Camlite Electronics, Inc

# FC2000TX

## Short Range Audio Visual Transmitter
## Alignment Procedure

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# 1 Introduction

The FC2000TX is a short range FM transmitter for broadcasting an audio/video signal designed for low power applications. This document describes the alignment and testing of the transmitter assembly.

## 1.1 Equipment

Table 1.1 Equipment List

| item | name | description |
|---|---|---|
| 1 | RF Spectrum Analyzer | Range 500 MHz to 4 GHZ<br>Impedance 50 Ohm<br>Resolution BW 3 KHz to 1 MHz<br>Video BW 100 Hz to 10 KHz |
| 2 | Power Supply | 12 VDC |
| 3 | RF Frequency Counter | Range 800 MHz to 1500 MHz |
| 4 | Volt-Ohm-Meter | Voltage Range 0 VDC to 20 VDC |
| 5 | Tuning Tool | non-conductive and non-ferromagnetic tuning tool |
| 6 | Antenna | 900 MHz, 50 Ohm with 3 ft coax cable and 50 ft coax cable. |
| 7 | Cable | coaxial cable, 50 ohm, BNC, length a/r |
| 8 | A/V Receiver | 900 MHz Audio/Visual receiver, CCTV-900 (or equivalent) + 0monitor. |
| 9 | FC2000 Fixture | Contains monochrome camera, microphone, provides power supply terminals for lab supply |

# 2 Alignment Procedure

## 2.1 Setup

2.1.1 Test fixture setup

Turn off the lab supply. Connect the 12 VDC output of the lab supply to the test fixture.

2.1.2 Do a quick ohm test for solder shorts. Clip the ground lead of the VOM to the ground lead of the transmitter assembly. Check for ground short at the locations listed in table 2.1. In particular, there is a higher that usual probability of a solder short occurring around the NE68139R transistors (Q1, Q2, Q3).

Table 2.1 Ohm test

| location | description | approximate reading |
|---|---|---|
| E4 | Power Supply, 12 VDC, 200 mA | 100 ohm<br>50 ohm or lower may indicate Q3 collector is shorted to Q3 emitter. |
| D2-R26 | Zener 5 VDC regulator | 15 ohm |
| Q3-R12 | VCO base | High-Z (5K+)<br>120 ohm if shorted to emitter |
| Q2-R5 | Amplifier base | High-Z (1K+)<br>33 ohms if shorted to emitter |
| Q2-R3 & Q2-R4 | Amplifier collector | R3 impedance should be different than R4.<br>If not then there may be a collector to emitter short. |
| Q1-C39 & Q1-C3 | Amplifier collector | C39 impedance should be different than C3.<br>If not then there may be a collector to emitter short. |
| Q1-R15 & Q1-C3 | Amplifier collector | R15 impedance should be different than C3.<br>If not then there may be a base to emitter short. |

2.1.3 Power and audio/visual signals are applied to the transmitter assembly through wires that penetrate the shield. Table 2.2 shows the color code and location of each wire.

Table 2.2 Wire Color Codes

| wire color | description | location |
|---|---|---|
| RED | Power Supply, 12 VDC, 200 mA | E4 |
| BLACK | Power Supply, Ground | E5 |
| YELLOW | Video | E2 |
| WHITE | Audio | E1 |

Clip the test fixture leads to the UUT as follows: clip the camera lead to the yellow wire, clip the microphone lead to the white wire, clip the +12 VDC lead to the red wire, and clip the ground wire to the black lead.

2.1.4 Solder wire antenna to E3.

## 2.2 Basic Transmitter Alignment and Test

This test verifies FM modulator VCO startup, frequency lock, and transmission power.

2.2.1 Attach 50 ohm sense antenna to the spectrum analyzer with the three foot cable for bench testing. Remove the video clip and turn on the power to the transmitter assembly.

2.2.2 Set the spectrum analyzer to view the 902 MHz to 928 MHz frequency band. Use the sense antenna to measure the near-field produced by the transmitter assembly. Verify that a strong constant wave (CW) signal appears at 914 MHz. You may observe the audio sidebands at this time.

