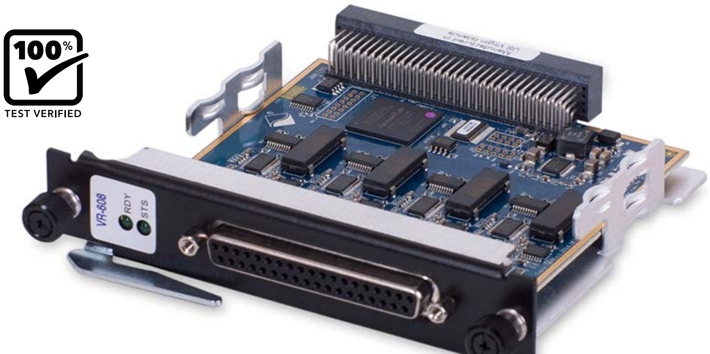
DNA/DNR-VR-608

8-Chan Variable Reluctance and Counter Interface

- DNA/DNR/DNF-VR-608 for "CUBE" /RACKtangle I/O chassis
- Wide input ranges (50 mV to 250 V p-p)
- Conditioned inputs directly drive digital outputs
- Bipolar (VR) inputs up to 300 kHz.
- Unipolar (Hall / TTL) inputs up to 18 kHz
- Inter-tooth timing allows acceleration tracking
- High/Low tooth index detection
- Open sensor detection



DNR-VR-608 for use in RACKtangle™ chassis.
DNA-VR-608 boards are for use in "Cube" chassis.

General Description:

The DNA/DNR/DNF-VR-608 are 8-channel, variable reluctance sensor interface boards designed for use in UEI's "Cube", RACKtangle and FlatRACK chassis respectively. Electronically, they are identical. The boards are designed for use in a wide variety of motion and rotation monitoring applications. Each channel provides a fully differential input and is capable of monitoring VR output levels as high as 250 Volts peak-to-peak. The board is also an ideal choice as a general counter unrelated to variable reluctance sensors including hall effect sensors as it can be used to measure an extremely wide variety of AC signals.

The VR-608 provides a unique and powerful signal conditioner mode where the VR/Hall inputs are conditioned and made available as a TTL compatible digital outputs. The board supports a matrix configurations where any input can be directed to any or all of the digital outputs. For applications where the VR-608 is primarily used as a signal conditioner, the input to Dout mapping can be set to start running at power up, even if the host Cube or RACK is not running any applications software.

The DNx-VR-608 offers a maximum input pulse rate of 300 kHz. The maximum input pulse rate is somewhat dependent on the signal level. The detailed specs to the right show pulse rates obtainable at different input signal levels. The minimum detectable input signal may be fixed at 50 mVp-p or may be set to "Adaptive Peak Threshold" mode where the threshold is set at approximately 30% of a time averaged input. A watchdog circuit resets the input to minimum threshold level if the input "drops out" for 85 mS. Open sensor/disconnected cable detection is also provided on the VR-608 board.

The DNx-VR-608 supports the following operating modes:

- Timed Count/Frequency: Counts the number of teeth detected during a specified time interval and returns the velocity in RPM.
- N pulses: Measure the time taken to detect N teeth and returns velocity in RPM
- Z/Index pulse: Measure the number of teeth and the time elapsed between two Z/Index pulses The Z/Index tooth is usually a gap or a double tooth on the encoder wheel. The max input frequency is approximately 50 kHz in the double tooth mode.
- Inter-tooth time: For those looking to measure at very low rates and/or to track acceleration between teeth, a powerful inter-tooth timing function is available. This function measures the time differential between teeth with a resolution of 15.2 nS at a counter depth of 32 bits. Each measurement is stored in a FIFO, so acceleration profiles over the entire input operating range can be acquired for indefinite periods.

The input impedance of each channel is greater than 40 kOhms with less than 250 pF of capacitance. This high impedance ensures the board is compatible with an extremely wide range of variable reluctance sensors.

