201545 Truckee 2.4GHz FM TV Transmitter RF Module operational Description and Specification

1.0 General Description:
The Truckee 2.4GHz FM Transmitter is an RF module that is capable transmitting video and audio NTSC or PAL television signals in the 2400-2485MHz ISM frequency band. The transmitter accepts a composite video signal from any video source. The transmitter also accepts audio from any high level source. The transmit RF output frequency and audio sub-carrier frequency are set by the 3-wire, serial interface. Output power this transmitter is approximately 1mW.

2.0 Transmitter Topology

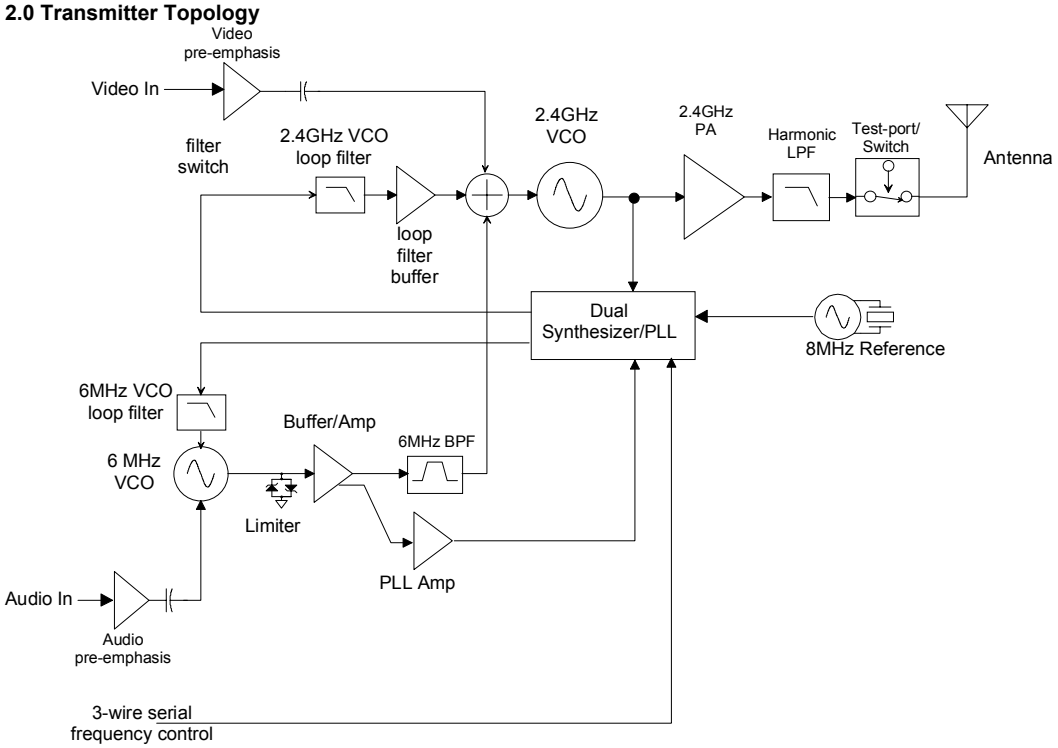

Figure 1

Figure 1 above; shows the block of the FM transmitter topology. The transmitter is essentially PLL stabilized VCO, operating at the output frequency, that is a directly modulated by the video signal. The VCO is controlled by a PLL and tuneable over the 2400-2485MHz ISM band.
The input composite video signal is filtered by a video pre-emphasis network and applied to tuning port of the RF VCO to provide wideband FM modulation. The video deviation is not adjustable and is set by design.

The RF VCO is controlled by the RF section of the dual synthesizer/PLL integrated circuit. This is a integer-N PLL with very low loop bandwidth.

The audio signal is filtered by an audio pre-emphasis network and applied directly to the one of the two tuning ports of the 6.0MHz sub-carrier VCO to provide an FM modulated audio sub-carrier. The audio deviation is set by design. The frequency of the sub-carrier VCO is tuned and stabilized by the digital synthesizer/PLL through the other VCO tuning port.

The 6 MHz audio sub-carrier is then amplitude limited by the diode limiter circuit in order to maintain a constant sub-carrier level. The limited sub-carrier signal is then amplified and buffered by the sub-carrier buffer amplifier in order to increase the signal level and isolate the VCO. The buffered sub-carrier is then filtered to remove harmonics by a narrow band bandpass filter. A secondary output from the buffer amplifier is further amplified and amplitude limited by the PLL Amp. The PLL Amp squares and limits the amplitude of the 6.0MHz sub-carrier signal in order to ensure positive clocking of the Synthesizer/PLL.

The filtered sub-carrier output from the bandpass filter is combined with the pre-emphasised video signal, and the buffered RF loop filter signal at the summing node at the VCO tuning port. The summing node is simply a resistive adder circuit that combines the tuning signal with the video and audio sub-carrier modulation in the correct proportion for proper deviation and frequency control of the VCO.

