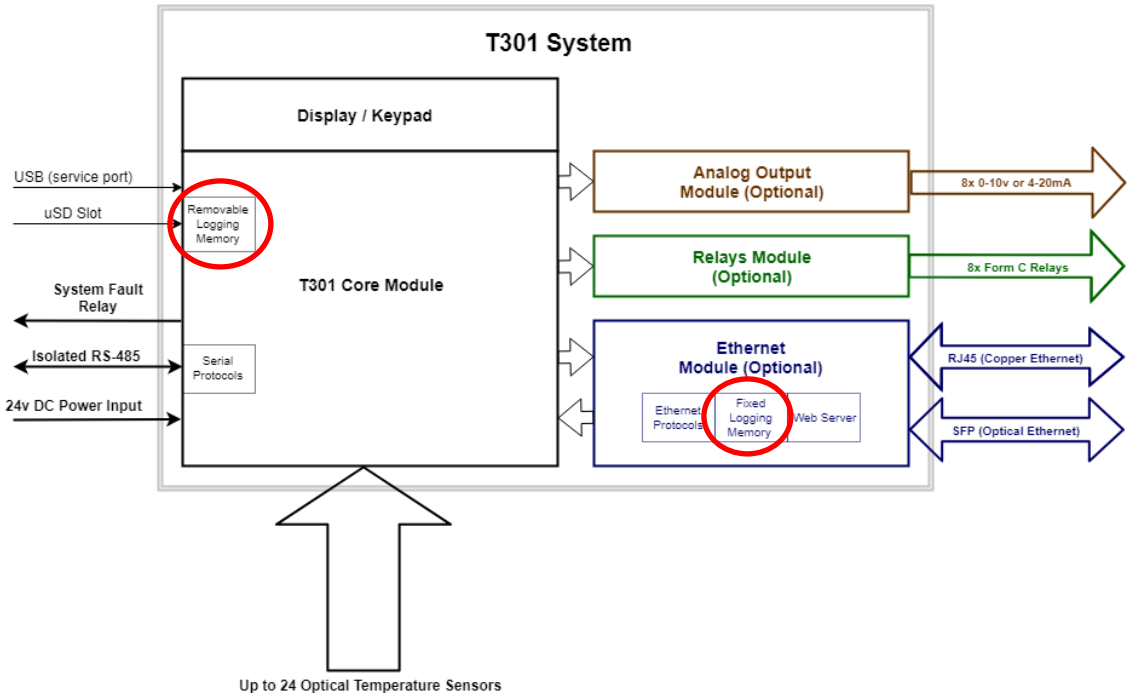
To make it easier to read this cid file, it might be a good idea to change it extension from .cid to .xml; a sample is shown here:



8.3 Data logging with the Ethernet option

The following schematic will help you understand how data logging is performed in the T301 instrument when a microSD memory card was ordered from Rugged Monitoring. If the logging process is started (either from the front panel, from the webserver or Rugged Connect), the same temperature data will be saved both in the removable microSD card controlled by the base (or core) processor and in the non-removable memory card controlled by the Ethernet processor. Logging rate is always the same for both boards.

Both logging memories are shown in the schematic with red circles.



9 MODBUS REGISTER TABLE

This chapter gives a description of the Modbus registers included in the T301 instrument. If you want to connect to the T301 using the serial RS-485 port or if you want to connect using the Modbus over the Ethernet protocol, you will need this information.

1 Function code: 0x01 Read Coils Read only

1.1 System Info Factory_struct

Reg Address	Name	Description	1 bit	Encoding
0x0000	Relay1	Relay 1 state (given after Failsafe [0x400] consideration)		0 = de-energized; 1 = energized
0x0001	Relay2	Relay 2 state (given after Failsafe [0x410] consideration)		0 = de-energized; 1 = energized
0x0002	Relay3	Relay 3 state (given after Failsafe [0x420] consideration)		0 = de-energized; 1 = energized
0x0003	Relay4	Relay 4 state (given after Failsafe [0x430] consideration)		0 = de-energized; 1 = energized
0x0004	Relay5	Relay 5 state (given after Failsafe [0x440] consideration)		0 = de-energized; 1 = energized
0x0005	Relay6	Relay 6 state (given after Failsafe [0x450] consideration)		0 = de-energized; 1 = energized
0x0006	Relay7	Relay 7 state (given after Failsafe [0x460] consideration)		0 = de-energized; 1 = energized
0x0007	Relay8	Relay 8 state (given after Failsafe [0x470] consideration)		0 = de-energized; 1 = energized

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 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; 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*
0x0190-0x019F	…	Channel 09	**…**	*Same as Channel 01 structure*
0x01A0-0x01AF	…	Channel 10	**…**	*Same as Channel 01 structure*
0x01B0-0x01BF	…	Channel 11	**…**	*Same as Channel 01 structure*
0x01C0-0x01CF	…	Channel 12	**…**	*Same as Channel 01 structure*
0x01D0-0x01DF	…	Channel 13	**…**	*Same as Channel 01 structure*
0x01E0-0x01EF	…	Channel 14	**…**	*Same as Channel 01 structure*
0x01F0-0x01FF	…	Channel 15	**…**	*Same as Channel 01 structure*
0x0200-0x020F	…	Channel 16	**…**	*Same as Channel 01 structure*
0x0210-0x021F	…	Channel 17	**…**	*Same as Channel 01 structure*
0x0220-0x022F	…	Channel 18	**…**	*Same as Channel 01 structure*
0x0230-0x023F	…	Channel 19	**…**	*Same as Channel 01 structure*
0x0240-0x024F	…	Channel 20	**…**	*Same as Channel 01 structure*
0x0250-0x025F	…	Channel 21	**…**	*Same as Channel 01 structure*
0x0260-0x026F	…	Channel 22	**…**	*Same as Channel 01 structure*
0x0270-0x027F	…	Channel 23	**…**	*Same as Channel 01 structure*
0x0280-0x028F	…	Channel 24	**…**	*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 val; 1 = max val; 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 val; 1 = max val; 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*

2.5 Relays **Relay_struct**

Reg Address	Name	Description	16 bits	Encoding
0x0400	R01_FailSafe	Relay 01 Reverse logic	Unsigned	Define: 0 = Default; 1 = De-Energized if active
0x0401-0x0408	R01_Name	Relay 01 Name	Unsigned	16 bytes long string
0x0409-0x040F	R01_Reserved	*Reserved for Future use*	Unsigned	Set to 0x0000
0x0410-0x041F	…	Relay 02	…	…
0x0420-0x042F	…	Relay 03	…	…
0x0430-0x043F	…	Relay 04	…	…
0x0440-0x044F	…	Relay 05	…	…
0x0450-0x045F	…	Relay 06	…	…
0x0460-0x046F	…	Relay 07	…	…
0x0470	R08_FailSafe	Relay 08 Reverse logic	Unsigned	Define: 0 = Default; 1 = De-Energized if active
0x0471-0x0478	R08_Name	Relay 08 Name	Unsigned	16 bytes long string
0x0479-0x047F	*R08_Reserved*	*Reserved for Future use*	*Unsigned*	*Set to 0x0000*
0x0480-0x04FF	*RFU*	*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*

