



Data acquisition hardware

Data acquisition (DAQ) is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer.

The components of data acquisition systems include:

1. Sensors that convert physical parameters to electrical signals. The most common sensors in the industry are pressure, flow, temperature, concentration, speed, rotation, level, etc.,
2. A signal conditioner (transmitters) that convert the sensor signals into electrical signals (analogue), for use with instrumentation in a data acquisition and/or control system, typically 4-20 mA (see below) or 0-5 V, 0-10 V
3. Analogue-to-digital converters (A/D), which convert the analogue signals into digital values
4. Software programs developed for collecting the digital values, converting them into real process measurements, displaying these process parameters in a graphical form and analysing the data, such as the Stat-SPC© Data acquisition version.

1.- Sensors

The typical sensors in the industry are normally flow meters, pressure transmitters, thermocouples for temperature measurements, level indicators, humidity indicators, etc. provided with a transmitters (signal conditioners) that converts the signal of the specific instrument into typically **4-20 mA**, 0-5 Volts, 0-10 V. This primary elements are normally part of a control loop that compares a process set point with the actual process variable and gives a feedback to, for instance a control valve, that open or closes to maintain the process variable equal to the set point. All this is normally accomplished with a Distributed Control System (DCS) that monitors and controls all the different process parameters. The DCS systems have already incorporated all the Analogue-to-digital converters as well as the software required.

2.- Analogue-to-digital converters (A/D converters)

These are electronic devices, with one or several analogue inputs and a single serial or USB output to be connected to the PC.

The Stat-SPC© has been developed to support different A/D devices provided with USB output, supporting up to 15 data acquisition points simultaneously (process variables or channels).

For purposes of this tutorial, we have chosen the commercial A/D data acquisition device DI-155 from [DataQ Instruments®](#), which has four analogue inputs (channels).

The proper drives and software needs to be installed for these devices, and a [Virtual Serial COM Port](#) will be created during the installation. No need to have Serial Ports installed in your PC. Please follow the vendor instructions for the installation.

[\(see info at the end of the page about Virtual Serial ports & Ports allocation\)](#)

3.- Software

The Stat-SPC©, supporting simultaneously up to 15 channels, provides the necessary conversion of the digital signals received from the A/D converter into real process measurements, displaying these measurements in real time in a graphical form and performing an statistical analysis on each channel, including the control loop performance.

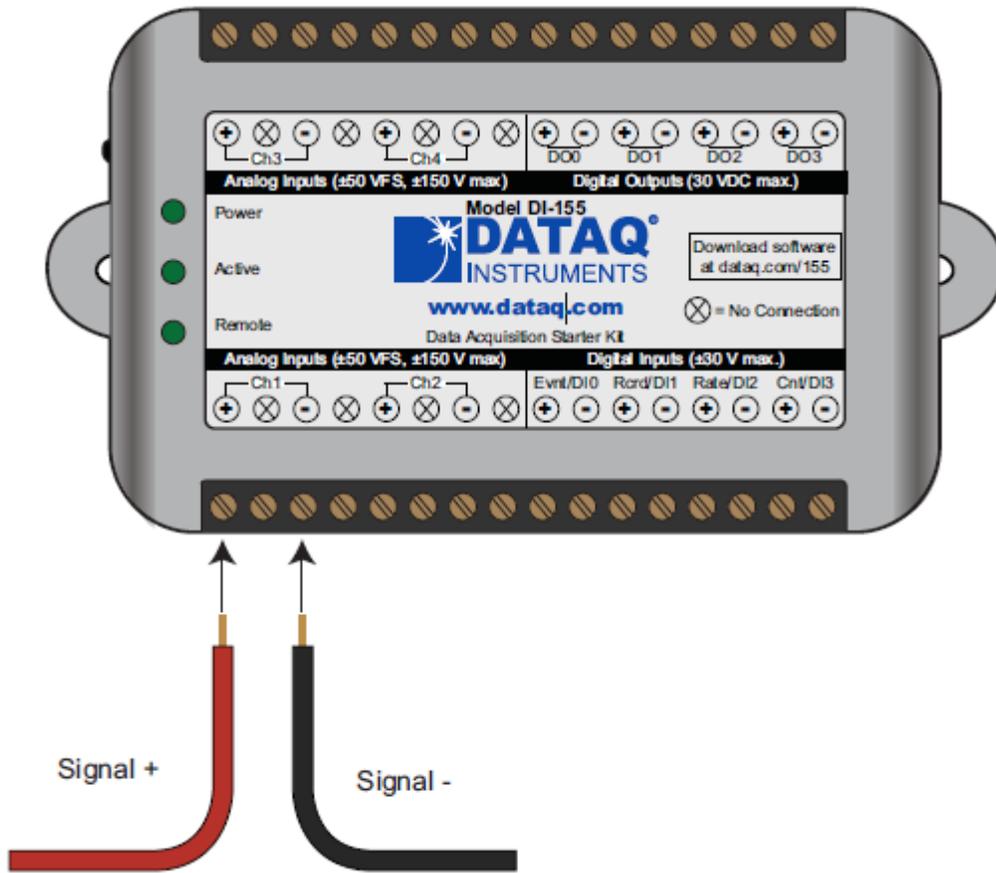
Among other characteristics of the Stat-SPC© are:

