DIT 5200™

Differential Impedance Transducer

FEATURES AND BENEFITS

- True differential for common mode rejection at an economical price.
- High precision eddy current balanced bridge technology.
- Capable of subnanometer resolution.
- Thermal stability ±.03% FS/°C, at null ±.005% FS/°C.
- Small package size: just 7.7 cubic inches.
- High sensitivity: up to 10V/mil (394 mV/µm).
- Extremely linear, to 0.1% full range.
- Single and dual channel configurations.

APPLICATIONS

- Fast steering mirror.
- Servo control position feed back.
- Stage positioning.
- Angular displacement indication.
- X-Y orbit position feed back.
- Stylus position.

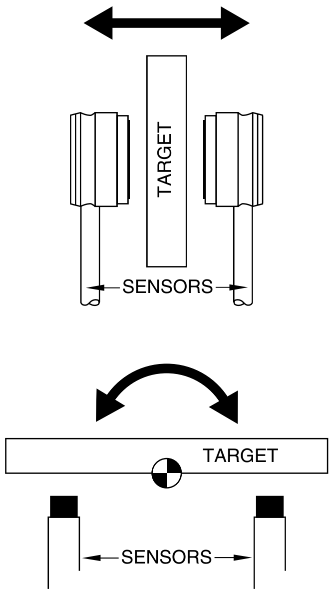
TECHNOLOGY OF DIFFERENTIAL BRIDGE SYSTEMS

DIFFERENTIAL MEASUREMENTS

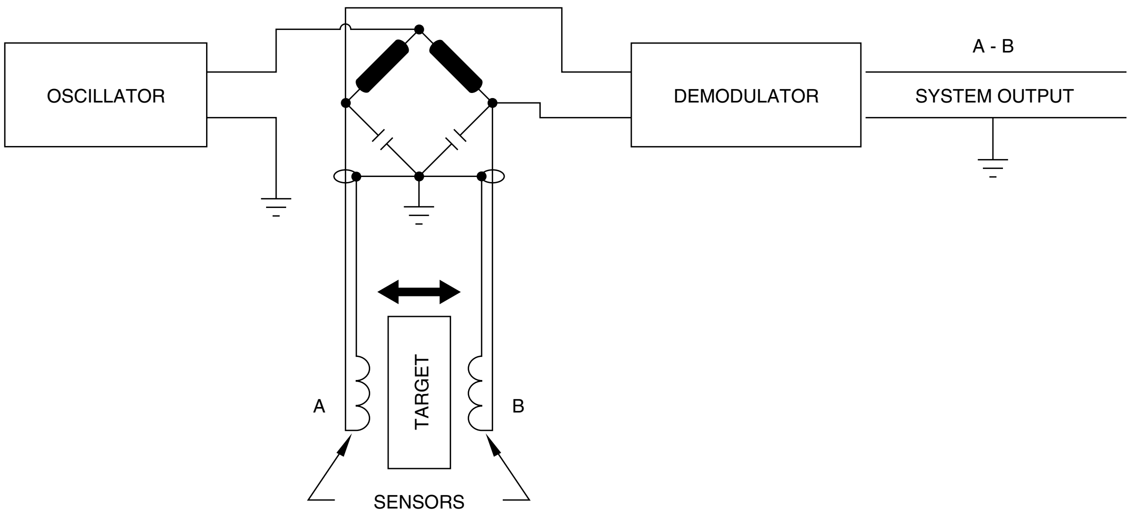
In an eddy current differential system, the two coils in the inductive bridge are housed in two separate sensors. Rather than one active coil and one reference coil, both sensors contain active coils as in figure 2. These two sensors are usually placed on opposite sides of a target or opposite sides of a target pivot point, as in figure 1.

THEORY OF OPERATION

As the target moves closer to one sensor, it moves away from the other. Therefore as the impedance in one leg of the inductive bridge increases, the other decreases. This push-pull effect amplifies the linear output-per-displacement and eliminates the need for summation amplifiers that add noise and drift. As a result, differential systems provide greater resolution and thermal stability than single-ended systems.



