

Using Eddy-Current Sensors For Thread Detection

Applicable Equipment:

Lion Precision eddy-current sensors with thread detecting probes

Applications:

All thread detection applications

Summary:

This Application Note describes the use and setup of thread detecting probes with standard Lion Precision eddy-current sensor electronics. Different electronics are required for ferrous versus nonferrous materials.

Introduction

Specially designed thread-sensing probes can be used with standard eddy-current sensor electronics to detect the presence/absence of threads in a hole. Thread sensors generate different output voltages for tapped versus untapped holes.

The ECA101 is used for ferrous materials and can create a voltage difference of 3-4 volts between tapped and untapped holes. The ECL101 is used for nonferrous materials and creates a 1.0 volt difference between tapped and untapped holes.

Basic Theory of Operation

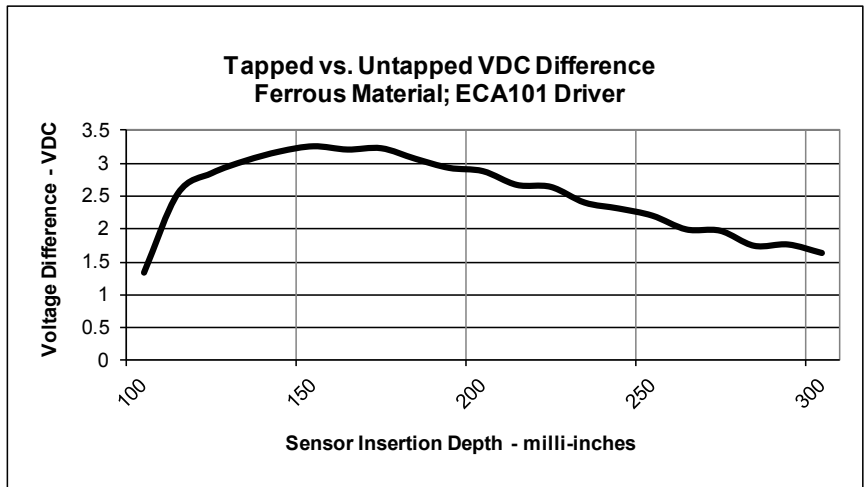
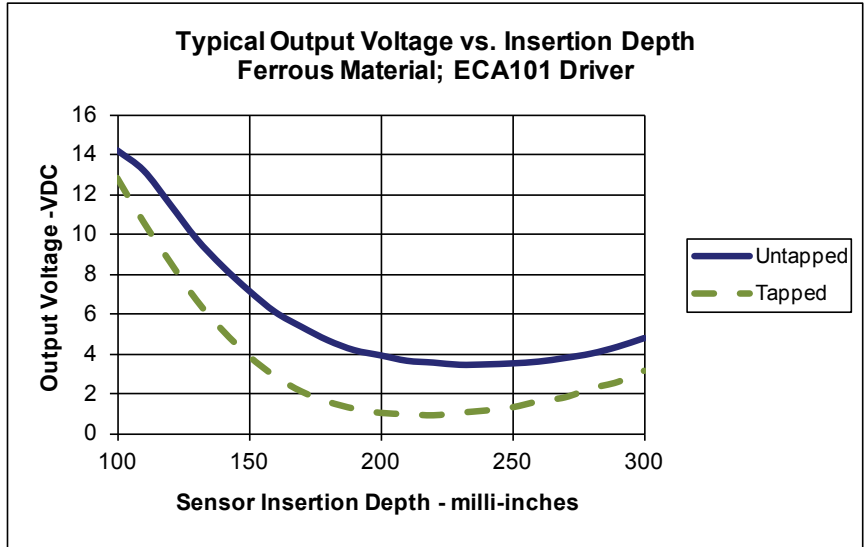
Eddy-Current probes are primarily designed as displacement sensors measuring changes of the gap between the sensor and the target. Specially designed thread-detection probes have longer probe-tip extensions which allow for deeper hole penetration and for the magnetic field of the sensing coil to engage the sides of the hole being tested.

The fundamental principle is that an untapped hole's surfaces are, on average, "closer" to the probe than a tapped hole's surfaces. This change in average distance from the probe to the surrounding material creates a change in output voltage from the electronics.

