

## OPERATIONS AND MAINTENANCE MANUAL FOR THE

RST-571 360 CHANNEL

RST-572 720 CHANNEL

NAV-COM TRANSCEIVER (on-line edition)

(S/N 500 and above)

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## A. INTRODUCTION

The models RST-571/572 NAVCOM transceivers are build-it-yourself avionics equipment designed to give many flight hours of reliable use. The transceiver can be built in a 360 channel version (RST-571) or a 720 channel version (RST-572). In either case, the navigation receiver has 200 channels (50 kHz spacing).

The transceivers feature single crystal synthesized operation, where any of the 920 (720 + 200) possible channel frequencies is quartz-locked to a single stable reference frequency. Channel selection is done with sturdy, reliable thumbwheel switches which are backlit for night operation. The switches have gold-plated contacts for extremely long life and resistance to "switch noise".

The communications receiver features dual-gate field-effect low-noise input transistors for best sensitivity and burn-out protection, crystal filtering in the intermediate frequency amplifier, and the latest integrated circuit technology.

The navigation receiver, in addition to the features of the communications receiver, has a digital VOR/LOC circuit phaselocked to the received nav signal, thus providing absolute accuracy that only a digital circuit can provide. Thumbwheel switch entry of the VOR radial provides positive indication of the selected radial as well as a much-improved method of reciprocal bearing calculation.

## SPECIFICATIONS:

### COMMUNICATIONS TRANSMITTER

CHANNELS: 720 (25 kHz spacing) RST-572 360 (50 kHz spacing) RST-571

FREQUENCY TOLERANCE: plus or minus .0026 from -30 to +60 degrees Centigrade

FREQUENCY RANGE: 118.00 to 135.975 MHz

POWER OUTPUT: 2.0 watts (typical CW power) into a nominal 50 ohm antenna

MODULATION: 90% nominal (adjustable for any civilian carbon or transistor dynamic microphone)

SIDETONE: Adjustable from zero to 10 volts peak-to-peak

## COMMUNICATIONS RECEIWER

CHANNELS: 720 (25 kHz spacing) RST-572    360 (50 kHz spacing) RST-571  
FREQUENCY RANGE: 118.00 to 135.975 MHz  
SENSITIVITY: 1 microvolt will give 1 watt speaker output with 6 dB S+N/N  
SELECTIVITY: plus/minus 10 kHz (r) 6 dB plus/minus 25 kHz @ 40 dB    plus/minus 50 kHz @ 60 dB  
SPURIOUS RESPONSES: below -60 dB  
SQUELCH: Carrier operated, settable 0-20 microvolts  
AUDIO OUTPUT: 4 watts into a 4 ohm speaker, 10 volts p-p to 4 sets of 150 ohm headphones  
AGC CHARACTERISTIC: Less than 6 dB change in audio output from 10 to 50k microvolts

## NAUIGATION RECEIWER

CHANNELS: 200 (50 kHz spacing)  
FREQUENCY RANGE: 108.00 - 117.95 MHz.  
SENSITIVITY: 2 microvolts will provide 1 watt of speaker audio and a flyable course indication  
SELECTIVITY: plus/minus 15 kHz (c) 6d8, plus minus 75 kHz (r) 60 d8  
SPURIOUS RESPONSES: Below -60 dB  
AUDIO OUTPUT: 4 watts into a 4 ohm speaker, 10 volts p-p to 4 sets of 150 ohm headphones  
AGC CHARACTERISTIC: Less than 6 dB change in audio output from 10 to 50k microvolts  
VOR/LOC ACCURACY: 3 degrees typical

## GENERAL DATA

LIGHTING: 0-12 volts for zero to full switch backlighting; indicator lamps light inversely to switch backlighting. Dimmer circuit requires 300 mA to operate.  
AUX AUDIO INPUTS: 2 isolated inputs, 10 kohm input impedance, gain adjustable 0-10  
GLIDE SLOPE CHANNELING: Binary coded decimal output from NAU selector switches available (soon)  
SUPPLY UOLTAGE: 11-16 volts DC, negative ground  
SUPPLY CURRENT: 450 mA (squelched receive) 800 mA (full audio receive) 1.5 amperes (xmit)  
AUDIO FREQUENCY RESPONSE: plus/minus 3 d8 from 300 to 3k Hz, rolloff above 3k Hz 6 dB/octave  
SIZE: 16.5 x 8.9 x 27.5 cm (6.5 x 3.5 x 10.8 inches)  
WEIGHT: 2 kg (4.5 lbs)

REFERENCE: All internally generated frequencies are referenced in phase locked loops to one temperature compensated reference crystal. COM receive, COM transmit, and NAU receive are all locked to this one crystal oscillator (3.2 MHz fundamental).

(Note: specifications subject to change without notice or obligation to incorporate changes in previously constructed units.)

## E. TEST AND CALIBRATION

The following procedures are designed to assist in troubleshooting and alignment after the first initial calibration has been completed by RST labs. These procedures may be used by a qualified technician to troubleshoot the transceiver down to the component level by applying the proper inputs and noting anomalous outputs. After the replacement of the defective components, realignment may be necessary. If no defective part is found, it is extremely wise to contact RST labs before recalibration.

IT IS ABSOLUTELY ILLEGAL FOR THIS DEVICE TO BE USED WITHIN THE BOUNDARIES OF THE UNITED STATES OF AMERICA WITHOUT RETURNING IT TO RST FOR TYPE ACCEPTANCE TESTING. YOU MAY TELL WHETHER THIS DEVICE HAS BEEN TYPE ACCEPTED BY A STAMP ON THE CHASSIS REAR THAT READS, IN PART, "FCC DATA: BSUBYCRST-571" OR "BSUBYCRST-572".

### TEST EQUIPMENT REQUIRED:

DC Voltmeter, 11 Megohm input impedance. Heath IM-5228  
Oscilloscope with low-capacity probe. Heath IO-4105  
Signal Generator, RF. HP 608  
Signal generator, AF. Heath IG-1275  
Power meter, RF. HP 431a  
Spectrum Analyzer, 10-1000MHz. Nelson Ross/Polarad PSA-531  
Sweep Generator, 0-300 MHz. Texcan VS-40  
UOR Simulator, TIC T-12A  
Bird Wattmeter, Model 43 with proper slug.  
RST receiver extension module.  
RST board extender.

(Equivalent test equipment may be substituted for any of the above)

## 1. PC034FILTER AND POWER SUPPLY TEST

a. Remove all boards from the chassis and place them on a conductive surface to prevent damage to cmos devices.

b. Connect a 13.6 volt power supply and a dimmer supply to the power connector. Rotate the front panel "power switch", R2/52, to the "on" position.

c. Check for 13.6 volts at J5, pin 19 (PC029). Check for 10 volts  $\pm 0.5$  at J5, pin 15. Load pin 15 with a 10 ohm 10 watt resistor and note the 10 volt supply dropping less than 0.1 volt.

d. Adjust the dimmer supply to 13.6 volts. Check to see that all thumbwheel switch lamps are lit in each digit. Short the following points to ground: J6, pins 18, 19, and 20 (PC033). Adjust R103 on PC034 for 4 volts at point PL. The T0, FROM, and OFF lamps must light at about one-quarter brilliance. Adjust the dimmer supply from 13.6 to 0 volts and then back to 13.6 volts. The voltage at PL should smoothly and inversely track the dimmer voltage, and the lamps should vary from quarter to full brilliance. Unground J6 pins 18, 19, and 20. The voltage at PL should not vary more than  $\pm 2.0$  volts from the 3 lamp load to no load. Temporarily ground chassis pins J6-10 and J6-1B one at a time and note the XMIT and ON lights respectively lighting.

e. Connect a sweep generator (100-150 MHz, 0 dBm) to the nav antenna jack, J13, on the chassis. Using a 50 ohm detector at J9, pin 16 (PC052), adjust T106-T110 on PC034 for best passband 108-118 MHz and sharpest rejection below 108 MHz. Maximum loss at any point in the passband can be no greater than 3.5 dB.

f. Connect a sweep generator (100-150 MHz, 0 dBm) to the com antenna jack on the chassis. Using a 50 ohm detector at J3, pin 16 (PC030), adjust T101-T105 for best passband 118-136 MHz and sharpest rejection above 136 MHz. Maximum loss at any point in the passband can be no greater than 4.0 dB.

g. Using a 50 ohm detector at J2, pin 6 (PC035), key the transmitter and note a loss not greater than 1 dB across the band 118-136 MHz.

h. Wax seal all transformers on PC034.

## 2. PC029 AUDIO AMPLIFIER AND MODULATOR

a. Install PC029 into chassis and apply power.

b. Connect a 4 ohm speaker load to J1-11 and a 39 ohm headphone load to J1-12, the speaker and headphone outputs respectively.

c. Connect a .03 volt PP 1000 Hz sine wave signal from a 600 ohm generator to J5, pin 2. Minimum speaker and headphone output is 5 volts PP with no visible distortion. Speaker and headphone output levels must be within  $\pm 3$  dB of each other. Repeat for input at J5, pin 3.

d. Connect a 1 volt PP 1000 Hz sine wave signal from a 600 ohm generator to the aux audio input, J1-7, on the chassis cable connector. Adjust R416 so that speaker and phones outputs are just below the clipping level.

e. Connect an RST standard modulator signal to J1-14, the microphone audio input on the chassis cable connector. Adjust R430 for 50% depth of modulation at PC035, pin 20 across a ten ohm, five Watt load. Adjust R411 for 2.5 volts PP at the headphone output. (Alternative - use a standard dynamic microphone and adjust R430 for 100% modulation; adjust R411 for 5 volts PP at the headphone output.)

f. Note the +10 supply voltage at PC029, pin 15. Check to see that this voltage appears at PC029 pin 14 with less than 0.2 volts drop. Key the transmitter and note the voltage dropping to less than 1 volt. Check to see that pin 12 has risen to within 0.2 volts of the +10 supply. Unkey the transmitter and check that pin 12 drops to less than 1 volt.

