C11V Analog to Digital Converter
User Manual

Acknowledgements

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General Information

The C11V converts an analog voltage within the range of ± 2.5 volts from a laboratory instrument (Doppler flow probes, oxygen sensors, strain gauges, etc.) into a serial digital data stream compatible with the Dataquest system. The analog voltage is input via the BNC connector located on one end of the converter. The output of the C11V to the Data Exchange Matrix (DEM) will be a frequency similar to the output of a single-channel transmitter paired with a receiver. Plug the output cable connected to the C11V into any jack of the DEM to supply the C11V with power.

Specifications

Operational Temperature Range	0 - 50°C
Input Voltage Range	±2.5 V
Current Drain	< 5 mA
Input Impedance	≥ 90 kOhm
Open Input	Output frequency will represent a ~0.75 volt input
Output Characteristics	2000-6000 Hz over input range, 50% duty cycle, 2.5V = 2000 Hz, 0V = 4000 Hz, -2.5V = 6000 Hz
Bandwidth	500 Hz
Compatibility	Compatible with Dataquest A.R.T. and pre-A.R.T. systems
Cable Length	≤ 15 m
Power	From DEM, 5.75 - 12 VDC
Pinouts	Pin 2 = frequency output; Pin 1,4 = ground; pin 8 = supply; All other pins open

Using the C11V Analog to Frequency Converter

Connect any analog signal within the range of ± 2.5 V to the C11V via a BNC connector. Then connect the 8-pin modular output to a DEM. The output of the C11V to the DEM will be a frequency similar to the output of a single-channel transmitter paired with a receiver. This output relationship will be of the form:

Input Voltage	Output Frequency
2.5 V	2000 Hz
0V	4000 Hz
-2.5 V	6000 Hz

Configuring a C11V Converter in the Configuration Module

This example provides basic instructions on how to configure a C11V to collect frequency data.
1. Select a Data Exchange Matrix, right click, and choose **New Converter**... to display the New Converter Wizard - Step 1 window.
2. Select **C11V** from the list in the converter list and enter the serial number in the space provided.
3. Click **Next** to continue to Step 2 of the wizard.
4. Select the Species for your animal.
5. Enter a unique Animal ID of your choice.
6. Click **Next** to continue to Step 3 of the wizard.
7. Select a Data Exchange Matrix and a jack connection for this device. A receiver, converter, or Data Exchange Matrix icon indicates a current device connection. A sun icon designates available jacks.
8. Click **Finish** to accept the connection information and complete the configuration procedure. The configuration tree is updated to show the new converter and the available signals.

Conversion to Predefined Data types

Typically, the C11V is used with non-telemetered signals from hard-wired amplifiers. These signals may be blood flow, pressure, ECG, or other physiologic signals. Each of these signals is pre-defined in the Dataquest A.R.T. Configuration module and may be selected to enable saved data to be converted to the desired units.

Flow

Each of the blood flow data types can be selected in the Signal Properties for configuring converters. Simply select C11V- (Doppler Shift, Flow Velocity, Flow Volume, TT Flow Volume, TT Flow). These data types may also require some calibration values to be entered such as probe frequency or vessel size. The following examples demonstrate how to configure a C11V to measure Doppler Shift, Flow Volume, Flow Velocity, and Transit Time Flow Volume in Dataquest A.R.T. and OpenART. Please refer to the appropriate software manual for assistance with configuring other signal types or contact DSI Technical Services.

Configuring a C11V to measure Doppler Shift
1. If using a C11V to collect Doppler Shift data, configure the C11V as previously explained, making sure to specify an Animal Species in the configuration.
2. In the Signal Properties window, change the signal type from Unconverted to Doppler Shift. The software assumes that the C11V is a C12V, even if it was configured as a C11V. Therefore, some settings must be changed under the **Advanced** Tab in the Signal Properties window. For a C11V, Converter Bias=4000 and Converter Gain=-800.
3. No calibration values are required for a Doppler Shift signal.

Configuring a C11V to measure Flow Volume
1. If using a C11V to record Flow Volume data, configure the C11V as previously explained, making sure to specify an Animal Species in the configuration.
2. In the Signal Properties window, change the signal type from Unconverted to Flow Volume. The software assumes that the C11V is a C12V, even if it was configured as a C11V. Therefore, some settings must be changed under the **Advanced** Tab in the Signal Properties window. For a C11V, Converter Bias=4000 and Converter Gain=-800.
3. The calibrations required for flow volume are probe frequency and diameter. These values should be provided in the literature for the probe. Enter the appropriate values in the calibration fields.

