

## Wireless Monitoring Systems

The cornerstones of Lignomat's wireless system is the outstanding knowledge of how to measure moisture and the experience in manufacturing top-quality moisture meters. We developed the wireless system over 20 years ago as part of our dry kiln control systems for lumber dryers and predryers. The system has proven reliable in extreme conditions of high humidity and temperatures up to 185°F.

Since then, we expanded the system to not only measure wood moisture:

- Exterior and interior temperature of materials
- Relative humidity and ambient temperature
- Dew point temperature and GPP
- In-situ RH Probes for moisture in concrete
- Wood moisture and EMC

**Data Logging:** The transmitters function like moisture meters and/or temperature measuring gauges. They are programmed to take measurements every minute and send the values instantly to the receiver. The receiver sends each complete set of transmitter values to a PC. The PC saves the values and produces graphs and logs. The PC needs to be connected by a 4-wire cable to the receiver and powered up to save measurements. It does not need to be a dedicated PC, the PC can be used for other tasks.

Data transmission from transmitters to receivers is wireless, which allows free placement of transmitters without having to handle any cables other than the short connection between probe and transmitter. The short measuring cables can be elongated.

### Receiver

The receiver collects measurements from up to 20 transmitters within its range. One receiver can obtain measurements from any combination of different transmitters. The receiver downloads all measurements to a PC via a 4-conductor cable. To extend the range for data acquisition between transmitters and receivers, receivers can be daisy-chained.

### Transmitter MC or EMC

Measures moisture in wood, drywall and other solid materials. Wood moisture readings are in percent, corrected for different wood species and the temperature of the wood. The transmitter can also be connected to Lignomats EMC station and measure the EMC of the surrounding air.

Teflon-coated PK probes or stainless steel screws are embedded in wood, drywall and other materials. A short cable connects the transmitter to the probes. Each measuring point has one transmitter for individual, accurate measurements.

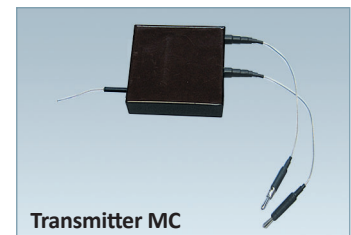
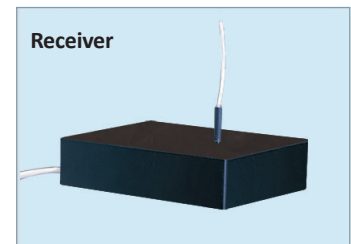
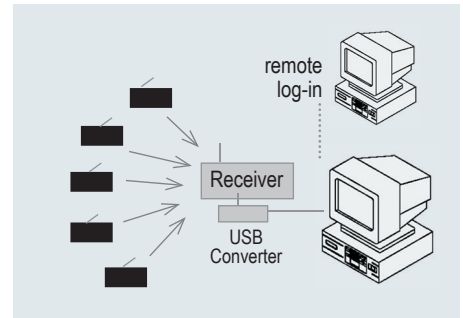
### Transmitter TE

Measures exterior and interior temperature of materials. A highly accurate stainless steel probe is used to obtain measurements. TE Transmitters are often used in the kiln industry for required documentation of heat treatment before exporting lumber (Phytosanitation Heat Treatment).

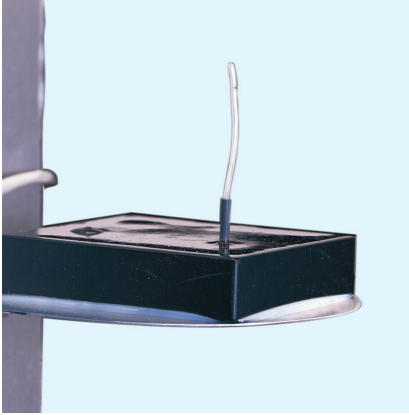
### Transmitter MC/TE

Measures moisture content and temperature with one transmitter: Uses same measuring technology and same probes as Transmitter MC and Transmitter TE.