### 3. PC035 TRANSMITTER BOARD

a. Install PC035 into chassis and apply power. Connect a 100-150 MHz @ 2 mW sweep generator to J2, pin 20. (Alternative -- if sweep generator not available, use 118.0, 127.0, and 135.0 MHz test frequencies.)

b. Connect a power meter with demodulated output to J12, the COM antenna jack on the chassis. Ground the PTT line and observe the RF power at the 1.5 Watt or greater level, with no "fuzz" or other evidence of instability on the demodulated output.

c. Using 50% modulation, observe the swept output at the demodulated output of the power meter and adjust L201-204 (by spreading or compressing turns) for best average modulation over the 11B-136 MHz band; minimum modulation in the band is 30% (60% of 50%). Do not allow the modulator to become so warm as to affect the percentage modulation.

d. Remove power and remove PC035 from chassis.

### 4. PC031 NAV SYNTHESIZER

a. Install the PC031 board into the chassis on a RST board extender.

b. Check J8, pin 15 with a low-capacitance probe for an 8v PP signal at 3.2 MHz, centered on 4v dc.

c. Set the front panel nav switch for 108.00 MHz. Connect a frequency counter to J8, pin 20 with a probe with less than 2 pf of shunt capacity. Adjust C510 for 142.00 MHz +/-2 kHz.

d. Set the front panel thumbwheels to all whole MHz and fractional MHz frequencies 108.00-117.95 and note a constant 34 MHz difference between thumbwheel switch command and counter reading.

## 5. PC032 COM SYNTHESIZER

a. Install PC032 into chassis; PC031, and PC029 should still be in the chassis. Apply power to the radio.

b. Ground the key line and check all whole and fractional MHz settings of the COM thumbwheel switch. Connect a voltmeter to J4, pin 5 and note a logic low except when the MHz thumbwheels are set below 118 or above 135.

c. Unground the key line and note the counter reading of all whole and fractional MHz settings of the COM thumbwheel switches PLUS 35 MHz. NOTE: it may be necessary to connect the counter directly to J2, pin 20 (PC035), and remove the power meter. Power meter readings mean nothing with this section.

d. Leave PC032 installed and remove power.

## 6. PC031 Com Transmit UCO

a. Remove PC035 from the chassis and connect a milliwattmeter (5 mW) end counter to J2, pin 20 of the empty socket.

b. Set the front panel frequency control for 127 MHz. Ground the key line and adjust L501 for 4 volts at JB, pin 4 (PC031). Note the counter does not move from a reading of 127:00 MHz +/- 2 kHz.

c. The power at pin 20 of PC035 socket must be greater than 0.5 mW. Note -- power may vary with card extender. Power reading should be compensated for extender board, or extender board should be removed.

d. Set the frequency selector to 11B and then 135 MHz. Power at the band edges must be greater than 1 mW. Adjust L501 for 8 volts on the COM VCO tune line (pc pin 4).

e. Remove power and leave PC031 installed.

## 7. PC030 COMMUNICATIONS RECEIVER BOARD

a. Install PC030 into an RST standard receiver extension module and the extension module into the chassis. Connect a swept 35 MHz (+/- 100 kHz) at -50 dBm to pin 20. Remove the VCO tune voltage and connect a +5 volt supply to pin 11. Adjust R355 maximum CW and then back CCW so

that pin 14 (RF AGC) just goes to zero volts and pin 8 is still at the + supply stop. Adjust R348 maximum CW.

b. With an oscilloscope connected to TPI, adjust T301-305 for maximum undistorted output consistent with a 10 kHz minimum bandwidth.

c. Remove the 5 volt supply from pin 11 and connect a 0-10 volt supply. Connect a milliwattmeter (5 mW) and counter to pin 6. Adjust the supply to 4 volts and adjust L305 for 162 MHz at a minimum power of 2 mW. Adjust the supply from 1.5 to 7 volts and ensure the band 153 to 171 MHz is covered with a minimum power of 2 mW across the band. Readjust L305 if necessary to equalize and center the 153-171 MHz band within the 1.5 and 7 volt limits.

d. Remove the variable voltage power supply and reconnect the UCO tune line to pin 11. Set a crystal-controlled generator and the com receiver thumbwheels to the same frequency at or close to 127 MHz. Adjust L301, L302 to maximize output at PC030, pin 4. Receiver must have 0.1 volts p-p of audio at 6 dB S+N/N at PC030, pin 4 with a maximum generator output of 2 microvolts, modulated 50%.

e. Remove the input signal. Set R355 so that the voltage at U304 pin 8 is one volt below the maximum available. (i.e. Set to one volt below the top rail stop.) Dial across the 11B-135 MHz band and note where this voltage is the highest. If necessary, reset R355 to keep the voltage out of the stops. Adjust R355 to one volt below the top stop at the frequency where the voltage is the highest. Reconnect the input signal and set R348 so that a nominal 75 microvolt (+/- 25 uv) signal will just break the squelch with the front panel squelch control maximum CCW. Check to see that the minimum signal necessary to break squelch is less than 2 microvolts.

f. Remove power and remove PC030 from chassis.

## 8. PC052 NAVIGATION RECEIVER BOARD

a. Install PC052 into an RST standard receiver extension module and the extension module into the chassis. Connect a swept 34 MHz (+/- 100 kHz) at -50 dBm to PC052, pin 20. Remove the vco tune voltage and connect a +5 volt supply to pin 11. Adjust R755 maximum CW.

b. With an oscilloscope connected to TPI, adjust T701-705 for maximum undistorted output consistent with a +/-15 kHz minimum bandwidth.

c. Remove the 5 volt supply from pin 11 and connect a 0-10 volt supply. Connect a milliwattmeter (5 mW) and counter to pin 6. Adjust the supply to 4 volts and adjust L705 for 147 MHz at a minimum power of 2 mW. Adjust the supply from 1.5 to 7 volts and insure that the 142-152 MHz band is covered with a minimum power of 2 mW across the band. Readjust L705 if necessary to equalize and center the 142-152 MHz band within the 1.5 and 7 volt limits.

d. Remove the variable voltage power supply and reconnect the VCO tune line to pin 11. Set a crystal-controlled generator and the nav receiver thumbwheels to the same frequency at or close to



113 MHz. Adjust L701, L702 to maximize output at PC052, pin 4. Receiver must have 0.1 volts p-p of audio at 6 dB s+n/n at PC052, pin 4 with a maximum generator output of 4 microvolts, modulated 50%.

e. Adjust the input signal to 1000 microvolts, modulated with a standard VOR test signal (30% each 30 and 9960 Hz). Adjust R755 for 1.5 volts p-p output at PC052, pin 4.

f. Remove power and remove PC052 from chassis.

## 9. PC024 OMNI - LOCALIZER DETECTOR

a. Install PC024 and PC033 (no alignment required) into chassis. PC029, PC031, PC032, and PC052 should have already been installed and aligned.

b. Adjust R901 fully CCW. Adjust R933 for 5 volts dc measured at TP3 (test point 3). Adjust R940 to center front panel meter. With meter centered, TP4 should give a reading of 5 volts dc +/- 1 volt.

c. Connect a standard UOR 0 degree TO signal to J13, the NAU antenna jack, at a level of 1000 microvolts. This signal should produce a demodulated VOR signal at a level of 1.5 volts P-P delivered to PC024 at pin 20. Adjust R901 for 5 volts P-P as measured at TP1. Adjust R914 to give maximum amplitude of the 30 Hz VOR reference signal measured at TPS. Adjust R922 for maximum amplitude of the 30 Hz VOR variable signal measured at TP2. With the A and B channels of a dual trace oscilloscope, connected to pins 2 and 13 of PC024, readjust R922 so the measured pulses are coincident +/- 50 microseconds.

d. Set the front panel OBS switch to 180 degrees. Note the yellow FROM lamp is lit and the meter is zeroed to within 3 degrees. Move the OBS switch to 170 and 190 and note the meter swinging left and right respectively 10 +/- 3 degrees.

e. Set the OBS switch to 90 and note the FROM lamp changing to a TO lamp at 90 +/- 15 degrees. Repeat at 270 on the OBS switch.

f. Connect a standard centered LOC signal of 1000 microvolts to J13, the NAV antenna jack. In the same fashion as above, adjust R954 for maximum amplitude of the 90 Hz localizer signal measured at TP4. Adjust R959 for maximum amplitude of the 150 Hz localizer signal measured at TP3. If the front panel meter is not centered at 0 for a centered LOC signal, adjust the trim potentiometer (R954 for the 90 Hz or R959 for the 150 Hz) of the filter that gave the largest amplitude measurement. The needle should now be centered.

g. Note that the yellow FROM lamp is lit any time a LOC signal is present, and must stay lit with a stable meter reading to a sensitivity greater than 15 microvolts. An unbalance of +/- 2dB must cause a needle deflection of 5 (+3-0) degrees on the meter.

h. Remove power and install remaining boards.