Configuring a C11V to measure Flow Velocity
1. If using a C11V to record Flow Velocity data, configure the C11V as previously explained, making sure to specify an Animal Species in the configuration.
2. In the Signal Properties window, change the signal type from Unconverted to Flow Velocity. The software assumes that the C11V is a C12V, even if it was configured as a C11V. Therefore, some settings must be changed under the **Advanced** Tab in the Signal Properties window. For a C11V, Converter Bias=4000 and Converter Gain=-800.
3. The calibration required for flow velocity is probe frequency. This value should be provided in the literature for the probe. Enter the appropriate value in the calibration field.

Configuring a C11V to measure Transit Time Flow Volume with a Transonic Probe
1. Assume that a user has a transonic probe with two calibrations. At 0V, the probe outputs 0L/min, and at 1 V, it outputs 2L/min. The output has to remain within +/- 2.5 volts. Otherwise, a C12V must be used.
2. If using a C11V to bring in TT Flow Volume, configure the C11V as previously explained, making sure to specify an Animal Species in the configuration.
3. In the Signal Properties window, change the signal type from Unconverted to TT Flow Volume. The default calibration value for TT Flow Volume is 0.25 V/L/min. The software assumes that the C11V is a C12V, even if it was configured as a C11V. Therefore, some settings must be changed under the **Advanced** Tab in the Signal Properties window. For a C11V, Converter Bias=4000 and Converter Gain=-800.
4. To determine the calibration value, use the equation 1V=2 L/min. Dividing 1V by 2 L/min gives a calibration value of 0.5 V/L/min. Enter this value into the calibration field.

Other Predefined Data Types

If a signal other than flow is being used, first select the C11V from the converter menu and then select the desired signal from the signals menu. If pressure is being monitored, "Gauge Pressure" should be selected rather then "Pressure". This way the ambient room pressure will not be subtracted from the pressure measurements (measurements from fluid-filled or sensor-tipped catheters are already measured relative to room pressure). If the signal is a biopotential or temperature signal, select the appropriate signal. The first two examples are for use with the Dataquest A.R.T. or OpenART systems, and the last is for use with Dataquest A.R.T. Analog. Please refer to the appropriate software manual for assistance with configuring other signal types or contact DSI Technical Services.

Configuring a C11V to measure Gauge Pressure
1. Configure a C11V as previously explained and leave the signal type as Unconverted.
2. Return to the main Acquisition window by selecting **File - Exit**. Select **Yes** to save the changes made to the configuration file.
3. In the main Acquisition window, right click on the animal icon that represents the C11V and choose **Continuous Sampling**….. The Continuous Sampling window appears.
4. Select **Diagnostic Trace** and then click **OK**. The Real-Time Graphs window appears.
5. Record the frequency value displayed in the Real-Time Graphs window when 0 mmHg of pressure is applied to the probe.
6. Record the frequency value displayed in the Real-Time Graphs window when 100 mmHg of pressure is applied to the probe.
7. Return to the main Acquisition window, right click on the animal icon that represents the C11V and choose **Sampling Off**.
8. Select **Configuration - Hardware** to open the Configuration window.
9. Double click on the C11V icon to display the Unconverted signal.
10. Highlight the Unconverted signal, right click, and choose **Properties**. The Signal Properties window appears.
11. Click on the **Signal** Tab and change the signal type from Unconverted to Gauge Pressure.
12. Click on the **Calibration** Tab and enter the values recorded in steps 5 and 6 in the appropriate fields.
13. Click **OK** to complete the configuration procedure.

Configuring a C11V to measure ECG
Use the following procedure to automatically suppress the mean of the ECG data signal. Doing so centers the signal around zero, eliminating baseline shift. The C11V is still connected directly to the Data Exchange Matrix and a receiver is not required, however, in the software the C11V is configured as a CA-F40 transmitter on an old-generation receiver.
1. In the Configuration module, select the appropriate Data Exchange Matrix, right click and choose **New Receiver**…to display the New Receiver Wizard - Step 1 window.
2. Select **RLA1020** from the list in the receiver list and enter a unique serial number in the space provided.
3. Click **Next** to continue to Step 2 of the wizard.
4. Select a Data Exchange Matrix and a jack connection for this device. The converter will actually be physically connected to this jack. A sun icon designates available jacks.

5. Click **Finish** to accept the connection information. You will next be prompted to add a new Transmitter to this Receiver. Click **Yes**.
6. In the New Transmitter Wizard - Step 1 window, select **TA10CA-F40** from the list. Enter a unique serial number.
7. Click **Next** to continue to Step 2 of the wizard.
8. Select the Species for your animal.
9. Enter a unique Animal ID of your choice.
10. Click **Finish** to accept the New Transmitter connection. You will now be prompted to enter a calibration value for the configured transmitter.
11. Specify a calibration value of 50 mV on the **Calibrations** tab in the Signal Properties window.
12. Click **OK** to complete the configuration procedure.

