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Smart Wireless THUM™ Adapter
Model 775
Theory of Operation

The model 775 Smart Wireless THUM™ adapter is typically connected to a field instrument that is monitoring a process variable. A wiring diagram for the model 775 connected to field instrument (pressure transducer) is shown in Figure 1. The THUM has 2 wires for power, and 2 wires for communicating via wired HART protocol with a field instrument. The operating current for the THUM is determined by the field instrument, which is typically a 4 – 20 mA device. The THUM regulates the voltage across its power terminals (+ Loop and – Loop) to vary from 2.5 v to 1.0 v as the current in the loop varies from 4 to 20 mA.

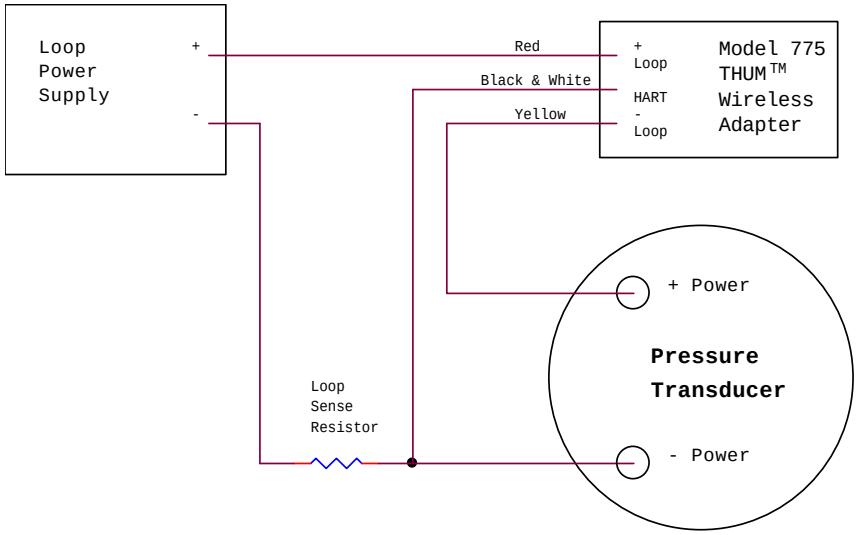

Figure 1. Wiring diagram for model 775 and field instrument

A block diagram for the THUM electronics is shown in Figure 2. It shows a redundant loop current path, which ensures that the field instrument will have a path for its 4 – 20 mA loop current even if the THUM electronics fail and discontinue functioning. The DC/DC converter (regulator) converts the voltage on the THUM power terminals to a fixed voltage of 2.3 volts for

powering the various THUM circuits. Op amp U2 senses the 4 – 20 mA current flowing through Rs and adjusts the voltage at the variable voltage network accordingly. This results in the voltage from + Loop to – Loop varying as the loop current varies. Op amp U1 works in conjunction with this 2.3 v DC/DC converter, Vref, transistor Q1, and the voltage clamp/current shunt to regulate the voltage on the power terminals to the appropriate voltage.

The LDO takes the 2.3 v input from the DC/DC converter (regulator) and provides a 2.0 v output to provide power to the microcontroller, memory, and HART communications circuits. The brownout detect circuit signals the microcontroller as to whether or not there is ample power to enable writing to the flash and nonvolatile memory (FRAM). The reset circuit monitors the output of the 2.0 v LDO to ensure that the microcontroller does not attempt to operate unless it has ample power supply voltage.