Material Differences

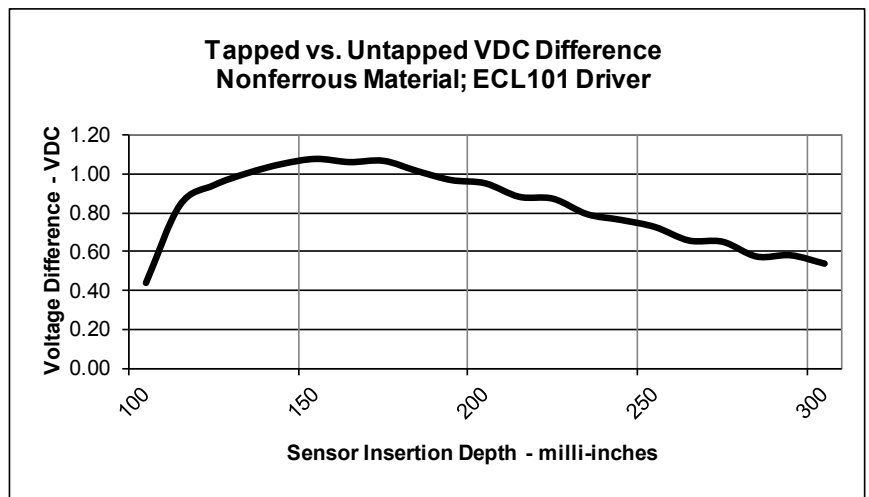
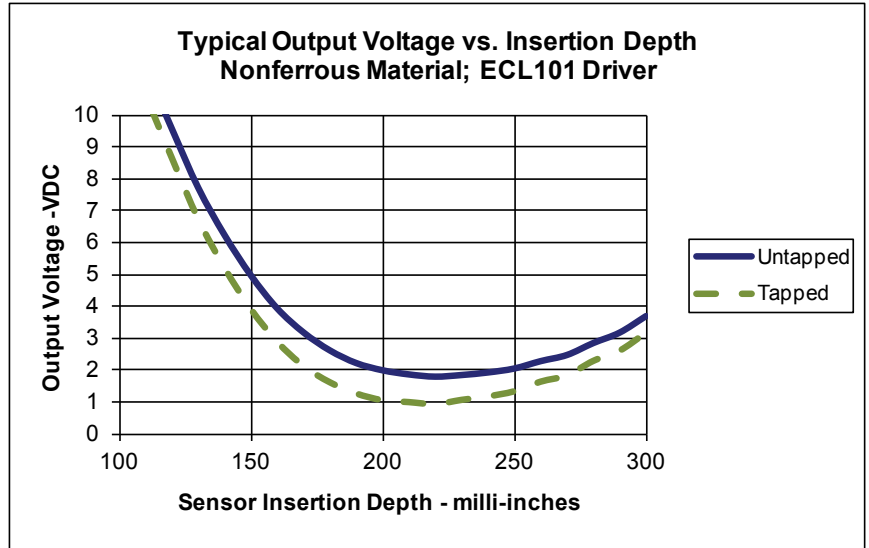
Ferrous Materials (Steel)

Thread sensing in ferrous materials is accomplished with a thread sensing probe and ECA101 driver electronics. The output voltage differences between tapped and untapped holes is substantial as shown below in the charts of typical output voltages.



Nonferrous Materials (Aluminum)

Thread sensing in nonferrous materials is accomplished with a thread sensing probe and ECL101 driver electronics. The output voltage differences between tapped and untapped holes are much less than with ferrous materials. This has proven to work reliably but greater consideration must be given to the application as the margin for error is smaller. The charts below show typical output voltages for nonferrous applications.



Selecting a Probe and Driver Electronics

Driver Electronics

The ECA101 used with ferrous materials offers an analog output voltage and a setpoint switched output. The switched output can be used to create a Go/NoGo type indication for thread detection.

The ECL101 used with nonferrous materials has an analog output only which will have to be evaluated by a data acquisition system to determine the presence/absence of threads.

Each driver model manual has a "Thread Sensing" addendum with instructions on how to best setup the sensor for sensing threads.

Thread Sensing Probes

Probe selection is dependent on material type and hole/thread type. Ferrous materials (steel) use the ECA101 Driver; nonferrous materials (aluminum) use the ECL101 Driver.

