



Carbon+Unitrode-1™ Sensor for Carbon Fiber Composites Specifications



Figure 1
Carbon+Unitrode-1™ Dielectric/Conductivity Sensor
Side Exit (right), Rear Exit (left)

DESCRIPTION

The Carbon+Unitrode-1™ is designed for cure monitoring of carbon fiber composites like carbon fiber sheet molding compound (CF-SMC) or carbon fiber reinforced prepreg (CFRP) in presses, molds or harsh environments.

Dielectric sensors normally require filters to block conductive fillers and prevent short circuiting of the electrodes. Filters, however, must be replaced manually after each test and add time, effort and cost, so it is necessary to avoid them in rapid, repetitive operations. For cure monitoring without filters, the electrode of the Carbon+Unitrode-1™ has a rugged, insulating coating that allows direct contact with carbon fiber composites.

The Carbon+Unitrode-1™ may be mounted so the electrode is flush with a platen or mold surface, insuring no interference with the flow of material during processing. The high temperature polymer body is protected by a stainless steel sheath with a nominal 1.0" (2.54 cm) diameter. A thermocouple is positioned just below the surface to allow measurement of process temperatures. Dielectric and thermocouple signals are routed through a 10-foot (3 m) long stainless steel conduit to high temperature connectors. Sensor and cabling are rated for operation up to 220 °C and are suitable for R&D, QA/QC and manufacturing applications with repetitive operations.

SPECIFICATIONS

Dimensions (available with side or rear exit conduit):

Diameter, sensor head	: 1.0" (2.54 cm) nominal
Height, sensor head	: 1.0" (2.54 cm) nominal
Length, conduit	: 10' (3 m) nominal
Diameter, active face	: 0.69" (17.5 mm)
Diameter, electrode	: 0.50" (12.7 mm)

Composition:

Body	: High temperature polymer
Sheath/conduit	: Stainless steel
Cabling	: Teflon insulated

Operational:

Temperature, maximum	: 220 °C (428 °F)
Frequency, mid-con mode	: 0.1 Hz – 100 KHz

Sensor Parameters (dependent on material):

A/D ratio	: Consult Lambient Technologies
Base capacitance	: ~13 pF (actual value may vary)

Thermocouple : Type J standard, Type K avail. upon request

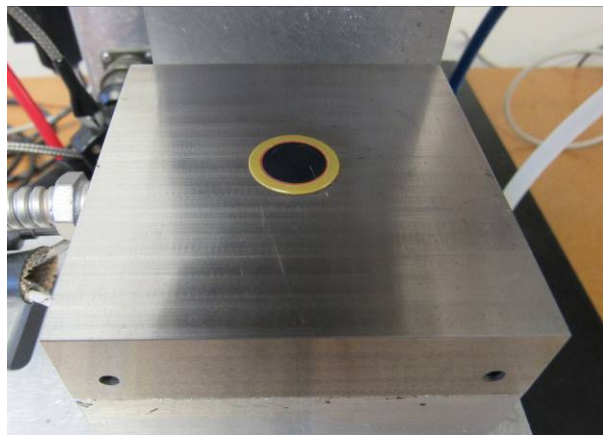


Figure 2: Carbon+Unitrode-1" sensor in press platen



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OPERATING MODES

The Carbon+Unitrode-1" may be used with all Lambient Technologies dielectric instruments in either mid-conductivity or high-conductivity mode. The sensor makes a bulk measurement of material between the central electrode, shown close-up in Figure 3 and the surrounding, grounded mold and/or the opposite mold face, as illustrated in Figure 4.



Figure 3
Close-up view of Carbon+Unitrode-1" sensor
(side exit version shown)

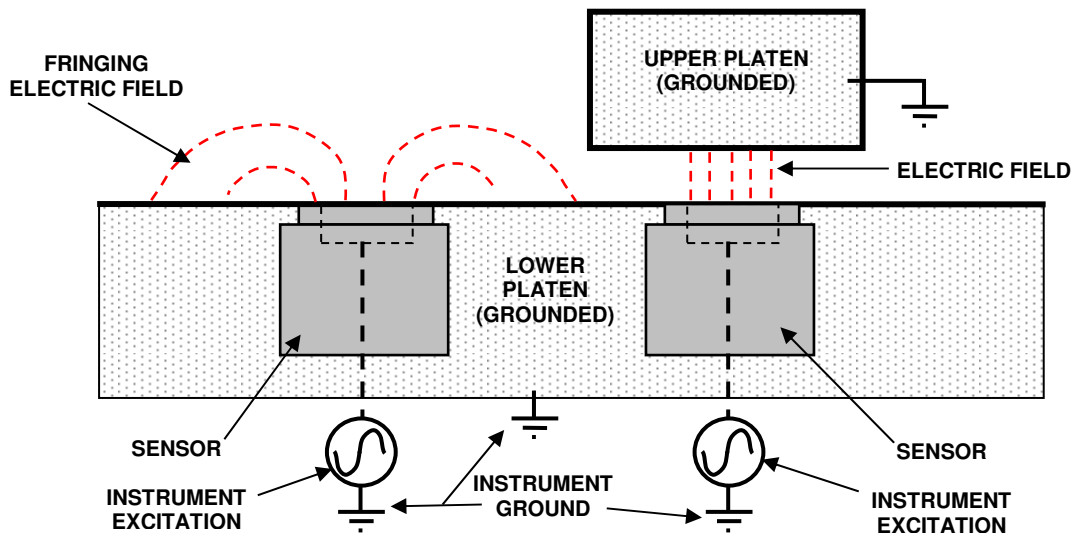


Figure 4
Carbon+Unitrode-1" sensor
using nearby grounded surface as second electrode

FORM FACTORS

The Carbon+Unitrode-1" may be specified with the conduit exiting from the side or the rear as shown in Figure 5. Contact Lambient Technologies for current mechanical dimensions of the sensor.

