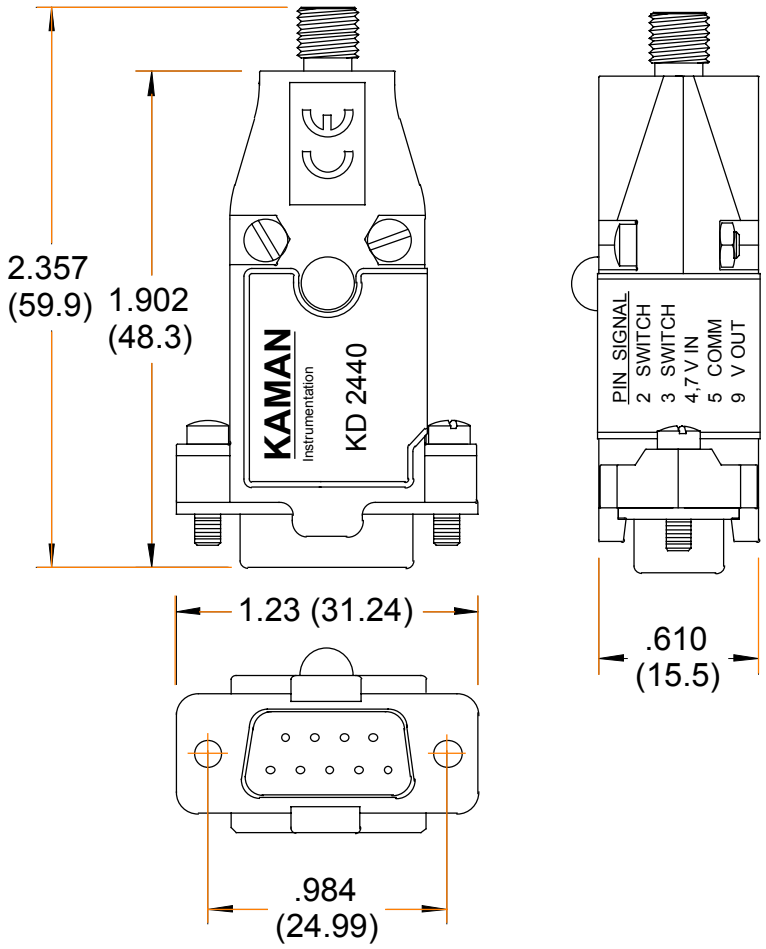
KD-2440

Noncontact Displacement Measuring System User's Manual

This apparatus, when installed and operated per the manufacturer's recommendations, conforms with the protection requirements of EC Council Directive 89/336/EEC on the approximation of the laws of the member states relating to Electromagnetic Compatibility. Please refer to the KD-2440 Declaration of Conformity or contact Kaman Precision Products for details.



KD-2440

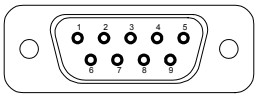
Kaman Precision Products' Displacement Measuring System Model KD-2440 is a noncontact linear proximity measuring system. This low-cost, easy-to-use system makes precision static and dynamic measurements of metal targets, and thickness measurements of non-conductive material backed by metal. The system includes a switching output that will track RPM measurement to 10Khz.

Features Summary / Advantages

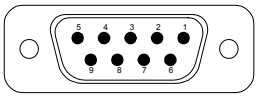
- Outstanding Precision: Static Resolution to 12 Microinches
- Easy to Adjust
- Excellent Performance with Ferrous Targets
- Variable Voltage Input from 12 to 24 Volts DC
- Adjustable Gain for up to 22 Volts Output with 24 Volts Input
- Compact Rugged Electronics and Sensors
- Temperature Tolerant Sensors (to 400°F)
- Level Adjustable Switched Output to 10Khz for Process Control
- Drop in Replacement to Kaman's KD-2400 with Accessories Kit

KD-2440 Unit

The KD-2440 system consists of three subassemblies: the sensor with integrated cable, the signal conditioning electronics module, and the power and output cable. The KD-2440 electronics uses a standard DB-9 connector to bring +12 Vdc to +24 Vdc into the electronics and provide outputs for the analog voltage and switch functions.