Select the probe from the tables below:

Ferrous Materials		
Use ECA101 Driver		
Metric	Inch	Probe
M6 x 1	1/4-20	T5BZ
M7 x 1	1/4-28	T5BZ
M8 x 1.25 M8 x 1	5/16-18 5/16-24	T6BZ
M10 x 1.5 M10 x 1.25	3/8-16 3/8-24	T7BZ
M12 x 1.75 M12 x 1.25	7/16-20 1/2-13	T8BZ
M14 x 2 M14 x 1.5	9/16-12 9/16-18	T10BZ
M16 x 2 M16 x 1.5	5/8-11 5/8-18	T12BZ

Nonferrous Materials		
Use ECL101 Driver		
Metric	Inch	Probe
M5 x .8	—	T5BZ
M6 x 1	1/4-20 1/4-28	T6BZ
M7 x 1	5/16-18	T7BZ
M8 x 1.25 M8 x 1	5/16-24	T8BZ
M10 x 1.5 M10 x 1.25	3/8-16 3/8-24	T10BZ
M12 x 1.75 M12 x 1.25	7/16-20 1/2-13	T12BZ
M16 x 1.5 M16 x 2	—	T16BZ

Mechanical and Mounting Considerations

Centering

The output voltage will change if the probe is not perfectly centered in the hole. The change is not large, but especially for nonferrous materials with smaller margin of error, this should be considered when using the probes. Complete details are available in the Technical Library on the Lion Precision website in The "Thread Sensing Probe Centering Errors" TechNote LT02-0015:

<http://www.lionprecision.com/tech-library/technotes/eddy-0015-thread-centering.html>

Protecting the Probe

Severe centering errors or other mishaps may cause the probe to crash into the target. Nonferrous sensor diameters are about 85% of the hole size, while ferrous sensors are about 65% of the hole size. The table below shows typical gap sizes:

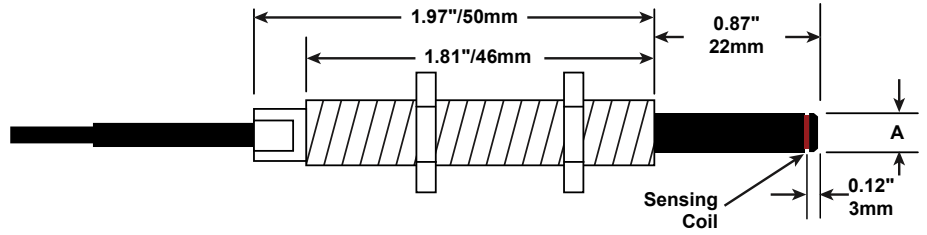
Ferrous Materials		
Hole Size	Probe	Gap (inch/mm)
M6 x 1	T5BZ	0.035/0.88
M7 x 1	T5BZ	0.054/1.37
M8 x 1.25	T6BZ	0.052/1.31
M8 x 1	T6BZ	0.057/1.45
M10 x 1.5	T7BZ	0.065/1.65
M10 x 1.25	T7BZ	0.071/1.80
M12 x 1.75	T8BZ	0.087/2.21
M12 x 1.25	T8BZ	0.096/2.44
M14 x 2	T10BZ	0.088/2.24
M14 x 1.5	T10BZ	0.098/2.49
M16 x 2	T12BZ	0.092/2.33
M16 x 1.5	T12BZ	0.101/2.58

Nonferrous Materials		
Hole Size	Probe	Gap (inch/mm)
M5 x .8	T5BZ	0.018/0.46
M6 x 1	T6BZ	0.018/0.46
M7 x 1	T7BZ	0.018/0.46
M8 x 1.25	T8BZ	0.018/0.46
M8 x 1	T8BZ	0.024/0.60
M10 x 1.5	T10BZ	0.018/0.46
M10 x 1.25	T10BZ	0.024/0.61
M12 x 1.75	T12BZ	0.018/0.46
M12 x 1.25	T12BZ	0.027/0.68
M16 x 1.5	T16BZ	0.018/0.46
M16 x 2	T16BZ	0.028/0.71

Spring-loaded probe mounts can be used to protect probes from damage in case of crash. Three models are available for different probe sizes:

Model:	SN-08	SN-12	SN-18
Internal Thread (must match probe)	M8x1 (T5BZ-T8BZ)	M12x1 (T10BZ-T12BZ)	M18x1 (T16BZ)
External Thread	M16x1.5	M22x1.5	M30x1.5
Maximum Extension	0.35" (8.9mm)	0.41" (10.4mm)	0.49" (12.4mm)

Thread Sensing Probe Dimensions



Mechanical Specifications		
Probe	Dimension "A"	Body Thread
T5BZ	0.13" / 3.3mm	M8x1
T6BZ	0.16" / 4.1mm	
T7BZ	0.20" / 5.1mm	
T8BZ	0.23" / 5.8mm	
T10BZ	0.30" / 7.5mm	M12x1
T12BZ	0.37" / 9.3mm	
T16BZ	0.52" / 13.1mm	M18x1