

dataTaker[®]

Intelligent Data Logging Products

DT90 Range

DT90L and DT90N

User's Manual



A complete guide to:

- data acquisition
- data logging
- programming
- sensor wiring
- communications

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DT90 Range User's Manual

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Please refer to the following table and information for compliance requirements of the DT90 Series.

Domain	Applicable Standards
Safety (Product with Integrated Modem)	AS/NZS 60950.1:2015
EMC  	EN 55032: 2015 EN 55035: 2017 EN 61000-3-2: Ed. 4.0 (2014) EN 61000-3-3: Ed. 3.0 (2013) AS/CA S042: 2015
FCC & IC	CFR47 FCC Part 15, Subpart B (Class B)
CE RED for Integrated Modem	EN 62311:2008 EN 60950-1:2006+A11:2009+A12:2010+A12:2011+A2:2013 EN 301 489-1 V2.2.1 EN 301 489-19 V2.1.0 (Draft) EN 301 489-52 V1.1.0 (Draft) EN 301 511 V12.5.1 (2017-03) EN 301 908-1 V11.1.1 (2016-07) EN 301 908-2 V11.1.1.2 (2017-08) EN 301 908-13 V11.1.2 (2017-07) EN 303 413 V1.1.1

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Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Cet équipement a été testé et reconnu conforme aux limites d'un appareil numérique de classe B, conformément à la partie 15 des règles de la FCC. Ces limites sont conçues pour fournir une protection raisonnable contre les interférences nuisibles lorsque l'équipement est utilisé dans un environnement commercial. Cet équipement génère, utilise et peut émettre de l'énergie radiofréquence et, s'il n'est pas installé et utilisé conformément au manuel d'instructions, peut causer des interférences nuisibles aux communications radio. Le fonctionnement de cet équipement dans une zone résidentielle est susceptible de causer des interférences nuisibles, auquel cas l'utilisateur devra corriger l'interférence à ses propres frais.

Les changements ou modifications non expressément approuvés par la partie responsable de la conformité pourraient annuler l'autorisation de l'utilisateur d'utiliser l'équipement.

This product contains modem – FCC ID ZMONL668AM00

❖ **Disposal of Product and Batteries**

This product is subject to the EU Directive 2012/19/EU for Waste Electrical and Electronic Equipment (WEEE). As such product must not be disposed of in general waste facilities. Please refer to local regulations or contact your distributor on how to dispose this product in an environmentally friendly manner.



Dispose of used batteries via an appropriate recycling facility only.

❖ **Warning**

dataTaker products are not authorized for use as critical components in any life support system where failure of the product is likely to affect the system's safety or effectiveness.

This equipment is compliant with class B of EN55032. In residential environment this equipment may cause radio interference.

❖ **Important: Firmware Version Covered in This Manual**

This version of the dataTaker DT90 Range User's Manual (UM-0090-B1E) applies to the DT90 range of data loggers (DT90L, DT90N).

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Part A – The DT90

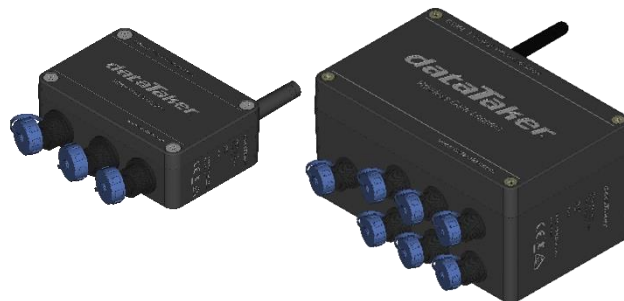


Figure 1: dataTaker DT90N (left); DT90L (right)

DT90 Concepts

What is the DT90?

The DT90L and DT90N dataloggers, are compact all-in-one monitoring modules, designed specifically for remote measurements, where emphasis is on low power, small size and ease of deployment. Having an analogue 16-bit channel resolution and digital counters with SDI-12 / MODBUS RTU support it makes it possible to connect various sensors in the field with minimum time.

Simple connectivity via USB on-site makes it easy to configure and test the deployed monitoring module. Remote configuration gives the possibility to tune the system to arising needs. Variable sampling and transmission schedules are possible to set up. The whole design is made to keep it small, simple and effective, meaning; low maintenance, long uninterrupted working time and money saved!

The DT90 Product Family

The DT90 product family includes the following models:

- The **DT90L** is a low cost, low power Compact variant of data logger
- The **DT90N** is a Nano variant which is smaller model of DT90

DT90-Friendly Software

DT90 Configuration is a desktop based application for programming and monitoring DT90 Series data loggers. This **Config** software requires installation in your PC. It provides a totally simple interface to create and set channels, each channel can have different reading rate.

DT90 Configuration has inbuilt chart to view historic data values and download data. It also possible to trigger instantaneous measurement.

All software is provided on the CD supplied with your DT90, and updates are available from the dataTaker website, www.datataker.com (Support/ Downloads section).

About This Manual

This manual is intended for all users of the DT90. It describes:

- How to connect sensors and other devices to the DT90's input and output channels.
- How to program the DT90 to collect and return data as required.
- How to manage the data that the DT90 collects.

A Tour of the DT90's Interfaces

The DT90 have 2 interfaces with the outside world:

❖ **Communication/ Power and Sensor Interface**

On the bottom part of DT90, there are nine round connectors – in which each connector has a dedicated interface:

- Connector PC: External power and communication to PC interface

DT90L only:

- Connector A1: 2 x voltage inputs or 2 x current inputs and 2 x 12V voltage excitation
- Connector A2: 2 x voltage inputs or 2 x current inputs and 2 x 12V voltage excitation
- Connector A3: 2 x RTD (PT100) inputs in 3 wire configuration or 2 x voltage inputs
- Connector A4: 2 x RTD (PT100) inputs in 3 wire configuration or 2 x voltage inputs

DT90L and DT90N:

- Connector D1: 3 x pulse inputs and 1 x 12V voltage excitation
- Connector D2: 1 x SDI12 input and 1 x MODBUS input

❖ **Modem Interface**

On the top part of DT90, there is coaxial screw connector for main antenna.

Getting Started

Power

DT90 models include an internal 3.6 V Li-ion battery which can power the logger if the main external supply is interrupted. Several selection for main power are AC/DC adaptor, 12V/ 24V external battery or 9V/ 12V solar panel.

When power is connected and the lid is open, you could observe one LED below the left white terminal will start blinking.

Important: The DT90 is shipped with its internal battery disconnected. We recommend the battery is connected as soon as practical so that it can charge from the mains adaptor or other external power source.

Connecting to a Host Computer

In order to program the DT90, it is generally necessary to connect it to a "host" computer. There is a cable for **Connector PC** for USB connection to a PC. 3. The Windows "New Hardware Found" wizard will then run automatically (if required) to complete the installation of the necessary drivers.

Launch **DT90 Configuration** to establish a connection.

Getting Help

This user manual is available in dataTaker website (www.datataker.com), including database of frequently asked questions, code examples, sensor information, application notes, video tutorials and an online forum.

Designing Your Data Logging System

Data acquisition and data logging are orderly processes and should be undertaken in a systematic way. In order to obtain effective information efficiently, do the following:

- Identify the quantities to be measured.
- Select the sensors, considering measurement range, accuracy, stability, ruggedness and cost.
- Select the wiring configuration and data rates.
- Determine sensor output scaling, that is, the relationship between sensor output voltage/ current and the actual quantity.
- Decide on the sample frequency – don't sample faster than you need to.
- Decide on the method of data recovery and alarms.

The remainder of this manual will help you address these questions and then generate a suitable program for your DT90.

Measurements

What can the DT90 Measure?

Analog

Using its analog inputs, the DT90 can directly measure the following:

- **DC voltage** (50mV, 2.5V ranges)
- **4-20mA current loop**
- **temperature** (RTDs)

Digital

The DT90's counter channels allow the measurement of:

- **pulse count** (32 bit)

Serial

Various “smart sensors” can also be read:

- **SDI-12** based sensor networks
- **MODBUS RTU** via RS485

Part B – DT90 Configuration

What is DT90 Configuration?

