Voltage measurements

Scope

Voltage is the most common measurement type and forms the basis of most other calculated channel types such as resistance, current, thermocouples etc.
While the *DT80* can read Voltages up to 30 VDC, Voltages over 3 VDC require an attenuation bridge to be switched into the measurement circuit. This is done by selecting the Voltage range from the advanced tab in the *dEX* configuration builder.

Prerequisite

This worked example assumes basic knowledge of;
1. *dEX, DeTransfer or WEB UI.*
2. *dataTaker* programming language.

Equipment

Hardware;
1. *DT80* range *dataTaker* data logger. Version 8.06.0001 firmware or later.
2. A Voltage source.

Software;
1. *dEX*
2. *DeTransfer*.

Manuals;
1. *DT80* User manual Version UM-0085-B1 or later
2. Sensor specification, User manual or installation guide.

Quick start

Voltage measurements

Wiring

Signal + to + terminal
Signal – to - terminal

Note: Cable shielding is to be connected to either the Digital Ground or the ground screw terminal.

1. When using *dEX* web based configuration interface

a. Open your web browser and enter the TCP/IP address of your *DT80* series data logger.

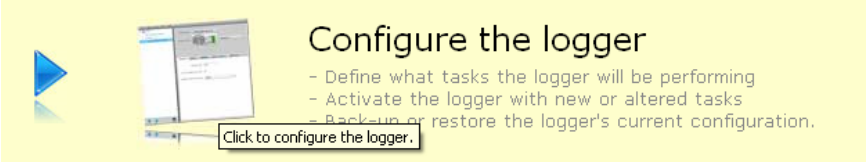

Figure 1 Accessing *dEX* configuration builder

b. In the Menu tree select Schedule_1 then click on “Add” in the menu bar

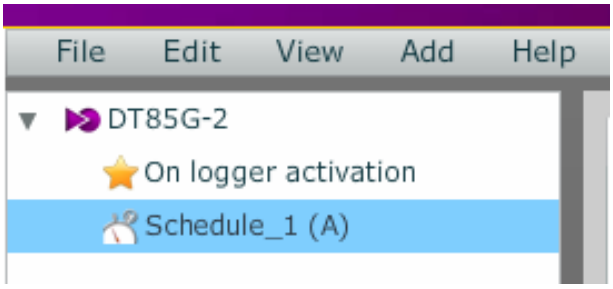

Figure 2 Adding a measurement

c. Expand out the add menu following the path Measurement and click on Voltage menu option.

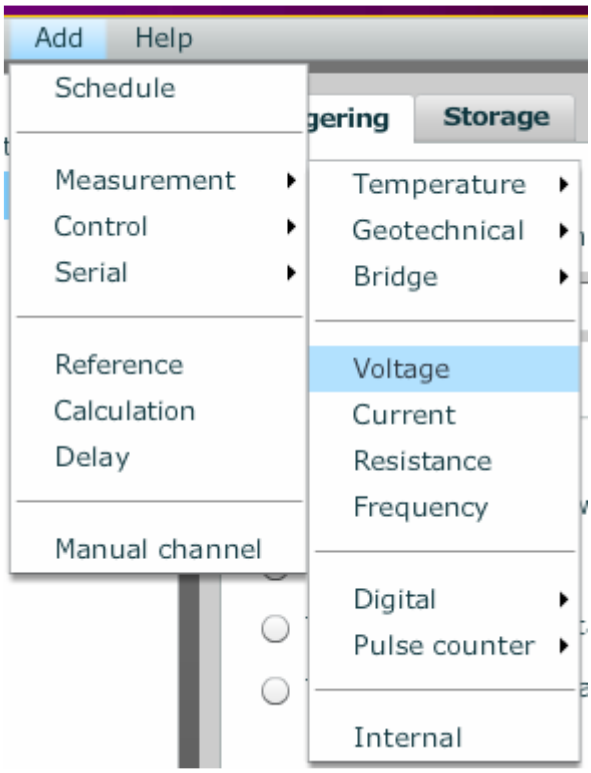

Figure 3 Adding Voltage channel type

d. In the tree view give the channel a unique and meaningful name. To accept the name click on the tick. Note: This name will be referred to in later calculations.

