ONTRAK
CONTROL SYSTEMS
DATA ACQUISITION AND CONTROL

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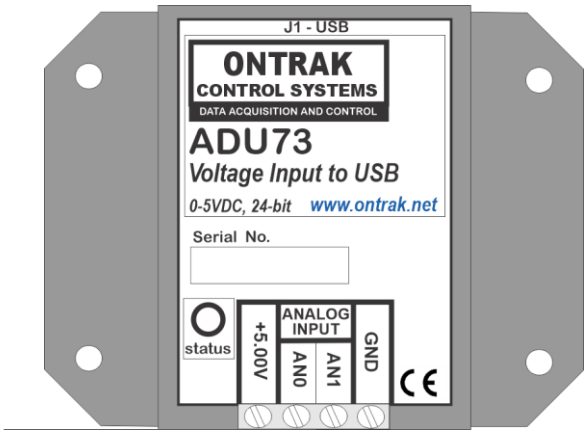
Unit # 3
Sudbury, Ontario
CANADA P3A 4R7
(705) 671-2652

ADU73 Voltage Input to USB Interface User Manual

Ver 2.0



EU Declaration of Conformity

We, the undersigned,

Manufacturer:	Ontrak Control Systems Inc.
Address, City	1545 Maley Drive, Unit 3, Sudbury
Province, Country, Postal Code	Ontario CANADA P3A 4R7
Phone	(705) 671-2652
Email Address	tom@ontrak.net

certify and declare under our sole responsibility that the following Apparatus:

Model No: ADU73	**SN:**U00001 and higher.
Description:	**Voltage Input to USB Interface**
Brand:	**Ontrak Control Systems Inc.**

Conforms with the essential requirements of the EMC Directive 2004/108/EC, via Annex II, based on the following specifications applied:

RF Emissions	*EN55011:2009/A1:2010 Class B*
ESD Immunity	*IEC 61000-4-2:2008 Level 2 Criterion B*
RF Immunity	*IEC 61000-4-3:2006 +A1:2007 +A2:2010 Level 2 Criterion B*

And therefore complies with the essential requirements and provisions of the EMC directive.

The technical documentation is kept at the following address:

Company:	Ontrak Control Systems Inc.
Address, City	1545 Maley Drive, Unit 3, Sudbury
Country, Postal Code	Canada P3A 4R7
Phone Number	(705) 671-2652
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Name of Person binding the manufacturer.	Tom Fortin
Tom Fortin- Director Ontrak Control Systems Inc	October 20, 2022 Sudbury , Ontario, CANADA

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Table Of Contents

1. What is Included and Where to Start

The ADU73 ships complete with a 10' USB cable, and this User Manual.

A complete SDK including DLL, programming language examples, and AduHidtest software is available at:
http://www.ontrak.net/programming.htm
Programming examples include Windows, Linux, Python, C.NET, VB.NET, LabView, Matlab, OSX and others.

First time users should first review the ASCII command set for the ADU73 and then use AduHidTest USB test software to become familiar with the operation of the various features of the product.

Note: The AduHid DLL requires one of the following Windows operating systems, XP, Vista, Windows 7, Windows 8 or Windows 10/11. The programming section of the web site also contains examples for use with various other operating systems and provides details that allow use of the ADU73 without using the Windows based AduHid DLL

2. ADU73 Features

- Dual 0-5.00 VDC inputs with 24-bit resolution.
- Ratio-metric or absolute measurements.
- Programmable sample rates from 2.5 to 1000 s/s.
- 5.00VDC @ 20mA output for sensor excitation enables ratio-metric measurements.
- 5.000V reference output short-circuit protected.
- 24-bit stable at 2.5 s/s in ratio-metric mode.
- Data can be polled or streamed.
- Ideal for resistive sensors such as linear pots, string pots, thermistors, or any resistive measurement.
- 2500V Isolation
- High retention USB Connector.
- CE Marked
- Bi-colour LED status indicator.
- High quality cage-clamp type terminal blocks.
- Uses standard HID drivers included with Windows XP,7,8,10.11 32-bit or 64-bit.
- Mini-driver (DLL) provided for use with VB, VC, .NET, LabVIEW, MatLAB, TestPoint and others.
- Meets IEC61000-4-2 ESD protection for USB port.
- Available in flange (standard) or DIN rail mount.

3. The ADU73 STATUS LED

The ADU73 STATUS LED is a bi-colour (Red/Green) led indicator used to identify the current status of the ADU73 USB connection.

The LED modes are;

RED -ADU73 powered but not enumerated.
GREEN -ADU73 powered and enumerated by host computer.
OFF -ADU73 disconnected from USB bus **OR** host computer has entered SLEEP/SUSPEND mode.

The ADU73 can be connected to the USB bus via the enclosed 10' A-B USB cable. The cable provides both power and communications connections to the ADU73. When first connected, the STATUS led will turn RED indicating power is applied. For Windows operating systems, a message may flash on the screen indicating;

New hardware Found
ADU73 Voltage Input to USB Interface

Depending on the version of Windows, the host may prompt to search for a driver. Select,

Let Windows Search for a Driver

and click next.

