



REF: RF Thermometer FCC Submission

1) RF Thermometer Overview:

The Headwaters RF Thermometer is a portable 3-channel 315 MHz telemetry system for remote indoor / outdoor temperature monitoring over short distances, typically 50 to 250 feet. The product consists of two components. A Temperature and Humidity Receiver that takes received information and shows it on a display. A Temperature and/or Humidity Sensor Transmitter Unit. Up to three transmitter units can be used with a single Receiver.

2) Remote Sensor / TRANSMITTER:

The remote sensor / transmitter is the unit consisting of the 315 MHz RF oscillator PCB and the temperature/humidity sensing OKI 64162 microcontroller PCB. The unit transmits 984 millisecond data packets on a schedule of approximately once per minute, with no less than 30 seconds between transmissions. The average duty cycle of any 100 milli-second portion of the transmission does not exceed 28 percent, permitting an increase in the peak output power from the transmitter. The sensor / transmitter is designed to function over a temperature range of -40 C to + 50 C. The measurement accuracy is specified as + / - 1.0 C or better over -40 C to +50 C range with a displayed resolution of 0.1 C. For best performance of transmitter in cold temperatures lithium cells may be used instead of 1.5 Volt alkaline cells. The unit will operate for at least 1 year on two 1.5 Volt AA lithium cells.

The RF oscillator is SAW resonator, stabilized, using a one-transistor Colpitts configuration. A wire antenna is connected to the PCB. The oscillator is turned ON by applying +3 volts to the data input (transistor base) from a CMOS output pin of the 64162 microcontroller. The microcontroller performs the functions of measuring temperature/humidity, displaying the temperature/humidity on a liquid crystal display, checking battery voltage, sensing the channel ID settings, and sending the data to the transmitter at the appropriate times. The 64162 uses a 32768 Hertz quartz watch crystal for the clock generator. A thermistor is used for temperature sensing. A humidity sensor is used for humidity data.

The 984 millisecond transmission consists of a preamble and sync, followed by an 8 bit channel ID, a 3-bit setup word and 2 identical 16-bit temperature/humidity words. Each bit consists of a single 4.576 millisecond RF pulse and 3 x 4.576 milliseconds of no RF (giving a 25% duty cycle for the overall data stream). A Manchester-like encoding technique is used where 1's and 0's are defined by the position of the RF pulses.

2a) RF Oscillator PCB:

Supply voltage = 3 volts from (2) AA 1.5 volt cells

Supply current = approximately 2.3 milliamps, while keyed ON

On/off keying (OOK) modulation with 315 MHz carrier.

R.F. field strength, accounting for pulsed duty cycle, averaged over a 100 mS window will be a maximum of 78.7 microvolts/metre @ 3 metres (11 dB higher than for an unmodulated continuous wave carrier) as per F.C.C. regulations.

Keying rate 54.6 bits/second .

Harmonic levels sufficiently low to comply with F.C.C. regulations..

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2b) Microcontroller PCB:

This board uses an OKI 64162 mask-programmed single chip CMOS 4-bit microcontroller, with a supply voltage of 3 volts, a 32768 Hz clock frequency (quartz watch crystal) and a 400kHz higher speed RC clock. The typical microcontroller supply current is 15 microamperes. A negative temperature coefficient thermistor is used for temperature sensing. The 64162A TO pin (transmit out) goes from ground to + 3 volts to activate the 315 MHz oscillator.

Other Details:

The battery low detect function (internal to OKIMSM64162) is used to set a flag in the transmission if the batteries become weak . The low battery condition is shown on Transmitter display.

The micro-controller initiates data transmissions at intervals (greater than 30 and less than 60 seconds). The connections between the transmitter and the OKIMSM64162 are +3 V, GROUND and DATA.

2c) Transmitter Antenna:

This is a 15 inch linear wire with a protective covering.

2d) Transmitter Probe:

This is a minimum 45 inch two lead wire with potted thermistor at end.

Transmitter User Inputs:

Channel Select switch - to select between 3 distinct data ID codes (channels).

Degrees C/Degrees F switch – changes the display of temperature information

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