MAINTENANCE MANUAL
MAIN BOARD ASSEMBLY
N29/85154000920 148-174 MHz

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DESCRIPTION

The Main Board performs most of the radio's functions. It is divided into two sections by a partition in the aluminum casting. The audio, logic and system circuitry are located in one section, near the front of the radio. The RF Circuit including the synthesizer, exciter and power control circuit of the transmitter are located in the other section, near the back of the radio.

CIRCUIT ANALYSIS

AUDIO CIRCUIT

The audio circuit is located on the front section of the Main Board and on the same side as the display. The audio circuit provides all audio and tone processing for the receiver and transmitter. The audio circuit obtains all control signals from the logic circuit and interconnects with the MIC through an 8 pin RJ connector (J5). The audio circuit contains 4 main paths: a receiver audio path, a tone path, a transmitter audio path, and a receiver squelch path.

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Receiver Audio Path

Unfiltered receiver audio from the RF Circuit **(RX AUDIO_TONES)** is passed through the receiver audio path which consists of a band pass filter, muting gates, a volume control amplifier, and a 4 watt audio PA. Refer to Figure 1 for a block diagram of the receiver audio path and tone path.

RX_AUDIO_TONES first passes through a 20.0 kHz RC low pass filter, to eliminate the IF component from the RF circuit. Q23 provides additional drive for the rest of the audio circuit. The audio signal from Q23 feeds a 300 Hz high pass filter (U16-A) which provides rejection of low frequency noise and a gain of 1 (0 dB) above 300 Hz. The filter output from U16-A feeds a 3 kHz low pass filter (U16-B).

The audio signal output from U16-B feeds Voice Mute Switch (DSW1-B). This switch is closed in the receive mode when voice signal is desirable. Switch DSW1-B is muted during the idle or standby mode, the transmit mode, or when only tone alerting is desired. The Voice Mute Switch DSW1-B allows muting the receiver audio only.

The audio from DSW1-B feeds two Volume Control Amplifiers (U65-A and U65-B). The Signaling Tone line is summed with the receiver audio at the volume control amplifier. The signaling tones are used to alert and signal the listener of any events.

Signaling tones are generated by the Microprocessor in the logic circuit. Receiver volume control is provided by a digital trimpot and a 4 watt audio PA. The output from the voice mute switch feeds a 16 level volume control.

Volume control is achieved by two digital trimpots (DSW1-D, DSW1-A). Each is stepped by data from Microprocessor U77. When the **VOLUME/DOWN** buttons are pushed on the Control Panel, the Microprocessor senses the **UP/DOWN** control input ports and then steps the pot through its **TRIM_CLK** and **SY_TR_DATA** lines. The Microprocessor provides data to the pot for 16 levels of volume. The volume setting is stored in the personality EEPROM U82. When the radio is turned on, the microprocessor sends this data to the trimpots to return to the same volume setting.

Each programmable trimpot and switch is controlled by a digital trimpot IC which communicates with the Microprocessor through its data **SY_TR_DATA**, clock **TRIM_CLK** and strobe **TRIM_STB** pins. The filtered receiver audio from the Volume Control Amplifier U65-B feeds a second muting switch DSW1-E. This switch provides additional muting when the radio is in the idle mode, standby mode or while transmitting.

The 4 Watt audio Power Amplifier (U79) is fed by voltage divider R116 and R111 which determines the receive audio sensitivity at 1 kHz deviation. U79 has a gain of 29 dB. C253, C57 and R151 prevent high frequency oscillations.

U79 is muted (switched off) when DSW1-E is opened. The 4 watt audio output is routed from the Main Board to the speaker through J8. Audio output is also available on the 8-way modular MIC connector J5 and optional data interface connector J2. The internal speaker can be disabled by unplugging J8. An external speaker can then be connected through connector J1.

Tone Path

The tone path removes voice and noise signals from the unfiltered receiver audio **RX_AUDIO_TONES** to provide the logic circuit Microprocessor with limited tones and data. The path consists of CG tone low pass filters, a T99 tone bypass switch and a tone limiter.

Received tones are passed through CG tone low pass Filter (U7-A and U75-A). All CG tones below 220 Hz are passed while rejecting all other audio to reduce voice blocking of the tone. Analog switch DSW2-B provides a shorted path around the low pass filter to allow detection of Type 99 paging tones.

When the radio is in Type 99 mode, the Microprocessor turns on DSW2-B to bypass the low pass filter. This allows the paging tones to be coupled directly to the Tone Limiter U67-A. U67-A is a comparator which provides a limited signal at the tone frequency to the Microprocessor. The Microprocessor software decodes the limited tones. The pull up resistor for the comparator output is provided by the Microprocessor port.

After all tone signalling has been completed, DSW2-B is turned off. The tone path is now through the low pass filter which separates the CG tone from the voice signal. The CG tone is then limited by U67-A and passed to the Microprocessor for detection.

Receiver Squelch Path

The squelch circuit monitors the level of high frequency noise on the receiver output to determine if a carrier is quieting the receiver. A squelch adjustment sets the noise threshold level required to operate the squelch circuit at 8-10dB SINAD. When the noise falls below the threshold level, the carrier activity sensor (CAS) output switches to 5 volts. The CAS signal feeds the Microprocessor. The squelch path consists of a high pass filter, a noise rectifier/amplifier, and a comparator.

RX_AUDIO_TONES is the unfiltered receiver audio output from the RF circuit. A 6 kHz High Pass Filter (U64-A) removes all voice signals from the **RX_AUDIO_TONE** output. The filter provides a gain of 8 dB at 8-10 kHz and drops 3 dB at the 6 kHz cutoff frequency.

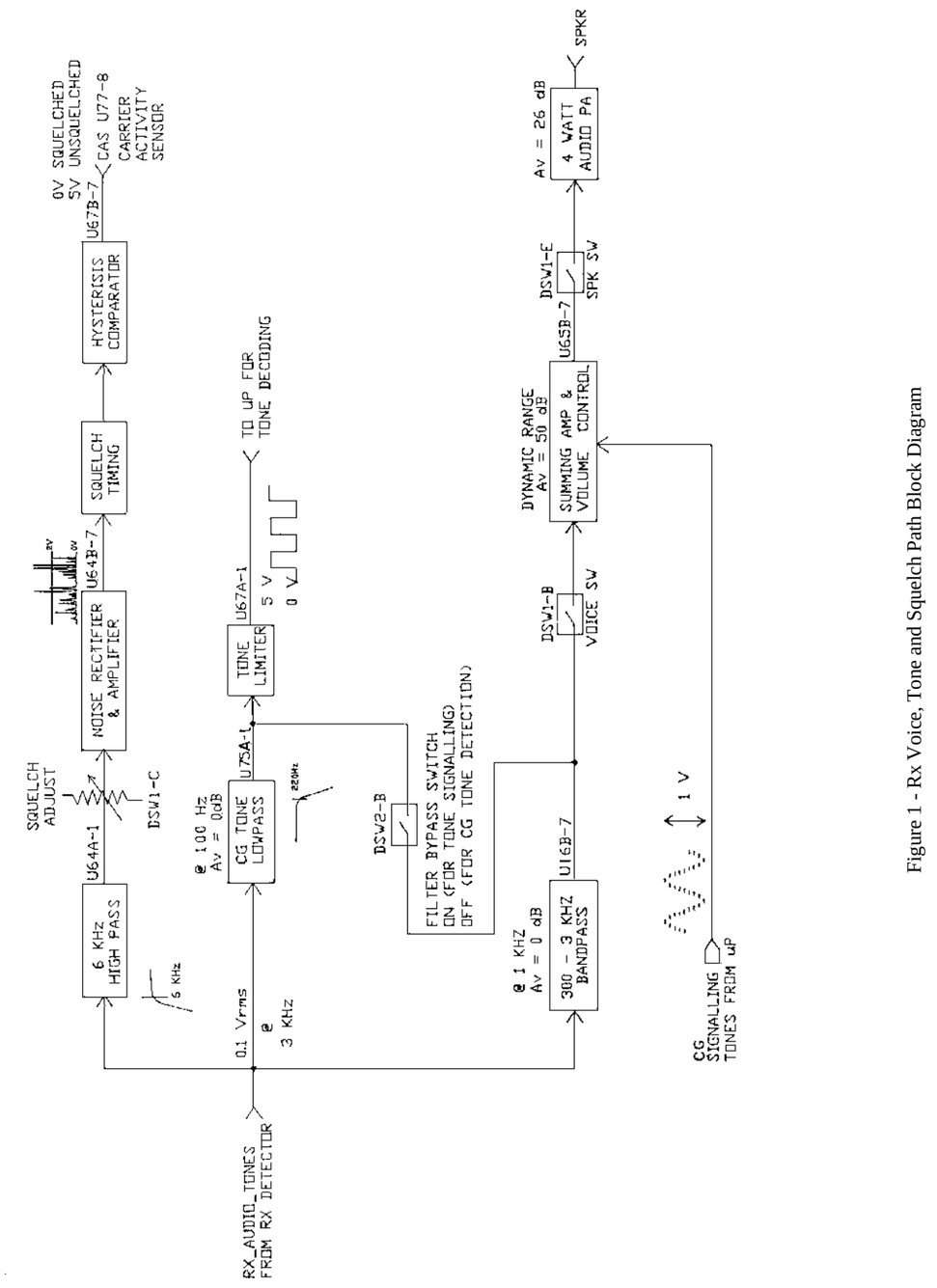

Figure 1 - Rx Voice, Tone and Squelch Path Block Diagram

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Noise in the 6-8 kHz range is coupled to the Squelch Adjust DSW1-C, which varies the level of noise to the noise Rectifier/Amplifier U64-B. U64-B is biased at ground, amplifying only the positive peaks of the noise by about 9 dB.

The rectified noise is filtered by R95 and C21 to provide an average DC level proportional to the noise level. This DC level is applied to the inverting (-) of Comparator U67-B. The non-inverting input (+) of U67-B is referenced to 90 mV.

When the DC noise level falls below 90 mV DC, the comparator output switches the CAS line to + 5 Volts to tell the Microprocessor the channel is busy with a carrier. The comparator output will remain at a logic high until the DC noise level exceeds 120 mV. This difference in voltage between the CAS turn-on and turn-off points provides sufficient hysteresis to eliminate "bubbling" or chattering noise from the speaker. The "bubbling" would normally be caused by transitional changes in the DC level around the reference point. The hysteresis is provided by R142.

Transmitter Audio Path

The audio circuit provides all transmitter audio processing. The **MIC HI** input signal is amplified, pre-emphasized, limited, and low pass filtered. Processed transmit audio and tones feed the Deviation Adjust Pot DSW2-A before leaving the audio circuit to feed the synthesizer VCO on the RF circuit.

The **MIC HI** input signal is nominally 80 mV rms at 1 kHz to produce 2.1 kHz deviation. C35, R113 and U74-A provide the 6 dB/octave pre-emphasis. C35 controls the cut-off point for the high frequency pre-emphasis above 3 kHz. R113 and DSW2-D provide an adjustable MIC sensitivity of about 12.7 dB. Voltage divider R132, R133, R134 and R135 provide the operating reference bias for U74-C and U74-D. The voltage divider also provides the limiter reference voltages for D2. When the **MIC HI** input signal is at a level such that the output of U74-A does not exceed 400 mVp-p, the gain at 1 kHz is 24 dB at U72-B pin 7. When the audio level tries to exceed 400 mVp-p at U74-A, diodes D2 conduct on the negative and positive half cycles to clip the voltage at a maximum of 400 mVp-p.

The output of D2 is fed to analog switch DSW2-E. This switch mutes microphone audio and is controlled by the Microprocessor. This switch allows muting the voice signal in the receiver mode and when only tones are to be transmitted.

The switched voice signal feeds amplifier U72-D which provides deviation adjustment. Two other inputs exists at U72-D which sums the signalling tone input and the CG tone input with the voice signal. The signaling tone is generated by the Microprocessor as a 5 Vp-p square wave. The Channel Guard tones are generated by a 5 bit DAC. This signal level is the result of a 5 bit binary weighted summer at U10-A. Next, the high frequency harmonic component is filtered away by U10-B. The output of U72-D feeds U72-C and U72-B which form a post limiter filter with a total of 18 dB/octave of filtering to the limited voice signal. The post limiter filter also provides filtering for the signalling and CG tones.

The low frequency CG tone is fed into the phase and level adjust network U72-A. The output from U72-A **TONE_MOD** (along with the **VCTCXO_CTRL**), provide the VC input to the VCTCXO (U57).

The output of U72-B **TX-MOD** is fed to the Synthesizer VCO on the RF circuit. The combined voice/tone audio is adjusted in level to produce the following ratio of deviation:

Limited voice deviation of 3.75 kHz

Channel Guard tone deviation of .75 kHz.

The CG tones are transmitted with no voice present. Their levels are set for optimum system performance. The voice and CG tones are transmitted simultaneously. The summation of these signals can produce a maximum deviation of 4.5 kHz. Figure 2 provides a block diagram of the transmitter audio path.

LOGIC CIRCUIT

The logic circuit controls the operation of the radio. It is located on the front section of the Main Board, near the speaker.

The logic circuit contains a Microprocessor and the associated memory circuits including an EPROM for controlling the processor. The software in the EPROM determines the version of the radio. A programmable "personality" EEPROM stores customer frequencies, tones, and options.

Refer to Figure 3 for a block diagram of the logic circuit. Refer to the IC data section of this manual for pin out information on integrated circuits and modules.

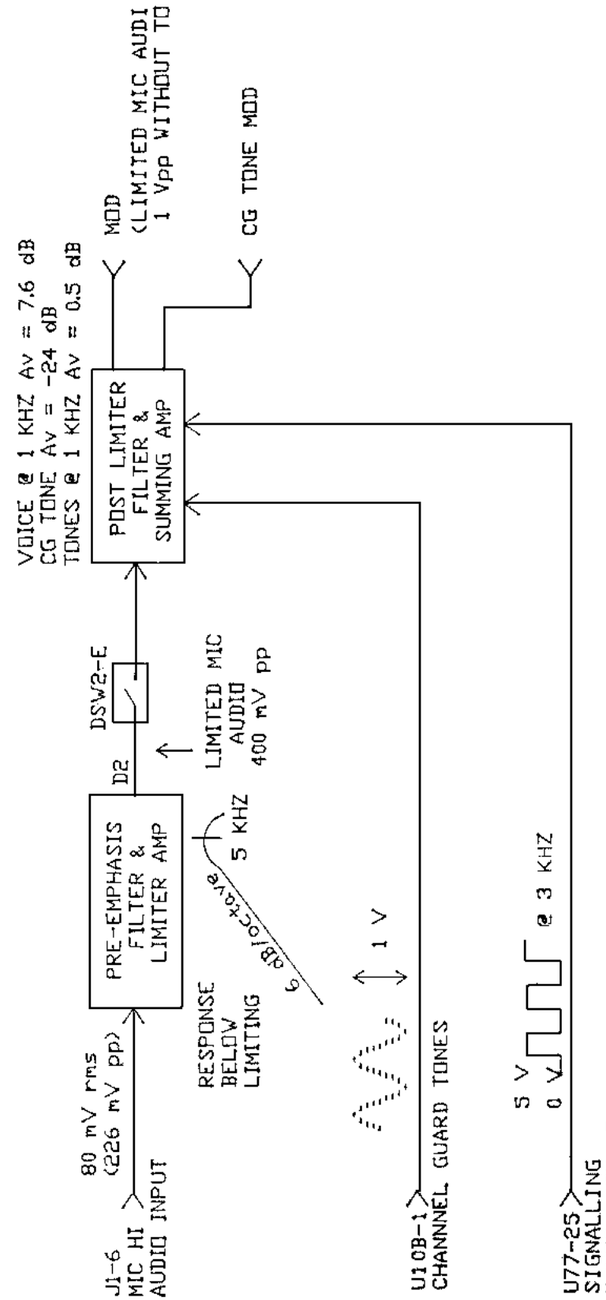

Figure 2 - Tx Audio Block Diagram

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Microprocessor

Microprocessor U77 (SIEMENS SAB 80C535) is an 8-bit processor that performs the logical functions to provide the control signals required in the radio. An external 11.0592 MHz crystal (Y1) is used for the clock. Serial data is used for communication between the Microprocessor and the test handset. The Microprocessor controls the following:

- Synthesizer
- Transmit circuit
- Decoding of system tones
- Generation of system tones
- Transmitter and receiver audio mute gates

Erasable PROM (EPROM)

EPROM U1 is a CMOS 32-kilobyte device. All information required by the Microprocessor for system operation resides in this EPROM. The EPROM contains both the operating system software and the test software. Octal latch U3 is used to demultiplex the address/data bus from the microprocessor to provide the A0 to A7 address lines for the EPROM.

