U1713-2 DIGITAL INTERFACE MODULE -D10 INSTALLATION MANUAL

U1713-2-D10 Revision: C

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	Name	Released
Prepared By:	Matthew Richardson	
Approved By:	Matthew Richardson	

Log of Revisions:

Revision	Date	Originator	Change Description
A	7.23.2021	M. Richardson	Initial Release
B	9.30.2021	M. Richardson	Added –A05 Daughter Card
C	9.28.2022	M. Richardson	- Added Section on Application Notes and Certification Basis - Updated DO-160G Qualification Levels - Added Aircraft Wiring specifications - Added Daughter Card Descriptions and Signal Types

Contents

References

- *DO-178C, Software Considerations in Airborne Systems and Equipment Certification, RTCA*
- *DO-160G, Environmental Considerations and Test Procedures for Airborne Equipment, RTCA*
- *AC 20-152, Design Assurance Guidance for Airborne Electronic Hardware, FAA*
- *ARP-4754, Guidelines for Development of Civil Aircraft and Systems, SAE*

1. Description

The U1713-2 Digital Interface Module is a software configurable adapter that can receive and transmit various aircraft protocol signals.

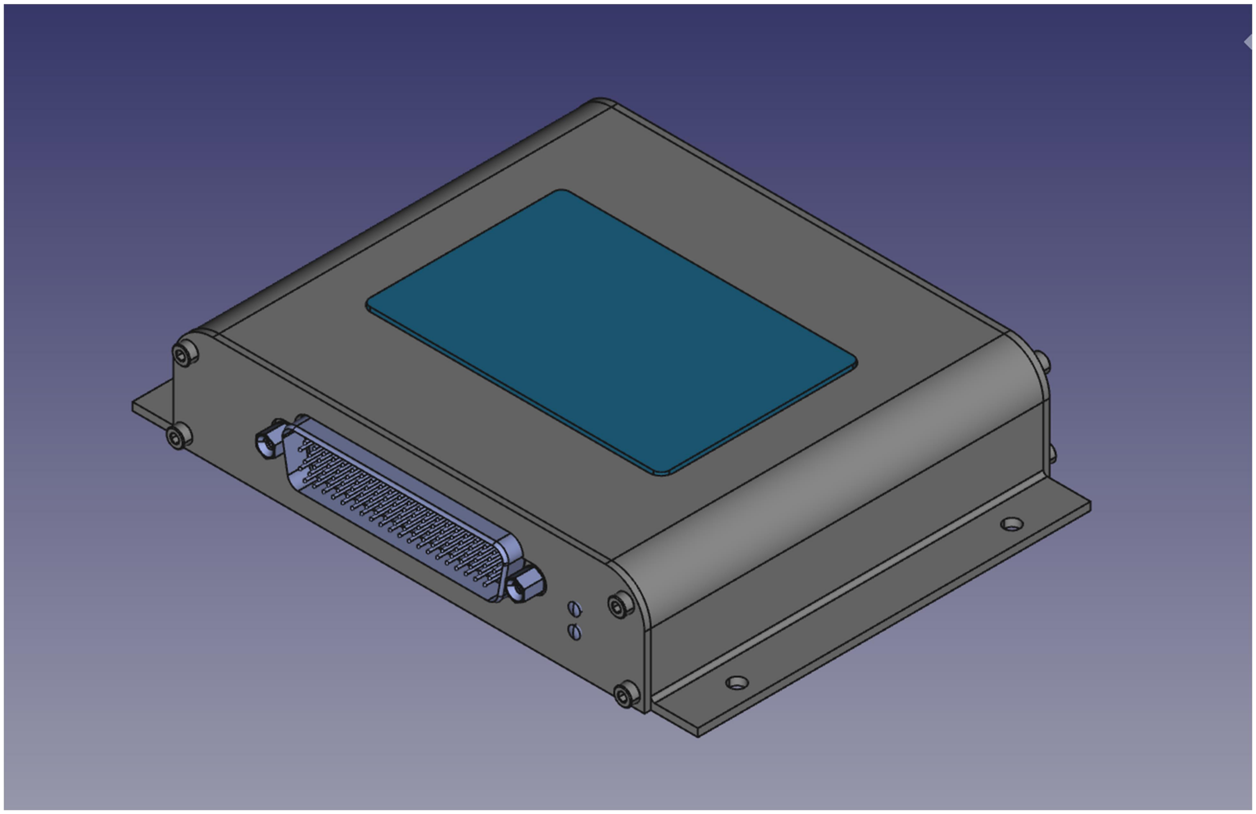


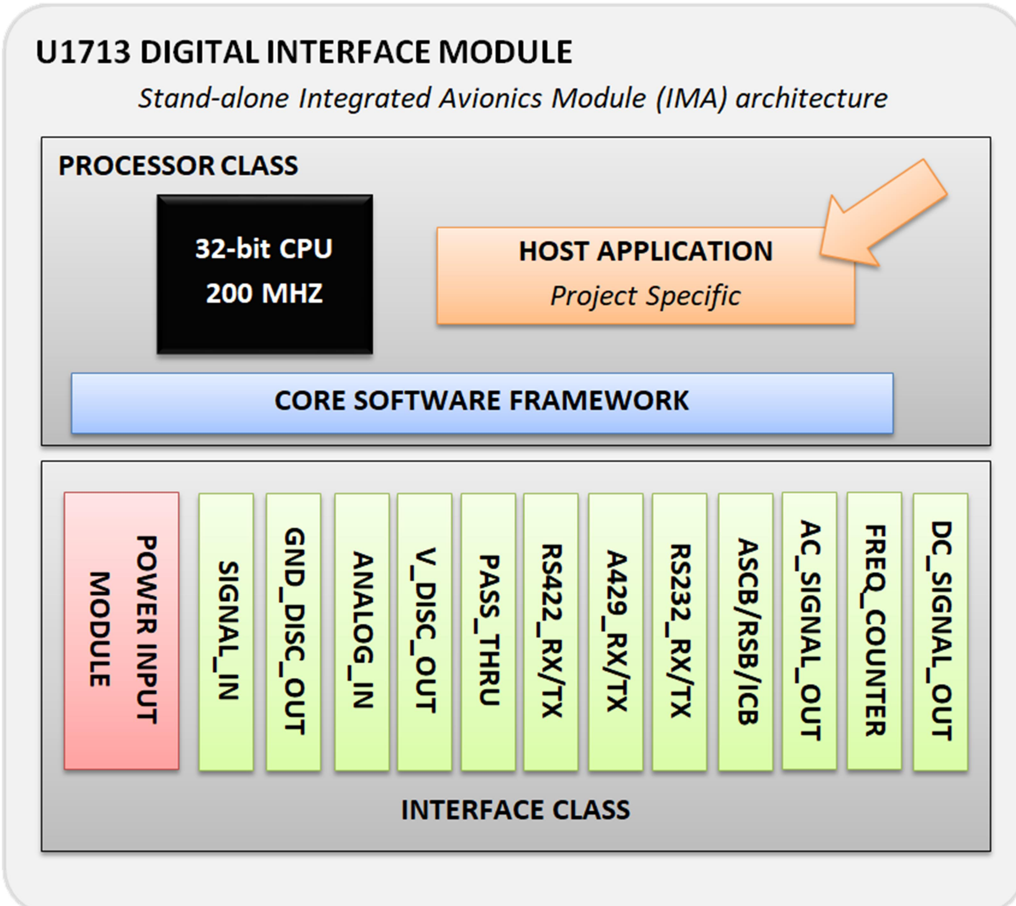
Figure 1, U1713-2 Digital Interface Module

A hosted application [software] gives the U1713-2 specific functionality. Software can control some or all ports defined in this application, to do simple conversions between various protocols or even perform safety-critical computing tasks.

This installation manual covers basic information for all possible configurations of the U1713-2. Application-specific Installation Manuals and/or Application Notes are provided for each configuration.

2. Hosted Application

The U1713 module is configured through a Hosted Application (as defined by TSO C-153A) that both provides port configuration and functionality.

