

# HK - 1 Microwave Transmitter for Measuring the Moisture in Coal

## SIGNIFICANT IMPROVEMENTS HAVE BEEN MADE TO MEASURE THE MOISTURE OF COAL IN REAL TIME

The HK-1 Microwave Transmitter for measuring the Moisture in Coal is a continuous measuring system that allows for a rapid and accurate measurement. Due to an innovative concept and its simplicity of use, the HK1 will revolutionize the Real Time Measurement of Moisture in Coal. The ability to quickly collect samples and perform a real time calibration makes the calibration process quicker than ever.

### Application Example



- **COAL ON A CONVEYOR BELT**

*Measure the Moisture of Coal on a Belt*

For Bulk Density Compensation, you can now use -

- A Mechanical Belt Scale
- A Gamma Gauge
- A Height Measurement

### Application Example



- **COAL IN A CHUTE**

*Measure the Moisture of Coal in a Chute*

For Bulk Density Compensation, you can now use -

- A Gamma Gauge

FOR MORE INFORMATION PLEASE CALL

HK INSTRUMENT SYSTEMS

PHONE: (412) 653 - 7717

# Technical Specifications:

Measurement Method:	Microwave Phase Shift method
Measurement Range:	0 to 100% Moisture
Repeatability:	+/- 0.1% Moisture
System Size:	4" to 12" bed depth
Signal output 1:	0/4 – 20 mA; isolated; self powered; max. load 500 ohms. Product % H2O
Signal output 2:	0/4 – 20 mA; isolated; self powered; max. load 500 ohms. % H2O or Temperature
Signal input:	PT100 RTD (2-wire connection. Max cable length 150 ft.)
Current input:	0/4 – 20 mA, non isolated, Max load 125 ohms, for Compensation
RS 232 out:	4800, 9600 Baud

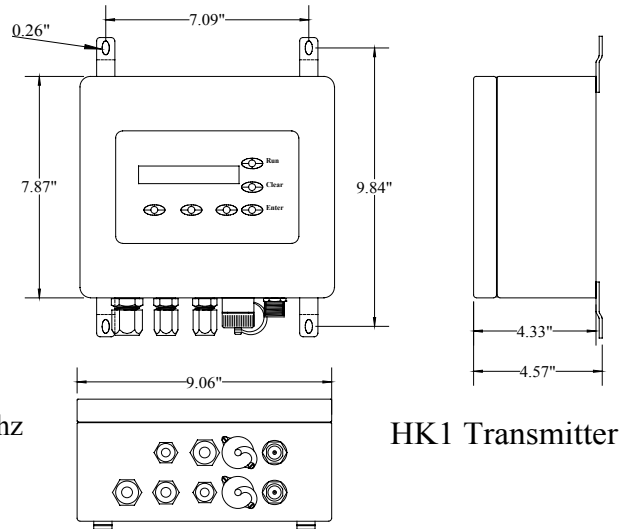
## System Components:

- Microwave Transmitter
- Remote Keypad (Optional)
- Coaxial Cables (39 inches max.)
- Microwave Spiral Horn Antenna (Pair)
- 2-Wire RTD

## Transmitter Specifications:

Voltage:	115 / 230 VAC
Power:	approx. 50VA
System:	Microprocessor with non-volatile memory
Display:	2 X 24 alphanumeric LCD
Housing:	Epoxy coated Aluminum
	NEMA 4, IP 65
Weight:	10 lbs.

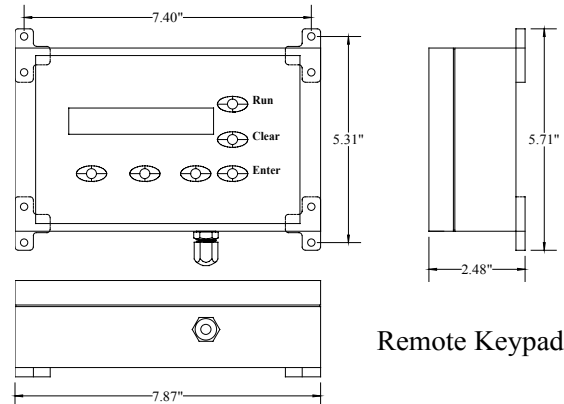
Operating temperature:	0 °C to 50 °C
Storage temperature:	-40 °C to 85 °C
Microwave frequency:	ISM – Band; Multi or 2.45 Ghz
Maximum Power:	0 dBm, 1 mW
Sensitivity:	-80 dBm, 10 nW
Noise immunity:	IEC 801, part 1-5
Radiation:	VDE 0871 Class B
Instrument Safety:	IEC 1010-1



HK1 Transmitter

## Remote Read-out Unit Specifications:

Housing:	FRP Plastic NEMA 4, IP65
Weight:	2 lbs.
Cable length:	max. 200 ft.