After several seconds, the STATUS led will turn green indicating enumeration is complete. The enumeration process is completely transparent to the application program as the ADU73 is a full-speed USB HID class device. Enumeration is completed by the Windows (or other) operating system standard USB HID drivers. Once enumerated, if no handle is opened to the ADU73 within a few seconds, Windows may suspend the ADU73 causing the LED to turn off.

The ADU73 can be connected directly to the host hub or externally powered hubs.

Caution: (Use of System Suspend/Sleep): If the Windows (or other) operating system allows the host computer to enter suspend mode, attached USB devices will be set to suspend mode. In this mode the power draw of the ADU73 drops to less than 2.5mA (USB2.0 Specification). In suspend mode the ADU73 Status LED is turned off. Once the host computer is revived from sleep/suspend mode, the ADU73 status LED will turn on. The configuration word is maintained at its last setting when recovered from sleep mode. Ensure system power settings are set such that the host computer does not enter sleep mode during normal operation.

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4. AduHidTest USB Device Test Program

AduHidTest is a Windows based USB device test program used to test the connection of ADU data acquisition devices to a USB port. The program is also a useful tool to allow programmers to become familiar with the ADU73 command set. AduHidTest tutorials and AduHidTest software can be downloaded from the Ontrak website at: http://www.ontrak.net/programming.htm. **Note:** the program requires the AduHid.dll to operate and it should be copied to the same directory as the AduHidTest.exe file.

There are three steps in using a USB device in any application software. The three steps are;

1. Obtain a handle for the USB device.
2. Send commands to the USB device.
3. Receive data from the USB device.

STEP 1: Obtain a handle for the ADU73

A handle is a unique code that application software uses to identify a USB device for the purpose of reading and writing to the device. A USB bus can have up to 128 devices connected to a single host and there are three criteria that can be used to open a handle. The three criteria are, Vendor ID, Product ID and Serial Number. If a single device is connected to the bus, any of the three criteria may be used. If multiple devices are connected, we recommend using the Serial Number to open the handle.

(All ADU devices have their unique serial number printed on the top label)

When run, the AduHidtest Software will display the following window.

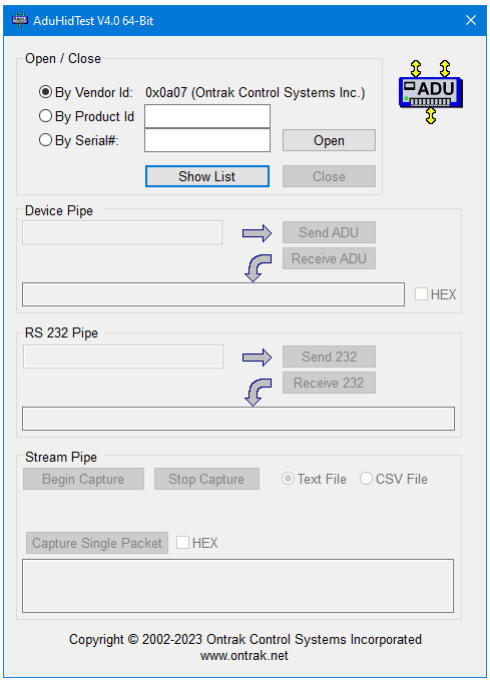


Figure 1: AduHidTest Software Window

The Open/Close section of the window is where the handle is determined. Click on the ***Show List*** button to view the devices connected to the USB bus. (Note: Only ADU devices will be listed) Figure 2 shows the window that appears when the ***Show List*** Button is clicked.

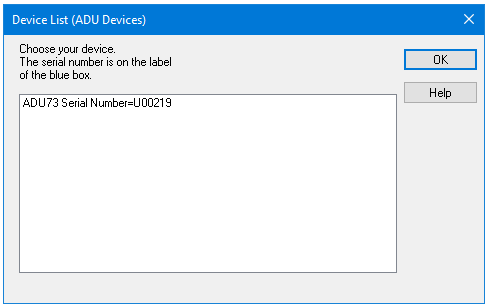


Figure 2: ***ShowList*** Window

The window indicates that there is one ADU73 connected with serial number U00219. Select the device by double clicking on the text ***"ADU73 serial number = U00219"***. The AduHidTest main window will now display the product ID and Serial number. Click the ***By Serial #*** radio button and then click ***Open*** to open the handle to the selected ADU73.

