

Multifunction Panel I/O Interface

Model UEI-PIO-1010

- Compact board level size (4.5" x 8.5" x 0.75")
- Small enough to be mounted behind an instrument panel
- Standard Ethernet Interface
- IEEE-1588/PTP and 1PPS synchronization
- Rugged (5g Vibe, 100g Shock, -40 to 70 °C)
- MTBF > 140,000 hours (>15 years)
- Complete Windows, Linux and RTOS software support
- Fully compatible with UEI DNA/DNR software (same API)
- PC-based or standalone/embedded controller operation
- Hex switches allow selection of IP address without a PC

I/O highlights

- 16 SE / 8 Differential 18-bit analog input channels
- ± 80 to ± 0.156 V analog input ranges
- Dual 16-bit ± 10 V or 0-20 mA analog output channels
- Sixteen 0-55 VDC digital I/O bits, four TTL DIO bits
- 500 mA DOuts with 16-bit PWM resolution
- Dual 32-bit counters and 4 logic level DIO
- Up to 2 kHz update rates
- Trigger input and output
- RS-232/422/485 and I²C ports
- 350 Vrms Isolation



General Description:

The UEI-PIO-1010 is a fully integrated I/O system. At 4.5" x 8.5" x .75" it is small enough to easily fit between an instrument panel and the bulkhead of a simulator/trainer, or in a huge variety of other tight spaces. With over 40 I/O channels, the combination of small size and large I/O count makes it an ideal solution for a wide variety of applications. The 15+ year MTBF combined with the unit's rugged construction means it's ideally suited for installation in locations without easy access. It is not going to need either routine service or repairs.

Deployment Options:

Based on the same SoloX/ARM-based processor used in our popular Cube and RACKtangle series, the UEI-PIO-1010 may be configured in PowerDNA mode, where the chassis operates as a slave to a host PC, or in UEIPAC mode, where it operates in a fully stand-alone/embedded or SCADA modes.

PowerDNA mode: In PowerDNA mode, the chassis operates as a slave I/O device, running under the control of a host PC. All application code in this mode is created and run on the host. The host PC controls the device using standard PowerDNA libraries and standard tools. PowerDNA mode offers almost unprecedented software support, including:

- All popular operating systems, including Windows, Linux, VxWorks, QNX, RTX and InTime.
- All popular programming languages, including C, C#, C++, Python, JAVA, VB and VB.NET.
- All popular application packages, including MATLAB, Simulink, LabVIEW, and more.

UEIPAC Embedded/Standalone/SCADA mode: In UEIPAC mode, the standard firmware running on a traditional PowerDNA chassis is replaced by a standard Linux operating system. The user then writes the Linux application that runs on the UEI-PIO-1010 hardware. For more information on the UEIPAC deployment, please see the specifications shown on the following page or visit the [UEIPAC on our website](#).

The UEI-PIO-1010 uses an ARM Cortex-A9 processor running at 1 GHz. With 1 GByte of RAM and 8 GByte of eMMC FLASH, the unit has plenty of CPU capability to handle even the most challenging I/O application. The unit also provides a eUSB slot for SSD storage.

The UEI-PIO-1010 is also available in different deployment options, including UEISIM, UEI iDDS, UEIMODBUS and UEIOPC. More information on these deployment options can be found below, or see our website.*

UEISIM series: Simulink users will appreciate the ability to use Simulink Coder to compile and deploy their models on the UEISIM hardware.

UEIPAC iDDS series: This deployment can be configured to run the rapidly growing family of iDDS products with Historian functionality. System configuration is made easy by an intuitive, easy to use web/HTML interface.

* For access to a serial terminal, you will need the [CBL-PIO-DBG](#) cable.

I/O Description: The multifunction I/O ensures you have the type of I/O you need, and the high channel density ensures you have all the I/O channels required in the panel space available. The UEI-PIO-1010 offers a powerful combination of I/O, including 16 single-ended/8 differential analog inputs, 2 analog outputs, 20 bits of digital I/O, an I²C port and an RS-232/422/485 port.

