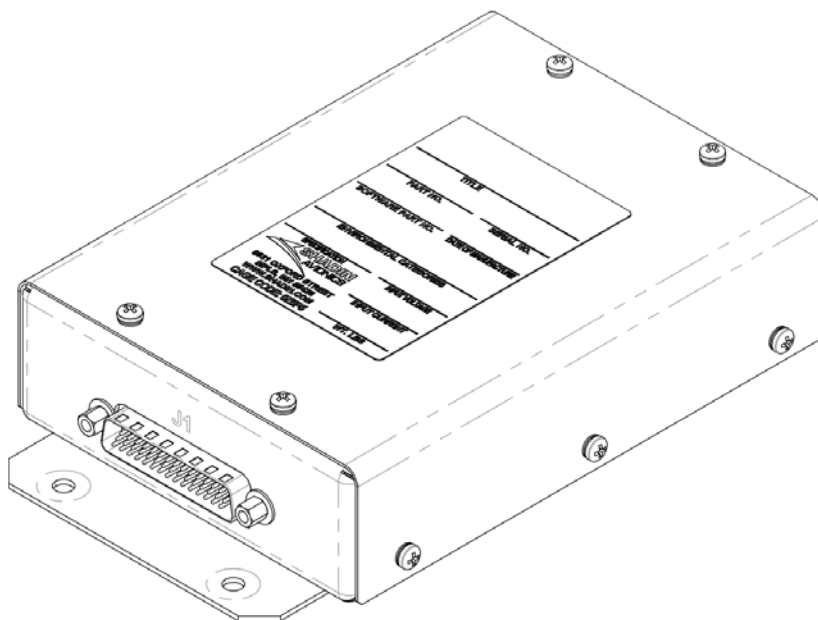




AIS-380 FUEL FLOW ADAPTER

P/N: 833811-01



INSTALLATION MANUAL MANUAL P/N: M833811-01 REV B

SHADIN AVIONICS
6831 Oxford Street
St. Louis Park, MN 55426

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REVISION LOG

Rev	Date	ERN	DESCRIPTION
–	22 JAN 2016	1509/004	Baseline Release
A	16 OCT 2018	1810/004	Corrected typo bit 29 on page 8
B	15 JAN 2019	1901/001	Updated table 1 and deleted Bell 412 EPI Installation

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1 OVERVIEW

The information in this manual is subject to change without notification.

1.1 SCOPE

This manual is intended to determine a proper installation of the AIS-380 FUEL FLOW ADAPTER. Installation instructions should be read and followed.

1.2 PRODUCT DESCRIPTION

The AIS 380 Fuel Flow is a product designed to provide fuel flow on a digital output bus to a display or GPS receiver that can receive ARINC 429 or RS-232. The AIS Fuel Flow receives a digital frequency signal from a fuel transducer or equivalent, ARINC 429 air data, and ARINC 429 heading. The AIS Fuel Flow combines this data and re-transmits it on an ARINC 429 or RS-232 serial output bus.

The ARINC 429 speed, K-factor, single/twin engine selection, fuel density, and serial output formats are configurable using the PC based configuration tool referenced later in this installation manual.

A basic overview is shown below in Figure 1.

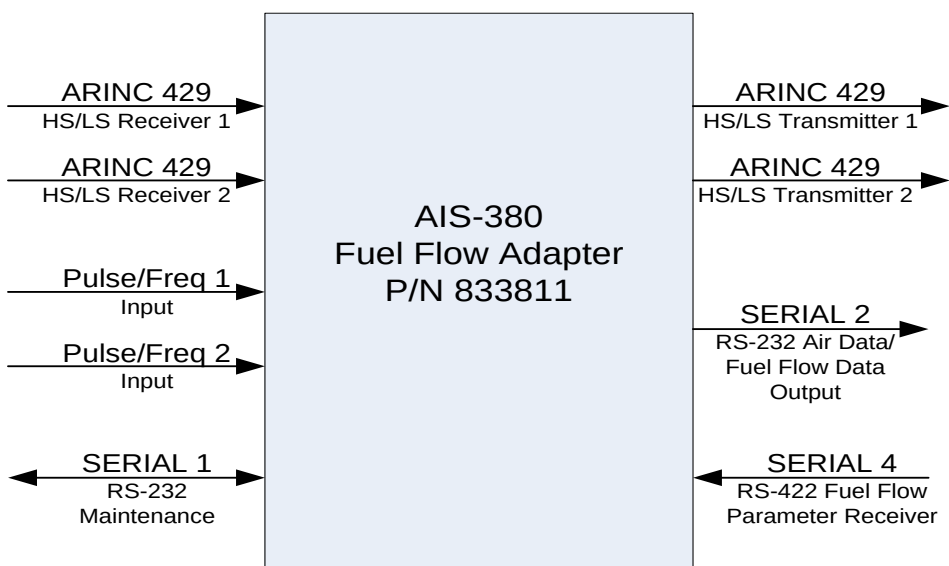


Figure 1 : AIS-380 Fuel Flow Adapter Overview

The features which are applicable to all standard installations are listed below:

- Two +12 VDC power supplies are available for powering fuel flow transducers
- ARINC 429 inputs are forwarded to the ARINC 429 outputs
- ARINC 429 speed (high or low) is configurable. Each ARINC 429 channel input and output speed is matched when configured, e.g. ARINC 429 channel 1 input channel set for high speed results in ARINC 429 channel 1 output set for high speed
- Fuel Flow labels 244 (Total Fuel Flow) and 347 (Left and Right independent Fuel Flow based on SDI) are generated and output at an 8 Hz rate when configured for normal fuel flow format.

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2 SPECIFICATIONS

For a complete listing of product qualifications please review the Environmental Qualification Form (EQF) found in Section 4.

2.1 PHYSICAL

Nominal Dimensions:	6.90"L x 4.24"W x 1.57"H
Weight:	0.7 pounds (lbs)
Mounting:	4 Screws (See Installation Drawing D833811-01)
Mounting Locations:	6.25"L x 2.00"W

2.2 ELECTRICAL

Power Supply Voltage:	+28VDC Nominal
Supply Current:	100mA at +28VDC
Protection:	Not internally fused

2.3 FUNCTIONAL

2.3.1 *INPUTS:*

The AIS-380 accepts the following inputs

- Two Discrete Fuel Flow pulse/frequency signals
- One RS-232 Serial Interface for Maintenance
- One RS-422 Serial Interface compatible to fuel flow parameters
- Two ARINC 429 High Speed or Low Speed signals with Air Data and Heading labels as shown in Table 1 below.

2.3.2 *OUTPUTS:*

The AIS-380 provides the following outputs

- ARINC 429 label set described in section 1.4 forwarded from input
- Two ARINC 429 High Speed or Low Speed signals
 - o Label 244 and 347
- One RS-232 Serial Interface with fuel flow data, reference Table 3 for serial output formats.

Table 1 below defines the ARINC 429 labels which are received at the input of the AIS-380 and the labels that are transmitted out.

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Table 1 – ARINC 429 Data I/O

	ARINC 429 Input	ARINC 429 Output
ARINC 429 Channel 1	102, 203, 204, 205, 206, 207, 210, 211, 212, 213, 234, 235, 236, 237, 312, 314, 350, 353	102, 203, 204, 205, 206, 207, 210, 211, 212, 213, 234, 235, 236, 237, 312, 314, 350, 353, 244, 347
ARINC 429 Channel 2	320	320, 244, 347

Labels 244 and 347 are the labels generated by the AIS-380 and are shown in bold at the ARINC 429 output.

All of the data listed in the ARINC 429 Output column in Table 1 above is sent out on SERIAL 2 in RS-232 format.