Sampling frequency from 10 samples per second to to 1/3600 samples per second for each channel

Filtering capability of the signals received by individually configuring each channel as X-Rbar, Median or X-s charts.

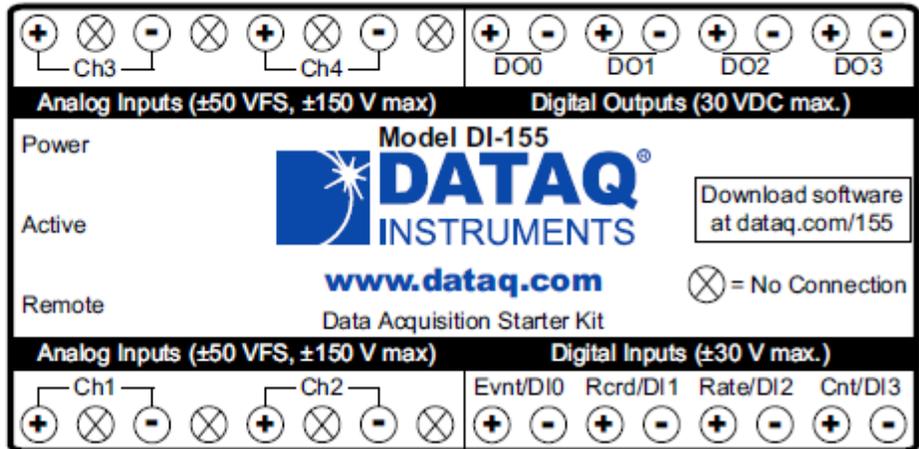
Saving the data into a normal Stat-SPC Microsoft® Access© database for further analysis of the data using the full statistical capability of the program (full statistical calculations, histogram, control charts, graphics, correlation and regression analysis, etc.)

Exporting, in real time, the acquired data into an Excel® (.xls) spreadsheets.