DT90 Configuration is a desktop application to program DT90 series data logger, it will need to be installed on a PC. This application will set channels, excitation output, data transfer and alarm. It is also possible to plot a chart on historical data.

Connecting to DT90 Configuration

You can establish a connection to DT90 via USB cable.

Main Menu

Page Description

The Main Menu of DT90 Configuration provides 6 options:

- **Configuration** – to configure the logger for reading signal from sensors, setting up data transmission and alarms.
- **Connect** – to establish connection to the logger
- **Instantaneous Measurement** – to get instantaneous reading from logger, download data, set up time and clear logged data.
- **Firmware Update** – to update firmware
- **Display Data** – to display downloaded data
- **About DT90 Configuration** – to display software version

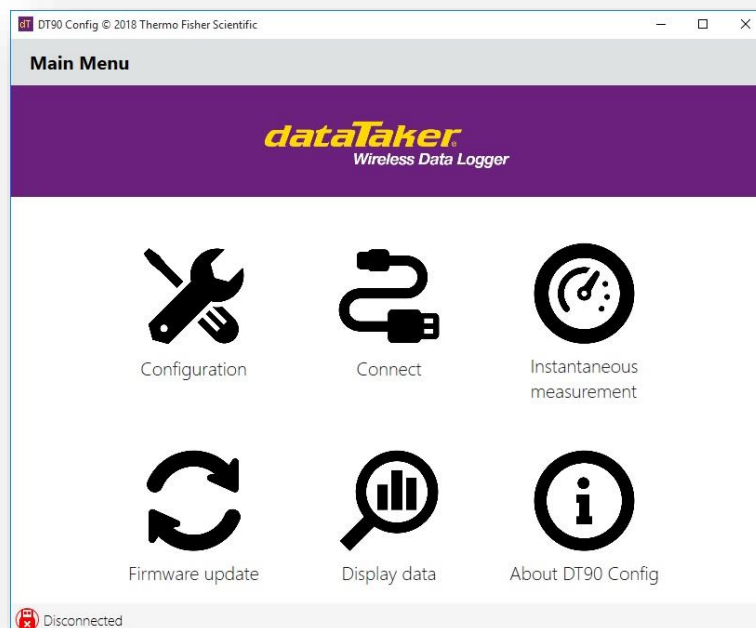


Figure 2: Main Menu Windows

Configuration

Page Description

Configuration menu provides simple and intuitive access to the logger's operation, Select **Configuration** option from the main menu to access the configuration window.

Configuration windows comprises the following elements:

- **Properties Pane** on the right hand side is used to display various setting depending on menu selection. User can define these setting according to requirements.
- Menus on the left hand side are used to access each configuration setting. There are four menus: **Sensors**, **Global Sensor Settings**, **Data Transmission** and **Alarm**. Clicking on a menu will reveal menu items and each item selection would be displayed in the properties pane.
- The banner area along the top screen contains one **Home** button which provides a link back to Main Menu and two information tags: **Station Name** and **Logger Type**.
- The bottom of the screen displays **Connection Status** to the logger.

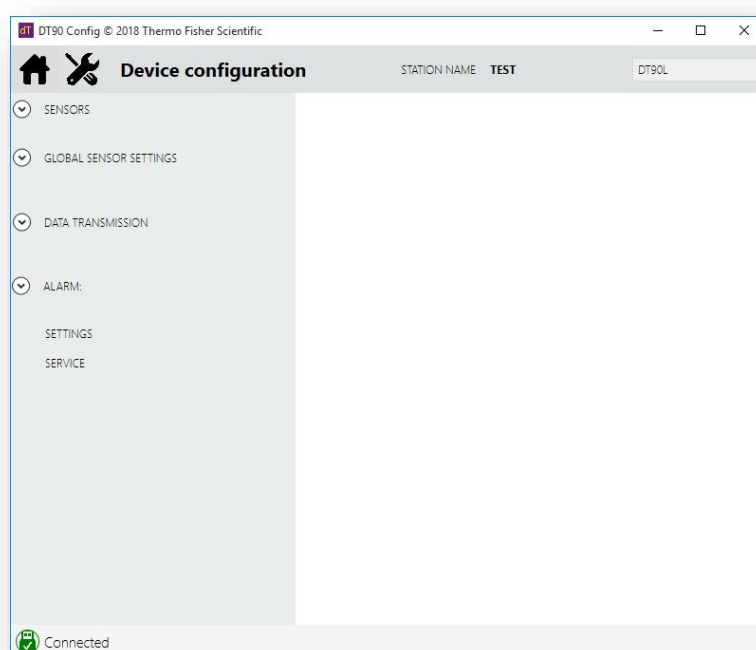


Figure 3: Configuration Windows

Sensors

Sensors menu is used to create measurement channel based on sensor's output signal. There are 2 possible "maximum number" of available channels in a logger unit depending on firmware version, 13 channels (factory default) and 26 channels (optional).

The above selection will determine the number of maximum data point to be recorded in FLASH memory, with 16 MB in size the logger can hold 260,000 data points (for 13 channels) or 130,000 data points (for 26 channels).

13 channels	Date	Time	Zone	Empty1	Empty2	Empty3	...	Empty12	Empty13
26 channels	Date	Time	Zone	Empty1	Empty2	Empty3	...	Empty25	Empty26

Table 1: Logger memory mapping

Each channel have might be configured by setting the following fields:

Figure 4: Weather Station Sample Program

Input

Signal source for the channel, selected from the list depending on the device.

The drop-down list includes:

- **SDI-12** – digital sensors operating in compliance with SDI-12 standard (see [SDI-12 \(P14\)](#))
- **Internal analog** – measurement of the logger's internal parameters such as: voltage of the built-in battery, voltage of the external power source, 5V and 12V auxiliary power
- **MODBUS RTU** – digital sensors operating in compliance with MODBUS RTU standard (see [MODBUS RTU \(P14\)](#))
- **Pulse Counter** – predefined pulse sensor necessary for operating a rain gauge (usually tipping bucket rain gauges), with pulse output
- **External analog** – measurement of analogue values of voltage and currents from external sensors (see [Analog \(P13\)](#))
- **Wind Gauge** – predefined pulse counter necessary for operating a classic mechanical anemometer – pulse output only
- **Status** – predefined pulse sensor for handling logical signal sources 1/0

Name

The **Name** field includes the name of the given channel defined by the user up to 20 characters. The name might include any string of ASCII characters.

Parameter

The **Parameter** field allows to select additional options related to a given input signal type. The example below shows a drop-down list of available parameters for **Internal Battery**.

Cycle

The **Cycle** field allows to define the measurement interval for that particular channel. You can choose intervals ranging from 1 minute to 24 hours from the drop-down menu. Measurements shall be taken with respect to 00.00 hour of the logger's time (**midnight reference**) without the option of entering a time shift. The table below indicates midnight reference of taking measurements based on time interval values:

5 minutes interval	Measurement 00:00:xx	Measurement 00:05:xx	Measurement 00:10:xx	...	Measurement 23:55:xx
4 hours interval	Measurement 00:00:xx	Measurement 04:00:xx	Measurement 08:00:xx	...	Measurement 20:00:xx

Table 2: Midnight reference to measurement interval

The number of seconds shown here as **xx** depends on the sensor connected to the logger and on the so-called **Measurement Delay** available in **Global Sensor Settings** tab. The time, at which measurement is recorded in FLASH non-volatile memory is the time of completing a sampling cycle.

In special cases, when sensor requires a longer starting time (i.e. to start up, stabilize the reading after start-up - **Measurement Delay**) and while the measurement cycle of a sensor is long (i.e. in order to damp the measurement), a measurement time shift greater than 60 s may occur, and this is considered normal.

❖ “Other” Interval Option

There is one more way to define sampling intervals by selecting “Other” option in the **Cycle** field. You will be presented 24 hours check box in hourly basis. Selecting any of the box will prompt the logger to start measurement at the beginning of the selected hour. This “Other” option will disable a standard measurement interval.

