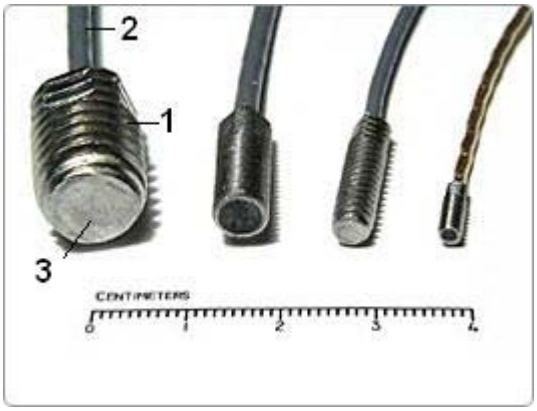
MicroStrain®

Non-Contact
DVRT® Quick Start Guide

Non-Contact DVRT®
NC-DVRT-0.5
NC-DVRT-1.0
NC-DVRT-1.5
NC-DVRT-2.5
NC-DVRT-5.0

DVRT®

The Differential Variable Reluctance Transducer (DVRT®) is designed for precision linear measurements.



The DVRT® is comprised of 3 main components:

1. a rigid **body**,
2. a **connector cable** for electronics, and
3. a **sensing face**.

Electronics

The DVRT® may be connected to any of the following MicroStrain signal conditioning products:

- DEMOD-DVRT housed in either a Motherboard chassis or Smart Motherboard chassis
- DEMOD-DVRT-TC housed in either a Motherboard chassis or Smart Motherboard chassis
- DEMOD-DIN
- DEMOD-DC® 2
- DVRT-Link™

Certificate of Calibration

Every DVRT® is paired and calibrated at the factory with its own signal conditioner. Each DVRT® and signal conditioner pair are shipped with a Certificate of Calibration which should be consulted to insure that the pair is always connected and used together. An example Certificate of Calibration is shown below:

Certificate of Calibration

This document certifies that the equipment referenced below meets published specifications.

Date of Calibration:	11/17/08	
Sensor Model:	NC-DVRT-1.0	
Sensor Serial Number:	1312-0572	
Signal Conditioner Model:	DEMOD-DC	
Signal Conditioner Serial Number:	3118-5037	
-3dB Bandwidth:	800	
Slope (mm/V):	2.14579	*
Offset(mm):	-0.4403	
Calibrated by:	PJL	
Calibration Temperature (deg C):	22	
Calibration Frequency:	Static (< 2Hz)	
Warm up time:	>15 minutes	†
If Non-Contact, Target Material:	416 SS	

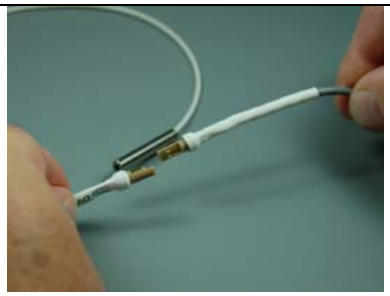
Sensor Color Key

__ black
__ red
__ blue
__ green
__ yellow
__ white

Here we see an NC-DVRT-1.0 with serial number 1312-0572 calibrated with a DEMOD-DC® 2 serial number 3118-5037. Each DVRT® and each signal conditioner are clearly marked with their serial number. If you have received multiple DVRT®s and signal conditioners, it is mandatory that you marry the pairs together using the information from the Certificates of Calibration.

Connections

The DVRT® **connector cable** terminates in a 4 pin hermaphroditic LEMO connector and requires a CBL1, CBL2 or CBL25 mating cable to connect to a DEMOD-DVRT, DEMOD-DVRT-TC or DEMOD-DIN. No mating cable is required to connect to the DEMOD-DC® 2 or DVRT-Link™.



The CBL1, CBL2 and CBL25 mating cables have a 4 pin hermaphroditic LEMO connector on one end and a 4 pin keyed locking LEMO connector on the other with a red dot for alignment.

Connecting the DVRT® and DEMOD-DVRT

- Connect the DVRT® to the CBL1, CBL2 or CBL25.
- Connect the CBL1 to the 4 pin LEMO connector on the DEMOD-DVRT by aligning the red dots and pushing the connector in until it locks.
- Connect your DAQ to the BNC connector on the DEMOD-DVRT.