Label 347 - The AIS-380 converts the fuel flow from gallons/hr to lbs/hr to be transmitted on label 347. Label 347 provides fuel flow per engine by using the SDI bits to indicate which engine, and sending each engine's data in a round robin fashion. SDI bits 10,9 = 0,1 (Left), 1,0 (Right). Transmit interval = 125 msec, for an effective transmit interval of 250 msec per engine. The data format is as follows:

Bits	1 2 3 4 5 6 7 8	9 10	11 12	13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28	29	30 31	32
	Label 347	SDI	0 0	DATA	S	SM	Parity

Data type	BNR	Equipment ID: 029	Bit 29 = 0 (Sign)
Significant bits	16		Bit 30, 31 = 1, 1 (Normal Op)
Resolution	0.5 lbs/hr (LSB value)		Bit 30, 31 = 0, 0 (Failed)
Range	32768 lbs/hr		Bit 32 ⇒ ODD Parity

Label 244 - The AIS-380 outputs Total Fuel Flow Rate on label 244 also in lbs/hr. Label 244 provides total fuel flow. Transmit interval = 125 msec, for an effective transmit interval of 250 msec per engine. The data format is as follows:

Bits	1 2 3 4 5 6 7 8	9 10	11 12	13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28	29	30 31	32
	Label 244	0 0	0 0	DATA	S	SM	Parity

Data type	BNR	Equipment ID: 08D	Bit 29 = 0 (Sign)
Significant bits	16		Bit 30, 31 = 1, 1 (Normal Op)
Resolution	0.5 lbs/hr (LSB value)		Bit 30, 31 = 0, 0 (Failed)
Range	32768 lbs/hr		Bit 32 ⇒ ODD Parity

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2.3.3 AIRDATA AND HEADING CONVERSION (OPTIONAL)

See Figure 2 below

Inputs: The Air Data and Heading sources provide data to the AIS-380 via ARINC 429 inputs. ARINC 429 Channel 1 accepts Altitude, Airspeed, and OAT ARINC 429 labels. ARINC 429 Channel 2 accepts the Mag Heading ARINC 429 label. See Table 1 above for specific ARINC 429 labels used.

Output: The AIS-380 transmits the data along with fuel flow data to the GPS via the RS-232 port, Channel 2. The RS-232 serial format is programmed using the Maintenance Interface. The available formats are listed in Table 3 below in Section 5.1.2.

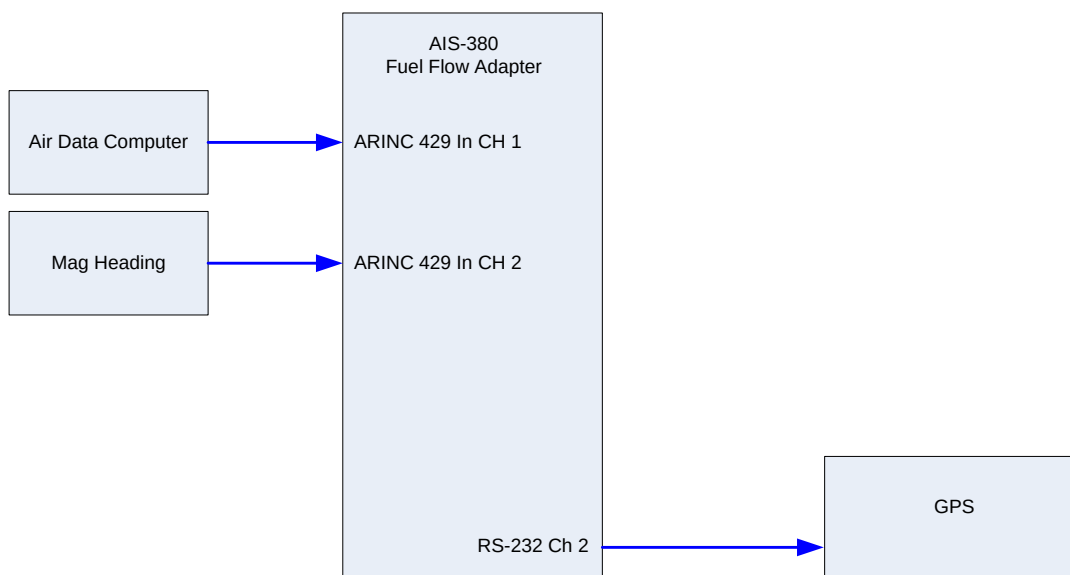


Figure 2 : Air Data Computer/Heading ARINC 429 to RS-232

2.4 ENVIRONMENTAL

Qualification testing was conducted on P/N 833811-00 which uses the identical hardware as the 833811-01.

MANUFACTURER'S SPECIFICATION AND/OR OTHER APPLICABLE SPECIFICATION:
 RTCA/DO-160F [A4X]BBB[R(B,B1) U2(F,F1)]EXXXXXZ[BXX]AZ[CC][RR]M[XXJ33]XXAX

Operating Temperature -40°C to +70°C
 Storage Temperature -55°C to +85°C

Equipment can run indefinitely within stated environmental range with no external cooling.

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2.5 SOFTWARE CERTIFICATION

This product was developed in accordance with RTCA/DO-178B Design Assurance Level C.

2.6 REGULATORY CERTIFICATION

This product meets requirements of TSO-C44c INCOMPLETE SYSTEM.

2.7 RELIABILITY

MTBF (Mean Time Between Failures) Greater than 20,000 hours

Mean time between failures (MTBF) is calculated following MIL-HDBK-217F guidance as a starting point, when available field or vendor data is used in place of MIL-HDBK-217F predictions. The AIS-380 prediction is for an environment of airborne, inhabited, cargo. At 20°C the prediction is 36,367 hours and at 40°C it is 22,607 hours.

2.8 ACCURACY

Fuel Flow conversion based on $\pm 10\text{Hz}$ of max input of 2 KHz typical accuracy is 0.1% of full scale with max of 0.5% of full scale.

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3 INSTALLATION

3.1 LIMITATIONS

The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those installing this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standards. TSO articles must have separate approval for installation in an aircraft. The article may be installed only if performed under 14 CFR part 43 or the applicable airworthiness requirements.

This equipment is developed to Design Assurance Level (DAL C). TSO-C44c lists the loss of fuel flow functionality to be Hazardous. It is the responsibility of those installing this article to determine if it meets the needs set forth in the System Safety Assessment.

3.2 INCOMPLETE SYSTEM

Shadin Avionics manufactures the AIS-380 833811 as an incomplete system under TSO-C44c, *Fuel Flowmeters* and performs to the relevant performance standards of AS407C, *Fuel Flowmeters* as tested by RTCA/DO-160F, *Environmental Conditions and Test Procedures for Airborne Equipment*.

The AIS-380 is compatible with any fuel transducer whose output is a pulse/frequency in the range of 0 to +13VDC and within 2Hz to 2KHz. Installation Drawing D833811-01, included in Appendix A of this manual, provides connector J1 pin out information for proper wiring.

The AIS-380 provides data conversion for display. The installer must substantiate the interoperability when showing compliance to the applicable airworthiness.

3.2.1 PERFORMANCE STANDARDS

The AIS-380 meets the performance standards of AS407C paragraph 3.3 for Environmental Conditions, 4.5 for Power Variations, as defined in section 4 of this document in the Environmental Qualification Form (EQF) for an incomplete system to the fuel flowmeter. Scale errors are within 0.5% in accordance with paragraph 6.1 of AS407C.

3.3 MOUNTING

The AIS-380 FUEL FLOW ADAPTER (P/N 833811-01) can be mounted in any orientation in the aircraft. The hardware should be mounted using four (4) number 8 size screws in a dry location. The equipment should be installed in a controlled temperature and pressurized location.

3.4 ELECTRICAL CONNECTION

Installation Drawing D833811-01, included in Section 6 of this manual, provides connector J1 pinout information. The wiring type specified on the installation drawing should be used to interface with the AIS-380.

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3.4.1 TYPICAL INSTALLATION WIRING

Standard installation is shown below in Figure 3.