Remote Keypad

# HK INSTRUMENT SYSTEMS

IRWIN, PENNSYLVANIA

---

**INDUSTRIES:** MINING, POWER PRODUCTION, & FOOD PRODUCTION

**APPLICATION:** MEASURING THE AMOUNT OF MOISTURE IN A BULK MATERIAL BEING TRANSPORTED ON A BELT OR IN A CHUTE. COAL, BAUXITE, AND CORN WOULD BE EXAMPLES OF TYPICAL BULK MATERIALS.

**INSTALLATION:** THE MICROWAVE HORN ANTENNAE CAN BE INSTALLED AS NON-CONTACTING SENSORS ON A BELT OR ON A CHUTE. THERE IS AN ANTENNA ON ONE SIDE OF THE MATERIAL AND ONE ON THE OTHER.

THE COMPLETE MICROWAVE SYSTEM WILL BE COMPRISED OF TWO HORN ANTENNA, TWO COAXIAL CABLES, AND A MICROWAVE TRANSMITTER.

WHEN BULK DENSITY COMPENSATION IS REQUIRED, AN ANALYSIS OF POSSIBLE TECHNIQUES FOR COMPENSATION WILL BE ANALYZED.

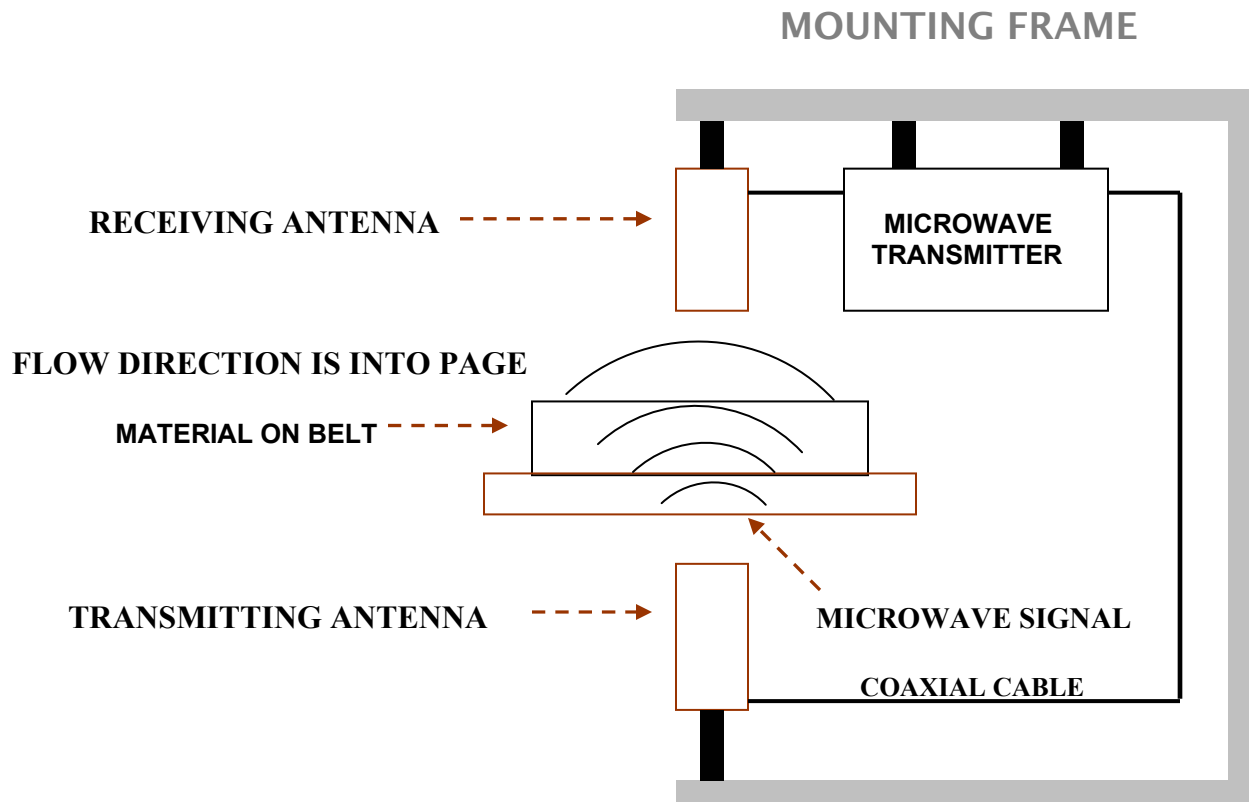
**VALIDATION:** THE STANDARD TEST METHOD WHICH IS USED BY LABS TO DETERMINE THE % MOISTURE OF A BULK MATERIAL IS LOSS OF WEIGHT BY DRYING. AN OVEN OR A SIMILAR DEVICE IS USED TO DRY THE SAMPLE. THE AMOUNT OF WEIGHT LOSS WILL BE USED TO DETERMINE THE SAMPLE'S MOISTURE CONTENT.