2.8 Device Ethernet Config

Reg Address	Name	Description	16 bits	Encoding
0x0A00-0x0A03	ETH0 IP	Device Eth0 IP address (RJ45)	Unsigned	IP [0].[1].[2].[3]
0x0A04-0x0A07	ETH0 SubnetMask	Eth0 Subnet mask	Unsigned	IP [0].[1].[2].[3]
0x0A08-0x0A0B	ETH0 Gateway	Eth0 Gateway	Unsigned	IP [0].[1].[2].[3]
0x0A0C-0x0A0F	ETH0 DNS	Eth0 DNS server	Unsigned	IP [0].[1].[2].[3]
0x0A10	ETH0 Config	Eth0 port configuration bits	Unsigned	
0x0A11	ETH0 EnabledServices	Eth0 Services enabled	Unsigned	
0x0A12-0x0A1F	*ETH0 Reserved*	*Eth0 Reserved for Future use*	*Unsigned*	*Set to 0x0000*
0x0A20-0x0A23	ETH1 IP	Device ETH1 IP address (Fiber)	Unsigned	IP [0].[1].[2].[3]
0x0A24-0x0A27	ETH1 SubnetMask	Eth1 Subnet mask	Unsigned	IP [0].[1].[2].[3]
0x0A28-0x0A2B	ETH1 Gateway	Eth1 Gateway	Unsigned	IP [0].[1].[2].[3]
0x0A2C-0x0A2F	ETH1 DNS	Eth1 DNS server	Unsigned	IP [0].[1].[2].[3]
0x0A30	ETH1 Config	Eth1 port configuration bits	Unsigned	
0x0A31	ETH1 EnabledServices	Eth1 Services enabled	Unsigned	
0x0A32-0x0A3F	*ETH1 Reserved*	*Eth1 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 rDData_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	…
0x0109	CH09_Status	Channel 09 Current status	Unsigned	…
0x010A	CH10_Status	Channel 10 Current status	Unsigned	…
0x010B	CH11_Status	Channel 11 Current status	Unsigned	…
0x010C	CH12_Status	Channel 12 Current status	Unsigned	…
0x010D	CH13_Status	Channel 13 Current status	Unsigned	…
0x010E	CH14_Status	Channel 14 Current status	Unsigned	…
0x010F	CH15_Status	Channel 15 Current status	Unsigned	…
0x0110	CH16_Status	Channel 16 Current status	Unsigned	…
0x0111	CH17_Status	Channel 17 Current status	Unsigned	…
0x0112	CH18_Status	Channel 18 Current status	Unsigned	…
0x0113	CH19_Status	Channel 19 Current status	Unsigned	…
0x0114	CH20_Status	Channel 20 Current status	Unsigned	…
0x0115	CH21_Status	Channel 21 Current status	Unsigned	…
0x0116	CH22_Status	Channel 22 Current status	Unsigned	…
0x0117	CH23_Status	Channel 23 Current status	Unsigned	…
0x0118	CH24_Status	Channel 24 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	…
0x0129	CH09_Gain	Channel 09 Current Gain	Unsigned	…

0x012A	CH10_Gain	Channel 10 Current Gain	Unsigned	...
0x012B	CH11_Gain	Channel 11 Current Gain	Unsigned	...
0x012C	CH12_Gain	Channel 12 Current Gain	Unsigned	...
0x012D	CH13_Gain	Channel 13 Current Gain	Unsigned	...
0x012E	CH14_Gain	Channel 14 Current Gain	Unsigned	...
0x012F	CH15_Gain	Channel 15 Current Gain	Unsigned	...
0x0130	CH16_Gain	Channel 16 Current Gain	Unsigned	...
0x0131	CH17_Gain	Channel 17 Current Gain	Unsigned	...
0x0132	CH18_Gain	Channel 18 Current Gain	Unsigned	...
0x0133	CH19_Gain	Channel 19 Current Gain	Unsigned	...
0x0134	CH20_Gain	Channel 20 Current Gain	Unsigned	...
0x0135	CH21_Gain	Channel 21 Current Gain	Unsigned	...
0x0136	CH22_Gain	Channel 22 Current Gain	Unsigned	...
0x0137	CH23_Gain	Channel 23 Current Gain	Unsigned	...
0x0138	CH24_Gain	Channel 24 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	...
0x0149	CH09_SigStr	Channel 09 Current Signal Strength (100% - 0%)	Unsigned	...
0x014A	CH10_SigStr	Channel 10 Current Signal Strength (100% - 0%)	Unsigned	...
0x014B	CH11_SigStr	Channel 11 Current Signal Strength (100% - 0%)	Unsigned	...
0x014C	CH12_SigStr	Channel 12 Current Signal Strength (100% - 0%)	Unsigned	...
0x014D	CH13_SigStr	Channel 13 Current Signal Strength (100% - 0%)	Unsigned	...
0x014E	CH14_SigStr	Channel 14 Current Signal Strength (100% - 0%)	Unsigned	...
0x014F	CH15_SigStr	Channel 15 Current Signal Strength (100% - 0%)	Unsigned	...
0x0150	CH16_SigStr	Channel 16 Current Signal Strength (100% - 0%)	Unsigned	...
0x0151	CH17_SigStr	Channel 17 Current Signal Strength (100% - 0%)	Unsigned	...
0x0152	CH18_SigStr	Channel 18 Current Signal Strength (100% - 0%)	Unsigned	...
0x0153	CH19_SigStr	Channel 19 Current Signal Strength (100% - 0%)	Unsigned	...
0x0154	CH20_SigStr	Channel 20 Current Signal Strength (100% - 0%)	Unsigned	...
0x0155	CH21_SigStr	Channel 21 Current Signal Strength (100% - 0%)	Unsigned	...
0x0156	CH22_SigStr	Channel 22 Current Signal Strength (100% - 0%)	Unsigned	...
0x0157	CH23_SigStr	Channel 23 Current Signal Strength (100% - 0%)	Unsigned	...
0x0158	CH24_SigStr	Channel 24 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	...
0x0169	CH09_Amplitude	Channel 09 Current Amplitude	Unsigned	...
0x016A	CH10_Amplitude	Channel 10 Current Amplitude	Unsigned	...
0x016B	CH11_Amplitude	Channel 11 Current Amplitude	Unsigned	...
0x016C	CH12_Amplitude	Channel 12 Current Amplitude	Unsigned	...
0x016D	CH13_Amplitude	Channel 13 Current Amplitude	Unsigned	...
0x016E	CH14_Amplitude	Channel 14 Current Amplitude	Unsigned	...
0x016F	CH15_Amplitude	Channel 15 Current Amplitude	Unsigned	...
0x0170	CH16_Amplitude	Channel 16 Current Amplitude	Unsigned	...
0x0171	CH17_Amplitude	Channel 17 Current Amplitude	Unsigned	...
0x0172	CH18_Amplitude	Channel 18 Current Amplitude	Unsigned	...
0x0173	CH19_Amplitude	Channel 19 Current Amplitude	Unsigned	...
0x0174	CH20_Amplitude	Channel 20 Current Amplitude	Unsigned	...
0x0175	CH21_Amplitude	Channel 21 Current Amplitude	Unsigned	...
0x0176	CH22_Amplitude	Channel 22 Current Amplitude	Unsigned	...
0x0177	CH23_Amplitude	Channel 23 Current Amplitude	Unsigned	...
0x0178	CH24_Amplitude	Channel 24 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	...
0x0189	CH09_Temperature	Channel 09 Current Temperature	Unsigned	...
0x018A	CH10_Temperature	Channel 10 Current Temperature	Unsigned	...
0x018B	CH11_Temperature	Channel 11 Current Temperature	Unsigned	...
0x018C	CH12_Temperature	Channel 12 Current Temperature	Unsigned	...
0x018D	CH13_Temperature	Channel 13 Current Temperature	Unsigned	...
0x018E	CH14_Temperature	Channel 14 Current Temperature	Unsigned	...
0x018F	CH15_Temperature	Channel 15 Current Temperature	Unsigned	...
0x0190	CH16_Temperature	Channel 16 Current Temperature	Unsigned	...
0x0191	CH17_Temperature	Channel 17 Current Temperature	Unsigned	...
0x0192	CH18_Temperature	Channel 18 Current Temperature	Unsigned	...
0x0193	CH19_Temperature	Channel 19 Current Temperature	Unsigned	...
0x0194	CH20_Temperature	Channel 20 Current Temperature	Unsigned	...
0x0195	CH21_Temperature	Channel 21 Current Temperature	Unsigned	...
0x0196	CH22_Temperature	Channel 22 Current Temperature	Unsigned	...
0x0197	CH23_Temperature	Channel 23 Current Temperature	Unsigned	...
0x0198	CH24_Temperature	Channel 24 Current Temperature	Unsigned	...