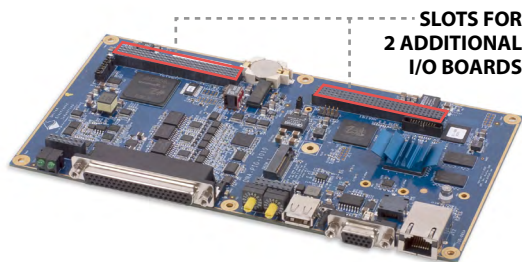
The UEI-PIO-1010 offers 8 software selectable A/D ranges from ± 80 V to ± 0.156 V with 18-bit resolution. The ± 80 Volt range makes the PIO-1010 an ideal measurement solution in a host of simulation, aerospace, automotive and power generation applications, where many DAQ products' 10 volts maximum input range cannot be used without external signal conditioning. The "high voltage" and "low voltage" configurations are programmable on a per-channel basis. Programmable gains combined with the board's 18-bit A/D converter provides resolution as low as 1.19 microvolts. The PIO-1010 provides sample rates as high as 1000 samples per second on each channel (16 k/s aggregate). Two D/A channels offer either ± 10 Volt or 4-20 mA outputs with 16-bit resolution and provide 20% overrange capability.

The unit offers 20 bits of digital input/output broken into 16 bits of industrial voltage I/O and 4 bits of logic-level I/O (settable in banks of 2). Each bit of DIO may be independently set as input or output. Industrial inputs and outputs have a wide operating range from 3.3 V to 55 VDC. The industrial range (not logic-level) inputs have programmable pull up/down resistors that can be independently enabled and allow inputs to monitor contacts connected to a supply voltage or ground. Inputs are sensed with an A/D that can sample up to 200 kHz, so high and low voltage thresholds are programmable and allowing change of state detection with 5 μ s resolution. The industrial (not logic-level) outputs can be set as current sourcing (switch between Vcc and the output), current sinking (switch between Gnd and the output), push-pull (connect to Vcc or Gnd, not at the same time) or can act as a simple switch to Vcc or Gnd. These are divided into banks of 4, and each bank can be connected to a different Vcc if required. Industrial digital outputs can be configured as flexible high resolution lighting controllers with PWM or softstart outputs with 16-bit pulse width resolution. The PWM/softstart parameters are selectable on a per-channel basis. Outputs are protected with 1.25 Amp fast-blow fuses.

Analog input, industrial digital input (including digital in, analog values and change of state), serial and I²C data may be streamed to their own FIFOs or a single combined FIFO with timestamps. In/Din time stamps are generated at the start of the scan, while each byte of serial data received is time stamped upon receipt.

Two 32-bit counters are provided which can be connected to any digital input pin, while the counter outputs can be used to drive two dedicated industrial outputs. TTL level trigger in/out out are also provided.

The UEI-PIO-1010 also includes two communications ports. The first is



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an RS-232/422/485 that can be set for any baud rate from 300 baud to 2 Mbaud with 0.01% frequency accuracy. The second communications port is an I²C port that fully supports the UM10204 specification with Standard, Fast and Fast+ baud rates. The I²C port supports master/slave concurrently, allowing loopback testing and bus monitoring. SDA/SCL have +5 V pull-ups, but are 3.3 V compliant.

The UEI-PIO-1010 offers 350 Vrms of isolation between the I/O connections and the chassis and power supply. The analog and digital sections of this board are also isolated from each other. The unit is rugged and offers reliable operation even in extreme environments. It will operate through 5g vibration, 100g shock, from -40 to 70 °C temperatures and will function at altitudes up to 70,000 feet.

