

Camlite Electronics, Inc  
**FC2000TX**  
Short Range Audio/Visual Transmitter  
Theory of Operation

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## **1 Introduction**

The FC2000TX by Camlite Electronics, Inc. (CAMLITE) is a short range wireless audio/visual camera housed in a flashlight. It is a short range FM transmitter that operates in the 902 MHz to 928 MHz frequency band.

## **2 Baseband Processing**

### **2.1 Video Signal**

The transmitter assembly accepts an NTSC encoded video signal on the yellow wire attached to E3. The video bandwidth of this signal is 4 MHz. The video input of the transmitter is terminated in 75 ohms. The video signal is coupled to the control input of the FM modulator by a passive network that includes potentiometer R101. R101 is adjusted to control the modulation factor of the transmitted signal. The input is DC blocked with a 1 uF capacitor to protect the FM modulator.

### **2.2 Audio Signal**

The transmitter assembly accepts an audio signal on the white wire attached to E1. The audio signal amplitude modulates a 5.5 MHz local oscillator to create the sideband carrier signal that carries the audio information. The local oscillator is a series-mode negative resistance oscillator (Q5). The frequency is tuned by adjusting the slug in inductor T2. The oscillator output is buffered by amplifier Q4 then band limited by ceramic filter X1. The resulting signal is coupled to the FM modulator with a passive network.

## **3 FM Modulator**

The FM modulator is a negative-resistance oscillator (Q3) with a pi resonator. A microstrip coupler is used as the inductive element of the resonator and to couple the output of the FM modulator to the power amplifier stage. The modulator is tuned by a voltage applied to varicap diode D1. The control signal from the synthesizer applied to this diode to control the output frequency. The audio and video signals are summed into the control signal of the synthesizer to FM modulate the carrier signal.

## **4 Synthesizer**

The synthesizer circuit (U2) contains a phase/frequency detector, a prescaler, a frequency divider, and a charge-pump output used to electronically tune the FM modulator. The registers of the synthesizer are programmed at startup with PIC microcontroller U1. The crystal oscillator of the microcontroller is used as the 4.00 MHz frequency reference for the synthesizer. The transmission frequency of the modulator is hardcoded into the firmware of the microcontroller.

## **5 Power Amplifier**

The power amplifier consists of two cascaded common emitter amplifiers. A common bias current is used to set the operating point of both stages in order to reduce overall power consumption. The interstage coupling circuit reduces the low frequency gain of the transistor amplifiers to prevent saturation. The output of the power amplifier is coupled to the antenna and to the feedback input of the synthesizer chip with passive networks.

## **6 Antenna**

The power amplifier is coupled to a monopole antenna with a series parallel network that has a low pass filter characteristic. This network attenuates harmonics of the fundamental carrier frequency.

## **7 Shields**

The transmitter assembly is shrink wrapped with a non-conductive material then wrapped with aluminum foil. A copper braid connects the transmitter assembly to this outer shield at a single point. The battery wires and the audio and video wire exit the shield at the same location. All of these wires are threaded through a toroid bead to prevent conducted radiation from the FM modulator. The toroid is located no more than 0.25 inches from the place where the wires leave the shield. The antenna exits the shield along the edge of the transmitter assembly where it is laid along the inside of the FC2000 housing.

## **8 Power Supply**

The transmitter assembly accepts 12 VDC power through the red wire attached to E4. The ground reference for the transmitter assembly is the black wire attached to E5. The unit draws approximately 80 mA of current.

A zener diode (D2) regulates the 5 VDC supplied to the microcontroller, synthesizer circuits, and the 5.5 MHz oscillator. All other circuits operate directly from 12 VDC.