10 IEC 60870-5 DATA MAP

This chapter gives a description of the IEC 60870 parameters included in the T301 instrument. If you want to connect to the T301 using the serial RS-485 port or if you want to connect using the Modbus over the Ethernet protocol, you will need this information.

Rugged Monitoring **IEC 60870-5 data map**

Version: 1.1

ASDU type **1: M_SP_NA_1** **Single point information**

1

1.1 Alarm status

IOA	Sector	Name	Description	Type	Encoding	Class
171	1	AlarmLatch01	Alarm latch 01	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
172	1	AlarmLatch02	Alarm latch 02	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
173	1	AlarmLatch03	Alarm latch 03	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
174	1	AlarmLatch04	Alarm latch 04	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
175	1	AlarmLatch05	Alarm latch 05	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
176	1	AlarmLatch06	Alarm latch 06	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
177	1	AlarmLatch07	Alarm latch 07	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
178	1	AlarmLatch08	Alarm latch 08	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
179	1	AlarmLatch09	Alarm latch 09	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
180	1	AlarmLatch10	Alarm latch 10	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
181	1	AlarmLatch11	Alarm latch 11	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
182	1	AlarmLatch12	Alarm latch 12	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
183	1	AlarmLatch13	Alarm latch 13	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
184	1	AlarmLatch14	Alarm latch 14	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
185	1	AlarmLatch15	Alarm latch 15	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
186	1	AlarmLatch16	Alarm latch 16	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
187	1	AlarmLatch17	Alarm latch 17	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
188	1	AlarmLatch18	Alarm latch 18	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
189	1	AlarmLatch19	Alarm latch 19	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
190	1	AlarmLatch20	Alarm latch 20	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
191	1	AlarmLatch21	Alarm latch 21	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
192	1	AlarmLatch22	Alarm latch 22	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
193	1	AlarmLatch23	Alarm latch 23	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
194	1	AlarmLatch24	Alarm latch 24	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
195	1	AlarmLatch25	Alarm latch 25	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
196	1	AlarmLatch26	Alarm latch 26	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
197	1	AlarmLatch27	Alarm latch 27	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
198	1	AlarmLatch28	Alarm latch 28	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
199	1	AlarmLatch29	Alarm latch 29	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1

200	1	AlarmLatch30	Alarm latch 30	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
201	1	AlarmLatch31	Alarm latch 31	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1
202	1	AlarmLatch32	Alarm latch 32	M_SP_NA_1	0 = no latched alarm, 1 = latched alarm	1

1.2 Relay status **Factory_struct**

Reg Address	Sector	Name	Description	1 bit	Encoding	Class
203	1	Relay1	Relay 1 state (given after Failsafe consideration)	M_SP_NA_1	0 = de-energized; 1 = energized	1
204	1	Relay2	Relay 2 state (given after Failsafe consideration)	M_SP_NA_1	0 = de-energized; 1 = energized	1
205	1	Relay3	Relay 3 state (given after Failsafe consideration)	M_SP_NA_1	0 = de-energized; 1 = energized	1
206	1	Relay4	Relay 4 state (given after Failsafe consideration)	M_SP_NA_1	0 = de-energized; 1 = energized	1
207	1	Relay5	Relay 5 state (given after Failsafe consideration)	M_SP_NA_1	0 = de-energized; 1 = energized	1
208	1	Relay6	Relay 6 state (given after Failsafe consideration)	M_SP_NA_1	0 = de-energized; 1 = energized	1
209	1	Relay7	Relay 7 state (given after Failsafe consideration)	M_SP_NA_1	0 = de-energized; 1 = energized	1
210	1	Relay8	Relay 8 state (given after Failsafe consideration)	M_SP_NA_1	0 = de-energized; 1 = energized	1

2 ASDU type **11: M_ME_NB_1** **Measured value, scaled value**

2.1 Temperature Data **rData_Temp_struct**

IOA	Sector	Name	Description	Type	Encoding	Class
1	1	CH01_Temperature	Channel 01 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
2	1	CH02_Temperature	Channel 02 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
3	1	CH03_Temperature	Channel 03 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
4	1	CH04_Temperature	Channel 04 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
5	1	CH05_Temperature	Channel 05 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
6	1	CH06_Temperature	Channel 06 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
7	1	CH07_Temperature	Channel 07 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
8	1	CH08_Temperature	Channel 08 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
9	1	CH09_Temperature	Channel 09 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
10	1	CH10_Temperature	Channel 10 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
11	1	CH11_Temperature	Channel 11 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
12	1	CH12_Temperature	Channel 12 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
13	1	CH13_Temperature	Channel 13 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
14	1	CH14_Temperature	Channel 14 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
15	1	CH15_Temperature	Channel 15 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
16	1	CH16_Temperature	Channel 16 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2

17	1	CH17_Temperature	Channel 17 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
18	1	CH18_Temperature	Channel 18 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
19	1	CH19_Temperature	Channel 19 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
20	1	CH20_Temperature	Channel 20 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
21	1	CH21_Temperature	Channel 21 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
22	1	CH22_Temperature	Channel 22 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
23	1	CH23_Temperature	Channel 23 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
24	1	CH24_Temperature	Channel 24 Current Temperature	M_ME_NB_1	Temperature x 100 [e.g. 12345 for 123.45]	2
25	1	CH01_Status	Channel 01 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
26	1	CH02_Status	Channel 02 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
27	1	CH03_Status	Channel 03 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
28	1	CH04_Status	Channel 04 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
29	1	CH05_Status	Channel 05 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
30	1	CH06_Status	Channel 06 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
31	1	CH07_Status	Channel 07 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
32	1	CH08_Status	Channel 08 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
33	1	CH09_Status	Channel 09 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
34	1	CH10_Status	Channel 10 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
35	1	CH11_Status	Channel 11 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
36	1	CH12_Status	Channel 12 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
37	1	CH13_Status	Channel 13 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
38	1	CH14_Status	Channel 14 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
39	1	CH15_Status	Channel 15 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
40	1	CH16_Status	Channel 16 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
41	1	CH17_Status	Channel 17 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
42	1	CH18_Status	Channel 18 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
43	1	CH19_Status	Channel 19 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
44	1	CH20_Status	Channel 20 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
45	1	CH21_Status	Channel 21 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
46	1	CH22_Status	Channel 22 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
47	1	CH23_Status	Channel 23 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
48	1	CH24_Status	Channel 24 Current status	M_ME_NB_1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal	1
49	1	CH01_SigStr	Channel 01 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
50	1	CH02_SigStr	Channel 02 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
51	1	CH03_SigStr	Channel 03 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
52	1	CH04_SigStr	Channel 04 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
53	1	CH05_SigStr	Channel 05 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2