The UEI-PIO-1010 is supported by the DNA-CBL-MF-101, which runs the digital and analog signals through separate bundles to minimize noise. Those wishing to use a screw terminal adaptor can use the DNA-STP-MF-101. For those wishing to create their own cables, all connections are through a standard 62-pin "D" connector, allowing OEM users to build custom cabling systems with standard, readily available components.

AC Power Supply is offered separately.



The DNA-STP-MF-101 provides easy to use connections to all UEI-PIO-1010 I/O signals.

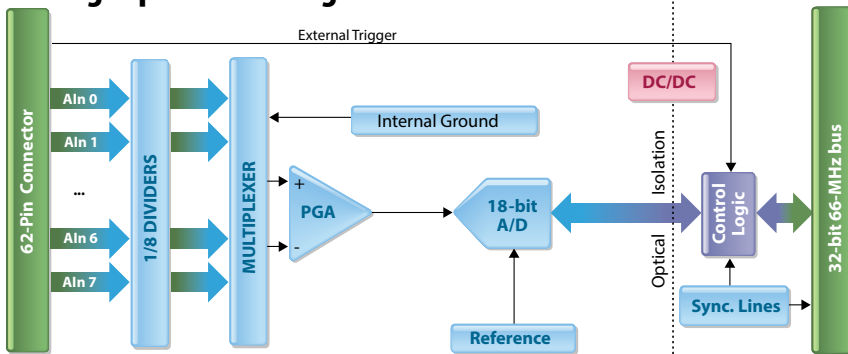
Analog Inputs:

Technical Specifications: (typical at 25°C unless otherwise stated)

Analog Inputs		
Number of channels	16 single-ended or 8 fully differential	
Input configuration	Multiplexed	
ADC resolution	18 bits	
Sampling rate	2000 samples/second per channel	
High voltage mode	Resolution	Accuracy (at 25°C)
±80 V	610 µV	±24 mV
±20 V	153 µV	±6 mV
±5 V	38.1 µV	±2.5 mV
±1.25 V	9.54 µV	± 700 µV
Input impedance	>2.2 MΩ Diff / 1.1 Meg Ω SE	
Input offset current	< 72 µA	
Overvoltage protection	± 100 Vdc	

Analog Inputs		
Low voltage mode	Resolution	Accuracy (at 25°C)
±10 V	76.3 µV	±2.5 mV
±2.5 V	19.1 µV	±300 µV
±0.625 V	4.77 µV	±170 µV
±0.156 V	1.19 µV	±115 µV
Input impedance	>10 MΩ	
Input offset current	±1 nA max, ±0.5 nA typical	
Overvoltage protection	± 100 Vdc	
Common mode rejection	100 dB typical (differential mode)	
Isolation	350 Vrms (analog in and out share one gnd)	

Analog Input Block Diagram:

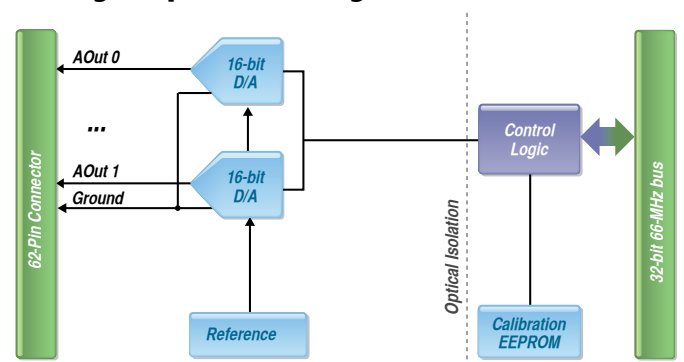


Analog Outputs:

Technical Specifications: (typical at 25°C unless otherwise stated)

