THEORY OF OPERATION

Refer to Block Diagram Drawing No. 702-115, 702-117, and appropriate Schematic Diagrams.

CIRCUIT BOARD DESCRIPTION

PRE-AMP/MIXER Board, 800-251

Each of the four microphone inputs is fed to a low-noise differential op-amp (half of an NE-5532). Critical resistors in the input circuits are low-noise, precision, temperature stable types to obtain maximum performance from the pre-amps. Monolithic chip capacitors are used to filter RF voltages that may be present at the microphone inputs. The four op-amp outputs are fed to gain pots then resistively mixed and routed to the COMPRESSOR BOARD.

COMPRESSOR Board, 800-166

Several functions are performed on this board. Integrated Circuit IC-1 serves as a (a) pre-amp [not used on the SRPT-40, (b) pre-emphasis amplifier, (c) voltage-controlled attenuator, (d) regulator/ripple rejection. Pre-emphasized audio out of IC-1B is also fed to D2 - D3 which form an adjustable series peak-limiting circuit. This circuit is adjusted to limit only audio peaks which get past the compressor. The limiter circuit feeds a low-pass filter (L1, C23, R46) which reduces the audio bandwidth to that specified for the operating channel of the transmitter. To this is mixed the output of the tone encoder, IC-2A, which is a low-distortion Wien bridge oscillator. This composite signal is then fed to the Modulation port (on P2) of the Transmitter Synthesizer Board, 800-375AT. This audio signal is also fed to IC-2B which amplifies it to a level suitable for a 600 ohm headphone monitor. IC-2C is a DC amplifier the input of which is connected to the AGC (automatic gain control) circuit and the output of which drives the audio compression meter.

AUDIO REGULATION Board, 800-168-40A

This board simply provides a regulated B+ (approximately 11 Volts) to the Pre-Amp/Mixer Board, 800-251 and the Compressor Board, 800-166. This additional regulation helps reduce power supply noise and provides B+ isolation from other circuitry.

TRANSMITTER SYNTHESIZER Board, 800-375AT

The fundamental purpose of this board is to accomplish two things: (1) Generate the final output frequency and (2) FM modulate the mixed audio. The circuitry to achieve this consists of a Phase-Locked Loop (PLL), which includes a Frequency Synthesizer IC, Voltage-Controlled Oscillator, a pre-scaler, a reference frequency oscillator, and a low-frequency loop filter. The Frequency Synthesizer IC is a programmable device for setting internal counters for allowing the reference frequency oscillator to be a perfect multiple of the final output frequency. The reference frequency oscillator is a 12.8 MHz TCXO. The low-frequency loop filter is a one-Hertz active type. The 64/128 pre-scaler is used to help aid in the multiplying.

The audio output from the 800-166 COMPRESSOR board is fed into the TRANSMITTER SYNTHESIZER's VCO which FM modulates the signal at the final output frequency. This modulated RF output signal is then sent to the 800-373A Two-Stage RF PA board for final amplification.

Included on the TRANSMITTER SYNTHESIZER board is a high-speed microcontroller. This controller decodes and acts on commands sent from the Front Panel Control & Meter board (800-378A). These commands include new frequency change (direct or channel select), control switch settings, calibration, etc. The controller also monitors and regulates forward power, monitors VSWR and PA temperature, performs auto foldback of power due to high VSWR and then recovers when VSWR lowers, and performs auto shutdown of power due to very high temp. It has internal EEPROM for storing important information such as frequency channels and historical info. The controller also detects synthesizer lock and unlock as well as enabling a fastlock feature for far frequency changes.

FRONT PANEL CONTROL & METER Board, 800-378A

This board does the following:

- Collects and sends commands to the on-board microcontroller of the TRANSMITTER SYNTHESIZER board,

- Displays LED alarm information received from the TRANSMITTER SYNTHESIZER,
- Directs POWER ADJUST analog signal to TRANSMITTER SYNTHESIZER,
- Multiplexes all analog metering signals via METER SELECT knob for independently monitoring on METER,
- Sends state of the TRANSMIT/STANDBY switch.