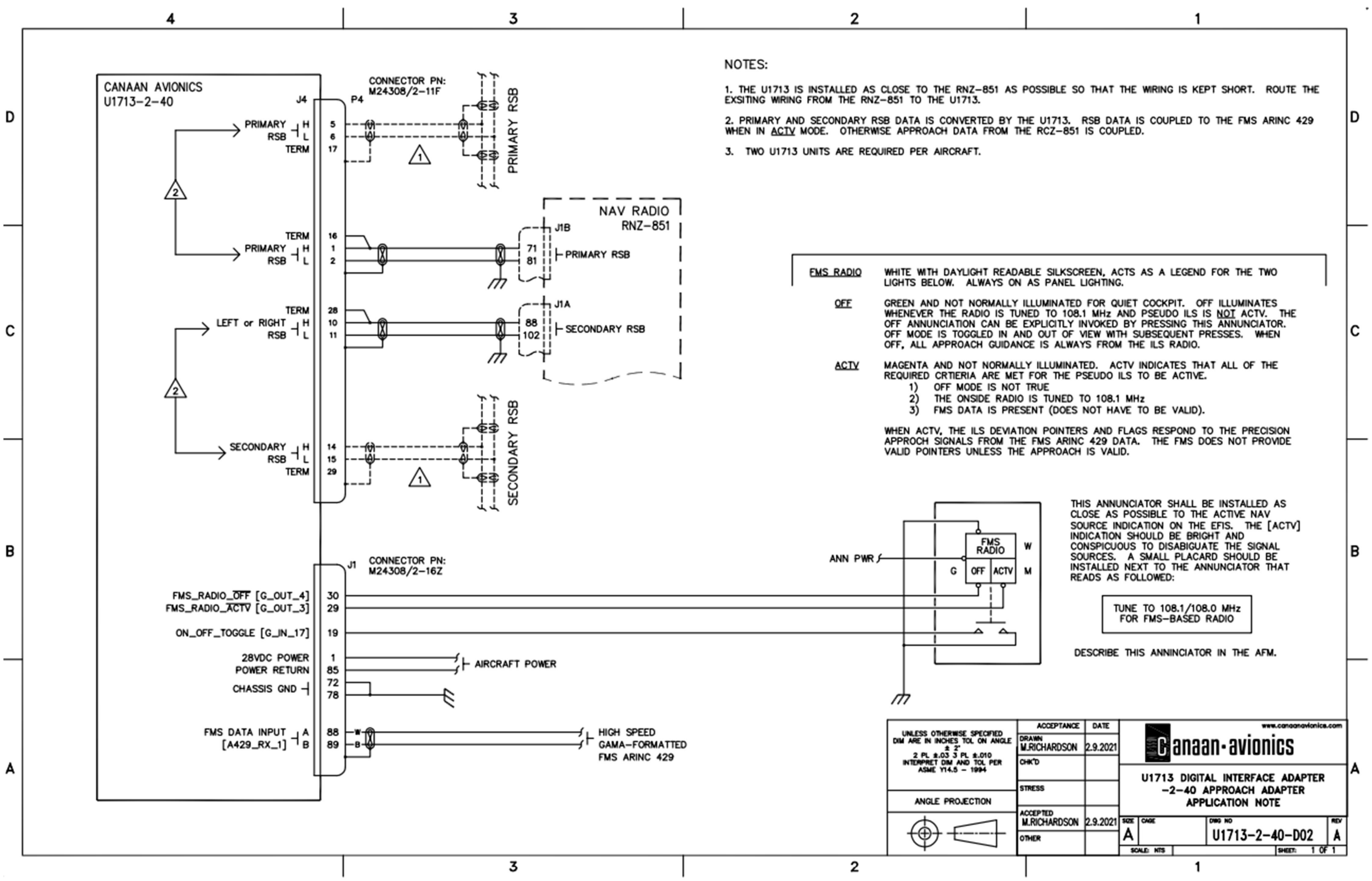


The unit has a single loadable software part that executes on a 200MHz ARM CPU. The U1713 contains no complex hardware as defined by AC 20-152, meaning that it is a simple processor/interface class module. Software on the device configures and has access to all of the ports available and drives all of the Signal Types.

Developing the Hosted Application typically starts with an STC project. Canaan Avionics can either receive requirements from the end-user (such as the STC owner) or Canaan Avionics can generate requirements for the end user and provide them to be part of the STC project.

3. Application Notes

The Application Notes provide a system-level configuration of the U1713 and how it interfaces with other systems in the architecture. Each U1713 configuration has an Application Note which serves to specifically identify the interfaces, provide a block diagram, pin-outs, and notes for the functional aspects of the software. This is how the highest-level functionality is communicated, and how this installation manual is supplemented.