Analog Output	
Channels / resolution	2 channels / 16-bit resolution
Voltage Output mode	
Voltage output ranges	±10 V, ±5 V at ±10 mA
Output accuracy	±10 V: ±3 mV, ±5 V: ±1.5mV
Output impedance	< 0.1 Ω not including any cables
Current Output mode	
Current outputs	0–20 mA, 4–20 mA, ±24 mA
Output Accuracy	0–20 mA: ±3 µA, 4–20 mA: ±3 µA, -1 to 22 mA: ±3.5 µA
Maximum load resistance	1 kΩ
Update rate : Settling time	2000 update/sec max : 100 µS to 0.03%
Isolation	350 Vrms (analog in and out share one gnd)

Analog Output Block Diagram:

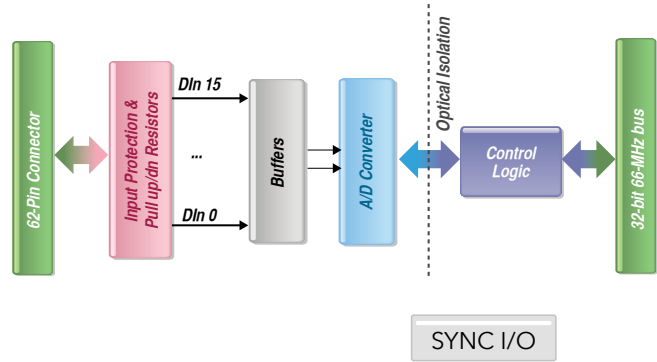


Digital I/O*:

Technical Specifications: (typical at 25°C unless otherwise stated)

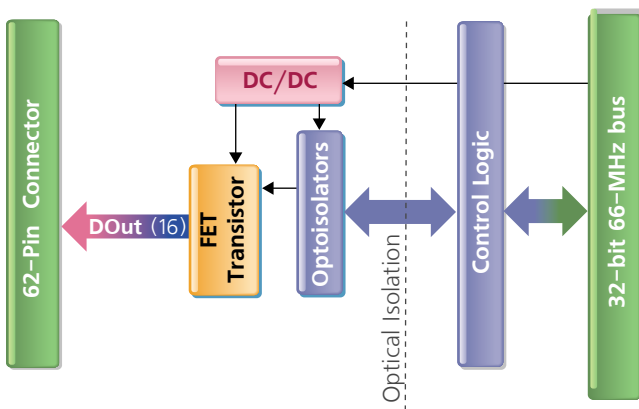
Industrial Digital I/O: 16 bits independently selectable as input or output	
Digital Input specifications	
Input range	0–55 VDC
Input high / low voltage	Programmable from 0–55 VDC
Input impedance	> 1.1 MΩ
Input open circuit state	98 kΩ Pull-up or pull-down resistors are software enabled (both also may be enabled).
Input protection	±100 VDC
Input throughput	1 kHz max
Input HIGH voltage	Programmable from 0 to 55 VDC
Input LOW voltage	Programmable from 0 to 55 VDC
Hysteresis	Programmable, 0 to 55 VDC
Guardian series read	
Change of state detection	Based on the change of one or more inputs.
COS timestamp accuracy	Accurate to 5 μs
Voltage measurement & threshold voltage accuracy	± 275 mV (0–55 VDC)
Digital Output specifications	
Configurations	Current sink/source, Ground/open or Vcc/open (Vcc is user provided in banks of 4 bits)
Output drive	500 mA per channel, continuous
Output protection	1.25 Amp fast-blow fuse on each output
Output voltage drop	< 600 mV at 500 mA (Incl std 3' cable)
Output Off impedance	> 1.1 MΩ
Output Off leakage current	< 50 μA (with 55 V input)
Output throughput	1000 updates per second, maximum
PWM output	0 to 100% in 0.0015% increments (16-bit resolution)
PWM cycle rate	Up to 10 kHz
Logic-Level Digital I/O and Trigger In / Out	
Bits	4 DIO set as DIIn or DOut in banks of 2
Logic level	5 V logic, 3.3 V compliant inputs

Digital input Block Diagram:



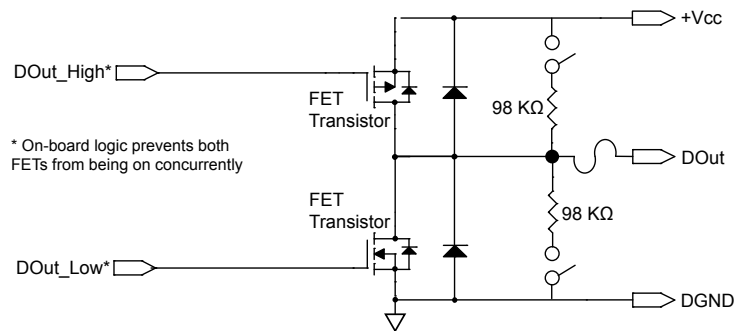
***Notes:** DOut and DIIn share the same pin on the I/O connector. Vcc is provided in blocks of 4 channels. To provide proper output functionality with Vcc left open, a 2 MΩ resistor is connected to an internal 60 V power supply. With neither pull-up/down resistors enabled and the output off, a DMM measurement of the Vcc pin will read approximately +60 V. This will not impact functionality with pull-up/down resistors.

Digital Output Block Diagram:



Notes: DOut and DIIn share the same pin on the I/O connector. Vcc is provided in blocks of 4 channels. DIO-0 through DIO-3 share a Vcc connection as do DIO-4 to DIO-7, DIO-8 to DIO-11 and DIO-12- DIO-15. To provide functionality with Vcc left open, a 2 MΩ resistor is connected to an internal 60 V power supply.

Single Digital Output Channel Simplified Schematic:



Communication Port Specifications:

Serial Port	
Configuration	1 port, software selectable RS-232, 422 or 485
Max baud rate	RS-232: 256 kb/s, RS-422/485: 2 Mb/s
Baud rate selection	300 to 2 Mbaud, 0.01% or better accuracy
RS-232/485 transceiver	MAX3160E with fail-safe RS-485 RX term
FIFO size	2048 words
I ² C Port	
Ports	1 port, Master, Slave or Bus Monitor capability
Interface specification	Complies with UM10204
Max SCL speed	1 Mbit/S (compliant with SM: 100 kb, FM: 400 kb and FM+: 1 Mb)
Logic Level	5 V / 3.3 V compatible
Baud rate base clock	66 MHz, 24 MHz or PLL Based
FIFO size	Master Mode: 1k / 1k input/output Slave Mode: 512 / 512 input/output

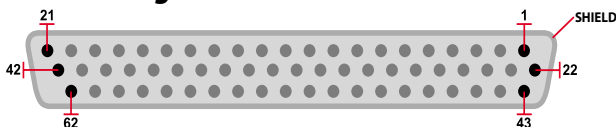
General and Environmental Specifications:

General and Environmental	
Isolation	350 Vrms All analog signals share one ground All digital/communications signals share one ground All analog and digital signals are isolated from the chassis and all other I/O boards
Voltage	9–36 VDC (AC adaptor included)
Power Consumption	< 9 W typical, 12W max
Weight (board only)	0.28 kg, 9.7 oz
Weight (with PIO-CASE)	0.84 kg, 29.6 oz
Operating Temp. (tested)	-40 to 70 °C (board level) -40 to 70 °C (installed in UEI-PIO-CASE) -40 to 70 °C (Installed in UEI-PIO-CASE-2)**
Operating Humidity	95%, non-condensing
*Vibration IEC 60068-2-6 IEC 60068-2-64	5 g, 10–500 Hz, sinusoidal 5 g (rms), 10-500 Hz, broad-band random
*Shock IEC 60068-2-27	100 g, 3 ms half sine, 18 shocks @ 6 orientations 30 g, 11 ms half sine, 18 shocks @ 6 orientations
MTBF	140,000 Hours

*Shock and vibrate specifications assume appropriate mounting/installation

**Derating may be required depending which additional I/O boards are installed

Pinout Diagram: DB-62 (female)