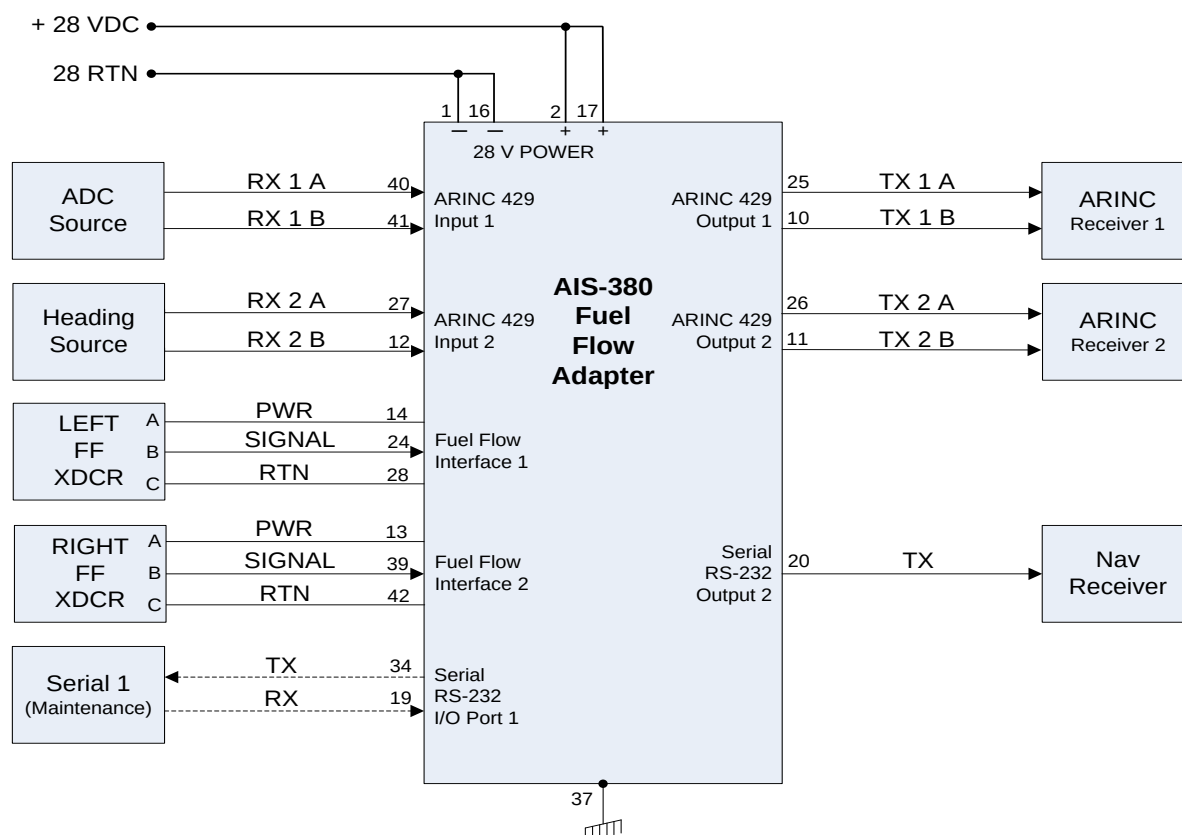


Figure 3 : Standard Fuel Flow Configuration

Aircraft power +28 VDC can be connected to both pins 2 and 17 for redundancy as shown in Figure 3. Alternatively, the unit can be powered only through pin 2, or only through pin 17. The same applies to the return lines: Pins 1 and 16 can both be routed to the aircraft 28 V return, or return can be connected to either pin 1 or pin 16.

Pin 37 is tied directly to the AIS-380 chassis. After the AIS-380 is mounted to the airframe, this pin is equivalent to airframe ground and can be used as a connection to cable shields in the connector backshell.

The Fuel Flow transducer wiring should be shielded twisted triple wires. Optimal shielding connections are shown above. Both fuel flow interfaces are wired identically. Tie each shield to pin 37 inside the backshell of the mating connector to the AIS-380. The shields are then left open at the transducer ends as shown in Figure 3.

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3.4.2 DC TO FREQUENCY INSTALLATION EXAMPLE

DC Fuel Flow installation with P/N 630502 is shown below in Figure 4.

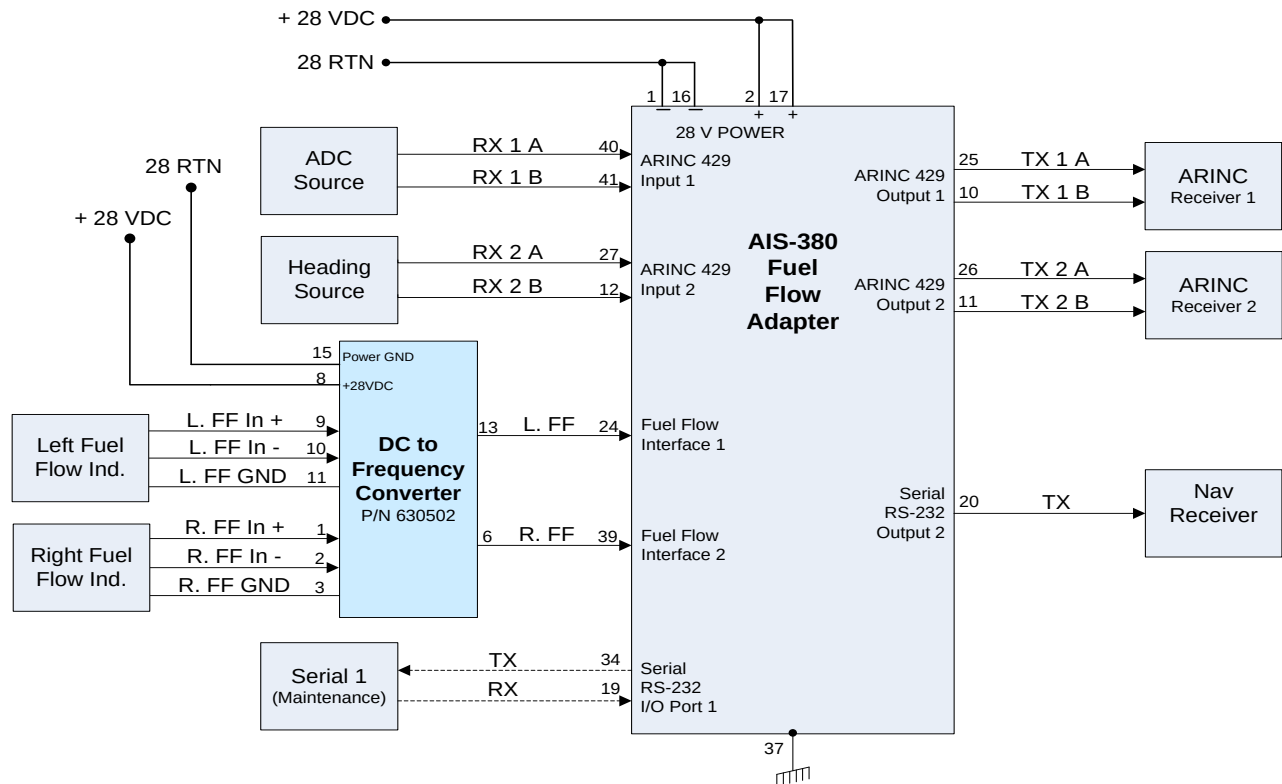


Figure 4 : DC Fuel Flow Installation with P/N 630502

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The DC Fuel Flow K-Factors and Offsets for specific aircraft/indicators are listed below in Table 2. If a specific aircraft/indicator is not listed, contact Shadin Avionics technical support at (952) 836-2269.

Table 2 – DC Fuel Flow K-Factors

Indicator P/N	K-factor (ppg)	Offset (Hz)
Beech King Air		
90-380009-2	49,050	24
90-380009-5	49,050	24
101-384009-1	49,050	24
101-384153-1,3	19,647	0
PC900-6A0600-XXX	24,599	0
PC900-1A0750-XXX	19,679	0
PC900-1A0800-XXX	18,449	0
Beechjet 400A		
PC900-3B2000-PH-1	7,400	0
Piper Cheyenne		
3265013-0601	29,470	0
3260513-1201	29,470	0
Cessna Citation		
393002-009	9,400	0
9912049-2	9,400	0
9912147-16	10,400	0
VSDL-OC208E	10,400	0
9912560-5	14,020	0
Israeli Aircraft Ind. Westwind		
1291-2	6,700	0

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3.4.3 GARMIN RECEIVER INSTALLATION EXAMPLE

Garmin GTN GPS Source installation is shown below in Figure 5.