Electrically Erasable PROM (EEPROM)

EEPROM U82 is designated the "personality" PROM. This personality PROM stores all required customer information which includes frequencies and tones. U82 is a 512 X 8 bit memory device. The EEPROM is programmed through J5 on the Main Board. DC power for U82 is switched by transistor Q21 during the active low reset pulse to the Microprocessor. Q21 removes + 5 Vdc from U82 to reset the EEPROM.

Horn Relay

The horn relay circuit consists of PNP buffer transistor Q20 and NPN relay driver transistor Q165. The horn relay is activated by the Microprocessor when a call is received. The circuit is capable of handling up to 500 milliamperes from an externally connected relay coil.

CAUTION

The CMOS Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the serviceman should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering, the iron should also have a 3-prong power cord connected to an outlet with a known good earth ground. A battery operated soldering iron may be used in place of the regular soldering iron.

SYNTHESIZER CIRCUIT

The synthesizer produces the 0 dBm input signal for the transmitter exciter circuit in the transmit mode and the + 8 dBm injection signal for the first mixer in the receive mode. Channels are selected by reprogramming the counters in Synthesizer U54 for a different divide number. This programming data is generated by the Microprocessor. Reference VCTCXO U57 provide a frequency stability of 5 ppm for the synthesizer chip.

Synthesizer

A simplified synthesizer block diagram is located in Figure 4. The synthesizer output signal is the VCO (voltage-controlled oscillator) frequency. This frequency is the transmit frequency in the transmit mode and the L.O. frequency in the receive mode.

The VCO frequency is controlled by a DC voltage applied across a varactor diode. This DC voltage is controlled by the phase detector in Synthesizer U54. This phase detector senses the phase and frequency of two input signals and causes the VCO control voltage to increase or decrease if they are not the same. This changes the VCO frequency until both inputs are synchronized. The VCO is then "locked" on frequency.

One input to the phase detector is the reference frequency (fR). This frequency is the 12.8 MHz reference oscillator frequency divided down by the reference counter in U54. The reference frequency is normally 12.5 kHz. The stability of the reference frequency determines the stability of the synthesizer output frequency.

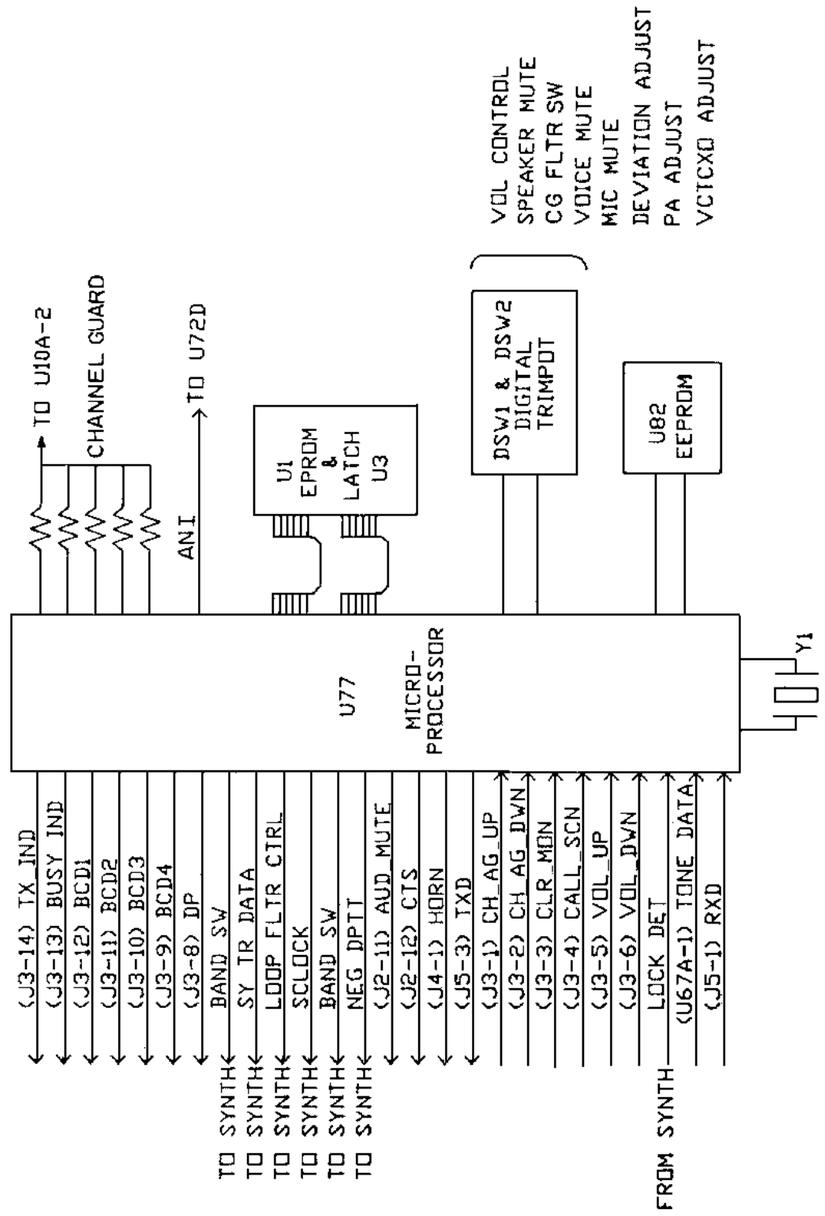

Figure 3 - Logic Circuit Block Diagram

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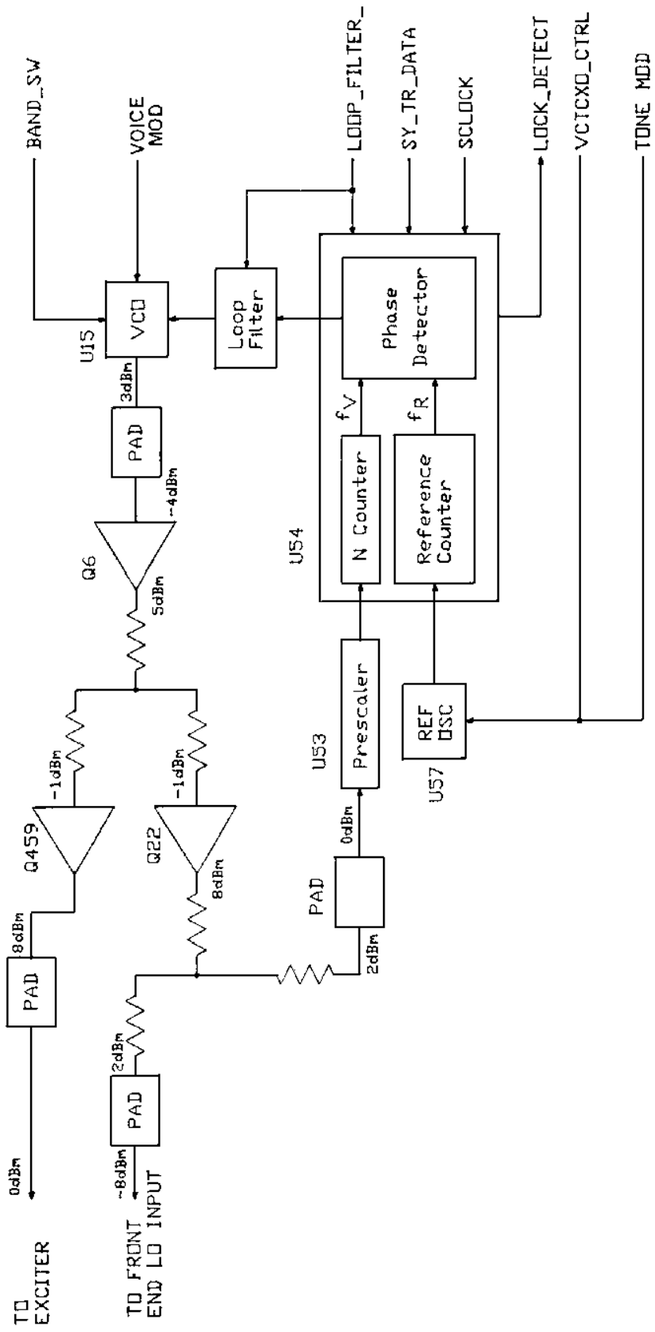

Figure 4 - Synthesizer Block Diagram

The reference VCTCXO U57 is temperature compensated to provide a frequency stability of ±5ppm from -30 to + 80 degrees °C. The reference frequency can also be finely trimmed by a DC voltage applied to the VC input of the VCTCXO.

The other input to the phase detector (fv) is derived from the VCO signal. The VCO frequency is divided down by Prescaler U53 and by the N counter in U54. These counters are programmed for each channel to divide by a number. This will result in an input to the phase detector that is the same as the reference frequency when the VCO is operating on the correct frequency. Note that the VCO, prescaler, N counter, and the phase detector form a loop. Therefore, if any component in this loop is defective, improper signals appear throughout the loop.

VCO U15

The VCO frequency is controlled by changing the DC voltage applied across a varactor diode inside. As the DC voltage across a varactor increases, the capacitance of the diode decreases and vice versa. This causes the VCO frequency to increase as the control voltage increases.

The VCO is frequency modulated in a similar manner. The transmit audio signal is applied across another varactor diode to vary the VCO frequency at an audio rate. A compensation network is used to ensure that modulation remains constant over the entire frequency band of the VCO. This compensation is required be-cause modulation tends to increase as VCO frequency gets higher.

The resonant frequency of the tank circuit is increased in the receive mode by approximately 45 MHz. It is achieved by switching in additional capacitance by means of a pin diode. This is done to keep the VCO control voltage in the middle of its range.

Injection Chain

The VCO signal is attenuated by a pad formed by R17, R13, and R14 before being coupled to amplifier Q6. The amplified signal is divided and applied to two other amplifiers Q459 and Q22. Output from amplifier Q459 is attenuated by R220, R222 and R221 to drive the Exciter Module. Output from amplifier Q22 is divided into two separate paths. One path goes to a pad formed by R226, R229, and R76 and then drives Prescaler U53. The other path provides the L.O. signal for the Front-End Module after attenuated by R207, R206, and R205.

Prescaler U53

The prescaler is hardware set to divide by 64/65. The division ratio is controlled by a logic signal at pin 6, the MODULUS CONTROL input from synthesizer IC U54. U53 divides by 64 when the control input from the synthesizer is high and by 65 when the control input is low.

Adaptive Loop Filter

The loop filter consists of C137, C138, C139, R39, R40, R41. This low pass filter controls synthesizer stability, lockup time and suppresses the loop reference frequency (f_R). Analog Switches U61-A and U61-D are used to bypass the resistance in the loop filter to speed up the lockup time. These switches are enabled for about 5 ms whenever the synthesizer chip is reprogrammed. A logic high closes the switch and a low logic opens the switch.

The VCO frequency is controlled by a DC voltage filtered by the loop filter. The input signal to the loop filter is the APD (analog phase detector) output of U54. This output is from a sample and hold circuit which produces a voltage proportional to the phase difference between the fV and fR signals. If the phase of fv lags that of fR, the APD output ramps up between the time the fv and fR pulses occur. Conversely, if fv leads fR, the APD output ramps down during this period. The greater the phase difference, the more the ramp voltage increases or decreases before it holds. When the synthesizer is far out of lock such as when the channel is changed, the VCO is swept into lock by pulses, occurring at a rate equal to the frequency difference between fR and fv.

Buffer Q16 provides a low impedance output to the loop filter. This isolates the high impedance output of the APD output so that it does not affect the roll off characteristics of the filter. Q16 also improves the current drive capability of the APD output which results in a faster lockup time.

RECEIVER CIRCUIT

The double conversion receiver circuit consists of a front end module, a 45 MHz IF module and a receive switch. Both modules are shielded to prevent interference to their sensitive circuits. See Figure 6, on page 12, for a block diagram of the Receiver section.

NOTE

The following circuit analysis for the Front End Module (VC1), references components found in Figure 5 on page 11. The schematic and outline of VC1 and any mention of the components are for reference only.

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Front End Module VC1

RF is coupled from the PA board through a coaxial cable to the receiver front end. Inside the front end module, a coupled-tuned circuit and a bandpass filter module F1 establish the receiver pass band of 18 MHz. The receiver is pretuned at the factory to the most commonly used section of the spectrum, but it may be adjusted to anywhere within the split by tuning the slugs of L1 and L2.

Q1 is a dual-gate MOSFET amplifier which serves to increase the sensitivity of the receiver. The first mixer is a double-balanced diode type formed by T1, T2, D1 and D2. It has inherent good LO-RF isolation and good intermodulation and spurious performance. The mixer assembly is shielded to prevent stray magnetic fields from affecting the neighbourhood circuit. A JFET Q3 with the gate grounded buffers the IF signal and provides a broadband termination to the mixer IF port ensuring good spurious as well as intermodulation performance. The LO signal from the synthesizer is amplified by Q2 to + 8 dBm to drive the mixer.

45 MHz IF Module VC2

A first IF frequency of 45 MHz is employed. This module contains a band pass crystal filter centered at the first IF frequency with a bandwidth of 15 kHz to provide part of the selectivity. The IF signal is further amplified and converted to the second IF frequency of 455 kHz where it is band pass filtered, limited and then demodulated. The IF module operates from a single 5 volt supply.

Receive Switch

During receive when **NEG_DPTT** goes high, Q1 and Q13 are turned on supplying 8 Volts to Vcc2 of the front end module. The 8 Volts applied to Vcc2 turns on the RF amplifier inside. The reverse happens during transmit.

TRANSMITTER CIRCUIT

The transmitter consists of a fixed tuned 1.5 Watt Exciter Module, a power control circuit and a transmit switch.

Exciter Module U52

The synthesizer drives the exciter module at 0 dBm. Exciter Module U52 operates from a switched 8 volt supply. The module is designed for wideband operation and requires no adjustment. Both input and output ports operate at a 50 ohm impedance level. Output power is varied by means of the AGC voltage which may be varied between 6 to 12.5 volts.

Power Control Circuit

The function of the power control circuit is to maintain a constant output power across the band. Thermistor U14 senses the temperature inside the radio and reduces the output power when the temperature exceeds a set threshold. This circuit controls the supply voltage t the last amplifier in the exciter module U52.

The DC voltage proportional to the RF output power from the detector circuit on the power amplifier board feeds the (+) input of op-amp U55-A. A fixed reference voltage developed by potential divider R54 and R55 feeds the (-) input of the same amplifier. The difference is amplified and drives the (-) input of U55-B. The difference between the two inputs is amplified and varies the drive to transistor Q4 and Q15. With **NEG_DPTT** pulled low by the microprocessor during transmit, Q3 and Q14 are turned on. This enables Q15 to vary the supply voltage to the last amplifier in the exciter module, thus achieving variable output power.

Thermistor U14 and resistor R166 form a variable voltage divider with temperature. Above a set threshold, diode D8 conducts and **PA_REF** is reduced which then throttles the output power down.

Transmit Switch

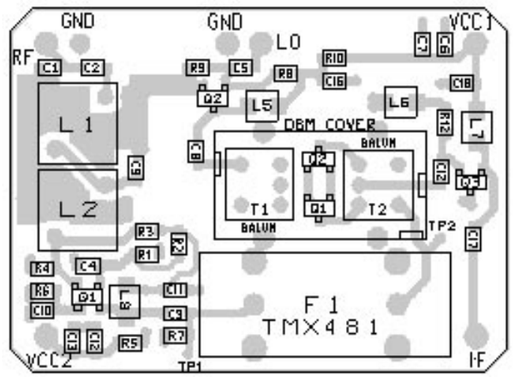
During transmit, the Microprocessor pulls the **NEG_DPTT** line low, the collector of Q5 then goes high and turns on Q12. Q12 then supplies the base drive to turn on transistor Q1 7 which provides **8V_SW** to the exciter module and the PIN diode switch on the PA Board.

POWER DISTRIBUTION

The audio circuit receives 13 volts from the **A + _SW** line on the Main Board. This voltage feeds Regulator U22 and audio PA U79. The regulator supplies 5 volts to all op-amps except U70. A regulated 1.8 volt bias supply is provided by Regulator U83, operating from the **A + _SW** line. A regulated 8 volt supply is provided by D11 to U70, operating also from the **A+ _SW** line.

Voltage Regulator U63 supplies a regulated 5 volts DC to the Microprocessor, the EPROM and the latch circuit. A reset circuit is built into U63 to provide the Microprocessor with a reset signal required during its power-up routine.

