Product Overview

The Ti400 Series of Thermal Imagers are handheld imaging products that can detect infrared radiation (IR). The primary use is for preventive maintenance and diagnosing problems in industrial environments. These products are not intended for sale to consumers. The series has three versions labeled Ti400, Ti300, and Ti200.

The versions use the same common IR camera body assembly (Fluke part number 4340874). This IR camera body is shown in Figure 1. Other than the model numbers, the electronics, mechanical components, layout, bill of materials, assembly procedures, and test processes are the exactly same for the three versions.   The versions are configured through software flags in the flash RAM at the end of the production line to match the customer's order.

The differences between the versions are the following:

IR Resolution:
Ti400 provides 320 x 240 IR pixel resolution, Ti300 provides 240 x 180 IR pixel resolution, and Ti200 provides 200 x 150 IR pixel resolution. The same 320x240 IR Sensor is used in all three versions. Embedded software within the IR Camera decimates the 320x240 IR image to achieve 200x150 and 240x180 resolutions.

Thermal Sensitivity:
The thermal sensitivity is the minimal temperature difference that the thermal camera can detect. Ti400 and Ti300 can detect down to 0.05 °C temperature difference. Ti200 can detect down to 0.075 °C temperature difference. The native thermal sensitivity of the IR Camera is 0.050 °C. Embedded software within the IR Camera reduces the thermal sensitivity for the Ti200 version.

The IR Camera body of the thermal imager contains the following radios:
- 802.11b/g (WLAN)
- Bluetooth
- 802.15.4 (Communicates with other Fluke-made devices having a Fluke proprietary 802.15.4 type radio)

The radios are contained on the main processing circuit board (Fluke PN 4106556) .

Radio Theory of Operation
The Fluke Ti200/300/400 Thermal imagers support three radio standards: 802.15.4, 802.11 b/g and Bluetooth, all operating on the 2540MHz ISM band. The three transceivers share an antenna and matching network. The system processor controlled RF switch selects which radios are connected to the antenna. The radios operate in one of two modes:

1. 802.15.4 enabled, WiFi and Bluetooth both disabled.
2. WiFi and Bluetooth both enabled, 802.15.4 disabled. The antenna used is a 2.45GHz Ceramic Chip Antenna with a peak gain of 1.5dBi. The thermal imager, including the radios, will automatically cease operation and thus communication once battery capacity reaches a specified minimum threshold.

802.15.4:
A Texas Instruments CC2530F256 IC, wireless transceiver radio is used to communicate with other compatible wireless products. The transceiver is short range and low power, with a physical layer compliant to IEEE 802.15.4 . The packet structure incorporates a point to point proprietary method.

The radio IC has an RF core that controls the internal transceiver (RF transmit and receive) segments.   In addition, it provides an interface between an internal 8051 MCU and the radio circuits. This makes it possible to issue commands, read status, and automate and sequence radio events.

The radio IC transceivers include a low noise amplifier, software controlled power amplifier, onboard RF transmit/receive, phase lock loop with internal voltage controlled oscillator, in-IC power supply regulation, and full spread-spectrum encoding and decoding. The radio IC is programmable in 1-MHz steps with 5.0 MHz channel spacing per the 802.15.4 standard. The radio IC also includes a packet-filtering and address-recognition capability. All radio settings and protocols are programmed at manufacturing and cannot be modified by a user. A SPI port is provided to communicate to an external CPU for receive (RX) and transmit (TX) data transfer and control.

The radio must first be initialized by the internal MCU before the transceivers are able to communicate with other products. The range of these transceivers is specified at 30ft but under ideal conditions my reach 100 ft. There are no additional peripheral devices supported or required at this time.
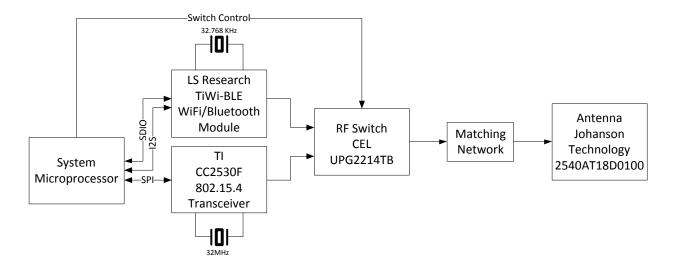
WLAN and Bluetooth:
An LS Research TiWI-BLE integrated radio module is used to provide both WLAN 802.11b/g and Bluetooth 2.1+BLE support. The TiWi module is based on the Texas Instruments WL1271L transceiver, and also includes power regulators, control circuitry, RF switch, and output power amplifiers for both WLAN and Bluetooth operation.

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For WLAN operation an SDIO port is provided to communicate to the system CPU for receive (RX) and transmit (TX) data transfer and control. For Bluetooth operation an I2S port is provided for data transfer and control. An additional serial UART, interrupt (IRQ), and module enable signals are provided for module control. These are also connected to the system processor.

All WLAN and Bluetooth radio settings and protocols are programmed at manufacturing and cannot be modified by a user, with the exception of WLAN channel selection.

Block Diagram

Fluke Ti200/300/400 Family of radio Instruments

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