DI-155 Signal Connections

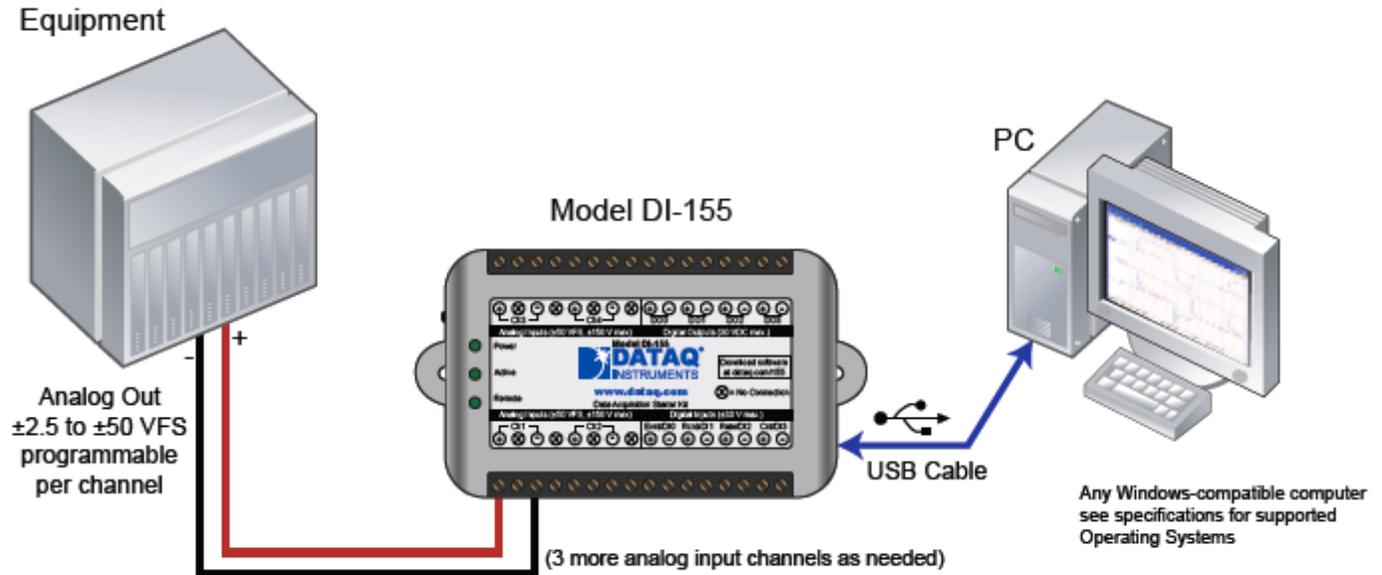
Refer to the following for screw terminal port identification.



Analog Inputs Ch#: Analog channels 1-4 (± 50 VFS, ± 150 V transient max.)

DI-155 A/D data acquisition device

Typical application



See additional information on [DATAQ](#) devices

Current to Voltage conversion

For many years, the field communication standard used by process automation equipment has been a milliampere (mA) analog current signal. In most applications the mA signal varies within a range of 4-20 mA in proportion to the process variable being represented. Virtually all installed plant instrumentation systems use this international standard to communicate process variable information.

In order to convert the 4-20 mA signals into the volts required by the A/D converter, a 250 Ω precision resistor has to be connected in the 4-20 mA loop according to this sketch

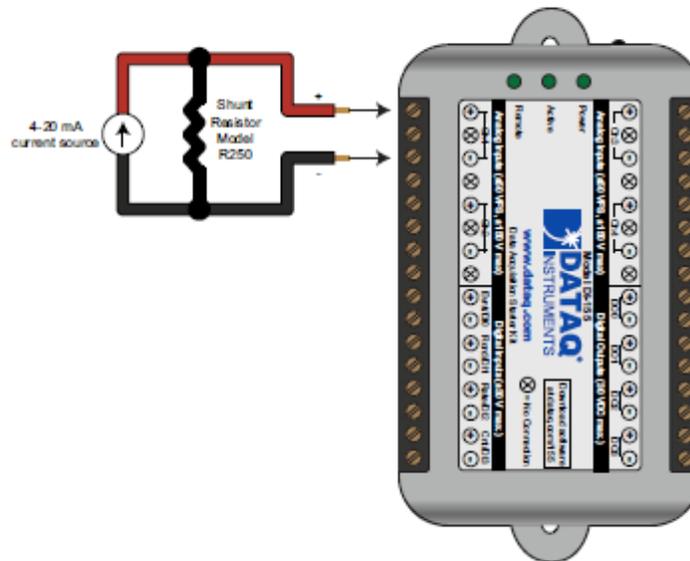
The resulting voltage will be:

$$4 \text{ mA} \times 250 \Omega = 1 \text{ Volt}$$

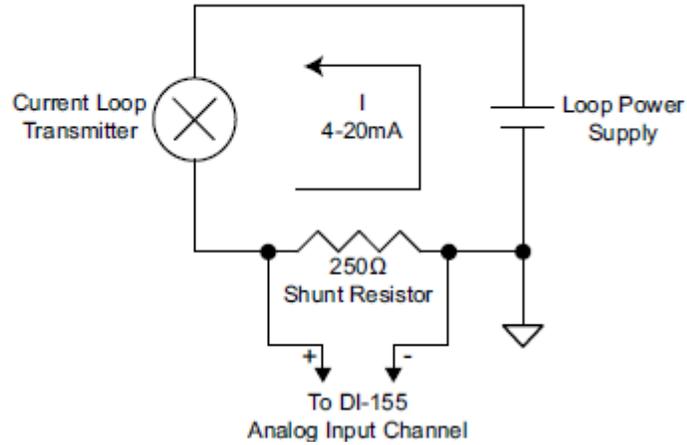
$$20 \text{ mA} \times 250 \Omega = 5 \text{ Volts}$$

4-20mA Current Loop Measurements

Use the following diagram for 4-20mA current loop measurement connections.



The shunt resistor should be placed on the low side of the circuit as shown below:

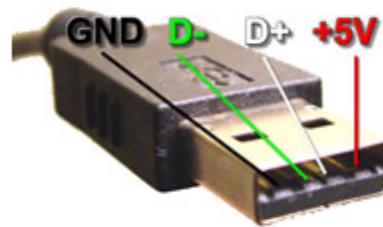


Therefore, the analogue signal to the A/D converter will be **1-5 Volts**

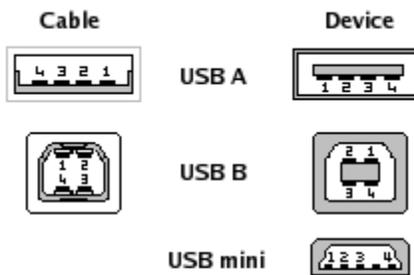
USB port



PC Cable USB Pin out Diagram



Other USB connectors Pin out



Pin	Signal	Color	Description
1	VCC	■	+5V
2	D-	□	Data -
3	D+	■	Data +
4	GND	■	Ground

Virtual COM Ports

These A/D devices use a Virtual COM Port to communicate with your computer. They have an alternate USB connection. When installed, you should notice that two drivers were installed to your computer - a USB driver and a Serial (COM) port driver. These instruments communicate with the virtual COM port using the COM port driver

Accessing the Windows Device Manager to determine the COM port designated for your Virtual COM Port USB Device

Open the Windows Device Manager. The Windows Device manager can be found at the Windows Control Panel or by holding the windows key down then pressing the Pause/Break key on your Windows keyboard to access the System Properties window. From there, the Device Manager should be accessible but may require an extra click or two (for example, in XP, click on the Hardware tab then on the Device Manager button)

