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INSTRUCTION BOOK (DRAFT)
SPD-2000 800MHz

1. Receiver Circuit

The FM dual-conversion super heterodyne receiver is designed for operation in the 851-870 MHz frequency range. The Receiver has intermediate frequencies (IF) of 115.65MHz and 450kHz. Adjacent channel selectivity is obtained by using two band pass filters, a 115.65MHz crystal filter and a 450kHz ceramic filter. The RX detector is the phase digitizer.

1-1 Receiver Front-end

A RF signal from antenna is coupled though the low pass filter/antenna switch, and band pass filter to the input of low noise amplifier Q101. The output of Q101 is coupled through band pass filter to input of 1'st Mixer Z101. Front End selectivity is provided by these band pass filter.

1-2 1'st Mixer

The 1'st Mixer is a Double-Balanced-Mixer Z101, that converts a RF signal the 851-870MHz range to 115.65MHz 1'st IF frequency. The signal on the output of Z101 is provided to the input of 1'st IF amplifier Q102.

1-3 1'st IF

The 1'st IF signal 115.65MHz from the output of the 1'st Mixer is coupled through 1'st IF amplifier Q102 to Crystal filter FL103. The highly-selective crystal filter FL103 provide the first portion of the receiver IF selectivity. The output of the filter is coupled through the impedance-matching net work to IF Receiver U101.

1-4 2'nd Mixer, 2'nd IF filter and 2'nd IF amplifier

IF Receiver U101 is an one-chip IC for digital communication system. It includes 2'nd Mixer, 2'nd IF amplifier and Limiter amplifier. With the internal circuits of U101, The 1'st IF signal is amplified and applied to the input of 2'nd Mixer. The 2'nd local injection frequency 115.2MHz is applied from 2'nd local amplifier Q104 to another input of the 2'nd Mixer. The 2'nd Mixer converts a 1'st IF signal 115.65MHz to 2'nd IF frequency 450KHz. Then the 2'nd IF signal is applied to Ceramic Filter FL105(Wide Band) or FL106 (Narrow Band), which provides the 450KHz selectivity. Those IF filters are controlled by IF.NARROW signal from the microcomputer (HILLARY:U700). The ~~output~~ of the 2'nd IF filter is applied through 2'nd IF amplifier and Ceramic Filter FL104(Wide Band) to Limiter amplifier. This IF signal is amplified and balanced outputs, RXIF and RXIF, are sent to HILLARY. These two lines, one positive and the other negative, are used to cancel out any noise that might get on the line. These balance outputs is applied to the phase digitizer on HILLARY and detected.

2, Transmitter Circuit

The Transmitter Circuit consists of Modulator IC (U203), Notch Filter, Variable attenuator (CR201), Buffer Amplifier (U202), Low Pass Filter, PA Module (U201). Automatic Power Control Circuit (Q207, Q201 and U301), Antenna Switch Module (Z302).

2-1 Modulator IC and Notch Filter

The main VCO, in the synthesizer circuit, is programmed to generate the TX local Injection frequencies (806 to 815 MHz and 851 to 870 MHz). The transmitter carrier frequencies are same of TX local Injection frequencies.
Notch Filter consists of C212, C233, C244, and L210. The output of U203 is applied to Notch Filter that is through an attenuator pad R204-R206.

2-2 Variable attenuator

The output of Notch Filter is applied to Variable attenuator circuit. Variable attenuator circuit consists of R202, R203, and CR201. The transmitter carrier power is controlled by applying control voltage from Power Control Circuit. This control voltage is applied through resistor R203 to the anode of variable capacitor CR201 and R202.

2-3 Buffer Amplifier and Low Pass Filter

The output of Variable attenuator circuit is applied to the Buffer Amplifier U202 that is amplified to +6dBm. The collector voltage for U202 is provided Switch circuit and is controlled by DPTT.
Low Pass Filter consists of C207, C208, C232, and L201. The output of U202 is applied to PA module input through the Low Pass Filter.

2-4 PA Module

The input of the PA Module is amplified to about 3W. B+ (7.5 V dc) is connected U201 through RF chokes L211. The PA Module consists of two stages RF amplifier. The first stage power supply voltage is supplied by power control circuit. The second RF amplifier operates in Class-C. This output can be regulated by power control circuit.

2-5 Automatic Power Control

The Automatic Power Control circuit samples the output power to the antenna to maintain a constant power level across the band. The Automatic Power Control circuit controls the Vcont voltage to PA Module U201.
Directional coupler is include of Antenna Switch Module. Directional coupler provides a sampled signal of transmit power for diode. Diode produce a positive DC voltage proportional to the transmitter circuit output power level, that is compared to a comparator (U301) from TX POWER CONT of control unit. The output of U301 is applied to DC amplifier Q207, then the output voltage of Q207 controls to the Vcont of PA Module for constant output power level.

2-6 Antenna Switch Module

The Antenna Switch Module consists of switch circuit and the Low Pass Filter.
During transmit, DPTT line from HILLARY is high level. Transistor Q205 turns on supply +7.2V to Antenna Switch Module Z302. When transmitting, the Antenna switch diode is low impedance.