Electronics DB-9 Connector Face



I/O Cable DB-9 Connector Face

DB-9 Connections and Power I/O Cable Color Chart:

Wire Color	Pin	Signal
	1	N/C
BLU	2	SWITCH RX
WHT	3	SWITCH TX
GRN	4	VIN (ALTERNATE)
BLK	5	COMM
	6	N/C
RED	7	VIN
	8	N/C
ORN	9	VOUT
CLR	-	CABLE SHIELD

Electronics

The KD-2440 electronics has two potentiometers accessible through openings in the enclosure for adjusting the GAIN and SWITCH SET POINT level.

An LED indicates when the optically-isolated switch is in the closed position. The KD-2440 electronics and sensors utilize SMA type coaxial connectors: female on the electronics, and male on the sensor cable. Two production-sensor configurations are available, the 9C and the 5CM. Data for these two sensors is shown on the following pages. The sensor must be attached snugly (finger tight) to the electronics assembly for the unit to function properly.

Mounting Instructions

Mounting the KD-2440 electronics module can be done using either of the two holes in the enclosure, and an M-3 or 4 screw. It is preferable not to remove both screws from the case for mounting purposes. An easier mounting method may be to use a cable tie wrap or zip tie.

Positioning the electronics module so that it is not the low point in the cable will keep liquids from running down the cable and into the electronics. Take care to route the sensor cable to avoid crushing or crimping it during use. Damage to the sensor cable may affect the desired set points and overall operation of the electronics.

Theory of Operation

The KD-2440 system operates on a traditional Colpitts oscillator circuit where the sensor acts as the resonating coil for the oscillator. The proximity of the target to the sensor face pulls the oscillator, changing its frequency and amplitude of modulation, controlling a variable gain oscillator section within the electronic circuit.

5CM Sensor Response Data:
5CM Sensor Response Data:

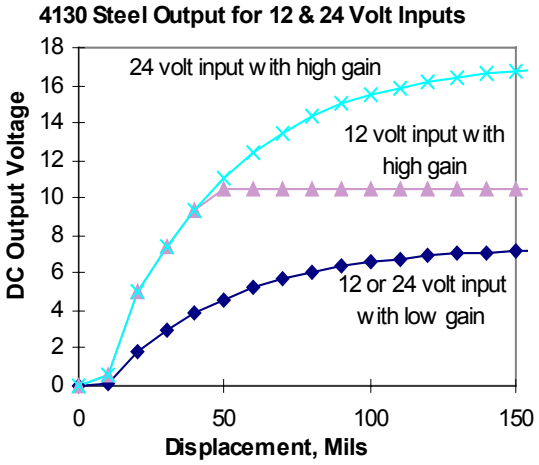
The signal is half-wave rectified and filtered to obtain an analog voltage proportional to the target position or displacement. The analog voltage output can be varied by adjustment of the gain. The input power is diode protected and regulated to provide a clean low-noise signal. The output is short-circuit current protected.

Adjustment and Calibration

The KD-2440 is instrumented with a ten volt regulator to provide a clean repeatable output signal. The input voltage must be maintained at a minimum of twelve volts for the regulator to function.

The gain (ratio of output voltage to target displacement) is used to adjust the output slope (output per displacement). When changing types of target materials or power supply voltages, it will be necessary to readjust the gain for the desired output voltage.

The KD-2440 can easily be adjusted or "calibrated" to obtain maximum output per displacement, maximum range, or any variation in between. Note that when the KD-2440 is adjusted for maximum output per displacement, it is at a minimum usable range, whereas a minimum gain gives a voltage change throughout the largest displacement for the same sensor, target, and range as depicted in the following graph:



The minimum gain is defined as being the lowest gain obtainable without pulling the circuit into saturation. Minimum gain can be obtained by setting the sensor displacement to a point within the usable range (preferably mid range), then slowly decreasing the gain potentiometer (clockwise) until the output saturates. At this point, increase the gain slightly to a point just above saturation (the output begins to change with a gain increase).

Example Calibration

To maximize the output slope for an application using a 5CM sensor with a .010" offset and a range of .040", follow these steps:

1. Adjust the sensor / target to its maximum displacement, plus the offset, plus approximately 20% of the range (.058").
2. Adjust the gain potentiometer to its minimum point (adjust clockwise until the analog output saturates)
3. Slowly increase the gain potentiometer (counter clockwise) until it saturates at its maximum point. this will be approximately two volts below the input voltage.
4. At this point, the module is calibrated to a maximum output per displacement condition. As the sensor is moved toward the target from approximately .058", the output will decrease. If the sensor / target displacement is increased beyond .058", the output will saturate at approximately two volts below the input.