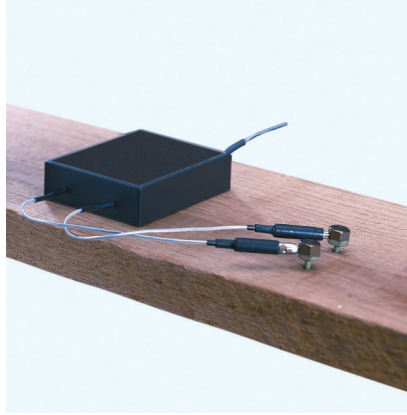
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## Wireless Monitoring Systems



Receiver mounted at wall. 4-conductor cable connects receiver to PC.



MC transmitter connected to PK probes. Cable from probes to transmitter is 10" long. Can be elongated with E-H extension cable.



EMC measuring station with transmitter sends EMC measurements directly to receiver to keep track of ambient conditions and climate in a dry kiln.

### EMC Measurements

**1.** The EMC holder with cellulose wafer is a device measuring equilibrium moisture content (EMC) directly. The wafer adapts quickly to the surrounding air and allows measurements of EMC. For example: If the EMC is 15%, any wood in the area will absorb or loose moisture until 15% has been reached. This works for ambient conditions or the climate in a dry kiln. Graph is included on page 4 showing relationship between EMC, relative humidity / temperature and drybulb-wet bulb temperatures.

### MC Measurements with PK Probes

**2.** PK Probes have been used in dry kilns to measure moisture content (MC) for over 50 years. The teflon-coated probes only measure at the tip. The probes have an enlarged head with a 4mm hole, which serves as a secure cable connection to the transmitter cable. If the 10 inches long cable between PK probes and transmitter is too short, add E-H cables to increase distance between transmitter location and probe.

### MC Measurements with EL, EG Pins and Stainless Steel Screws

**3.** To allow probing different materials at different depths, Lignomat offers EG pins 3/4" long or EL pins 7" long, which can be shortened to any length smaller than 7".

Stainless steel screws of any length can also be used. Measurements from un-insulated stainless steel screws always indicate the highest moisture value along the depth of the screws, could be the surface or the core. Teflon-coated pins measure only at the tip.

We offer LP-Hf cables with loops on one end for pins or screws and with 4 mm jacks on the other end to connect the transmitters. (Page 4)

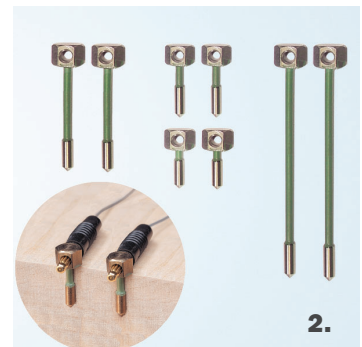
### Corrections for Wood Species and other materials

The wireless monitor software allows to enter correction factors for different wood species and other materials. We can supply the correction factors or you can enter your own. This ensures accurate moisture readings and allows the user to use the system for different materials.

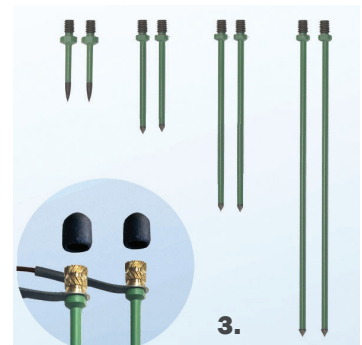
The correction factors for EMC measurements using the EMC holder and wafers are preprogrammed and the monitor gives temperature corrected true EMC values.



1.



2.