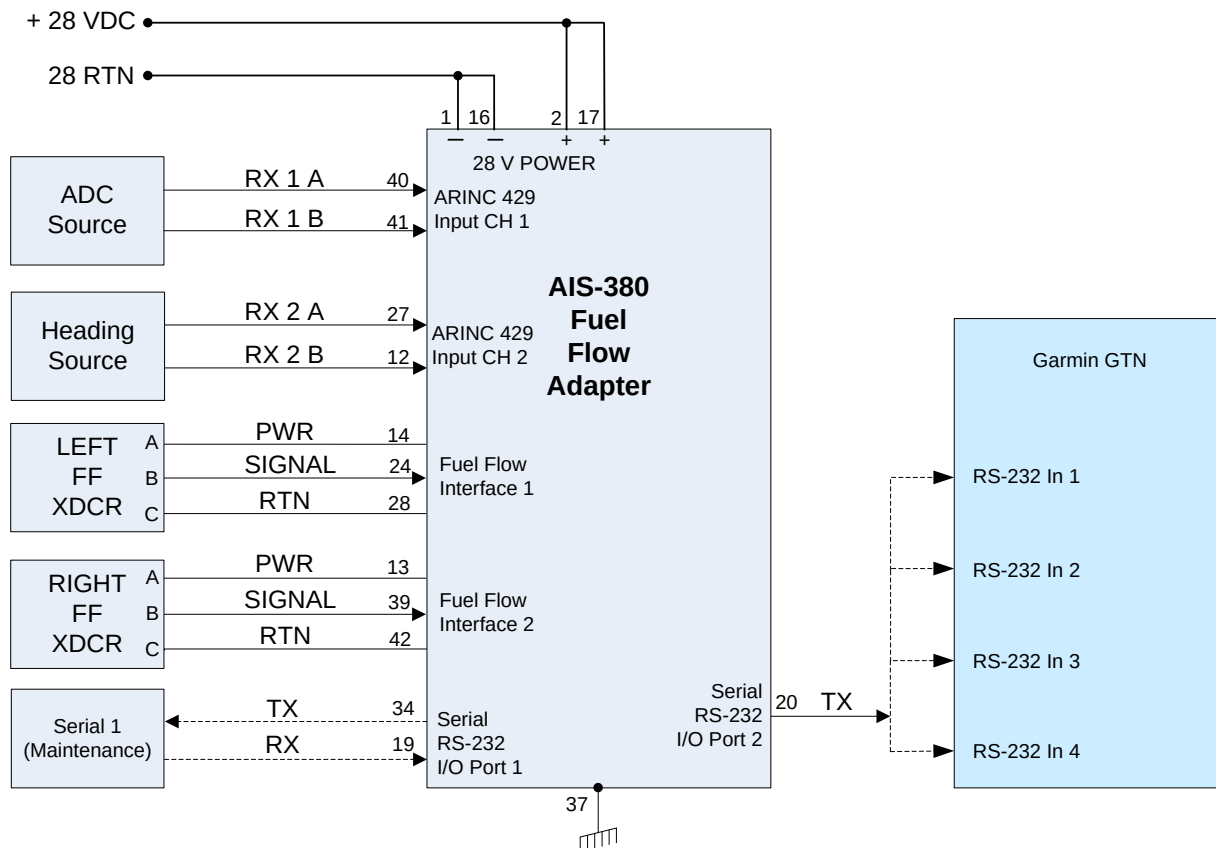


Figure 5 : Garmin Receiver Installation

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3.4.4 SINE TO SQUARE WAVE CONVERTER INSTALLATION EXAMPLE

The example for a Sine Wave to Square Wave converter installation is show below in Figure 6.

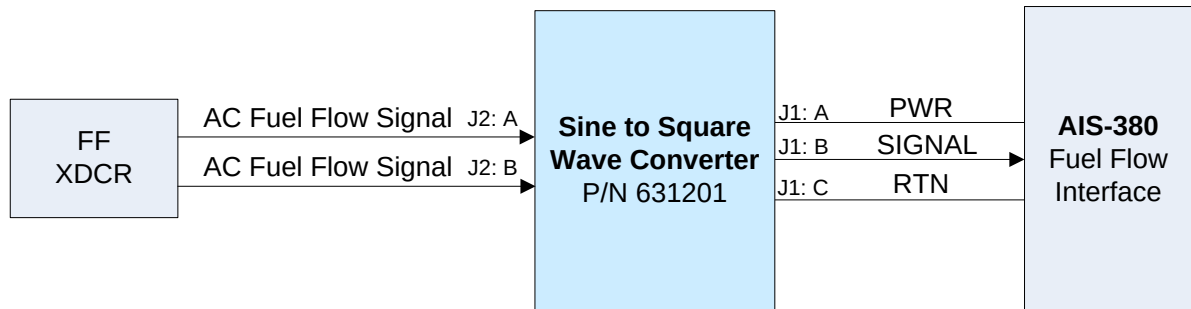


Figure 6 : Sine to Square Wave Converter Installation

3.5 REPAIR

Units needing repair or that have failed should be returned to Shadin Avionics. Contact technical support for assistance by phone at (952) 927-6500 or (800) 388-2849, or email at service@shadin.com

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4 ENVIRONMENTAL QUALIFICATION FORM (EQF)

The AIS-380 hardware was environmentally tested with all functions active to RTCA/DO-160F and is documented in Shadin Qualification Testing Report SD-110037. Qualification testing was conducted on P/N 833811-00; the hardware is identical to 833811-01, therefore qualified by similarity. Explosive Atmosphere testing was conducted P/N 833812-10 and passed. The 833812-10 contains the same circuit card assembly and similar enclosure as the 833811-00/-01, testing is documented in Shadin Qualification Testing Report SD-140054.

NOMENCLATURE: AIS-380 FUEL FLOW ADAPTER

TYPE/MODEL/PART NO: 833811-01 **TSO NUMBER:** TSO-C44c INCOMPLETE SYSTEM

MANUFACTURER'S SPECIFICATION AND/OR OTHER APPLICABLE SPECIFICATION:

Report SD-110037 and SD-140054, RTCA/DO-160F

MANUFACTURER: Shadin Avionics **ADDRESS:** 6831 Oxford Street, St. Louis Park, Minnesota 55426

<u>CONDITIONS</u>	<u>SECTION</u>	<u>DESCRIPTION OF TESTS CONDUCTED</u>
Temperature and Altitude	4.0	A4X
Low Temperature (Operating)	4.0	-40°C [See remarks (1)]
High Temperature (Operating)		+70°C
Altitude		42,000ft [See remarks (2)]
Decompression		42,000ft [See remarks (2)]
Overpressure		-15,000ft
Temperature Variation	5.0	Tested to Category B
Humidity	6.0	Tested to Category B
Operational Shock and Crash Safety	7.0	Tested to Category B
Vibration	8.0	Tested to Category R(B,B1)U2(F,F1)
Explosion	9.0	Qual by Similarity to Category E [See remarks (3)]
Waterproofness	10.0	Identified as Category X. Not tested
Fluids Susceptibility	11.0	Identified as Category X. Not tested
Sand and Dust	12.0	Identified as Category X. Not tested
Fungus	13.0	Identified as Category X. Not tested
Salt Spray	14.0	Identified as Category X. Not tested
Magnetic Effect	15.0	Tested to Category Z
Power Input	16.0	Tested to Category BXX
Voltage Spike	17.0	Tested to Category A
Audio Frequency Susceptibility	18.0	Tested to Category Z
Induced Signal Susceptibility	19.0	Tested to Category CC
Radio Frequency Susceptibility	20.0	Tested to Category RR
Radio Frequency Emission	21.0	Tested to Category M
Lightning Induced Transient Susceptibility	22.0	Tested to Category XXJ33
Lightning Direct Effects	23.0	Identified as Category X. Not tested
Icing	24.0	Identified as Category X. Not tested
Electrostatic Discharge	25.0	Tested to Category A.
Fire, Flammability	26.0	Identified as Category X. Not tested

REMARKS:

- (1) The 833811-00 was tested to -40°C, beyond the normal A4 category temperature limits.
- (2) The 833811-00 was tested to +42,000 ft., beyond the normal A4 category altitude and decompression limits.
- (3) The 833812-10 was tested in Explosive Atmosphere category E and passed.