This functionality is particularly useful if the sensors connected to the data logger do not require continuous powering, in which power will only activated for the time of measurement. Powering up the sensors before measurement and shutting off the power is preferred for all applications to preserve energy in the data logger.

INPUT: Internal analog

NAME: Internal Battery

PARAMETER: Battery voltage

CYCLE: 1 min

GRADUATION: Factor (a, b)

a= 1 b= 0

UNIT: V

PRECISION: 0.001

ALARM: Disabled

Figure 5: Internal Channel

Scaling

Values obtained from sensors might be scaled in order to obtain desired output value ranges. Scaling of measurements applies both to displayed temporary values and the values saved in non-volatile FLASH memory. Users can choose between two types of scaling. Both options come down to scaling using a linear function.

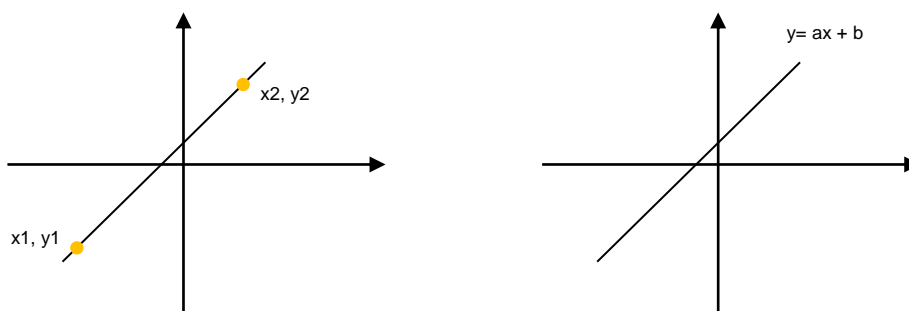


Figure 6: Scaling - Two points (left) and slope-intercept (right)

This scaling cannot accept floating point number, thus you will need to use workaround using two points scaling. For example if you need to define 1 pulse as 0.1 mm for precipitation, because you can't define 0.1 on "a" component thus you can use this method:

Figure 7: Scaling to achieve floating point factor

Unit

Each measurement channel might have a defined unit, with which the data are recorded and presented. **Unit** field might include up to 10 ASCII characters.

Precision

Precision field allows to determine the precision of decimal points within measurement data either in the display or transmitted data up to 4 digits (0, 0.1, 0.01, 0.001 and 0.0001). However the setting does not change the method of saving numbers in the memory, data are always saved in the memory with maximum precision.

Notes: This option does not influence the maximum amount of data saved in the memory.

Alarm

DT90 device allows to configure up to three event alarms. Alarms might be set for any channels, but not more than one alarm per channel. In order to activate alarm on a given measurement channel, change field Deactivated at the bottom of its window into the alarm number.

If an alarm is set on one channel, its configuration needs to be completed in [Alarm \(P16\)](#) tab.

Global Sensor Settings

Analogs

This page allows user to set the type of input of 8 analog channels, either as voltage, current or PT100. These analog channels are located on 4 connectors A1, A2, A3 and A4. This setting is required to set the logger for accepting the signal.

Figure 8: Analog channel allocations

MODBUS RTU

In this page user can set serial port setting as well as parameters location within MODBUS sensor including sensor address. Later on after setting up this page user can create channels within [Sensors \(P10\)](#) page.

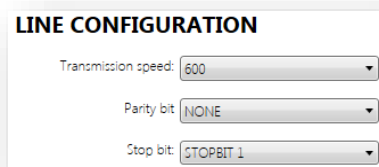


Figure 9: Serial port configuration

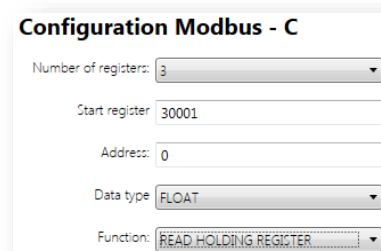
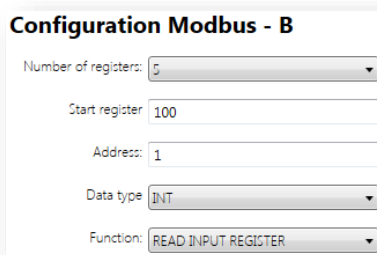
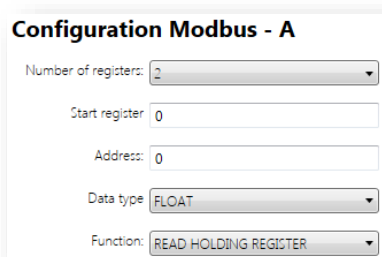


Figure 10: The first 3 MODBUS entries out of 10 entries

There are 9 configuration settings (from A to I) and each of them deals MODBUS block read. Users may utilise these 9 entries for either:

- 9 single parameter reading from a single sensor which have different register location
- 9 blocks read* from a single sensor as long as the total number of channels are within 26
- 9 blocks read* from up to 9 sensors as long as the total number of channels are within 26

Data type and MODBUS functions are configurable on each configuration setting. User may choose data type:

- **INT** (integer),
- **UINT** (unsigned integer)
- **FLOAT** (floating point)
- **INT32** (long integer)
- **UINT32** (unsigned long integer)

And choose MODBUS functions:

- Coils (function 1)
- Discrete Inputs (function 2)
- Holding Registers (function 3)
- Input Registers (function 4)

Notes: * Block read or block transfer refers to reading action of consecutive MODBUS register using a single command by defining the number of target registers. The maximum length for block read is 32 registers.

SDI-12

There are 8 sections within SDI12 settings ([Figure 11](#)), each setting has one main measurement (M!) with up to 20 parameters and 3 additional measurements (M1! – M3!) with 9 parameters each. Users may choose to use SDI12 version 1.0 (M) or version 1.2 (C), unfortunately it does not support version 1.3 (CC).

After setting up parameter location in this page, user will need to define the channels [Sensors \(P10\)](#) page.

SECTION A	SECTION B	SECTION C	SECTION D
Address: 0	Address: 1	Address: 2	Address: 0
Protocol: M	Protocol: M	Protocol: C	Protocol: M
Number of parameters: 2	Number of parameters: 3	Number of parameters: 3	Number of parameters: 0
M1: 2	M1: 0	C1: 2	M1: 0
M2: 2	M2: 0	C2: 0	M2: 0
M3: 2	M3: 0	C3: 0	M3: 0

SECTION E	SECTION F	SECTION G	SECTION H
Address: 0	Address: 0	Address: 0	Address: 0
Protocol: M	Protocol: M	Protocol: M	Protocol: M
Number of parameters: 0	Number of parameters: 0	Number of parameters: 0	Number of parameters: 0
M1: 0	M1: 0	M1: 0	M1: 0
M2: 0	M2: 0	M2: 0	M2: 0
M3: 0	M3: 0	M3: 0	M3: 0

Figure 11: SDI12 Settings

Other Settings

DT90 loggers enable powering measurement equipment from own power source. Depending on the logger model type the user can choose between:

- **12V** – stabilized 12 V voltage from an integrated inverter with maximum current efficiency at the level of 200 mA (DT90 L) and 100 mA (DT90 N)
- **5V** – stabilized 5 V voltage from an integrated inverter with maximum current efficiency at the level of 200 mA (DT90 L)

The user might apply the aforementioned supply voltage levels, depending on their needs. Please note that activating inverters for 5V and 12V voltage in one of two modes, that is, active during measurement or always active ([Figure 12](#)) can influence on electricity consumption of the internal battery pack.

After activating the voltage supply the sensors usually need a certain time to stabilise their operating parameters. This time differs between different sensor manufacturers and models. The **Measurement Delay** field shows integer numbers ranging from 0 – 120 s.

It is important to remember that cumulating the delay in initiating measurement with the measurement time might in particular cases result with incapability to obtain the smallest measurement intervals and data transmission intervals. In such case unforeseeable delays and irregularities in saving the measurements in non-volatile memory might occur. Moreover, the logger remains active and its energy intake is higher for the defined period of delay.