## 10. FINAL CALIBRATION

a. When completing one of the sections below, fill out the appropriate section of the individual calibration certificate. Install all boards in their individual chassis.

b. Set the front panel com thumbwheels to 127.00 MHz. Connect a power meter with both counter and demodulated output to the com antenna jack. Split a small fraction of the modulated output (-20 dB) and apply it to a spectrum analyzer. Key the transmitter and apply 50% sine wave modulation. The counter must indicate a stable 127 MHz transmitter output (+/-3175 Hz) at a 1.5 watt or greater level. The modulation must be 30% or greater at a distortion level of 10Á or less. The FM deviation must be +/-12.5 kHz or less down 25 dB, +/-25 kHz or less down 35dB and +/-62.5 kHz or less down 43dB+ 10 log Po. Check deviation, % modulation, and distortion at 118.0, 122.0, 130.0, and 135.0 MHz. Check all whole and fractional MHz settings of the com thumbwheel switch from 118.00 to 135.9x MHz. Check that the power output above 136 and below 118 MHz is not readable on the power meter (40 dB down).

c. Install the com receiver board, PC030, on an extender card. Turn power off to nav receiver board (or remove PC052). Input a crystal-controlled com signal to J12, the com antenna jack, as close to 127 MHz as possible, 50% modulation at 400 Hz. Adjust L301-302 and T301-305 -SLIGHTLY- (less than 1/2 turn) for best sensitivity, minimum noise, and minimum sine wave distortion to the signal at PC030, pin 4. Minimum acceptable sensitivity for 6dB s+n/n end 30 millivolts PP of audio is 2 microvolts at band center, rising to not more than 5 microvolts at band edges.

Adjust the front thumbwheel switches for a maximum dc voltage at U304-B, with no input signal. Set R355 for 1 volt below the top dc stop. Adjust R348 for a maximum squelch level of 75 microvolts on this frequency with the front panel squelch control fully CCW. Maximum signal to break squelch at the most sensitive position of the front panel squelch control is 4 microvolts.

d. Install NAU receiver board, PC052, on an extender card. Turn power off to com receiver board (or remove PC030). Input a standard VOR signal to J13, the nav antenna jack, as close to 113 MHz as possible, at a level of 2 microvolts. Adjust L701-702 and T701-705 -SLIGHTLY- (less than 1/2 turn) for maximum sensitivity, maximum 9960 Hz response, and minimum 30 Hz distortion. Set the input signal level at 1000 microvolts and adjust R755 for 1.5 volts PP out at PC052, pin 5.

e. Install VOR - LOC DETECTOR board, PC024, on an extender card. Input a standard VOR signal to the nav receiver jack, 1000 microvolts, 0 degrees FROM. Adjust R901 for 5 volts PP at U901-1. Adjust R922 for coincident pulses +/-50 usec at pc pins 2 and 13. Check 0, 90, 180, and 270 degrees TO and FROM; adjust R940 slightly to achieve 3 degrees maximum error on the front panel meter at these 8 headings. The maximum signal for lamp and meter operation is 5 microvolts; the heading accuracy +/-3 degrees must be met at 20 microvolts maximum. Localizer must operate at 15 microvolts maximum; needle must be centered +/-2 degrees at 20 microvolts maximum.

f. Wax transformer slugs on PC 030, PC 031, and PC 052. Use the minimum amount of wax necessary to immobilize the slug.-

g. Install the cover with 4 screws only. Check transmitter power output and modulation at 127 MHz. Check receiver sensitivities at center of band. Check UOR accuracy at center of band at 0 and 180 OBS settings only. Install cover with all screws.

h. Check transmitter power, modulation, and residual FM at 118, 127, and 135 MHz. The unit must meet specifications in (b), above.

i. Check com receiver sensitivity at low, middle, and high ends of the band. Receiver must meet sensitivity and squelch requirements of (c), above.

j. Check VOR and LOC accuracy and sensitivity at low, middle, and high ends of the band. Receiver must meet specifications of (e), above, except that VOR error can have 5 degrees maximum error on two headings out of the 8.

## F. THEORY OF OPERATION

This theory of operation will consider the transceiver as 8 separate blocks. these blocks are:

1. Power supply and regulator; lamp dimmer circuitry
2. Audio amplifier and modulator; pilot announcement circuitry
3. Communication receiver
4. Communication transmitter
5. Communication synthesizer
6. Navigation synthesizer
7. Navigation receiver
8. Navigation converter/driver

In most instances, these blocks will all be self-contained on one printed circuit board, but on several occasions, there will be a small (but vital) portion of that block's circuitry on another board. For instance, the communication transmitter' block is almost all on PC035 (COM XMTR). However, the voltage-controlled-oscillator that actually sets the frequency on which the transmitter transmits is located on PC031 (NAV SYNTH). This was done for several reasons -- some practical, some electrical -- but please be aware as you read this theory of operation that there will be exceptions to the general rule.

## 1. POWER SUPPLY AND REGULATOR

The function of the power supply and regulator is to input the primary power for the transceiver (+13.6 volts DC) from the aircraft battery bus, filter the battery voltage to remove any unwanted spikes and noise, take a portion of the battery voltage and regulate it down for the low-power circuits of the transceiver, and to provide a lamp dimmer circuit for the front panel control illumination. The components for this function are on PC034, which is mounted on the chassis rear.

Primary voltage comes in to the transceiver through power connector J1 pin 6, thence to PC034 point PF, through a VHF noise filter (C102-Z101-C101) to remove any unwanted noise, then to switch S1 on the back of COM volume control R1, and then back to PC034 point PS. From here it splits. One line goes back to the audio/modulator board PC029 through PC034 point PU, and another part of the supply voltage goes to integrated circuit voltage regulator U101 pin 1. This regulator, in conjunction with reference diode CR102 sets the output voltage of the IC regulator to +10 volts DC. This regulator can supply 1 ampere of current, and is short circuit proof. The +10 volt regulated supply exits PC034 at point PT.

Lamp dimmer voltage comes in to the transceiver through power connector J1 pin 1. This voltage must be zero for daytime conditions, and up to +12 volts for night lighting. The current draw for full night lights is approximately 0.3 amperes into J1 pin 1. This dimmer voltage is brought onto PC034 at point LD. During daytime operation, this voltage is zero, and the bias on Q101 base is zero. This allows Q102 to turn on completely, and the result is +12 volts available at PC034 point PL. This point is connected to the T-F lamps on the front panel, and lights them at full brilliance during daytime operations. The front panel meter lamps and the thumbwheel switch lamps, connected to TL, receive no voltage, and thus are not lit. During night operation, the aircraft lamp dimmer bus is brought above zero volts to a point of desired night lamp brightness. This voltage biases on Q101, which in turn begins to bias off Q102, and thus dim the T-F lamps. Simultaneously, the meter and thumbwheel switch lamps are being illuminated by the voltage available at PC034 point TL. R103 is adjusted for the desired amount of T-F lamp dimming during night operations.

## 2. AUDIO POWER AMPLIFIER AND MODULATOR

All of the circuits in this section are on PC029, which is installed into J4 on the chassis. This board provides high-power outputs for headphones, speaker, and modulator circuits; provides the circuit that switches the +10 supply between COM and NAV modes; and provides circuitry to implement the pilot announcement system.

The +10 regulated supply from PC034-PT comes in to J4 pin 15. If pin 7 (KEY) is not grounded to place the transceiver in the TRANSMIT mode, Q403 is turned on through R403, R401, and the emitter-base diode of Q401. When Q403 turns on, it in turn turns on Q402, and connects pin 14 (+10 RCV) to the +10 supply. This action provides +10 power to the entire NAV and COM receiver circuits. If pin 7 is grounded (which happens when the pilot depresses his PTT switch),

Q403 and Q402 are turned off, and Q401 turns on through R401. This turns off the +10 receive bus and turns on the +10 transmit supply.

Receiver audio from the volume control comes in pin 2 (COM) and pin 3 (NAV). In addition, auxiliary audio input comes in pin 5. These 3 signals are summed and amplified by a factor of 2 in U4048. U4048 output in the receive mode is set at a nominal 5 volts by the +10 receive supply and voltage divider R427, R428. (In the transmit mode, this amplifier is biased off by R434).

The audio out from U4048 is split by R43T, R406 and is coupled to speaker amplifier U403 and headphones amplifier U402. These amplifiers are set for a voltage gain of 15, so that approximately 1 volt p-p at U4048 pin 1 will fully drive both amplifiers to more than full output.

