DNA/DNR/DNF-MF-101

Multifunction analog and digital I/O board

- DNA/DNR/DNF-MF-101 for use in "Cube", RACKtangle® and FLATRACK™ I/O chassis
- 16 SE / 8 Differential 18-bit analog input channels
- ±80 V to ± 0.156 V analog input ranges
- 2 16-bit ±10 V or 0-20 mA analog output channels
- 16 digital I/O bits 0-55 VDC, 4 logic level DIO
- 500 mA Douts with 16-bit PWM resolution
- Dual 32-bit counters
- up to 2 kHz update rates
- Trigger input and output
- 1 RS-232/422/485 port, 1 I²C port
- 350 Vrms Isolation

DNR-MF-101 shown is for DNR series RACKtangle chassis. Also available for DNA (Cube) and DNF (FLATRACK) chassis.

General Description:

The DNA/DNR/DNF-MF-101 are multifunction analog and digital I/O boards for use in UEI's Cube/RACKtangle/FLATRACK I/O chassis respectively. The board offers a powerful combination of I/O including 16 single-ended/8 differential analog inputs, 2 analog outputs, 20 bits of digital I/O, one I²C port and one RS-232/422/485 port.

The board offers 8 software selectable A/D ranges from ±80 V to ±0.156 V with 18-bit resolution. The ±80 Volt range makes the DNx-MF-101 an ideal measurement solution in a host of automotive, aerospace 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 DNx-MF-101 provides sample rates as high as 2000 sample per second on each channel (16 k/s aggregate). Two ±10 voltage or current (e.g. 4-20 mA) 16-bit analog outputs are also provided.

The board offers 20 bits of digital input/output broken into 16 bits of industrial voltages where each bit may be independently set as input or output. Four bits of TTL level DIO are also provided (programmed as I/O in banks of two). Industrial inputs and outputs have a wide operating range from 3.3V to 55 VDC. The industrial range (not logic-level) inputs have programmable pull up/down resistors that allow inputs to monitor contacts connected to a supply voltage or ground. Inputs are sensed with an A/D converter so high and low voltage thresholds are programmable and allowing change of state detection with 5 μs resolution. The industrial range (not logic-level) outputs can be set as current sourcing (a switch between Vcc and the output), current sinking (a switch between Gnd and the output), push-pull (connect to Vcc or Gnd but not at the same time) or can act as a simple switch to Vcc or Gnd.   Industrial digital outputs can also be configured as flexible controllers with PWM and 16-bit pulse width resolution or softstart. The PWM/softstart parameters are selectable on a per-channel basis. The 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 of a single combined FIFO with timestamps. Ain/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. The counter inputs can be connected to any digital input pin, while the counter outputs can be used to drive two dedicated industrial outputs.

The MF-101 board includes two communications ports. The first is 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 and supports Standard, Fast and Fast+ baud rates. The I²C port supports both master and slave concurrently allowing loopback testing and bus monitoring. SDA/SCL have +5V pull-ups, but are also 3.3 V compliant.

Technical Specifications: (typical at 25°C ±5°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
±1.25V	9.54 µV	±700 µV
Input impedance	> 1.13 MΩ Diff / 565 kΩ SE	
Input offset current	< 72 µA	
Overvoltage protection	± 100 Vdc	
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 Meg Ω	
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)	

The DNx-MF-101 offers 350 Vrms of isolation between itself and other I/O boards as well as between the I/O connections and the chassis. The analog and digital sections of this board are also isolated. Like all UEI I/O boards, the board offers operation in extreme environments and has been tested to 5g vibration, 100g shock, from -40 to +85 °C temperatures and will function at altitudes up to 70,000 feet.

The board is supported by a variety of cable and screw terminal options certain to meet the needs of almost all users (please see page 4 for details). 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.

The DNx-MF-101 is supported by a complete software "suite" including support for Windows, Linux and all popular RTOS. Windows support is provided by the UEIDAQ Framework which includes a powerful software interface to Windows programming languages and DAQ applications including LabVIEW and MATLAB. An extensive factory written software suite is also provided for all popular "non-Windows" operating systems including Linux, VXworks, QNX, RTX, INtime and more. All software support includes extensive example programs that make it easy to cut-and-paste the I/O software into your applications.