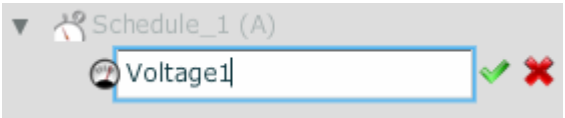

Figure 4 Naming the channel

e. In the view pane, click on “Select wiring” and select the first wiring option [Independent - Voltage (+/-)].

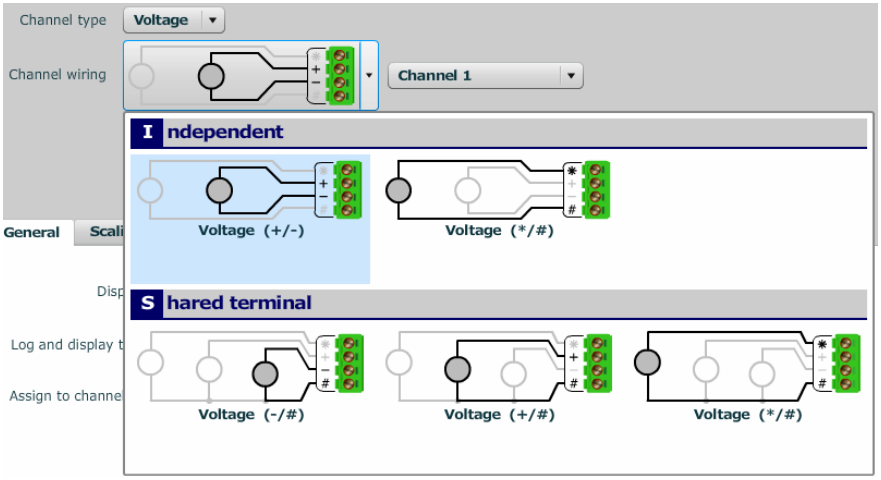

Figure 5 Selecting wiring type

f. In the view pane, click on the channel selector and select the analog channel number the vibrating wire sensor is physically connected to.

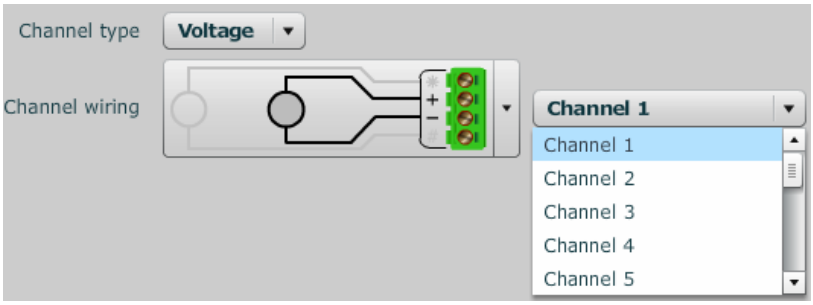

Figure 6 Selecting analog channel number

g. For Voltages over 3 VDC click on the “Advanced” tab and select “Auto range (300 mV to 30 V)”

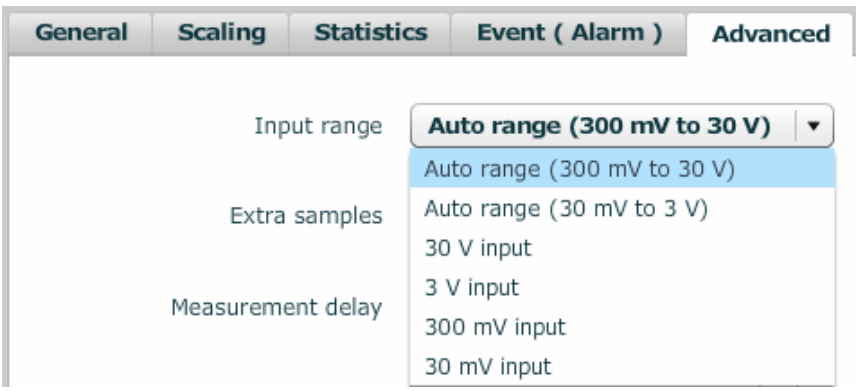

Figure 7 Selecting Voltages up to 30 V

h. To send the configuration to the logger, on the menu bar, Click on “File” -> “Save to logger”