Switched Output Operation

The KD-2440's switched output is a simple on / off switch with a corresponding LED indicator lamp. The switch is in a closed condition when the LED is illuminated. The switch can be adjusted to trip anywhere along the sensor range using the "Switch Setpoint" potentiometer.

CLEANING

The KD-2440 is not designed to be immersed or operated while immersed in liquids. Solvents may damage electronics module, sensor, or power I/O cable. Clean the unit with a damp cloth.

EMI PERFORMANCE

The KD-2440 conforms with the applicable standards of Council Directive for *Generic for Light Industrial and Commercial Use*. Under some EMI environments, at specific frequencies, the KD-2440 unit may experience a change in output voltage. In general, when exposed to those environments covered by the EMC directive, the user can expect less than 5% deviation of output. Contact Kaman Instrumentation for specific data or for recommended solutions if you experience problems with the KD-2440.

KD-2440

Specifications

ELECTRICAL

INPUT

Voltage: Regulated 12 VDC to 24 VDC
Current: Fuse limit input current from power source to 11 mA, .28W maximum at full load

ANALOG OUTPUT

Current (Full load): 4.2 mA maximum
Impedance: 50 ohms
Voltage: 0-22 VDC minimum with 24 VDC input
0-10 VDC minimum with 12 VDC input

SWITCHED OUTPUT

Opto-Isolated
Load Current: 100 mA maximum AC or DC
Load Voltage: 30V rms, 42.4V peak, or 60Vdc
On Resistance: 30 ohms minimum / 50 ohms maximum
Switch Point Hysterisis: 0.56% of full scale for 9C sensor, and 0.97% of full scale for 5CM sensor, using 24Vdc input on 4130 steel.

FREQUENCY RESPONSE

0-10 KHz (± 3db)

RESOLUTION

Better than 0.008% of measuring range using a 5CM sensor on a 4130 steel target at mid scale, and 12Vdc input

ENVIRONMENTAL

ENCLOSURE RATINGS

Sensor: IP 67
Electronics: IP 61

OPERATING TEMPERATURE RANGE

Sensor and cable: 0°F to 400°F (-18°C to 205°C)
Electronics: 32°F to 150°F (0°C to 66°C)

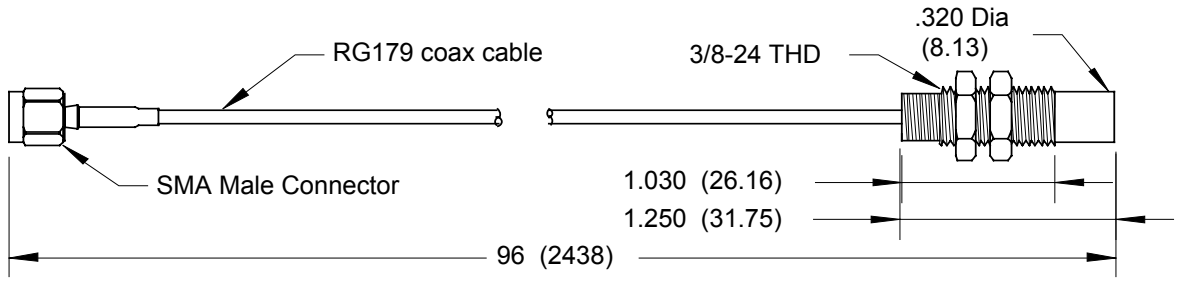
STORAGE TEMPERATURE RANGE

Sensor and cable: -60°F to 400°F (-52°C to 205°C)
Electronics: -58°F to 212°F (-50°C to 100°C)

THERMAL DRIFT

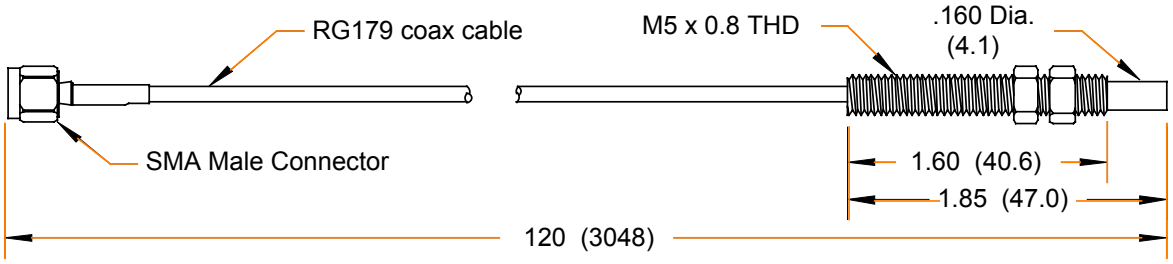
Less than 0.22% per °C of full scale for sensor, electronics or system.