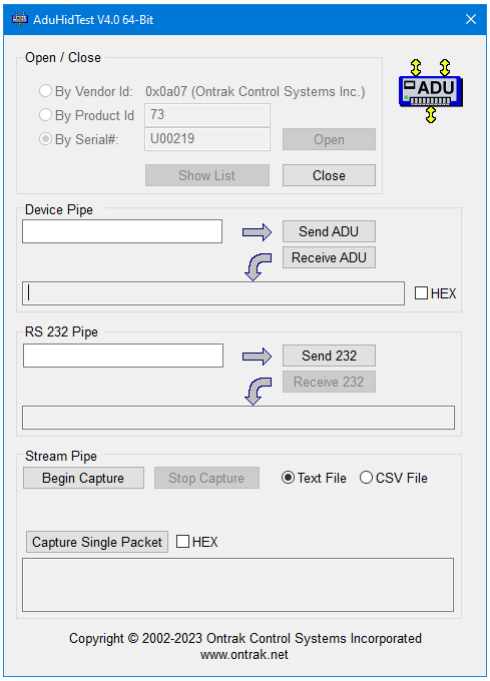
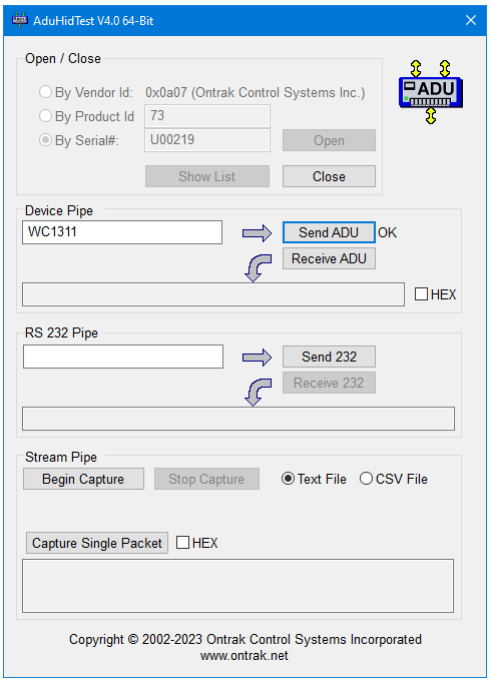


Figure 3: ***Handle open to the ADU73***

Once connected, you may now send commands via the available "pipes" on the ADU73 device. Pipes are the individual connections to functional sections of the ADU73. The ***Device Pipe*** is used to send standard ASCII ADU commands to, and receive data from, the ADU73. This includes the configuration command, read commands, and streaming control commands. The ***RS232 Pipe*** is not used on the ADU73. The ***Stream Pipe*** is a read only pipe used to retrieve streaming data from the ADU73.

STEP 2: Sending Commands to the ADU73

The first step in using the ADU73 is to send your desired configuration word to set sample speed and enable appropriate input channels for the application. For our example we will configure the ADU73 to sample at 10s/s with both channels enabled. This corelates to a configuration word of WC1311 which is typed into the device pipe data window and then ***Send ADU*** button is clicked to send the word to the ADU73.



Note: The default power-up configuration word is WC1411 which configures the ADU73 to 100s/s with both AN0 and AN1 eneabled.

Figure 4: Sending Configuration Word

3. Receive data from the USB device.

Now that the ADU73 is configured, the input data can be read. Type "***RD0"*** into the device pipe send window and click ***Send ADU***. An ***OK*** will appear beside the ***Send ADU*** button if successful. Click the ***Receive ADU*** button to retrieve data which will appear in the received data window.

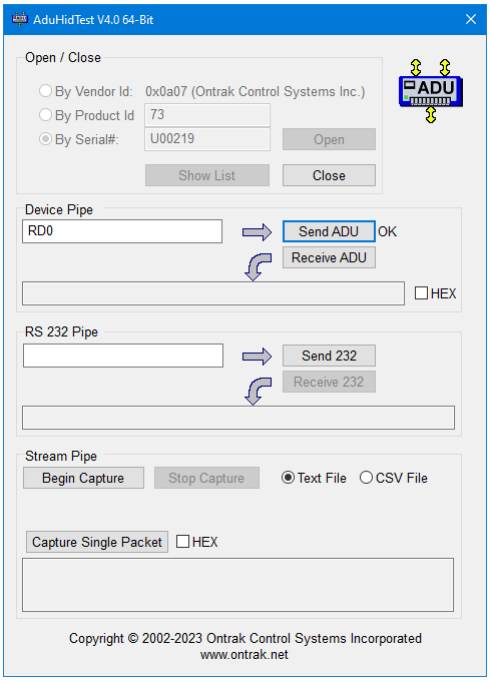


Figure 5: Sending “RD” Command

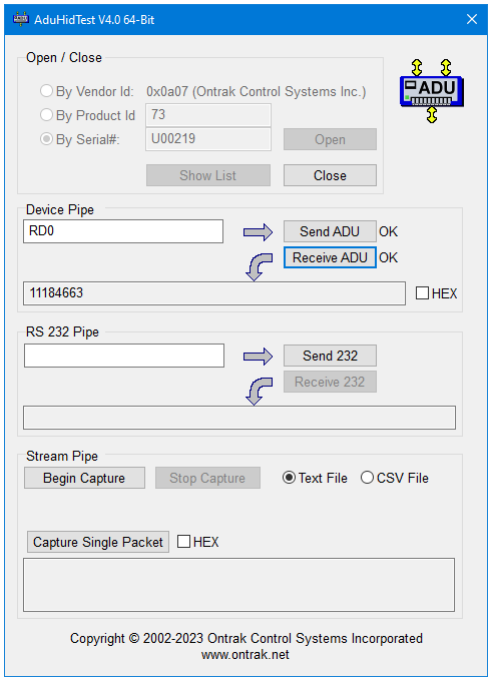


Figure 6: Receiving Data

Streaming Data From the ADU73

For low-speed applications where data is read at 500s/s or lower, a polling method of retrieval is suitable. Considering that USB bus specifications guarantee 1000 packets/second, the theoretical maximum polling speed is 500s/s because sending the read command, and then receiving the data, each take up one packet time. Polling applications send and receive, data and commands, on the ***Device Pipe***.