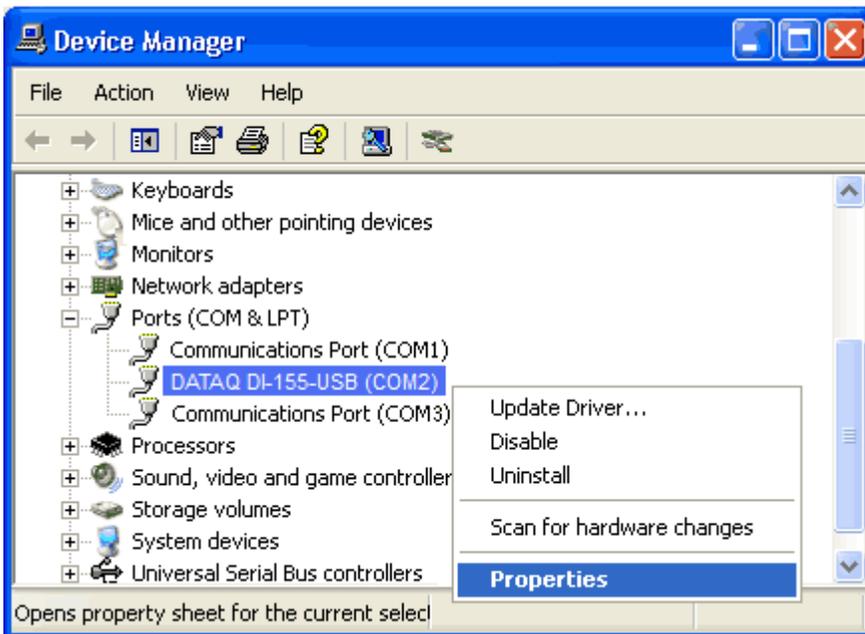
Find Ports (COM & LPT) and expand by clicking the + box to the left. This shows all COM and LPT ports currently assigned on your computer.

Find DATAQ DIxxx (COM#) - # is the COM port assigned to your device.

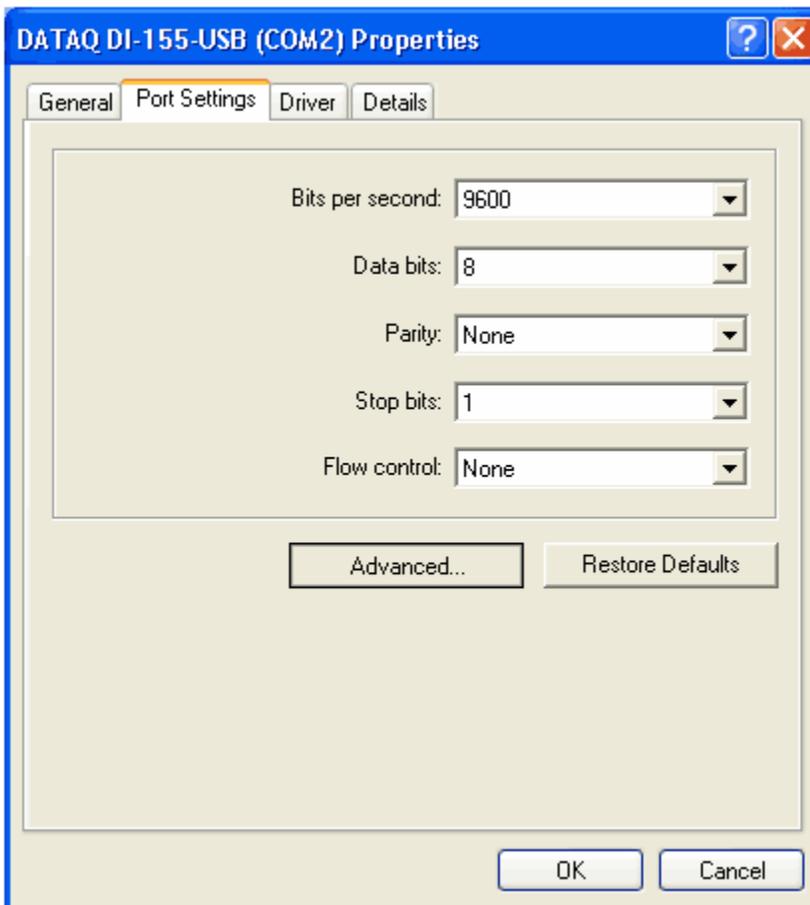


Change the COM port Number of your Device.