54	1	CH06_SigStr	Channel 06 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
55	1	CH07_SigStr	Channel 07 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
56	1	CH08_SigStr	Channel 08 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
57	1	CH09_SigStr	Channel 09 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
58	1	CH10_SigStr	Channel 10 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
59	1	CH11_SigStr	Channel 11 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
60	1	CH12_SigStr	Channel 12 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
61	1	CH13_SigStr	Channel 13 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
62	1	CH14_SigStr	Channel 14 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
63	1	CH15_SigStr	Channel 15 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
64	1	CH16_SigStr	Channel 16 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
65	1	CH17_SigStr	Channel 17 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
66	1	CH18_SigStr	Channel 18 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
67	1	CH19_SigStr	Channel 19 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
68	1	CH20_SigStr	Channel 20 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
69	1	CH21_SigStr	Channel 21 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
70	1	CH22_SigStr	Channel 22 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
71	1	CH23_SigStr	Channel 23 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
72	1	CH24_SigStr	Channel 24 Current Signal Strength (100% - 0%)	M_ME_NB_1	0 to 100 for 0% to 100% (make sure signal is valid [status])	2
73	1	CH01_Amplitude	Channel 01 Current Amplitude	M_ME_NB_1	Internal use	None
74	1	CH02_Amplitude	Channel 02 Current Amplitude	M_ME_NB_1	Internal use	None
75	1	CH03_Amplitude	Channel 03 Current Amplitude	M_ME_NB_1	Internal use	None
76	1	CH04_Amplitude	Channel 04 Current Amplitude	M_ME_NB_1	Internal use	None
77	1	CH05_Amplitude	Channel 05 Current Amplitude	M_ME_NB_1	Internal use	None
78	1	CH06_Amplitude	Channel 06 Current Amplitude	M_ME_NB_1	Internal use	None
79	1	CH07_Amplitude	Channel 07 Current Amplitude	M_ME_NB_1	Internal use	None
80	1	CH08_Amplitude	Channel 08 Current Amplitude	M_ME_NB_1	Internal use	None
81	1	CH09_Amplitude	Channel 09 Current Amplitude	M_ME_NB_1	Internal use	None
82	1	CH10_Amplitude	Channel 10 Current Amplitude	M_ME_NB_1	Internal use	None
83	1	CH11_Amplitude	Channel 11 Current Amplitude	M_ME_NB_1	Internal use	None

84	1	CH12_Amplitude	Channel 12 Current Amplitude	M_ME_NB_1	Internal use	None
85	1	CH13_Amplitude	Channel 13 Current Amplitude	M_ME_NB_1	Internal use	None
86	1	CH14_Amplitude	Channel 14 Current Amplitude	M_ME_NB_1	Internal use	None
87	1	CH15_Amplitude	Channel 15 Current Amplitude	M_ME_NB_1	Internal use	None
88	1	CH16_Amplitude	Channel 16 Current Amplitude	M_ME_NB_1	Internal use	None
89	1	CH17_Amplitude	Channel 17 Current Amplitude	M_ME_NB_1	Internal use	None
90	1	CH18_Amplitude	Channel 18 Current Amplitude	M_ME_NB_1	Internal use	None
91	1	CH19_Amplitude	Channel 19 Current Amplitude	M_ME_NB_1	Internal use	None
92	1	CH20_Amplitude	Channel 20 Current Amplitude	M_ME_NB_1	Internal use	None
93	1	CH21_Amplitude	Channel 21 Current Amplitude	M_ME_NB_1	Internal use	None
94	1	CH22_Amplitude	Channel 22 Current Amplitude	M_ME_NB_1	Internal use	None
95	1	CH23_Amplitude	Channel 23 Current Amplitude	M_ME_NB_1	Internal use	None
96	1	CH24_Amplitude	Channel 24 Current Amplitude	M_ME_NB_1	Internal use	None
97	1	CH01_Gain	Channel 01 Current Gain	M_ME_NB_1	Internal use	None
98	1	CH02_Gain	Channel 02 Current Gain	M_ME_NB_1	Internal use	None
99	1	CH03_Gain	Channel 03 Current Gain	M_ME_NB_1	Internal use	None
100	1	CH04_Gain	Channel 04 Current Gain	M_ME_NB_1	Internal use	None
101	1	CH05_Gain	Channel 05 Current Gain	M_ME_NB_1	Internal use	None
102	1	CH06_Gain	Channel 06 Current Gain	M_ME_NB_1	Internal use	None
103	1	CH07_Gain	Channel 07 Current Gain	M_ME_NB_1	Internal use	None
104	1	CH08_Gain	Channel 08 Current Gain	M_ME_NB_1	Internal use	None
105	1	CH09_Gain	Channel 09 Current Gain	M_ME_NB_1	Internal use	None
106	1	CH10_Gain	Channel 10 Current Gain	M_ME_NB_1	Internal use	None
107	1	CH11_Gain	Channel 11 Current Gain	M_ME_NB_1	Internal use	None
108	1	CH12_Gain	Channel 12 Current Gain	M_ME_NB_1	Internal use	None
109	1	CH13_Gain	Channel 13 Current Gain	M_ME_NB_1	Internal use	None
110	1	CH14_Gain	Channel 14 Current Gain	M_ME_NB_1	Internal use	None
111	1	CH15_Gain	Channel 15 Current Gain	M_ME_NB_1	Internal use	None
112	1	CH16_Gain	Channel 16 Current Gain	M_ME_NB_1	Internal use	None
113	1	CH17_Gain	Channel 17 Current Gain	M_ME_NB_1	Internal use	None
114	1	CH18_Gain	Channel 18 Current Gain	M_ME_NB_1	Internal use	None
115	1	CH19_Gain	Channel 19 Current Gain	M_ME_NB_1	Internal use	None
116	1	CH20_Gain	Channel 20 Current Gain	M_ME_NB_1	Internal use	None
117	1	CH21_Gain	Channel 21 Current Gain	M_ME_NB_1	Internal use	None
118	1	CH22_Gain	Channel 22 Current Gain	M_ME_NB_1	Internal use	None
119	1	CH23_Gain	Channel 23 Current Gain	M_ME_NB_1	Internal use	None
120	1	CH24_Gain	Channel 24 Current Gain	M_ME_NB_1	Internal use	None

2.2	**Channel Config**	**User_channel_struct**

Reg Address	Sector	Name	Description	Type	Encoding	Class
121	1	CH01_Enable	Channel Enable 01	M_ME_NB_1	0 = Disable; Enable otherwise	2
122	1	CH02_Enable	Channel Enable 02	M_ME_NB_1	0 = Disable; Enable otherwise	2
123	1	CH03_Enable	Channel Enable 03	M_ME_NB_1	0 = Disable; Enable otherwise	2
124	1	CH04_Enable	Channel Enable 04	M_ME_NB_1	0 = Disable; Enable otherwise	2
125	1	CH05_Enable	Channel Enable 05	M_ME_NB_1	0 = Disable; Enable otherwise	2
126	1	CH06_Enable	Channel Enable 06	M_ME_NB_1	0 = Disable; Enable otherwise	2
127	1	CH07_Enable	Channel Enable 07	M_ME_NB_1	0 = Disable; Enable otherwise	2
128	1	CH08_Enable	Channel Enable 08	M_ME_NB_1	0 = Disable; Enable otherwise	2
129	1	CH09_Enable	Channel Enable 09	M_ME_NB_1	0 = Disable; Enable otherwise	2
130	1	CH10_Enable	Channel Enable 10	M_ME_NB_1	0 = Disable; Enable otherwise	2
131	1	CH11_Enable	Channel Enable 11	M_ME_NB_1	0 = Disable; Enable otherwise	2
132	1	CH12_Enable	Channel Enable 12	M_ME_NB_1	0 = Disable; Enable otherwise	2
133	1	CH13_Enable	Channel Enable 13	M_ME_NB_1	0 = Disable; Enable otherwise	2
134	1	CH14_Enable	Channel Enable 14	M_ME_NB_1	0 = Disable; Enable otherwise	2
135	1	CH15_Enable	Channel Enable 15	M_ME_NB_1	0 = Disable; Enable otherwise	2
136	1	CH16_Enable	Channel Enable 16	M_ME_NB_1	0 = Disable; Enable otherwise	2
137	1	CH17_Enable	Channel Enable 17	M_ME_NB_1	0 = Disable; Enable otherwise	2
138	1	CH18_Enable	Channel Enable 18	M_ME_NB_1	0 = Disable; Enable otherwise	2
139	1	CH19_Enable	Channel Enable 19	M_ME_NB_1	0 = Disable; Enable otherwise	2
140	1	CH20_Enable	Channel Enable 20	M_ME_NB_1	0 = Disable; Enable otherwise	2
141	1	CH21_Enable	Channel Enable 21	M_ME_NB_1	0 = Disable; Enable otherwise	2
142	1	CH22_Enable	Channel Enable 22	M_ME_NB_1	0 = Disable; Enable otherwise	2
143	1	CH23_Enable	Channel Enable 23	M_ME_NB_1	0 = Disable; Enable otherwise	2
144	1	CH24_Enable	Channel Enable 24	M_ME_NB_1	0 = Disable; Enable otherwise	2
145	1	CH01_Offset	Channel Temperature Offset 01	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
146	1	CH02_Offset	Channel Temperature Offset 02	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
147	1	CH03_Offset	Channel Temperature Offset 03	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
148	1	CH04_Offset	Channel Temperature Offset 04	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
149	1	CH05_Offset	Channel Temperature Offset 05	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
150	1	CH06_Offset	Channel Temperature Offset 06	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
151	1	CH07_Offset	Channel Temperature Offset 07	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
152	1	CH08_Offset	Channel Temperature Offset 08	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
153	1	CH09_Offset	Channel Temperature Offset 09	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
154	1	CH10_Offset	Channel Temperature Offset 10	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
155	1	CH11_Offset	Channel Temperature Offset 11	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
156	1	CH12_Offset	Channel Temperature Offset 12	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2

