Midland G12 THEORY OF OPERATION

Circuit Composition and Operation Theory

The basic explanation for the circuit composition the one board controlling the analog circuit parts and the digital circuit parts for the other control.

Receiver

Receive parts is composed in the double conversion system, which has the 1st IF Frequency of 45.1 MHz and 2nd Frequency of 455 KHz. The 4 pole MCF used in the 1st IF, and the sensitivity repression are reduced for the more stable reception.

RF Front-End

The signal received by the antenna will be transmitted to the band pass filter through the antenna switching circuit consisted of L101. The front RF amplifier transistor Q601 consists of the L601, L602, C100, C602, C604 input band pass filter and L604, L605, L606,L607, C605, C606, C607, C608, C609, C610, C611, C612, C613 band pass filter primarily diminishes the other signal rather then the 1st IF image and other signal within the reception band and amplifier only the necessary signal within the RF.

1st Mixer

The receiver which has been amplifier in the RF front end is provided to the base of the 1st mixer Q102. The 1st L/O signal provide from the VCO is supplied to the emitter of Q102 and converted to the 1st IF 45.1 MHz

1st IF Filter and 1st IF Amplifier

The signal converted by Q102 to 45.1 MHz, the 1st frequency, changes its impedance through L3, C113 and then is infused to the fundamental MCF which has the center frequency of 45.1 MHz and the width of $\pm$3.75 KHz. Here, the signal reduces the image and other unwanted signal for the 2nd IF, and changes its impedance again through R111. Then the signal is infused to the Q103, the 1st IF amplifier. The signal infused to the Q103 is amplifier approximately by 20 dB in other to acquire the required reception sensitivity, and infused to the IC101 which functions as the 2nd mixer, the 2nd IF amplifier, and the FM detector.

2nd Mixer, and IF, FM Detector (IC101)

The receiver IF signal of 45.1 MHz, which has been infuse to IC101 is mixed with the 2nd L/O signal of 44.645 MHz, and converted to 455 KHz, the 2nd IF frequency. The receiver signal converted to the 2nd IF signal frequency passed through the CF103, the ceramic filter of 455 KHz again. After the limiting inside the IC101 and the FM demodulating by the quardrature detector inside the IC101, the signal offers the output through the 9th pin of IC101. The 2nd Local signal of 44.645 MHz which infused to the IC101 filter and uses directly the 9th pin of IC101. The squelch circuit is composed to detect the noised from the received signal demodulate in the 9th pin of the IC101. For this purpose, the noise filter is using the OP Amplifier inside the IC101.

De-Emphasis and 300 Hz (IC102)

The audio signal which has been FM demodulate in the IC101 is supplies to the IC102 which function as the De-emphasis and 300 Hz HPF. The IC102-B has the 300 Hz HPF with the 1st characteristics and the De-emphasis characteristics with the center frequency of approximately 200 Hz, the IC102-C has the 300 Hz HPF with the 6th characteristics, they function as a normal De-emphasis and also reduce the signal such as CTCSS to unwanted noised.

Audio Power Amplifier (IC3)

Audio Power Amplifier (IC3) The receiver audio signal which has been manual adjusted to the appropriate volume in by VR1 are supplied to the 8th pin of the IC3 amplifier approximately by 20 dB. Then, it turns up the speaker with the maximum output of 0.3 watts. The 2nd pin of the IC402 is the audio mute terminal. If a voltage supply to the 2nd pin of IC402 is supplied to this terminal, the IC402 stops functioning as the audio power amplifier regardless of the signal supplied to the 8th pin of the IC402. And there is no sound from the speaker.

Transmitter

The transmitter parts of the HP-448 is designed to amplify the RF signal oscillated and modulated by the synthesizer to approximately 10 or 500 mW by the power MOS FET Amplifier.

Pre-emphasis (IC201)

The voice signal input from the microphone is pre-emphasized at the IC201-B. The signal comes out of the IC201-A is limited to certain amplitude for the voice signal not to exceed the allowable bandwidth assigned for transmission

TX Power Amplifier (Q219)

The transmitted signal of approximately 7 mW, combined at the driver TR is supplied to pin gate of the Q219 power MOS FET amplifier. The transmitted signal amplifier to 500mW control by Q215 and 10mW control by Q27. The transmitted signal amplifier to 500/10 mW (depend on function) here passes the TX LPF of the 2nd characteristics of the L104, L205 and L206 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 C215 and R211.