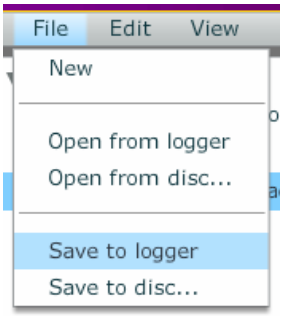

Figure 8 Sending configuration to logger

2. When using the *dEX* command window or *DeTransfer*.
a. Connect to the *DT80 series* 2 data logger.
b. In the send window type the command nV Where n is the analog channel number the Voltage input is connected to. For Voltage measurements over 3 VDC send the command nHV. This will cause the *DT80* to take a single reading from the load cell.
c. Sample result will be returned to the receive window.

Voltage measurement in detail

Voltage is a measure of the electrical potential when measured between two arbitrary points. Multiple separate voltage measurements can share a common reference point, (Known as single ended inputs or shared common) or each measurement can have an independent reference point. (Known as differential input)

Each analog input channel on a *DT80* range series 2 data logger can read either 2 isolated differential inputs or 3 single ended inputs (Common ground)

Differential inputs

In the differential mode, the signal voltage is applied between the + and – or the * and # terminals of the analog input channels. The differential voltage measured by the *DT80* range logger is the difference of the voltages between the two terminals.

The differential mode of voltage measurement is used for

1. Floating Sources - when neither of the outputs from the signal source can be connected to ground.
2. Grounded Sources - when one of the outputs from the signal source is grounded independently of the *dataTaker*. Connecting it to the *dataTaker* ground could result in a ground loop.
3. Noisy Signals - when noise is equally present in both sides of the sensor output (e.g. mains or line hum). Differential mode largely cancels out this common mode noise.

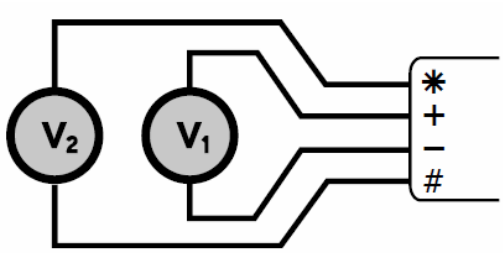

Figure 9 Wiring for Differential inputs

Single ended wiring

If the Voltages share a common ground then up to three Voltages can be connected to one analog input on the *DT80*. It is important the input Voltages do not exceed the common mode Voltage for the input range. The main advantage of using single ended inputs is the increased channel count that can be achieved.

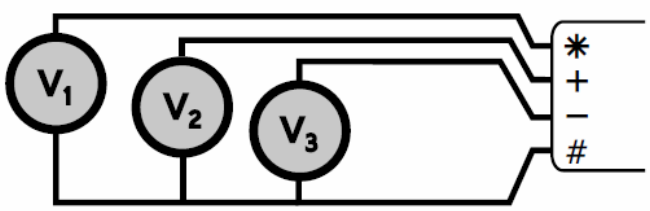

Figure 10 Wiring for Single Ended inputs

Input Ranges

The *DT80's* instrumentation amplifier has three switchable gain settings. These give three basic Voltage measurement ranges (30mV, 300mV and 3V full scale).
The analog inputs also include switchable 10:1 attenuators, which effectively provide a fourth range (30V). By default the appropriate gain range is selected automatically. The first time a channel is measured, the *DT80* will select the highest input range (3V if attenuators are not enabled, 30V if they are). If the reading is close to zero then up to two additional measurements will be made on progressively lower input ranges. For subsequent measurements of the same channel, the *DT80* will initially use the same input range as was used previously. If the reading is over range or close to zero then the input range will be adjusted up or down respectively and the measurement repeated.
The auto-ranging process may therefore cause the time taken to sample a channel to be increased on occasion. To avoid this, the gain can be locked on a particular setting, using the GLx channel options. In *dEX* click on the “Advanced” tab and select the appropriate gain range. (See figure 7.)