157	1	CH13_Offset	Channel Temperature Offset 13	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
158	1	CH14_Offset	Channel Temperature Offset 14	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
159	1	CH15_Offset	Channel Temperature Offset 15	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
160	1	CH16_Offset	Channel Temperature Offset 16	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
161	1	CH17_Offset	Channel Temperature Offset 17	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
162	1	CH18_Offset	Channel Temperature Offset 18	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
163	1	CH19_Offset	Channel Temperature Offset 19	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
164	1	CH20_Offset	Channel Temperature Offset 20	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
165	1	CH21_Offset	Channel Temperature Offset 21	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
166	1	CH22_Offset	Channel Temperature Offset 22	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
167	1	CH23_Offset	Channel Temperature Offset 23	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2
168	1	CH24_Offset	Channel Temperature Offset 24	M_ME_NB_1	Temperature Offset x 100 [e.g. 125 for 1.25C]	2

2.3 Data System Info **rData_SysInfo_struct**

IOA	Sector	Name	Description	Type	Encoding	Class
233	1	MajorVersion	Firmware Major Version	M_ME_NB_1	0 to 99	2
234	1	MinorVersion	Firmware Revision	M_ME_NB_1	0 to 99	2
235	1	GenErrorH	System error code MSW	M_ME_NB_1	Internal use	None
236	1	GenErrorL	System error code LSW	M_ME_NB_1	Internal use	None
237	1	CalibErrorH	Calibration CRC err (1 bit per channel) MSW	M_ME_NB_1	Internal use	None
238	1	CalibErrorL	Calibration CRC err (1 bit per channel) LSW	M_ME_NB_1	Internal use	None
239	1	InternalTemp	Internal temp x 100	M_ME_NB_1	Internal temperature x 100 [e.g. 3846 for 38.46]	2

2.4 System Info **Factory_struct**

Reg Address	Sector	Name	Description	Type	Encoding	Class
241	1	Device	Type of Device	M_ME_NB_1	Define: 1 = L201; 2 = T301; 3 to 7 = OEM	2
242	1	Model	Device Model	M_ME_NB_1	Reserved	2
243	1	NbChannel	Number of Channels	M_ME_NB_1	1 to 32 for 1 to 32 channels	2
244	1	CalibYY	Calibration Year	M_ME_NB_1	18 for 2018	2
245	1	CalibMM	Calibration Month	M_ME_NB_1	1 to 12	2
246	1	CalibDD	Calibration Day	M_ME_NB_1	1 to 31	2
247	1	SerialNumberH	Unique ID Serial Number MSW	M_ME_NB_1	MSW of the 32 bits variable	2
248	1	SerialNumberL	Unique ID Serial Number LSW	M_ME_NB_1	LSW of the 32 bits variable	2

2.2 User Config **User_config_struct**

Reg Address	Sector	Name	Description	Type	Encoding	Class
250	1	AcquisitionMode	Acquisition Auto Gain Mode	M_ME_NB_1	Define: 0 = Reserved; 1 = Fixed Time; 2 = AGC on	2
251	1	TempAveraging	Averaging	M_ME_NB_1	50 to 100; 100 = 100% of last val (no avg) = default	2
252	1	HoldLastGood	Hold Last Good value for x scan	M_ME_NB_1	0 to 9; Default = 3	2
253	1	LogEn	Internal Logging Enable	M_ME_NB_1	0 = Disable; 1 = Enable Not Logging; 2 = Logging	2
254	1	LogRate	Internal Logging Rate	M_ME_NB_1	Defines	2

11 DNP 3.0 DATA POINT MAP

This chapter gives a description of the DNP 3.0 data map included in the T301 instrument. If you want to connect to the T301 using the serial RS-485 port or if you want to connect using the Modbus over the Ethernet protocol, you will need this information.

Rugged Monitoring **DNP3 data point map**

Version: 1.1

1 **Object group** **10** **Binary inputs**

1.1 **Alarm status**

Address	Name	Description	Group	Var	Class	Encoding
1	AlarmLatch01	Alarm latch 01	1	2	0	0 = no latched alarm, 1 = latched alarm
2	AlarmLatch02	Alarm latch 02	1	2	0	0 = no latched alarm, 1 = latched alarm
3	AlarmLatch03	Alarm latch 03	1	2	0	0 = no latched alarm, 1 = latched alarm
4	AlarmLatch04	Alarm latch 04	1	2	0	0 = no latched alarm, 1 = latched alarm
5	AlarmLatch05	Alarm latch 05	1	2	0	0 = no latched alarm, 1 = latched alarm
6	AlarmLatch06	Alarm latch 06	1	2	0	0 = no latched alarm, 1 = latched alarm
7	AlarmLatch07	Alarm latch 07	1	2	0	0 = no latched alarm, 1 = latched alarm
8	AlarmLatch08	Alarm latch 08	1	2	0	0 = no latched alarm, 1 = latched alarm
9	AlarmLatch09	Alarm latch 09	1	2	0	0 = no latched alarm, 1 = latched alarm
10	AlarmLatch10	Alarm latch 10	1	2	0	0 = no latched alarm, 1 = latched alarm
11	AlarmLatch11	Alarm latch 11	1	2	0	0 = no latched alarm, 1 = latched alarm
12	AlarmLatch12	Alarm latch 12	1	2	0	0 = no latched alarm, 1 = latched alarm
13	AlarmLatch13	Alarm latch 13	1	2	0	0 = no latched alarm, 1 = latched alarm
14	AlarmLatch14	Alarm latch 14	1	2	0	0 = no latched alarm, 1 = latched alarm
15	AlarmLatch15	Alarm latch 15	1	2	0	0 = no latched alarm, 1 = latched alarm
16	AlarmLatch16	Alarm latch 16	1	2	0	0 = no latched alarm, 1 = latched alarm
17	AlarmLatch17	Alarm latch 17	1	2	0	0 = no latched alarm, 1 = latched alarm
18	AlarmLatch18	Alarm latch 18	1	2	0	0 = no latched alarm, 1 = latched alarm
19	AlarmLatch19	Alarm latch 19	1	2	0	0 = no latched alarm, 1 = latched alarm
20	AlarmLatch20	Alarm latch 20	1	2	0	0 = no latched alarm, 1 = latched alarm
21	AlarmLatch21	Alarm latch 21	1	2	0	0 = no latched alarm, 1 = latched alarm
22	AlarmLatch22	Alarm latch 22	1	2	0	0 = no latched alarm, 1 = latched alarm
23	AlarmLatch23	Alarm latch 23	1	2	0	0 = no latched alarm, 1 = latched alarm
24	AlarmLatch24	Alarm latch 24	1	2	0	0 = no latched alarm, 1 = latched alarm
25	AlarmLatch25	Alarm latch 25	1	2	0	0 = no latched alarm, 1 = latched alarm
26	AlarmLatch26	Alarm latch 26	1	2	0	0 = no latched alarm, 1 = latched alarm
27	AlarmLatch27	Alarm latch 27	1	2	0	0 = no latched alarm, 1 = latched alarm
28	AlarmLatch28	Alarm latch 28	1	2	0	0 = no latched alarm, 1 = latched alarm
29	AlarmLatch29	Alarm latch 29	1	2	0	0 = no latched alarm, 1 = latched alarm
30	AlarmLatch30	Alarm latch 30	1	2	0	0 = no latched alarm, 1 = latched alarm
31	AlarmLatch31	Alarm latch 31	1	2	0	0 = no latched alarm, 1 = latched alarm
32	AlarmLatch32	Alarm latch 32	1	2	0	0 = no latched alarm, 1 = latched alarm