The RF VCO output at 2.4GHz is further amplified to provide an output level of approximately -0dBm to the antenna. The output lowpass filter removes the harmonics created by the VCO and amplifiers.

The antenna is a dipole antenna realised on a FR4 PCB with about 1dBi gain.

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The RF and sub carrier VCOs are controlled an integer-N PLL locked to the 8.00MHz crystal reference. The PLL is programmed via the 3-wire serial interface.

The 8.00MHz crystal reference is provided by a single transistor discrete crystal oscillator.

Measurement conditions
Ambient temperature range: 0 to 40°C

3.0 Input dc Power

	Description	Value	Limit / Tolerance	Units
3.1	**Input dc Voltage**	3.3	±10	V
3.2	**Input current**	44	<50	mA
3.3	**Noise (dc-10MHz BW)**	-	<200	uV RMS

4.0 RF Specification

	Description	Value	Limit / Tolerance	Units
4.1	**RF Output Frequency Range**	2400-2485	min-max	MHz
4.2	**Tuning Increment**	50	-	kHz
4.3	**Frequency** accuracy and stability	-	±100	ppm
4.4	**Lock time**		<100	mS
4.5	**Antenna port Output impedance**	50	-	Ω
4.6	**Antenna port VSWR**	1.00:1	<2:1	-
4.7	**Output power**	0dBm	±1.5 (tbd)	dB
4.8	**Harmonics (FCC 15.249 limits)**	typ. <-50	<-40	dBc
4.9	**Spurious output (FCC 15.249 Limits)**	typ. <-60	<-50	dBc

5.0 Video Specification

	Description	Value	Limit / Tolerance	Units
5.1	**Video input voltage (single ended)**	0.5	-	V pk-pk
5.2	**Video input impedance**	4.5K	>4.0K	Ω
5.3	Video frequency response (after CCIT-405 equalization) **30Hz-4.2MHz reference at 500kHz** 10Hz-4.2MHz	-	 ±0.5 ±1.5	dB
5.4	**Video pre-emphasis**	**CCIT-405 standard**		
5.5	**Video modulation deviation (peak)** Modulation slope is positive (positive voltage swing results in higher frequency) 10kHz @ 1.0Vpk-pk 100kHz @ 1.0Vpk-pk 1MHz@ 1.0Vpk-pk			MHz
5.6	**Video signal to noise ratio**			dB
5.7	**Luminance pulse response 2t P&B**	-	<1	%
5.8	**Color differential phase**	-	<1	deg.
5.9	**Color differential gain**	-	<1	%
5.10	**APL response per field residual**	-		%
5.11	**Group delay 30Hz-4.2MHz**	-	<±100	nS

6.0 Audio System Specifications

	Description	Value	Limit / Tolerance	Units
6.1	**Audio input Voltage (Maximum)**	500	<1000	mV p-p
6.2	**Audio input impedance**	100	>50	KΩ
6.3	**Audio total harmonic distortion (THD)** 500mV pk-pk sine wave at 1kHz	0.4	<1.0	%
6.4	**Audio Sub-carrier level**	-25	tbd	dB
6.5	**Audio S/N**		>70	dB
6.6	**Audio frequency response** 100-8kHz reference at 1kHz	0	±1	dB
6.7	**Audio pre-emphasis**		50	uS
6.8	**Deviation (FM) for audio frequencies below pre-emphasis break-point . at 1kHz**	23	±2.3	kHz pk

6.9	**Audio sub carrier frequency**	6.0	±30	kHz

8.0 Interface and Channel Programming.
The tuning of the transmitter is accomplished by programming the RF and audio PLL though the 3-wire serial interface. The tables below show the programming information for the local oscillator PLL programming. A fourth signal, SDO is used to read the internal state of the synthesiser.

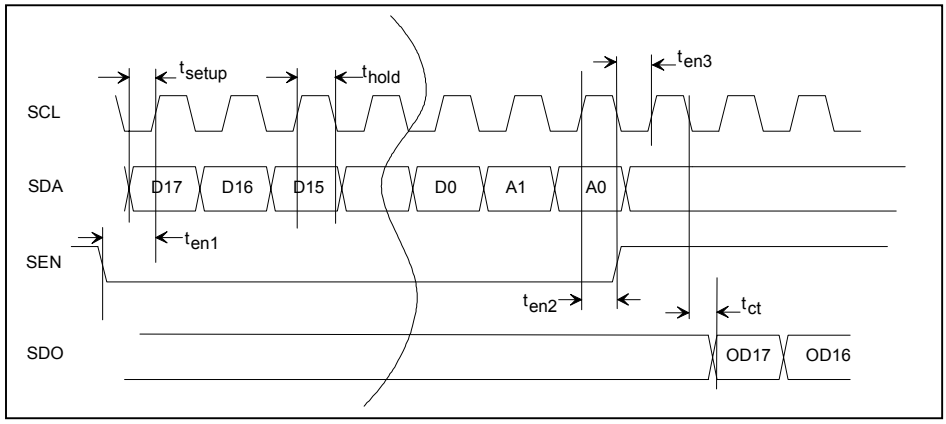
The transmitter channel selection is accomplished though the 3-wire serial interface. The serial interface timing diagram is shown in figure 2 below. The table below specifies the timing relationship:

Interface Levels
(Input dc = 5.00 volts.)

