LIST OF EXHIBITS

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General Information Required For Type Acceptance

(1)Type of Emission:

F3E

(2)Frequency Range:

a. Headset:

TX: 174 MHz ~ 174.9 MHz (Total 10 channels)

RX: 210 MHz ~ 210.9 MHz (Total 10 channels)

b. Base station:

TX: 210 MHz ~ 210.9 MHz (Total 10 channels)

RX: 174 MHz ~ 174.9 MHz (Total 10 channels)

(3)Power Range and Controls: There are no power adjustable elements and power level is fixed.

(4)DC voltages and Current into Final Amplifier:

Final Amplifier Characteristics:

Power supply: 2.15 Volts regulated from 2.5V Battery

Vce: 1.75 Volts

Ice: 3.2mA

(5)Description of any circuits or devices employed for suppression of spurious radiation, for limiting modulation and for limiting power.

Suppression of Spurious Radiation:

The circuitry between the collector of Q1 and the base of Q2 and the circuitry between the collector of Q2 and the antenna are coupled resonator filters centered at the transmitter frequency and suppress all out of band harmonics.

Limiting Modulation:

The transmitter audio processing is contained in IC1 and the external circuitry connected to IC1.This IC is configured as an ALC circuit providing microphone gain and compression beyond a certain drive level.

Limiting Power:

There is no circuitry specifically included to limit power. Output power is limited by the collector current in Q2.

Theory of Operation of Headset

Headset Transmitter Theory Of Operation

Introduction:

The following theory of operation describes in detail how the headset transmitter RF functions.

Microphone Input:

The microphone input is a noise canceling type. It is intended that the microphone be positioned with-in 1 inch of the mouth or so.

Automatic Level Control:

This circuit is designed to provide a constant audio output when the input is variable (soft vs loud speech). The component used is a Philips Semi-conductor NE578 compandor IC configured to provide ALC. With these settings, some amplitude variations will be present at normal speech levels.

Crystal Modulation:

The output of the ALC is fed to a varactor diode. The changing audio characteristics change the capacitance of the diode which is connected to the crystal. This changing capacitance pulls the resonant frequency of the crystal.

Crystal Oscillator / X5 Multiplier:

The crystal oscillator for this circuit uses a colpitts topology. Incorporated into the circuit is a high frequency 3rd overtone mode crystal. The collector of the oscillator is tuned to the 5th harmonic of the crystal. There is a capacitor adjustment to trim the oscillator to with in 5 kHz of the actual transmit frequency.

Filter:

The output of the oscillator is connected to the main filter block for the transmitter. The filter type is a 3 pole coupled resonator centered at the transmit frequency. This filter

is optimized to provide as much suppression of the 2nd, 3rd, and 4th harmonics of the oscillator as possible and no attenuation of the 5th harmonic which is the transmitter frequency.

Power Amplifier:

This is the final gain stage for the transmitter. The amplifier is operating in the class A mode and the collector is tuned to the transmitter output frequency to reduce the amount of filtering required on the output.

Filter:

The output filter is a 1 pole coupled resonator type with antenna match. This circuit provides further harmonic suppression and isolation of the PA from the antenna.

Antenna:

The antenna is a helical type wound on a 1/4 by 20 nylon thread stock. The helical antenna is operating in the normal mode and therefore has similar performance to a 1/2 lambda end fed dipole.

Theory of operation , Headset Receiver

Duplex filter:

This circuit is used to match the antenna to the low noise amplifier and reject the interference which out of needed frequencies.

LNA:

The low noise amplifier is a low current and voltage , high performance bipolar transistor manufactured by HP. The amplifier configuration is common emitter. This device provides excellent gain and the noise figure is about 1dB.

Local Oscillator:

The reciever local oscillator uses a Colpitts topology.This configuration was chosen because it works well with overtone cut cyrstals. The crystal used for this oscillator is cut for series resonance at the channel frequency minus 10.7 MHz.There is an adjustable capacitor which is used to trim the oscillator on the

exact frequency.

Mixer:

The signal on the output of the preselector and the local oscillator are combined in the transistor to create the I.F. at 10.7 MHz. And the I.F. signal and the reference frequency (10.245MHz) are combined in the mixer to generate the 455KHz signal. The mixer is part of the FM I.F. IC (Motorola MC3361C). The mixer is a narrow band FM I.F. IC and also provides a small amount of I.F. gain.

Audio Amplifier:

The demodulation signal will be into the audio amplifier IC to drive the speaker. The audio amplifier is manufactured by Philips.

Theory of Operation of Base Station

Transmitter is the same as headset topology.

Theory of Operation, Base Station Receiver

Introduction:

The following theory of operation describes in detail how the Base Station Receiver functions.

Power supply.

Regulated DC voltage is delivered to the PCB assembly via Power plug. Voltage regulation is accomplished with IC2 and IC3(+5VDC).The +5VDC supply (VCC) is used by all circuits. When you put the headset into charging place , the power will auto shut down and no radiation RF signal.

Antenna:

The antenna is a helical type wound on a 1/4 by 20 nylon thread stock. The helical antenna is operating in the normal mode and therefore has similar performance to a 1/2 lambda end fed dipole.