DELAY MEASUREMENTS

Offset [sec]: 10

POWER

12V: All time

5V: Measurement time

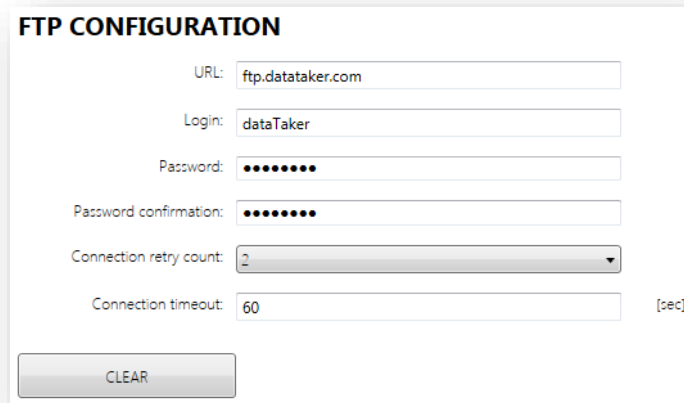
Figure 12: Power Output setting

That's why the value entered in **Measurement Delay** field should be optimally adapted to the applied sensors. Please consult the sensor manual or manufacturer support to receive information about warm up time.

It is also possible to supply the sensor power at all times, but it is not advised if the logger is using batteries or solar panels for power.

Data Transmission

Data transmission setting control data connection to 4G network, FTP destination as well as transmission interval. Within FTP configuration user will need to provide server name and credential, you can also set the number of retries if the transmission failed.

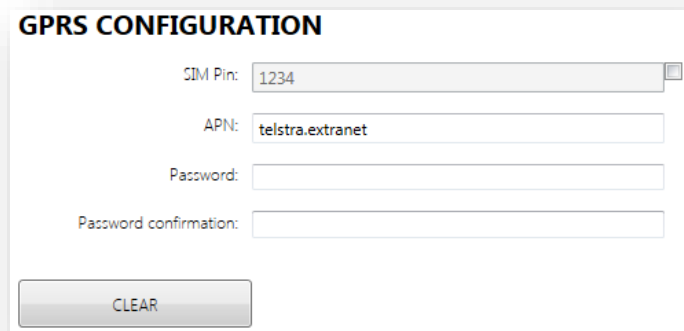


The FTP Configuration form contains the following fields and controls:

- URL:
- Login:
- Password:
- Password confirmation:
- Connection retry count: (dropdown menu)
- Connection timeout: [sec]
- CLEAR button

Figure 13: FTP configuration

Within GPRS configuration, user can set the pin to access SIM card as well as defining APN information. The checkbox next to Pin entry is used to enable and disable pin feature.

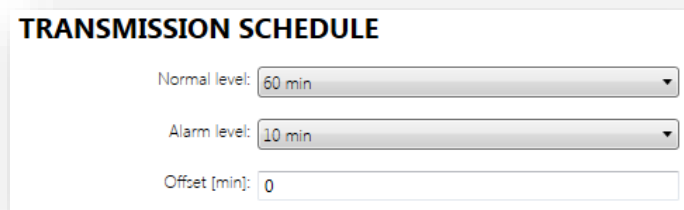


The GPRS Configuration form contains the following fields and controls:

- SIM Pin: ☐
- APN:
- Password:
- Password confirmation:
- CLEAR button

Figure 14: GPRS configuration

The last setting is transmission interval for FTP data, you can have 2 types of interval depending on the limit you defined within Alarm page. The first one is a normal interval which happen when the reading value is not exceeding alarm limit, and the next one is alarm interval which happen when the value exceeds defined alarm limit.



The Transmission Schedule form contains the following fields and controls:

- Normal level: (dropdown menu)
- Alarm level: (dropdown menu)
- Offset [min]:

Figure 15: Transmission schedule

Alarm

Alarms are triggered based on the value measured for a given channel. Alarm might be triggered by a measured value exceeding the upper or lower threshold (only one threshold might be selected). The logger will exit from the alarm mode the measured value does not exceed the set thresholds.

Alarm mode may trigger:

- A change of transmission intervals (settings in **Data Transmission** tab), however it will not change the sampling interval on that channels.
- Sending one text message to maximum three destination number.

❖ Alarm Configuration

This setting will allow user to set alarm threshold from three possible alarm events. The selection is limited to upper or lower threshold exclusively, which mean only one threshold can be selected on every event. There are 3 thresholds in total which usable across all 26 channels.

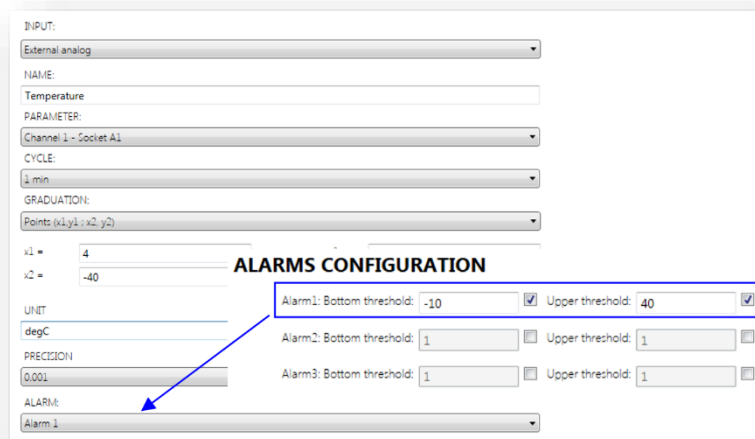


Figure 16: Alarm configuration and placement on a channel

❖ SMS Configuration

SMS Configuration page is used to set destination number for SMS, there are 3 numbers available and user can also set service center for SMS.

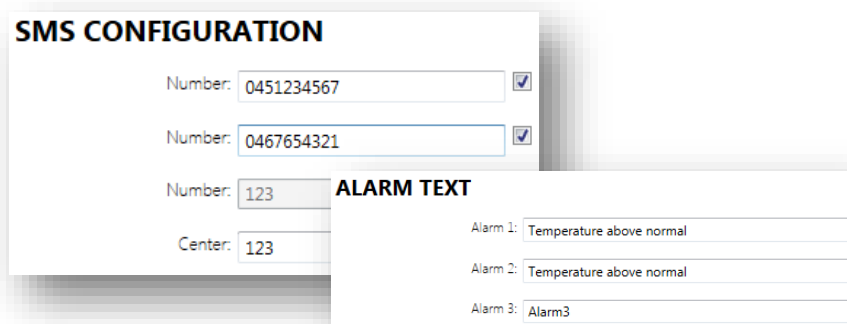


Figure 17: SMS Configuration and Alarm Text

❖ Alarm Text

Alarm test is used to define the content of SMS alarm, there are 3 entries available each is related to destination number in SMS Configuration (see [Figure 17](#)).

Setting

Setting page is used to set station name on the logger and time. There is a checkbox to enable time synchronisation with GSM network also a button to match with PC time. The checkbox is checked as a default and we recommend to keep this setting for maintaining logger time stamp.

Connect

Page Description

Connect menu provides a tool to establish connection to the logger via USB.

If DT90 device is powered and has been correctly connected to a computer using an USB cable, the software will automatically recognize the loggers COM port number after clicking **Auto Detect** button. While **Save** button will allow you to save the port's setting as well as initiating the connection.