TOP VIEW



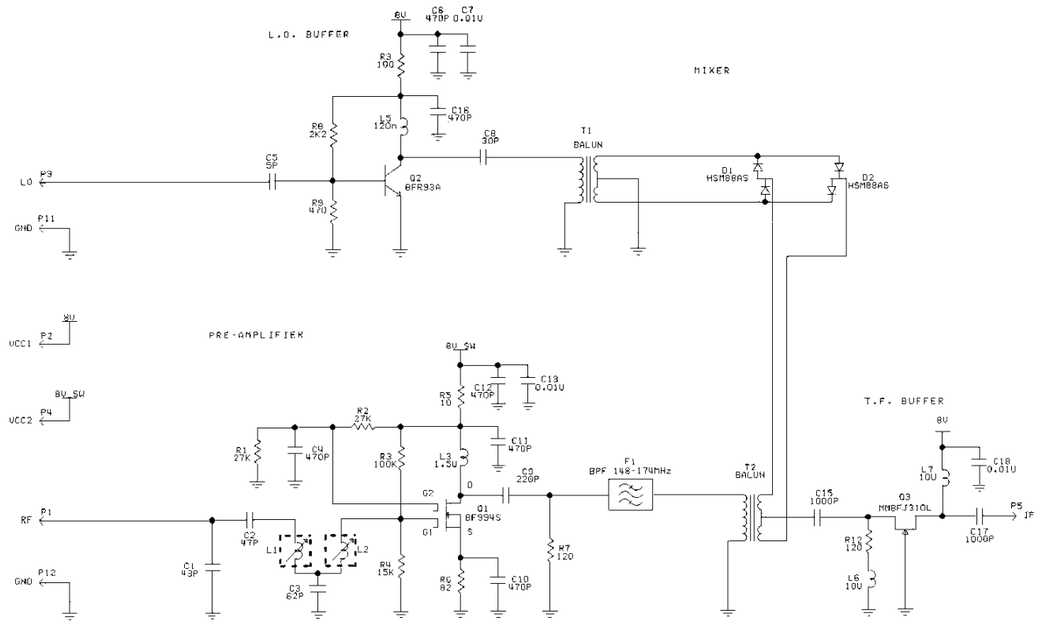


Figure 5 - Schematic And Outline For Front End Module VC1

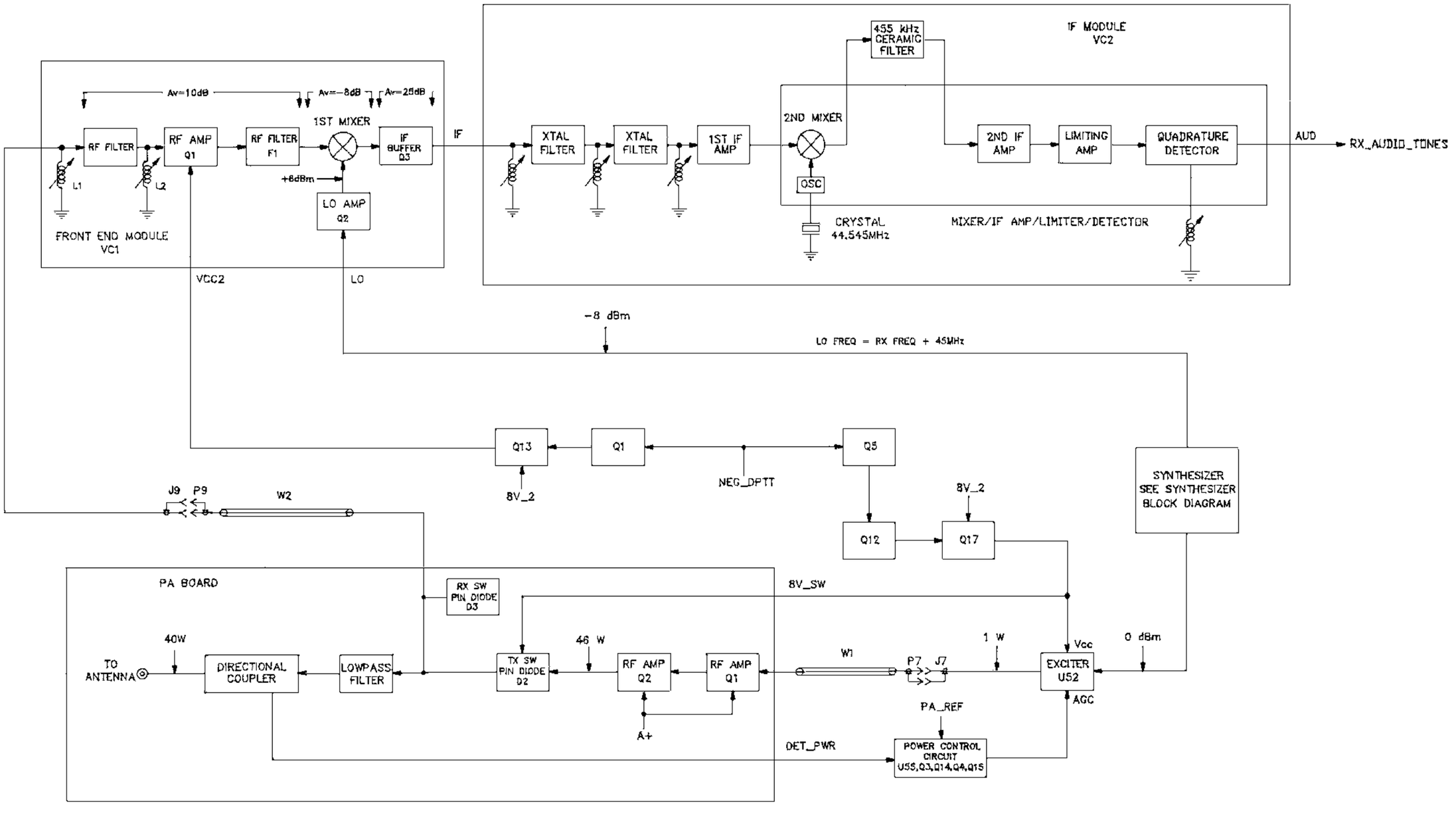


Figure 6 - Rx and Tx Block Diagram

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Transistor circuit Q24 is a filter for the **IGN_A +** battery voltage. This circuit is used to reduce "alternator whine" interference. The filtered **A + _FILTER** (13 volts) is used in the handset and on the audio circuit.

The RF circuit is powered by three Regulators U58, U30 and U60, which operate from the switched 13.8 volts (**A + _SW**) line. Regulator U58 supplies 8 volts exclusively for the VCO to ensure low synthesizer noise. Regulator U30 supplies 8 volts to the PLL IC U54, injection amplifier chain Q6, Q22 and Q459 of the synthesizer, U55 in the power control circuit of the transmitter, the Exciter Module U52 and also the receiver Front End Module VC 1.

A 5 volt Regulator U60 supplies power to the receiver IF module, VCTCXO in the synthesizer and also to the prescaler.

SERVICE NOTES

AUDIO CIRCUIT

1. Refer to the block diagrams Figures 1 and 2, for proper signal levels and gains for the various audio paths.

2. All bias point (VB) shown on the audio circuit schematic diagram are generated by Regulator U83. None of the operational amplifier circuits will operate properly without this voltage.

When measuring signal levels, remember that the inverting (-) input ports are "virtual grounds." Little or no measurable AC voltages will be present at these ports.

LOGIC CIRCUIT

DC Checks

Power for the logic circuit is supplied by the 13 volts on J4-pin 4.

1. Check for +5 volts ±0.25 volts on U63, Pin 5.

2. Check Power-On Reset on U77, Pin 10 (see Figure 7). If not present, check Regulator U63, Pin 2 and transistor Q21.

3. Check for oscillator activity by examining the ALE clock on U77, Pin 50 (see Figure 8). If not present, examine the system clock on U77, Pin 30 and 40 (at 11.059 MHz). The presence of the system clock but no ALE may indicate a bad U77. If the system clock is not present, Y1 and related components may be suspected.

4. All output lines from the Microprocessor are pulled high to + 5 Volts through resistors inside the Microprocessor. If a line is high, you may ground that pin and monitor the result. However, if a line is low, the line may not be forced to + 5 volts.

SYNTHESIZER CIRCUIT

Synthesizer troubleshooting consists of first checking for the proper DC levels, then determining if the proper waveforms are present and checking individual modules.

DC Checks

8.2 volts is supplied by Regulator U30 and serves as the biasing voltage for transistor circuits Q6, Q22, Q459 and Q16. The VCO U15 is powered by a separate 8 volt Regulator U58. The 8.2 volts supply is decoupled by a 10 ohm resistor R30 resulting in 7.95 volts at pin 2 of the module. A 5 volt Regulator U60 provides power for VCTCXO Module U57. A 47 ohm resistor R23 decouples the DC supply. Approximately 5 volts exist at pin 1 of the VCTCXO Module.

Waveforms

Synthesizer waveforms in Figures 9 through 11 were measured with a 10 megaohm, 30 pF probe. Use DC coupling.

Module Isolation

VCTCXO Module U57:

Look for a wave form similar to the reference on pin 2 (refer to Figure 9). If the waveform is not present, the module is probably defective.

VCO UIS:

In the receive mode, connect a DC power supply to pin 5. With 1.6 Vdc on pin 5, the output at pin 1 should be approximately 193 MHz. With 6 Vdc on pin 5, the output should be approximately 219 MHz. Either change to transmit mode or force the **BAND_SW** line to 8 volts. This will change pin 3 to ground. The out-put frequencies for 1.5 Vdc and 6.9 Vdc should be approximately 45 MHz higher.

Output power of the VCO can be measured by connecting a coaxial cable to pin 1 of the module. R17 and R13 should be disconnected from the circuit. The output power should be around 2 - 5 dBm.

Prescaler U53:

Connect pin 5 of the VCO to a power supply set at 3 Vdc. With the radio in receive mode, monitor the frequency of the VCO at the junction of R225 and R479. DC short pin 6 of U53 to ground. This will cause U53 to divide by 65. The frequency at pin 4 of U53 should be the VCO frequency divided by 65. Tie pin 6 to 5 Vdc, to force it to divide by 64. Check the frequency at pin 4 to verify that this happens. Improper division may indicate a faulty prescaler.

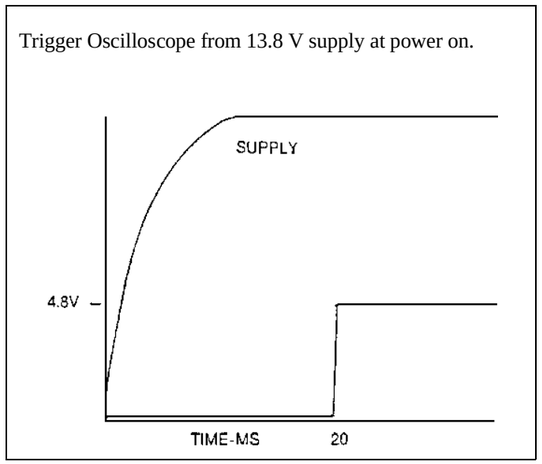


Figure 7 - Microprocessor (U77, Pin 10)

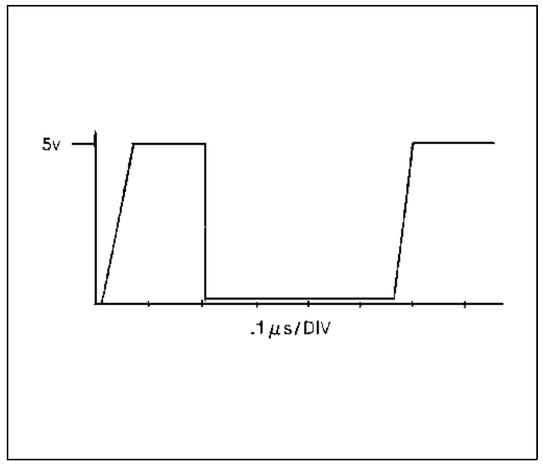


Figure 8 - Microprocessor (U77, Pin 50)

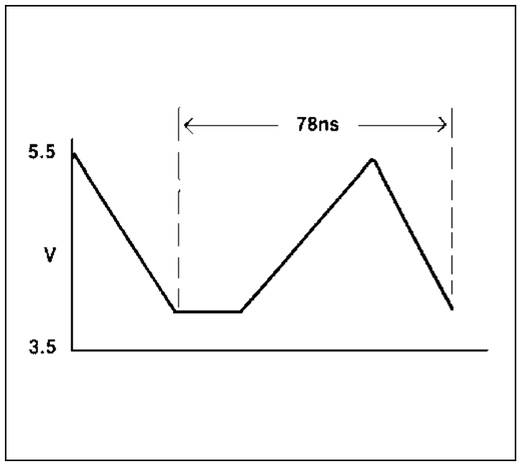


Figure 9 - Reference Oscillator (Input to U54, Pin 2)

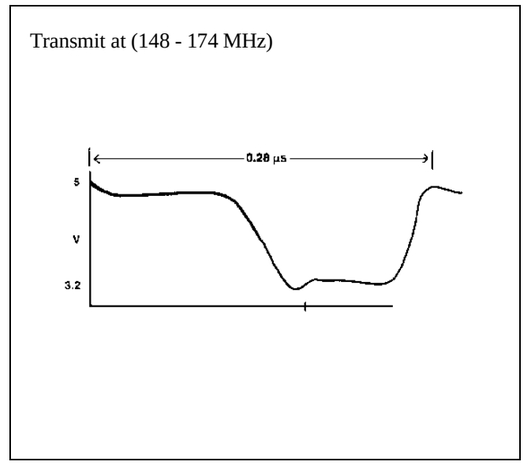


Figure 10 - F_{IN} (Input to U54, Pin 10)

LBI-38756

Bilateral Analog Switch U61:

This switch is used to short around parts of the loop filter during channel scan. A shorted (to ground or adjacent gate) gate may be isolated by comparing voltages through the loop filter to those of a functioning radio. Defective gates might be suspected when the radio does not change frequency quickly enough.

Phase-Lock-Loop U54:

There are no specific checks which aid in the evaluation of U54. Usually it is suspected only if all other checks are OK. Before changing, visually inspect chip components for mechanical damage and check resistances through the loop filter.

The top of the ramp is approx. 0.8 Volts DC greater than the control voltage on PD out, Pin 17.

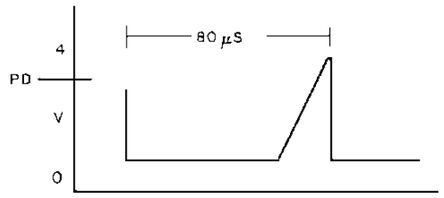


Figure 11 - Ramp (Generated in U54 and Appears on Pin 15)

Injection Chain Q6, Q22, Q459:

Refer to synthesizer block diagram to check gain of each individual stage.

TRANSMITTER CIRCUIT

Transmitter problems may be located on the main board or on the PA board. Most of them can be identified by checking the TX stage gains shown in Figure 6 - RX and TX Block Diagram. Refer to the Power Amplifier Board manual, LBI-38758, for problems located on the PA Board.

Transmitter Troubleshooting

1. Ensure that the **NEG_DPTT** is low when the microphone PTT is keyed down.

2. Check for approximately 8 volts at the Vcc input of the exciter module. If not present, troubleshoot the TX switch circuitry, Q5, Q12 and Q17.

3. Check for a 6 - 12.5 volts adjustable voltage at the AGC input of the exciter module. Adjust the power level control to maximum, the voltage at the AGC input should be approximately 12.5 volts. If not present, check power control circuitry, U55-A, U55-B, Q3, Q14, Q4 and Q15.

4. Check for approximately 0 dBm at the exciter module input and a minimum of 1.5 watts at the output. If the input is abnormal, the problem may be in the synthesizer injection chain. If the output is abnormal, the module might be suspected.