# Technical Specifications: (typical at 25°C ±5° C unless otherwise stated)

Analog Output	
Channels / resolution	2 channels / 16-bit resolution
Voltage Output mode	
Voltage output ranges	±10 V, ± 5 V at ±5 mA
Output accuracy	tempco: 3 ppm/°C typical, 10 ppm/°C max
±10 V	±3 mV
±5 V	±1.5 mV
Output impedance	< 0.1 Ω not including any cables
Current Output mode	
Current output ranges	0-20 mA, 4-20 mA, -1-22 mA
Output accuracy	tempco: 3 ppm/°C typical, 10 ppm/°C max
0-20 mA	±3 µA
4-20 mA	±2.6 µA
-1-22 mA	±3.5 µA
Current outputs	0.02% of FSR (25°C), 0.07% of FSR (over temp)
Maximum load resistance	750 Ω
Update rate : Settling time	2000 update/sec max : 100 µS to 0.03%
Isolation	350 Vrms (analog in and out share one gnd)
Industrial Digital I/O	
Channels / direction	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.
Input protection	±100 VDC
Guardian input accuracy	Tempco: 15 ppm/°C
0-55 V	275 mV
Input throughput	1 kHz max
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 55V input)
Output throughput	1000 updates per second, max
PWM output	0 to 100% in 0.0015% increments (16-bit resolution)
PWM cycle rate	up to 10 kHz

| Logic-Level Digital I/O	
Bits	4 (direction set in groups of 2)
Logic level	5 V logic
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
I²C Port	
Ports	1, Master, Slave or Bus Monitor capability
Interface specification	Complies with UM10204
Max SCL speed	1 Mbit/S (compliant with SM: 100kb, FM: 400 kb and FM+: 1Mb
Logic Level	5V / 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	
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
Power Consumption	< 5 W (not including output loads)
Operating Temp. (tested)	-40 °C to +85 °C
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

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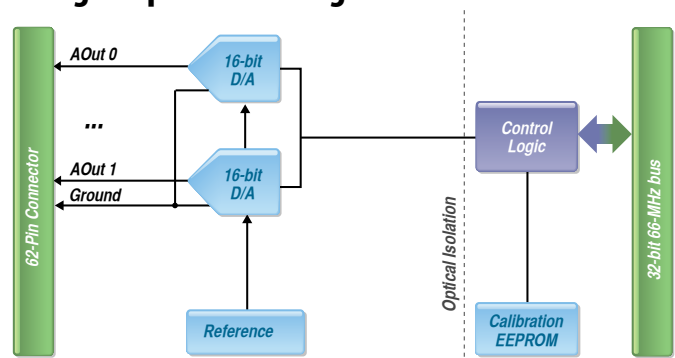
Analog Input Block Diagram:
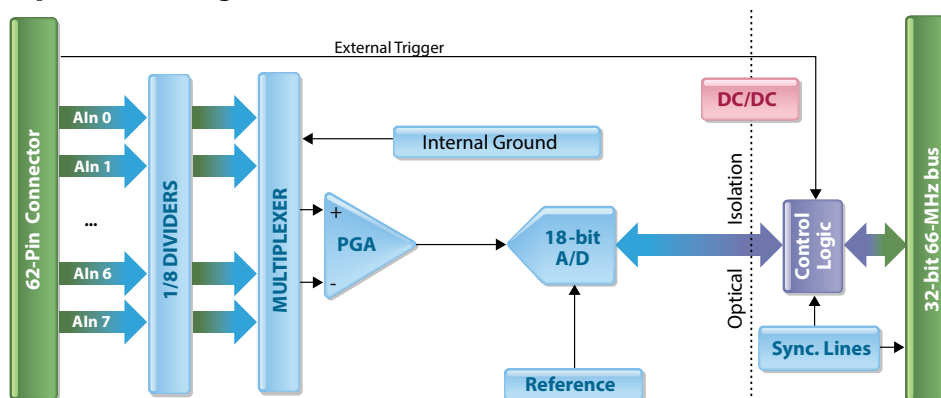
Digital Input Block Diagram:
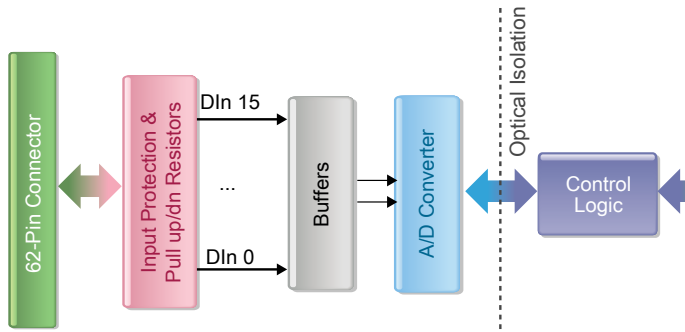
Notes: Dout and DIn share the same pin on the I/O connector. Vcc is provided in blocks of 4 channels. To provide proper output functionality with Vcc left open, a 2 MΩ resistor is connected to an internal 60 V power supply. With neither pull-up/down resistors enabled and the output off, a DMM measurement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

