Eddy Current Surface Sensors

SE Systems manufactures the finest quality RF sensors for testing metal parts and products. This data sheet describes standard RF surface sensors produced by SE Systems. Over 2000 different sensors permit selection of the ideal sensor for your application. SE Systems also produces standard encircling sensors, ID sensors for inspection of holes and tubes, and a wide range of custom sensors for specific applications.

smartEDDY can work with eddy-current sensors produced by almost any manufacturer. However, test success is dependent upon use of the right sensor. Many probe manufacturers fail to consider important design details which can compromise your measurement or test. Poor sensors lead to unstable tests, erroneous measurements, incessant adjustments and frequent sensor replacement.

SE Systems strives to produce the highest quality sensors giving you the best possible test performance. SE Systems' sensors are designed with the following important details in mind.

Important design details

- Sensor impedance
- Sensing area
- Field orientation
- Part sensitivity
- Pressure insensitivity
- Temperature insensitivity
- Electromagnetic shielding
- Cable integrity
- Wear resistance
- Damage tolerance

What is a surface sensor?

RF surface sensors test metal parts or products by passing the active end of the sensor close to the area to be tested. The RF energy from the probe tip penetrates into the metal, interacts with the local magnetic permeability and induces local electrical current eddies. Part of the energy is reflected back to the sensor carrying information on the part shape, discontinuities, electrical conductivity and magnetic permeability.

Standard surface sensors produce eddy-currents traveling in a ring parallel to the test surface. The diameter of the eddy-current depends upon the sensor design.

Standard Surface Sensors

Standard surface sensors come in small and large sizes, in housings of stainless steel or plastic with ferrite, plastic, or ceramic cores. Small sensors are one-half inch in diameter by two inches long and have integral snap-in Fischer cable connectors. The large sensors are one inch in diameter by three inches long and have integral twist-lock Burndy cable connectors. All sensors are temperature compensated to reduce sensitivity to changes in ambient temperature. All sensors have documented sensitivity and measured frequency spectrum.

Shielded Surface Sensors.
These sensors have stainless steel housings and come in small and large sizes. Shielding provides several benefits:

- Defined sensing diameter
- Isolation from surrounding metal
- Better temperature compensation
- Less electromagnetic interference
- Deeper penetration
- Better wear resistance
- Greater damage tolerance

Absolute and differential sensors are available. Sensing area ranges from 0.05 inch (1.2 mm) to 0.94 inch (23.5 mm) in diameter. Available test frequencies depend upon core type and diameter. Test frequencies range from 250 Hz to 6 MHz.

Cores are made of ferrite, plastic or ceramic. Ferrite cores are used to achieve low frequency and hence deep penetration. Ceramic zirconia cores are used when precision lift-off control is required such as when making coating thickness measurements.

Unshielded Surface Sensors
These sensors are made of Delrin and come in small and large sizes. Absolute and differential sensors are available. Core diameters range from 0.06 inch (1.4 mm) to 0.72 inch (18 mm). Test frequencies depend upon core diameter and range from 8 kHz to 6 MHz.

Corner Sensors
These sensors have Delrin housings with ferrite cores. They come in small and large sizes and have a shaped tip. The tip is rounded at the core diameter, changing to a 90˚ cone and changing again to a 30˚ cone out to the full housing diameter. These sensors are used to inspect concave corners. (-ZR) added to the part number indicates a toughened zirconia face plate to extend life in severe wear conditions.

Remote Field Surface Sensors
These sensors operate in the reflectance mode and are sensitive to the diffusing eddy-current rather than the direct eddy-current. Remote field probes have poorer resolution but provide deeper penetration, better reach, and sensitivity to discontinuities parallel as well as perpendicular to the test surface.

Severe wear options

Four options are available which greatly extend the life of a sensor if it is frequently in contact with or dragged across test pieces. To specify a severe wear option, add the corresponding letters to the part number.

UHMW Tape (-TP)
UHMW Polyethylene tape 0.005 inches thick can be added to contact surfaces to extend the life of the sensor. This tape has a very low coefficient of friction and superior wear resistance. After extensive use the tape can be replaced. SE Systems will apply the tape to the probe and provide you with extra tape sufficient for at least 1000 applications.

Hardened Housing (-HD)
Shielded sensors can be provided with hardened stainless steel housings. Sensor housing is hardened to Rc-55 and is available for all small and large shielded sensors.

Sapphire Wear Rings (-SP)
Sapphire is one of the hardest materials known and provides nearly infinite life if the test surface is relatively smooth. The sensing element can still be damaged by sharp protrusions that may penetrate inside the ring. The sapphire wear ring is available for all shielded or unshielded small surface sensors with a tip diameter greater than 0.30 inch (7.5 mm).

Tungsten Carbide Wear Plates (-TC)
A thin tungsten carbide plate can be added to the sensing end to protect the probe from wear and sharp protrusion, which may damage the sensor. Tungsten carbide is much harder than steel and greatly extends the life of the sensor. For test surfaces with local protrusion such as one with weld splatter, the tungsten carbide wear plate provides the best protection. Tungsten carbide wear plates are available for shielded probes with sensing areas greater than 0.10 inch (2.5 mm) and at test frequencies less than 250 kHz.

Reduced tip option

Small shielded sensors can be provided with the sensing end 0.05 inch (1.2 mm) larger than the sensing diameter. Large shielded sensors can be provided with a reduced tip 0.1 inch (2.5 mm) larger than the sensing diameter. To specify a reduced tip add “-RT” to the part number.

Custom Surface Sensors

SE Systems is well known for its custom sensors to meet special needs. SE Systems has made multiple element sensors to inspect superconducting cable on cabling lines, nuclear fuel assemblies during maintenance intervals, stampings in the press, and fuel injector bodies during manufacture to name a few. We have built sensors with sensing area diameters ranging from a fraction of a mm to several meters, remote field, reflectance, high temperature and water proof sensors, sensors with shaped sensing areas and current flowing perpendicular to the test surface.

SE Systems has provided high precision sensors with impedance and sensitivity matched to better than one percent. High precision sensors eliminate the need for changing test parameters when a sensor is replaced.

Call and speak to one of our applications engineers for further information.

Mechanical Stabilizing

Sometimes it is hard to manually maintain orientation of small diameter sensors, particularly sensors with reduced tips or when an edge is to be scanned.

Delrin Shoe (SE 3.0-shoe)
The Delrin shoe is designed to hold any small diameter sensor. Shoe is 3/4 inch in diameter and 2 inches high. Bottom end of the shoe is counter-sunk such that on a flat surface a ring approximately 3/4 inch in diameter by 1/32 wide contacts the surface. In addition there is a 90˚ notch cut across the bottom face which can be used to center sensors on an edge.

Vertical Slide Fixture (SE 3.0-Slide)
This fixture when combined with a smartEDDY measurement system and a small shielded ceramic core sensor, permits very accurate measurement of thin walls or coatings. This fixture consists of a one inch travel, precision, linear slide mounted in a Delrin fixture. Parts up to three inches thick can be tested.

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