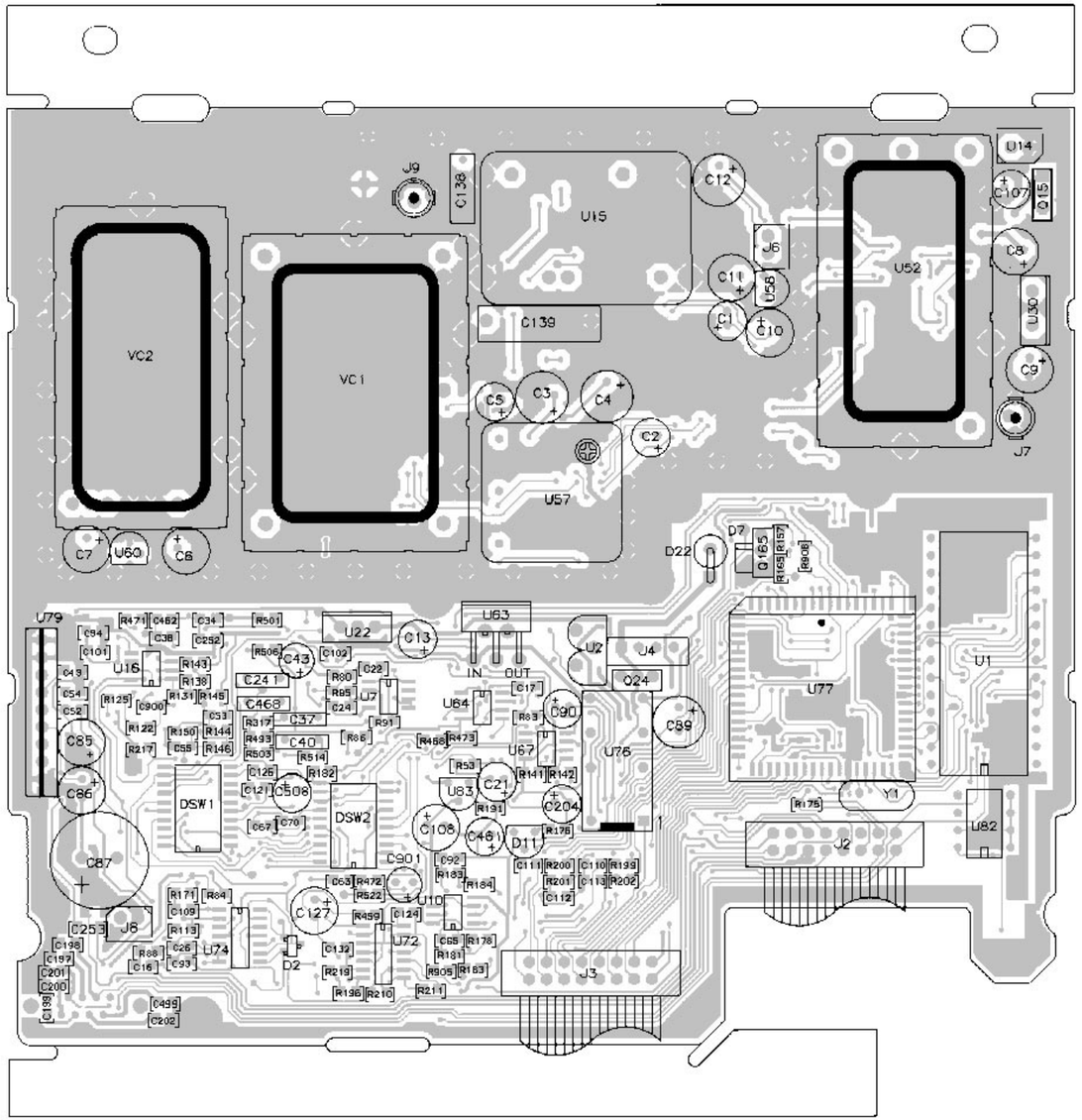
RECEIVER CIRCUIT

Refer to the following Receiver Circuit Symptoms and Checks chart to isolate a receiver problem.

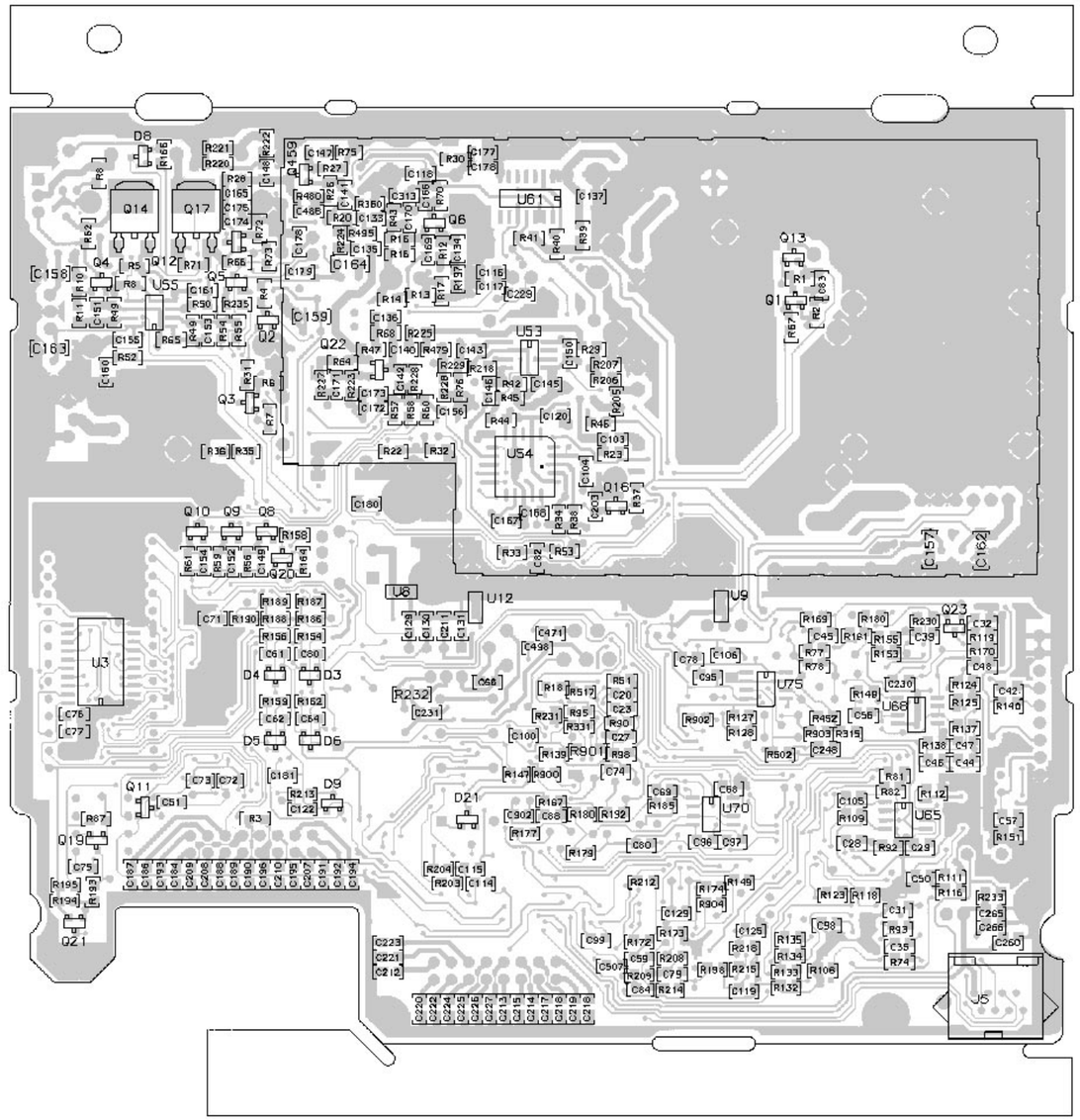
RECEIVER CIRCUIT SYMPTOMS AND CHECKS

SYMPTOMS	CHECKS
No Audio	1. Supply voltage to Front End and IF modules 2. Level and frequency of LO injection 3. IF module output
Poor SINAD	1. Consult Figure 6 RX-TX Block Diagram to check stage gain 2. Input coaxial cable 3. Shorted PIN diode switch on PA board
Distorted Audio	1. LO injection frequency 2. IF module

TOP VIEW

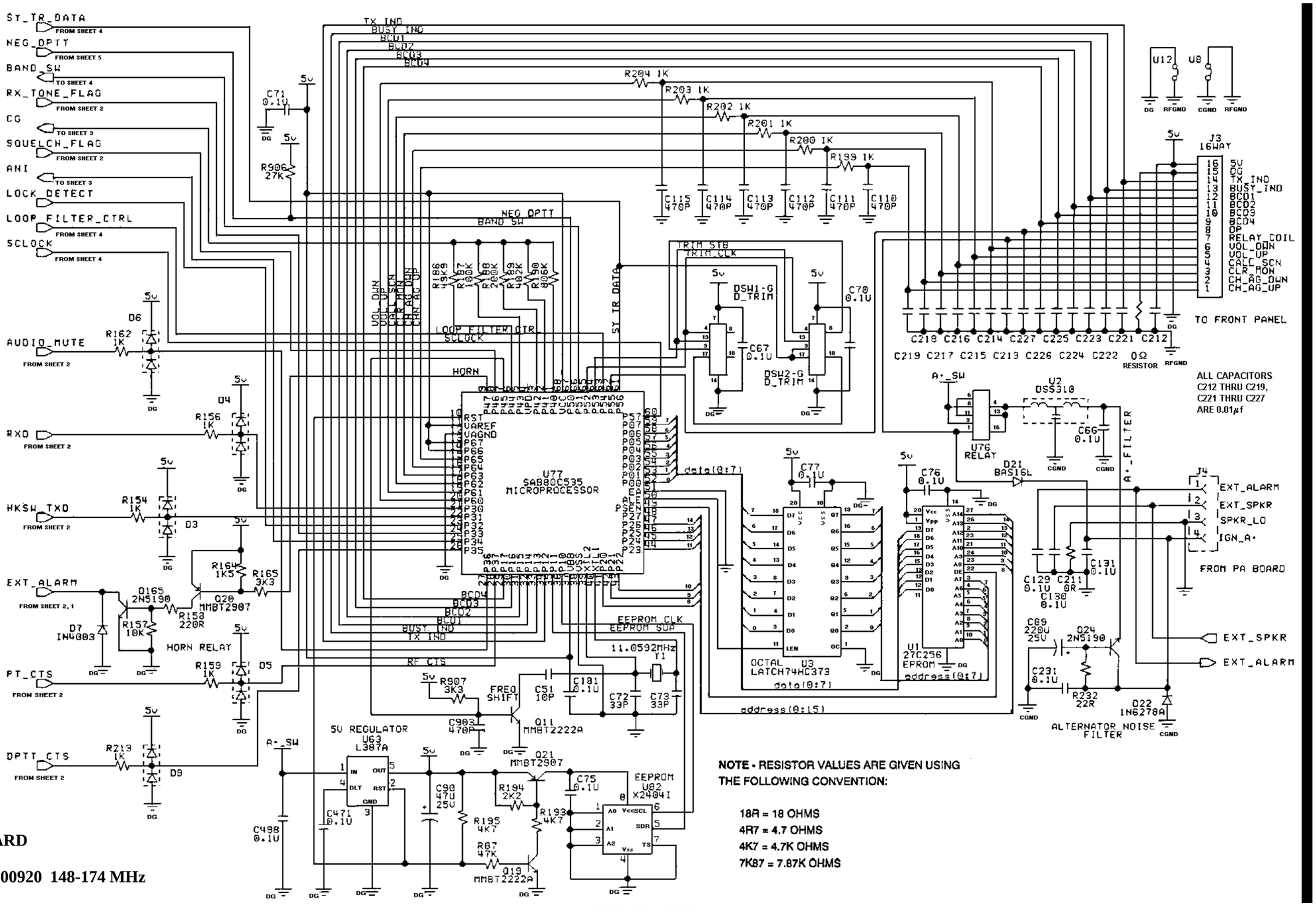


BOTTOM VIEW



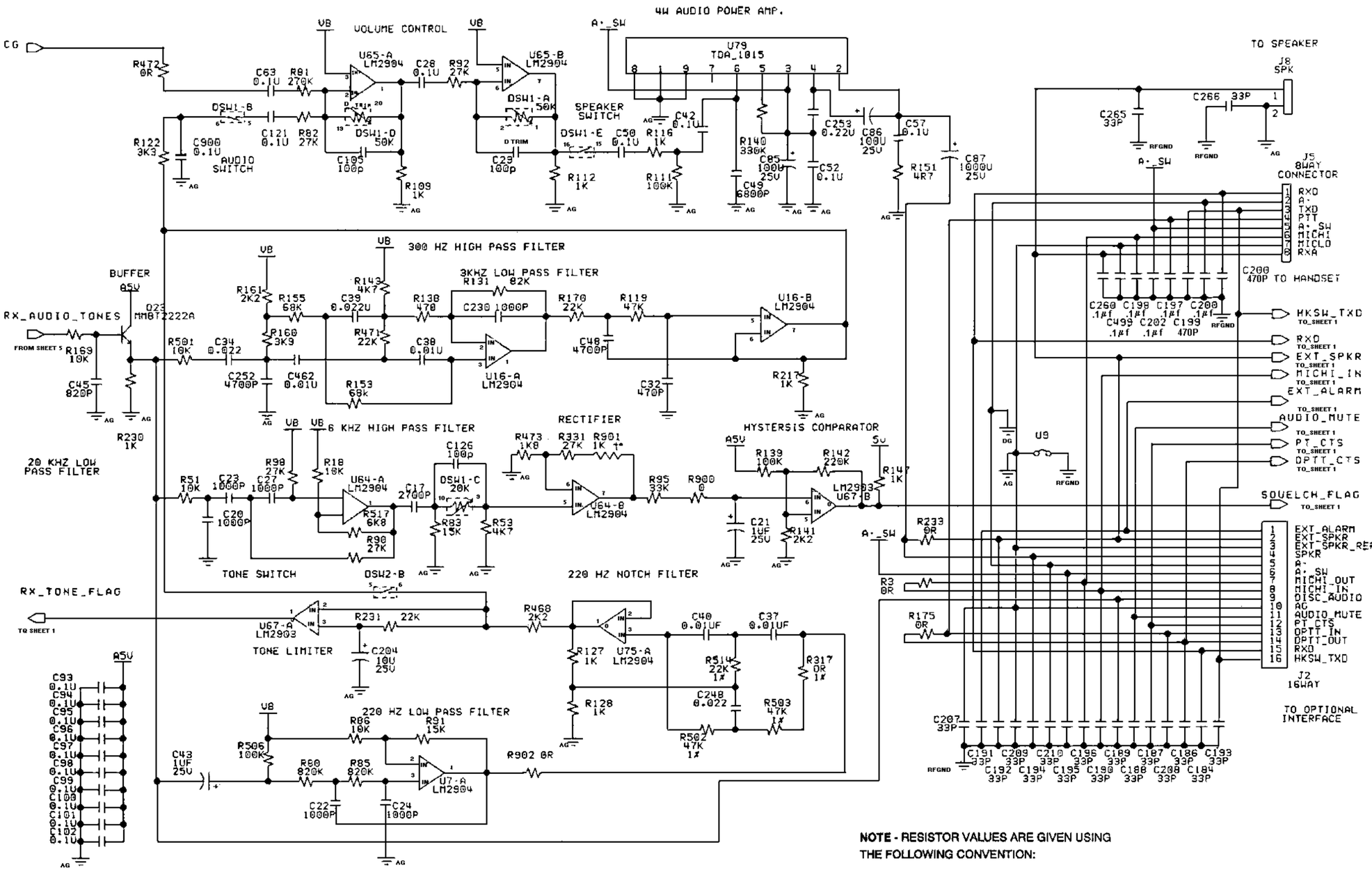
(042-54000162)

MAIN BOARD
N29/85154000920 148-174 MHz



MAIN BOARD
CPU
N29/85154000920 148-174 MHz
Sheet 1

(RC-8670, SHEET 1, ISSUE B)

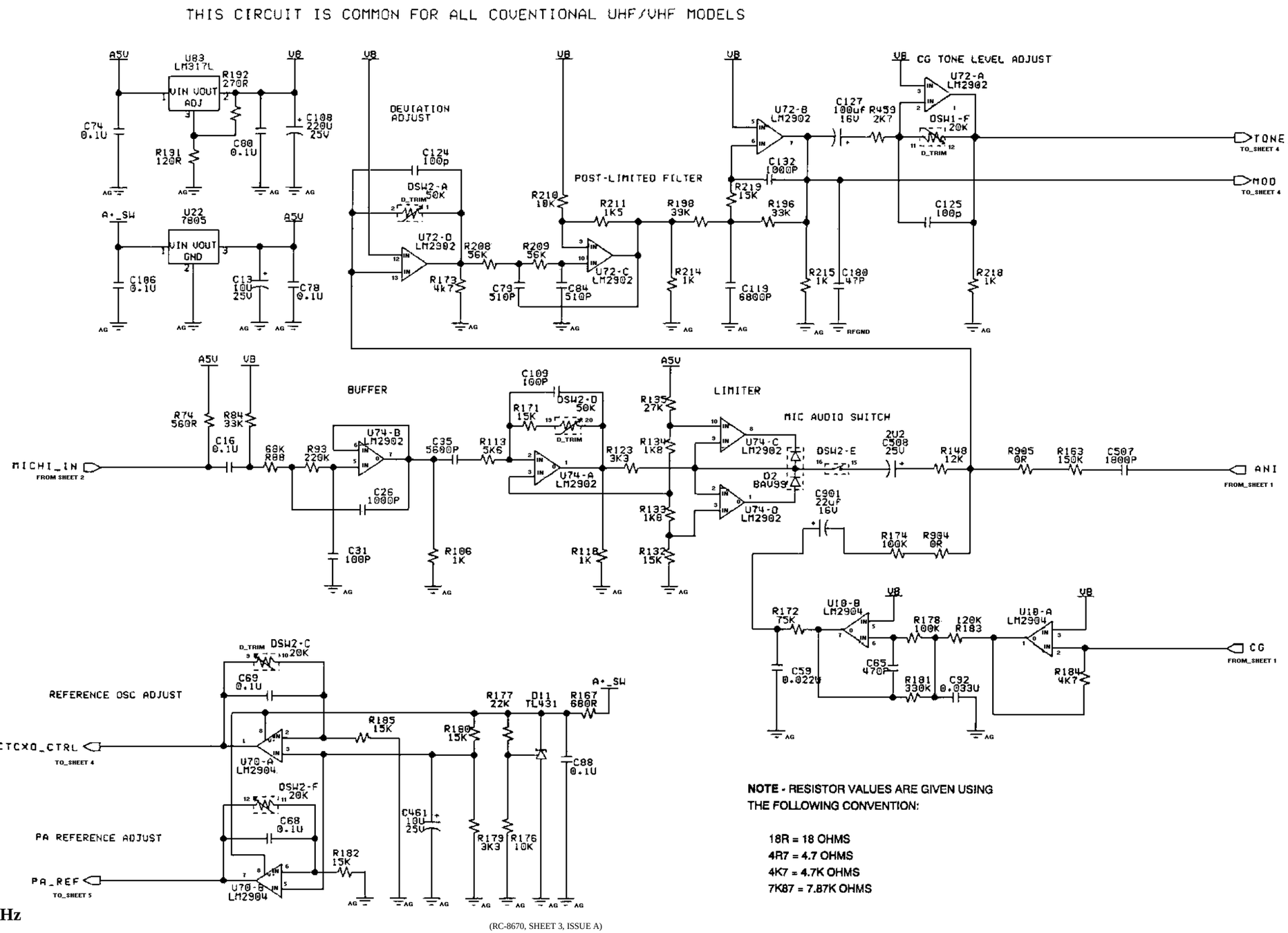


NOTE - RESISTOR VALUES ARE GIVEN USING THE FOLLOWING CONVENTION:

18R = 18 OHMS
4R7 = 4.7 OHMS
4K7 = 4.7K OHMS
7K87 = 7.87K OHMS

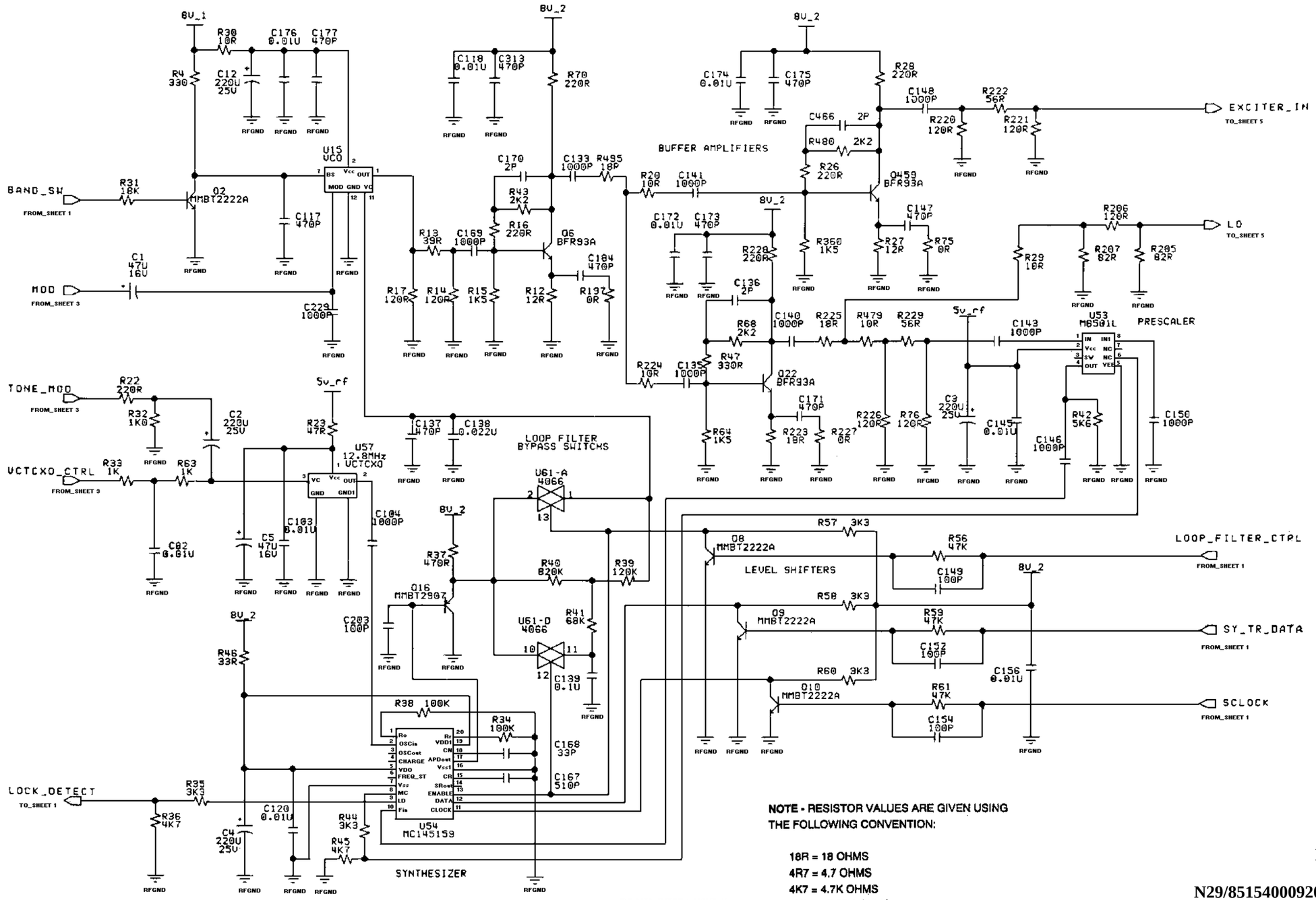
(RC-8670, SHEET 2, ISSUE B)

MAIN BOARD
Receiver Board
N29/85154000920 148-174 MHz
Sheet 2



MAIN BOARD
Transmitter Audio
N29/85154000920 148-174 MHz
Sheet 3

(RC-8670, SHEET 3, ISSUE A)

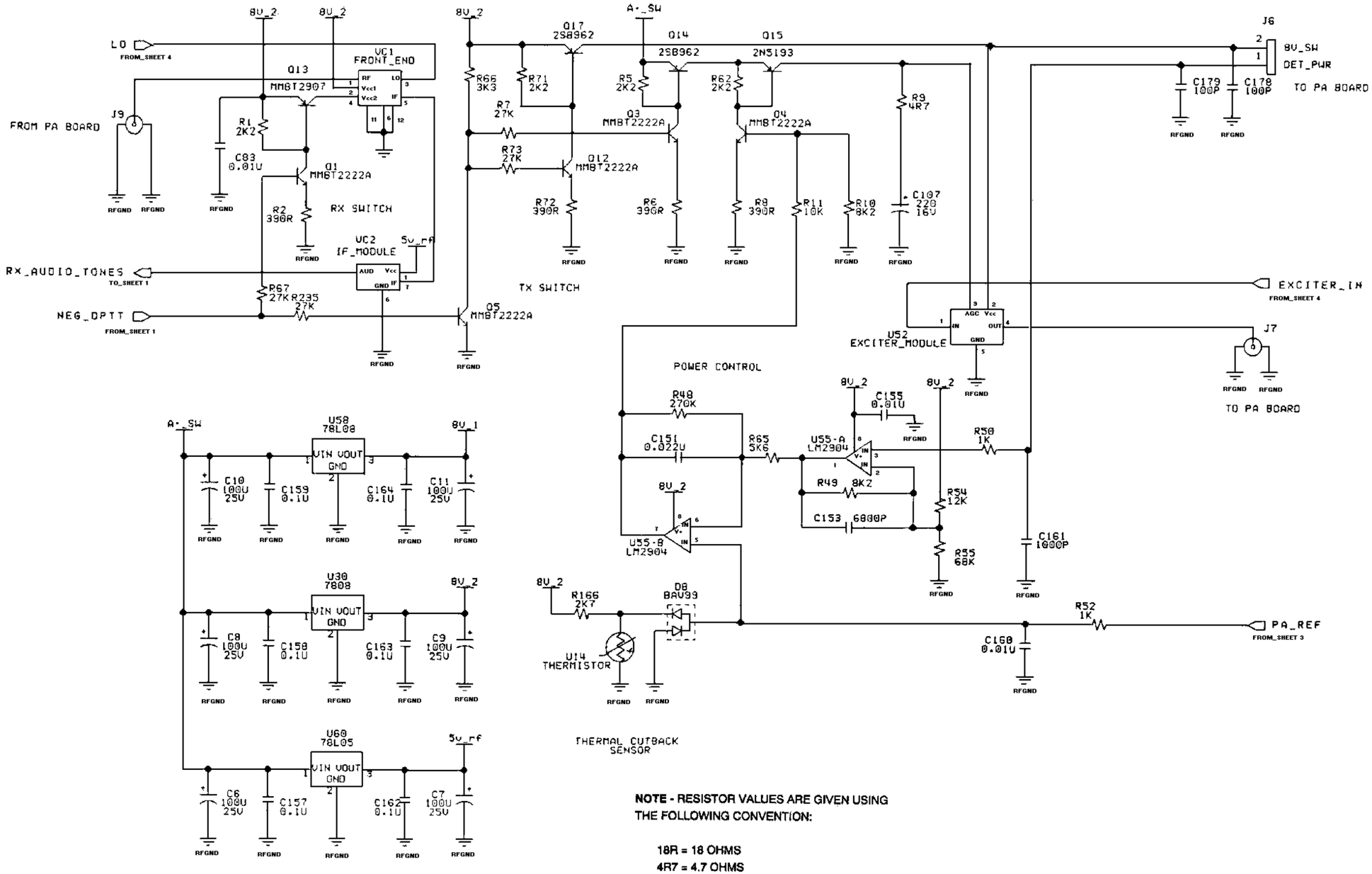


NOTE - RESISTOR VALUES ARE GIVEN USING THE FOLLOWING CONVENTION:

18R = 18 OHMS
4R7 = 4.7 OHMS
4K7 = 4.7K OHMS
7K87 = 7.87K OHMS

(RC-8670, SHEET 4, ISSUE A)

MAIN BOARD
Synthesizer
N29/85154000920 148-174 MHz
Sheet 4



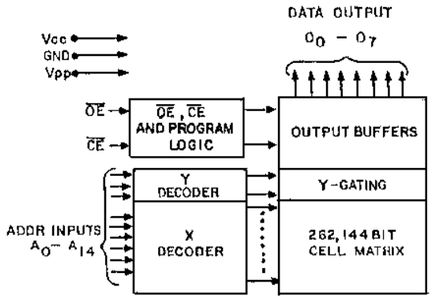
NOTE - RESISTOR VALUES ARE GIVEN USING THE FOLLOWING CONVENTION:

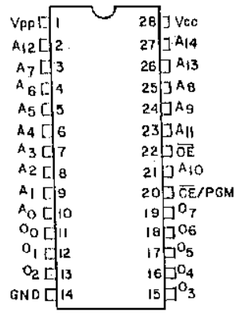
18R = 18 OHMS
4R7 = 4.7 OHMS
4K7 = 4.7K OHMS
7K87 = 7.87K OHMS

(RC-8670, SHEET 5, ISSUE A)

MAIN BOARD
Receiver and Transmitter AGC
N29/85154000920 148-174 MHz
Sheet 5

U1 - EPROM (27C256)

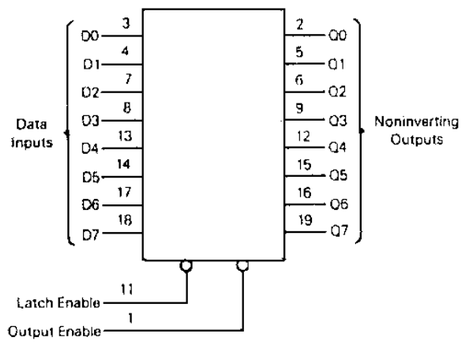




PIN NAME	
$A_0 - A_{14}$	ADDRESSES
CE	CHIP ENABLE
OE	OUTPUT ENABLE
$O_0 - O_7$	OUTPUTS
$\overline{PGM}$	PROGRAM
NC	NO CONNECT

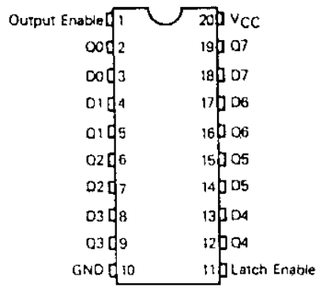
U3 LATCH (74HC373)

BLOCK DIAGRAM



Pin 20 = V_{CC}
Pin 10 = GND

PIN ASSIGNMENT

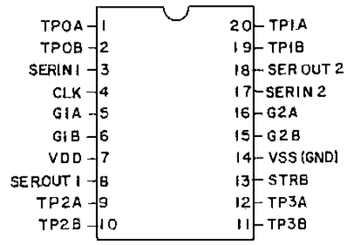


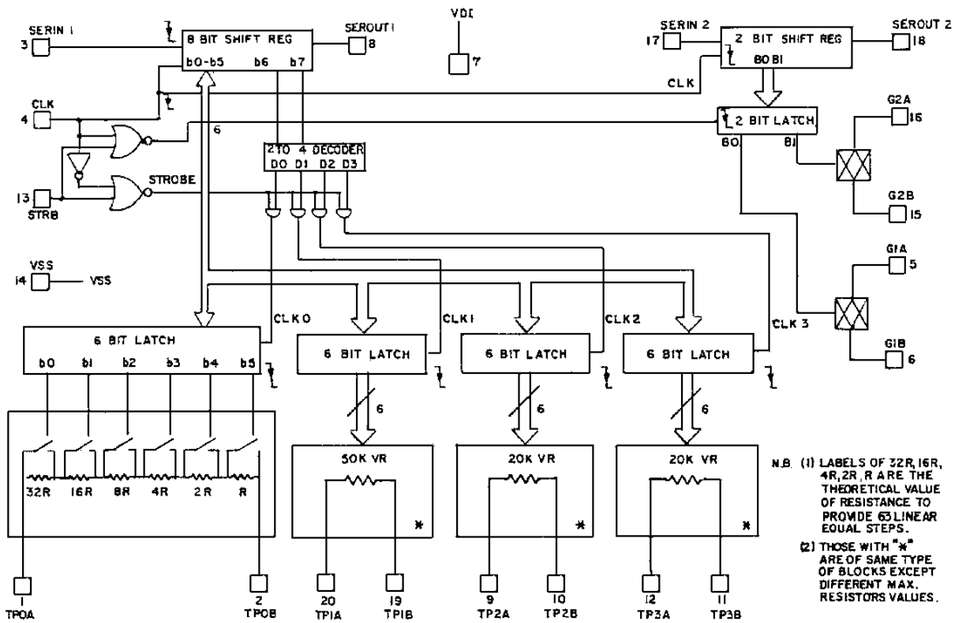
FUNCTION TABLE

Output Enable	Latch Enable	D	Output
L	H	H	H
L	H	L	L
L	L	X	no change
H	X	X	Z

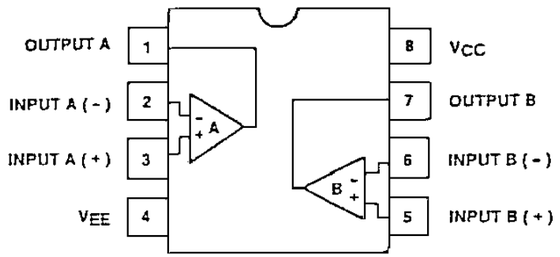
X = don't care
Z = high impedance

DSW1 & DSW2 - DIGITAL TRIMPORT

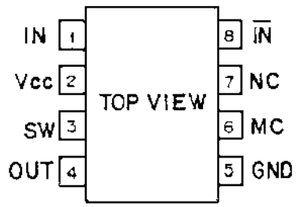


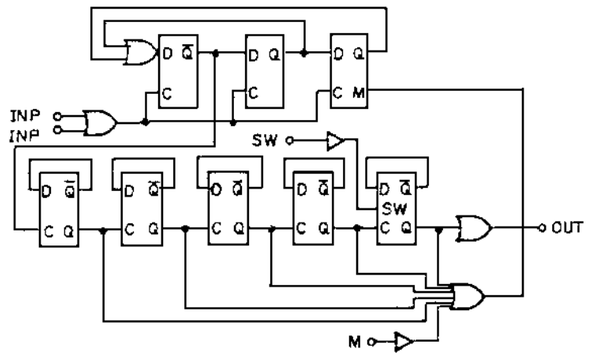


U7, U10, U16, U55, U64, U65, U70
& U75 - OPERATIONAL AMPLIFIER (LM2904)

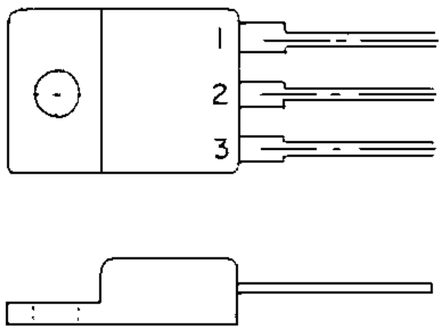


U53 - TWO MODULAS PRESCALER (MB501/MB501L)