**RESULTS:** CORRELATION BETWEEN LAB VALUES AND MICROWAVE READINGS IS VERY GOOD IF THE BULK DENSITY IS CONSTANT. CORRELATION IS ALSO VERY GOOD IF CHANGES IN THE BULK DENSITY CAN BE ACCURATELY COMPENSATED FOR.

## **CONCLUSIONS:**

1. THE HK-1 MICROWAVE INSTRUMENT SYSTEM WILL ACCURATELY MEASURE AND CONTROL THE % MOISTURE OF MANY BULK MATERIALS BEING TRANSPORTED ON A BELT OR IN A CHUTE. IT IS CRUCIAL TO CONTROL AMBIENT CONDITIONS AND MEASUREMENT CONDITIONS AS MUCH AS POSSIBLE. THIS MAY REQUIRE A TEMPERATURE CONTROLLED NEMA BOX, OR A LEVELING SYSTEM TO HOLD THE LEVEL OF THE MATERIAL ON THE BELT CONSTANT.
2. FOR A HIGH DEGREE OF ACCURACY:
  - A. LOADING ON THE BELT OR IN THE CHUTE MUST BE CONSTANT. THIS REQUIRES A CONSTANT HEIGHT OF THE MATERIAL ON THE BELT, A FULL CHUTE AND RELATIVELY CONSTANT PARTICLE SIZE.
  - B. PROCESS CONDITIONS MUST BE STABLE. WHEN THE APPLICATION IS A BATCH PROCESS, BATCH RUNS MUST BE LONG ENOUGH TO STABILIZE PROCESS CONDITIONS.
  - C. AMBIENT CONDITIONS MUST BE CONTROLLED. INSTALLATIONS WITH LARGE AMBIENT TEMPERATURE VARIATIONS MUST HAVE A CONTROLLED ENCLOSURE.

## DRAWING OF BELT INSTALLATION FOR HORN ANTENNA SYSTEM



### DESCRIPTION:

1. THE MATERIAL WHICH IS FLOWING ON A BELT PASSES BETWEEN TWO MICROWAVE ANTENNAE WHICH ARE MOUNTED ON A FRAME AND CONNECTED TO A MICROWAVE TRANSMITTER WITH COAXIAL CABLES.
2. THE MICROWAVE TRANSMITTER GENERATES A MICROWAVE SIGNAL. IT TRAVELS TO THE TRANSMITTING ANTENNA OVER A COAXIAL CABLE.
3. THE TRANSMITTING ANTENNA SENDS A SIGNAL WHICH TRAVELS IN AIR, THROUGH THE MATERIAL, IN AIR AND TO THE RECEIVING ANTENNA.
4. THE RECEIVING ANTENNA MEASURES THE SIGNAL AND SENDS IT TO MICROWAVE TRANSMITTER WHERE IT IS ANALYZED.
5. CHANGES IN THE MICROWAVE SIGNAL ARE USED TO CALCULATE MOISTURE CONTENT (% H<sub>2</sub>O).

