THEORY OF OPERATION

Circuit Composition And Operation Theory
The basic explanation for the circuit composition
DF-205 consists mainly of the one board controlling the analog circuit parts and the digital circuit parts.

1. Receiver

DF-205 transmission parts is composed in the double conversion system, which has the 1st IF Frequency of 21.7MHz and the 2nd IF frequency of 450KHz. With the front-end which has an excellent band characteristics and skirt characteristics, the 2 pole MCF used in the 1st IF, and the 4 pole ceramic filter in the 2nd IF, the reception interrupting factors such as the image and the sensitivity repression are reduced for the more stable reception.

1-1. RF Front-end

The signal received by the antenna will be transmitted to the front-end through the antenna switching circuit consisted of L212, L211, L209, C224, C222, C221, C219. The front-end consists of the RF amplifier transistor Q101, Q102 and input/output band pass filter. Each input/output band pass filter has the bandwidth of approximately 10MHz, primarily diminishes the other signal rather then the 1st IF image and other signal within the reception band and amplifies only the necessary signal within the RF.

1-2. 1st Mixer

The receiver signal which has been amplified in the RF fronted is provided to the base of the 1st mixer Q103. The 1st L/O signal provide from the PLL module is supplied to the emitter of Q103 and converted to the 1st IF 21.7MHz.

1-3. 1st IF Filter and 1st IF Amplifier

The signal covered by Q103 to 21.7MHz, the 1st frequency changed its impedance through C118, L106, and then is infused to the fundamental MCF(F102) which has the center frequency of 21.7MHz and the band width of +/-3.75KHz. Here, the signal reduces the image and other unwanted signal for the 2nd IF, and changes its impedance again through the R113. Then the signal is infused to the Q104, the 1st IF amplifier. The signal infused to the Q104 is amplified approximately by 20dB in other to acquire the required reception sensitivity, and infused to the U1 which functions as the 2nd mixer, the 2nd IF amplifier, and the FM detector.

1-4. 2nd Mixer, 2nd IF, FM Detector(U1)

The receiver IF signal of 21.7MHz, which has been infused to U1 is mixed with the 2nd L/O signal of 21.25MHz, and converted to 450KHz, the 2nd IF frequency. The receiver signal converted to the 2nd IF frequency passed through the F1, the ceramic filter of 450KHz again. After the limiting inside the U1 and the FM demodulating by the quarature detector inside the U1, the signal offers the output through the 9th pin of the U1.
The 2nd L/O signal of 21.25MHz which infused to the U1 filters and uses directly the crystal of 21.25MHz. The squelch circuit is composed to detect the noises from the received signal demodulate in the 9th pin of the U1. For this purpose, the noise filter is using OP amplifier inside the U1.

1-5. De-Emphasis and 300Hz HPF (U801)

The audio signal which has been FM demodulate in the U1 is supplies to the U801 which function as the De- emphasis and 300Hz HPF.
Since the U801B has the 300Hz HPF with the 1st characteristics and the De-emphasis characteristics with the corner frequency of approximately 200Hz, and U801A, and the U801C has the 300Hz HPF with the 6th characteristics, they function as a normal De-emphasis and also reduce the signal such as CTCSS to unwanted noises from the speaker.

1-6. Audio Power Amplifier (U602)

The received audio signal which has been adjusted to the appropriate electrical volume in Pin 53,54,55,56 of U901 are supplied to the 2nd pin of the U601 and amplified approximately by 20dB. Then, it turns up the speaker with the maximum output of 0.3Watts.
The 7th pin of the U601 is the audio mute terminal. If a voltage supply to the 7th pin of the U601 is supplied to this terminal, the U601 stops functioning as the audio power amplifier regardless of the signal supplied to the 3nd pin of the

U601, and there is no sound emitter from the speaker.

2. Transmitter

The transmission part of the DF-205 is designed to amplify the RF signal oscillated and modulated by the synthesizer to approximately 27dBm by the power transistor of Q203, Q204.

2-1. Pre-emphasis and Vox Operating, Limiter (U601B)

The voice signal input from the microphone is pre-emphasized at the U801A. The signal which comes out of the D701 is limited to a certain amplitude for the voice signal not to exceed the allowable band width assigned for transmission.

Voice signal is input through microphone. This amplified signal flows into U801A and Q903, and its output is converted to either ON or OFF by Q904. Then it activates 'VOX' function.

2-2. 3KHz LPF (U801D)

After passing the D701 limiter, the signal is combined with the CTCSS tone at the digital circuits, and is supplied to the 3KHz LPF has the 4th characteristics and adjusts the assigned frequency band width not to exceed the allowable range.