The DNx-VR-608 is fully isolated from the UEI chassis as well as other I/O boards installed in the chassis. In addition, the inputs are divided into four sets of channel pairs, and each two-channel pair is isolated from the others. Each isolated channel pair is also supported with a logic level digital output.

All connections are made through 37-pin D connectors that ensure that mating cables or connectors are readily available. Users may also use the DNA-STP-37 screw terminal panel via DNA-CBL-37 series cables.

Software is included, providing a comprehensive, yet easy-to-use API that supports all popular operating systems, including Windows, Linux, and most real-time operating systems—such as QNX, Intime, VXworks, and more. Additionally, the UEIDAQ Framework—an even higher level Windows driver—supplies complete support for those creating applications in many popular Windows programming languages, as well as data acquisition software packages such as LabVIEW and MATLAB/Simulink.

Technical Specifications:

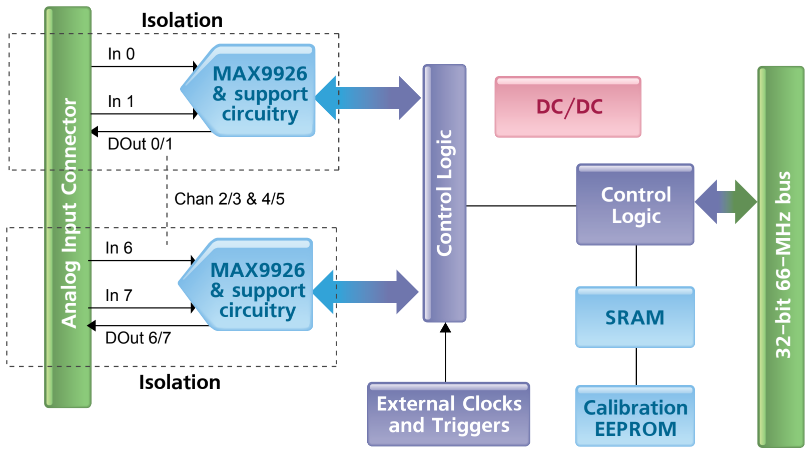
Number of channels	8
Channel configuration	Differential
Channel isolation	4 isolated banks of two channels
Input Impedance	> 40 kOhm, < 250 pF
Input voltage range	Up to 250 Vp-p
Maximum pulse rate (bipolar, VR input mode)	300 kHz at ≥ 3.2 Vp-p 200 kHz at ≥ 2.1 Vp-p 100 kHz at ≥ 1.1 Vp-p 50 kHz at ≥ 0.5 Vp-p 25 kHz at ≥ 0.25 Vp-p 10 kHz at ≥ 0.125 Vp-p ≤ 5 kHz at ≥ 0.08 Vp-p
Minimum detectable input (VR input mode)	50 mVp-p, fixed input mode
Max pulse rate, unipolar mode	18 kHz (V_{low} <1V, V_{high} > 3.5 V
Measurement accuracy	Please see the following page
Inter-tooth timing	
Time base resolution	15.15 nS
Counter depth	32-bits
Timing measurement range	20 µS to 65 seconds
Overvoltage protection	300 Vp-p
GENERAL SPECIFICATIONS	
Power dissipation	< 3W
Isolation	350 Vrms
Operating Temp. Range	Tested -40 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* *IEC 60068-2-64*	100 g, 3 ms half si ne, 18 shocks @ 6 orientations 30 g, 11 ms half sine, 18 shocks @ 6 orientations
Altitude	120,000 FT
MTBF	180,000 hours

Connection Options:

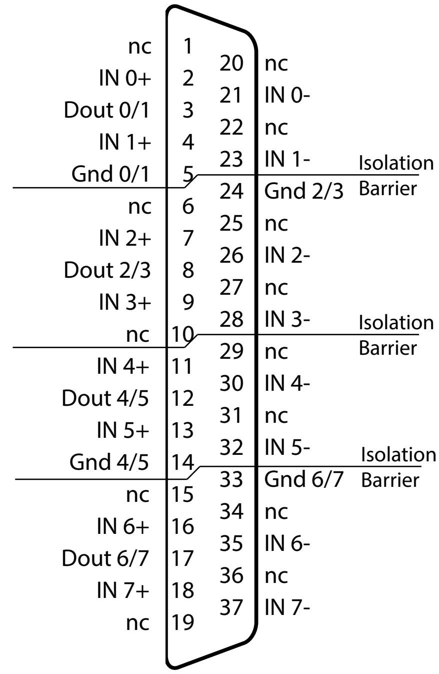
Terminal Panels	Matching Cable	Description
DNA-STP-37	DNA-CBL-37(S)	Connects all I/O signals to easy to use screw terminals

Tel: **(508) 921-4600**
Fax: **(508) 668-2350**

Block Diagram:



Pinout Diagram: (37-pin female dSub)



Measurement Resolution and Accuracy:

The DNA/DNR/DNF-VR-608 accuracy is largely based on the chassis master clock. The master 66 MHz clock offers the following accuracy:

10 ppm	Initial Accuracy
15 ppm	Temp drift over -40 to +85°C operating range
5 ppm	Drift over time (first year, less per year thereafter)

For the calculations here, we will assume a flat 30 ppm accuracy of the 66 MHz clock, or a period of 15.15 nS.

Unlike most analog measurements, the operating mode of the VR-608 board along with the input frequency have a great impact on overall measurement accuracy and resolution.

Timed Count/Frequency: *Counts the number of teeth detected during a specified time interval and returns the velocity in RPM.*

In this mode, the accuracy is determined by the input frequency and the duration over which you count. The rough equation to determine resolution is simply:

$$\text{resolution} = 100 / ((\text{input frequency}) \times (\text{sample duration}))$$

For example, if the input frequency is 10 kHz sampled for 1 second, the resolution is one part in 10,000 or 0.01%. If the input frequency is 1 kHz and the sample duration is 0.1 Hz, the resolution is one part in 100, or 1%. To compensate for crystal error you need only add a flat 0.003% (for the 30 ppm master clock error).

$$\text{Accuracy} = 1 / ((\text{input frequency}) \times (\text{sample duration})) + 0.003\%$$

Note that if you "play" with these numbers, you will see that this measurement mode is well suited for applications with high input frequencies, that do not have to be updated quickly. For lower frequency inputs and/or for systems requiring quicker data updates, consider using the N-pulses (a.k.a. N-teeth) mode.

N pulses: *Measure the time taken to detect N teeth and returns velocity in RPM*

Unlike the timed count mode, this mode determines RPM by measuring the time delay between teeth. This mode simple counts the number of 66 MHz master clock pulses that occur between teeth. (To return RPM you do need to enter the number of teeth on the sensor gear into the software.) The resolution of this mode is:

$$\text{Resolution} = \frac{100 \times (\text{Input Frequency})}{N \times 66{,}000{,}000}$$

Where N is the number of teeth you wish to include after the first tooth. For example if you want to measure the time between adjacent teeth, N=1. If you wish to measure the time between the first tooth and the fourth, N=3.

This mode is subject to the same 0.003% accuracy of the 66 MHz master clock, so:

$$\text{Accuracy} = \frac{100 \times (\text{Input Frequency})}{N \times 66{,}000{,}000} + 0.003\%$$

For example, if your input frequency is 20 kHz, and you select N=1, your system accuracy would be 0.0333%. If the input frequency remains 20 kHz, but you sample the time between the first tooth and the third (N=2), the accuracy becomes 0.0182%.

Selecting a larger "N" increases the resolution of the measurement, but also decreases the frequency at which you can make measurements. This is a trade-off that must be made based on your applications' accuracy requirement , the input frequency and how quickly you need to sample the data. If your frequency is high and/or your need to acquire the data is not fast, you may wish to consider the Timed Count/ Frequency mode mentioned in the section to the left.