The example Application Note [above] is for the U1713-2-40 Approach Adapter. The Application Note identifies the ports used and how they are wired to other systems. The STC developer uses the Application Note [and this Installation Manual] to develop detailed Installation Drawings and to help develop Ground Test Plans and Flight Test Plans. Canaan Avionics uses the Application Note to communicate and validate the software functionality.

4. Certification Objectives

The U1713 is previously certified platform with the hardware qualified to DO-160G, software processes approved under TSO/PMA according to DO-178C. The Hosted Application provides functionality and that is certified at the aircraft level, under the TC/STC.

ARP-4754, *Guidelines for Development of Civil Aircraft and Systems*, is one of many acceptable means for stitching together aircraft-level functional requirements with sub-systems, such as the U1713. ARP-4754 compliance is not required for most projects, but it does establish a requirement traceability concept that both verifies and validates functionality of the whole aircraft as a system.

See https://www.canaanavionics.com/cert_process.aspx for more information regarding the typical U1713 data package, the cert objectives, and how these processes dovetail into the aircraft-level design approvals.

5. Environmental Qualification

CONDITIONS	DO-160G SECTION	EQUIPMENT QUALIFICATIONS & CATEGORIES OF CONDUCTED TESTS
Temperature and Altitude	4.0	(A2)(F2)
Temperature		
Low Operating	4.5.1	-55 °C
High Operating	4.5.3	+70 °C
Low Storage	4.5.1	-55 °C
High Storage	4.5.2	+85 °C
In-Flight Loss of Cooling	4.5.4	X
Altitude	4.6.1	55,000 feet
Temperature Variation	5.0	B
Humidity	6.0	B
Shock	7.0	B
Operational	7.2	6 g peak
Crash Safety	7.3	
Impulse	7.3.1	18 g peak
Sustained	7.3.2	18 g min
Vibration	8.0	S(C)(L)(M)
Explosion Proofness	9.0	E1
Waterproofness	10.0	X
Fluids Susceptibility	11.0	X
Sand and Dust	12.0	X
Fungus Resistance	13.0	F Modified
Salt Spray	14.0	X
Magnetic Effect	15.0	Z
Power Input	16.0	A
Voltage Spike	17.0	A
Audio Frequency Conducted	18.0	Z
Induced Signal Susceptibility	19.0	ZC
RF Susceptibility	20.0	W
Emissions of RF Energy	21.0	M
Lightning Induced Transient Susceptibility	22.0	B3G3L3
Lightning Direct Effects	23.0	X
Icing	24.0	X
Electrostatic Discharge	25.0	A Modified
Fire Flammability Test	26.0	X

6. Design/Manufacture Qualifications

TSO:	C153A
DO-178C DAL:	Level B/A, depending on requirements

7. Power Input

28VDC (Nominal)	15VDC (min) to 32VDC (max)
110mA (Nominal)	*more current if directly running currents from Discrete IO
Circuit Breaker	1 Amp

8. Weight

0.85 lbs

9. Aircraft Wiring

Various wiring types may be permitted with the U1713, determined by the installer and the design/installation approvals at the STC level. However, the U1713 often performs safety critical applications in environments that may have significant Electromagnetic Interference (EMI). For this reason, Canaan Avionics recommends using wire types that meet or exceed the wire that the U1713 was qualified with [per table below].

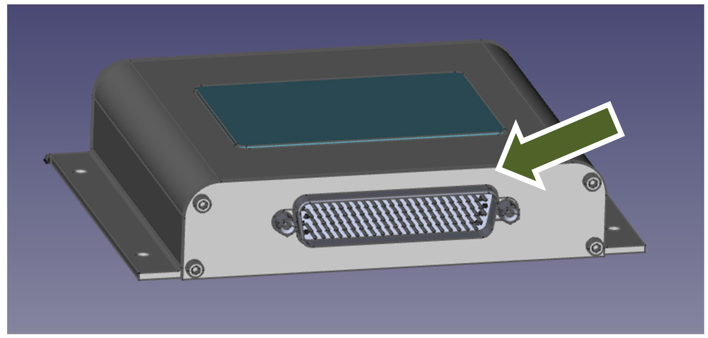
Note: All wiring except for the power and grounding should be shielded if the U1713 performs safety-related functions. All wiring except for the power and grounding should be 24 Gauge.