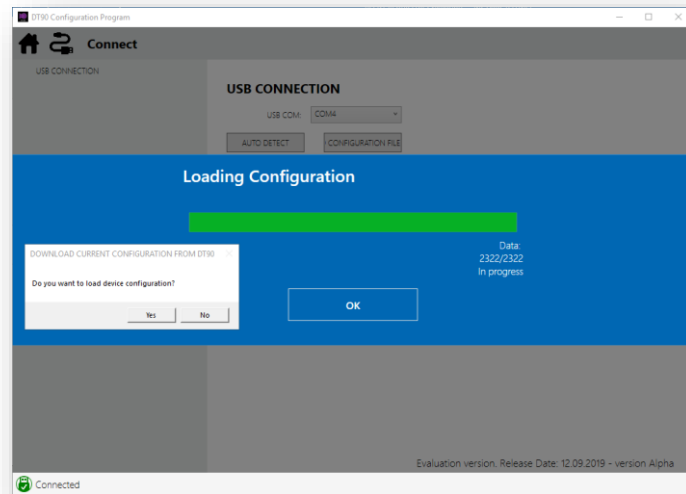


Figure 18: Connect Windows and Loading Configuration

The first response after a connection have been established is whether the user want to upload the existing configuration or start the program from scratch.

Instantaneous Measurement

Page Description

Instantaneous Measurement menu provides a simple interface to run a test on the recent loaded configuration, as well as download the data, getting logger clock and clearing the log.

Instantaneous Measurement windows comprises the following elements:

- **Device Logs** which occupy most of the screen.
- Menus on the lower side of Device Logs. There are four menus: **Measurement**, **Load Data**, **Get Time** and **Clear Log**.
- The banner area along the top screen contains one **Home** button which provides a link back to **Main Menu** and two information tags: **Station Name** and **Firmware Version**.
- The bottom of the screen displays **Connection Status** to the logger.

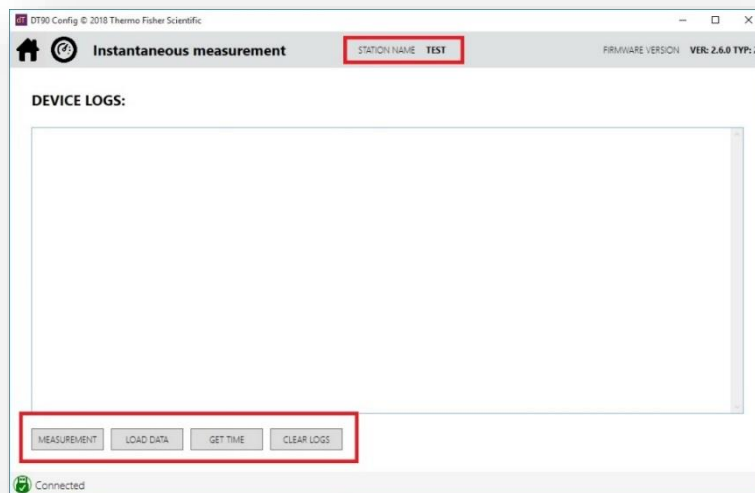


Figure 19: Instantaneous Measurement Windows

Measurement

DT90 data logger enables taking measurements "on request". When configuration is complete, you can check whether all parameters have been set in compliance with the user's initial assumptions. You can check whether all the connected sensors operate correctly.

After selecting Instantaneous measurement tab from the main menu, the window from is visible.

Load Data

If data transmission using mobile network fails, or if the user decides not to use wireless transmission, measurement data might be downloaded using a dedicated USB cable and computer with **DT90 Config** software.

After establishing connection with the logger data download can be triggered. The appearing window allows to select the location and name, under which the data file is saved. After confirmation the logger starts data transmission. Depending on memory capacity, transmission might take from several dozens of seconds to even several minutes. Progress in transmission is shown in a filled up bar.

Get Time

This function will show logger's current time and time synchronisation status

Clear Log

This function will clear the content of Device Logs.

Firmware Update

Requirements

DT90 configuration software enables updates of DT90 logger's software via USB interface. Before starting software update ensure that the connection between the computer and the logger is stable. The connection cable needs to be in a good condition. It is recommended that its length does not exceed two metres.

It is not recommended to use an extension cable for USB to update the firmware. Unstable connection resulting from damaged or too long cable might result in interrupting transmission during software upload. Irreversible blocking of a data logger's operation might be a result of it. In such case only a repair at the manufacturer's service centre is possible to restore the logger to work. A safe charge level of the internal battery pack is another condition of safe software update.

A safe update is possible if the battery voltage exceeds approximately 3.6V.

Note: Only a .hex file provided by the manufacturer can be used for update. The manufacturer is not liable if the user uses a file from an unreliable source.

Update Process

When the correct .hex format file is copied to the computer's hard drive it is necessary to check if DT90 device has been connected to the computer. When a connection has been established then firmware update can start, after selecting an appropriate file provided by the manufacturer.

Note: Configuration, data collection and transmission are not available during update process.

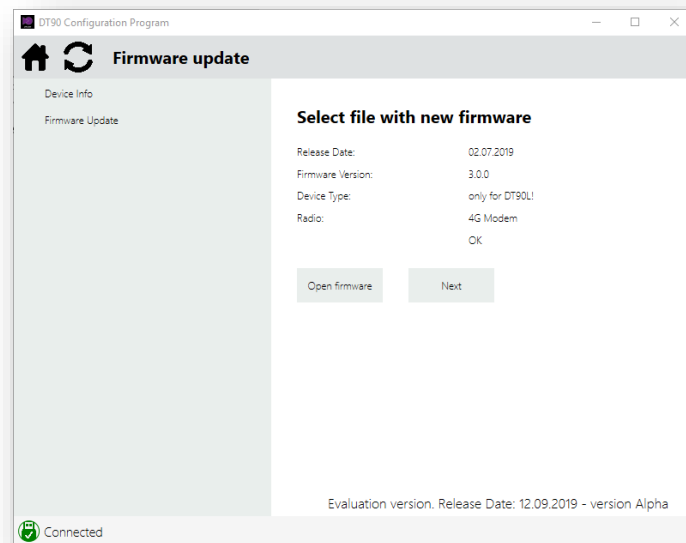


Figure 20: Firmware Update Windows

Display Data

Page Description

Display Data menu provides a simple interface to plot the unloaded data into a chart.

Display Data windows comprises the following elements:

- The small top portion is **Folder Path** which allow user to select folder with the data file.
- The lower portion is **Data Files**, with **Chart** button on the right.
- The banner area along the top screen contains one **Home** button which provides a link back to Main Menu.
- The bottom of the screen displays **Connection Status** to the logger.

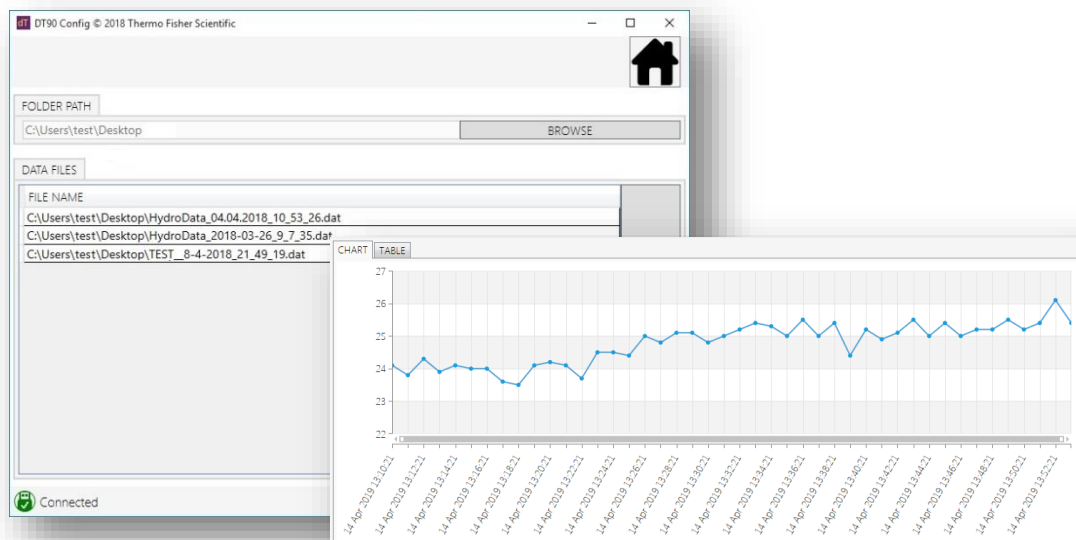


Figure 21: Display Data Windows – Temperature Chart

After opening the chart windows, you may select the parameter to see (left top corner drop down menu), choose data range of the chart and zoom in specific area in the chart. The Y axis will automatically follow the maximum/ minimum values within data range.