1.2 **Relay status**

Reg Address	Name	Description	Group	Var	Class	Encoding
101	Relay1	Relay 1 state (given after Failsafe consideration)	1	2	1	0 = de-energized; 1 = energized
102	Relay2	Relay 2 state (given after Failsafe consideration)	1	2	1	0 = de-energized; 1 = energized
103	Relay3	Relay 3 state (given after Failsafe consideration)	1	2	1	0 = de-energized; 1 = energized
104	Relay4	Relay 4 state (given after Failsafe consideration)	1	2	1	0 = de-energized; 1 = energized
105	Relay5	Relay 5 state (given after Failsafe consideration)	1	2	1	0 = de-energized; 1 = energized
106	Relay6	Relay 6 state (given after Failsafe consideration)	1	2	1	0 = de-energized; 1 = energized
107	Relay7	Relay 7 state (given after Failsafe consideration)	1	2	1	0 = de-energized; 1 = energized
108	Relay8	Relay 8 state (given after Failsafe consideration)	1	2	1	0 = de-energized; 1 = energized

2 Object group 30 Analog inputs

2.1 Temperature Data

IOA	Name	Description	Group	Var	Class	Encoding
1	CH01_Temperature	Channel 01 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
2	CH02_Temperature	Channel 02 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
3	CH03_Temperature	Channel 03 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
4	CH04_Temperature	Channel 04 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
5	CH05_Temperature	Channel 05 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
6	CH06_Temperature	Channel 06 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
7	CH07_Temperature	Channel 07 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
8	CH08_Temperature	Channel 08 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
9	CH09_Temperature	Channel 09 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
10	CH10_Temperature	Channel 10 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
11	CH11_Temperature	Channel 11 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
12	CH12_Temperature	Channel 12 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
13	CH13_Temperature	Channel 13 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
14	CH14_Temperature	Channel 14 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
15	CH15_Temperature	Channel 15 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
16	CH16_Temperature	Channel 16 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
17	CH17_Temperature	Channel 17 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
18	CH18_Temperature	Channel 18 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
19	CH19_Temperature	Channel 19 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
20	CH20_Temperature	Channel 20 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
21	CH21_Temperature	Channel 21 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
22	CH22_Temperature	Channel 22 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
23	CH23_Temperature	Channel 23 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
24	CH24_Temperature	Channel 24 Current Temperature	30	2	1	Temperature x 100 [e.g. 12345 for 123.45]
31	CH01_Status	Channel 01 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal

32	CH02_Status	Channel 02 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
33	CH03_Status	Channel 03 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
34	CH04_Status	Channel 04 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
35	CH05_Status	Channel 05 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
36	CH06_Status	Channel 06 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
37	CH07_Status	Channel 07 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
38	CH08_Status	Channel 08 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
39	CH09_Status	Channel 09 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
40	CH10_Status	Channel 10 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
41	CH11_Status	Channel 11 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
42	CH12_Status	Channel 12 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
43	CH13_Status	Channel 13 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
44	CH14_Status	Channel 14 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
45	CH15_Status	Channel 15 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
46	CH16_Status	Channel 16 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
47	CH17_Status	Channel 17 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
48	CH18_Status	Channel 18 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
49	CH19_Status	Channel 19 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
50	CH20_Status	Channel 20 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
51	CH21_Status	Channel 21 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
52	CH22_Status	Channel 22 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
53	CH23_Status	Channel 23 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
54	CH24_Status	Channel 24 Current status	30	2	1	Error code: 0 = Valid; 2 = Disabled; 3 = No Signal
61	CH01_SigStr	Channel 01 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
62	CH02_SigStr	Channel 02 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
63	CH03_SigStr	Channel 03 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
64	CH04_SigStr	Channel 04 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
65	CH05_SigStr	Channel 05 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
66	CH06_SigStr	Channel 06 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
67	CH07_SigStr	Channel 07 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
68	CH08_SigStr	Channel 08 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
69	CH09_SigStr	Channel 09 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
70	CH10_SigStr	Channel 10 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
71	CH11_SigStr	Channel 11 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
72	CH12_SigStr	Channel 12 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
73	CH13_SigStr	Channel 13 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
74	CH14_SigStr	Channel 14 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
75	CH15_SigStr	Channel 15 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
76	CH16_SigStr	Channel 16 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])

77	CH17_SigStr	Channel 17 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
78	CH18_SigStr	Channel 18 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
79	CH19_SigStr	Channel 19 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
80	CH20_SigStr	Channel 20 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
81	CH21_SigStr	Channel 21 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
82	CH22_SigStr	Channel 22 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
83	CH23_SigStr	Channel 23 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
84	CH24_SigStr	Channel 24 Current Signal Strength (100% - 0%)	30	2	1	0 to 100 for 0% to 100% (make sure signal is valid [status])
91	CH01_Amplitude	Channel 01 Current Amplitude	30	2	1	Internal use
92	CH02_Amplitude	Channel 02 Current Amplitude	30	2	1	Internal use
93	CH03_Amplitude	Channel 03 Current Amplitude	30	2	1	Internal use
94	CH04_Amplitude	Channel 04 Current Amplitude	30	2	1	Internal use
95	CH05_Amplitude	Channel 05 Current Amplitude	30	2	1	Internal use
96	CH06_Amplitude	Channel 06 Current Amplitude	30	2	1	Internal use
97	CH07_Amplitude	Channel 07 Current Amplitude	30	2	1	Internal use
98	CH08_Amplitude	Channel 08 Current Amplitude	30	2	1	Internal use
99	CH09_Amplitude	Channel 09 Current Amplitude	30	2	1	Internal use
100	CH10_Amplitude	Channel 10 Current Amplitude	30	2	1	Internal use
101	CH11_Amplitude	Channel 11 Current Amplitude	30	2	1	Internal use
102	CH12_Amplitude	Channel 12 Current Amplitude	30	2	1	Internal use
103	CH13_Amplitude	Channel 13 Current Amplitude	30	2	1	Internal use
104	CH14_Amplitude	Channel 14 Current Amplitude	30	2	1	Internal use
105	CH15_Amplitude	Channel 15 Current Amplitude	30	2	1	Internal use
106	CH16_Amplitude	Channel 16 Current Amplitude	30	2	1	Internal use
107	CH17_Amplitude	Channel 17 Current Amplitude	30	2	1	Internal use
108	CH18_Amplitude	Channel 18 Current Amplitude	30	2	1	Internal use
109	CH19_Amplitude	Channel 19 Current Amplitude	30	2	1	Internal use
110	CH20_Amplitude	Channel 20 Current Amplitude	30	2	1	Internal use
111	CH21_Amplitude	Channel 21 Current Amplitude	30	2	1	Internal use
112	CH22_Amplitude	Channel 22 Current Amplitude	30	2	1	Internal use
113	CH23_Amplitude	Channel 23 Current Amplitude	30	2	1	Internal use
114	CH24_Amplitude	Channel 24 Current Amplitude	30	2	1	Internal use
121	CH01_Gain	Channel 01 Current Gain	30	2	1	Internal use
122	CH02_Gain	Channel 02 Current Gain	30	2	1	Internal use
123	CH03_Gain	Channel 03 Current Gain	30	2	1	Internal use
124	CH04_Gain	Channel 04 Current Gain	30	2	1	Internal use
125	CH05_Gain	Channel 05 Current Gain	30	2	1	Internal use
126	CH06_Gain	Channel 06 Current Gain	30	2	1	Internal use
127	CH07_Gain	Channel 07 Current Gain	30	2	1	Internal use
128	CH08_Gain	Channel 08 Current Gain	30	2	1	Internal use
129	CH09_Gain	Channel 09 Current Gain	30	2	1	Internal use