Connecting the DVRT® and DEMOD-DVRT-TC

- Connect the DVRT® to the CBL1, CBL2 or CBL25.
- Connect the CBL1 to the 4 pin LEMO connector on the DEMOD-DVRT-TC by aligning the red dots and pushing the connector in until it locks.
- Connect your DAQ to the BNC connector on the DEMOD-DVRT-TC.

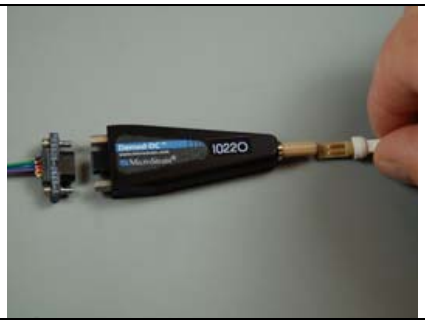
Connecting the DVRT® and DEMOD-DIN

- Connect the DVRT® to the CBL1, CBL2 or CBL25.
- Connect the CBL1 to the DEMOD-DIN by aligning the red dots and pushing the connector in until it locks.
- Connect your DAQ to the V Out and GND connectors on the DEMOD-DIN.

Caution!!! When removing the LEMO connector from the DEMOD-DVRT, DEMOD-DVRT-TC or DEMOD-DIN, grasp the knurled diameter and pull straight out. The lock will release and the connector will detach. Do not twist or rotate the LEMO connector.

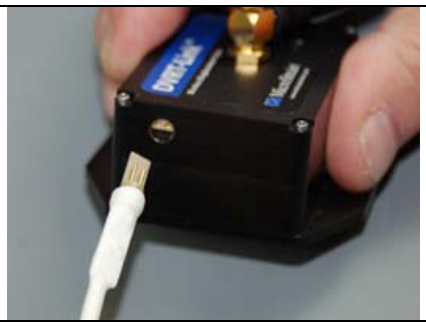
Connecting the DVRT® and DEMOD-DC® 2

- The DVRT® **connector cable** is plug-compatible with the DEMOD-DC® 2.
- Connect the DVRT® directly to the DEMOD-DC® 2.
- Connect your DAQ to the 0-5 Volts Output and Ground on the DEMOD-DC® 2.



Connecting the DVRT® and DVRT-Link™

- The DVRT® **connector cable** is plug-compatible with the DVRT-Link™.
- Connect the DVRT® directly to the DVRT-Link™.
- Use the DVRT-Link™ with the USB Base Station and Agile-Link software.



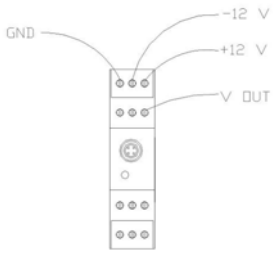
Powering and Wiring the Signal Conditioner

Powering the Motherboard and Smart Motherboard

- The DEMOD-DVRT and DEMOD-DVRT-TC are housed within the Motherboard chassis.
- Plug the 5 pin male connector of the power supply into the female connector on the Motherboard backplane.

Powering and Wiring the DEMOD-DIN

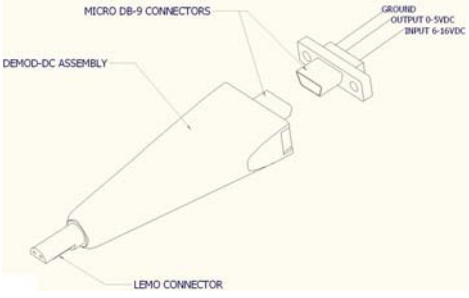
- GND from power source
- +12 V from power source
- -12 V from power source
- V Out to DAQ
- GND to DAQ



Powering and Wiring the DEMOD-DC® 2

- Purple Ground from power source
- Blue 0-5 VDC Output to DAQ
- Green 6-16 VDC from power source

Caution! Do not connect the output lead to power. The circuit is unprotected and unwarranted damage will result.