SHADIN AVIONICS

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Customer Service: (952) 836-2269

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5 CONFIGURATION TOOL

This section describes the use of the 833811-01 Fuel Flow Configuration Tool. The AIS-380 is to be configured on a test bench using the configuration tool prior to installation in the aircraft. Below is a list of the equipment needed and the instructions for installing and configuring the AIS-380 with the configuration tool.

Equipment List

- +18 V to +28 V DC Power Supply
- CK833811-01 Configuration Kit for 833811-01*
- Desktop or Laptop PC with serial port or USB adapter if no serial port is available

Installation Requirements for PC

- Windows XP SP3 or Windows 7/8/10
- 1 MB hard disk space
- Intel® Pentium® Processor, 1.6 GHz minimum
- 500 MB RAM minimum

* Contact Shadin Tech Support to obtain CK833811-01:

Web: www.shadin.com
E-mail: service@shadin.com
Phone: (952) 927-6500 or
(800) 388-2849

The software and the cable required for this tool are included in the kit. Alternatively, a cable configured per Figure 7 below can be built to interface the AIS-380 to the PC. The software can be acquired separately from Shadin Tech Support.

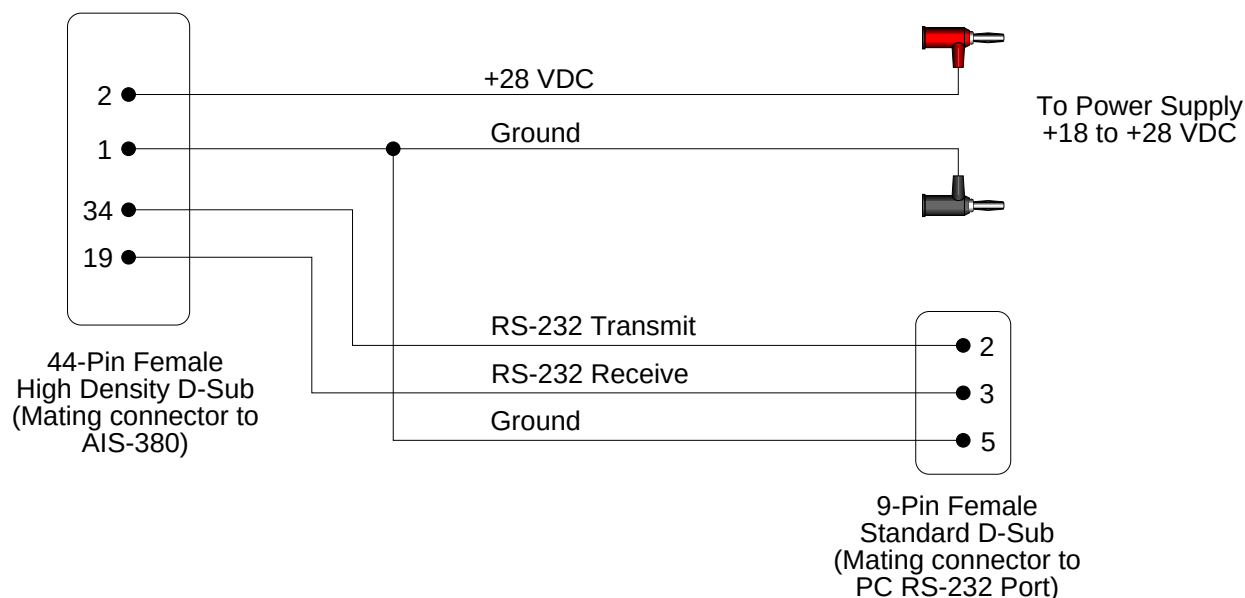
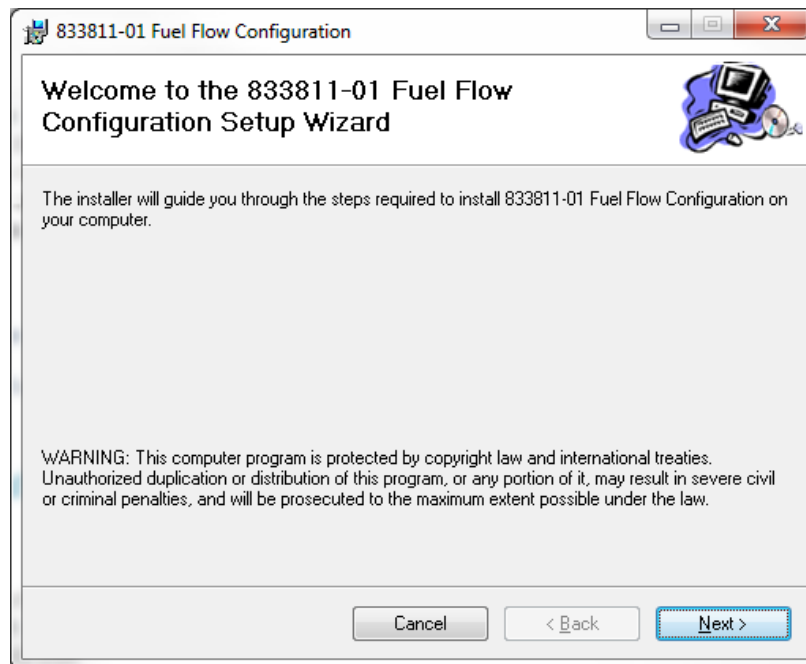


Figure 7 : Field Configuration Cable

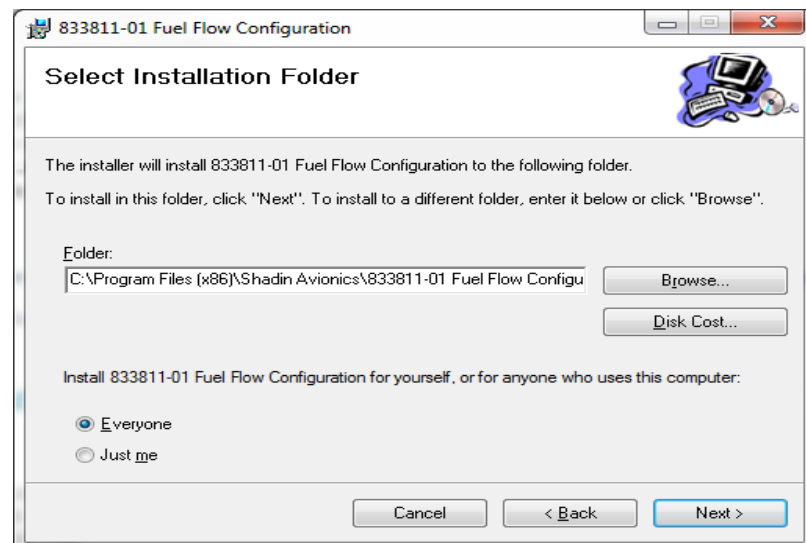
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5.1.1 CONFIGURATION TOOL SOFTWARE INSTALLATION

- (1) Copy 463803-01.msi and setup.exe to a local folder on the PC.
- (2) Run setup.exe. The following dialog box will appear:



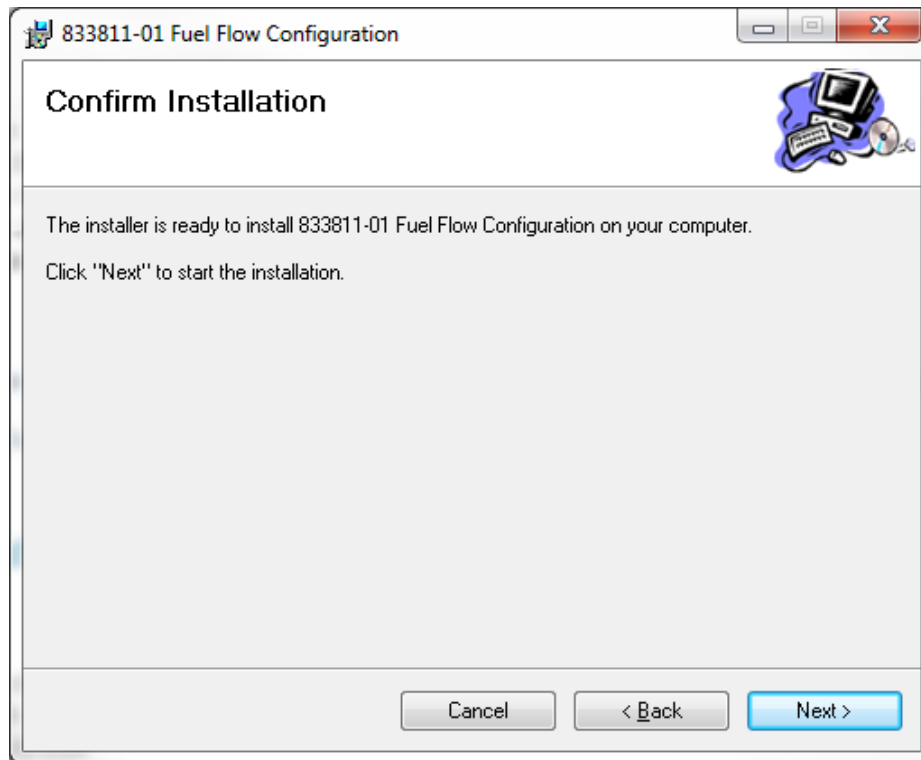
- (3) Follow the Setup Wizard instructions.
- (4) Click Next



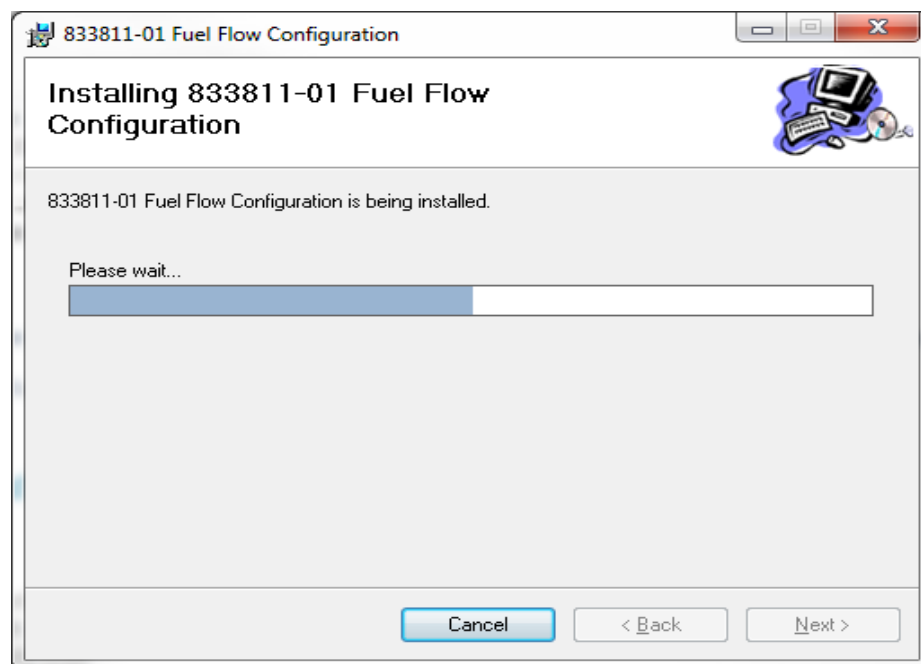
- (5) Choose install location and user access to tool (Default settings are shown in the picture above) and click on Next.

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(6) A Confirm Installation window will appear as shown below, click Next.

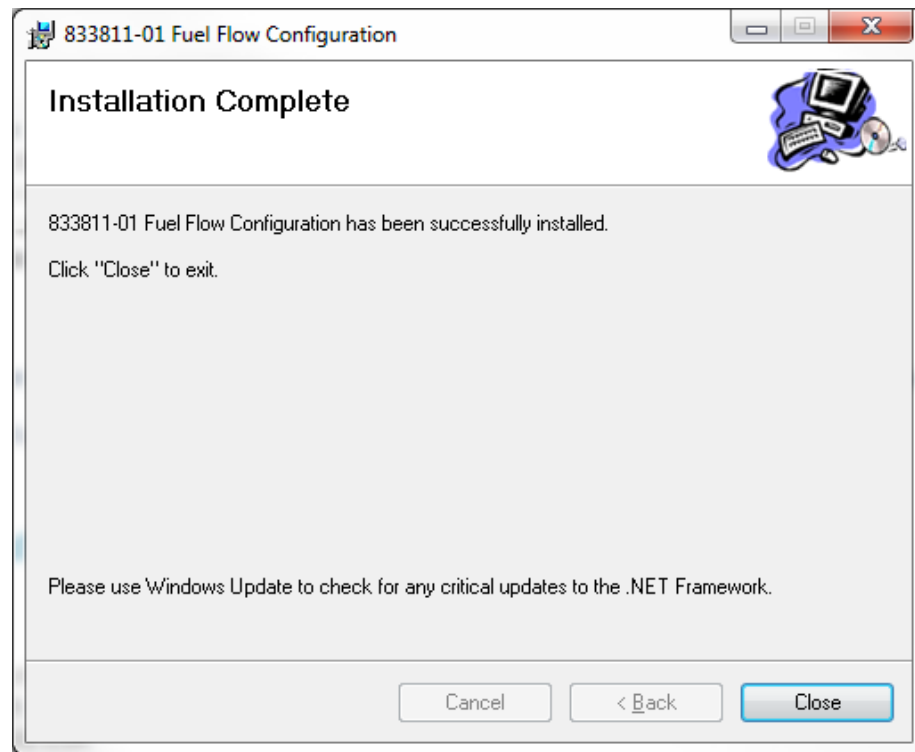


(7) A progress bar will appear as seen below



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(8) After installation, confirm the following message is displayed: "833811-01 Fuel Flow Configuration has been successfully installed."

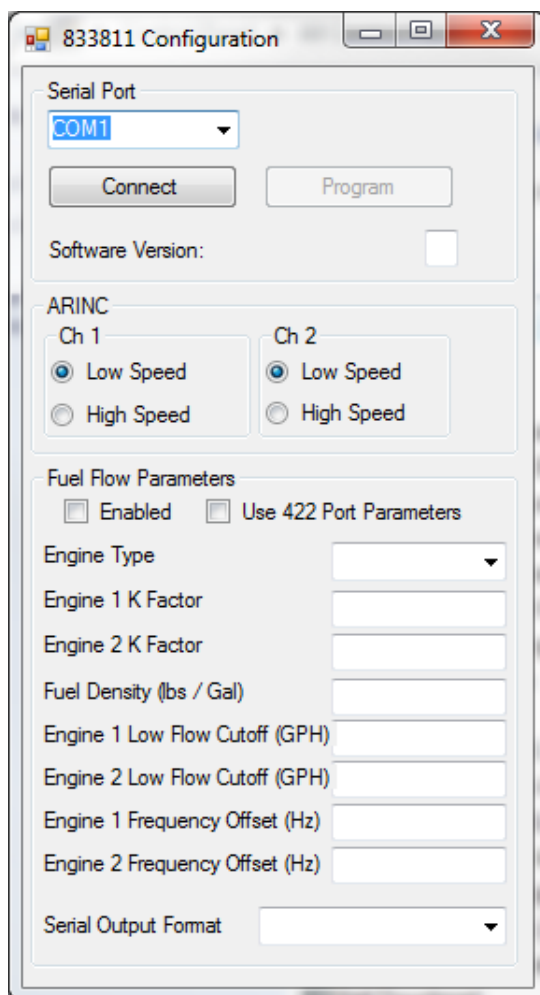


(9) Close the 833811-01 Fuel Flow Configuration Wizard dialog box.