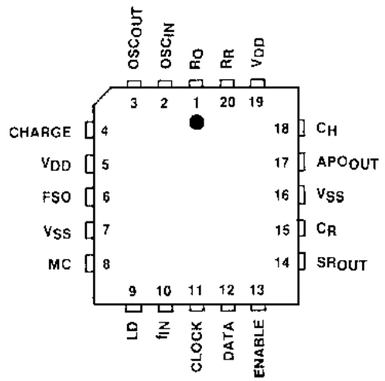


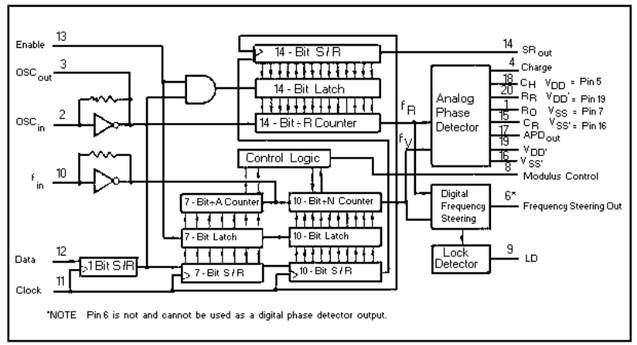


U22 & U30 - POSITIVE VOLTAGE REGULATOR
(NJM7800A)

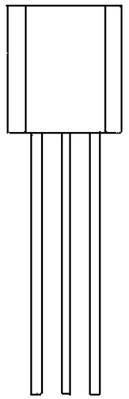


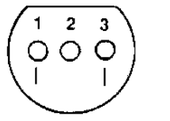
U54 - PHASE LOCK LOOP (MC145159





U58 & U60 - VOLTAGE REGULATOR

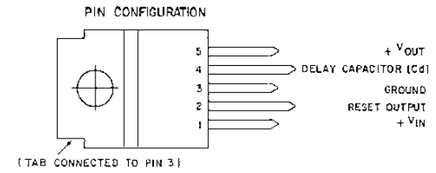


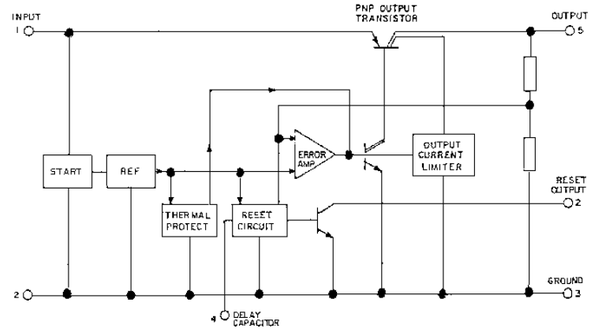


PIN INDENTIFICATION

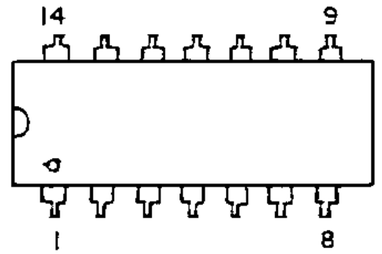
PIN 1. OUTPUT
PIN 2. GROUND
PIN 3. INPUT

U63 - REGULATOR WITH RESET (L387A)

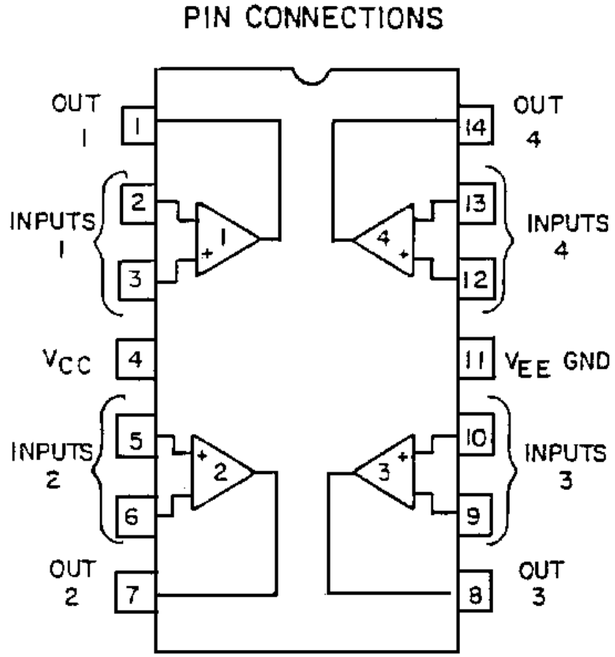




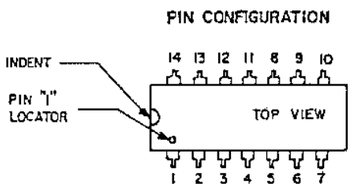
U72 & U74 QUAD OP AMP (LM2902)

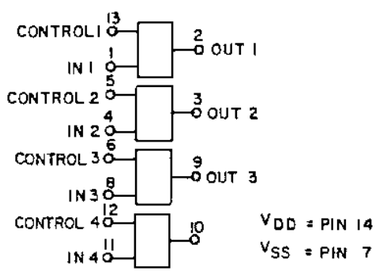


PIN CONNECTIONS

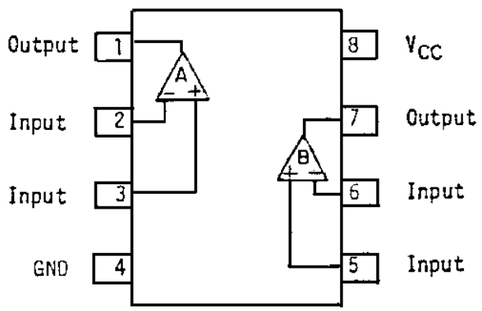


U61 - QUAD ANALOG SWITCH (MC14066B)

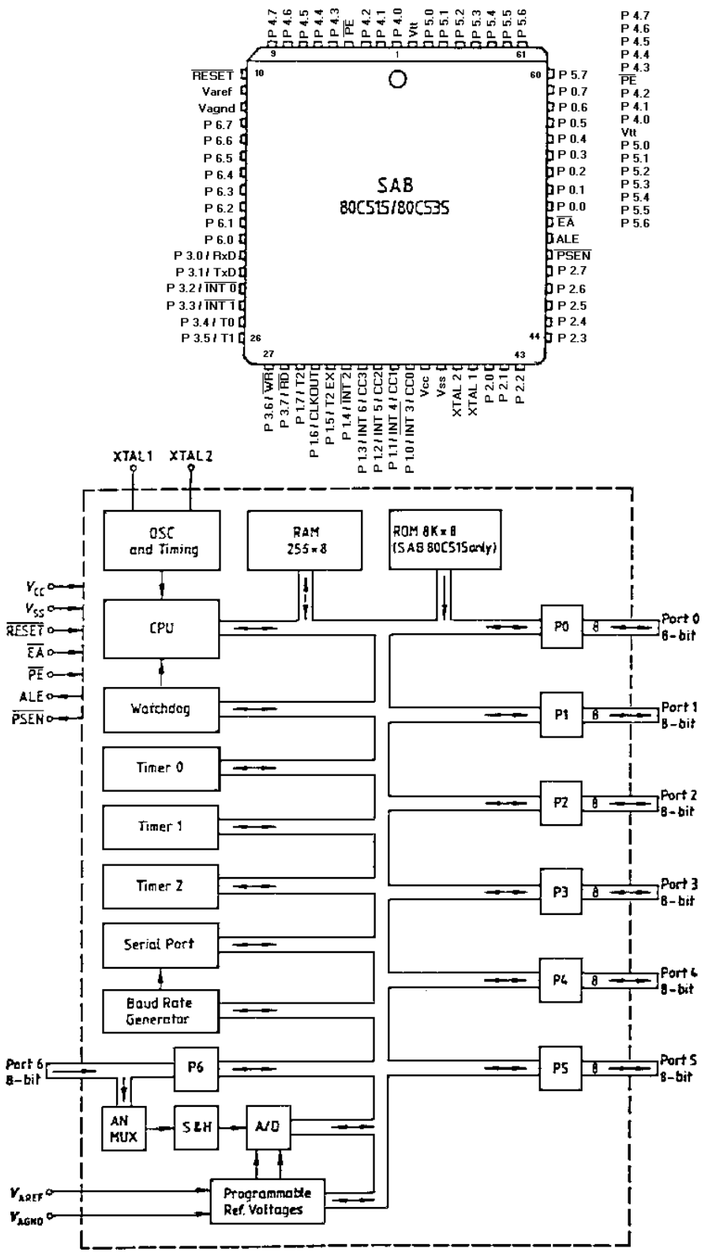




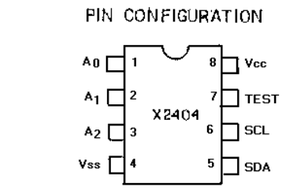
U67 - COMPARATOR (NJM2903)

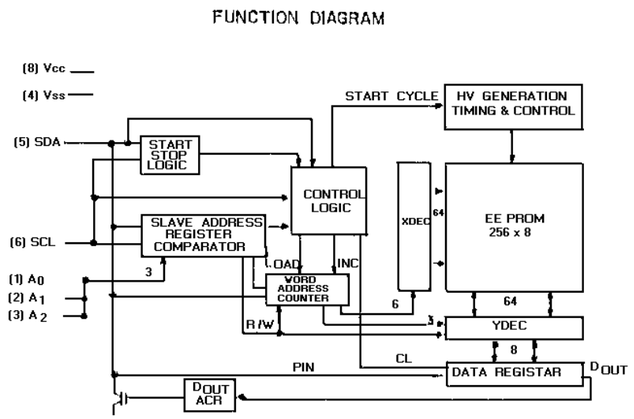


U77 - MICROPROCESSOR (SAB 80C535)



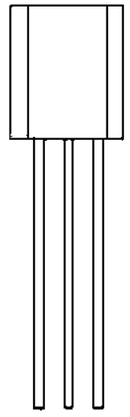
U82 - EEPROM (X24041)

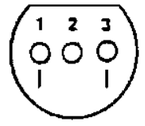




1 A0→TO Vss
2 AND 3 A AND A ADDRESS INPUTS
4 Vss
5 SDA SERIAL DATA — I²C BUS
6 SCL SERIAL CLOCK —
7 TEST INPUT — TO Vss
8 Vcc

U83 - VOLTAGE REGULATOR (LM317L)



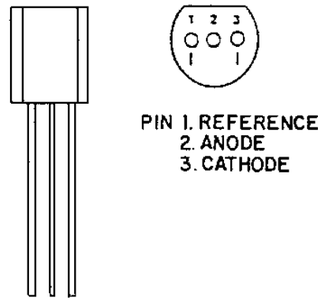


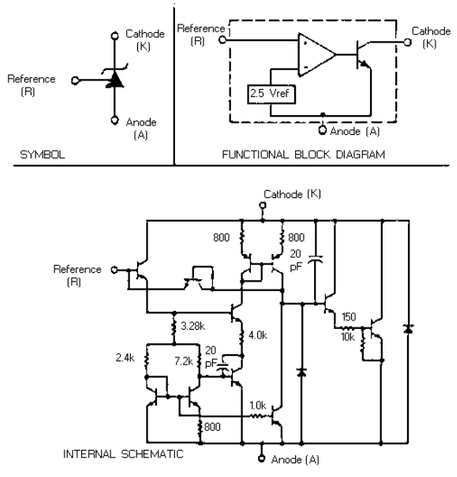
BOTTOM VIEW

PIN INDENTIFICATION

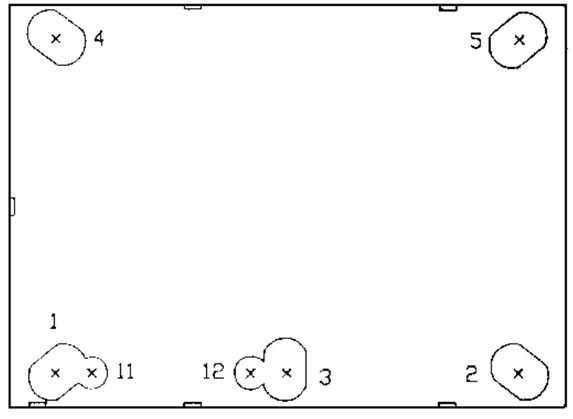
PIN 1 ADJUST
PIN 2. OUTPUT
PIN 3. INPUT

D11 - PROGRAMMABLE PRECISION REGULATOR (TL431, A)



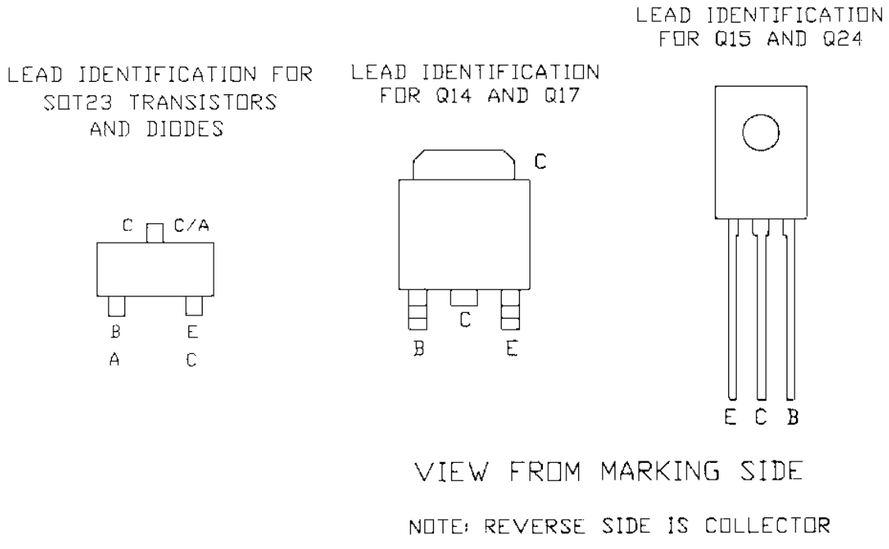


VC1 - FRONT END MODULE

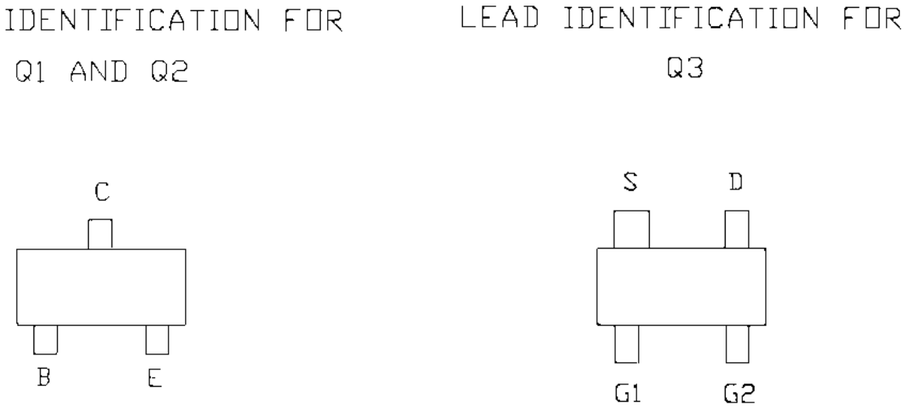


1. RF
2. Vcc1
3. LO
4. Vcc2
5. IF
11. GND
12. GND

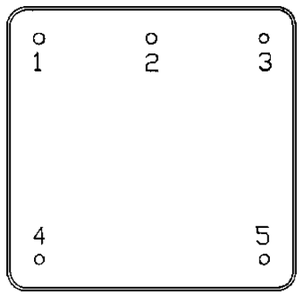
Q14, Q15, Q17, Q24 AND SOT23 TRANSISTORS AND DIODES



VC2 - IF MODULE

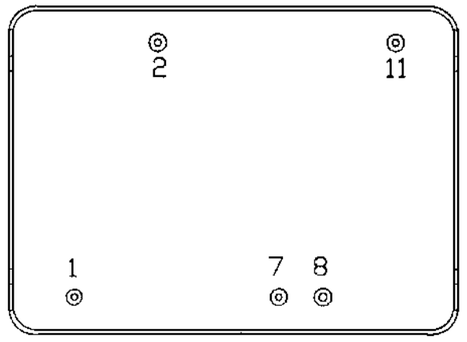


U57 - VCTXO



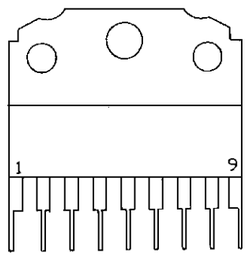
1. Vcc
2. OUTPUT
3. CONTROL
4. GND
5. GND