3. Frequency Synthesizer Circuit

It consists of the Reference Oscillator, PLL Frequency Synthesizer chip U305, Loop filter, Rx VCO Z303, and Tx VCO Z304.
PLL Frequency Synthesizer chip receives PLL data, and control information from the microcomputer and from this generates the Tx/Rx RF frequencies. It also provides frequency lock status to the microcomputer.
Rx VCO and Tx VCO are locked to the Reference Oscillator by a single direct-divide synthesis loop consisting of the Feedback Buffer, Prescaler, and PLL Frequency Synthesizer chip.
The Tx VCO operates over a frequency range of 806-825MHz, 851-870MHz.
The Rx VCO operates over a frequency range of 735.35-754.35MHz.

-1 Reference Oscillator

he reference oscillator consists of a 1.5ppm TCXO (Temperature Controlled Compensated Crystal scillator). The standard of reference oscillator frequency is 19.2MHz.

he TCXO is enclosed in a RF shielded can. The TCXO is compensated by internal temperature ompensated circuit for both low and high temperature. With no additional compensated the oscillator will rovide 1.5 PPM stability from -30°C to +60°C.

-2 PLL Frequency Synthesizer chip

LL Frequency Synthesizer chip U305 contains a programmable reference oscillator divider(R), prescaler, hase detector, and programmable VCO dividers (+N, A).

he reference frequency 19.2MHz from the reference oscillator is divided by a fixed integer number to otain a 6.25KHz or 3.125KHz channel reference for the synthesizer. This divide value can be changed by C PROGRAMMER.

he internal phase detector compares the output of the reference divider with the output of internal counter. he count counter receives as its input the VCO frequency divided by the Prescaler and programmed by the icrocomputer.

his results in an error voltage when the phase differ and a constant output voltage when phase-detector input ompare in frequency and phase. If a phase error is detected, an error voltage is developed and applied to the CO DC offset and loop filter to reset the VCO frequency. The count of the +N, A counters is controlled by e frequency data received on the SC.CLK, SC.DATA - and SC.SYN1LE- line from the microcomputer.

/hen a different channel is selected or when changing to the transmit or receive mode an error voltage is enerated and appears at the phase-detector output, causing the Phase Locked Loop to acquire the new equency.

-3 Loop filter

he Loop filter consists of R314 through R319 and C321 through C326. This filter controls the bandwidth nd stability of the synthesizer loop.

/hen a different channel changing or changing to the transmit or receive mode, analog switch is controlled y VCO RX/TX for PLL lock up first.

he output of the filter is applied to the varicaps in the transmit and receive VCO to adjust and maintain the CO frequency. The use of to VCO allows rapid independent selection of transmit and receive frequencies cross the frequency split.

-4 Rx VCO

he Rx VCO consists of low-noise silicon transistor oscillator, and followed by high-gain buffer.

he VCO is switched on and off VCO RX/TX line. When VCO RX/TX is low, the Rx VCO is turned on, ansistor Q301 is on. The Rx VCO output is typically 0dBm. The output is applied to the PLL Frequency ynthesizer chip for VCO frequency control and as the Receiver frequency to Rx 1'st Mixer through the 1'st ocal oscillator buffer amplifier. The VCO voltage need only be set once at some frequency of the band and plit, after which it operates over the entire split with no additional tuning.

-5 Tx VCO

he Tx VCO is basically the same as the Rx VCO. The VCO consists of silicon transistor oscillator followed y high-gain buffer amplifier. When VCO RX/TX is high, the Tx VCO is turned on, transistor Q302 is on.

-6 Lock Detect

he Lock Detect signal is outputted from synthesizer IC (U305-18). The LOCK(U305-18) is low if a large equency error exist, and will carry unlock condition to the microcomputer.

Safety Information

Radio Frequency (RF) Energy

Your Com-Net Ericsson transceiver, which radiates RF electromagnetic energy during transmit mode, is designed to comply with the following National and International Standards and Guidelines with regard to RF energy and electromagnetic energy exposure to humans:

- IEEE C95.3-1991 published August 21, 1992
- FCC OET Bulletin 65 Edition 97-01
- NCRP Report No. 119 Issued 1993
- FCC Report and Order No. FCC 96-326 (August 1996)
- American National Standards Institute (C95.1 – 1992)
- International Commission on Non-Ionizing Radiation Protection (ICNPR-1986)
- European Committee for Electrotechnical Standardisation (CENELEC)

To ensure safe and efficient operation of your Com-Net Ericsson transceiver, always adhere to the following guidelines to assure that your exposure to RF electromagnetic energy is within the above safe standards.

- Never operate transceiver without proper antenna firmly attached.
- When transmitting, hold radio in an upright position approximately 5 cm (2 inches) from mouth.
- Keep antenna at least 2.5 cm (1 inch) from body when transmitting.

Electromagnet Interference/Compatibility

Your Com-Net Ericsson transceiver generates RF energy when transmitting that can possibly cause interference with other devices or systems. To avoid such interference, turn off radio when in an area where signs are posted to do so. For example, when in hospitals, aircraft, or other areas that are sensitive to electromagnetic radiation such as blasting sites, do not operate the transmitter.