Beside chart you may also see the data in tabular form and also convert it into CSV file. Conversion will take the currently displayed data or all parameters in the file.

About DT90 Configuration

This page contains additional information about the application such as version number and release date for that version, also explain the contact information for the logger.

Part C – Sensors & Channels

Overview

This section describes how to use the DT90's analog, digital and serial inputs to measure many different physical quantities. The focus here is on the measurement process – connecting up a sensor and successfully reading it.

The following topics are covered for each sensor type:

- An overview of how a measurement is made
- Wiring configurations – how to physically connect to the DT90's input terminals.
- The applicable DT90 channel types and channel options – that is, how to program the DT90 to read the particular sensor or measure the particular quantity.

This section also includes some general information about how the DT90's analog measurement system works, and how to get the best out of it.

What Can Be Measured?

Analog channel types:

- voltage
- current and current loops
- RTD (PT100)

Digital channel types:

- pulse counters

Serial channel types:

- SDI-12
- MODBUS RTU

Connector and Pin Assignment

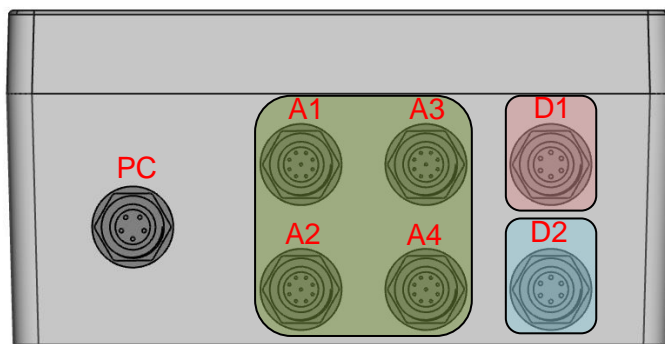


Figure 22: Connectors setup for DT90L, analog (green), serial (brown), and digital (blue)

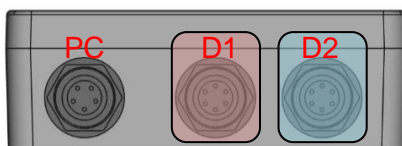


Figure 23: Connectors setup for DT90N, serial (brown) and digital (blue)

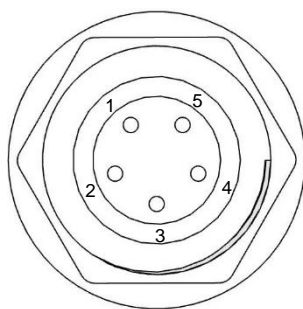
There are two connector setup within DT90 depending on model.

DT90L (Lite model) has 7 connectors, while DT90N (Nano model) has 3 connectors

- Connector PC for power and external communication
- Connector A1, A2, A3 and A4 for analog signal – not available in DT90N
- Connector D1 and D2 for digital/ serial signal.

Power and Communication Connector (PC)

Connector PC is used for power input and USB communication. Each function will utilise different cable.



Pin	Function
1	Gnd/ USB Gnd
2	Vcc
3	USB Data +
4	USB Data -
5	USB Vcc

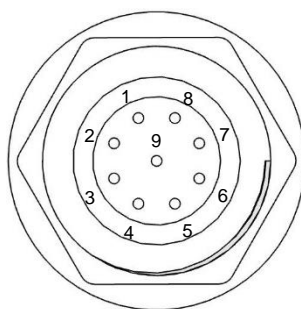
Figure 24: 5-pin Power/ Communication Connector

Analog Input Connectors (A1 – A2 – A3 – A4)

Not available on DT90N

Analog inputs use 9 pin connectors which can be used either as voltage channel, current channel and RTD channel. Other than input channels, this connector can serve as voltage output.

Although each connectors are compatible for three signals, there is a limitation of 2 sensors per connector. So users are required to have wiring plan based on sensor numbers. This wiring will make impact on channel declaration when programming on **DT90 Config**.



Pin	Function
1	Gnd
2	Vout1 12V
3	Iin 1/ RTD 1a
4	RTD 1b
5	Vin 1
6	Vout2 12V/ RTD 2a
7	Iin 2/ RTD 2b
8	Vin 2
9	N/A
	PE

Figure 25: 9-pin Analog Inputs Connector

Voltage Inputs (A1 – A2 – A3 – A4)

There are 2 possible connections:

- pin 5 for **Vin** and pin 1 for **Gnd**
- pin 8 for **Vin** and pin 1 for **Gnd**

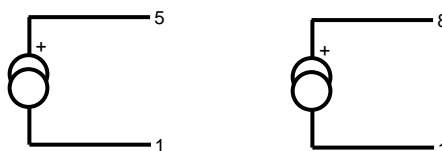


Figure 26: Voltage Channels – Wiring Configuration

Current Inputs (A1 – A2)

There are 2 wiring methods for current channels depending on voltage source:

- Voltage source taken from the logger (Vout) with 2 possible connections:
 - o pin 2 for **Vout** with pin 3 for **lin**
 - o pin 6 for **Vout** with pin 7 for **lin**

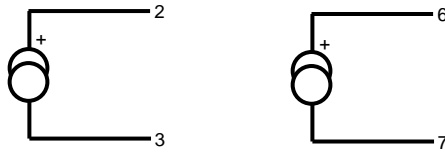


Figure 27: Current Channels – Internal Supply Wiring Configuration

- Voltage source from external with 2 possible connection
 - o pin 1 for **Gnd** with pin 3 for **lin**
 - o pin 1 for **Gnd** with pin 7 for **lin**

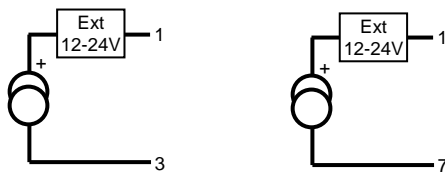


Figure 28: Current Channels – External Supply Wiring Configuration

RTD Inputs (A3 – A4)

RTD channel will read 3 wire PT100 and there are 2 possible connections:

- pin 3 + 4 on one lead and pin 1 on other lead
- pin 6 + 7 on one lead and pin 1 on other lead

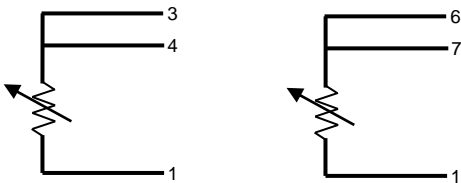
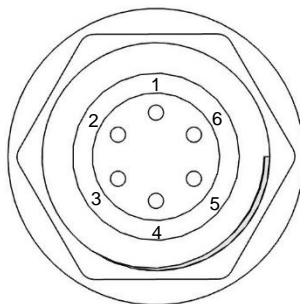


Figure 29: RTD Channels – Wiring Configuration

Digital/ Serial Input Connectors (D1 – D2)

Counter Inputs (D1)

Counter inputs use 6 pin connector with a total 3 connected sensors.



Pin	Function
1	Gnd
2	Vout 12V
3	Vout 5V
4	Counter 1
5	Counter 2
6	Counter 3
	PE

Figure 30: 6-pin Digital Inputs Connector

These counter inputs rely on impulse signal in which transient change of signal amplitude occurs. However it may be used to read dry contact signal (i.e: reed contact) as long as external voltage is applied to generate the impulse signal.

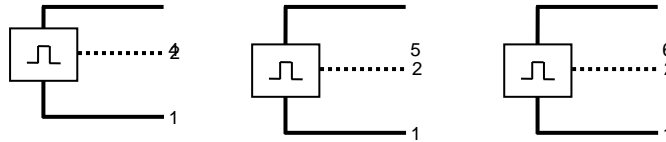


Figure 31: Pulse Channels – Wiring Configuration

SDI-12/ MODBUS RTU Channel (D2)

A single connection for both SDI-12 and MODBUS is available in this connector.