130	CH10_Gain	Channel 10 Current Gain	30	2	1	Internal use
131	CH11_Gain	Channel 11 Current Gain	30	2	1	Internal use
132	CH12_Gain	Channel 12 Current Gain	30	2	1	Internal use
133	CH13_Gain	Channel 13 Current Gain	30	2	1	Internal use
134	CH14_Gain	Channel 14 Current Gain	30	2	1	Internal use
135	CH15_Gain	Channel 15 Current Gain	30	2	1	Internal use
136	CH16_Gain	Channel 16 Current Gain	30	2	1	Internal use
137	CH17_Gain	Channel 17 Current Gain	30	2	1	Internal use
138	CH18_Gain	Channel 18 Current Gain	30	2	1	Internal use
139	CH19_Gain	Channel 19 Current Gain	30	2	1	Internal use
140	CH20_Gain	Channel 20 Current Gain	30	2	1	Internal use
141	CH21_Gain	Channel 21 Current Gain	30	2	1	Internal use
142	CH22_Gain	Channel 22 Current Gain	30	2	1	Internal use
143	CH23_Gain	Channel 23 Current Gain	30	2	1	Internal use
144	CH24_Gain	Channel 24 Current Gain	30	2	1	Internal use

2.2 Channel Config

Reg Address	Name	Description	Group	Var	Class	Encoding
151	CH01_Enable	Channel Enable 01	30	2	0	0 = Disable; Enable otherwise
152	CH02_Enable	Channel Enable 02	30	2	0	0 = Disable; Enable otherwise
153	CH03_Enable	Channel Enable 03	30	2	0	0 = Disable; Enable otherwise
154	CH04_Enable	Channel Enable 04	30	2	0	0 = Disable; Enable otherwise
155	CH05_Enable	Channel Enable 05	30	2	0	0 = Disable; Enable otherwise
156	CH06_Enable	Channel Enable 06	30	2	0	0 = Disable; Enable otherwise
157	CH07_Enable	Channel Enable 07	30	2	0	0 = Disable; Enable otherwise
158	CH08_Enable	Channel Enable 08	30	2	0	0 = Disable; Enable otherwise
159	CH09_Enable	Channel Enable 09	30	2	0	0 = Disable; Enable otherwise
160	CH10_Enable	Channel Enable 10	30	2	0	0 = Disable; Enable otherwise
161	CH11_Enable	Channel Enable 11	30	2	0	0 = Disable; Enable otherwise
162	CH12_Enable	Channel Enable 12	30	2	0	0 = Disable; Enable otherwise
163	CH13_Enable	Channel Enable 13	30	2	0	0 = Disable; Enable otherwise
164	CH14_Enable	Channel Enable 14	30	2	0	0 = Disable; Enable otherwise
165	CH15_Enable	Channel Enable 15	30	2	0	0 = Disable; Enable otherwise
166	CH16_Enable	Channel Enable 16	30	2	0	0 = Disable; Enable otherwise
167	CH17_Enable	Channel Enable 17	30	2	0	0 = Disable; Enable otherwise
168	CH18_Enable	Channel Enable 18	30	2	0	0 = Disable; Enable otherwise
169	CH19_Enable	Channel Enable 19	30	2	0	0 = Disable; Enable otherwise
170	CH20_Enable	Channel Enable 20	30	2	0	0 = Disable; Enable otherwise
171	CH21_Enable	Channel Enable 21	30	2	0	0 = Disable; Enable otherwise
172	CH22_Enable	Channel Enable 22	30	2	0	0 = Disable; Enable otherwise
173	CH23_Enable	Channel Enable 23	30	2	0	0 = Disable; Enable otherwise
174	CH24_Enable	Channel Enable 24	30	2	0	0 = Disable; Enable otherwise
181	CH01_Offset	Channel Temperature Offset 01	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
182	CH02_Offset	Channel Temperature Offset 02	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
183	CH03_Offset	Channel Temperature Offset 03	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
184	CH04_Offset	Channel Temperature Offset 04	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
185	CH05_Offset	Channel Temperature Offset 05	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]

186	CH06_Offset	Channel Temperature Offset 06	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
187	CH07_Offset	Channel Temperature Offset 07	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
188	CH08_Offset	Channel Temperature Offset 08	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
189	CH09_Offset	Channel Temperature Offset 09	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
190	CH10_Offset	Channel Temperature Offset 10	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
191	CH11_Offset	Channel Temperature Offset 11	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
192	CH12_Offset	Channel Temperature Offset 12	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
193	CH13_Offset	Channel Temperature Offset 13	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
194	CH14_Offset	Channel Temperature Offset 14	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
195	CH15_Offset	Channel Temperature Offset 15	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
196	CH16_Offset	Channel Temperature Offset 16	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
197	CH17_Offset	Channel Temperature Offset 17	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
198	CH18_Offset	Channel Temperature Offset 18	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
199	CH19_Offset	Channel Temperature Offset 19	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
200	CH20_Offset	Channel Temperature Offset 20	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
201	CH21_Offset	Channel Temperature Offset 21	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
202	CH22_Offset	Channel Temperature Offset 22	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
203	CH23_Offset	Channel Temperature Offset 23	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]
204	CH24_Offset	Channel Temperature Offset 24	30	2	0	Temperature Offset x 100 [e.g. 125 for 1.25C]

2.3 Data System Info

IOA	Name	Description	Group	Var	Class	Encoding
210	MajorVersion	Firmware Major Version	30	2	0	0 to 99
211	MinorVersion	Firmware Revision	30	2	0	0 to 99
212	GenErrorH	System error code MSW	30	2	0	Internal use
213	GenErrorL	System error code LSW	30	2	0	Internal use
214	CalibErrorH	Calibration CRC err (1 bit per channel) MSW	30	2	0	Internal use
215	CalibErrorL	Calibration CRC err (1 bit per channel) LSW	30	2	0	Internal use
216	InternalTemp	Internal temp x 100	30	2	1	Internal temperature x 100 [e.g. 3846 for 38.46]

2.4 System Info

Reg Address	Name	Description	Group	Var	Class	Encoding
220	Device	Type of Device	30	2	0	Define: 1 = L201; 2 = T301; 3 to 7 = OEM
221	Model	Device Model	30	2	0	Reserved
222	NbChannel	Number of Channels	30	2	0	1 to 32 for 1 to 32 channels
223	CalibYY	Calibration Year	30	2	0	18 for 2018
224	CalibMM	Calibration Month	30	2	0	1 to 12
225	CalibDD	Calibration Day	30	2	0	1 to 31
226	SerialNumberH	Unique ID Serial Number MSW	30	2	0	MSW of the 32 bits variable
227	SerialNumberL	Unique ID Serial Number LSW	30	2	0	LSW of the 32 bits variable

2.2 User Config

Reg Address	Name	Description	Group	Var	Class	Encoding
230	AcquisitionMode	Acquisition Auto Gain Mode	30	2	0	Define: 0 = Reserved; 1 = Fixed Time; 2 = AGC on
231	TempAveraging	Averaging	30	2	0	50 to 100; 100 = 100% of last val (no avg) = default
232	HoldLastGood	Hold Last Good value for x scan	30	2	0	0 to 9; Default = 3
233	LogEn	Internal Logging Enable	30	2	0	0 = Disable; 1 = Enable Not Logging; 2 = Logging
234	LogRate	Internal Logging Rate	30	2	0	Defines

12 IEC 61850 CID FILE DESCRIPTION

The following presents some comments that are applicable to entries (logical nodes) in the Rugged Monitoring CID file (effectively the ICD file). These have been extracted from the T301 CID file.