2-3. TX Power (Q502)

The transmitted signal of approximately 3mW, combined at the vco buffer amp Q302 is supplied to the base of the Q201, Q202 amplifier. The transmitted signal amplified to 27dBm here passes the TX LPF of the 2nd characteristic of the L206 and the C209, C211, and RX/TX switching takes place by the D201. After this, the signal is provided to the antenna the TX LPF of the 1st characteristics, consisted of the L209, L211, L212.

3. Frequency Synthesizer

3-1. Voltage Control Oscillator (VCO)

The VCO of the DF-205 oscillates 440.8625MHz to 446.0125MHz under the transmission condition and 462.5625MHz to 467.7125MHz under the reception condition. The VCO consists of the colpit oscillator of the Q301, and contains the oscillator frequency of approximately 21.7MHz during the transmission / reception conversion. That is since the VCO should oscillate relatively low frequency during reception compared to transmission, the D302 is directly biased by the Q303.

Therefore as a result, the C324 is added in parallel to the resonance circuit of the VCO to oscillate a low frequency. During transmission, a relatively high frequency should be oscillate compared to reception. Therefore, the D302 is adversely biased by the Q303, and as a result, the C324 which is added in parallel to the resonance circuit of the VCO is removed to oscillate the desired transmission frequency.

The VCO is controlled by controlled by the U401 PLL IC in order to oscillate the accurate frequency. The VCO is controlled by the U401 PLL IC in order to oscillate accurate frequency. The output frequency of the VCO is supplied to the U401 PLL IC immediately. At the U401, TCXO(21.25MHz) by the X401 is compared to the output frequency of the VCO. The VCO is controlled through the loop filter consisted of the C413, R404, R403 C412 and the C411 in order to oscillate the stable frequency wanted for the radio.

The VCO controlled voltage which ahs passed the loop filter is supplies to the D301 variable capacitance diode, and the VCO an oscillate the PLL programmed frequency by the capacity variation in the D301. In addition, the L302 on the VCO circuit functions as frequency for the VCO to be properly controlled by the U401 PLL IC.

3-2. RX/TX Buffer Amplifier (Q302)

The RF signal oscillate at the VCO is provide to the Q103 RX 1st mixer through the Q302 during the reception, and is provide to the Q201 power driver amplifier through the Q302 during the transmission.

3-3. PLL Frequency Synthesizer (U401)

The PLL synthesizer of the DF-205 consists of the signal loop PLL circuit with the reference of 6.25KHz. The U401 PLL IC includes all the functions such as the reference oscillator, the driver, the phase detector, the lock detector, and the programmable divider.

At the reference oscillator, the 21.25MHz TCXO of the X401 is connected to the pin 10 of the U401 to oscillate the

frequency of 21.25MHz. The TCXO(21.25MHz) is the temperature compensation circuit to maintain the frequency within the allowable error range even under a low temperature of -20℃.
The phase detector send out the output power to the loop filter through pin 14 of the U401. If the oscillation frequency of the VCO is low compared to the reference frequency, the phase detector sends out the output power in positive pulse. If the oscillation frequency of the VCO is high, phase detector sends out the output power in negative pulses. Therefore, the VCO can maintain the frequency set.
The programmable divider maintains the desired frequency with the control from the CPU. The dividing ratio, "N" to oscillate the desired frequency is as below :
N = VCO oscillation frequency / reference frequency
If the desired frequency is 462.5625MHz, then
N = 462.7125MHz / 0.00625MHz = 74034

4. CTCSS Processing

4-1. RX CTCSS Tone Processing

The received CTCSS tone is sent out through 9th pin of the U1, and supplies to the U701A, U701B and U701C Low Pass filter(67Hz~250Hz) through the U701D. The voice band signal which can affecter the reception of the CTCSS tone is decreased enough at the U701. The cut off frequency at the U701D is adjusted by the U901 CPU to suit the characteristics of the CTCSS tone.
The CTCSS tone received at the U701D is supplies to the 17th and 34th pin of the U901 CPU, and receives the desired CTCSS tone.

4-2. TX CTCSS Tone Processing

CTCSS tone is generated at CPU(pin 45th, 46th, 47th, 48th of U1) using digital to analog converter method. The TX CTCSS tone composed at the U901 CPU is properly reduce at the R927. R928, C912, C913. TX CTCSS tone is combined with the TX voice signal through the U801 audio amplifier, and supplies to the R315 TX deviation control resistor.

5. CPU and MEMORY

Most of the control functions of the DF-205 are controlled by the U901 CPU.
The U901 CPU has the internal ROM in the capacity of 8Kbyte, and the program for the operation of the U901.
When the power of the DF-205 turned on, the U901 reads the data necessary for the operation from the U902 EEPROM, and decide the operation channel, frequency, etc.
If the user alters any parameter of the radio, the U901 updates the altered parameter to the U902.