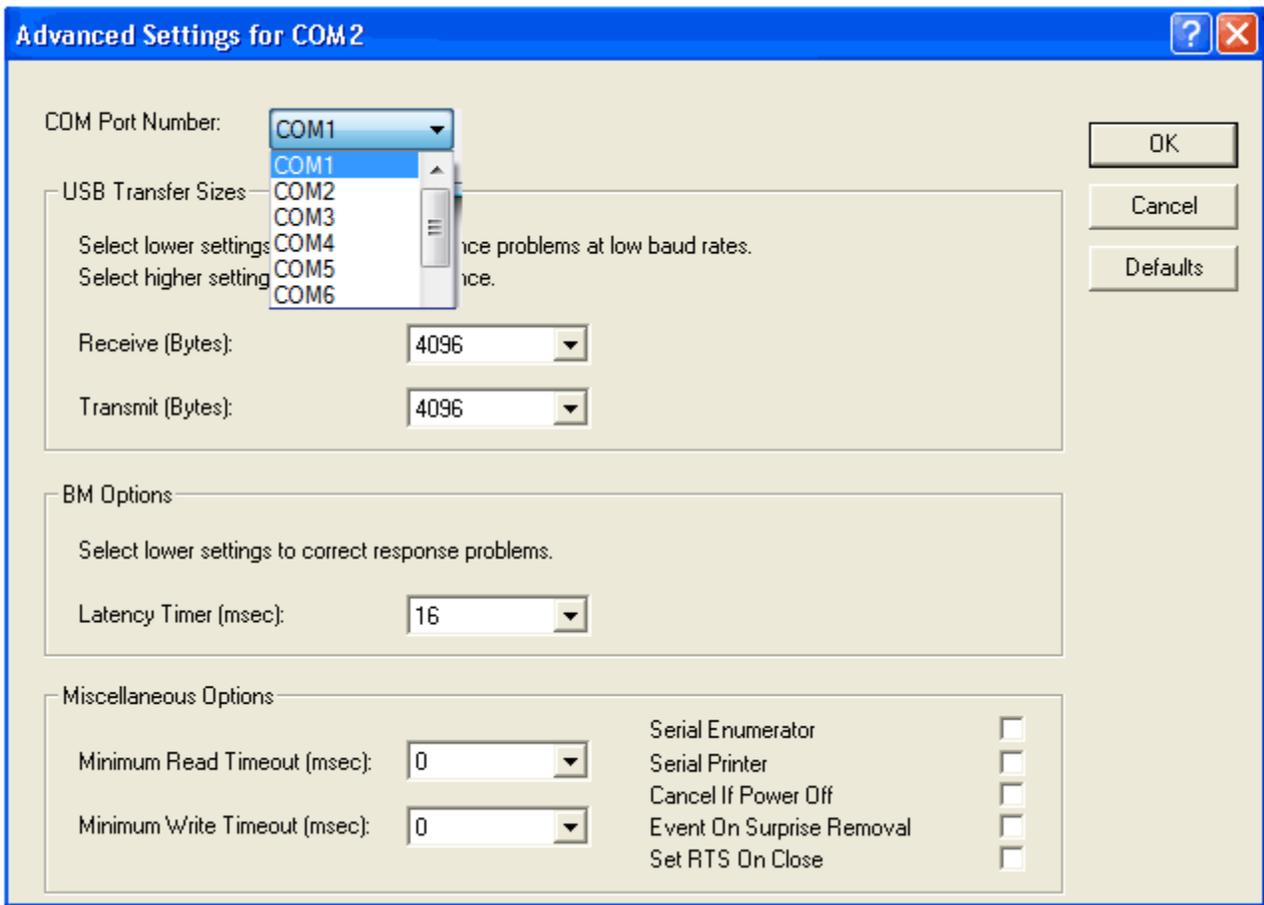
- a. Right-click on DATAQ DIxxx (COM#).
- b. Click on Properties.



- c. Click on the Port Settings tab.
- d. Click on the Advanced button.



- e. Click the down arrow on the COM Port Number drop-down menu.
- f. Select an alternate COM port number (Must be COM 16 or lower).



Important notice

The assigned COM port must always be in between 1 and 16. No higher COM port than 16 will be supported by this software