The ADU73 features a streaming function where the user can send a **Stream Start (SS)** command on the **Device Pipe** and the ADU will send data on the separate ***Stream Pipe*** at rates up to 1000 packets per second, depending on the ***Configuration Word*** setting.

After the ***Start Steam*** command is sent on the device pipe a single packet can be captured using the ***Capture Single Packet*** button.

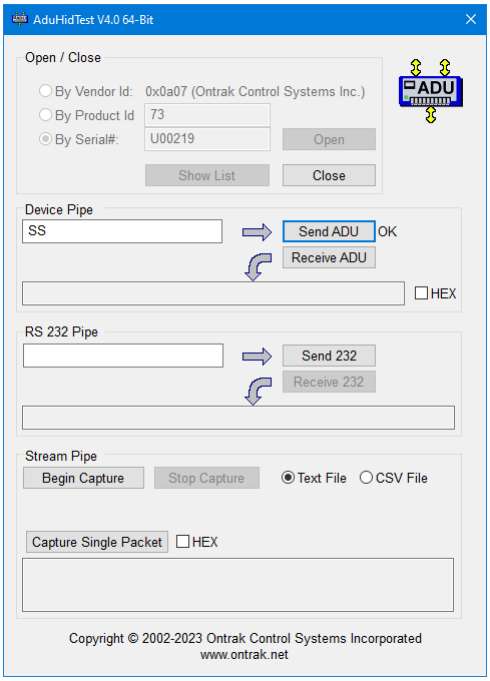


Figure 7: Sending ***Stream Start (SS)*** Command

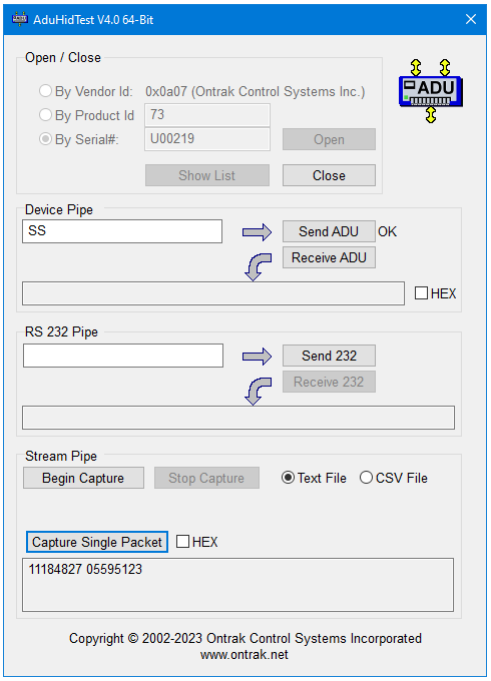


Figure 8: Capturing a single Packet of Data

A single packet of data is two 24-bit readings (00000000-16777215) representing the two 0-5VDC analog inputs (AN0 and AN1) on the ADU73, returned in ASCII format with a space delimiter. Analog channels that are disabled return "00000000".

Data packets can also be captured to text, or CSV files. Capturing of data is started by clicking the ***Begin Capture*** button. Capturing data to a file is stopped by clicking the ***Stop Capture*** button.

In text format, the file contains date and time capture started, and one line for each captured packet. Each line shows time of capture in hours:min:sec:ms format, followed by complete HEX data (63 bytes) and the ASCII representation of data. (Figure 9)

Packets can also be captured to a CSV file, which use comma as a delimiter, for use with Excel or other spreadsheet software. The CSV file can be directly opened in Excel and contains time of capture and sample data conveniently arranged in columns. (Figure 10)

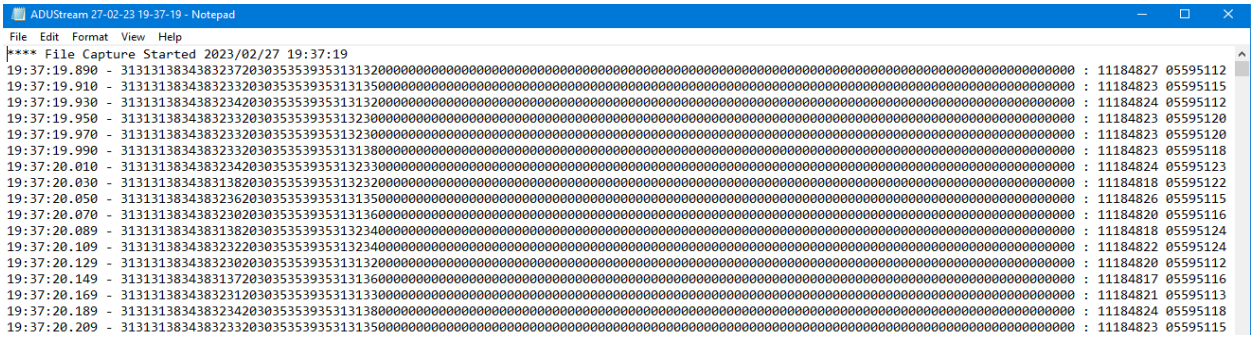


Figure 9: Text File Listing (Unused bytes are padded with nulls (**00h**)