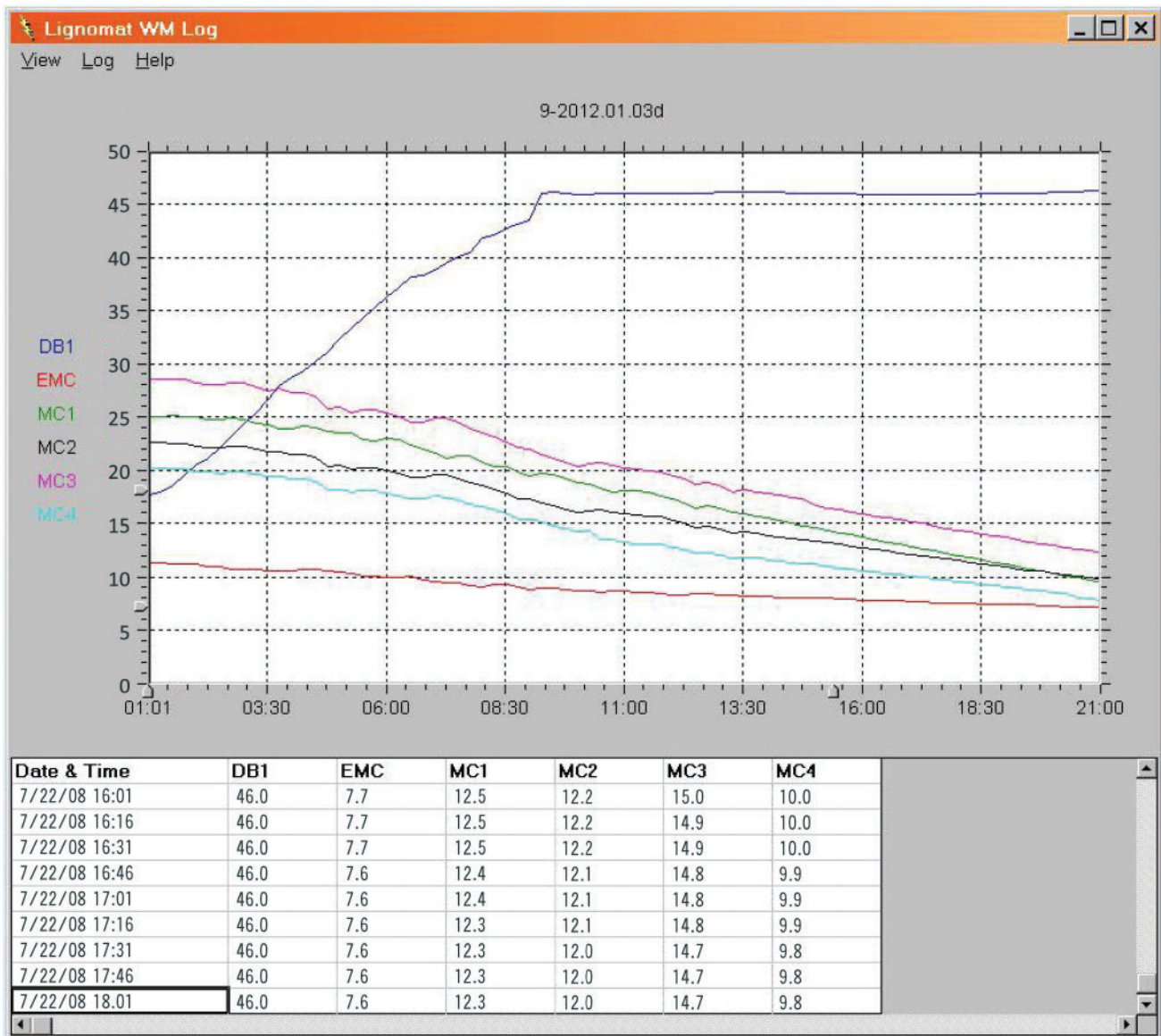


3.

## Wireless Monitor Screen Shot

Graph and log show measured values for:

Temperature (dry bulb), EMC (equilibrium moisture content) and 4 moisture probes.



### SPECIFICATIONS:

Transmitter and receiver: Size 2.75"x2.75"x 0.75". Air and watertight, totally sealed off from the environment. Rated for temperatures between -20 to 185°F.

Operating Range: Up to 1000 feet line-of-sight. If necessary receivers can be daisy-chained to extend the range of signal transmission.

Receiver: Equipped with 4-conductor cable (6ft) to USB port. cable can be ordered longer to connect receiver to PC.

Transmitters: Range for wood moisture: 2% to 99% at 70°F for wood, 0.1% to 22% for sheetrock. Equipped with 2 wires 10" long with 4mm banana plugs to make connection to PK probes or LP-Hf cable.

RH/T transmitters: Rated for temperatures between 0 to 160°F. Equipped with 3.5mm stereo jack to connect RH adapter and RH BluePeg probe.

