C12V Analog to Frequency Converter
User Manual

Acknowledgements

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General Information

The C12V converts an analog voltage within the range of ± 10 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 C12V 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 C12V into any B or C row jack of the DEM to supply the C12V with power.

Specifications

Operational Temperature Range	0 - 50°C
Input Voltage Range	±10 V
Current Drain	< 5mA
Input Impedance	>=100 kOhm
Open Input	Output frequency will represent a ~0.8 volt input
Output Characteristics	1000 – 2000 Hz over input range, 50% duty cycle -10V = 2000Hz, 0V = 1500 Hz, 10V = 1000Hz
Bandwidth	0-250Hz
Compatibility	Compatible with Dataquest A.R.T. and pre-Dataquest A.R.T. systems
Cable Length	≤ 15 m
Power	From DEM, 5.75 - 12 VDC
Accuracy, Linearity	± 50mV exclusive of Temperature and Voltage
Frequency Change vs. Temperature	Less than 100mV shift from 25°C to 0°C or 50°C
Frequency Change vs. Supply voltage	Less than 250mV change from 5.75V to 12V
Pinouts	Pin 2 = frequency output; Pin 1,4 = ground; Pin 8 = supply; All other pins open

Using the C12V Analog to Frequency Converter

Connect any analog signal within the range of ±10V to the C12V via a BNC connector. Then connect the 8-pin modular output to a DEM. The output of the C12V 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
10V	1000Hz
0V	1500Hz
-10V	2000Hz

Configuring a C12V Converter in the Configuration Module of Dataquest A.R.T.

This example provides basic instructions on how to configure a C12V 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 **C12V** 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 C12V 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. Selecting a signal type converts collected data to the desired units.

Flow

Each of the blood flow data types can be selected in the Signal Properties for configuring converters. Simply select C12V- (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 C12V 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 C12V to measure Doppler Shift

1. If using a C12V to collect Doppler Shift data, configure the C12V as previously explained, specifying **C12V-Doppler Shift** as the converter type, and enter the C12V's unique serial number.
2. Specify an animal species and unique Animal ID.
3. Select a Data Exchange Matrix jack connection for the converter.
4. Click **Finish** to accept the connection.
5. No calibration values are required for a Doppler Shift signal, therefore, the Signal Properties window does not need to be edited.

Configuring a C12V to measure Flow Volume

1. If using a C12V to collect Flow Volume data, configure the C12V as previously explained, specifying **C12V-Flow Volume** as the converter type, and enter the C12V's unique serial number.
2. Specify an animal species and unique Animal ID for the animal.
3. Select a Data Exchange Matrix jack connection for the converter.
4. Click **Finish** to accept the connection, and continue to the Signal Properties window to enter calibrations.
5. Enter the probe frequency and probe diameter calibration values. These values should be provided in the literature for the probe.

Configuring a C12V to measure Flow Velocity

1. If using a C12V to collect Flow Velocity data, configure the C12V as previously explained, specifying **C12V-Flow Velocity** as the converter type, and enter the C12V's unique serial number.
2. Specify an animal species and unique Animal ID for the animal.
3. Select a Data Exchange Matrix jack connection for the converter.
4. Click **Finish** to accept the connection, and continue to the Signal Properties window to enter calibrations.
5. Enter the probe diameter calibration value. This value should be provided in the literature for the probe.

Configuring a C12V to measure Transit Time Flow Volume

1. If using a C12V to collect TT Flow Volume data, configure the C12V as previously explained, specifying **C12V-TT Flow Volume** as the converter type, and enter the C12V's serial number.
2. Specify an animal species and unique Animal ID for the animal.
3. Select a Data Exchange Matrix jack connection for the converter.
4. Click **Finish** to accept the connection, and continue to the Signal Properties window to enter calibrations.
5. Enter the calibration value. The default calibration is 0.25 V/L/min.

Notes: To calculate the calibration value, use two known flow velocities and their corresponding voltages and calculate the slope.
For example:
At a flow velocity of 50 mL/sec (3 L/min), the voltage is 5 V.
At a flow velocity of 0 mL/sec (0 L/min), the voltage is 0 V.
The calibration value is 1.667 V/L/min

Other Predefined Data types

If a signal other than flow is being used, first select the C12V 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 following 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 C12V for Gauge Pressure
1. Configure a C12V 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 C12V 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 pressure sensor.
6. Record the frequency value displayed in the Real-Time Graphs window when 100 mmHg of pressure is applied to the pressure sensor.
7. Return to the main Acquisition window, right click on the animal icon that represents the C12V and choose **Sampling Off**.
8. Select **Configuration - Hardware** to open the Configuration window.
9. Double click on the C12V 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.

Note: To create a configuration that collects LV gauge pressure data from a C12V converter, choose LV Gauge Pressure in Step 11 instead of Gauge Pressure.

Configuring a C12V 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 C12V is still connected directly to the Data Exchange Matrix and a receiver is not required, however, in the software the C12V 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 C12V 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 **C12V-Flow Velocity**. 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. and OpenART
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

$y_1 = 0$ $x_1 = 1500$
$y_2 = 1$ $x_2 = 1450$
$y = ax + b$
$y_1 = 1500a + b$ $0 = 1500a + b$
$y_2 = 1450a + b$ $1 = 1450a + b$
$(y_1 - y_2) = (1500a - 1450a)$
$(y_1 - y_2) = 50a$
$a = (y_1 - y_2)/50 = (0-1)/50 = -0.02$
$0 = 1500(-0.02) + b$
$b = 30$

Order: 1
Coefficient A: -0.02
Coefficient B: 30

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 set 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 C12V 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: -0.02
   Coefficient B: 30
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 C12V 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: -0.02
   Coefficient B: 30
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 C12V in the Configuration module, select **Edit - New**. The Connection Setup window will appear.
2. Choose **Select - Converter** and once the Converter Window appears, choose C12V 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=-0.02, Coefficient B=30, 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 Lower Calibration=0.