▲ *Figure 1: Differential target configurations.*

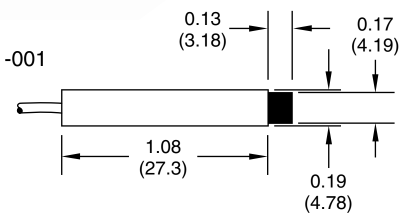


▲ *Figure 2: Differential system block diagram.*

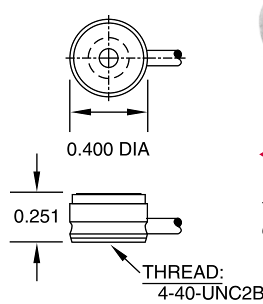
DIFFERENTIAL SENSORS FOR DIT-5200

◀ *15N sensor*

▶ *15N sensor configuration*



20N sensor ▶



◀ *20N sensor configuration*

CALCULATING EFFECTIVE RESOLUTION IN YOUR APPLICATION

Equivalent RMS input noise: A figure of merit used to quantify the noise contributed by a system component. It incorporates into a single value, several factors that influence a noise specification such as signal-to-noise ratio, noise floor, and system bandwidth. Given a measuring system's sensitivity/scale factor and the level of "white" noise in the system, equivalent RMS input noise can be expressed using actual measurement units.

Effective resolution: An application dependent value determined by multiplying the equivalent RMS input noise specification by the square root of the measurement bandwidth.

Example: A 15N sensor monitoring a reciprocating target moving ±10 mils (FR) filtered externally to a 15KHz bandwidth.

1. Calculate a value for equivalent RMS input noise. From the equivalent RMS input noise table, use the value of equivalent RMS input noise for a 15N sensor calibrated over a ±10 mil range. Multiply this by the full range of the calibration. Divide by 100. The noise value is a percent of full range.

(0.00007% X 0.020 inches) / 100 =
1.4×10^{-8} inches or 0.014 µinches.

2. Calculate effective resolution. From step 1, take the equivalent RMS input noise and multiply by the square root of the measurement bandwidth in Hz.

$$0.014\ \mu\text{inches} \times \sqrt{15000} = 1.714\ \mu\text{inches}$$

3. Approximate peak-to-peak resolution. From step 2, take the effective resolution and multiply by 6.6.

1.714 µinches X 6.6 = 11.312 µinches

EQUIVALENT RMS INPUT NOISE

Range ± mils	Range ± mm	Sensor	% Full Range at Full Range	% Full Range at Null
10	0.25	15N	0.00007%	0.00002%
10	0.25	20N	0.00012%	0.00004%
20	0.51	15N	0.00004%	0.00002%
20	0.51	20N	0.00007%	0.00002%
35	0.89	15N	0.00004%	0.00002%
50	1.27	20N	0.00004%	0.00002%
75	1.91	20N	0.00002%	0.00002%

SYSTEM SPECIFICATIONS (COMMON TO ALL)

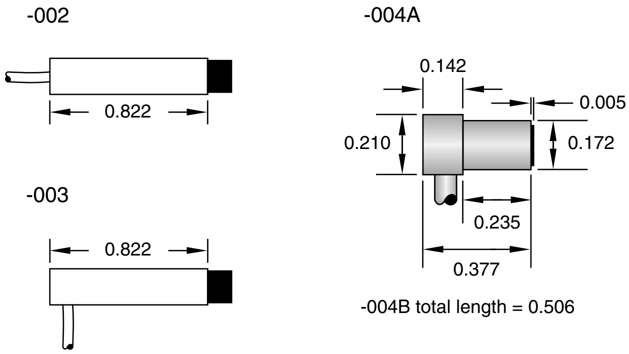
Target material: Aluminum.
Output voltage: ±10 volts typical.
Power dissipation:
At 15N sensor head: <0.5 mW/sensor typical.
At 20N sensor head: <2 mW/sensor typical.
Electronics: <1.35 Watts.
Frequency response: 0-20 kHz.
Input voltage: ±15 volts.
Output impedance: <1 Ohm.
Weight:
Electronics: 6 oz.
W/4 15N sensors: 8 oz.
Operating temperature range:
Electronics: +32°F to +140°F (0°C to +60°C).
Sensors: -62°F to +220°F (-52°C to +105°C).
Storage temperature range:
Electronics: -26°F to +180°F (-32°C to +82°C).
Sensors: -62°F to +220°F (-52°C to +105°C).