Note: Ground shields using ring terminals into the backshell. Keep shield terminations shorter than 3".

Gauge	Single	Single-Shielded	Twisted-Shielded	ASCB/RSB
22	M22759/16-22-9	M27500-22TG1T14	M27500-22TG2T14	X
24	M22759/16-24-9	M27500-24TG1T14	M27500-24TG2T14	ECS PN: 322402

10.Main Board (J1 Connector)

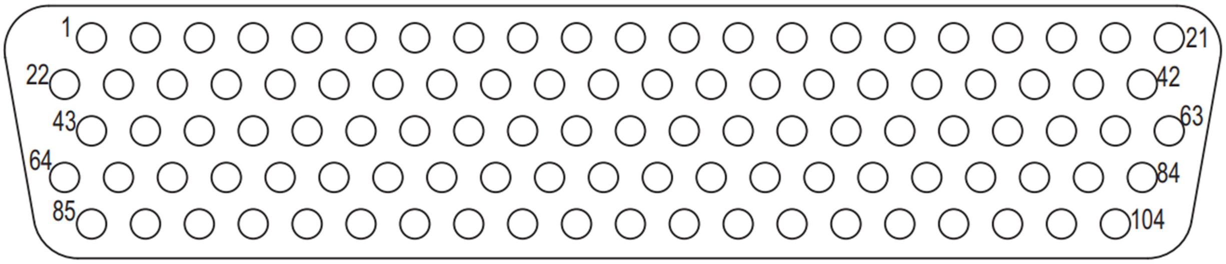
The J1 connector is the main connector and is always used for an U1713 integration. J1 contains the power inputs and most of the basic Port Types. The U1713 may also be configured with daughter cards to add more ports, and often there is a J2 connector associated with each daughter configuration.



10.1. Pin-out

Pin	Description	Pin	Description	Pin	Description	Pin	Description
1	PWR_28VDC+	27	GND_DISC_OUT_1	53	GND_DISC_OUT_27 +	79	RS422_TX_0_L
2	SIGNAL_IN_0	28	GND_DISC_OUT_2	54	GND_DISC_OUT_28 +	80	RS422_RX_0_H
3	SIGNAL_IN_1	29	GND_DISC_OUT_3	55	GND_DISC_OUT_29 +	81	RS422_RX_0_L
4	SIGNAL_IN_2	30	GND_DISC_OUT_4	56	GND_DISC_OUT_30 +	82	CHASSIS_GND
5	SIGNAL_IN_3	31	GND_DISC_OUT_5	57	GND_DISC_OUT_31 +	83	RS422_RX_1_H
6	SIGNAL_IN_4	32	GND_DISC_OUT_6	58	ANALOG_IN_0_H	84	RS422_RX_1_L
7	SIGNAL_IN_5	33	GND_DISC_OUT_7	59	ANALOG_IN_0_L	85	RTN_28VDC
8	SIGNAL_IN_6	34	GND_DISC_OUT_8	60	ANALOG_IN_1_H	86	A429_RX_0_A
9	SIGNAL_IN_7	35	GND_DISC_OUT_9 +	61	ANALOG_IN_1_L	87	A429_RX_0_B
10	SIGNAL_IN_8	36	GND_DISC_OUT_10	62	ANALOG_IN_2_H	88	A429_RX_1_A
11	SIGNAL_IN_9	37	GND_DISC_OUT_11	63	ANALOG_IN_2_L	89	A429_RX_1_B
12	SIGNAL_IN_10	38	GND_DISC_OUT_12	64	V_DISC_OUT_0	90	A429_RX_2_A
13	SIGNAL_IN_11	39	GND_DISC_OUT_13	65	V_DISC_OUT_1	91	A429_RX_2_B
14	SIGNAL_IN_12	40	GND_DISC_OUT_14	66	CHASSIS_GND	92	A429_RX_3_A
15	SIGNAL_IN_13	41	GND_DISC_OUT_15	67	PASS_THRU_0 +	93	A429_RX_3_B
16	SIGNAL_IN_14	42	GND_DISC_OUT_16	68	PASS_THRU_1 +	94	A429_TX_0_A
17	SIGNAL_IN_15	43	GND_DISC_OUT_17 +	69	PASS_THRU_2 +	95	A429_TX_0_B
18	SIGNAL_IN_16	44	GND_DISC_OUT_18	70	PASS_THRU_3 +	96	A429_TX_1_A
19	SIGNAL_IN_17	45	GND_DISC_OUT_19 +	71	PASS_THRU_4 +	97	A429_TX_1_B
20	SIGNAL_IN_18	46	GND_DISC_OUT_20 +	72	CHASSIS_GND	98	RS232_0_RX
21	SIGNAL_IN_19	47	GND_DISC_OUT_21 +	73	PASS_THRU_5 +	99	RS232_0_TX
22	SIGNAL_IN_20	48	GND_DISC_OUT_22	74	PASS_THRU_6 +	100	RS232_1_RX
23	SIGNAL_IN_21	49	GND_DISC_OUT_23	75	3.3V_OUT	101	RS232_1_TX
24	SIGNAL_IN_22	50	GND_DISC_OUT_24 +	76	5V_OUT	102	RS422_TX_1_H
25	SIGNAL_IN_23	51	GND_DISC_OUT_25 +	77	RS422_TX_0_H	103	RS422_TX_1_L
26	GND_DISC_OUT_0	52	GND_DISC_OUT_26 +	78	CHASSIS_GND	104	PASS_THRU_7 +