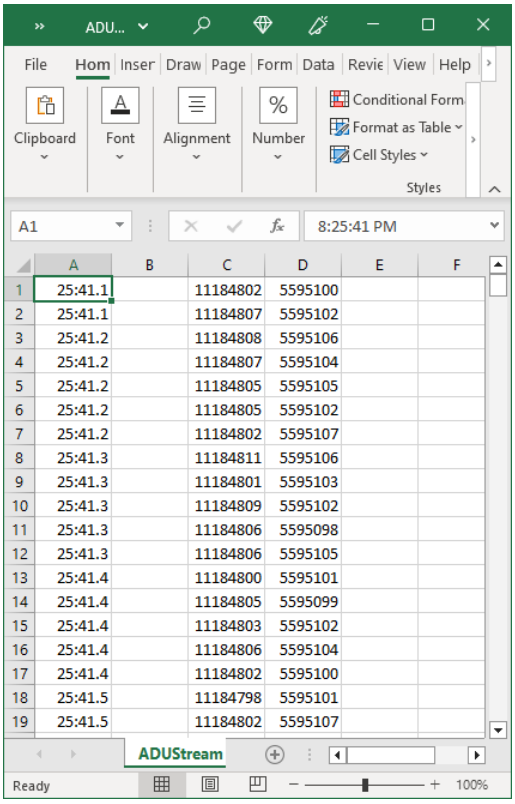


Figure 10: CSV File open in Excel

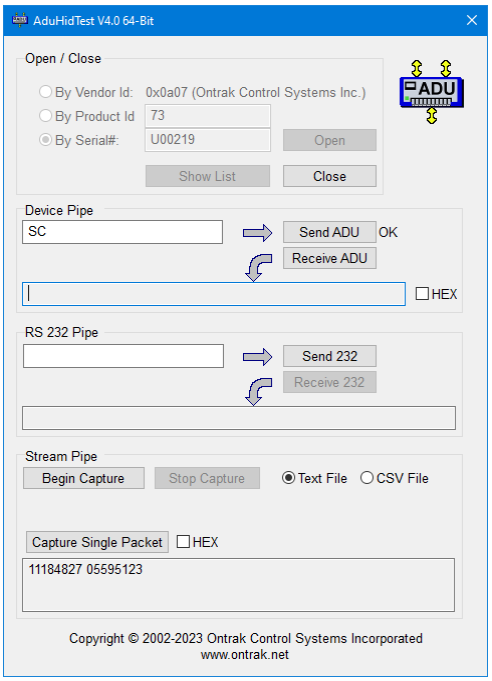


Figure 11: Sending ***Stream Cancel (SC)*** Command

Clicking the ***Stop Capture*** button does **not** stop the data stream from the ADU73. To stop the data stream, the **Stream Cancel (SC)** command should be sent on the device pipe. (Figure 11)