9C Sensor Specifications:



Target Material	9C Sensor Measuring Range	
Non-Ferrous (Aluminum)	0 - 0.175 in.	(0 - 4.45 mm)
Non-Magnetic Steels (304 Stainless)	0.025 - 0.200 in.	(0.64 - 5.08 mm)
Magnetic Steels (4130)	0.040 - 0.275 in.	(1.02 - 6.99 mm)

5CM Sensor Specifications:

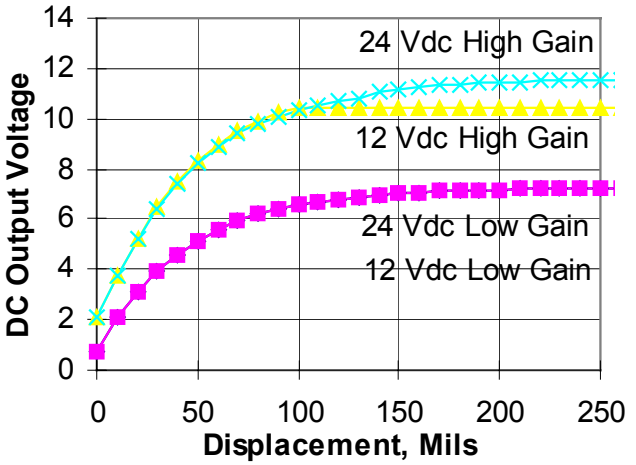


Target Material	5CM Sensor Measuring Range	
Non-Ferrous (Aluminum)	0 - 0.100 in.	(0 - 2.54 mm)
Non-Magnetic Steels (304 Stainless)	0.010 - 0.125 in.	(0.254 - 3.18 mm)
Magnetic Steels (4130)	0.015 - 0.150 in.	(0.38 - 3.8 mm)

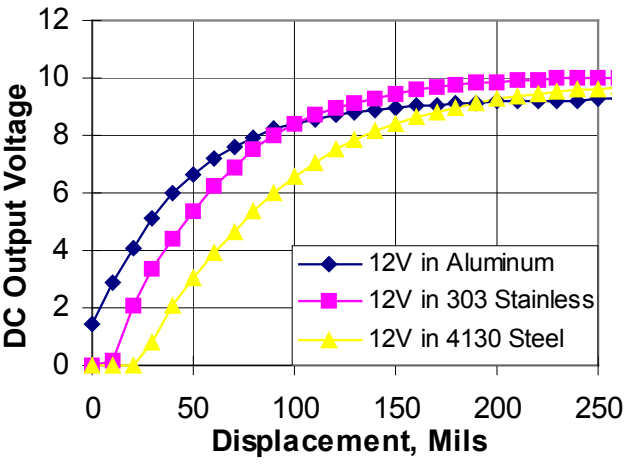
Dimensions are in inches (millimeters)

9C Sensor Response Data:

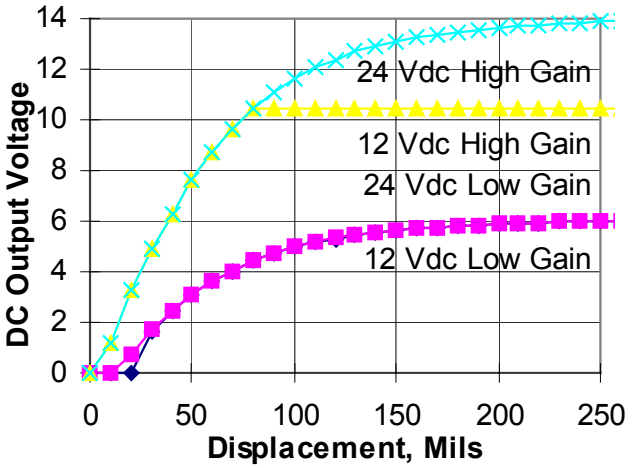
Aluminum Output for 12 & 24 Volt Input



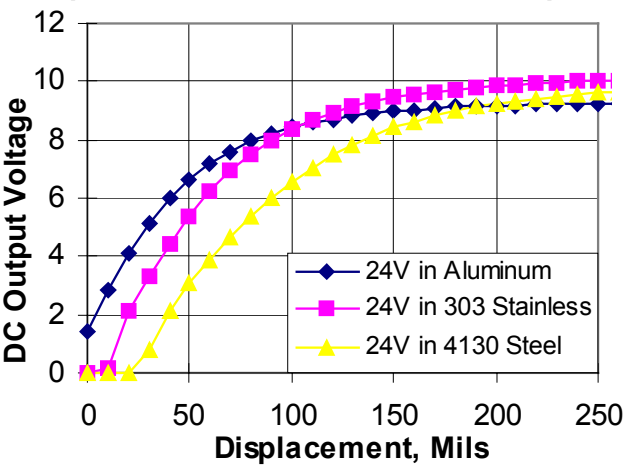
Outputs at Medium Gain & 12 Volt Input



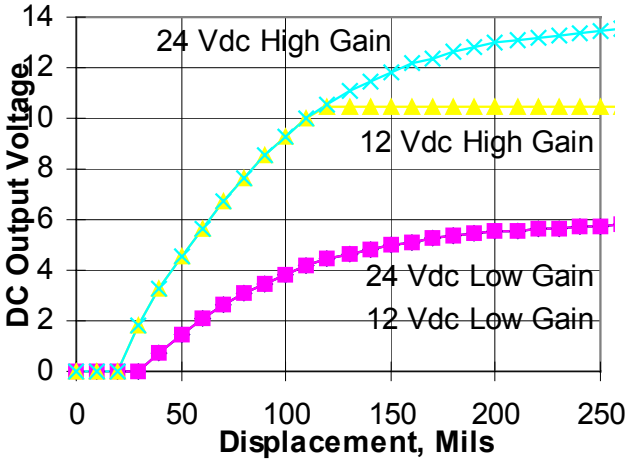
303 SS Output for 12 & 24 Volt Input



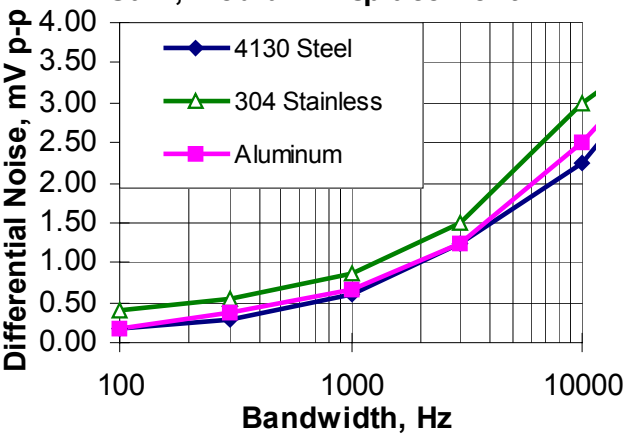
Outputs at Medium Gain & 24 Volt Input



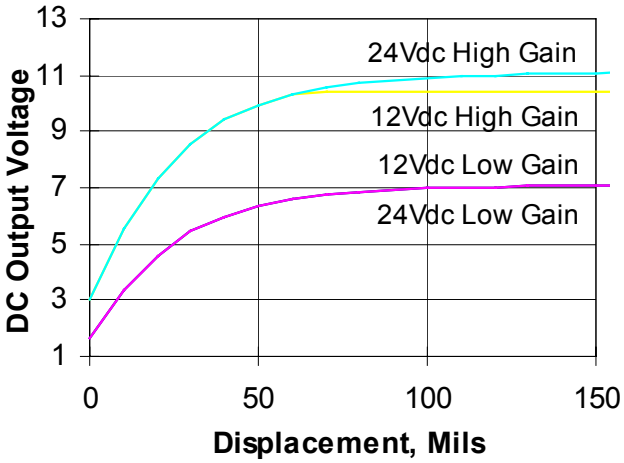
4130 Steel Output for 12 & 24 Volt Inputs