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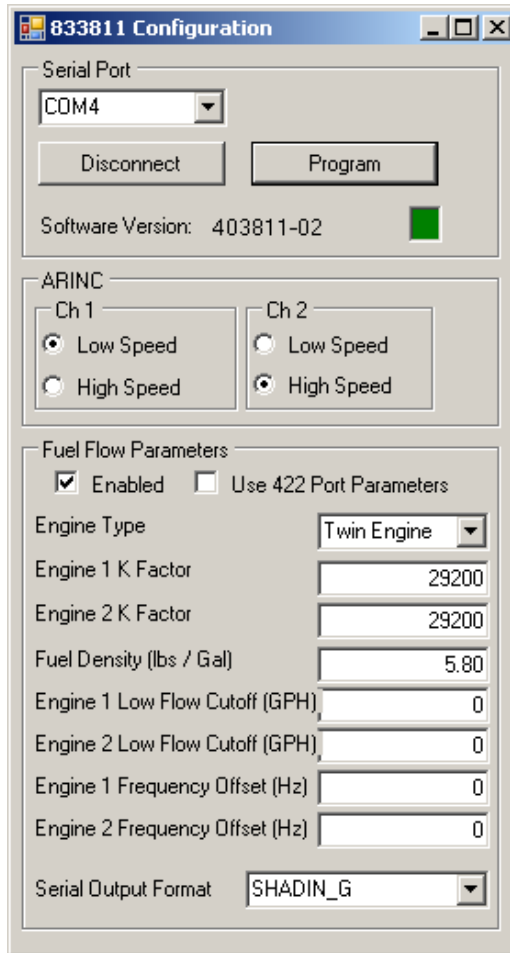
5.1.2 USING THE CONFIGURATION TOOL

- (1) Connect the PC to the AIS-380 using the Field Configuration Cable.
- (2) Apply +28 VDC to the power leads of the Configuration cable which is connected to the AIS-380.
- (3) On the PC, navigate to the location of the 833811-01 Fuel Flow Configuration Tool icon which points to the newly installed program 463803-01.exe. Double-click the icon to start up the program. The following dialog box will appear:



- (4) Select the appropriate COM Serial Port which is connected to the AIS-380 and press the Connect button.

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833811 Configuration

Serial Port
COM4
Disconnect Program
Software Version: 403811-02

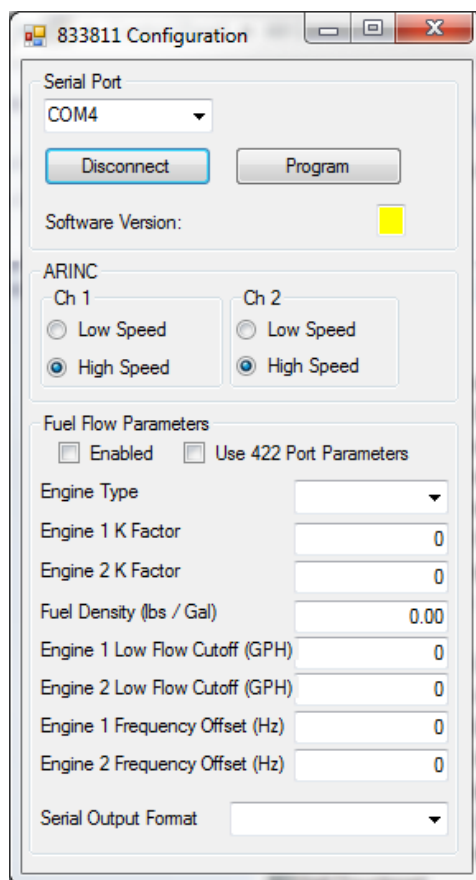
ARINC
Ch 1
☒ Low Speed
☐ High Speed
Ch 2
☐ Low Speed
☒ High Speed

Fuel Flow Parameters
☒ Enabled ☐ Use 422 Port Parameters
Engine Type: Twin Engine
Engine 1 K Factor: 29200
Engine 2 K Factor: 29200
Fuel Density (lbs / Gal): 5.80
Engine 1 Low Flow Cutoff (GPH): 0
Engine 2 Low Flow Cutoff (GPH): 0
Engine 1 Frequency Offset (Hz): 0
Engine 2 Frequency Offset (Hz): 0
Serial Output Format: SHADIN_G

(5) Wait for the Software Version number to appear, and the status indicator located next to the software version number to turn from yellow to green. If the indicator remains yellow, check the serial port cable connections and re-run the program.

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Below is an example of the result of a disconnected serial cable. Note the box next to Software Version remains yellow in color:



- (6) Select the desired speed for each ARINC channel.
- (7) Under Fuel Flow Parameters, select Enabled.
- (8) Set Use 422 Port Parameters box to unchecked..
- (9) Select the appropriate Engine Type from the drop-down list: Single Engine or Twin Engine.
- (10) Enter a Fuel Flow K Factor number between 200 and 100000 (pulses per gallon) for each applicable engine. The K Factor can normally be found on the fuel flow transducer.

Note: the K Factor programmed should be in pulses per gallon whereas the K Factor listed on the transducer is typically in the abbreviated notation, factor of 1000. (example: Transducer with a K Factor of 29.2 should be programmed as 29200 pulses per gallon)

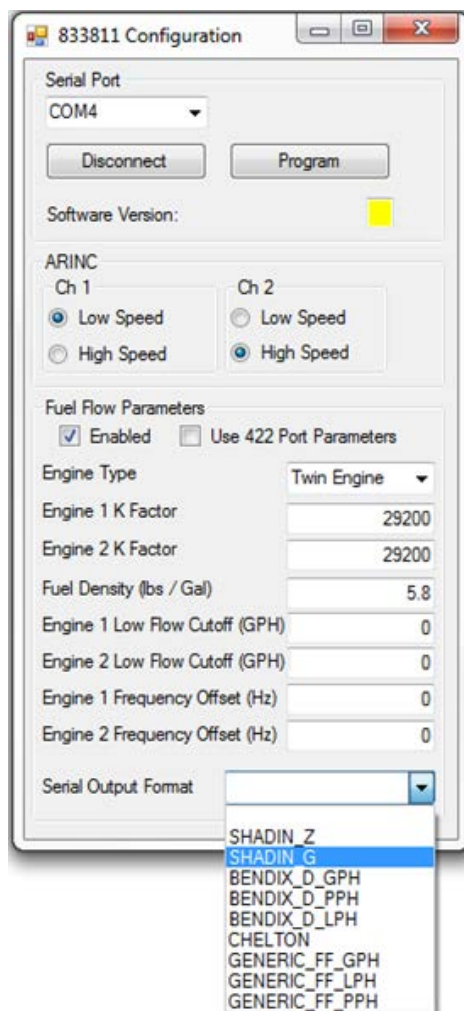
- (11) Enter a Fuel Density number between 0.00 and 10.00. Fuel Density examples are 5.80 for AvGas and 6.70 for Jet A.