RH BluePeg Probe: RH: +/-2% for 10 to 90%, +/-3% for 0 to 10% and above 90%  
Temp: +/-0.5°F for 32° to 120°F, 1°F between 5° to 32°F and 120° to 160°F  
Size: 1.75" long and 0.5" diameter



PK probes, EL pins, EG pins and screws  
to monitor moisture conditions with  
moisture meters, data loggers and wireless transmitters.



To connect EL and EG pins and stainless steel screws:

LP-H cable with loops and 4mm plugs connects to Ligno-VersaTec and Lignometer K via Adapter H.  
LP-Hf cable with loops and 4mm jacks connects to MC transmitter (transmitter wires have 4mm plugs).  
LP-mini-cable with loops and 2mm plugs connects to mini-Ligno DX/C, S/DC, MD/C and MC Tracker.

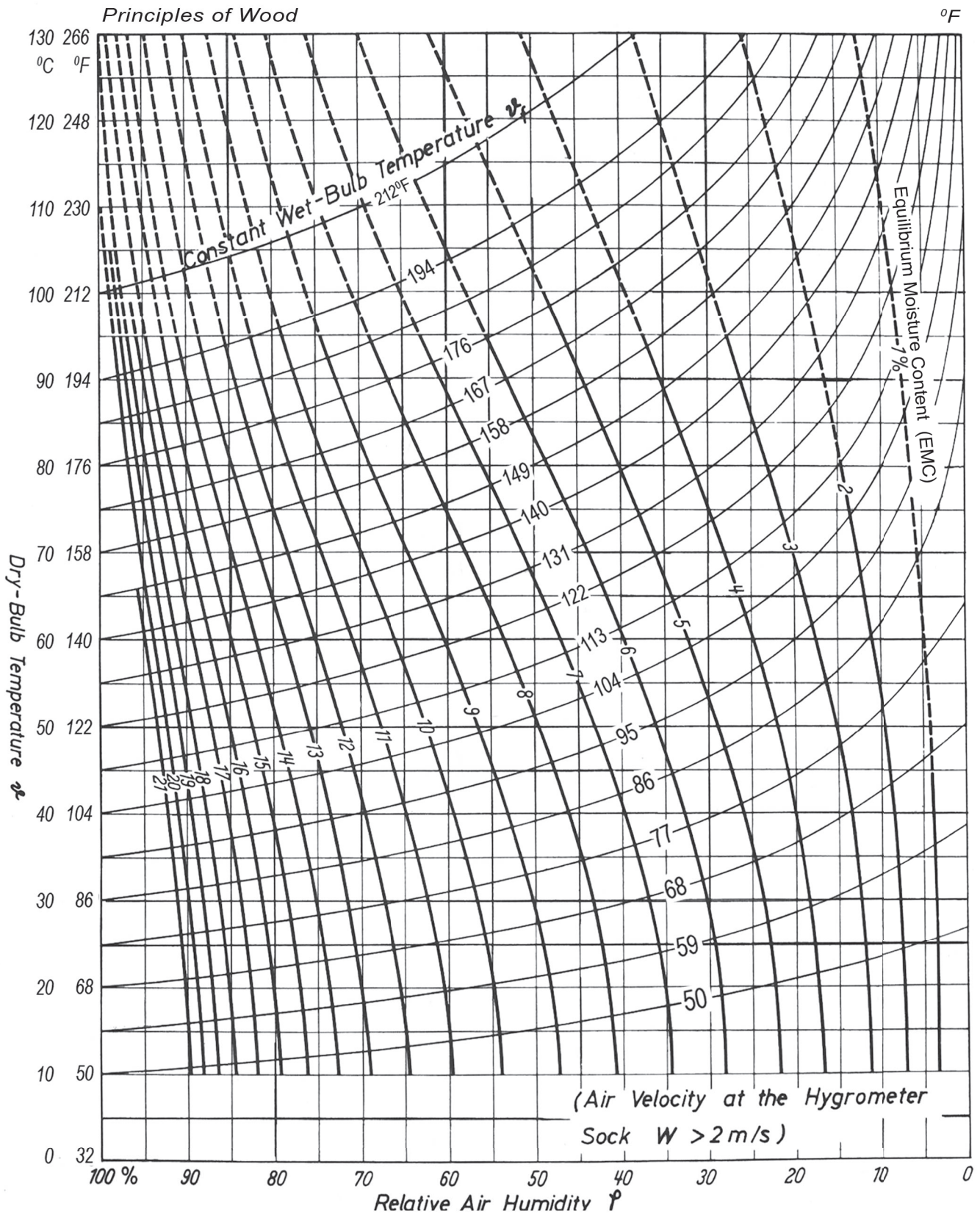
Loop nuts need to be ordered separately for EG and EL pins.