If the +10 transmit bus is activated, the pilot's microphone connected to pin 4 is biased by Q406 and amplifier U404A is activated. (U404A is normally biased off in the receive mode by R423). This combination of events causes any audio present at the pilot's microphone to be amplified by U404A and appear at U404A pin 7 as an approximately 3 volts p-p. R430 selects a fraction of this signal and CR403, CR404 form a compressor circuit to increase the average percentage modulation by clipping (approximately 6 dB compression) any large spikes in the spoken audio to no more than 1.2 volts p-p. This microphone audio signal is then filtered by C433, C416 to remove any high frequency distortion products generated in either the microphone amplifier or compressor, and U401 amplifies the resultant signal for use in modulating the transmitter. Note that the output of U401 is set internally to the device at  $V_{+}/2$  -- (6.8 volts DC) -- and the output swings up to the + supply rail (+13.6) and down to ground. This is a series transformerless modulator, and its output to J4 pin 20 will eventually be used to modulate the RF output of the transmitter. A fraction of this output voltage is adjustable by R411 and input to the headphone amplifier U402. This is the sidetone provision of the modulator.

If the +13.6 bus is switched on, Q405 is turned on through R418, and provides a ground to the "ON" light.

### 3. COMMUNICATIONS RECEIVER

The function of the communications receiver is to select the desired receive signal, demodulate the signal, and output the signal's audio to The power audio amplifier board. Most of the components are on PC030, but the system RF filter is on PC034.

The COM RF signal first comes into the transceiver through BNC connector J12. It then goes to PC034-CI, through transmit-receive relay RL101, and through a 9 section LC filter made up of inductors T101-105 and capacitors C131-139. This filter's passband is 118-136 MHz., and the stop band is selected so that the receiver's image frequency is rejected in excess of 60 dB. (The image frequency is the selected receive frequency plus 70 MHz.). This filtered signal then is output at PC034-CR.

From here the RF signal goes to J3 pin 16, the connector for PC030. On this board, the signal is first amplified 10 dB by Q301, then mixed down to 35 MHz. by Q302. This mixing action takes place between the RF signal and a local oscillator frequency generated by voltage-controlled oscillator Q304. The

frequency of oscillation of Q304 is controlled by varactor diode CR305, which is in turn controlled by the voltage coming in to PC030 at J3 pin 11. This tuning voltage is controlled by the COM synthesizer board PC032. The function of Q304 is to provide an input to Q302 which is 35 MHz. higher in frequency than the desired receive frequency. Thus, to receive frequency 123.3, Q304 must oscillate at 158.3 MHz., and it is the function of the synthesizer (PC032) to cause the correct tuning voltage to make this happen. Q305 is a buffer amplifier that isolates oscillator Q304 from mixer Q302 and J3 pin 6.

The output at pin 6 will be compared in the synthesizer and will result in the tuning voltage for CR305 to bring oscillator Q304 to oscillate on the selected frequency.

The 35 MHz signal from the mixer then goes through crystal filter FL301-FL303. This is the primary filter for the entire receiver; it is this filter that sets the bandwidth of the entire system. The filter is matched to intermediate frequency (IF) amplifier U301 by T302. U301-303 comprise a very high-gain 35 MHz amplifier chain, and the high-level output of U303 is demodulated by CR302-303. From there, the audio signal is routed through noise clipper CR304 and is output as a 20 millivolt audio signal to U3048. The audio signal becomes amplified about 50 times by U3048, and is output to the audio amplifier board (PC029) at J4 pin 4.

A second portion of the audio signal rectified by CR302-303 is routed to automatic gain control (AGC) amplifier U304C. You will notice that the audio signal demodulated by CR302-303 is DC coupled to U304C. The idea is to keep this DC level at the same point for all signals -- weak and strong -- so that all audio output from the receiver is at the same approximate level. If there were no AGC, then a receiver adjusted to receive a weak signal would become very loud when a strong signal came in. This DC component of the output signal is amplified 1000 times (60 dB) in U304C, and then routed to the IF amplifier chain U301-303 pin 7. The DC voltage on pin 7 controls the amount of gain each amplifier can give, so by reducing the voltage on pin 7, we reduce the gain of each amplifier. Since the gain is reduced on each amplifier in proportion to the level of the signal at the output of the demodulator, the net result is to keep the DC level out of the demodulator, and hence the audio signal level, the same for weak and strong signals.

A portion of this IF AGC voltage is also routed to amplifier U304D. This amplifier's bias is set by R353-354 so that it is not turned on until the IF AGC voltage reaches a certain point. At that point, U304D pin 14 begins to rise in proportion to the received signal strength. In so doing, this voltage at pin 14 begins to turn on CR301, which then shunts some of the input RF signal to ground. If it were not for this delayed turn-on of U304D, the received audio would have more noise than necessary strong signal. U304D waits (or delays) until the RF signal received is well out of the noise of the amplifier circuits until it begins its AGC action. Between the IF and the RF AGC amplifiers, the output signal has less than a 6 dB change for input signals in the range 10-100,000 microvolts (an 80 dB change).

Another portion of the IF AGC voltage from U304C goes to squelch gate U304A. The front panel control R2 sets a bias voltage through R351 which causes U304A pin 1 to go to zero volts. This in turn biases U304B pin 7 to go to zero volts, and the audio signal attempting to pass through U304B will get through. When the IF AGC voltage begins to rise (indicating that a signal is being received), then U304A pin 2 begins to receive more and more voltage. When this voltage overcomes the bias set by the squelch control, then U304A pin 1 rises immediately to 10 volts, biasing the audio amplifier on, and allowing the audio signal to pass on to PC030 pin 4.

#### 4. COMMUNICATIONS TRANSMITTER

The function of the communications transmitter is to take voice modulation information and it on an internally generated RF carrier of several watts. Most of the transmitter components are located on PC035.

The COM VCO, located on PC031, generates the selected COM frequency. Q502 is the voltage controlled oscillator whose frequency is determined by the bias on CR505. This oscillator has been designed to produce a spectrally pure signal at the frequency selected by the COM thumbwheel switches. The output of this oscillator is split between identical buffer amplifiers Q503-504. One part of this buffered VCO output goes to the COM synthesizer on PC032 (via PC031 pin 2 to PC035 pin 20), and the other goes to the COM transmitter circuits on PC035. The power delivered to the synthesizer will eventually determine the amount of bias supplied to PC031 pin 4, and thus determine the transmitter frequency.

The inputs for this board to operate properly are:

- a. 10 mW of RF from a 50 ohm source 118-136 MHz at VCO INPUT (pin 20)
- b. +10 volts at ENABLE (pin 17)
- c. +10 volts at +10 XMIT (pin 18)
- d. +6.8 volts at MODULATION (pin 16).

Assuming all the inputs exist as listed, the RF signal in the band 118 - 136 MHz comes in to class A amplifier Q201. This amplifier raises the power level to the 50 mW range ( $G = 7$  dB). This signal is then passed to Q202, a class AB amplifier, where the nominal output level is 200 mW ( $G = 6$  dB). This 200 mW signal is then amplified in Q203 and Q204 to the final level of 2 to 3 watts. Also, Q203 and Q204 output level is very linearly dependent upon the collector voltage supplied to pin 16 (MODULATION). If this collector voltage happens to be an audio waveform, the output of this board will be an RF signal modulated by this audio waveform. The output of Q204 passes through a 2-section lowpass pi filter before exiting the board at pin 6 (RF OUT). This filter (C223, C224, L205) in addition to the filtering effect of the tuning coils in the transmitter reduce the second and higher harmonics to the -60 dB level.

If the synthesizer is commanded to an output frequency outside the band 118.00 to 135.975, circuits described in section 7 (COM synthesizer) automatically detect the error and reduce the ENABLE signal to zero. This effectively shuts off the power amplifier; the output of the board with ENABLE zero is more than 70 dB below normal output. In addition, lock detector circuitry will also reduce ENABLE to zero if for some reason the loop does not lock to the crystal controlled reference. If the loop is locked to the reference and is set on an authorized frequency, ENABLE goes to +10 volts, turning on both transmitter and Q205, which gives the XMIT light on the front panel s ground through pin 10, lighting the XMIT light.

## 5. COMMUNICATIONS SYNTHESIZER

The function of the communications synthesizer is to input signals from the communications transmitter VCO on PC031 in the transmit mode, or from the communications receiver VCO on PC030 in the receive mode, compare either of these signals to a crystal-controlled reference and the selected frequency from the COM thumbwheel switches on the front panel, and then output a tuning voltage to either of the VCO's to lock them to the selected frequency. In addition, the COM synthesizer must detect an out-of-band or out-of-lock condition and inhibit the transmitter from putting out spurious or illegal signals. Most of the components of the COM synthesizer are on PC032.

The COM synthesizer circuit is centered around a Large Scale Integrated Circuit (LSI) chip which contains the functional equivalent of several thousand MOS-FET transistors. This LSI device provides dual-modulus prescale counters, phase detector, lock detect, reference oscillator and divider functions while drawing less than half a milliampere of supply current.

The function of the COM synthesizer is to compare the output of the COM receiver voltage controlled oscillator (located on the com receiver board) with a crystal-controlled reference and supply a tuning signal to the COM VCO which will cause the COM VCO frequency to be phase-locked to the crystal-controlled reference.

This particular synthesizer is of the dual-modulus (or "swallow counter") type which provides an excellent channel spacing capability (25 kHz) with high reference frequency requirements. The swallow counter technique will be described in a subsequent paragraph.

A crystal controlled reference frequency from the NAV synthesizer board (PC031) comes from J5 pin 13 to PC032 through J6 pin 13. An internal decoder divides this 3.2 MHz signal by 128, thus producing an internal precision 25 kHz reference frequency.