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(12) Select the applicable Serial Output Format based on the equipment that will be connected to SERIAL 2 in the planned aircraft installation. The serial output formats available are given in Table 3 below:

Table 3 – Serial Output Formats

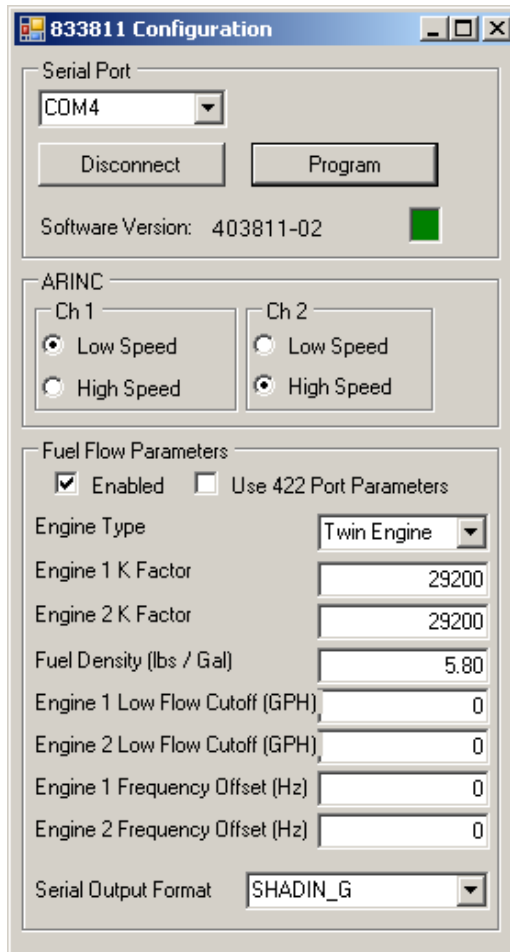
SHADIN_Z
SHADIN_G
BENDIX_D_GPH
BENDIX_D_PPH
BENDIX_D_LPH
CHELTON
GENERIC_FF_GPH
GENERIC_FF_LPH
GENERIC_FF_PPH



(13) Press the Program button. Wait for the status indicator to turn from yellow to green. The AIS-380 configuration is now set.

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See the example below for a configuration with all fields completed:



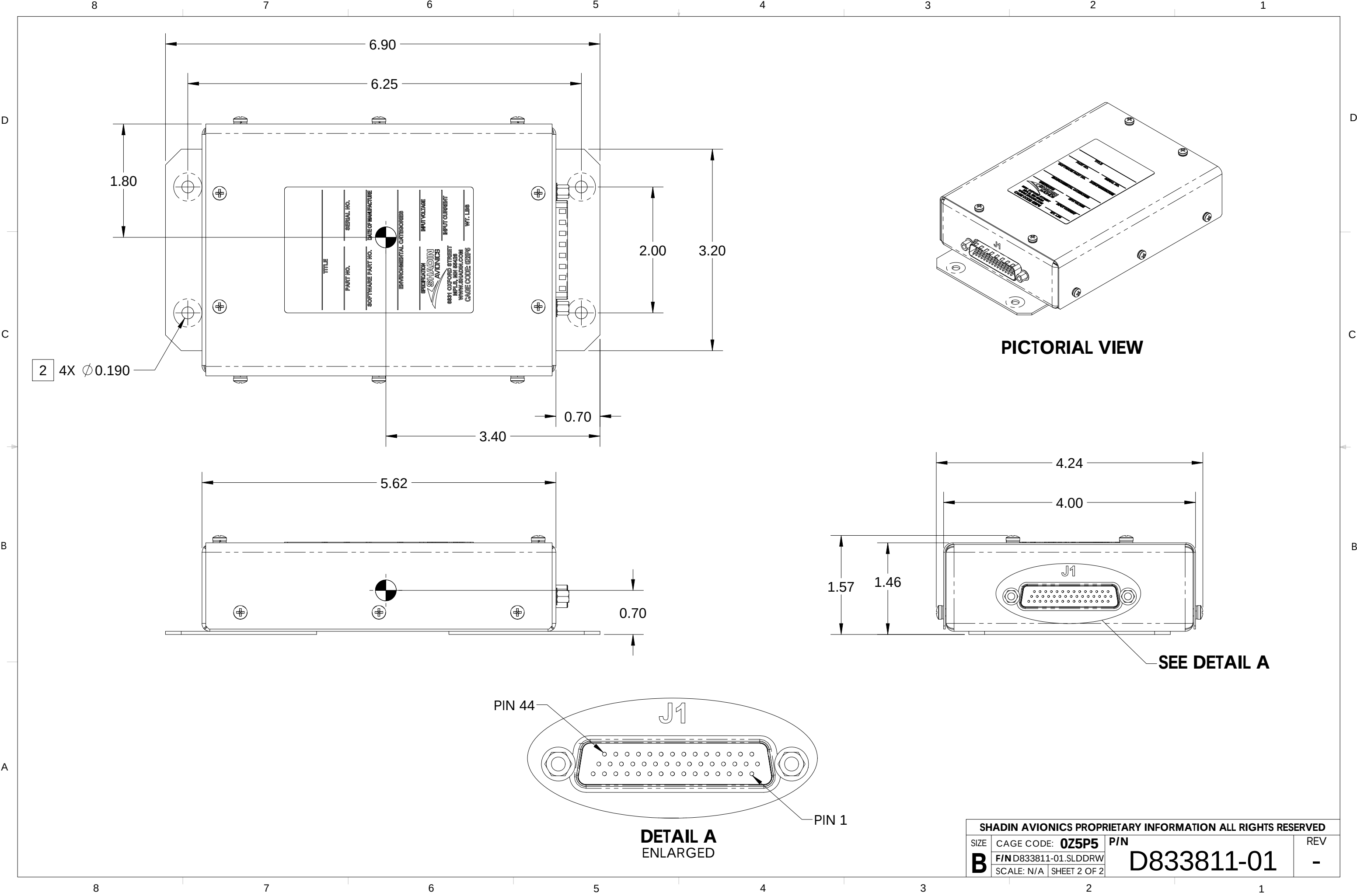
The screenshot shows the '833811 Configuration' window. It has three main sections: 'Serial Port', 'ARINC', and 'Fuel Flow Parameters'.
 - **Serial Port:** A dropdown menu is set to 'COM4'. Below it are 'Disconnect' and 'Program' buttons. The 'Software Version' is '403811-02' next to a green status indicator.
 - **ARINC:** Two columns, 'Ch 1' and 'Ch 2', each have radio buttons for 'Low Speed' and 'High Speed'. In both columns, 'High Speed' is selected.
 - **Fuel Flow Parameters:** A checkbox 'Enabled' is checked, and 'Use 422 Port Parameters' is unchecked. Below are several fields: 'Engine Type' (dropdown set to 'Twin Engine'), 'Engine 1 K Factor' (29200), 'Engine 2 K Factor' (29200), 'Fuel Density (lbs / Gal)' (5.80), 'Engine 1 Low Flow Cutoff (GPH)' (0), 'Engine 2 Low Flow Cutoff (GPH)' (0), 'Engine 1 Frequency Offset (Hz)' (0), and 'Engine 2 Frequency Offset (Hz)' (0). At the bottom, 'Serial Output Format' is set to 'SHADIN_G' via a dropdown.

(14) Turn power OFF to the AIS-380 and disconnect the configuration cable. The AIS-380 is now ready for aircraft installation.

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6 APPENDIX A: INSTALLATION DRAWING

Installation drawing D833811-01 is provided on the next page.



PICTORIAL VIEW

SEE DETAIL A

SHADIN AVIONICS PROPRIETARY INFORMATION ALL RIGHTS RESERVED				
SIZE	CAGE CODE: 025P5	P/N	REV	
B	F/N D833811-01.SLDDRW	D833811-01		-
SCALE: N/A		SHEET 2 OF 2		

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7 APPENDIX B: INSTALL KIT, PARTS LIST

The install kit parts list K833811-00 is provided on the next page.

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Release Date: 2013/02/14
Approved: ZK

Rev: -

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PARTS LIST

Part #: **K833811-00**

Drawing #s: NA

Description: **INSTALL KIT, AIS 833811-00**

<u>FN</u>	<u>P/N</u>	<u>QTY.</u>	<u>DESCRIPTION</u>	<u>MFG.</u>	<u>MFG.#</u>	<u>DESIGNATION</u>	<u>COMMENTS</u>
5	232012	1	CONN, HD D-Sub 44 Pin, Female Crimp w/FC8022D2 Contacts	POS	ODD44S1000X		
10	232507	1	CONN, Backshell, 25P D-Sub, Zinc Die Cast	APH	17E-1657-25		
15	239004	1	TOOL, INSERT/EXTRACT M81969/1-04	NWK	59K0052		
20	753217	1	Thermal Label, 4"x 1"	ULI	S-8601		
25	PK1001	2	BAG, 2.5 x 3, 4 MIL Zip Lock				
30	PK1007	1	BAG, 6 x 8, 4 MIL				

7 items