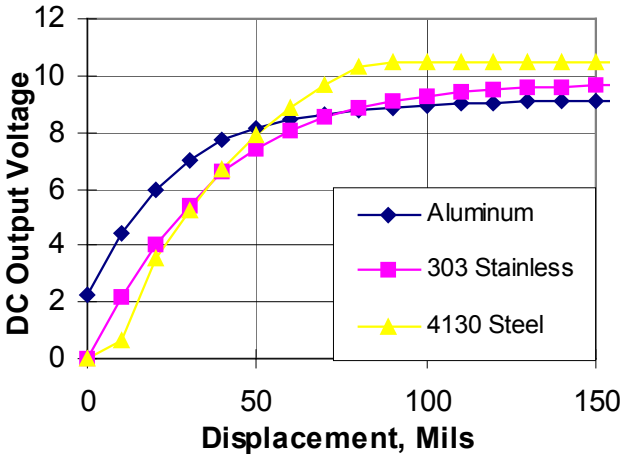
Example Output Noise @ 12Vdc Input, Mid Gain, Medium Displacement



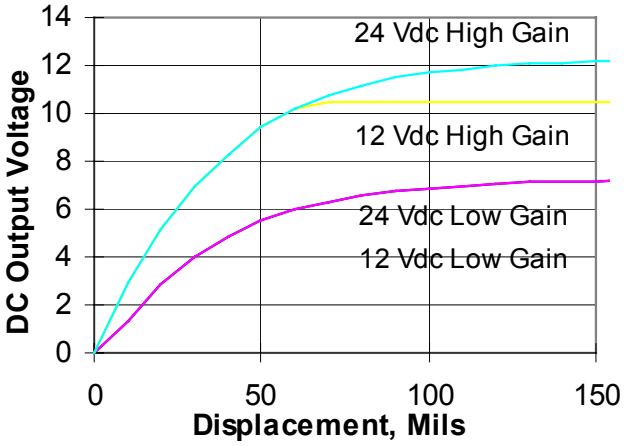
Aluminum Output for 12 & 24 Volt Inputs



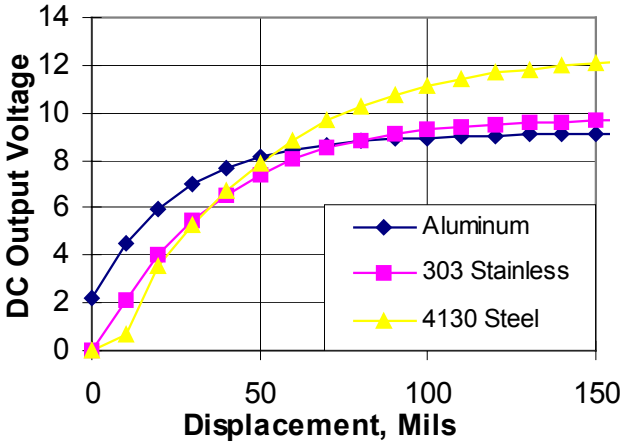
Outputs at Medium Gain & 12 Volt Input



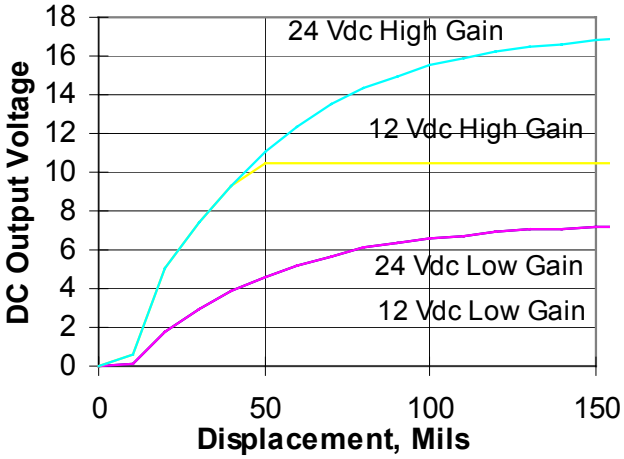
303 SS Output for 12 & 24V Inputs



Outputs at Medium Gain & 24 Volt Input



4130 Steel Output for 12 & 24 Volt Inputs



Example Output Noise @ 12Vdc Input, Mid Gain, Medium Displacement