Note; Auto-ranging does not affect the attenuator setting. Each channel definition command specifies (either implicitly or explicitly) whether the attenuators should be on or off.

Warning: Maximum input voltage on any analog input is ±35V dc, relative to the AGND/EXT# terminal. If this is exceeded permanent damage may occur.

Common mode range

Because a Voltage measurement is between two arbitrary points, any point can be nominated as the zero or ground point. It is quite common for sensors or communications to be powered from different power supplies each with their own ground. These ground points can all be at different potentials (Voltage levels) hence the Voltage being measure can have a part of the Voltage common to both the Positive and the Negative when compared to measuring systems ground.

Consider figure 11. The *DT80* (Right hand side) has a common mode range of 3.5 VDC and the Voltage to be measured (Left hand side) outputs 3 V and the Voltage difference between the two ground points is 0.4 V then the measurements system will “See” 0.4 V at the # terminal and 3.4 V at the + terminal. As 3.4 V is less that the 3.5 V common mode range the system will be able to measure the difference between the + and # terminals. Note: 0.4 Volts is *common* to both lines hence the name.

Now consider the case where the potential difference between the two ground points is 1.1 V. There will now be 1.1 V at the # and 4.1 Volts at the + terminal.
This 4.1 V exceeds the3. 5 V common mode range and there for the *DT80* system will not be able to measure the difference between the two terminals.

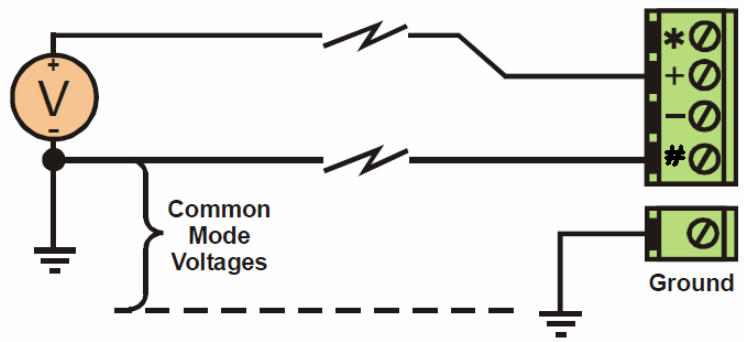

Figure 11 Common mode Voltages

However because the *DT80's* analog ground is isolated from the digital ground, it can normally "float" up to match whatever common mode voltage is present on the sensor being measured, thereby keeping the common mode voltage seen by the DT80's amplifier within limits. For this reason it is important to avoid linking the analog ground (Ext #) to the Digital ground (DGnd) as you will increase the chances of common mode measurement problems.

Grounding of cable shielding

A shielded signal cable is recommended. Shielded wiring will reduce the potential risk of electrical noise. The preferred shield connection point is either one of the *DT80* digital ground (D GND) terminals, a case ground terminal strip or the ground point on either end of the *DT80* range end plates (Refer Fig 12.)

Figure 12 *DT80 range dataTaker* showing grounding point (Silver screw)

dataTaker

Training Note

TR-10RD

Programming the *DT80* data logger

DeTransfer / *WEB UI example (Differential Inputs).*

Enter the following *dataTaker* code into the send window of *DeTransfer* or the data logger WEB UI command send pane and send to the data logger.

Code example 1:
Voltage measurement

```
BEGIN"Voltage"
'Sample Voltage masurement.

RA"Schedule_1"("b:",ALARMS:OV:100KB:W60,DATA:OV:1MB)5S LOGONA
 1V("Voltage 1") 'Measure up to 3 VDC
 2HV("Voltage 2")     'Measure over 3 VDC
END
```


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