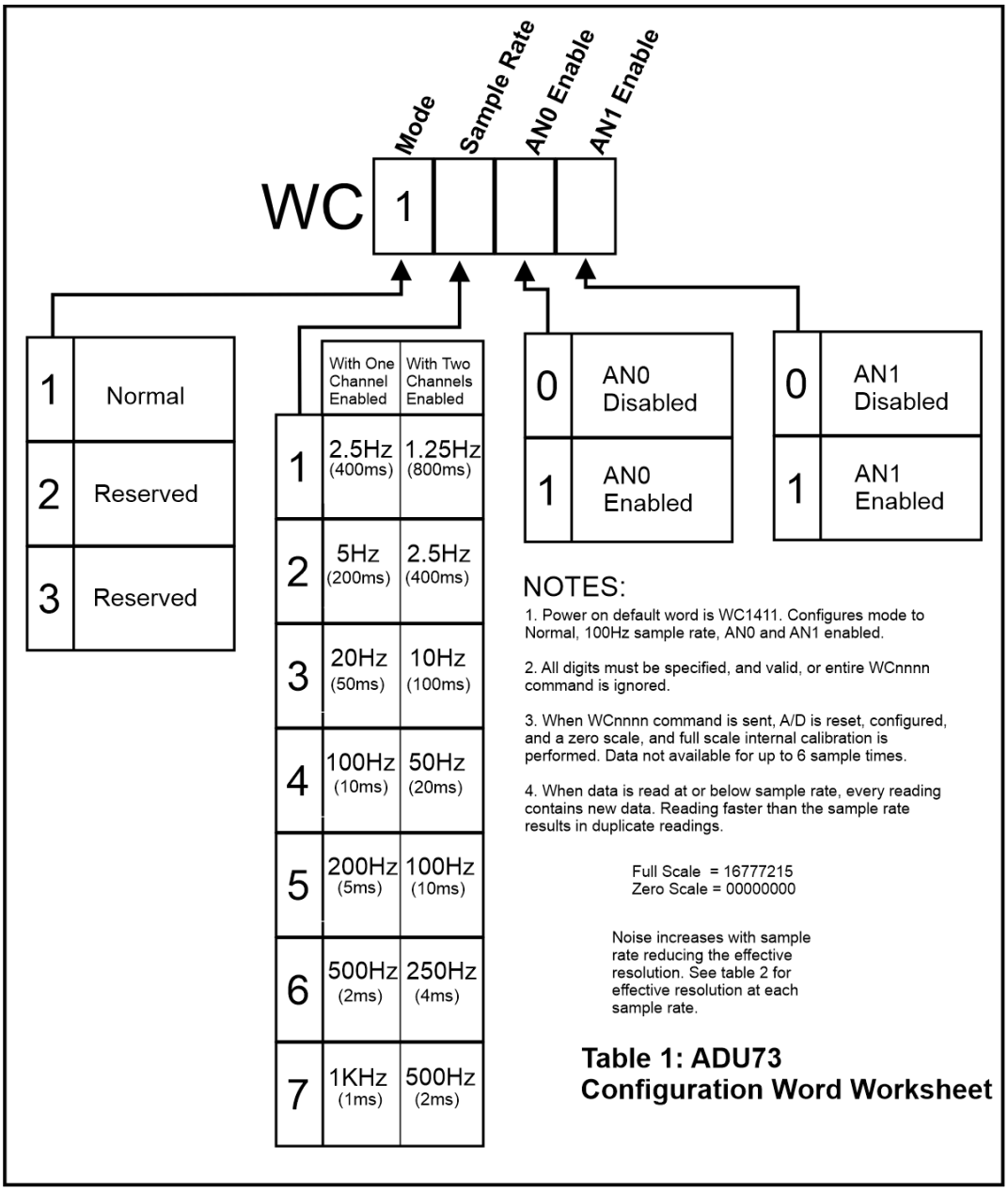
5. ADU73 Command Summary

WCnnnn	Configures mode, sample rate, enables/disables individual channels, and performs a self-calibration. (nnnn= configuration word)
RC	Returns present configuration word. (4 bytes)
RD0	Returns present reading for AN0 (8 bytes 00000000-16777215)
RD1	Returns present reading for AN1 (8 bytes, 00000000-16777215)
RD	Returns present reading for AN0 and AN1 with a Space (20h) delimiter (17 bytes, 00000000 00000000 – 16777215 16777215)
SS	Start Streaming
SC	Cancel Streaming

6. ADU73 Command Descriptions

6a) Determine and Send Configuration Word

The ADU73 features a simple command set where all configuration data is sent to the ADU73 using a single configuration word consisting of 4 bytes. The configuration word sets the sample rate, and individual channel enables. Table 1 outlines the available settings.



After the configuration word is determined, it is sent using the **WCnnnn** command, and it can be read using the **RC** command.

WCnnnn Configures mode, sample rate, enables/disables individual channels, and performs a self-calibration. (nnnn= configuration word)

For example;

WC1710

(sets sample rate = 1000s/s, AN0 enabled, AN1 disabled)

RC Returns present configuration word. (4 bytes)

For example;

RC
Returns…
1601 (sample rate = 500s/s, AN0 disabled, AN1 enabled)

NOTE: The effective resolution is determined by the selected sample rate. As the sample rate increases, noise increases, which reduces the effective resolution of the ADU73. Table 2 shows the effective resolution at all available sample rate settings for both ratio-metric and absolute measurements.

			Sample Rate						
			1	2	3	4	5	6	7
Mode	1	Normal	Ratio-Metric 24(24) Absolute 24(23)	Ratio-Metric 24(22.4) Absolute 23.4(22.7)	Ratio-Metric 23.9(21.2) Absolute 23.2(20.2)	Ratio-Metric 23.6(20.6) Absolute 22.8(20)	Ratio-Metric 23.1(20.4) Absolute 22.3(19.6)	Ratio-Metric 22.4(19.7) Absolute 22.1(19.2)	Ratio-Metric 22.2(19.2) Absolute 21.9(18.8)

Table 2: ADU73 Resolution in Bits - Effective (p-p)

6b) Reading Input Levels (Polling)

The ADU73 features two 0-5VDC analog inputs. Reading the ADU73 can be done by using either polling or streaming methods. To poll the ADU73 the **RD0, RD1 or RD** commands are used.