Input RFP SCL, SDA and SEN					
PARAMETER	**CONDITIONS**	**MIN**	**TYP.**	**MAX.**	**UNIT**
input voltage HIGH		2.1	-	-	V
input voltage LOW		-	-	0.9	V
input current HIGH	V_{IH}=3.0V	-1	-	1	uA
input current LOW	V_{IL}=0V	-1	-	1	uA
SDO output (read Mode if used)					
output voltage HIGH	source current = 500uA	2.6			V
output voltage LOW	sink current = 500uA			0.4	V

Serial Interface Timing (nS)

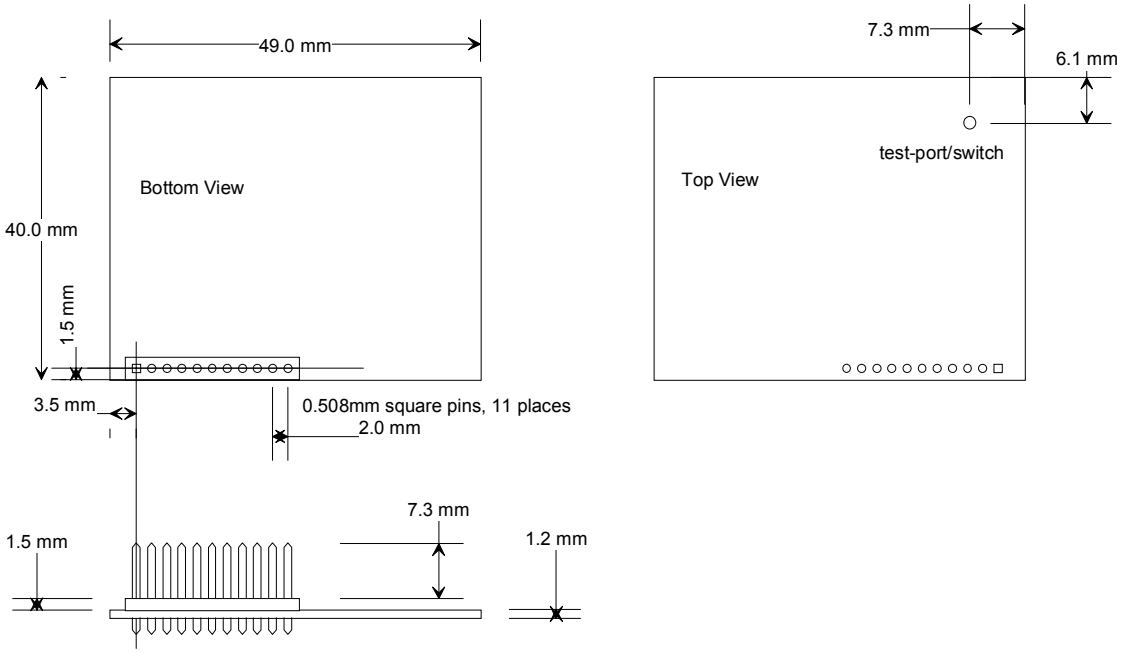
Parameter	**Symbol**	**Min**	**Max**
SDA set-up time to SCL↑	t_{setup}	5	-
SDA hold time from SCL↑	t_{hold}	0	-
SEN↓ to SCL↑ delay time	t_{en1}	10	
SCL ↑to SEN↑ delay time	t_{en2}		
SEN ↑to SCL↑ delay time	t_{en3}		
SCL↓ to SDO↑ delay time	t_{enct}	15	



Truckee 201545 Transmitter RF Module Package Footprint

Note: Pad location shown top view

Truckee Transmitter PCB
201545-0000-PA2



Pin Designation:

1	SCL_IN	Serial clock input
2	SDA_IN	Serial data input
3	SENB_IN	Serial enable input
4	VIDEO_IN	Composite video input
5	Audio_IN	Audio input
6	+5V	DC input bias voltage
7	GND	Circuit board ground
8	N/C	No connection, not used.
9	CLP	Video clamp input (TTL low for Clamp enable)
10	+3.3V	DC input power
11	SDO	Serial Data Output
12	GND	Case ground
13	GND	Case ground
14	GND	Case ground
15	GND	Case ground