



## Embedded Moisture Sensor

### General Description

The Embedded Moisture Sensor (EMS) is an indirect moisture measurement device also known as a *Duff Gauge*, *Surrogate Moisture Sensor* or *Wood Resistance Humidity Sensor*.

The EMS sensor is used to perform an indirect measurement of moisture levels in materials not compatible with standard measurement techniques, such as gypsum, concrete, masonry and insulation. The EMS sensor uses known moisture and temperature response curves of Hemlock as a baseline and is further calibrated by correlating the electrical characteristics with gravimetric measurements. Sensors are embedded in the material to be monitored to obtain the relative moisture level of the surrounding area through capillary absorption.

Sensor readings are acquired by the *WiDAQ*, a precision data acquisition device, and transmitted to the *Building Intelligence Gateway* where sensor specific temperature compensated calibration curves are applied.

Two sensor grades are available. Commercial grade sensors use published *a* and *b* calibration values for the wood species used. Research grade sensors are individually calibrated to accurately relate gravimetric moisture content with electrical moisture content. Typical sensor elements are based on Western Hemlock, a hardwood with favourable characteristics.

### Features

- The EMS is available in both block and plug styles. The cylindrical plug sensor is suitable for monitoring stone, concrete, and masonry, where drilling a hole to the appropriate depth is the most practical access. The block style is suitable when a cut-out at the correct location is feasible, for example, in rigid insulation and gypsum sheathing. Further details and custom sizes are available on request.
- Measurement capability beyond typical Relative Humidity Sensors. Typical RH sensors are limited to non-condensing moisture.
- Sensor interfaces to SMT Industrial or Mobile WiDAQ unit.
- Sealed and rugged design allows for deployment in harsh construction environments
- Integrated temperature sensor used for temperature compensation and for reporting temperature sensor data.
- Research grade EMS units are individually calibrated to produce *a* and *b* calibration constants for an accurate moisture content calculation. Formulae available upon request.

## Typical Application

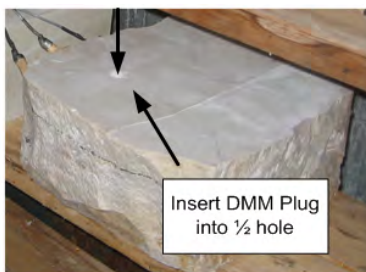


Figure 1. Installation of EMM plug

### Installation Instructions:

- Drill hole 1/2" in diameter into material
- Drill depth at least 2" so that sensor is completely enveloped by material. Additional depths are at the discretion of the user. Moisture will take longer to penetrate to the core of the sample.
- Using the dust from the drill hole to fill any spaces created around the plug .
- Seal the top of the plug with epoxy or caulking.

**Functional Specifications**
**Electrical Characteristics**

Operating Voltage	2V to 12VDC
Resistance Measurement Range	100Ω to 1GΩ
Thermistor Measurement Range	-40°C to 125°C
Thermistor part number	MF52C1104F4150
NTC Thermistor Beta Value	4150K
BiG/Analytics Sensor Config	Thermistor: MF52 (C) Moisture: Moisture (%)

**Environmental**

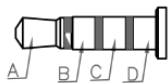
Operating Temperature	-40° to 50°C
Application Temperature	5° to 50°C
Storage Temperature	-40° to 50°C
Storage Humidity	30% to 70% RH

**Physical**

Dimensions	Plug: 38mm x Φ13mm (1.5" x Φ 0.5")
	Block: 50 x 38 x 19mm (2" x 1.5" x 0.75")
	Custom Sizes and Configs Available Upon Request
Wiring	22 AWG 4 conductor stranded (typical)

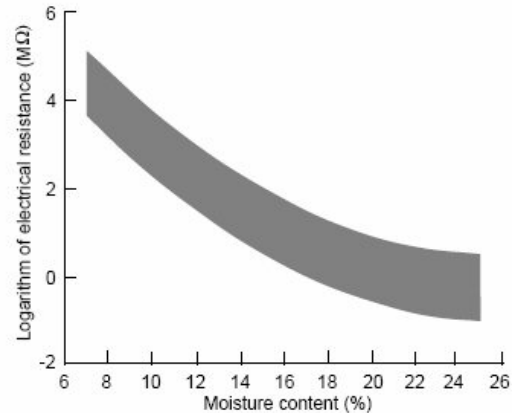
**Wire Diagram**

Wire	EMS	Audio	CAT5	Function
1	A	Red	Blue	Moisture
2	B	Black	Orange	Thermistor
3	C	Yellow	Wh/Orange	Thermistor (Com)
4	D	Green	Wh/Blue	Moisture (Com)



Scale: 2:1

Refer to documentation for leaded cable. Leaded cables are subject to change depending on the type of cable specified.

**Moisture Content Calculation**


Change in electrical resistance of wood with varying moisture content levels for most wood species; 90% of test values are represented by the shaded area.

$$MC = \left[ \frac{R_s + (0.567 - 0.0260x + 0.000051x^2)}{0.881(1.0056^x)} - b \right] + a$$

Where

- MC moisture content at 23°C
- R resistance to moisture based on above graph
- x temperature of the wood (°C), and
- a,b species correction regression coefficients

[See SMT Research moisture content notes and papers..](#)

**Ordering Information**

6' stereo cable	EMS-001 -006-02
6' leaded cable	EMS-001 -006-01
30' leaded cable	EMS-001 -030-01
Calibrated 6' stereo cable	EMS-011 -006-02
Calibrated 6' leaded cable	EMS-011 -006-01
Calibrated 30' leaded cable	EMS-011 -030-01

Specifications are subject to change without notice