10.2. Connector Layout

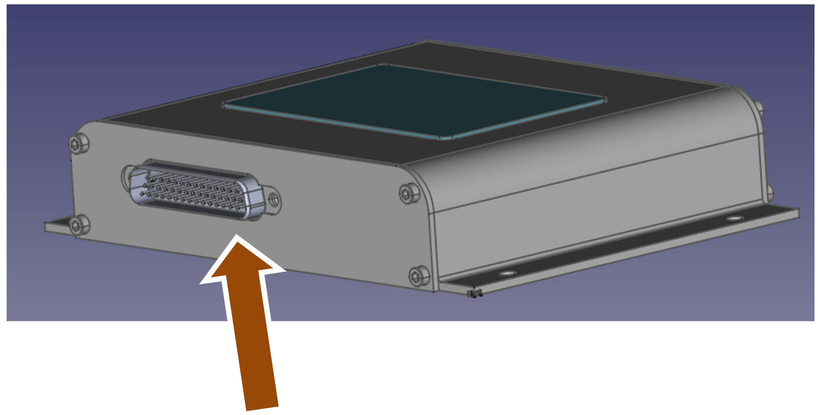


10.3. Connector Kit

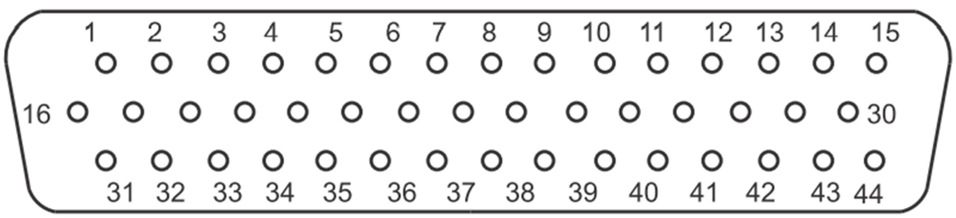
K210724-1 (Canaan Avionics)

11. Daughter Cards (J2 Connector)

Daughter Cards are a provision that is added to the U1713 by the top level configuration drawing of the module's data package. Daughter Cards are optional and provide additional ports and sometimes an additional connector (J2) to the back side of the module. When the Daughter Card has a connector, then a 44 pin connector is added as J2.



11.1. Connector Layout



11.2. Connector Kit

K210724-2 (Canaan Avionics)

11.3. A02 Daughter Card

This Daughter Card repurposes the PASS_THRU_X pins on the J1 connector to add a combination of A429_RX(TX) and ANALOG_IN ports. When the –A02 Daughter Card is installed, the default configuration J1 PASS_THRU pins are overridden to the following values.

A429_RX(TX) and ANALOG_IN ports replace the following SIGNAL_IN pins:

J1	Signal	J1	Signal
68	A429_RX_4_A	74	A429_TX_2_A
70	A429_RX_4_B	104	A429_TX_2_B

J1	Signal	J1	Signal	J1	Signal
67	ANALOG_IN_3_H	69	ANALOG_IN_4_H	71	ANALOG_IN_5_H
GND	ANALOG_IN_3_L	GND	ANALOG_IN_4_L	73	ANALOG_IN_5_L

Note There is no J2 for the A02 Daughter Card.

