DTC Communications

T2050

TECHNICAL / ALLIGNMENT MANUAL

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# T2050

## TECHNICAL / ALLIGNMENT MANUAL

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The T2050 is miniature VHF narrow-band FM audio transmitter for application in Police Radio Service technical surveillance, and personnel protection. The T2050 features two channel synthesized operation in any 2 MHz segment over the frequency range of 150 to 174 MHz with an RF output power of .20 Watts.

The T2050 is housed in a disguise assembly and incorporates an integral "AA" 1-cell battery holder. The antenna is integral to the disguise, thus eliminating the need for a separate antenna assembly.

## AUDIO CHARACTERISTICS

The T2050 utilizes linear audio compression with a 45dB dynamic range. This provides the end user excellent audio performance over a wide range of audio conditions and audio input levels.

## BATTERY SUPPLY VOLTAGE

The T2050 operates on a power source of 1.2 to 1.65 VDC.

## CHANNEL SELECTION

The T2050 is a two channel device. The frequencies are factory programmable via a built in serial-data interface.

## POWER SWITCH

The T2050 incorporates no power switch for control of the transmitter. The power is ON when the battery is inserted.

# T2050 SPECIFICATIONS

## ELECTRICAL

| | |
|---|---|
| Frequency range | Any 2 MHz segment 150 - 174 MHz |
| Channels | 2 (programmable) |
| Maximum channel separation | 2 MHz |
| RF Power output | @1.5 VDC<br>.20 < Po < .25 W |
| Frequency stability | +/- 2.5 ppm<br>-30 to +65 deg C. |
| Modulation Type | NBFM type 11K2F3E |
| Deviation | +/-2.5 kHz peak<br>(maximum) |
| Spurious and Harmonics (conducted) | -45 dBc |
| Audio frequency response | +2 to -6dB from<br>a 6dB / octave<br>pre-emphasis<br>300 Hz to 2500 Hz |
| AGC range | 45 dB |
| Microphone (integral to disguise) | FET - electret |

## POWER SUPPLY ...

| | |
|---|---|
| Voltage input range | 1.2 – 1.65 VDC |
| Supply current | 450 mA |

## TX AUDIO

(ref schematic T-2050)

The TX Audio is capable of driving the FM modulator to constant peak deviation over a microphone audio range of 45 dB.

Microphone audio is routed to AGC stage U1. Compressed audio is fed to operational amplifier U2 which functions as a 6 dB per octave (pre-emphasis) frequency shaper over the range of 300 to 2500 Hz with the response peak centered at 2500 Hz.

The pre-emphasized audio is fed to a diode clipper. Processed audio is then routed to a two-pole lowpass filter implemented by op-amp U3.

## TRANSMIT VOLTAGE CONTROLLED OSCILLATOR

One half of the primary VHF transmit frequency is generated by a Colpitts oscillator implemented by integrated circuit U4 (MAX2620). The frequency is determined by a resonant tank circuit formed by capacitors C17, C19, C20 and inductor L1. Frequency modulation is provided by paralleled variable capacitance diodes D2 A and B placed in series with inductor L1. The VCO output signal is split into two output paths. The first output is fed to the synthesizer IC U5, while the second output is fed to the doubler/driver device, Q1.

## POWER AMPLIFIER

The RF Power Amplifier (Q2) is implemented by a single metal-oxide field effect transistor. The +15dBm signal from the doubler/driver is fed to the FET gate via a resonant impedance matching network. Gate bias Voltage is supplied via RV2. PA drain impedance matching and filtering is provided via inductor L6, series connected L7 – L9, and shunt capacitors C38-C40. This is a 3-section harmonic suppression low pass filter structure. Potentiometer RV2 also provides a variable gate bias voltage that is use to set the output power level during factory test and alignment.

## FREQUENCY SYNTHESIZER

Integrated circuit U5 (LMX2306) functions as a single component serial input PLL half-frequency synthesizer. It implements a dual modulus 8 / 9 prescaler, a 5 bit programmable swallow counter, a 13 bit programmable main counter, and a 14 bit reference divider. It also implements a charge-pump type phase detector. The main parameters of the PLL are:

Phase comparator reference frequency  variable 10 to 20 kHz

Main reference TCXO input frequency 12.8 MHz

Counter parameters for a 161.050 MHz example are:

```
Main counter (N) = 201
Swallow counter  =  20
Ntotal = N * P + A where P = 64
       = 201 * 64 + 20
       = 12884
Output frequency = Ntotal * Fref
                 = 12884 * 12.5 kHz
                 = 161.050 MHz
```

PLL IC U5 is serially programmed via the microcontroller IC U8.