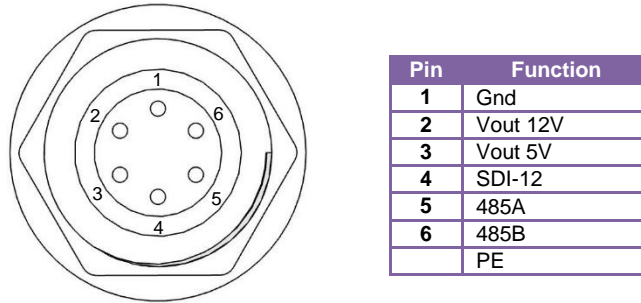


Figure 32: 6-pin Serial Inputs Connector

For SDI-12 input, users may refer to the following figure for wiring configuration. They may connect up to 2 sensors to the logger using the same wire (pin out). The logger support up to 8 addresses for SDI-12 (**0 – 7**), three additional measurements (**M1! – M3!**).

Twenty parameters are supported on the main measurement (**M!**) and nine parameters for the additional measurements. In total the logger may provide reading for 32 parameters per sensor.

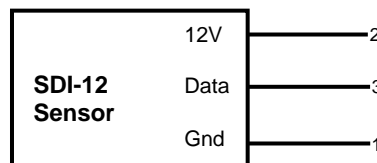


Figure 33: SDI-12 Channels – Wiring Configuration

The logger supports RS485 connection on MODBUS RTU protocol, please use the following figure for wiring configuration. Users may connect one MODBUS sensor with a maximum 16 parameters. The logger support four MODBUS functions (coils, discrete inputs, holding registers, input registers), however there is only a single setting because the reading is based on block read.

Each register may be set into specific number and bit number:

- 16 bit (integer, unsigned integer)
- 32 bit (long integer, long unsigned integer, floating point)

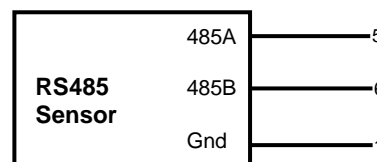


Figure 34: RS485 Channels – Wiring Configuration

Voltage Output

Several pins are **Vout** and they can provide a continuous 12V or 5V output for the sensor. User may also utilise this output as part of current channel configuration.

Please be aware that pin out location will be different from each connector, so it is recommended to look up this manual or connector labelling for reference.

Connector Labelling

Each cables has their own labelling for easy wiring so user does not need to look up this manual for reference. The colour indicates pin assignment from pin 1 to pin 8 for **Connector A2**. Pin 9 is not used, while PE is cable shielding to be connected to earth.

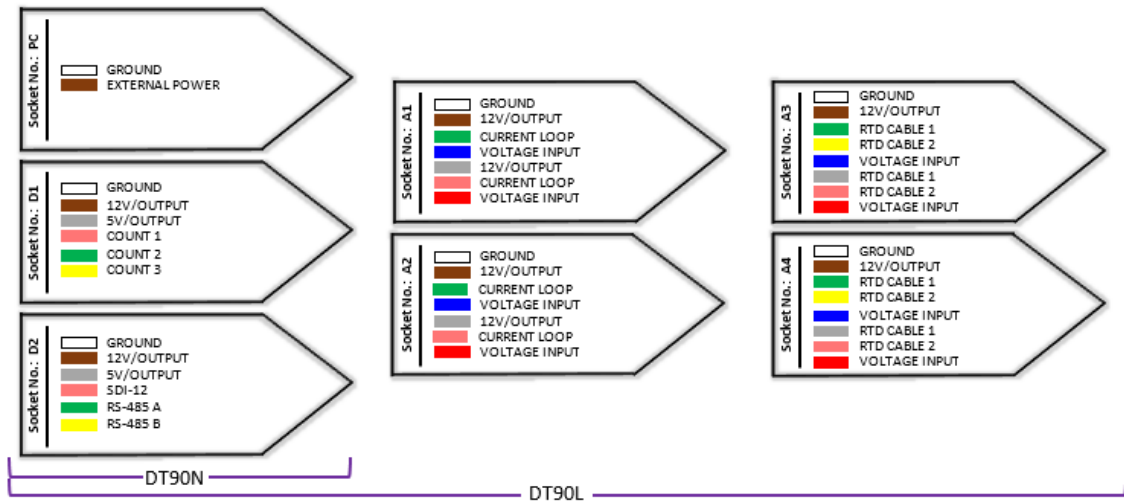


Figure 35: Socket Labels – Colour cable marking

- Notes:**
1. The above connector labelling is based on socket number in which identical to connector ID in this manual. The reason of using letter instead of number in this manual for the user not to be confused with pin numbering.
 2. The same thing for colour code, in this manual, instead of using colour, pin assignment is using number. This will make an easy approach to understand pin location.

Part D – References

DT90 Series Specifications

Analog Channels

Not available on DT90N

- Inputs: 8 dedicated analog channels
- Effective resolution: 16 bit
- Each connectors may host 2 inputs

Voltage Inputs

- Default switchable range: 0-50 mV; 0-2.5 V;
- Connectors: A1, A2, A3 and A4

Current Inputs

- Range: 0-20 mA; 4-20 mA
- Connectors: A1 and A2

RTD Inputs

- Types: Pt100
- Connectors: A3 and A4

Sensor Excitation (Supply)

- 12V/ 5V regulated supply for powering sensors & accessories on connector A1, A2 and D1 up to 200 mA
-

Digital Channels

Counter Inputs

- Inputs: 3 dedicated counter channels.
- Connector: D1

Serial Inputs

SDI-12

- 1 SDI-12 input on connector D2, support up to 2 sensors.
- Each sensor can have 32 values on 3 additional SDI12 measurements.

Modbus Client (master)

- 1 serial (RS485) port dedicated with Modbus client protocol, support up to 10 sensors in block read
 - Available on connector D2
 - Baud rate: 600 to 115,200
-

Data Processing

Alarms

- Condition: high and low threshold
- Number of conditions: 3
- Actions: send SMS, increase/ decrease sampling or transmission rate

Scheduling of Data Acquisition

Can read up to 26 channels with individual schedule rate from 1 minute to 24 hours.

Data Storage

- Internal Store
- Capacity: 16MB (minimum 500,000 data points)

Hardware

Power Supply

External voltage

- 5 to 25 Vdc
- 9 V or 12 V solar panel

Internal battery

- Rechargeable Li-ion 3.7 Vdc 16 Wh (DT90N); 3.7V 48 Wh (DT90L)
- Service life: approx. 5-10 years
- Charging cycles: approx. 1000-2000 for a 100-90% battery discharge cycle

Integrated Cellular Modem

Features

- Alarms: Send SMS messages
- Data: Send data to a FTP server
- SIM interface: SIM Socket (1.8V/3V)

Networks

- LTE FDD: Band 1/3/5/7/8/20/28
- LTE TDD: Band 38/40
- WCDMA: Band 1/5/8
- GSM/GPRS/EDGE: 850/900/1800MHz

Physical and Environment

- Construction: Black anodized aluminum cast case.
- Dimensions:
 - DT90L: 180 x 100 x 80 mm (excluding plug and antenna)
 - DT90N: 100 x 70 x 38 mm (excluding plug and antenna)
- Weight: 1.25 kg (DT90L); 0.5 kg (DT90N)
- Temperature range: -40°C to 70°C
- Humidity: 0-100% RH, when lid is closed
- Protection rating: IP67

Accessories Included

- Resource USB: includes software and user manual.
- Communication cable: USB
- Sensor (connector) cables: 6 set

Care and Maintenance

Transport

DT90 data logger starts measurement after receiving power from a single-use or rechargeable battery (it does not have a power switch). Due to this fact the device should be disconnected from power for transport and storage. This prevents premature discharging and logging non-representative measurements.