VOX Mode of Operation

At VOX mode condition, whenever the modulating frequency is present, unit goes on TX Mode or is transmitting automatically for hands-free operation. As discussed above whenever the speech or modulating signal is converted into electrical signal by the microphone is always low due to inverter's electrical characteristic. At VOX Mode, Q205 is on and the signal though IC201-A Pre-emphasis amplify then goes to R55, and Q208 which is the VOX level control (control the sensitivity or amount of voice level trigger to CPU.).The CPU control unit into TX mode.

Midland G12 Frequency Synthesizer
Voltage Control Oscillator (VCO)

The VCO of oscillates 430.0000 MHz to 460.0000 MHz under the transmission condition and 384.9000 MHz to 414.9000 MHz under the reception condition. The VCO consist of the clip oscillator of the Q301 and contains the oscillator frequency of approximately 45.1 MHz during the transmission/reception conversion. That is since the VCO should oscillate relatively low frequency during reception compared to transmission, the D306 is biased by the Q303.

Therefore as a result, the C306 is added in parallel to the resonance circuit of the VCO to oscillate a low frequency. During transmission, a relatively high frequency should be oscillation compared to reception. Therefore, the D303 is adversely biased by the Q303, and as a result, the C306 is added unparallel to the circuit of the VCO is removed to oscillate the desired transmission frequency. The VCO is controlled by the IC301 (PLL IC) in order to oscillate accurate frequency. The output frequency of the VCO is supplied to the IC301 PLL IC immediately. At the IC301, TCXO (21.250 MHz) by the TCXO (X2) is compared to the output frequency of the VCO. The VCO is controlled the loop filter consisted of the L301 in order to oscillate the stable frequency wanted for the radio. The VCO controlled voltage as passed the loop filter is supplies to the D301 varicap diode, and the VCO an oscillator the PLL programmed frequency by the capacity variance in the D301. In addition, the L1 on the VCO circuit function as frequency for the VCO to be properly controlled by the IC301 PLL IC.

PLL Frequency Synthesizer (IC301)

The PLL synthesizer of the signal loop PLL circuit with the reference of 6.25 kHz. The IC2 PLL IC includes all the function such as the reference oscillator, the driver, the phase detector, the lock detector, and the programmable divider. At the reference oscillator, the 21.250 MHz TCXO of the TCXO is connected to the pin 10, 11 of the IC301 to oscillate the frequency of 21.250 MHz. The TCXO is the temperature compensation circuit to maintain the frequency within the allowable error rang even under a low temperature of -20° C. The phase detectors send out the output power to the loop filter through 3rd pin of the IC301. If the oscillation frequency of the VCO is low compared to the reference frequency, the phase detector sends out output power in positive pulse. If the oscillation frequency of the VCO is high, phase detector send put can maintain the frequency set. The programmable divider maintains the desired frequency with 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 430.0000 MHz

TX

N = 430.0000 MHz / 0.00625 MHz = 68800

RX

N = 430.0000 MHz – 45.1 MHz] / 0.00625 MHz = 61584

CTCSS and DCS PROCESSING

RX (CTCSS and DCS) Tone Processing

The received CTCSS or DCS tone is sent out through 9th pin of the IC101 and supplies to the IC103 switching capacitor filter. The voice signal which can effected the reception of the CTCSS or DCS tone is decreased enough at the IC103. The cut off frequency at the IC103 is adjusted by the IC401 CPU to suit the characteristic of the CTCSS or DCS tone. The CTCSS or DCS tone received at the IC103 is supplies to the 10th, 20th pin of the IC401 CPU, and receives the desired CTCSS or DCS tone.

TX CTCSS and DCS Tone Processing

The TX CTCSS or DCS tone composed at the IC401 supplies to the IC201-D switched capacitor filter reduce enough the components in the high frequency which can effect the voice communication. And the TX CTCSS or DCS tone is combined with the TX voice signal through the IC201-D and CTCSS or DCS signal from 14 pin of IC201-D (If used CTCSS or DCS channel) to the filter and buffer IC(IC201-D) became the audio out for modulation with carrier at D302 by used RV4 adjust the modulation level.

CPU and Memory

Most of the control functions of the HP-448 are controlled by the IC401 CPU. The IC401 CPU has the internal ROM in the capacity of 32 K byte, and the program for the operation of the IC401. When the power is turned on, the IC401 reads the data necessity for the operation from the IC402 EEPROM, and decide the operation channel, frequency, etc. If the user alters any parameter of the radio, the IC401 updates the altered parameter to the IC402.