Pin	Signal	Pin	Signal	Pin	Signal
1	CTS232 / TX+485	22	TX232 / TX- 485	43	CTS232 / RX- 485
2	I2C SCL	23	DGnd	44	RX232 / TX+485
3	I2CSDA	24	+5 V -TTL	45	Trig Out
4	DIO 2	25	DGnd	46	Trig In
5	DIO 0	26	DVcc 0-3	47	DIO 3
6	DIO 6	27	DGnd	48	DIO 1
7	DIO 4	28	DVcc 4-7	49	DIO 7
8	DIO 10	29	DGnd	50	DIO 5
9	DIO 8	30	DVcc 8-11	51	DIO 11
10	DIO 14	31	DGnd	52	DIO 9
11	DIO 12	32	DVcc 12-15	53	DIO 15
12	DIO-TTL 0	33	DGnd	54	DIO 13
13	DIO-TTL 2	34	DGnd	55	DIO-TTL 1
14	AO Gnd 1	35	AOut 1	56	DIO-TTL 3
15	AO Gnd 0	36	AOut 0	57	Aln DF1- / SE3
16	Aln DF0- / SE1	37	Aln DF0+ / SE0	58	Aln DF1+ / SE2
17	Aln DF2- / SE5	38	Aln DF2+ / SE4	59	AGnd
18	Aln DF3- / SE7	39	Aln DF3+ / SE6	60	AGnd
19	Aln DF4- / SE9	40	Aln DF4+ / SE8	61	Aln DF5- / SE11
20	Aln DF6- / SE13	41	Aln DF6+ / SE12	62	Aln DF5+ / SE10
21	Aln DF7- / SE15	42	Aln DF7+ / SE14		

Notes:

AO Gnd 0/1: All analog signals share the same ground. However, AO Gnd 0/1 grounds are matched to the Analog outputs on the PCB. Using the AO Gnd 0/1 pins for AOut 0/1 respectively will minimize output noise and voltage drop on the outputs due to PCB resistance. All analog grounds are fully isolated from Digital/COM grounds.

AGnd: This is the ground for all analog connections. All AGnd (and AO Gnd) pins are connected together on the PCB. All analog grounds are fully isolated from Digital/COM grounds.

Aln DFn- / SEm: This pin is for differential analog input channel n- or in Single Ended mode, channel m.

Aln DFn+ / SEm: This pin is for differential analog input channel n+ or in Single Ended mode, channel m.

DGnd: This is the ground connection for all digital I/O and communications ports. All DGnd pins are connected together on the PCB. DGnd is fully isolated from AGnd.

DVcc n-m: The digital output are divided into 4 groups of 4. If you desire to provide a Vcc for the digital output to switch on/off, you have the option of using more than one drive voltage.

Ordering Information

Product	Description
UEI-PIO-1010	Panel I/O – Processor and Multifunction I/O board with 16 A/D, 2 D/A, 20 DIO, one I ² C and one RS-232/422/485 port
UEI-PIO-CASE	Rugged, heavy-duty brushed aluminum housing for the UEI-PIO Panel I/O boards
UEI-PIO-CASE-2	Rugged, 2- layer case allowing the installation of two standard DNA-series I/O boards.
CBL-PIO-DBG	Breaks out to power, serial and sync, allowing debugging of UEI ECAT boards and the UEI-PIO-1010
DNA-MF-CBL-STP	STP and Cable Kit for Panel I/O and MF-101 products
DNA-VxWORKS	VXWorks compatible software driver
DNA-QNX	QNX compatible software driver
UEIPAC Linux SX TK	Programmers ToolKit for ARM based embedded/standalone Linux developers (site license: only one TK required regardless of UEI-PIO-1010 units deployed)
DNA-PSU-100-D	AC Power Supply for UEI-PIO Multifunction Panel I/O Interface (not included with UEI-PIO-1010)
Extended Warranty	Option to purchase UEI's extended warranty (up to 10 years) is available