The 10 mW COM VCO input comes into pin 20, and thence into U608. This device is so designed as to divide the input frequency by 40 if pin 9 of U607 is logical 1 (high), and by 41 if pin 9 is logical 0 (low). (Note - logical high is defined as 8 volts or higher, logical low is defined as being 2 volts or less. ) The output of U608 pin 3 is a square wave at approximately 3.75 MHz if the input COM VCO frequency is approximately 160 MHz. (This output of U502 must be viewed using a low-capacity oscilloscope probe). With input power below 1 mW at the COM VCO input pin 20,



the output at U608 pin 3 will either be zero or a very low-level "hash" as U608-609 search for a valid input.

This prescaled frequency comes into LSI U607 at pin 1. This frequency must now be divided down inside U607 so that the input frequency may be compared to the crystal-controlled reference frequency of 25 kHz. There are two counters within the LSI to perform this function, called the "N" and "A" counters. We will now make use of an arbitrarily chosen frequency, say, a desired receive frequency of 124.75 MHz, in order to illustrate how the divider chain works.

In order to receive 124.75 MHz, the receiver local oscillator must be at  $(124.75 + 35.00)$  or 159.75 MHz. In order to reference this frequency to 25 kHz, the total divide ratio must be  $(159.75 / .025)$  or 6390:1 total division. The only way to achieve this ratio with dividers that can be programmed with a binary code is if we let the A counter command a divide-by 41 for 30 counts, and then divide-by 40 for 159 counts. Since we have binary inputs to the A and N counters of the LSI U607, we can program in this code with thumbwheel switches. However, since this synthesizer will have to respond to not only the receiver local oscillator signal in the receive mode but also the transmit signal in the

transmit mode, some sort of provision will have to be made to switch the divide-by ratio when the transceiver goes from the transmit to the receive mode. This conversion takes place in the "offset generator" consisting of U603/606, which will be discussed shortly.

U601/602/604/605 form what is called a "code converter". The function of this code converter is to take the input from standard digital thumbwheel switches and program into the synthesizer U607 the proper code, as described below. This converter takes the BCD code from the thumbwheel switches and converts it to standard digital code for U607. Therefore, the numbers shown on the BCD switches are the actual frequency selected for both receive and transmit of the transceiver. However, if it was not for the offset generator, the frequency of the local oscillator could not be set automatically. U603/606 take the code selected by the thumbwheel switches and ADD 35 (for an IF frequency of 35 MHz) to this code in the receive mode. Thus, the synthesizer commands a frequency equal to the thumbwheel frequency in the transmit mode, and thumbwheel frequency + 35 in the receive mode. U603/606 are what are called digital half-adders. If U603 pin 9 is LOW, then nothing (zero) is added to the code converted thumbwheel frequency. If U603 pin 9 is HIGH, then digital 35 (00100011), where U606 is the 4 MSB and U603 is the 4 LSB, is added to the converted code. The output of the offset generator is fed directly into U607, which is a "swallow counter" prescaler.

You may be interested in the way Motorola describes the action of this swallow counter scheme: "The modulus control output (pin 9) will be low at the beginning of a count cycle and will remain low until the A counter has counted down from its programmed value. At this time, modulus control goes high and remains high until the N counter has counted the rest of the way down from its programmed

value (N-A counts since both N and A are counting down during the first portion of the cycle).

Modulus control is then set back low, the counters preset to their respective programmed values, and the above sequence repeated. This provides for a total programmable divide value  $N(\text{total}) = N * P + A$  where P and P+1 represent the dual modulus prescaler divide values respectively for high and low modulus control levels; N the number programmed into the N counter, and A the number

programmed into the A counter.

The dividers N and A are programmed with logical high inputs. Divider N has 10 inputs called N0, N1, N2. . . N9, and divider A has 6 inputs called A0, A1. . . A5. These are the divide ratios expressed in binary form as a power of 2. Thus, for the N divider to be programmed to 159 as in the above step, the following code was set into the N divider:

N7=1    N6=0    N5=0    N4=1    N3=1    N2=1  
N1=1    N0=1

(Translation: Connecting N7 to +10, N6 and N5 to ground, and N4 through N0 to +10 yields a divide-by ratio of 159. Another way of saying this is that  $10011111 = 159$ )

As you can see, any divide ratio from 1 (2 to the 0 equals 1) to 1023 may be programmed into the N divider.

In a similar manner, the number 30 may be programmed into the A counter by setting the following code onto the A divider inputs:

A0=0 A1=1 A2=1 A3=1 A4=1 A5=0

With this A counter, any number from 1 to 63 may be programmed in.

It is also true that there are only 17 whole-megahertz steps from 118 to 135 MHz, so the divide ratios of the N counter (which IS the whole-megahertz counter) in receive need only go from a divide ratio of 6120 to 6800. The code changes to go from 108 (bottom of the NAV band) to 135 (top of the COM band)

go in the following manner (note: 108=10001110 means that for a receive frequency of 108 MHz, N0 is at zero volts, N1 through N3 are at +10 volts, N4, N5, and N6 are at zero volts, and N7 is at +10 volts).

108=10001110 109=10001111 110=10010000 111=10010001 112=10010010 113=10010011  
114=10010100 115=10010101 116=10010110 117=10010111 (Rcv offset = 34 MHz.)

118=10011001 119=10011010 120=10011011 121=10011100 122 10011101 123=10011110  
124=10011111 125=10100000 126=10100001 127=10100010 128=10100011 129=10100100  
130=10100101 131=10100110 132=10100111 133=10101000 134=10101001 135=10101010  
(Rcv offset = 35 MHz.)

The codes in transmit (frequencies from 118 to 135 MHz only) are:

118=01110110 119=01110111 120=01111000 121=01111001 122=01111010 123=01111011  
124=01111100 125=01111101 126=01111110 127=01111111 128=10000000 129=10000001  
130=10000010 131=10000011 132=10000100 133=10000101 134=10000110 135=10000111

By the same sort of logical process, the A counter (which is actually the fractional megahertz counter) may be programmed by logical zeroes and ones on the lines AO - A5.) For fractional values from .00 to .95 MHz, the following table shows the logical signal on each of the lines AO - A5 (Note:

.35=001110 means that for a setting of .35 MHz on the fractional megahertz switch, A0 is connected to zero volts, A1, A2, and A3 are connected to +10, A4 and A5 are connected to zero volts.

.00=000000	.02=000001	.05=000010	.07=000011	.10=000100	.12=000101
.15=000110	.17=000111	.20=001000	.22=001001	.25=001010	.27=001011
.30=001100	.32=001101	.35=001110	.37=001111	.40=010000	.42=010001
.45=010010	.47=010011	.50=010100	.52=010101	.55=010110	.57=010111
.60=011000	.62=011001	.65=011010	.67=011011	.70=011100	.72=011101
.75=011110	.77=011111	.80=100000	.82=100001	.85=100010	.87=100011
.90=100100	.92=100101	.95=100110	.97=100111		

The end result of all this dividing is to compare the frequency and phase of the COM VCO local oscillator (in receive) or the transmitter VCO (in transmit) signal with the crystal-controlled 25 kHz reference frequency. This comparison is performed in a phase/frequency detector internal to LSI U607. If the divided COM UCO frequency is greater than the reference, or if the phase of the VCO leads the reference, then U607 pin 7 will remain at logic 1 and pin 8 is a variable duty cycle square wave. Conversely, if reference is higher in frequency than VCO, or if reference phase leads VCO, then U607 pin 8 goes logical high, and pin 7 is the square wave. If the reference and variable are locked in frequency and phase, then both 7 and 8 are high except for some very, very fast needle-width pulses at a 25 kHz repetition rate pulsing low. If these two phase detector outputs are integrated and compared in a high-impedance operational amplifier (U610), then the output of this amplifier will drive the COM UCO (transmit or receive) to the proper phase-locked frequency. The time constant of this integrator is somewhat critical, in that too long a time constant will cause the UCO to take a very long time to come to the correct frequency, while too short a time constant will allow the needle-width pulses of the phase detector to modulate the COM VCO, causing undesirable 25 kHz sidebands on the COM VCO local oscillator signal and on the transmitter output. The lock time of this loop has been calculated and measured as 10 milli-seconds to go from one end of the band to the other, and the undesired 25 kHz sidebands of the UCO are down approximately 80 dB.

The COM synthesizer is powered by the +10 constant (unswitched) line, so that the synthesizer is active during both receive and transmit functions. However, power is removed from the COM transmitter - during receive, and from the COM receive local oscillator VCO during transmit, so that the synthesizer can only receive signals from one source at a time.

It is possible that an illegal frequency code might be selected by the thumbwheel switches. For example, it is quite possible to select 115.0 MHz with the COM thumbwheels. To prevent transmission on an illegal frequency, and to prevent reception of unwanted signals, U604 is connected as an "illegal code detector". The output of U604 to J6 pin 5 is an inhibit signal passed to the transmitter board PC035. This signal prevents the transmitter from being activated when an

illegal code is selected. Similarly, should the synthesizer not lock to the reference frequency, U607 pin 28 will cause U605/U604 to inhibit the transmitter.

## 6. NAVIGATION SYNTHESIZER

The function of the navigation synthesizer is to input a signal from the navigation receiver VCO on PC052, compare it to both the reference and the thumbwheel code, and output a tuning signal to the VCO to lock the VCO to the thumbwheel frequency selected. Almost all the components for the synthesizer are on PC031.

