Dew point monitor design

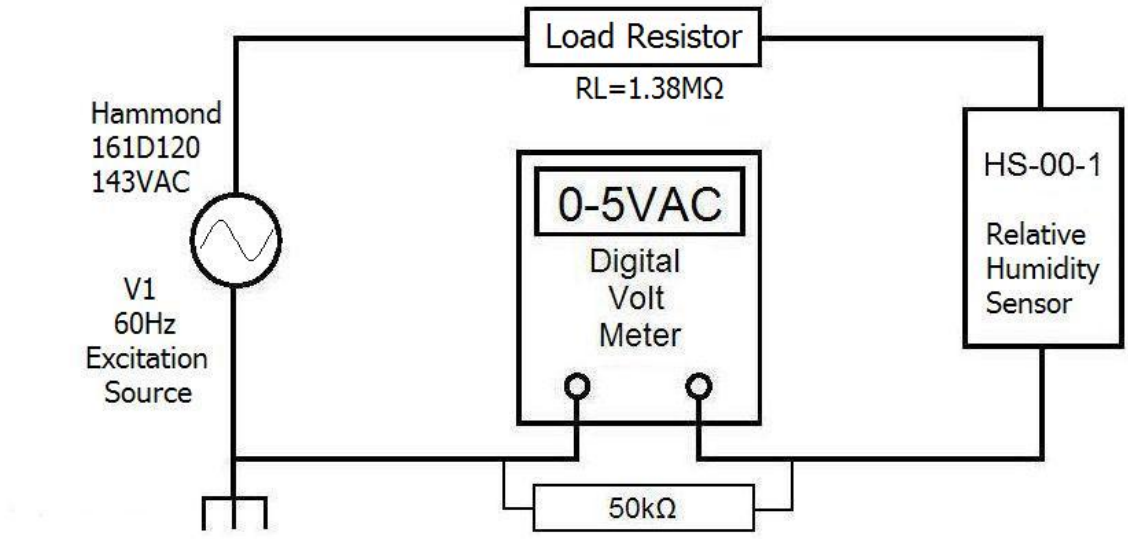
Monitoring of transmission line pressure is standard at most broadcast transmitter sites. Unfortunately pressure alone does not ensure transmission line dehydrators are operating properly. Keeping transmission lines dry is perhaps the most important antenna related preventive maintenance item we can perform on the ground. Sending wet air up the tower is a guarantee of trouble, especially at high power multiple carrier sites. Transmission line air should always be better than -40C dew point, although in some places even this may be inadequate and -50C dew point required. We need a way to confirm dehydrator operation.

I've seen several antenna and cable failures that could be directly attributed to moisture. There were even splitter cables that needed to be disconnected for water to pour out! Had the dehydrator been monitored the failures may have been avoided. Detecting a single dehydrator failure could save several thousand dollars in repair expense and eliminate long outages.

Many dehydrators use indicating silica gel beads to display proper operation. The beads will gradually change color from blue to violet at about 10%RH and then to pink and eventually white at about 50%RH. The dew point for 10%RH is about -10C. At high power even this amount of moisture can cause excessive RF leakage. By the time a gradual color change is noticed the lines will be filled with wet air.

A dew point monitor is easy to construct. Parts cost is less than $100. I've assembled two dew point monitors using model HS-00-1 Dunmore sensors supplied by Ohmic Instruments. This sensor is designed to measure as low as 0.5%RH or dew point about -40C at 21C sample air temperature. The manufacturer says the sensor becomes unstable below this point and measurements are unpredictable.

A voltage measurement is taken with a digital multimeter and a lookup table indicates the dew point. It is the ultimate KISS dew point monitor, and should rival any other in terms of sensitivity.



Caution: The sensor must be used with AC only. DC current will permanently damage the sensor. Never measure its resistance with a multimeter!

The dew point monitor can have a long response time for measuring dry air. It can take up to 30 minutes for a saturated sensor to stabilize and provide accurate readings. Do not compare readings from two dew point monitors if both start with wet sensors. The drying time of the sensors will vary and give conflicting readings, especially if they use different range sensing elements. Going the other way, the sensor is quite rapid to detect moisture.

Warren Stone VO1KS@eastlink.ca 4 May 2011

Sensor voltage to dew point conversion

VAC	DPºC	VAC	DPºC	VAC	DPºC
0.150	<-40	2.00	-35	4.00	-28
0.625	-40	2.50	-33	4.50	-25
1.00	-38	3.00	-32	4.80	-21
1.50	-36	3.50	-30	4.90	-18

The 0.150VAC reading is the sensor's lowest measured value. Calculated dew point at this voltage is -45C but sensor instability limits certainty below -40C. Some further reduction in sensor voltage may be seen if the AC input voltage fluctuates slightly.

Parts list

Ohmic Instruments humidity sensor HS-00-1	$31.50
3/4" Tee connector 022T-12-12	$22.31
2x 3/8" NPT male to 3/8" compression fitting 68C-06-06 2x $2.53	$5.06
3x 3/4" NPT male to 3/8"NPT female reducer 209P-12-06 3x $2.59	$7.77
3/8" NPT dome connector RD09NA	$1.51
Slide on pin connectors	
Single pair shielded wire	
XLR3-M connector	
Hammond case 1141H	$7.32
Hammond transformer 161D120	$6.26
XLR3-F chassis mount connector	
BNC chassis connector	
3/8" NPT dome connector RD09NA $1.51, nut NN09BK $0.36	$1.87
1.6Mohm, 10Mohm, 100kohm resistors	
Heat shrink tubing, various sizes	
Single pair shielded wire	
AC power cord	
Total	$83.60

Complete dew point monitor

The sensor fits inside the large Tee fitting and plugs into the transformer box via a XLR connector. The voltmeter connects via a BNC connector and coaxial cable. The picture is from an early 0-100mVAC prototype.

The Ohmic Instruments HS-00-1 sensor specification sheet is available at their web page.
http://ohmicinstruments.com

Using a Hygrodynamics 1205-2 relative humidity sensor, the following table can be used
Sensor voltage to dew point conversion (assuming 80F sample air)

VAC	DPºC	VAC	DPºC	VAC	DPºC
0.10	-41.8	1.0	-22.6	3.0	-19.8
0.20	-30.8	1.5	-22.1	3.5	-18.8
0.30	-28.3	2.0	-21.7	4.0	-16.0
0.40	-25.6	2.5	-20.9	4.5	-13.5
0.50	-24.0				

A more detailed explanation is available on my personal web page.
http://members.rennlist.org/warren/RelativeHumidityAndDehydrators.pdf