Digital Output Block Diagram:
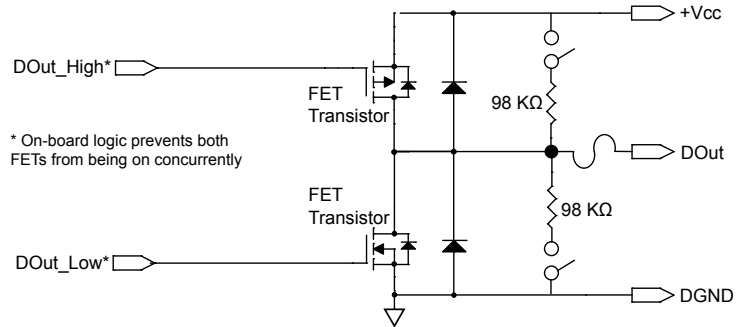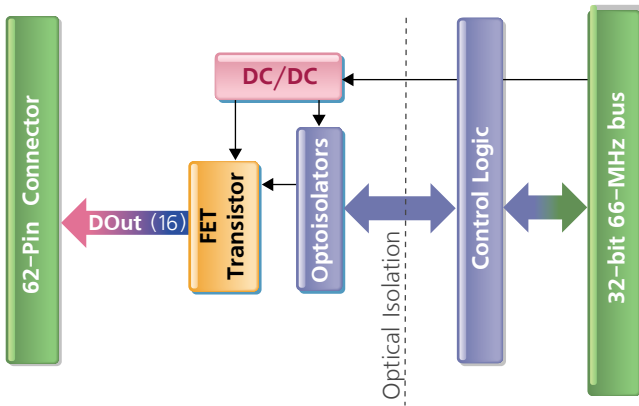
* On-board logic prevents both FETs from being on concurrently

Notes: Dout and DIn 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.

Pinout Diagram: DB-62 (female)
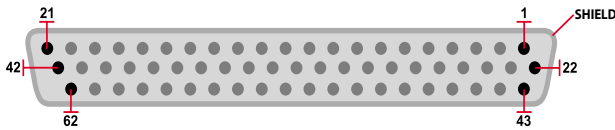
Pin	Signal	Pin	Signal	Pin	Signal
1	RTS232/TX485+	22	TX232/TX485-	43	CTS232/RX485-
2	I2C SCL	23	Gnd	44	RX232/RX485+
3	I2C SDA	24	+5V-TTL	45	Trig Out
4	DIO-02	25	DGnd	46	Trig In
5	DIO-00	26	DV 0-3	47	DIO-03
6	DIO-06	27	DGnd	48	DIO-01
7	DIO-04	28	DV 4-7	49	DIO-07
8	DIO-10	29	DGnd	50	DIO-05
9	DIO-08	30	DV 8-11	51	DIO-11
10	DIO-14	31	DGnd	52	DIO-09
11	DIO-12	32	DV 12-15	53	DIO-15
12	TTL 0	33	Gnd	54	DIO-13
13	TTL 2	34	Gnd	55	TTL 1
14	AGnd 1	35	AOut 1	56	TTL 3
15	AGnd 0	36	AOut 0	57	AIn 3/1-
16	AIn 1/0-	37	AIn 0/0+	58	AIn 2/1+
17	AIn 5/2-	38	AIn 4/2+	59	AGnd
18	AIn 7/3-	39	AIn 6/3+	60	AGnd
19	AIn 9/4-	40	AIn 8/4+	61	AIn 11/5-
20	AIn 13/6-	41	AIn 12/6+	62	AIn 10/5+
21	AIn 15/7-	42	AIn 14/7+		

Notes

Signals are isolated in three groups:

1.) Analog I/O (in blue) is referenced to AGnd. All AGnd and AGnd 0/1 pins are connected together on the PCB. However, AGnd 0/1 grounds are matched to the Analog outputs on the PCB. Use AGnd for all analog inputs and AGnd 0/1 for AOut 0/1 respectively.