The navigation synthesizer is very similar to the communications synthesizer, with the following exceptions:

- a. There is no switchable offset adder circuitry. The code from the nav switches is encoded directly to the synthesizer. N values from 142 (108 MHz + 34 MHz) to 151 (117 MHz + 34 MHz) are converted directly by discrete diode (CR501-504) and Q501.
- b. The master crystal oscillator for the entire synthesis scheme is on PC031. Y501 causes internal oscillator of synthesizer U501 to generate the 3.2 MHz. master clock signal. C510-512 form a temperature compensating circuit to keep the crystal frequency within .002% from -30 to + degrees C.

## 7. NAVIGATION RECEIVER

The function of the navigation receiver is identical to the communications receiver described above. While the communication receiver is optimized for the voice signals in the 118-136 MHz COM band, the navigation receiver is designed to select signals in the 108-118 MHz NAV bend. Most of the components of the navigation receiver are on PC052.

Signals intended for the NAV receiver come in to the transceiver through RCA-type connector J13 located on the chassis rear. The signal is brought onto PC034 point NI, is filtered by a similar arrangement to the COM filter, and is output at point NF.

From point NF, the filtered signal is routed to PC052 pin 16. From pin 16, the signal undergoes the exact same processing as the COM signal, except for the IF frequency, which is 34 MHz.. There are a number of small component value changes between the COM and the NAV receivers. The intent of these component changes is to allow the audio frequencies emphasized by the receiver to optimize the COM and NAV audio frequencies. For example, the lowest COM frequency that has to be passed is 300 Hz, while the NAV receiver has to have a frequency response down in the 1 Hz range in order to pass the 30 Hz VOR frequency with no phase shift. Conversely, the NAV receiver must have an upper frequency response of over 10 kHz in order to pass the VOR reference frequency, while the COM receiver must band-limited to 3 kHz to reduce the amount of noise present in the receiver output.

In addition, the squelch amplifier is deactivated and a separate DC coupled output from the amplifier is provided for the NAV receiver.

## B. NAVIGATION CONVERTER/DRIVER

The function of the NAV converter/driver is to take audio signals from the NAV receiver (PC052) and convert them into voltages necessary to drive the TO-FROM lamps and LEFT-RIGHT meter on the front panel. All of the components necessary for this conversion are contained on PC boards 033 and 024.

PC024, commonly called the converter board, inputs a signal from the NAV receiver board PC052 (J9 pin - 20). This signal, nominally 1.5 volts peak to peak, is made up of either the composite VOR signal (30 Hz variable phase and 9960 Hz reference) or the composite LOC signal (90 and 150 Hz). This 1.5 volt signal comes into PC024 at pin 20. The signal is attenuated in R901 so that the output of amplifier U902C (a x5 amplifier) is 5 volts p-p. This 5 volt signal is then applied to U902 B end D (VOR), and U903 C and D (LOC).

Assuming that a VOR signal is present, U902D is a highpass filter that removes the 30 Hz VAR component of the composite VOR signal and passes the 9960 REF signal with a voltage amplification of 30 (29 dB). Since the input to U902D is 5 volts p-p, this amplifier will saturate to both ground and the +10 supply, clipping this reference voltage at the output of U902D. The reference signal at this point is an "almost square" wave at 9960 Hz being frequency modulated plus and minus 480 Hz at a 30 Hz rate. This almost-square wave then goes to U901 which is a 9960 Hz phase locked loop ("PLL") FM detector. The output of U901 pin 10 is the 30 Hz FM modulation on the 9960 Hz reference carrier. This 30 Hz REF signal then goes through 30 Hz filter U902A, which makes a clean sine wave out of the relatively dirty PLL output, and then goes to comparator U906A which makes a very clean 30 Hz square wave from the filtered sine wave. U905A is connected as a differentiator such that it gives one 15 microsecond pulse every time the square wave transitions from low to high. Thus, the output of this board at pin 2 is a 15 microsecond pulse that occurs once every 33 milliseconds. This is the REF 30 Hz pulse. A second output of the PLL comes from U901 pin 1, and is a DC voltage that goes high whenever the loop has sufficient input signal to become locked. This voltage goes to gate U905D which will give a VOR LOCK signal at board pin 16 if both this REF and the VAR signals are both present.

The 30 Hz VAR component of the composite VOR signal goes through 30 Hz filter U9028 where the 9960 component is stripped from the signal and a clean 30 Hz sine wave is output at U9028 pin 7. This sine wave then goes to comparator U9068 where the sine wave is converted to a square wave. This signal is then differentiated in U9058 to become a 15 microsecond VAR pulse output at board pin 13. The squared VAR signal at U9068 pin 1 also goes to U908, a 108 kHz PLL. This loop takes the 30 Hz, VAR signal at pin 1 and compares it with the 30 Hz signal generated by taking the 108 kHz square wave at U908 pin 4 and dividing it by 3600 in U907. This 30 Hz pulse from the anodes of CR907-910 is applied to the

second input of the phase detector in U908 (pin 3). Thus, the 108 kHz signal at U908 pin 4 is phase-locked to the 30 Hz VAR signal, and each cycle of the 108 kHz signal represents 0.1 degree of phase. Q903 buffers this 108 kHz signal and outputs it at board pin 4. The phase lock detect voltage at U908 pin 1 goes to the second input of gate U905D for the VOR LOCK output at board pin 16. This lock signal also turns Q901 and Q902 on to prevent any unwanted output of the LOC amplifiers U903 C and D.

The VOR outputs of this board, then, consist of a 15 usec pulse that represents the reference phase point, or 0 degrees, or magnetic north (all the same point). There is a second 15 usec pulse that represents where the VOR station is relative to this board. It occurs a time after the REF pulse equivalent in degrees to the magnetic heading from the VOR station. Each degree of change clockwise from north is equivalent to 93 microseconds of time, so that a VAR signal that lagged the REF by 15 degrees would be about 1.4 milliseconds lag, at due south (180 degrees) the lag would be 16 milliseconds, and so on. The third VOR signal is a 108 kHz square wave, with each cycle of the wave equivalent in time to 0.1 degrees of phase.

If the signal is localizer instead of VOR, filters U903C passes the 90 Hz and U903D passes the 120 Hz. These filters are adjusted with no input by means of R933 and R940 so that the output of U9038 (5v +/- LOC) is exactly 5 volts referenced to board pin 3 (+5 NAV). If one tone predominates, indicating an off-runway-centerline condition, the d.c. voltage detected by CR905 or CR906 will rise and the output of U903 will go up or down, depending upon which tone is greater. If both tones are present, U905C gives a logic high output at board pin 17 (LOC LOCK).

The LOC output of this board, then, is a voltage that is above or below 5 volts by an amount equivalent to the difference in the level of the 90 and 150 Hz components of the localizer signal. If the 90 and 150 Hz tones are equal, the d.c. voltage at board pins 3 and 19 are equal.

PC033, commonly called the omni decoder board, takes the VOR reference pulse, the VOR variable pulse, the phase-locked 108 kHz squarewave, and digitally determines the phase relationship of the two pulses along with the phase difference between them. In addition, the omni decoder board also electronically calculates the amount of phase the aircraft is in deviation from a thumbwheel selected phase (OmniBearing Selector), OR the amount of amplitude deviation of the aircraft from the localizer centerline, and displays these errors on a standard left-right panel meter.

The VOR circuits will be described first. The VOR reference pulse comes in PC033 pin 7. This pulse resets flip-flop (FF) U802A Q output low. This point going low removes the inhibiting action of the preset input on U801/807-809 and these down-counters begin to count the pulses of the 108 kHz clock input to PC033 pin 15. When the counter chain reaches the number set in by the thumbwheel switches (pins 3,4,12,13 of the down-counters), then CR802-805 are all forward biased, resulting in a positive pulse from U8028 Q output. This positive pulse resets all the down-counters back to zero, sets U8128 Q output high, clocks in a reset pulse to U802A FF, which in turn, presets the down-counters with the thumbwheel switch information, and thus resets U802A Q output low. The net result of all this digital runaround is a pulse from U802A Q output differing from the VOR ref pulse by exactly the number of degrees of phase set in by the thumbwheel

switches. If you like, you can think of the down-counters U801/807-809 and their associated gating to be nothing more than a very accurate digital phase shifter. For example, if 087 are the digits set in to the OBS switches on the front panel, then the pulse at U8028 Q output will lag the VOR ref phase pulse by EXACTLY B7 electrical degrees of phase. If you are measuring this on an oscilloscope, you should see the two pulses differ by 8.05 milliseconds. (one degree of phase at 30 Hz is about 93 microseconds).

Meanwhile, the VOR var pulse has come in to PC033 pin 17, and has set the Q output of U812A high. This output will stay high for about 180 degrees of phase and then go low. This sets the 'FROM hemisphere' of phase; if the (REF phase plus thumbwheel delay) signal from U812A goes high any time during this FROM hemisphere, the VAR and REF+DELAY pulses are in the same 180 degree hemisphere, and the aircraft is on a FROM heading. If these two pulses are not in the same hemisphere, and the aircraft is on a TO course. Gates U813 decode this information, and output through Q802-803 to the appropriate T-F lamps. The second input of these AND gates comes from the VOR-LOC lock gate U811. If neither the VOR nor the LOC have achieved sufficient amplitude to assure reliable readings, neither the TO nor the FROM lamp gate will be on, and U805 will light the red OFF lamp. If the signal is LOC rather than VOR, then the logic will see what appears to be a FROM signal and light the FROM lamp, no matter what the relationship of the aircraft to the localizer signal.