MICROCONTROLLER

The function of the microcontroller is:

1. Read synthesizer frequency programming data from the non-volatile RAM contained within U10 at initial power-on.

2. Read (when connected) programming data from the serial programming port used to define the channel frequency.

# TRANSMITTER ALIGNMENT

The following section details the alignment of the T2050 transmitter.

## TEST EQUIPMENT

o DC power supply
  : 1.2 to 1.65 VDC
  : metered current 0 - 500 mA DC

o DC Voltmeter
  : 10 meg Ohm input impedance
  : 0 to 5 volt range

o Audio frequency generator
  : 1,000 Hz
  : 50 mV rms output level

o FM deviation monitor
  : 150 - 174 MHz
  : 2.5 kHz peak full scale

o RF power meter
  : 50 Ohm, terminated or "thru-line"

o Frequency counter
  : 150 - 174 MHz
  : 0.1 ppm frequency accuracy

o 50 Ohm attenuator pads
  : as required

o Spectrum analyzer
  : 10 MHz to 2.0 GHz

## PRELIMINARY

Preset the power supply to 1.5 VDC, and turn off the supply. Set the audio frequency generator to 1 kHz and adjust the output level to 50 mV RMS. Cable the transmitter under test per figure 1.

Preset the potentiometers RV1, RV2 as follows:

RV1 (deviation) to max CCW
RV2 (output power level) to max CCW

Note! The transmitter microcontroller NV RAM is loaded with the customer frequency. This is used to test and align the device.

VCO ADJUST

Frequency adjustment is not required: This is a wide range VCO circuit. The output circuit is peaked with C22 while monitoring the RF voltage at the base of

DOUBLER DRIVER

Q1

POWER AMPLIFIER

Adjust RV3 CW for an RF output power reading of 1.0 Watt.

*** 1.5 VDC Conditions of DC current and output power. ***

Idc < 500 milliamps
Pout = 0.20 Watt

Adjust the power supply to 1.5 VDC, note the output power and total supply current. Test output power and current at the lowest frequency (channel 1), and the highest frequency (channel 2).

*** 1.5 VDC Conditions of DC current and output power. ***

Idc < 450 milliamps
0.20 < Pout < 0.25 Watts

TRANSMITTER FREQUENCY

Monitor the output of the transmitter with the frequency counter. Adjust the trimmer capacitor located on the TCXO module (U6) until the transmitter frequency error with respect to the specified channel frequency is less than .2 ppm.

DEVIATION ADJUST

Monitor the Voltage at TP4 with the DVM.
Adjust RV1 for 1.4 VDC as read on the DVM.

TRANSMITTER DEVIATION

Set the channel select switch to channel 4. Monitor the transmitter output with the FM deviation monitor, and modulate the transmitter by connecting the audio frequency generator to the microphone input via the J1 accessory connector. Set the audio generator to a frequency of 1 kHz and the output level to 50 mV RMS. Set the deviation control (potentiometer RV2) for a peak deviation of 2 kHz.

Now set the channel select switch to channel 1, and then channel 10. Check that the deviation is:

1.8 kHz < FM Dev < 2.5 kHz

SPECTRUM CHECK

Cable the transmitter under test to the spectrum analyzer via appropriate attenuator pads. Perform a frequency sweep from 10 MHz to 2.0 GHz, and verify that the conducted spurious emissions are attenuated greater than 45 dB below the level of the carrier.

Vary the supply voltage over the range of 1.2 to 1.65 VDC. Verify that the output spectrum is clean and the conducted spurious emissions remain 45 dB or greater below the carrier.

Disconnect the transmitter under test from the spectrum analyzer and connect it to its own internal antenna. Using a "sniffer" antenna attached to the spectrum analyzer verify that the transmitter remains stable when driving the external antenna.

Perform the above radiated stability audit while varying the supply voltage over the range of 1.2 to 1.65 VDC.

** END OF ALIGNMENT PROCEDURE **