RD0 Returns present reading for AN0 (8 ASCII bytes 00000000-16777215)

For Example;

RD0
Returns..
15672221 (AN0= (15672221/16777215) x 5 = 4.670686V)

RD1 Returns present reading for AN1 (8 ASCII bytes, 00000000-16777215**)**

For Example;

RD1
Returns..
04234651 (AN1= (04234651/16777215) x 5 = 1.262024V)

RD Returns present reading for AN0 and AN1 with a Space (20h) delimiter (17 ASCII bytes, 00000000 00000000 – 16777215 16777215)

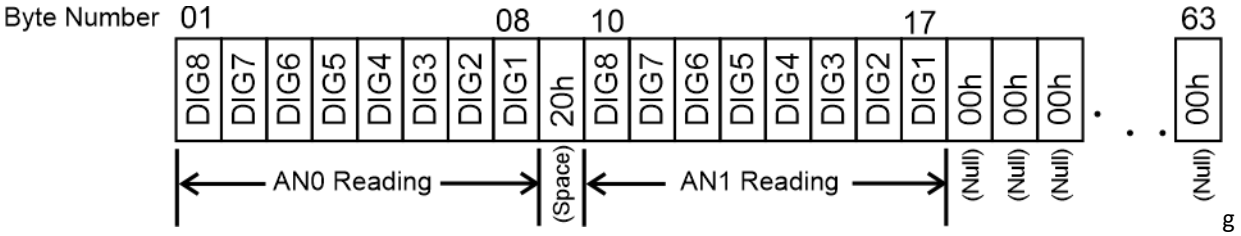
For Example;

RD
Returns..
15672221 04234651 (AN0= (15672221/16777215) x 5 = 4.670686V)
(AN1= (04234651/16777215) x 5 = 0.262024V)

6c) Reading Input Levels (Streaming)

The ADU73 can be configured to stream data to the host using the ***Stream Pipe***. When streaming, readings are sent via the ***Stream Pipe*** to the host via a separate handle that is opened for streaming. The ***Stream Pipe*** is read only.

In the case of the ADU73, a single packet of data is two 24-bit readings (00000000-16777215) representing the two 0-5VDC analog inputs (AN0 and AN1) on the ADU73, returned in ASCII format with a space delimiter. Analog channels that are disabled return "00000000". The number of packets per second is determined by the configuration word setting



of sample rate, and how many channels are enabled.

Figure 12: ADU73 Stream Packet Format

6d) Valid Input Voltage Range

The ADU73 is a precision measurement device with an input voltage range of 0.000 - 5.000 VDC. The absolute maximum voltage input is +5.3V, and the absolute minimum voltage input is -0.3V

CAUTION: Applied voltages above the absolute maximum, or below the absolute minimum, on any input may cause erroneous readings on one, or both inputs.

The ADU73 AN0 and AN1 inputs feature TVS devices for protection against ESD, and over/under voltage events on both analog input channels. Applied voltages outside the absolute maximum/minimum range may considerably reduce the input impedance of the ADU73.

7. ADU73 Connection Diagrams

7a) Connecting to Resistive Position Sensors

Figure 13 shows the connections required to interface the ADU73 to resistive position sensing potentiometers, including linear potentiometers and string pots. The potentiometers are biased using the +5.00V reference output to enable ratio-metric measurements. Minimum recommended potentiometer resistance 1K ohm. Do not draw more than 20mA in total from the +5.00V reference output.

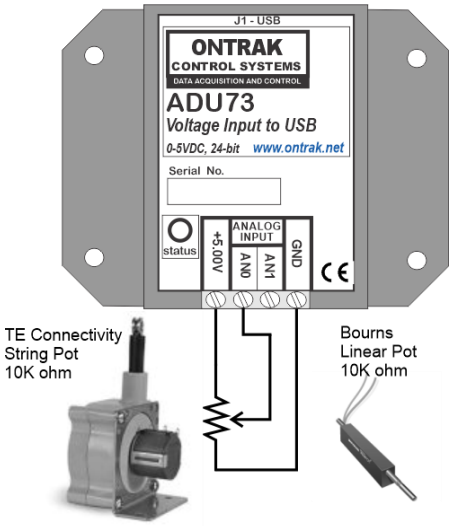


Figure 13: ADU73 Connection to String Potentiometer

7b) Connecting to Active Sensors

Active sensors can also be connected to the ADU73 with the only limitation being that a maximum of 20mA can be drawn from the +5.00VDC reference output to power the sensor. Figure 14 shows the connections to an MPXV5050DP pressure sensor from NXP. The MPXV5050DP draws only 7mA @ 5 VDC allowing two sensors to be connected safely.

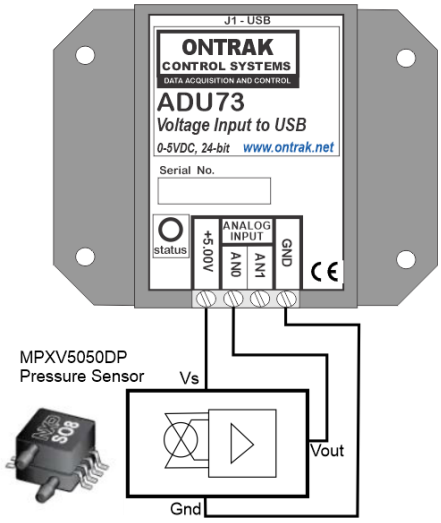


Figure 14: ADU73 Connection to MPXV5050DP Pressure Sensor

7c) Connecting to Thermistors

The ADU73 can be connected to thermistors using an external bias resistor. The external bias resistor resistance depends on both thermistor resistance, and the application requirements, and should be selected to ensure a maximum of 20mA is drawn from the +5.00V reference output. Up to two thermistors can be connected to the ADU73.