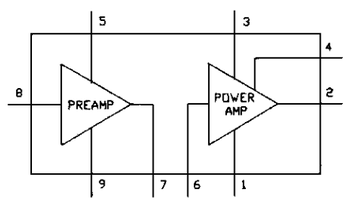
U15 - VCO



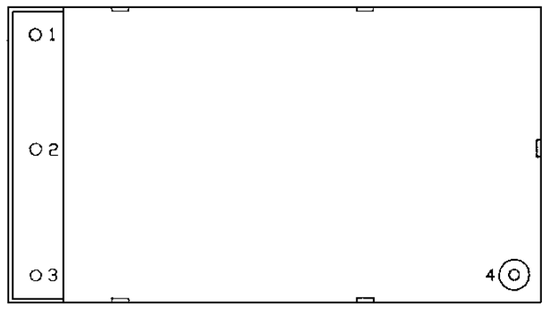
1. OUTPUT
2. Vcc
7. BANDSWITCH
8. MOD
11. CONTROL

U79 - AUDIO PA (TDA1015)





U52 - EXCITER



1. INPUT
2. Vcc
3. AGC
4. OUTPUT

MDS CONVENTIONAL RADIO (VHF)
MAIN BOARD ASSEMBLY
N29/85154000920 148-174 MHz
ISSUE 1

SYMBOL	PART NUMBER	DESCRIPTION
		——————— CAPACITOR ———————
C2	19A703314P12	Electrolytic: 100 µF, 25 V.
C13	19A701225P2	Electrolytic: 10 µF, 25 V.
C16	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C17		Surface Mount: 2700 pF, 50 V.
C20	19A702052P5	Surface Mount: 1000 pF, 50 V.
C21	19A703314P6	Electrolytic: 1 µF, 50 V.
C22 thru C24	19A702052P5	Surface Mount: 1000 pF, 50 V.
C26 and C27	19A702052P5	Surface Mount: 1000 pF, 50 V.
C28	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C29	19A702061P61	Surface Mount: 100 pF, 50 V.
C31	19A702061P61	Surface Mount: 100 pF, 50 V.
C32	19A702061P77	Surface Mount: 470 pF, 50 V.
C34	19A702052P28	Surface Mount: .022 µF, 50 V.
C35	19A149896P118	Surface Mount: 5600 pF, 50 V.
C37	19A701371P7	Polyester: .01 µF, 100 V.
C38	19A702052P14	Surface Mount: .01 µF, 50 V.
C39	19A702052P28	Surface Mount: .022 µF, 50 V.
C40	19A701371P7	Polyester: .01 µF, 100 V.
C42	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C43	19A703314P6	Electrolytic: 1 µF, 50 V.
C45		Surface Mount: 820 pF, 50 V.
C48	19A702052P110	Surface Mount: 4700 pF, 50 V.
C49	19A702052P112	Surface Mount: 6800 pF, 50 V.
C50	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C51	19A702236P44	Surface Mount: 56 pF, 50 V.
C52	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C57	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C59	19A702052P20	Surface Mount: .033 µF, 50 V.
C60 thru C62	19A702061P77	Surface Mount: 470 pF, 50 V.
C63	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C64 and C65	19A702061P77	Surface Mount: 470 pF, 50 V.
C66 thru C71	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C73	19A702236P38	Surface Mount: 33 pF, 50 V.
C74 thru C78	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C79		Surface Mount: 510 pF, 50 V.
C80	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C84		Surface Mount: 510 pF, 50 V.
C85 and C86	19A703314P12	Electrolytic: 100 µF, 25 V.
C87		Electrolytic: 1000 µF, 25 V.
C88	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C89	19A701225P9	Electrolytic: 220 µF, 25 V.
C90	19A701534P9	Tantalum: 47 µF, 6.3 V.
C92	19A702052P20	Surface Mount: .033 µF, 50 V.
C93 thru C102	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C105	19A702061P61	Surface Mount: 100 pF, 50 V.
C106	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C108	19A701225P9	Electrolytic: 220 µF, 25 V.
C109	19A702061P61	Surface Mount: 100 pF, 50 V.
C110 thru C115	19A702061P77	Surface Mount: 470 pF, 50 V.
C119	19A702052P112	Surface Mount: 6800 pF, 50 V.
C121	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C122	19A702061P77	Surface Mount: 470 pF, 50 V.
C124 thru C126	19A702061P61	Surface Mount: 100 pF, 50 V.
C127	19A703314P12	Electrolytic: 100 µF, 25 V.
C129 thru C131	19A702052P33	Surface Mount: .1u µF, 50 V.
C132	19A702052P5	Surface Mount: 1000 pF, 50 V.
C180	19A702236P42	Surface Mount: 47 pF, 50 V.
C181	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C184	19A702236P38	Surface Mount: 33 pF, 50 V.
C186 and C196	19A702236P38	Surface Mount: 33 pF, 50 V.
C197 thru C202	19A702236P38	Surface Mount: 33 pF, 50 V.
C204	19A701225P2	Electrolytic: 10 µF, 25 V.
C207 and C227	19A702236P38	Surface Mount: 33 pF, 50 V.
C230	19A702052P5	Surface Mount: 1000 pF, 50 V.
C231	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C248	19A702052P28	Surface Mount: .022 µF, 50 V.
C252	19A700052P110	Surface Mount: 4700 pF, 50 V.
C253		Surface Mount: .22 µF, 16 V.
C260	19A702236P38	Surface Mount: 33 pF, 50 V.
C265 and C266	19A702236P38	Surface Mount: 33 pF, 50 V.
C461	19A701225P2	Electrolytic: 10 uF, 25 V.
C462	19A702052P14	Surface Mount: .01 µF, 50 V.
C471	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C498	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C499	19A702236P38	Surface Mount: 33 pF, 50 V.
C507	19A149896P112	Surface Mount: 1800 pF, 50 V.
C508	19A703314P7	Electrolytic: 2.2 µF, 35 V.
C900	19A702052P33	Surface Mount: 0.1 µF, 25 V.
C901	19A703314P5	Electrolytic: 22 µF, 25 V.
C903	19A702061P77	Surface Mount: 470 pF, 50 V.
		——————— DIODE ———————
D2 thru D6	19A700053P1	Diode: BAV99.
D7	T324ADP1032	Rectifier: 1N4003.
D9	19A700053P1	Diode: BAV99.
D11	19A702939P2	Programmable Precision Regulator: TL431CLP.
D21	BAS16	Diode: 75V 0.25A BAS-16.
D22	ECG 4926	Zener: 18V, 1N6277A.
		——————— TRIMPOTS ———————
DSW1 and DSW2		Surface Mount: Digital Trimpot.
		——————— JACKS ———————
J5	N29/14954000020	Modular mic jack, 8-way.
		——————— RESISTORS ———————
R3		Surface Mount: 0 ohms, 1/10 w.
R53	19B801251P472	Surface Mount: 4.7K ohms, 1/10 w.
R18	19B801251P103	Surface Mount: 10K ohms, 1/10 w.
R51	19B801251P103	Surface Mount: 10K ohms, 1/10 w.
R74	19B801251P561	Surface Mount: 560 ohms, 1/10 w.
R80	19B801251P824	Surface Mount: 820K ohms, 1/10 w.
R81	19B801251P274	Surface Mount: 270K ohms, 1/10 w.
R82	19B801251P273	Surface Mount: 27K ohms, 1/10 w.
R83	19B801251P153	Surface Mount: 15K ohms, 1/10 w.
R84	19B801251P333	Surface Mount: 33K ohms, 1/10 w.
R85	19B801251P824	Surface Mount: 820K ohms, 1/10 w.
R86	19B801251P103	Surface Mount: 10K ohms, 1/10 w.
R87	19B801251P473	Surface Mount: 47K ohms, 1/10 w.
R88	19B801251P683	Surface Mount: 68K ohms, 1/10 w.
R90	19B801251P273	Surface Mount: 27K ohms, 1/10 w.
R91	19B801251P153	Surface Mount: 15K ohms, 1/10 w.
R92	19B801251P273	Surface Mount: 27K ohms, 1/10 w.
R93	19B801251P224	Surface Mount: 220K ohms, 1/10 w.
R95	19B801251P333	Surface Mount: 33K ohms, 1/10 w.
R98	19B801251P273	Surface Mount: 27K ohms, 1/10 w.
R106	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R109	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R111	19B801251P104	Surface Mount: 100K ohms, 1/10 w.
R112	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R113	19B801251P562	Surface Mount: 5.6K ohms, 1/10 w.
R116	19B801251P103	Surface Mount: 10K ohms, 1/10 w.
R118	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R119	19B801251P473	Surface Mount: 47K ohms, 1/10 w.
R122 and R123	19B801251P332	Surface Mount: 3.3K ohms, 1/10 w.
R127 and R128	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R131	19B801251P823	Surface Mount: 82K ohms, 1/10 w.
R132	19B801251P153	Surface Mount: 15K ohms, 1/10 w.
R133 and R134	19B801251P182	Surface Mount: 1.8K ohms, 1/10 w.
R135	19B801251P273	Surface Mount: 27K ohms, 1/10 w.
R138	19B801251P471	Surface Mount: 470 ohms, 1/10 w.
R139	19B801251P104	Surface Mount: 100K ohms, 1/10 w.
R140	19B801251P334	Surface Mount: 330K ohms, 1/10 w.
R141	19B801251P222	Surface Mount: 2.2K ohms, 1/10 w.
R142	19B801251P224	Surface Mount: 220K ohms, 1/10 w.
R143	19B801251P472	Surface Mount: 4.7K ohms, 1/10 w.
R147	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R148	19B801251P123	Surface Mount: 12K ohms, 1/10 w.
R151		Surface Mount: 4.7 ohms, 1/10 w.
R153	19B801251P563	Surface Mount: 56K ohms, 1/10 w.
R154	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R155	19B801251P563	Surface Mount: 56K ohms, 1/10 w.
R156	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R157	19B801251P103	Surface Mount: 10K ohms, 1/10 w.
R158	19B801251P220	Surface Mount: 220 ohms, 1/10 w.
R159	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R160	19B801251P392	Surface Mount: 3.9K ohms, 1/10 w.
R161	19B801251P222	Surface Mount: 2.2K ohms, 1/10 w.
R162	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R163	19B801251P154	Surface Mount: 150K ohms, 1/10 w
R164	19B801251P152	Surface Mount: 1.5K ohms, 1/10 w.
R165	19B801251P332	Surface Mount: 3.3K ohms, 1/10 w.
R167	19B801251P681	Surface Mount: 680 ohms, 1/10 w.
R169	19B801251P102	Surface Mount: 10K ohms, 1/10 w.
R170	19B801251P223	Surface Mount: 22K ohms, 1/10 w.
R171	19B801251P153	Surface Mount: 15K ohms, 1/10 w.
R172		Surface Mount: 75K ohms, 1/10 w.
R173	19B801251P472	Surface Mount: 4.7K ohms, 1/10 w.
R175		Surface Mount: 0 ohms, 1/10 w.
R176	19B801251P103	Surface Mount: 10K ohms, 1/10 w.
R177	19B801251P223	Surface Mount: 22K ohms, 1/10 w.
R178	19B801251P104	Surface Mount: 100K ohms, 1/10 w.
R179	19B801251P332	Surface Mount: 3.3K ohms, 1/10 w.
R180	19B801251P153	Surface Mount: 15K ohms, 1/10 w.
R181	19B801251P334	Surface Mount: 330K ohms, 1/10 w.
R182	19B801251P153	Surface Mount: 15K ohms, 1/10 w.
R183	19B801251P124	Surface Mount: 120K ohms, 1/10 w.
R184	19B801251P272	Surface Mount: 2.7K ohms, 1/10 w.
R185	19B801251P153	Surface Mount: 15K ohms, 1/10 w.
R186		Surface Mount: 49.9K ohms, 1/10 w.
R187	19B801251P104	Surface Mount: 100K ohms, 1/10 w.
R188		Surface Mount: 200K ohms, 1/10 w.
R189		Surface Mount: 402K ohms, 1/10 w.
R190		Surface Mount: 806K ohms, 1/10 w.
R191	19B801251P124	Surface Mount: 120 ohms, 1/10 w.
R192	19B801251P271	Surface Mount: 270 ohms, 1/10 w.
R193	19B801251P472	Surface Mount: 4.7K ohms, 1/10 w.
R194	19B801251P222	Surface Mount: 2.2K ohms, 1/10 w.
R195	19B801251P472	Surface Mount: 4.7K ohms, 1/10 w.
R196	19B801251P333	Surface Mount: 33K ohms, 1/10 w.
R198	19B801251P393	Surface Mount: 39K ohms, 1/10 w.
R199 thru R204	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R208 and R209	19B801251P563	Surface Mount: 56K ohms, 1/10 w.
R210	19B801251P103	Surface Mount: 10K ohms, 1/10 w.
R211		Surface Mount: 0 ohms, 1/10 w.
R213 thru R215	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R217 and R218	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R219	19B801251P153	Surface Mount: 15K ohms, 1/10 w.
R230	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R231	19B801251P223	Surface Mount: 22K ohms, 1/10 w.
R232	19B801251P220	Surface Mount: 22 ohms, 1/8 w.
R233		Surface Mount: 0 ohms, 1/10 w.
R317		Surface Mount: 0 ohms, 1/10 w.
R331	19B801251P273	Surface Mount: 27K ohms, 1/10 w.
R459		Surface Mount: 2.7K ohms, 1/10 w.
R468	19B801251P222	Surface Mount: 2.2K ohms, 1/10 w.
R471	19B801251P223	Surface Mount: 22K ohms, 1/10 w.

* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	PART NUMBER	DESCRIPTION
R472		Surface Mount: 0 ohms, 1/10 w.
R473	19B801251P182	Surface Mount: 1.8K ohms, 1/10 w.
R501	19B801251P103	Surface Mount: 10K ohms, 1/10 w.
R502 and R503	19B801251P473	Surface Mount: 47K ohms, 1/10 w.
R506	19B801251P104	Surface Mount: 100K ohms, 1/10 w.
R514	19B801251P223	Surface Mount: 22K ohms, 1/10 w.
R517	19B801251P682	Surface Mount: 6.8K ohms, 1/10 w.
R900		Surface Mount: 0 ohms, 1/10 w.
R901	19B801251P102	Thermistor: 1K ohms, 1/10 w.
R902		Surface Mount: 0 ohms, 1/10 w.
R904 and R905		Surface Mount: 0 ohms, 1/10 w.
R906	19B801251P273	Surface Mount: 27K ohms, 1/10 w.
R907	19B801251P332	Surface Mount: 3.3K ohms, 1/10 w.
		———— INTEGRATED CIRCUIT ——
U1	344A3732G1	(Programmed IC, contains software)
U2		Capacitor: 22 pF, 100 V DSS310.
U3		Surface Mount: LATCH MC74HC373.
U7		OP AMP, Dual: NJM2904M.
U10		OP AMP, Dual: NJM2904M.
U16		OP AMP, Dual: NJM2904M.
U22		REGULATOR: NJM7805A.
U63		REGULATOR: L387A.
U64		OP AMP, Dual: LM2904D.
U65		OP AMP, Dual: NJM2904M.
U67		COMPARATOR: NJM2903M.
U70		OP AMP, Dual: NJM2904M.
U72		OP AMP, Quad: LM2902D.
U74		OP AMP, Quad: LM2902D.
U75		OP AMP, Dual: NJM2904M.
U76	N29/26300000150	RELAY: LM44D00.
U77	N29/22154000060	MICROPROCESSOR, CMOS: SABBOC535-T40/85.
U79		Integrated Circuit: TDA1015.
U82		Integrated Circuit, CMOS: X24C04I 8DIL.
U83		REGULATOR: LM317LBZ .
		———— TRANSISTORS ———
Q11		Transistor, NPN: 200 mA 40V, MMBT3904.
Q19		Transistor, NPN: 600 mA 40V, PMBT2222A.
Q20 and Q21		Transistor, PNP: MMBT2907.
Q23		Transistor, NPN: 600 mA 40V, PMBT2222A.
Q24		Transistor, NPN: 2N5190.
Q165		Transistor, NPN: 2N5190.
		——————— CABLES ———————
W4	N29/85154001691	Cable assembly, 4-wire (PA board to Main Board).
W7	N29/85101700920	Flat ribbon cable, 16-wire.
		——————— CRYSTALS ————
Y1	N29/08054000190	Crystal: 11.0592 MHz.
		———— MISCELLANEOUS ———
	N29/40354000252	Cover, top or bottom.
	N29/40354000232	Mounting bracket.
	N29/40354000870	Ring terminal.
	N29/39120403052	Screw: M2.6 x 12. (Quantity of 4).
	N29/39154005012	Screw, hex, Philips: M4 x 8. (Used to secure mounting bracket, Quantity of 2).
	N29/39254000032	Washer, plain: M4. (Used to secure mounting bracket, Quantity of 2).
		Screw: M2.6 x 8. (Used to mount top and bottom covers, Quantity of 4).
		Washer, plain: M2.6. (Used to mount top and bottom covers, Quantity of 4).
		Washer, spring: M2.6. (Used to mount top and bottom covers, Quantity of 4).
		Nut: M2.6. (Quantity of 1).
		Screw, Taptite: M2 x 6. (Quantity of 16).
		Screw: M4 x 30. (Used to secure heatsink, Quantity of 2).
		Clip, shielding.
		Clip, regulator. (Quantity of 2).
		Shield.
		Clip.
		Shield-Cavity.
		Shield-Core.
		Shielding pad.
		Clip-Q15.
		IC socket, 28 pin.
		SYNTHESIZER
		———— CAPACITORS————
C1 and C2	19A703314P4	Electrolytic: 47 µF, 16 V.
C3 and C4	19A701225P9	Electrolytic: 220 µF, 25 V.
C5	19A703314P4	Electrolytic: 47 µF, 16 V.
C12	19A701225P9	Electrolytic: 220 µF, 25 V.
C82	19A702052P14	Surface Mount: .01 µF, 50 V.
C103	19A702052P14	Surface Mount: .01 µF, 50 V.
C104	19A702052P5	Surface Mount: 1000 pF, 50 V.
C117	19A702061P77	Surface Mount: 470 pF, 50 V.
C118	19A702052P14	Surface Mount: .01 µF, 50 V.
C120	19A702052P14	Surface Mount: .01 µF, 50 V.
C133	19A702052P5	Surface Mount: 1000 pF, 50 V.
C134	19A702061P77	Surface Mount: 470 pF, 50 V.
C135	19A702052P5	Surface Mount: 1000 pF, 50 V.
C136	19A702236P10	Surface Mount: 2.0 pF, 50 V.
C137	19A702061P77	Surface Mount: 470 pF, 50 V.
C138		Capacitor: .022 µF, 100 V.
C139		Capacitor: 0.1 µF, 400 V.
C140 and C141	19A702052P5	Surface Mount: 1000 pF, 50 V.
C143	19A702052P5	Surface Mount: 1000 pF, 50 V.
C145	19A702052P14	Surface Mount: .01 µF, 50 V.
C146	19A702052P5	Surface Mount: 1000 pF, 50 V.
C147	19A702061P77	Surface Mount: 470 pF, 50 V.
C148	19A702052P5	Surface Mount: 1000 pF, 50 V.
C149	19A702061P61	Surface Mount: 100 pF, 50 V.
C150	19A702052P5	Surface Mount: 1000 pF, 50 V.
C152	19A702061P61	Surface Mount: 100 pF, 50 V.
C154	19A702061P61	Surface Mount: 100 pF, 50 V.
C156	19A702052P14	Surface Mount: .01 µF, 50 V.
C167		Surface Mount: 1500 pF, 50 V.
C168	19A702061P77	Surface Mount: 470 pF, 50 V.
C169	19A702052P5	Surface Mount: 1000 pF, 50 V.
C170	19A702236P10	Surface Mount: 2.0 pF, 50 V.
C171	19A702061P77	Surface Mount: 470 pF, 50 V.
C172	19A702052P14	Surface Mount: .01 µF, 50 V.
C173	19A702061P77	Surface Mount: 470 pF, 50 V.
C174	19A702052P14	Surface Mount: .01 µF, 50 V.
C175	19A702061P77	Surface Mount: 470 pF, 50 V.
C177	19A702061P77	Surface Mount: 470 pF, 50 V.
C203	19A702061P61	Surface Mount: 100 pF, 50 V.
C229	19A702052P5	Surface Mount: 1000 pF, 50 V.
C313	19A702061P77	Surface Mount: 470 pF, 50 V.
C466	19A702236P10	Surface Mount: 2.0 pF, 50 V.
		———— TRANSISTORS————
Q2	BT2222A	NPN: 600 mA, 40 V, PMBT 222A.
Q6	BFR93A	NPN: BFR93A.
Q8 thru Q10	BT2222A	NPN: 600 mA, 40 V, PMBT 222A.
Q16	BT2907	PNP: MMBT2907.
Q22	BFR93A	NPN: BFR93A.
Q459	BFR93A	NPN: BFR93A.
		———— RESISTORS ————
R4	19B801251P331	Surface Mount: 330 ohms, 1/10 w.
R12	19B801251P120	Surface Mount: 12 ohms, 1/10 w.
R13	19B801251P390	Surface Mount: 39 ohms, 1/10 w.
R14	19B801251P121	Surface Mount: 120 ohms, 1/10 w.
R15	19B801251P152	Surface Mount: 1.5K ohms, 1/10 w.
R16	19B801251P331	Surface Mount: 330 ohms, 1/10 w.
R17	19B801251P121	Surface Mount: 120 ohms, 1/10 w.
R20	19B801251P100	Surface Mount: 10 ohms, 1/10 w.
R22	19B801251P221	Surface Mount: 220 ohms, 1/10 w.
R23	19B801251P470	Surface Mount: 47 ohms, 1/10 w.
R26	19B801251P331	Surface Mount: 330 ohms, 1/10 w.
R27	19B801251P120	Surface Mount: 12 ohms, 1/10 w.
R28	19B801251P221	Surface Mount: 220 ohms, 1/10 w.
R29 and R30	19B801251P100	Surface Mount: 10 ohms, 1/10 w.
R31	19B801251P183	Surface Mount: 18K ohms, 1/10 w.
R32	19B801251P102	Surface Mount: 1K ohms, 1/10 w.
R33	19B801251P102	Surface Mount: 1K ohms, 1/10 w.
R34	19B801251P104	Surface Mount: 100K ohms, 1/10 w.
R35	19B801251P332	Surface Mount: 3.3K ohms, 1/10 w.
R36	19B801251P472	Surface Mount: 4.7K ohms, 1/10 w.
R37	19B801251P471	Surface Mount: 470 ohms, 1/10 w.
R38 and R39	19B801251P104	Surface Mount: 100K ohms, 1/10 w.
R40	19B801251P824	Surface Mount: 820K ohms, 1/10 w.
R41	19B801251P823	Surface Mount: 82K ohms, 1/10 w.
R42 and R43	19B801251P222	Surface Mount: 2.2K ohms, 1/10 w.
R44	19B801251P332	Surface Mount: 3.3K ohms, 1/10 w.
R45	19B801251P472	Surface Mount: 4.7K ohms, 1/10 w.
R46	19B801251P330	Surface Mount: 33 ohms, 1/10 w.
R47	19B801251P331	Surface Mount: 330 ohms, 1/10 w.
R56	19B801251P473	Surface Mount: 47K ohms, 1/10 w.
R57 and R58	19B801251P332	Surface Mount: 3.3K ohms, 1/10 w.
R59	19B801251P473	Surface Mount: 47K ohms, 1/10 w.
R60	19B801251P332	Surface Mount: 3.3K ohms, 1/10 w.
R61	19B801251P473	Surface Mount: 47K ohms, 1/10 w.
R63	19B801251P102	Surface Mount: 1K ohms, 1/10 w.
R64	19B801251P152	Surface Mount: 1.5K ohms, 1/10 w.
R68	19B801251P222	Surface Mount: 2.2K ohms, 1/10 w.
R70	19B801251P221	Surface Mount: 220 ohms, 1/10 w.
R75	19B801251P100	Surface Mount: 10 ohms, 1/10 w.
R76	19B801251P121	Surface Mount: 120 ohms, 1/10 w.
R197	19B801251P100	Surface Mount: 10 ohms, 1/10 w.
R205	19B801251P820	Surface Mount: 82 ohms, 1/10 w.
R206	19B801251P121	Surface Mount: 120 ohms, 1/10 w.
R207	19B801251P820	Surface Mount: 82 ohms, 1/10 w.
R216		Surface Mount: 0 ohms, 1/10 w.
R220 and R221	19B801251P121	Surface Mount: 120 ohms, 1/10 w.
R222	19B801251P560	Surface Mount: 56 ohms, 1/10 w.
R223	19B801251P120	Surface Mount: 12 ohms, 1/10 w.
R224	19B801251P100	Surface Mount: 10 ohms, 1/10 w.
R225	19B801251P180	Surface Mount: 18 ohms, 1/10 w.
R226	19B801251P121	Surface Mount: 120 ohms, 1/10 w.
R227	19B801251P100	Surface Mount: 10 ohms, 1/10 w.
R228	19B801251P221	Surface Mount: 220 ohms, 1/10 w.
R229	19B801251P560	Surface Mount: 56 ohms, 1/10 w.
R360	19B801251P152	Surface Mount: 1.5K ohms, 1/10 w.
R479	19B801251P100	Surface Mount: 10 ohms, 1/10 w.
R480	19B801251P222	Surface Mount: 2.2K ohms, 1/10 w.
R495	19B801251P180	Surface Mount: 18 ohms, 1/10 w.
		———— INTEGRATED CIRCUIT ———
U15	N29/SMR16	VCO Module.
U53	N29/22100000123	PRESCALER: MB501PF.
U54	19B800902P5	Integrated Circuit: CMOS MC145159FN1.
U57	N29/31854000040	VCTCXO: 12.8 MHz ASD3004B.
U61	19A702705P1	Integrated Circuit: MC14066BD.
		TRANSMITTER
		———— CAPACITORS ————
C6 thru C11	19A703314P12	Electrolytic: 100 µF, 25 V.
C107		Polyester: 22 µF, 16 V.
C151	19A702052P28	Surface Mount: .022 µF, 50 V.
C153	19A702052P112	Surface Mount: 6800 pF, 50 V.
C155	19A702052P14	Surface Mount: .01 µF, 50 V.
C157 thru C159	19A702052P33	Surface Mount: 0.1 µF, 50 V.
C160	19A702052P14	Surface Mount: .01 µF, 50 V.
C161	19A702052P5	Surface Mount: 1000 pF, 50 V.
C162 thru C164	19A702052P33	Surface Mount: 0.1 µF, 50 V.
C178 and C179	19A702061P61	Surface Mount: 100 pF, 50 V.
		———— DIODE ————
D8	19A700053P1	Surface Mount: BAV99.
		———— TRANSISTORS ————
Q14	2SB962	Surface Mount, PNP: 3A, 30V, 2SB962-ZQ.
Q15	ECG185	PNP: 2N5193.
Q17	2SB962	Surface Mount, PNP: 3A, 30V, 2SB962-ZQ.
		———— RESISTORS ————
R5	19B801251P222	Surface Mount: 2.2K ohms, 1/10 w.
R6	19B801251P391	Surface Mount: 390 ohms, 1/10 w.
R7	19B801251P273	Surface Mount: 27K ohms, 1/10 w.
R8	19B801251P391	Surface Mount: 390 ohms, 1/10 w.
R9		Surface Mount: 4.7 ohms, 1/10 w.
R10	19B801251P822	Surface Mount: 8.2K ohms, 1/10 w.
R11	19B801251P102	Surface Mount: 10K ohms, 1/10 w.

SYMBOL	PART NUMBER	DESCRIPTION
R48	19B801251P184	Surface Mount: 180K ohms, 1/10 w.
R49	19B801251P822	Surface Mount: 8.2K ohms, 1/10 w.
R50	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R52	19B801251P102	Surface Mount: 1.0K ohms, 1/10 w.
R54	19B801251P123	Surface Mount: 12K ohms, 1/10 w.
R55	19B801251P683	Surface Mount: 68K ohms, 1/10 w.
R62	19B801251P222	Surface Mount: 2.2K ohms, 1/10 w.
R65	19B801251P562	Surface Mount: 5.6K ohms, 1/10 w.
R66	19B801251P332	Surface Mount: 3.3K ohms, 1/10 w.
R71	19B801251P222	Surface Mount: 2.2K ohms, 1/10 w.
R72	19B801251P391	Surface Mount: 390 ohms, 1/10 w.
R73	19B801251P273	Surface Mount: 27K ohms, 1/10 w.
R166	19B801251P272	Surface Mount: 2.7K ohms, 1/10 w.
R235	19B801251P273	Surface Mount: 27K ohms, 1/10 w.
		——— INTEGRATED CIRCUIT ——
U14		Thermistor: 10K ohms, 1/2 w.
U30	19A134717P3	REGULATOR: NJM7808A.
U52	N29/SMR15	EXCITER Module.
U55	LM2904D	OP AMP, Dual: LM2904D.
U58	19J706031P2	REGULATOR: NHM78L08A.
U60	19J706031P1	REGULATOR: NJM78L05A.
		RECEIVER
		————— CAPACITORS ————
C83	19A702052P14	Surface Mount: .01 µF, 50 V.
		————— TRANSISTORS————
Q13	BT2907	PNP: MMBT2907.
		————— RESISTORS ————
R1	19B801251P222	Surface Mount: 2.2K ohms, 1/10 w.
R2	19B801251P391	Surface Mount: 390 ohms, 1/10 w.
R67	19B801251P273	Surface Mount: 27K ohms, 1/10 w.
		MODULES VC1FRONT END N29/SMR14
		————— CAPACITORS ————
C1		Surface Mount: 43 µF, 50 V.
C2	19A702236P42	Surface Mount: 47 µF, 50 V.
C3	19A702236P44	Surface Mount: 56 pF, 50 V.
C4	19A702061P77	Surface Mount: 470 pF, 50 V.
C5		Surface Mount: 5 pF, 50 V.
C6	19A702061P77	Surface Mount: 470 pF, 50 V.
C7	19A702052P14	Surface Mount: .01 µF, 50 V.
C8		Surface Mount: 30 pF, 50 V.
C9		Surface Mount: 220 pF, 50 V.
C10 thru C12	19A702061P77	Surface Mount: 470 pF, 50 V.
C13	19A702052P14	Surface Mount: .01 µF, 50 V.
C15	19A702052P5	Surface Mount: 1000 pF, 50 V.
C16	19A702061P77	Surface Mount: 470 pF, 50 V.
C17	19A702052P5	Surface Mount: 1000 pF, 50 V.
C18 and C19	19A702052P14	Surface Mount: .01 µF, 50 V.

SYMBOL	PART NUMBER	DESCRIPTION
		———————— DIODES ————
D1 and D2		Mixer: HSM88AS.
		———————— FILTERS ————
F1		Filter, fixed tune, TMX481.
F2		Filter-Helical: 2581-181. (Used with SMR07).
F2		Filter-Helical: 2581-182. (Used with SMR06).
		———————— COILS ————
L1		Coil: .076 µH.
L2		Coil: .224 µH.
L3		Inducter: 1.5 µH
L4		Inductor: 10 µH.
L5		Inducter: .12 µH
L6 and L7		Inductor: 10 µH.
		———————— TRANSISTORS ————
Q1		FET-N-C 50 mA, 20 V.
Q2	BFR93A	NPN: BFR93A.
Q3	19A134578P1	JFET-N: MMBFJ310L.
		———————— RESISTORS ————
R1 and R2	19B801251P273	Surface Mount: 27K ohms, 1/10 w.
R3	19B801251P104	Surface Mount: 100K ohms, 1/10 w.
R4	19B801251P153	Surface Mount: 15K ohms, 1/10 w.
R5	19B801251P100	Surface Mount: 10 ohms, 1/10 w.
R6	19B801251P820	Surface Mount: 82 ohms, 1/10 w.
R7	19B801251P560	Surface Mount: 56 ohms, 1/10 w.
R8	19B801251P222	Surface Mount: 2.2K ohms, 1/10 w.
R9	19B801251P471	Surface Mount: 470 ohms, 1/10 w.
R10	19B801251P101	Surface Mount: 100 ohms, 1/10 w.
R12	19B801251P270	Surface Mount: 27 ohms, 1/10 w.
		———————— TRANSFORMERS ————
T1 and T2		Balun, 7 mm sq.
		———————— MISCELLANEOUS ————
		Brass pin.
		Top Cover, Front End.
		Bottom Cover, Front End.
		Frame, Front End.
		DBM cover.
VC2	N29/SMR08	RECEIVER IF Module.

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for the descriptions of parts affected by these revisions.

REV. A - RADIO UNIT

The following components were changed:

C212 19A702052P14 Surface Mount: 0.1µF, 50V
C219 19A702052P14 Surface Mount: 0.1µF, 50V
C221 19A702052P14 Surface Mount: 0.1µF, 50V
C227 19A702052P14 Surface Mount: 0.1µF, 50V

C197 19A702052P33 Surface Mount: 0.1µF, 25V
C198 19A702052P33 Surface Mount: 0.1µF, 25V
C202 19A702052P33 Surface Mount: 0.1µF, 25V
C260 19A702052P33 Surface Mount: 0.1µF, 25V
C499 19A702052P33 Surface Mount: 0.1µF, 25V

C199 19A702061P77 Surface Mount: 470pF, 50V
C220 19A702061P77 Surface Mount: 470pF, 50V

C201 Buss Wire
C220 Buss Wire

The following components were deleted:
C60-C62, C64, C122, C220.