Dataquest A.R.T. Analog Converter Configuration Example

Configuring a C11V for Flow Velocity
1. Open the Configuration Module by choosing **Configuration - Input Hardware** in the Dataquest A.R.T. Analog window.
2. Double click on a jack in the input matrix.
3. The Connection Setup window will appear. Choose **Select - Converter** to specify a converter type.
4. From the Converter dropdown list, choose **C11V**. Click **OK**.
5. Specify the appropriate animal species by choosing **Select - Species**.
6. Specify the appropriate signal type by choosing **Select - Signal**. Choose Flow Velocity.
7. In order to enter the probe frequency calibration value, choose **Edit - Calibrations** and enter the value specified for your probe.
8. Click **OK** in the Connection Setup window.
9. Click **OK** in the Configuration Module to return to the Dataquest A.R.T. Analog window.
10. In the Dataquest A.R.T. Analog Settings window, choose **Control - Settings**. On the **Output** tab, change the data type to Flow Velocity, Gain=1, Bias=0. Specify the Upper and Lower Calibration values accordingly.
11. Click **OK** to exit the Settings window.

Conversion to User-defined Units

Dataquest A.R.T., OpenART, and A.R.T. Analog
In order to convert to other units use the following relationship:

Input Voltage	Desired Conversion (y)	Output Frequency (x)
0V	y_1	x_1
1V	y_2	x_2

$y_1 = 0$ $\qquad$ $x_1 = 4000$
$y_2 = 1$ $\qquad$ $x_2 = 3200$
$y = ax + b$
$y_1 = 4000a + b$ $\qquad$ $0 = 4000a + b$
$y_2 = 3200a + b$ $\qquad$ $1 = 3200a + b$
$(y_1 - y_2) = (4000a - 3200a)$
$(y_1 - y_2) = 800a$
$a = (y_1 - y_2)/800 = (0-1)/800 = -0.00125$
$0 = 4000(-0.00125) + b$
$b = 5$

Order: $\qquad$ 1
Coefficient A: $\qquad$ -0.00125
Coefficient B: $\qquad$ 5

Following the procedure outlined in the "Conversion to Volts" section for Dataquest A.R.T. and OpenART, enter these settings in the Calibrations or Advanced tab of the Signal Properties window and set the data type and units in the Configuration Settings window. Note that only one set of data type and units can be applied to the Polynomial. For Dataquest A.R.T. Analog, the data type would be adjusted to Polynomial Fit on the Output tab in the Dataquest A.R.T. Analog Settings window.
* For Dataquest OpenART, please refer to the third party software's user guide for instructions on how to adjust the data type and units to Volts for a polynomial signal.

Conversion to Volts

Dataquest A.R.T.
The input signal may be converted to a voltage by performing the following steps:
1. When configuring the C11V in the Configuration module, choose Polynomial as the signal type on the **Signal** tab of the Signal Properties window.
2. Specify the following settings on the **Calibrations** or **Advanced** tab:
   Order: 1
   Coefficient A: -0.00125
   Coefficient B: 5
3. Save the configuration, and then exit the Configuration module
4. Select **Configuration - Settings** in Acquisition. On the **Sampling** tab of the Configuration Settings window, set the data type and units to Volts in the Polynomial box.

Dataquest OpenART

The input signal may be converted to a voltage by performing the following steps:

1. When configuring the C11V in the Configuration module, choose Polynomial as the signal type on the **Signal** tab of the Signal Properties window.
2. Specify the following settings on the **Calibrations** or **Advanced** tab:
   Order: 1
   Coefficient A: -0.00125
   Coefficient B: 5
3. Save the configuration, and then exit the Configuration module.

*Refer to the third party software's user guide for instructions on how to set the data type and units to Volts for a polynomial signal.

Dataquest A.R.T. Analog

The input signal may be converted to a voltage by performing the following steps:

1. When configuring the C11V in the Configuration module, select **Edit - New**. The Connection Setup window will appear.
2. Choose **Select - Converter** and once the Converter Window appears, choose C11V from the list and click **OK**.
3. Specify the appropriate animal species.
4. Choose **Edit - Advanced Setup** to adjust the signal properties.
5. Specify the signal type as Unconverted (Polynomial Fit).
6. Adjust the Coefficient A, Coefficient B, and Order calibrations by highlighting each calibration individually, clicking **Modify**, and typing in the following values: Coefficient A=-0.00125, Coefficient B=5, Order=1.
7. Click **OK** to exit the Advanced Signal Setup window.
8. Click **OK** to exit the Connection Setup window.
9. Click **OK** to exit the Configuration window.
10. Once the Dataquest A.R.T. Analog window is the primary window, choose **Control – Settings** to display the Dataquest A.R.T. Analog Settings window.
11. Select the **Output** tab and change the data type to Polynomial Fit. Leave the Slope and Bias calibrations as is. Specify an Upper Calibration=1, and a Lower Calibration=0.