Attaching the DVRT®

MicroStrain provides a range of attachment fixtures to secure the DVRT® **body** in the environment to be measured. Please consult with your MicroStrain support engineer to find the best approach for your particular requirements. **Note:** For the calibration to remain valid during operation, the DVRT® fixture material must be a polymer or 300 series stainless steel.

Target Material

The Non-Contact DVRT® is designed to measure the 'gap' between its sensing face and your 'target'. In most cases, you would have provided MicroStrain with a sample of your target's material. This target can be ferrous, non-ferrous, aluminum, brass and so forth. The example Certificate of Calibration (shown above) states that the target material used to produce the calibration was 416 Stainless Steel. The calibration is only valid for the stated target material.

Setting up the DVRT®, Signal Conditioner and Target

- Install the Non-Contact DVRT® in your application such that its sensing face will contact the target perpendicularly.
- Connect the Non-Contact DVRT® to its electronics.
- Power up the electronics so that voltage output can be observed.
- Bring the Non-Contact DVRT® into contact with the target so that the sensing face and target just touch.
- **Caution:** Be careful not to fully impact the two surfaces together; damage may result.
- Depending on the range of your particular Non-Contact DVRT® (1mm, 5mm, etc.), slowly widen the gap between the target and the Non-Contact DVRT® while observing the voltage change. Depending on the particular signal conditioner, output will increase or decrease over the range of the sensor.

Scaling Volts to Displacement

The Certificate of Calibration provides 3 calibration models to scale the voltage output of the DVRT® into a displacement measurement, being 1) Least Squares Linear Fit, 2) Multi-Segment Linear Fit, and 3) Polynomial Fit. The models provide the calibration coefficients and detail the formulas to compute displacement in millimeters (mm).
The Least Squares Linear Fit is the most common but least accurate way of calculating displacement. This method assumes that the DVRT® output is a perfectly linear straight line when in fact it is a curve function. Normally, we do not recommend that you use this method. We suggest that you use the Multi-Segment Linear Fit when you are initially setting up and testing any given installation. You may choose to move to the Polynomial Fit after you are satisfied that the installation is operating correctly.

Multi-Segment Linear Fit

Please refer to Multi-Segment Linear Fit page in your Certificate of Calibration. You will find calibration details similar to those shown in Figures 1 and 2 below. For this example, we are using the details from the NC-DVRT-1.0 referenced above which has a 1mm measurement range.

Multi-Segment Linear Fit Model	
	D = M(i)*x + B(i)
where	D = Displacement (mm)
	M(i) = Slope (mm/V)
	x = Sensor Output (V)
	B(i) = Offset (V)

Figure 1

Multi-Segment Linear Fit Results			
(i)	X(i) (V)	Slope, M(i) (mm/V)	Offset, B(i) (mm)
0	2.65161	-1.47397	2.90550
1	2.58364	-1.18863	2.16827
2	2.49936	-0.93764	1.54095
3	2.39252	-0.74119	1.07096
4	2.25736	-0.57721	0.70079
5	2.08380	-0.44795	0.43143
6	1.86015	-0.34425	0.23853
7	1.56914	-0.26276	0.11066
8	1.18788	-0.19881	0.03471
9	0.68399	-0.14890	0.00057
10	0.01119		

Figure 2

In Figure 2 we see the results of the calibration at various distances (gaps) between the sensing face and the target. When the face and target are just touching, the voltage will be around **0.01119**. When the gap is increased to 0.5mm, the voltage will be around **2.08380**. When the gap is increased to 1mm, the voltage will be around **2.65161**. Using the formula in Figure 1, we can calculate displacement from voltage as follows:

Displacement = Slope * Voltage + Offset

-0.50200mm = -0.44795mm/V * 2.08380V + 0.43143mm

Important Note: The displacement that is produced by this formula typically results in a negative value. The value should be considered to be the absolute of that value or in this example, +0.50200mm. The distance (gap) between the sensing face and the target is a positive value.

Congratulations!

You are off and running! MicroStrain engineers are always available by email, phone or SKYPE to support you in any way we can.

MicroStrain®
MicroStrain, Inc.
459 Hurricane Lane, Unit 102
Williston, VT 05495 USA
ph: 800-449-3878 fax: 802-863-4093
www.microstrain.com
support@microstrain.com