AIn n/m+ and AIn n/m is for Single Ended analog input channel n or for Differential analog input channel m.

2.) Industrial DIO (in red) is referenced to DGnd. Use DGnd as the return for DIO-n and DV n-m.

DV n-m is the user-supplied Vcc for industrial DO channels n-m. The digital outputs 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.

3.) Logic-level DIO (in black) is referenced to Gnd. Use Gnd as the return for TTL, Trig, +5V, RS232/485, and I2C.

Connectivity options:

The DNA-MF-CBL-STP is the ideal way to connect your field wiring to the DNx-MF-101 board. It provides both the cable and the screw terminal board in one easy-to-order part number. The screw terminal board is designed for intuitive connections where all signal names are shown on the silk screen and all signal types are brought out in groups. A 62-pin connector attaches to the DNx-MF-101 board. That cable splits out into separate 37-pin and 62-pin connectors which are plugged into the screw terminal board. The 37/62 pin split cable separates analog signals (37-pin) from digital signals (62-pin). Splitting the analog and digital signals into separate cables ensures good noise performance on the analog signals even when the digital I/O section might be switching high frequencies or currents.

The DNA-MF-CBL-STP contains two pieces. The DNA-CBL-MF-1M cable provides the 62-pin connector for the MF-101 board as the 37/62 pin cables that connect to the DNA-STP-MF-101 screw terminal board. The cable and screw terminal may be ordered separate if desired. This allows you to order spares, but perhaps most importantly, it allows you to hardwire screw terminal boards into more than one system and allows you to move the DNx-MF-101 board between applications without disrupting existing field wiring.

The DNA-CBL-MF-1M is included in the DNA-MF-CBL-STP kit. It provides the connection between the DNx-MF-101 I/O board and the DNA-MF-STP-101 screw terminal board.

The DNA-STP-MF-101 screw terminal panel is included in the DNA-MF-CBL-STP kit. It provides easy connection to all field wiring as all signal names are shown on the board's silk screen.
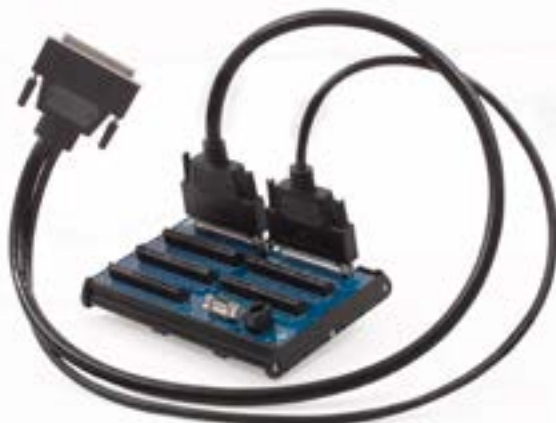
The DNA-MF-101 is also compatible with UEI's popular DNA-CBL-62, 62-pin cable and DNA-STP-62 screw terminal boards. This may be an attractive alternative when space is at a premium and/or your application is not switching high frequency and/or high power digital signals.

Ordering Information

Product	Description
DNx-MF-101	Multifunction I/O board with 16 A/D, 2 D/A, 20 DIO, one I²C and one RS-232/422/485 port
DNA-MF-CBL-STP	Cable and Screw terminal kit that provides simple connections to all MF-101 signals. Signal names are silk screened onto the screw terminal board.
DNA-CBL-MF-1M	1 Meter 62 conductor shielded cable that connects to DNA-STP-MF-101. (Included with DNA-MF-CBL-STP)
DNA-STP-MF-101	Screw terminal panel specially designed for MF-101 board. Signal names are silkscreened on board. (Included with DNA-MF-CBL-STP)
DNA-CBL-62	Standard 62-pin cable
DNA-STP-62	Standard 62-terminal screw terminal board
Extended Warranty	Option to purchase UEI's extended 5 year warranty is available