11.4. A03 Daughter Card

This Daughter Card provides analog output ports for interfacing things like analog autopilots, gyro systems, and flight data recorders.

J2	Description	J2	Description	J2	Description	J2	Description
1	V_DISC_OUT_2	12	FREQ_COUNTER_0	23	AC_REFERENCE_IN_L	34	DC_SIGNAL_OUT_3
2	V_DISC_OUT_3	13	FREQ_COUNTER_1	24	ANALOG_IN_3_H	35	DC_SIGNAL_OUT_4
3	V_DISC_OUT_4	14	FREQ_COUNTER_2	25	ANALOG_IN_3_L	36	DC_SIGNAL_OUT_5
4	V_DISC_OUT_2	15	FREQ_COUNTER_3	26	ANALOG_IN_4_H	37	DC_SIGNAL_OUT_6
5	V_DISC_OUT_6	16	AC_SIGNAL_OUT_0_H	27	ANALOG_IN_4_L	38	DC_SIGNAL_OUT_7
6	V_DISC_OUT_7	17	AC_SIGNAL_OUT_0_L	28	ANALOG_IN_5_H	39	DC_SIGNAL_OUT_0
7	V_DISC_IN	18	AC_SIGNAL_OUT_1_H	29	ANALOG_IN_5_L	40	DC_SIGNAL_OUT_9
8	CHASSIS_GND	19	AC_SIGNAL_OUT_1_L	30	CHASSIS_GND	41	DC_SIGNAL_OUT_10
9	CHASSIS_GND	20	AC_SIGNAL_OUT_2_H	31	DC_SIGNAL_OUT_0	42	DC_SIGNAL_OUT_11
10	RS232_2_RX	21	AC_SIGNAL_OUT_2_L	32	DC_SIGNAL_OUT_1	43	CHASSIS_GND
11	RS232_2_TX	22	AC_REFERENCE_IN_H	33	DC_SIGNAL_OUT_2	44	CHASSIS_GND

11.5. A05 Daughter Card

This Daughter Card has ports for ASCB Versions A/B/C conversions. The U1713 can act as a system on the ASCB network (such as an AHRS) or act as a Bus Controller to interface with the autopilot. The A05 Daughter also supports other Honeywell data busses, such as Radio Select Bus.

J2	Description	J2	Description	J2	Description	J2	Description
1	ASCB_0_H	12	RS232_2_RX	23		34	CHASSIS_GND
2	ASCB_0_L	13	RS232_2_TX	24		35	A429_TX_2_A
3	RS232_3_TX	14	ASCB_2_H	25		36	A429_TX_2_B
4	RS232_3_RX	15	ASCB_2_L	26	CHASSIS_GND	37	A429_RX_4_A
5	ASCB_1_H	16	ASCB_0_TERM	27	CHASSIS_GND	38	A429_RX_4_B
6	ASCB_1_L	17	ASCB_1_TERM	28	ASCB_3_TERM	39	A429_RX_5_A
7	CHASSIS_GND	18	CHASSIS_GND	29	ASCB_2_TERM	40	A429_RX_5_B
8	CHASSIS_GND	19	CHASSIS_GND	30	CHASSIS_GND	41	CHASSIS_GND
9	CHASSIS_GND	20	CHASSIS_GND	31	CHASSIS_GND	42	CHASSIS_GND
10	ASCB_3_H	21	CHASSIS_GND	32	CHASSIS_GND	43	CHASSIS_GND
11	ASCB_3_L	22		33	CHASSIS_GND	44	CHASSIS_GND

12. Port Types

Each of these ports types are available on the J1 Connector, and depending on the daughter cards installed these port types can be on the J2 Connector as well. Each port is software controlled, and the configuration is defined in the Application Note for the completed module.

SIGNAL_IN

SIGNAL_IN_X ports are multi-purpose inputs. Each can be configured as one of the following types:

Ground/Open Input: A ground [or voltage below 1.8 volts] is a logical TRUE.

28V/Open Input: A voltage greater than 4.5 volts is a logical TRUE.