Transport the device only with the antenna detached to prevent its breakage or damage to the antenna mounting bracket (IP67-rated). Use bubble foil or a similar solution to secure the connectors against shock in case of a fall or other impacts possible during transport.

Installation

❖ Outdoor Mounting

The data logger can be installed directly outdoors. The device is typically installed on masts and poles at a height providing an adequate installation spot and protection of the data logger and its sensors from third party access. The enclosure is designed to protect the device when operating in full sun as well as in shaded places during the winter.

Mount the device with the connectors downward and the antenna upward. This is meant to provide additional protection for the connectors during the installation.

The device can be also installed in electric boxes to provide an additional protection.

Notes: When roofing is not available, it is recommended to install the device on an angle, creating slope between two long edges. User may utilise mast holder (accessories) to provide the required slope.

❖ Sensors Wiring

Insert the sensor cable plugs according to their markings (dots on the plug and the socket) and then screw them in, applying gentle force until you feel slight resistance. The plug fixing nut is designed only to prevent disconnection of the plug from the connector. It does not serve a sealing function and its further tightening will not provide better sealing.

The sensors must be equipped with cable connectors that match those used in the data logger. The connectors differ in terms of the number of contacts and cable profile. The probes should be installed according to their DTR and/ or detailed design.

The electrical connections must be made according to the as-built documentation or the detailed documentation provided within a specific data logger delivery.

Notes: The connector is made of composite material and its overtightening may result in breaking the fixing nut. Return for repair if the nut is broken.

Warning: Do not deploy the device with damage connector socket.

Battery Installation, Inspection and Replacement

The device comes equipped with a Li-ion battery with improved temperature resistance. The internal electronic system manages the battery charging/discharging process, ensuring its long service life.

For a device installed in a place with good GPRS coverage performing one measurement every hour and transmitting the data once per day, the operation time with a standard 48 Wh Li-ion battery is approximately 50 days.

If the device does not send information on the battery charge level along with the transmitted measurement data despite being set to do so, the battery charge level can be read in the following way:

- Set a PC/ DT90 connection (USB)
- Select the **Sensors** tab in the **DT90 Configuration** software and check whether the internal power supply channel has been configured. If not, it must be configured first.
- Select the Logger tab in the **DT90 Configuration** software.
- Click the **Measurement** button and **DT90** will begin a measurement of the present values
- After the ordered measurement has been completed, the device will show the last measured values, including the battery voltage level

DT90 starts measurement after a battery connector is inserted (it does not have a power switch) into the board. If you want to turn DT90 off, disconnect the battery. This prevents premature battery discharging and logging non-representative measurements.

❖ Charging Flat Battery

If the device battery has discharged during transport it must be charged first. In order to do that, connect a working external power source (solar panel, an AC/ DC power supply) to the service/power supply port with the device enclosure open.

If no diodes on the motherboard light up, wait for 10 minutes and disconnect the external and internal power source (in this order). After 15 seconds connect them again in reverse order (first the internal and then the external power source). If no effect is observed, perform the entire procedure once again after 15 minutes.

If the data logger continues to give no answer, contact the manufacturer to consult further actions. If possible, check the internal power source voltage using a DC voltmeter at each disconnection by checking the voltage at the plug connectors (a meter with thin probes is required).

Moisture Absorber Replacement

Inspect the absorber every time you open the enclosure. It is advised to replace the absorber with a dry after a long period of operation without opening the enclosure (i.e.: 1 year). However periodic replacement is not required due to the IP67-rated device enclosure.

There are two types of moisture absorber that can be used:

- Capsule absorbers are cylindrical moisture absorbers made of white polypropylene that is sealed with a barrier that allows for moisture passing. Owing to the additional protection, it does not produce dust and is resistant to mechanical damage. The capsules have moisture indicators. A color change from light blue to light pink indicates that the capsule must be replaced regardless of the time since the last replacement.
- Pouch absorbers come in the form of a pouch filled with moisture-absorbing granules. This protection prevents dusting. It is also moderately resistant to mechanical damage. Pouch absorbers do not have moisture indicators. The condition of moisture-absorbing granules must be inspected visually through the pouch. A dry absorber is usually light colored and becomes darker with the increase in moisture.

Notes: 1. Pouch absorber can be dried up quickly in an oven with the temperature set to no more than 140°C (min. 100°C).
2. Capsule absorber cannot be dried up using the oven because of the risk of polypropylene melting.

Glossary

❖ **3G/ 4G modem**

A device or module that allows a computer to connect to the Internet via a 3G/ 4G network connection.

❖ **4–20 mA**

A common industrial measurement standard. A transmitter controls a current in the range of 4 to 20mA as a function of a measurement parameter. Any receiver(s) or indicator(s) placed in series can output a reading of the parameter. Main advantage is 2-wire connection and high immunity to noise pick-up.

❖ **Ω**

Ohm, a unit of resistance

❖ **channel**

Describes a measurement to take, or a control action to perform.

❖ **Firmware**

The "operating system" stored inside the DT90. The DT90's firmware is user-upgradeable.

❖ **FTP**

File Transfer Protocol. A TCP/IP protocol for copying files from one computer to another.

❖ **Modbus**

A widely used control and automation communications protocol, often used in SCADA systems.

❖ **PLC**

Programmable Logic Controller. Used to automate monitoring and control of industrial equipment.

❖ **resolution**

The smallest detectable increment of measurement — that is, the smallest change in input that produces a detectable change in output. In the field of data acquisition, resolution is the number of bits that the ADC uses to represent the analog signal — the greater the resolution, the smaller the changes in input signal that can be resolved/detected.

❖ **RTD**

Resistance Temperature Detector. A resistive sensor that changes resistance with changes in temperature.

❖ **sampling speed**

The maximum rate at which analog-to-digital conversions can be done. This includes any channel selection time, settling time (for the signal to stabilise) and processing time (if required).

❖ **SCADA**

Supervisory Control and Data Acquisition (SCADA) systems are used to monitor and control plant status and provide data logging facilities.

❖ **schedule**

A collection of channel definitions which will be evaluated when a certain trigger condition is true (e.g. the required time interval has elapsed, or a digital input has changed state)

❖ **SIM**

Subscriber Identify Module – a small card which electronically identifies a mobile subscriber. The DT90 loggers require a SIM card in order to be able to connect to a mobile network.

❖ **transducer**

A device that converts a physical parameter (temperature, for example) into an electrical voltage or current. It is usually a sensor with additional electronics for signal conditioning and scaling.

❖ **USB**

Universal Serial Bus. A standard method of connecting peripheral devices to a host computer. The DT90 operates USB device for programming via host computer.

Safety Information

General

- The installation should be carried out by persons who have familiarized themselves with this document and, if possible, have experience and practical knowledge regarding working with electronic equipment.
- Burn hazard – DT90 metal parts may become very hot in high ambient temperatures. Use protective gloves during device installation and maintenance.
- Protect the electronics against electrostatic discharge.
- Since this device runs at voltages lower than 24 V, it does not have to be operated (although it is recommended) by personnel authorized to handle electric and electronic devices such as electricians, electronics engineers, etc. (degrees and certificates vary from country to country, please check local regulations)
- In the event of failure, the device should be disassembled and sent for repair in the manufacturer's service centre or a service center authorized by the manufacturer. Any unauthorized device modifications or repairs are prohibited and will result in warranty becoming void.
- In order to minimize the risk of failure and hazards associated with it, the device should not be installed in extremely unfavorable conditions that present the following risks:
 - Submerging the device enclosure as a result of an increase in water level
 - Installation in open spaces on an installation pole without a lightning protection system with appropriate grounding
 - Occurrence of mechanical shocks, excessive quakes or vibrations
 - Hazardous areas with a risk of methane or other gas explosions – the use is prohibited
 - Electrostatic discharge
- In the case of devices equipped with a hydrostatic probe or a flowmeter featuring capillary tubing for atmospheric pressure compensation – lower it slowly and carefully into a casing pipe or a piezometer, avoiding any bending or rubbing of the sensor/probe wire.
- Do not dispose of used electrical and electronic equipment as household waste.

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