The VOR VAR and VOR REF+DELAY pulses have also been input to a chain of digital logic U812, 805, 806, 813, 811, 812, 804, and 803. The end result of this series of logic is to output pulses at U803 pins 10 and 11, the pulse width of each of these AND gate outputs being proportional to the difference in phase between VOR VAR and VOR REF+DELAY. In addition, the output pulses of U803 are phase-sign dependent. That is, (on FROM headings) if VAR lags DELAY, then U803 pin 10 outputs a pulse proportional to the phase error, with pin 11 remaining at zero, and if DELAY lags VAR, then pin 11 has the pulse, and pin 10 is zero. Finally, this AND gate output logic must reverse for TO headings -- pin 10 going low when pin 11 had gone low for FROM headings and vice versa.

U810 integrates (i.e. makes a DC signal from the AC pulses) these pulses and outputs the result to the L-R meter on the front panel. In addition, during LOC operation the '5v +-LOC' signal coming in PC033 pin 8 deflects the L-R meter proportional to the amplitude of the localizer signal unbalance.

This concludes the theory of operation of the RST-571/572 NAVCOM Transceivers.

All of the circuits in this section are on PC029, which is installed into J4 on the chassis. This board provides high-power outputs for headphones, speaker, and modulator circuits; provides the circuit that switches the +10 supply between COM and NAU modes; and provides circuitry to implement the pilot announcement system.

The +10 regulated supply from PC034-PT comes in to J4 pin 15. If pin 7 (KEY) is not grounded to place the transceiver in the TRANSMIT mode, Q403 is turned on through R403, R401, and the emitter-base diode of Q401. When Q403 turns on, it in turn turns on Q402, and connects pin 14 (+10 RCV) to the +10 supply. This action provides +10 power to the entire NAU and COM receiver circuits. If pin 7 is grounded (which happens when the pilot depresses his PTT switch), Q403 and q402 are turned off, and q401 turns on through R401. This turns off the +10 receive bus and turns on the +10 transmit supply.

Receiver audio from the volume control comes in pin 2 (COM) and pin 3 (NAV). In addition, auxiliary audio input comes in pin 5. These 3 signals are summed and amplified by a factor of 2 in U4048. U4048 output in the receive mode is set at a nominal 5 volts by the +10 receive supply and voltage divider R427, R428. (In the transmit mode, this amplifier is biased off by R434).

The audio out from U4048 is split by R43T, R406 and is coupled to speaker amplifier U403 and headphones amplifier U402. These amplifiers are set for a voltage gain of 15, so that approximately 1 volt p-p at U4048 pin 1 will fully drive both amplifiers to more than full output.

If the +10 transmit bus is activated, the pilot's microphone connected to pin 4 is biased by Q406 and amplifier U404A is activated. (U404A is normally biased off in the receive mode by R423). This combination of events causes any audio present at the pilot's microphone to be amplified by U404A and appear at U404A pin 7 as an approximately 3 volts p-p. R430 selects a fraction of this signal and CR403, CR404 form a compressor circuit to increase the average percentage modulation by clipping (approximately 6 dB compression) any large spikes in the spoken audio to no more than 1.2 volts p-p. This microphone audio signal is then filtered by C433, C416 to remove any high frequency distortion

products generated in either the microphone amplifier or compressor, and U401 amplifies the resultant signal for use in modulating the transmitter. Note that the output of U401 is set internally to the device at  $U+/2$  -- (6.8 volts DC) -- and the output swings up to the + supply rail (+13.6) and down to ground. This is a series transformerless modulator, and it's output to J4 pin 20 will eventually be used to modulate the RF output of the transmitter. A fraction of this output voltage is adjustable by R411 and input to the headphone amplifier U402. This is the sidetone provision of the modulator.

If the +13.6 bus is switched on, Q405 is turned on through R418, and provides a ground to the "ON" light.

### 3. COMMUNICATIONS RECEIUER



The function of the communications receiver is to select the desired receive signal, demodulate the signal, and output the signal's audio to The power audio amplifier board. Most of the components are on PC030, but the system RF filter is on PC034.

The COM RF signal first comes into the transceiver through BNC connector J12. It then goes to PC034-CI, through transmit-receive relay RL101, and through a 9 section LC filter made up of inductors T101-105 and capacitors C131-139. This filter's passband is 118-136 MHz., and the stop band is selected so that the receiver's image frequency is rejected in excess of 60 dB. (The image frequency is the selected receive frequency plus 70 MHz.). This filtered signal then is output at PC034-CR.

From here the RF signal goes to J3 pin 16, the connector for PC030. On this board, the signal is first amplified 10 dB by q301, then mixed down to 35 MHz. by Q302. This mixing action takes place between the RF signal and a local oscillator frequency generated by voltage-controlled oscillator Q304. The frequency of oscillation of Q304 is controlled by varactor diode CR305, which is in turn controlled by the voltage coming in to PC030 at J3 pin 11. This tuning voltage is controlled by the COM synthesizer board PC032. The function of q304 is to provide an input to Q302 which is 35 MHz. higher in frequency than the desired receive frequency. Thus, to receive frequency 123.3, q304 must Oscillate at 158.3 MHz., and it is the function of the synthesizer (PC032) to cause the correct tuning voltage to make this happen. q305 is a buffer amplifier that isolates oscillator Q304 from mixer q302 and J3 pin 6.

The output at pin 6 will be compared in the synthesizer and will result in the tuning voltage for CR305 to bring oscillator Q304 to oscillate on the selected frequency.

The 35 MHz signal from the mixer then goes through crystal filter FL301-FL303. This is the primary filter for the entire receiver; it is this filter that sets the bandwidth of the entire system. The filter is matched to intermediate frequency (IF) amplifier U301 by T302. U301-303 comprise a very high-gain 35 MHz amplifier chain, and the high-level output of U303 is demodulated by CR302-303. From there, the audio signal is routed through noise clipper CR304 and is output as a 20 millivolt audio signal to U3048. The audio signal becomes amplified about 50 times by U3048, and is output to the audio amplifier board (PC029) et J4 pin 4.

A second portion of the audio signal rectified by CR302-303 is routed to automatic gain control (AGC) amplifier U304C. You will notice that the audio signal demodulated by CR302-303 is DC coupled to U304C. The idea is to keep this DC level at the same point for all signals -- weak and strong -- so that all audio output from the receiver is at the same approximate level. If there were no AGC, then a receiver adjusted to receive a weak signal would become very loud when a strong signal came in. This DC component of the output signal is amplified 1000 times (60 dB) in U304C, and then routed to the IF amplifier chain U301-303 pin 7. The DC voltage on pin 7 controls the amount of gain each amplifier can give, so by reducing the voltage on pin 7, we reduce the gain of each amplifier. Since the gain is reduced on each amplifier in proportion to the level of the signal at

the output of the demodulator, the net result is to keep the DC level out of the demodulator, and hence the audio signal level, the same for weak and strong signals.

A portion of this IF AGC voltage is also routed to amplifier U304D. This amplifier's bias is set by R353-354 so that it is not turned on until the IF AGC voltage reaches a certain point. At that point, U304D pin 14 begins to rise in proportion to the received signal strength. In so doing, this voltage at pin 14 begins to turn on CR301, which then shunts some of the input RF signal to ground. If it were not for this delayed turn-on of U304D, the received audio would have more noise than necessary strong signal. U304D waits (or delays) until the RF signal received is well out of the noise of the amplifier circuits until it begins its AGC action. Between the IF and the RF AGC amplifiers, the output signal has less than a 6 dB change for input signals in the range 10-100,000 microvolts (an 80 dB change).

Another portion of the IF AGC voltage from U304C goes to squelch gate U304A. The front panel control R2 sets a bias voltage through R351 which causes U304A pin 1 to go to zero volts. This in turn biases U3048 pin 7 to go to zero volts, and the audio signal attempting to pass through U3048 will get through. When the IF AGC voltage begins to rise (indicating that a signal is being received) then U304A pin 2 begins to receive more and more voltage. When this voltage overcomes the bias set by the squelch control, then U304A pin 1 rises immediately to 10 volts, biasing the audio amplifier on, and allowing the audio signal to pass on to PC030 pin 4.

#### 4. COMMUNICATIONS TRANSMITTER

The function of the communications transmitter is to take voice modulation information and put it on an internally generated RF carrier of several watts. Most of the transmitter components are located on PC035.

The COM UCO, located on PC031, generates the selected COM frequency. Q502 is the voltage controlled oscillator whose frequency is determined by the bias on CR505. This oscillator has been designed to produce a spectrally pure signal at the frequency selected by the COM thumbwheel switches. The output of this oscillator is split between identical buffer amplifiers Q503-504. One part of this buffered UCO output goes to the COM synthesizer on PC032 (via PC031 pin 2 to PC035 pin 20), and the other goes to the COM transmitter circuits on PC035. The power delivered to the synthesizer will eventually determine the amount of bias supplied to PC031 pin 4, and thus determine the transmitter frequency.

