Circuit Description
MODEL T5100/5200
RF

I) TX Path

1. The antenna port has given 26 to 27dBm transmitted power and –119dBm sensitivity respectively.
2. There are matching network with TX/RX path switching between the antenna port and PA, it is consist with LC component and pin diode to match the PA to antenna with band pass filtering and isolating TX/RX path.
3. The path switching is consist of D101 and D102, the transmitted power will flow once the dc bias is given to these two diode and there will have 20 dB isolation between TX and RX path.
4. C102, C103, L101, C101 and L105 act as matching network (MN) to match output of PA to be 50 ohm.
5. There have a driver Q103 before the power input to PA from VCO, the power input to driver and PA is 0dBm and +18dBm respectively.
6. L101 and L105 are air coil in order to reduce the power dissipation as high power flowing along this path.
7. There is a single VCO solution, VCO acts as carrier generator (~0dBm) in TX mode and local oscillator (~-9dBm) in RX mode respectively.
8. The coil L113 acts as variable inductor for VCO voltage tuning. The VCO sensitivity is ~5MHz/V for both in TX mode and RX mode. The D104 acts as switching diode for 21.4MHz band switching. It is turned on in RX mode and off in TX mode by T3V.
9. Twin transistor Q106 is used in VCO, one for VCO and the other for buffer amplifier to give better isolation between VCO and driver amplifier, VCO and the 1st mixer.
10. The modulated signal feeds from R128 and modulated with D103
11. The loop filter is consist of LC component with 150Hz corner frequency in order to reject the reference frequency 3.125KHz.
12. The feedback frequency from VCO to PLL IC IC102 is filtered with C145 and C149 in order to reject the reference frequency 3.125KHz.
13. Q101 acts as switch for switching the PA, the Q104 is turned on once the PLL is locked in TX mode.
14. Q108 and Q107 act as switch, Q108 and Q107 are turned off in TX mode and inverse in RX mode to give the ground state to the band switching diode D103.
15. 20.95MHz crystal X101 works with direct compensation circuit to give +/-2.5ppm over -20C to +55C.
16. IC109 acts as voltage regulator to give stable voltage supply to +3V path.

II) RX Path

1. C113 and L104 were used to match the antenna to 50 ohm input port of saw filter BPF101, the saw filter is used to attenuate the unwanted signal and 1st IF image signal.
2. Q102 acts as LNA between SAW filter and 1st mixer to amplify the wanted signal by 10dB.
3. The dual gate FET Q105 acts as the 1st mixer. The resultant signal of mixer output is RX - LO, which is equal to the 1st IF frequency of 21.4MHz.
4. The frequency of 1st LO is injected from VCO to mixer Q105. L110 and C120 act as matching network to match VCO to mixer input port and give better isolation between them in order to improve the problem of malfunction.
5. Q107 acts as switch to turn on the RX path in RX mode in order to save the power consumption and prevent the noise from audio output of IF IC picked up by transmitted carrier.
6. The 1st IF crystal filter BPF102 with +/- 3.75KHz bandwidth provide better adjacent selectivity and 2nd IF image rejection.
7. The FM IF IC IC101 integrate the IF limiter, demodulator, 2 nd mixer and 2nd local oscillator.
8. The 2nd LO frequency is generated from the X101. The 2nd IF filter BPF103 is 450KHz filter with +/-4.5KHz bandwidth (G type) to further enhance the adjacent channel selectivity.
9. Noise detector is used for signal detection which is built with the internal op-amp of IF IC and the level is tuned to 8~12dB SINAD with VR102.

BASEBAND

(I) TX Path

1. Mic

   The internal/external mic transfer the sound pressure into electrical signal. About 5mV at 1KHz, when the mic is placed 3 to 4 cm from the lips. This signal will send to the mic amplifier to increase the signal level for compressor IC to process.

2. Mic. Amplifier
   The IC103D bias as a multi feedback high pass filter with 2-pole has a roll off at about 300Hz to reduce the hum noise. The voltage gain is about 18.3. The output will send to the input of compressor.

3. Compressor
   The compressor IC105 compress the audio signal to increase the average modulation level. The standard input level (0dB gain) of the compressor is 100mV. The output of compressor will send to next stage for emphasis.

4. Pre-emphasis
   Pre-emphasis is implement with the IC103C to produce a frequency response of 6dB/octave. This circuit also limit the maximum deviation at 2.5KHz to met the specification (standard deviation ~ 1.5KHz, maximum deviation ~ 2.5KHz). The output will send to next stage for limiting.

(II) RX Path

1. De-emphasis
   The de-emphasis of the demodulated signal from RF section is implemented with CTCSS IC. If CTCSS IC is not used, de-emphasis is implement with the RC network R163 and C182. The RC network has 2-pole with 0dB at 1KHz, 3.5dB at 0.5KHz and –8.5dB at 2.5KHz.

2. Expander
   The expander IC105 expand the audio signal to reduce the noise level. The standard output level for the expander is 100mV. The output will send to the speaker amplifier through volume control.

3. Volume Control
   The VR103 (volume control switch) has two function, the ON/OFF switch and speaker volume control.

4. Speaker Amplifier
   The speaker amplifier IC108 amplify the expander signal and output to the speaker. The speaker amplifier biases as a multi feedback high pass filter with 2-pole. The roll off is about 300Hz and the gain is about 39. The speaker amplifier can be mute by CPU through PIN 1 (High MUTE, Low UNMUTE). The maximum power output is about 150mW.

(III) CTCSS (T5200)

The CTCSS code generated by IC109. The CTCSS may be optional, add jumper along the RX audio path to replace IC109 and set CPU to NON-CTCSS mode.