PERFORMANCE SPECIFICATIONS

Range ±mil	Range ±mm	Null mil	Null mm	Sensor	Typical Non-Linearity ± %FR	Maximum Non-Linearity ±%FR	Typical Sensor TempCo ± %FR/°C	Resolution p-p%FR at 1 kHz BW at FR	Resolution p-p%FR at 1 kHz BW at Null	Dual Channel Part Number
10	0.25	15	0.38	15N	0.15%	0.30%	0.02%	0.015%	0.004%	854924-003
10	0.25	20	0.51	20N	0.10%	0.20%	0.02%	0.025%	0.005%	854925-002
20	0.51	25	0.64	15N	0.25%	0.50%	0.03%	0.008%	0.002%	854924-004
20	0.51	40	1.02	20N	0.15%	0.30%	0.02%	0.015%	0.005%	854925-003
35	0.89	40	1.02	15N	0.50%	1.00%	0.03%	0.005%	0.003%	854924-005
50	1.27	60	1.52	20N	0.25%	0.50%	0.03%	0.008%	0.003%	854925-004
75	1.91	85	2.16	20N	0.50%	1.00%	0.03%	0.005%	0.002%	854925-005

Note: Full range (FR) is considered as twice the ±range value.
Temperature coefficient at null <0.005% FR/°C typical.
Performance specifications are based on aluminum target.
For single channel system, add an S to the end of the dual channel part number. Ex: 854924-003S.

OPTIONAL 15N SENSORS



Note: All dimensions shown in inches.

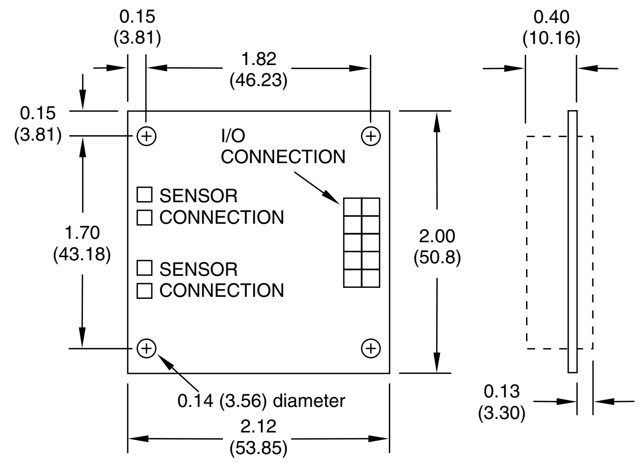
ORDERING INFORMATION

Each of the part numbers (see Performance Specifications on page 3) include the electronics housed in an aluminum enclosure, one pair of matched sensors per channel and an 18 inch I/O cable with mating 9-pin connector.

OEM applications have always been a Kaman specialty. We will work with your design engineers to provide a unique solution for your application.

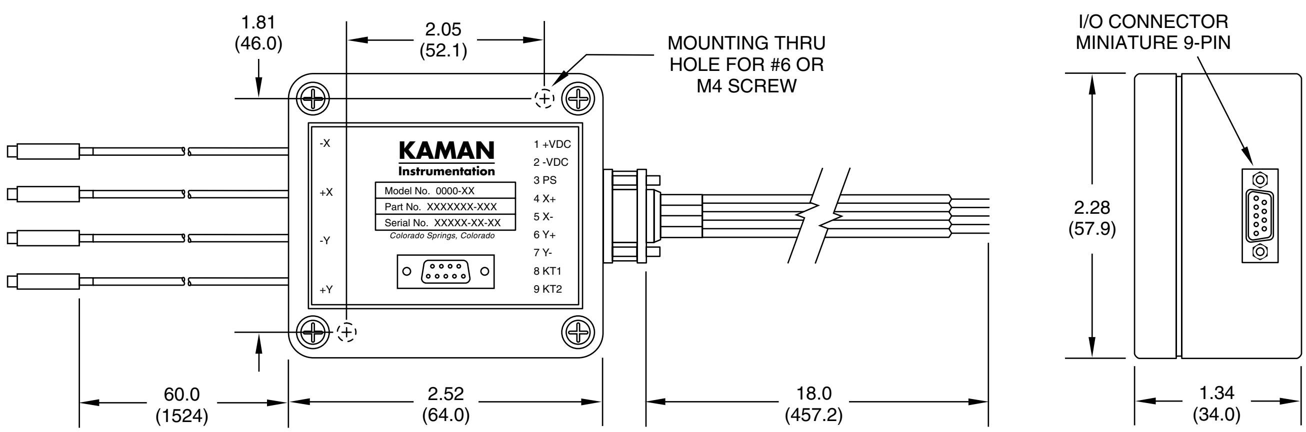
OEM CONFIGURATIONS

Sensors, cable lengths and electronics packaging can be reconfigured for special customer applications or OEM requirements.



Note: All dimensions shown in inches (mm).

▲ *Typical OEM PCB version electronics.*



Note: All dimensions shown in inches (mm).

▲ *Standard enclosure, dual channel 15N configuration. Note: single channel systems use the x axis sensor connectors.*

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