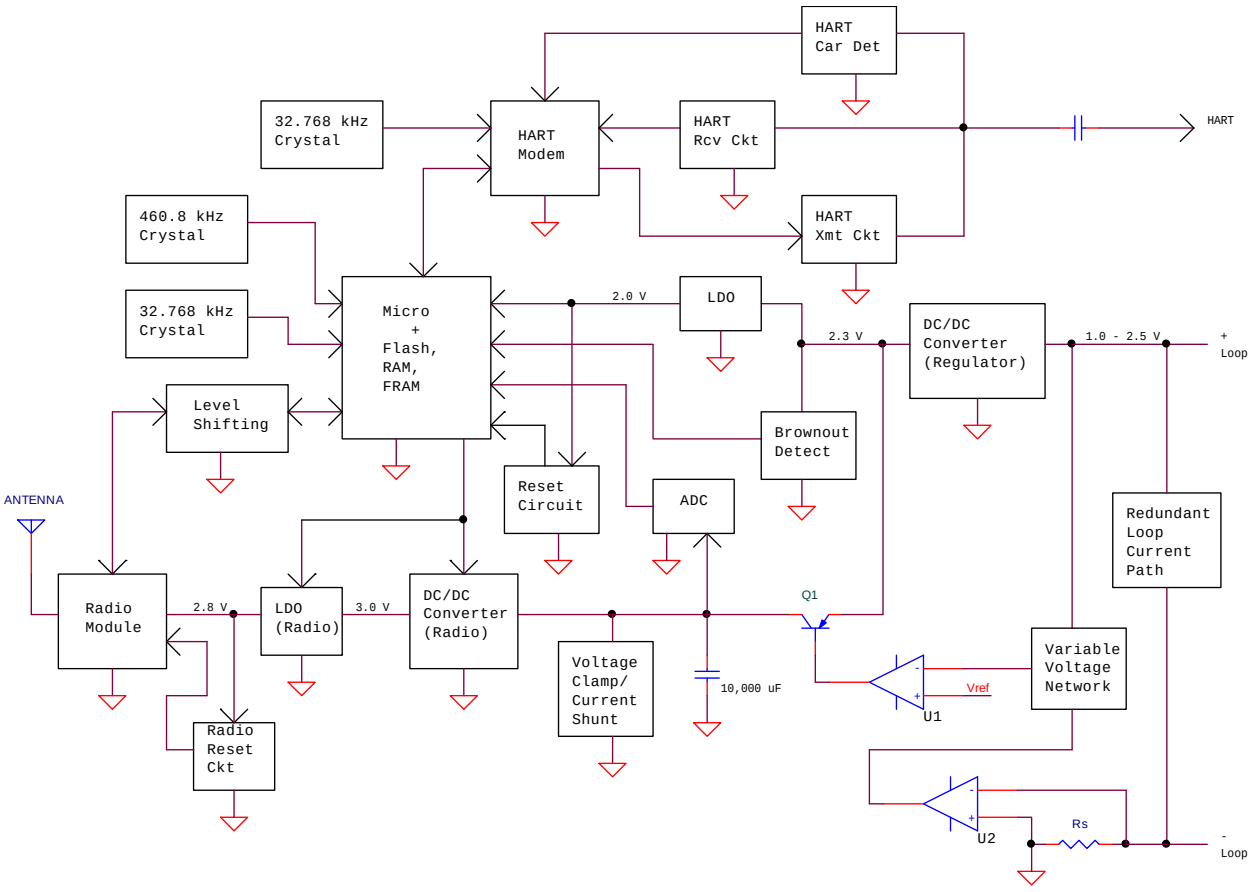

Figure 2. Electrical block diagram for model 775.

An analog to digital converter (ADC) monitors the voltage on a large electrolytic capacitor (10,000 uF) to ensure that power to the radio is not enabled unless there is ample charge on the capacitor. A voltage clamp/current shunt ensures that the voltage on the large capacitor is clamped to a reasonable voltage level, and provides an alternate path for shunt current once the capacitor is fully charged.

Power for the radio is provided off the large electrolytic capacitor. It is first stepped up to 3.0 v by a DC/DC converter (radio). This DC/DC converter is followed by the LDO (radio), which regulates this 3.0 v to 2.8 v while reducing the ac noise on the voltage supply. The LDO (radio) powers the radio with this 2.8 v. A radio reset circuit monitors the LDO (radio) output voltage and ensures that the radio does not attempt to operate unless there is adequate voltage on this supply. The interface logic signals between the microcontroller and the radio must be level shifted, since they operate off different power supply voltages.

The communications between the THUM and the field instrument occurs via the wired HART communications protocol. To support this communication the THUM has a HART modem, as well as analog transmit (HART Xmt Ckt), receive (HART Rcv Ckt) , and carrier detect (HART Car Det) circuits.

There are several crystals in the THUM electronics to provide clocks for various circuits. The HART modem operates off a 32.768 kHz crystal. The microcontroller for the THUM operates off both a 32.7678 kHz crystal and a 460.8 kHz crystal. Additionally, the radio contains internal clock generation circuits to produce the 2.45 GHz (nominal) transmit signal, and to facilitate receiving 2.45 GHz (nominal) signals.