EL pins can be shortened to any length between 7" and 1/2" long.

To connect PK probes:

PK-H cable with 4mm plugs on both ends connects to Ligno-VersaTec and Lignometer K via Adapter H  
PK-mini cable with 4mm and 2mm plugs connects to mini-Ligno DX/C, S/DC, MD/C and MC Tracker.

# EMC Graph: Wet - Dry - Bulb - RH - EMC - MC (°F)



Equilibrium moisture content of wood (EMC) according to R. Keylwerth and data from the U.S Forest Products Laboratory in Madison, Wisconsin 1951.

Example: When the dry-bulb temperature is 95°F and the relative humidity is 45%, then the corresponding wet-bulb temperature is 77°F and the equilibrium moisture content (EMC) is 8%.

## EMC: Relative Humidity and Wood Moisture Content

From the US Dept. of Agriculture Wood Handbook, "Wood as an Engineering Material"  
Humidity recommendations range from **30% – 50%** in a building.

Temperature recommendations range from **60°F – 80°F** in a building.

If ambient conditions stay within these recommendations, the moisture content of wood stays between 6% and 9% and the amount of expansion and contraction of wood is limited.

Examples:

- (1) Lumber at 7.7% will not change its moisture content if kept at 40% relative humidity and a temperature of 70°F.
- (2) Conditions in a warehouse are 60% relative humidity at 50°F. If dry wood is left in the warehouse for an extended period of time, the wood will pick up moisture until a moisture content of 11.2% is reached, regardless of wood species and initial moisture content.

**EMC Table**

T		Relative Humidity																		
°C	°F	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
-1	30	1.4	2.6	3.7	4.6	5.5	6.3	7.1	7.8	8.7	9.5	10.4	11.3	12.4	13.5	14.9	16.5	18.5	21.0	24.3
4	40	1.4	2.6	3.7	4.6	5.5	6.3	7.1	7.8	8.7	9.5	10.4	11.3	12.4	13.5	14.9	16.5	18.5	21.0	24.3
10	50	1.4	2.6	3.6	4.6	5.5	6.3	7.1	7.9	8.7	9.5	10.3	11.2	12.3	13.4	14.8	16.4	18.4	20.9	24.3
16	60	1.3	2.5	3.6	4.6	5.4	6.2	7.0	7.8	8.6	9.4	10.2	11.1	12.1	13.3	14.6	16.2	18.2	20.7	24.1
21	70	1.3	2.5	3.5	4.5	5.4	6.2	6.9	7.7	8.5	9.2	10.1	11.0	12.0	13.1	14.4	16.0	17.9	20.5	23.9
27	80	1.3	2.4	3.5	4.4	5.3	6.1	6.8	7.6	8.3	9.1	9.6	10.8	11.7	12.9	14.2	15.7	17.7	20.2	23.6
32	90	1.2	2.3	3.4	4.3	5.1	5.9	6.7	7.4	8.1	8.9	9.7	10.5	11.5	12.6	13.9	15.4	17.3	19.8	23.3
38	100	1.2	2.3	3.3	4.2	5.0	5.8	6.5	7.2	7.9	8.7	9.5	10.3	11.2	12.3	13.6	15.1	17.0	19.5	22.9
43	110	1.1	2.2	3.2	4.0	4.9	5.6	6.3	7.0	7.7	8.5	9.2	10.0	11.0	12.0	13.2	14.7	16.6	19.1	22.5
49	120	1.1	2.1	3.0	3.9	4.7	5.4	6.1	6.8	7.5	8.2	8.9	9.8	10.7	11.7	12.9	14.4	16.2	18.6	22.0

The values shown in the table above represent moisture content of wood in %