TWO-STAGE RF POWER AMPLIFIER Board, 800-373A

The RF output signal (50 mW max) from the TRANSMITTER SYNTHESIZER is fed into this TWO-STAGE RF POWER AMPLIFIER board. The RF goes through two stages of RF amplification. The first stage (U2) is a 1-Watt (max) pre-driver. It has an input and output transformer (T1 and T2) for achieving optimum 50 Ohm matching between the stages. The output of T2 is fed into the final PA module (U3) for an output of 50 Watts max. The signal is then low-passed filtered through FL1 and then fed through through a directional coupler for monitoring forward and reflected power. An Automatic Power Control (APC) circuit residing on the TRANSMITTER SYNTHESIZER board stabilizes and maintains an accurate output power level by comparing it to a reference power level which is set by the user via the front panel POWER ADJUST pot. The APC circuit samples the forward power via the coupled forward power on PA board.

This board also provides regulated B+ for powering the PA and the rest of the chassis when using 15-30 Volts external supply. Finally, there also exist circuitry for regulating the fan, measuring PA temperature, and monitoring PA current.

SWITCHING POWER SUPPLY, 800-324A

The Switching Power Supply accepts input from 90 to 264 VAC and supplies 15 VDC at 8 Amperes to power the SRPT-40A.

RPU TRANSMITTER I/O Board, 800-379AR

This board passes and distributes external power supply input via the back-panel ACCESSORY connector. It also passes and directs the ENCODE, TX REM CNTL, and external audio signals. All signals are LC filtered.

RF SYSTEM & CONTROL

Refer to Block Diagram Drawing 702-117. The fundamental RF generation of the SRPT-40A takes place on the TRANSMITTER SYNTHESIZER board in a circuit known as a Phased-Locked Loop (PLL). The final output frequency (Fout) is generated by the Voltage Controlled Oscillator (VCO). Fout is determined by the Reference Frequency (Fr) and N by the relation: Fout = Fr x N.

N is made up by the internal n and a counters of the Frequency Synthesizer IC and by P, the divide-by-64 prescaler. The value N is equal to: N=n x P + a. We can now write Fout in the form: Fout = Fr x (n x P + a).

Therefore, with P as a constant value of 64, the n and a counters can be programmed in such a way that the output frequency Fout will always be an integer multiple of the Reference Frequency, Fr. The a-counter will always be a number from 0 to 63, and the n-counter will be a number from 1 to 1023.

The Reference Frequency, Fr, is generated by the 12.8 MHz TCXO (Temperature Controlled Crystal Oscillator) and the internal R-counter of the Frequency Synthesizer IC. This relation is simply: Fr = Fosc / R, where Fosc = 12.8 MHz and R is the programmable R-counter.

The desired output frequency and the Reference Frequency information is sent from the operator via the front panel to the microcontroller. The microcontroller will set the n and a-counters to yield the requested output frequency, and will

set the R-counter to yield the requested Reference Frequency. The Reference Frequency is rarely changed, so typically, Fref is treated as a constant and only the output frequency is changed.

The output frequency is modulated by the injected audio at the input of the VCO. The amount of modulation is determined by the Modulation setting. The VCO will alter the output frequency in deviation and rate corresponding to the amplitude and rate (frequency) of the input voltage signal (audio). This is commonly known as frequency modulation (FM). Since the loop filter has a low frequency reponse (1 Hz), the PLL will not track the modulated signal and as a result, only the VCO output will change.

The RF power and power control circuit is shared by the TRANSMITTER SYNTHESIZER and the TWO-STAGE RF POWER AMPLIFIER. The output of the VCO is sent to a controlled amplifier and is then sent to the TWO-STAGE RF POWER AMPLIFIER for final amplification. To maintain a steady and constant RF output (over temperature and voltage changes), a sample of the RF output power (Forward coupling) is sent to the Automatic Power Control (APC) circuit and compared to a reference output power setting. Any delta changes are instantly compensated for in the APC circuit and an adjustment is made in the controlled amplifier. A MAX POWER setting can be user adjusted to limit the final RF output power.

The low-pass filter (LPF) following the final amplifier will filter out all spurious harmonics to a level lower than –60 dB. The Reverse coupling samples any return power and is sent to the microcontroller. Since the Forward coupling is also sent to the microcontroller, the VSWR can be determined. The microcontroller will “foldback” the output power if the VSWR exceeds a value of 4. Finally, all front panel alarms and indicators are sent from the microcontroller.