Duplex filter:

This circuit is used to match the antenna to the low noise amplifier and reject the interference which out of needed frequencies.

LNA:

The low noise amplifier is a dual gate MESFET manufactured by NEC. The amplifier configuration is common source.This device provides excellent gain and the noise figure is about 3dB.

Preselector Filter:

The preselector is a 2 pole coupled resonator type. There are one capacitor adjustment in the filter to optimize the band pass response. This filter, in conjunction with the input matching filter, provides a 3 pole band pass response for the front end of the receiver. The bandwidth of this filter is around 4 MHz.

Local Oscillator:

The reciever local oscillator uses a Colpitts topology.This configuration was chosen because it works well with overtone cut cyrstals. The crystal used for this oscillator is cut for series resonance at the channel frequency minus 10.7 MHz.There is an adjustable capacitor which is used to trim the oscillator on the exact frequency.

Mixer:

The signal on the output of the preselector and the local oscillator are combined in the mixer to create the I.F. at 10.7 MHz.The mixer is part of the FM Receiver I.C. (Motorola MC13156). The mixer is a double balanced active type using the Gilbert Cell topology. The mixer also provides a small amount of I.F. gain

10.7 MHz I.F.:

The next four stages after the mixer provide all the IF filtering and gain functions before audio detection. The output of the mixer is connected to a two element ceramic filter centered at 10.7 MHz. The bandwidth of the filter is 110 kHz. The output of the filter is connected to an IF Amplifier in the MC13156. This amplifier then feeds another ceramic filter for further IF shaping.The output of this filter is connected to the limiting amplifier inside the MC13156 where the signal is compressed before detection. The main function of the entire I.F. chain is to establish the receiver's operating bandwidth, system noise floor, and compress

the signal to eliminate any AM components.

Quadrature Detector:

The MC13156 includes circuitry to perform FM detection of the signal using a quadrature detector. The bandwidth of the detector is determined by a RLC resonant tank connected to the quadrature arm of the detector. The bandwidth of the tank is directly related to the Q of the circuit. The lower the Q, the wider the bandwidth, but the recovered audio is lower. The inductor in the tank is a tunable coil which is adjusted to provide the best linearity across the bandwidth of the tank (lowest audio distortion).

RSSI / Carrier Detect:

The MC13156 contains circuitry to measure the received signal strength and a carrier detect which can be used for squelching the audio when the signal gets too weak. The signal strength is determined by monitoring the current in the I.F. and limiting amplifiers. The RSSI output is a current output proportional to the signal strength. To establish a voltage, a resistor is placed from the output to ground. This resistor is adjustable so the squelch point can be set in test to the desired level.

Audio Buffer:

The recovered audio output of the MC13156 is connected to an operational amplifier buffer.

Squelch:

Audio squelch is accomplished by shorting the audio signal to ground through a 8.2 k resistor. The short circuit is supplied by using a MOSFET as an analog switch. The switch is controlled by the carrier detect circuit and an extra op amp which is used as an inverting comparator. The squelch point is adjustable.

Active Low Pass Filter:

The audio bandwidth for the receiver is established by a 4 pole active low pass filter. The filter uses two op-amps configured using multiple feed back. The bandwidth of the filter is from less than 50 Hz to greater than 15kHz.

Audio Output:

The output from the low pass filter is fed to a resistive divider to attenuate the signal level to 10mV rms (mike level input). The impedance of the circuit is set at 600 ohms. The output connector is a 3.5mm jack.

Tune-up procedure

1.Scope:

The purpose of this test procedure is to align and verify the minimum performance requirements for the RF-5615 RF transmitter assembly.

2.Test equipment:

The recommended test equipment is listed in the table below. Equivalent test equipment may be substituted.

HP8920B	RF communications test set
HP8596E	Spectrum Analyzer
V-1565	Oscilloscope
GPS-3030DD	Power supply
HP85024A	High frequency probe

3.Headset RF tune –up procedure:

a. Set the voltage of power supply to 2.5V.

b. Adjust the C14 to let the transmit frequency match each formal TX frequency

c. Measure the output power of the TX, make sure the power level is less than 5 dBm.

d. Adjust the C55 to trim the local oscillator frequency, make sure the center frequency is at 10.7MHz+/- 5KHz.

e. Input a 3KHz modulation signal , tune the C55 to match the center frequency is 455KHz and measure the SINAD in the TP13 and it must be greater than –95.

f. Trim the VR33 to adjust the "mute" function , let the RF signal is muting when receive weak signal.

4.Base station RF tune-up procedure:

a. Set the voltage of power supply to 9V.

b.Adjust the C87 to let the transmit frequency match each formal TX frequency

c.Measure the output power of the TX, make sure the power level is less than 5 dBm.

d.Adjust the C55 to trim the local oscillator frequency, make sure the center frequency is at 10.7MHz+/- 5KHz.

e.Input the modulation signal and set the input power is –60 dBm.

f.Trim the C39 , and make sure the power level is grater than –45dBm.

g.Adjust VL26 to achieve the Distortion is less than 1.2%.

h.Trim the VR33 to get the "mute" function.