2.2.3 L6 is adjusted until maximum transmitted power is observed. Compress or expand the coils of L6 by pulling with a non-abrasive tuning tool. Make small changes then remove your hands and body from the area of the transmitter when measuring power. If the transmitted power is greater than +7 dBm then detune the coil so that the measured power is not greater than +7 dBm. The measured power should not be less than +5 dBm. Measure and record the final transmitted power on the test data sheet.

2.2.4 Hold the antenna for the RF frequency counter in the near field of the transmitter assembly. Measure and record the transmission frequency on the test data sheet. The frequency should be 914 MHz ±100 KHz.

### 2.3 Audio Alignment and Test

The audio signal is applied from a high impedance button microphone to the transmission assembly through a white wire connected to E1. This signal AM modulates a 5.5 MHz local oscillator that connects to the FM modulator. This causes the audio information to appear on the 5.5 MHz sidebands of the transmitted signal.

2.3.1 Observe the transmitted signal on the spectrum analyzer. Set the span to 20 MHz so that the audio sidebands can be easily seen. Adjust the slug in inductor T1 until the power of each sideband is -7 dBc. Measure and record the final sideband power on the test datasheet.

### 2.4 Video Alignment and Test

A keyhole camera mounted in the lens cap of the flashlight assembly supplies a 4 MHz monochrome video signal to the transmitter assembly. The video signal is delivered through the yellow wire from the video camera assembly to wire point E2 on the transmitter assembly.

2.4.1 Attach the camera to the yellow lead connected to E2. Turn on the transmitted unit and observe the spectrum spread as the carrier is FM modulated by the video signal. Adjust R101 until the main lobe of the RF spectrum is 10 MHz wide at the 3 dB points beyond the upper and lower band edges. Measure and record the final signal bandwidth.

2.4.2 Turn off power and move the transmitted to the vertical transmission frame. Turn on the transmitted and observe the signal with the A/V receiver. Verify and record on the test datasheet that the audio signal and video signals are of acceptable quality.

## 3 Final Assembly

After the subcircuits are aligned, the transmission assembly is wrapped in an RF shield.

### 3.1 Securing L6

3.1.1 Remove the test antenna and install the antenna lead.

3.1.2 Carefully apply loctite to L6 to prevent further adjustment. Allow the glue to harden.

3.1.3 Place the insulated spacer over L6 and secure with loctite. Allow the glue to harden. This spacer will limit the minimum distance between the shield and the inductor to reduce capacitive leakage.

 

## 3.2 Installing the Shield

3.2.1 Solder a 2 inch piece of 0.125 inch copper braid to the bare patch on the solder side ground plane as shown in figure 3.2.

3.2.2 Obtain a 2 inch piece of 2 inch shrink tubing. Route the wires down the side of the transmitter assembly while inserting the assembly into the shrink tubing so that the wire exit the tubing next to the copper braid. The antenna lead should stick out one end of the shrink tubing and the copper braid and wires should stick out the opposite end of the shrink tubing. The entire transmitter circuit board should be inside the shrink tubing. Shrink the tubing. Trim tubing at the ends.

3.2.3 Stick one end of the foil tape to the shrink tubing then wrap one layer of foil around the transmitter assembly. Lay the copper braid smoothly over the foil and wrap one more layer of foil over the transmitter assembly so that the copper braid is pinched between two conductive layers.

3.2.4 Trim the foil away from the antenna lead exit point so that the shield is at least 0.125 inch away from the antenna lead in any direction.

## 3.3 Final Test

3.3.1 Reattach the transmitter assembly to the test fixture and turn on power.

3.3.2 Remove the video lead and verify that the transmitted power is the same as before.

3.3.3 Verify that the transmitted frequency is the same as before.

3.3.4 Verify that the audio sidebands are still at -7 dBc.

3.3.5 Examine the second and third harmonics of the carrier frequency. Verify that they are no higher than -40 dBc.

3.3.6 Reattach the video lead and verify that the transmitted bandwidth is still 10 MHz.

 