# HK INSTRUMENT SYSTEMS

PITTSBURGH, PA

## INDUSTRY: POWER AND MINING

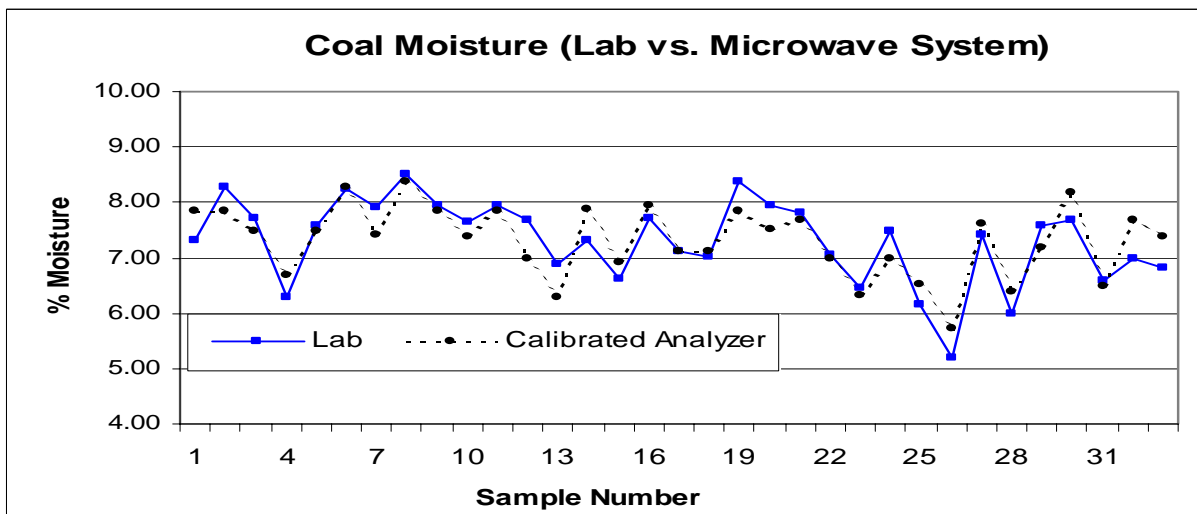
---

**APPLICATION:** TO MEASURE THE AMOUNT OF MOISTURE IN COAL ON A BELT OR IN A CHUTE.

**INSTALLATION:** THE HK-1 MICROWAVE INSTRUMENT SYSTEM WAS INSTALLED ON A BELT CARRYING COAL FROM A PREPERATION PLANT TO A BARGE LOAD OUT. THIS IS AN ACROSS THE BELT MEASUREMENT WITH BULK DENSITY COMPENSATION.

**TESTING:** SAMPLES WERE COLLECTED FROM THE BELT WITH A MECHANICAL SAMPLER. EACH SAMPLE REPRESENTED THE COAL FOR A ONE HOUR PERIOD. READINGS FROM THE MOISTURE SYSTEM WERE COLLECTED FOR AN HOUR AND AVERAGED.

**RESULTS:** CORRELATION BETWEEN THE LAB VALUES OF %H<sub>2</sub>O AND THE HK-1 MICROWAVE INSTRUMENT READINGS OF %H<sub>2</sub>O IS EXCELLENT. THERE IS NEVER MORE THAN 0.5% DIFFERENCE BETWEEN THE LAB AND THE HK-1 METER.



**CONCLUSIONS:** THE HK-1 MICROWAVE INSTRUMENT SYSTEM IS AN EXCELLENT TOOL THAT CAN BE USED TO MONITOR AND CONTROL THE AMOUNT OF MOISTURE IN COAL. THIS SYSTEM CAN BE INSTALLED ACROSS A BELT OR ACROSS A CHUTE.

THE BEST APPLICATIONS ARE ONES WHICH CONTROL THE BULK DENSITY OF THE COAL ON A BELT OR IN A CHUTE.

EXPECTED ACCURACY AT TWO SIGMA:

CRUSHED COAL -	+/- 0.5%
RAW COAL (EVERYTHING BELOW 2" DIAMETER)	+/- 0.7%
RAW COAL (RANDOM SIZES, BIG TO SMALL)	+/-1.0%