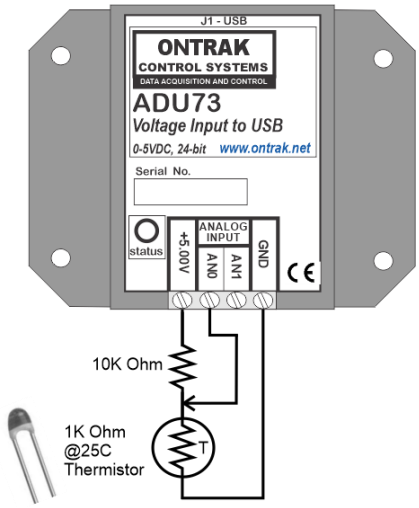


Figure15: ADU73 Connection to a Thermistor

7d) Connecting to External Voltage Sources.

The ADU73 can be connected to external voltage sources of up to 5VDC, including standard instrumentation 1-5VDC signals. Note that in this configuration, the ADU73 is operating in absolute voltage measurement mode. **CAUTION: No connection should be made to the +5.00V reference output when connecting external voltages. The external voltage source should not exceed 5.25V, or less than 0V.**

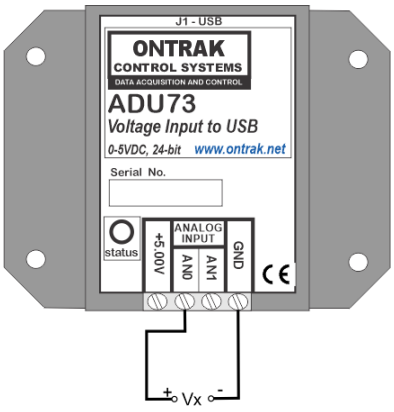
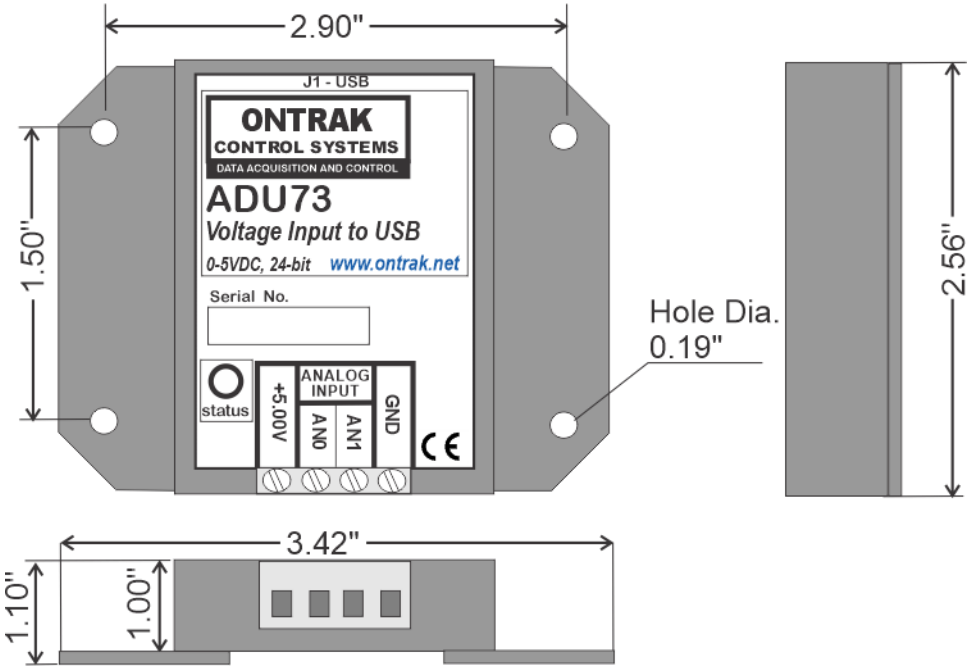


Figure 16: Connection to an External Voltage Source

8. Specifications and Dimensions

Supply Voltage	NONE (Bus Powered)	
USB Supply Current	50mA Typical 100mA Max	
Operating Temperature	-25C Min to 85C Max	
Isolation	2500V	
Analog Inputs (2)	**Ratio-metric Measurements**	**Absolute Measurements**
Input Range	0-5.000VDC (+5.3 MAX, -0.3V MIN)	0-5.000VDC (+5.3 MAX, -0.3V MIN)
Resolution	24-Bits (00000000-16777215)	24-Bits (00000000-16777215)
Total Absolute Unadjusted error	+/- .005% FSR Max.	+/- .04% FSR Max.
Temperature Stability	+/- 4ppm FSR/Degree C	+/- 4ppm FSR/Degree C
Reference Voltage	5.000 VDC +/- 2mv	5.000 VDC +/- 2mV
Programmable Sample Rates	2.5,5,20,100,200,500,1000	2.5,5,20,100,200,500,1000
Data Format	Decimal (ASCII)	
Certifications	CE	
Input Current	+/-3nA	
Special Functions		
5.000 Reference Voltage Output	5.000V @ 20mA max.	
Mounting Options	Flange Mount (STANDARD) , DIN Rail	



DIN Rail mount option available. Order part number ADU73-DIN