DC Analog Input: A 12-bit DC analog signal can be measured at 20Hz. The voltage range must be positive in relation to the signal ground, ranging from 0-5VDC.

Note: All Signal inputs have the configurable DC Analog Input range as described, except inputs 20-thru-23 which are ranged from 0-3.3VDC.

Frequency Counting: Given any voltage threshold desired, as defined by the DC Analog Input configuration, inputs can be configured as frequency counting for any frequency ranging from 0-100KHz. This type of configuration can be used for signals such as Engine Tach or Fuel Flow.

GND_DISC_OUT

These are discrete outputs that are capable of providing Ground/Open signals with one of the following configurations:

Ground/Open Output: A ground signal capable of providing a constant 200mA output for running relays or annunciators.

Note: The total for all outputs across all GND/Open Discrete Outputs should be less than 3.0 amps nominally for reasons of heat generation.

Ground/Open Pulse: A modulated output can provide Pulse-Width Modulation analog outputs for things like motor controls, tones or course DC analogs at low frequencies.

SENSE_IN

SENSE_IN are piggybacked on ports that have a "+", such as the GND_DISC_OUT_[X] + and PASS_THRU_[X] + ports. SENSE_IN ports can be used as a discrete input or a frequency counter. A common use for the SENSE_IN_[X] ports is for position strapping of the unit or for wrap-around verification that GND_DISC_OUT_[X] outputs are operating reliably for safety-critical applications.

V_DISC_OUT

These ports capable of providing 28V/Open signals with a constant 300mA output for running relays, valid flags, or annunciators. They are high-side-fet driven, providing a source for clicking relays, or for providing NAV Superflags.

Note *If there are V_DISC_IN pins, then the V_DISC_OUT draws current from power input to those pins. Apply power to the V_DISC_IN port by either splicing into the main box power or by powering through a separate 1 amp circuit breaker.*

ANALOG_IN

Precision Analog inputs are capable of receiving a 24 bit voltage from -3 to 48VDC. The precision of these is fine enough to be used for temperature thermocouples, flight control position sensors, current sensors/shunts, 150mA Deviations. These are differential amplified and isolated from ground. Maximum read frequency is 100Hz depending on the application.

A429_RX(TX)

The U1713 framework implements a full software controlled A429 "stack". The software drivers offer full control to mix and match any label, SDI, and parity on the same bus. Each port is capable of independently transmitting and receiving a maximum of 2,777 words per second. Words can be scheduled to be transmitted in a particular order, or cued when the software is ready to transmit them. Layered protocols are supported such as ARINC 615 or ARINC 708. Ports can be configured as either High Speed (100 kBits/sec) or Low Speed (12.5 kBits/sec).

RS_422_RX(TX)

RS-422 ports can be configured to support a number of commercial/industrial signal types such as RS-422/485. Collins Serial Data Bus (CSDB) is also supported. Signals can be software controlled through standard UART exchanges or "bit-banged" for unique protocols, such as control panel signals or even Honeywell data buses.

RS_232_RX(TX)

RS-232 signals can be software controlled through standard UART exchanges or can support non-synchronous communication.

FREQ_COUNTER

These are very high frequency, very high impedance (~47k ohm) input for measuring frequencies from 0-300kHz. The frequency transition point is detected through *1.5VDC,* providing high speed frequency counting for signals such engine tach sensors.

AC_SIGNAL_OUT

This is a software-controlled AC output capable of transmitting AC signals such as [not limited to]:

- ARINC-407
- Synchro-servo
- 393mV/degree pitch and roll commands

Note *Most AC_SIGNAL_OUT application require that the AC_REFERENCE_IN be wired to 26VAC reference.*

DC_SIGNAL_OUT

This is a software-controlled 16-bit DC output capable of transmitting DC signals such as [not limited to]:

- 150mA Navigation Deviations
- Radio Altitude Analogs
- AHRS Accelerometer Outputs
- Control Surface Positions for Flight Data Recorder Interfaces

ASCB

ASCB ports support end systems on an ASCB network. The ASCB may be one or more end systems on the network (such as an AHRS), or may be the bus controller (such as the autopilot or symbol generator). The ASCB ports support versions A/B/C and the ASCB clock in the case of ASCB version A. The ASCB ports can be configured for other Honeywell protocols, such as Radio Select Bus (RSB).

13. Mechanical