For a complete download of the ICD file, please download it from the webserver.

<LN desc="**Relay 1 Status**" inst="**1**" lnType="**GGIO_0**" lnClass="**GGIO**" prefix=""/>	GGIO1	Relay 1 state	GGIO_0
<LN desc="**Relay 2 Status**" inst="**2**" lnType="**GGIO_0**" lnClass="**GGIO**" prefix=""/>	GGIO2	Relay 2 state	GGIO_0
<LN desc="**Relay 3 Status**" inst="**3**" lnType="**GGIO_0**" lnClass="**GGIO**" prefix=""/>	GGIO3	Relay 3 state	GGIO_0
<LN desc="**Relay 4 Status**" inst="**4**" lnType="**GGIO_0**" lnClass="**GGIO**" prefix=""/>	GGIO4	Relay 4 state	GGIO_0
<LN desc="**Relay 5 Status**" inst="**5**" lnType="**GGIO_0**" lnClass="**GGIO**" prefix=""/>	GGIO5	Relay 5 state	GGIO_0
<LN desc="**Relay 6 Status**" inst="**6**" lnType="**GGIO_0**" lnClass="**GGIO**" prefix=""/>	GGIO6	Relay 6 state	GGIO_0
<LN desc="**Relay 7 Status**" inst="**7**" lnType="**GGIO_0**" lnClass="**GGIO**" prefix=""/>	GGIO7	Relay 7 state	GGIO_0
<LN desc="**Relay 8 Status**" inst="**8**" lnType="**GGIO_0**" lnClass="**GGIO**" prefix=""/>	GGIO8	Relay 8 state	GGIO_0
<LN desc="**FailSafe 1 Status**" inst="**11**" lnType="**GGIO_1**" lnClass="**GGIO**" prefix=""/>	GGIO11	Relay 1 configuration	GGIO_1
<LN desc="**FailSafe 2 Status**" inst="**12**" lnType="**GGIO_1**" lnClass="**GGIO**" prefix=""/>	GGIO12	Relay 2 configuration	GGIO_1
<LN desc="**FailSafe 3 Status**" inst="**13**" lnType="**GGIO_1**" lnClass="**GGIO**" prefix=""/>	GGIO13	Relay 3 configuration	GGIO_1
<LN desc="**FailSafe 4 Status**" inst="**14**" lnType="**GGIO_1**" lnClass="**GGIO**" prefix=""/>	GGIO14	Relay 4 configuration	GGIO_1
<LN desc="**FailSafe 5 Status**" inst="**15**" lnType="**GGIO_1**" lnClass="**GGIO**" prefix=""/>	GGIO15	Relay 5 configuration	GGIO_1
<LN desc="**FailSafe 6 Status**" inst="**16**" lnType="**GGIO_1**" lnClass="**GGIO**" prefix=""/>	GGIO16	Relay 6 configuration	GGIO_1
<LN desc="**FailSafe 7 Status**" inst="**17**" lnType="**GGIO_1**" lnClass="**GGIO**" prefix=""/>	GGIO17	Relay 7 configuration	GGIO_1
<LN desc="**FailSafe 8 Status**" inst="**18**" lnType="**GGIO_1**" lnClass="**GGIO**" prefix=""/>	GGIO18	Relay 8 configuration	GGIO_1
<LN desc="**System Information**" inst="**1**" lnType="**STMP_2**" lnClass="**STMP**" prefix=""/>	STMP1	Device configuration	STMP_2
<LN desc="**User Configuration**" inst="**2**" lnType="**STMP_1**" lnClass="**STMP**" prefix=""/>	STMP2	User configuration	STMP_1
<LN desc="**Data System Info**" inst="**3**" lnType="**STMP_3**" lnClass="**STMP**" prefix=""/>	STMP3	System info	STMP_3
<LN desc="**Channel Configuration Ch 1**" inst="**10**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP10	Channel 1 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 2**" inst="**11**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP11	Channel 2 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 3**" inst="**12**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP12	Channel 3 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 4**" inst="**13**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP13	Channel 4 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 5**" inst="**14**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP14	Channel 5 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 6**" inst="**15**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP15	Channel 6 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 7**" inst="**16**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP16	Channel 7 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 8**" inst="**17**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP17	Channel 8 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 9**" inst="**18**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP18	Channel 9 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 10**" inst="**19**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP19	Channel 10 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 11**" inst="**20**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP20	Channel 11 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 12**" inst="**21**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP21	Channel 12 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 13**" inst="**22**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP22	Channel 13 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 14**" inst="**23**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP23	Channel 14 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 15**" inst="**24**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP24	Channel 15 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 16**" inst="**25**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP25	Channel 16 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 17**" inst="**26**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP26	Channel 17 configuration (enable, offset)	STMP_4

<LN desc="**Channel Configuration Ch 18**" inst="**27**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP27	Channel 18 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 19**" inst="**28**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP28	Channel 19 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 20**" inst="**29**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP29	Channel 20 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 21**" inst="**30**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP30	Channel 21 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 22**" inst="**31**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP31	Channel 22 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 23**" inst="**32**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP32	Channel 23 configuration (enable, offset)	STMP_4
<LN desc="**Channel Configuration Ch 24**" inst="**33**" lnType="**STMP_4**" lnClass="**STMP**" prefix=""/>	STMP33	Channel 24 configuration (enable, offset)	STMP_4
<LN desc="**Temperature Data Ch 1**" inst="**50**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP50	Channel 1 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 2**" inst="**51**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP51	Channel 2 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 3**" inst="**52**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP52	Channel 3 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 4**" inst="**53**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP53	Channel 4 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 5**" inst="**54**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP54	Channel 5 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 6**" inst="**55**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP55	Channel 6 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 7**" inst="**56**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP56	Channel 7 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 8**" inst="**57**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP57	Channel 8 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 9**" inst="**58**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP58	Channel 9 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 10**" inst="**59**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP59	Channel 10 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 11**" inst="**60**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP60	Channel 11 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 12**" inst="**61**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP61	Channel 12 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 13**" inst="**62**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP62	Channel 13 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 14**" inst="**63**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP63	Channel 14 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 15**" inst="**64**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP64	Channel 15 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 16**" inst="**65**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP65	Channel 16 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 17**" inst="**66**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP66	Channel 17 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 18**" inst="**67**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP67	Channel 18 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 19**" inst="**68**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP68	Channel 19 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 20**" inst="**69**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP69	Channel 20 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 21**" inst="**70**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP70	Channel 21 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 22**" inst="**71**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP71	Channel 22 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 23**" inst="**72**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP72	Channel 23 status and temperature	STMP_5
<LN desc="**Temperature Data Ch 24**" inst="**73**" lnType="**STMP_5**" lnClass="**STMP**" prefix=""/>	STMP73	Channel 24 status and temperature	STMP_5

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