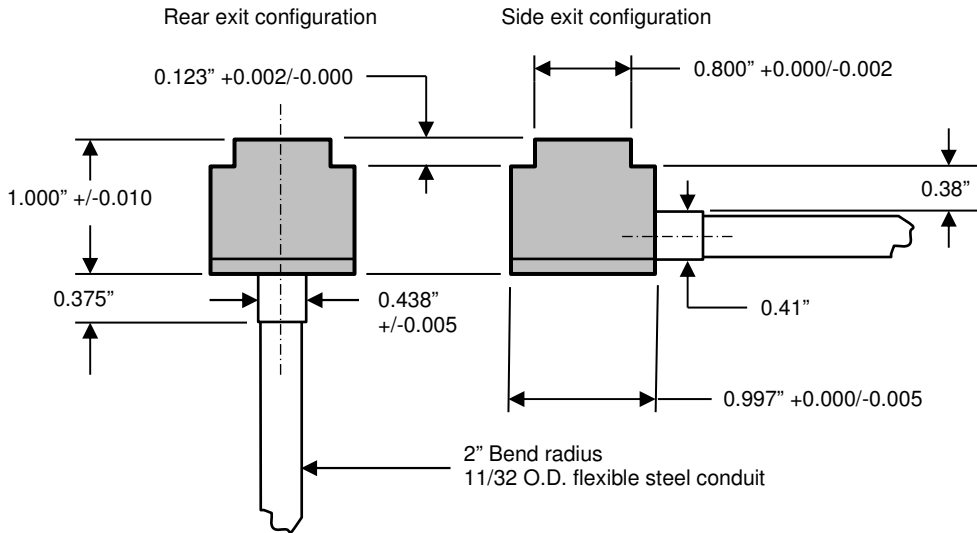


Figure 5
Nominal sensor form factors

INSTALLATION

The Carbon+Unitrode-1" is designed for optimal mounting from the rear side of a mold or platen as shown in Figure 6.

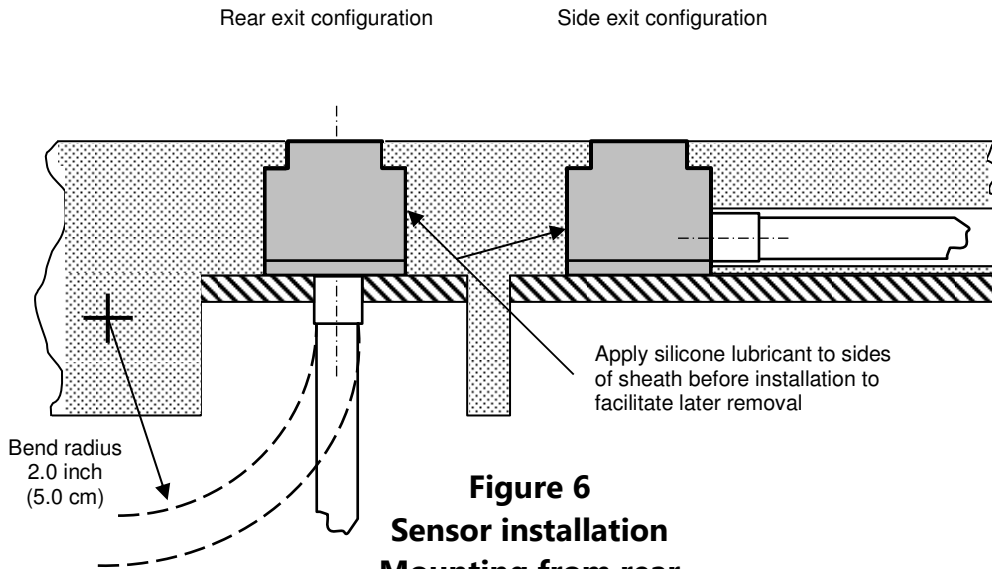


Figure 6
Sensor installation
Mounting from rear

It is important to support the bottom plate of the sensor to prevent high pressures from pushing it out of position. To facilitate removal when necessary, silicone lubricant may be applied to the side of the sheath before installation.

CARE AND HANDLING

Avoid contact with sharp objects. The insulating coating on the sensor is thin and hard, but it can be damaged by sharp objects. Scratching the coating may cause carbon fibers and fillers to short circuit the electrode and prevent good measurements.

Always apply mold release to the surface of the sensor before use with curing material. A silicone based mold-release is recommended to reduce conductive effects on the measurement. Damage to the sensor may result if mold release is not used and cured material is peeled from the surface.

Do not apply excessive tension to sensor conduit. Tugging on the conduit may damage leads to the sensor.

CLEANING

Careful use of a spatula or other scraping tool to remove samples will not damage the sensor, provided that mold release was applied to the sensor before curing.

Clean sensors with acetone, trichlorethylene or other solvent to remove oils and contaminants. Solvents or water adsorbed onto the surface of the ceramic normally will not interfere with cure monitoring because it is released at elevated temperature, and would not be present at typical process temperatures.

At room temperature, however, adsorbed solvent or water will appear as an additional conductive component and may dominate the measurement. In this case the gains in air may be elevated (less negative, approaching 0 dB at low frequencies) and phases may be significantly negative. Heating the sensor above 100 °C for a short time should remove adsorbed material.



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