The inputs for this board to operate properly are:

- a. 10 mW of RF from a 50 ohm source 11B-136 MHz at UCO INPUT (pin 20)

b. +10 volts at ENABLE (pin 17)

c. +10 volts at +10 XMIT (pin 18)

d. +6. B volts at MODULATION (pin 16).

Assuming all the inputs exist as listed, the RF signal in the band 118 - 136 MHz comes in to class A amplifier Q201. This amplifier raises the power level to the 50 mW range ( $G = 7$  dB). This signal is then passed to Q202, a class AB amplifier, where the nominal output level is 200 mW ( $G = 6$  dB). This 200 mW signal is then amplified in Q203 and Q204 to the final level of 2 to 3 watts. Also, Q203 and Q204 output level is very linearly dependent upon the collector voltage supplied to pin 16 (MODULATION). If this collector voltage happens to be an audio waveform, the output of this board will be an RF signal modulated by this audio waveform. The output of Q204 passes through a 2-section lowpass pi filter before exiting the board at pin 6 (RF OUT). This filter (C223, C224, L205) in addition to the filtering effect of the tuning coils in the transmitter reduce the second and higher harmonics to the -60 dB level.

If the synthesizer is commanded to an output frequency outside the band 118.00 to 135.975, circuits described in section 7 (COM synthesizer) automatically detect the error and reduce the ENABLE signal to zero. This effectively shuts off the power amplifier; the output of the board with ENABLE zero is more than 70 dB below normal output. In addition, lock detector circuitry will also reduce ENABLE to zero if for some reason the loop does not lock to the crystal controlled reference. If the loop is locked to the reference and is set on an authorized frequency, ENABLE goes to +10 volts, turning on both transmitter and Q205, which gives the XMIT light on the front panel a ground through pin 10, lighting the XMIT light.

## 5. COMMUNICATIONS SYNTHESIZER

The function of the communications synthesizer is to input signals from the communications transmitter UCO on PC031 in the transmit mode, or from the communications receiver UCO on PC030 in the receive mode, compare either of these signals to a crystal-controlled reference and the selected frequency from the COM thumbwheel switches on the front panel, and then output a tuning voltage to either of the UCO's to lock them to the selected frequency. In addition, the COM synthesizer must detect an out-of-band or out-of-lock condition and inhibit the transmitter from

putting out spurious or illegal signals. Most of the components of the COM synthesizer are on PC032.

The COM synthesizer circuit is centered around a Large Scale Integrated Circuit (LSI) chip which contains the functional equivalent of several thousand MOS-FET transistors. This LSI device provides dual-modulus prescale counters, phase detector, lock detect, reference oscillator and divider functions while drawing less than half a milliampere of supply current.

The function of the COM synthesizer is to compare the output of the COM receiver voltage controlled oscillator (located on the com receiver board) with a crystal-controlled reference and supply a tuning signal to the COM UCO which will cause the COM UCO frequency to be phase-locked to the crystal-controlled reference.

This particular synthesizer is of the dual-modulus (or "swallow counter") type which provides an excellent channel spacing capability (25 kHz) with high reference frequency requirements. The swallow counter technique will be described in a subsequent paragraph.

A crystal controlled reference frequency from the NAU synthesizer board (PC031) comes from J5 pin 13 to PC032 through J6 pin 13. An internal decoder divides this 3.2 MHz signal by 128, thus producing an internal precision 25 kHz reference frequency.

The 10 mW COM UCO input comes into pin 20, and thence into U608. This device is so designed as to divide the input frequency by 40 if pin 9 of U607 is logical 1 (high), and by 41 if pin 9 is logical 0 (low). (Note - logical high is defined as 8 volts or higher, logical low is defined as being 2 volts or less. ) The output of U608 pin 3 is a square wave at approximately 3.75 MHz if the input COM UCO frequency is approximately 160 MHz. (This output of U502 must be viewed using a low-capacity oscilloscope probe). With input power below 1 mW at the COM VCO input pin 20, the output at U608 pin 3 will either be zero or a very low-level "hash" as U608-609 search for a valid input.

This prescaled frequency comes into LSI U607 at pin 1. This frequency must now be divided down inside U607 so that the input frequency may be compared to the crystal-controlled reference frequency of 25 kHz. There are two counters within the LSI to perform this function, called the "N" and "A" counters. We will now make use of an arbitrarily chosen frequency, say, a desired receive frequency of 124.75 MHz, in order to illustrate how the divider chain works.

In order to receive 124.75 MHz, the receiver local oscillator must be at  $(124.75 + 35.00)$  or 159.75 MHz. In order to reference this frequency to 25 kHz, the total divide ratio must be  $(159.75 / .025)$  or 6390:1 total division. The only way to achieve this ratio with dividers that can be programmed with a binary code is if we let the A counter command a divide-by 41 for 30 counts, and then

divide-by 40 for 159 counts. Since we have binary inputs to the A and N counters of the LSI U607, we can program in this code with thumbwheel switches. However, since this synthesizer will have to respond to not only the receiver local oscillator signal in the receive mode but also the transmit signal in the

transmit mode, some sort of provision will have to be made to switch the divide-by ratio when the transceiver goes from the transmit to the receive mode. This conversion takes place in the "offset generator" consisting of U603/606, which will be discussed shortly.

U601/602/604/605 form what is called a "code converter". The function of this code converter is to take the input from standard digital thumbwheel switches and program into the synthesizer U607 the proper code, as described below. This converter takes the BCD code from the thumbwheel switches and converts it to standard digital code for U607. Therefore, the numbers shown on the BCD switches are the actual frequency selected for both receive and transmit of the transceiver. However, if it was not for the offset generator, the frequency of the local oscillator could not be set automatically.

U603/606 take the code selected by the thumbwheel switches and ADD 35 (for an IF frequency of 35 MHz) to this code in the receive mode. Thus, the synthesizer commands a frequency equal to the thumbwheel frequency in the transmit mode, and thumbwheel frequency + 35 in the receive mode. U603/606 are what are called digital half-adders. If U603 pin 9 is LOW, then nothing (zero) is added to the code converted thumbwheel frequency. If U603 pin 9 is HIGH, then digital 35 (00100011), where U606 is the 4 MSB and U603 is the 4 LSB, is added to the converted code. The output of the offset generator is fed directly into U607, which is a "swallow counter" prescaler.

You may be interested in the way Motorola describes the action of this swallow counter scheme:

"The modulus control output (pin 9) will be low at the beginning of a count cycle and will remain low until the A counter has counted down from its programmed value. At this time, modulus control goes high and remains high until the N counter has counted the rest of the way down from its programmed

value (N-A counts since both N and A are counting down during the first portion of the cycle).

Modulus control is then set back low, the counters preset to their respective programmed values, and the above sequence repeated. This provides for a total programmable divide value  $N(\text{total}) = N * P + A$  where P and P+1 represent the dual modulus prescaler divide values respectively for high and low modulus control levels; N the number programmed into the N counter, and A the number programmed into the A counter.

The dividers N and A are programmed with logical high inputs. Divider N has 10 inputs called N0, N1, N2. . . N9, and divider A has 6 inputs called A0, A1. . . A5. These are the divide ratios expressed in binary form as a power of 2. Thus, for the N divider to be programmed to 159 as in the above step, the following code was set into the N divider:

N7=1    N6=0    N5=0    N4=1    N3=1    N2=1  
N1=1    N0=1

(Translation: Connecting N7 to +10, N6 and N5 to ground, and N4 through N0 to +10 yields a divide-by ratio of 159. Another way of saying this is that 10011111 = 159)

As you can see, any divide ratio from 1 (2 to the 0 equals 1) to 1023 may be programmed into the N divider.

In a similar manner, the number 30 may be programmed into the A counter by setting the following code onto the A divider inputs:

AO=0 A1=1 A2=1 A3=1 A4=1 A5=0

With this A counter, any number from 1 to 63 may be programmed in.

It is also true that there are only 17 whole-megahertz steps from 118 to 135 MHz, so the divide ratios of the N counter (which IS the whole-megahertz counter) in receive need only go from a divide ratio of 6120 to 6800. The code changes to go from 108 (bottom of the NAV band) to 135 (top of the COM band)

go in the following manner (note: 10B=10001110 means that for a receive frequency of 108 MHz, N0 is at zero volts, N1 through N3 are at +10 volts, N4, N5, and N6 are at zero volts, and N7 is at +10 volts).

108=10001110 109=10001111 110=10010000 111=10010001 112=10010010 113=10010011  
114=10010100 115=10010101 116=10010110 117=10010111 (Rcv offset = 34 MHz.)  
118=10011001 119=10011010 120=10011011 121=10011100 122=10011101 123=10011110  
124=10011111 125=10100000 126=10100001 127=10100010 128=10100011 129=10100100  
130=10100101 131=10100110 132=10100111 133=10101000 134=10101001 135=10101010  
(Rcv offset = 35 MHz.)

The codes in transmit (frequencies from 118 to 135 MHz only) are:

118=01110110 119=01110111 120=01111000 121=01111001 122=01111010 123=01111011  
124=01111100 125=01111101 126=01111110 127=01111111 128=10000000 129=10000001  
130=10000010 131=10000011 132=10000100 133=10000101 134=10000110 135=10000111

By the same sort of logical process, the A counter (which is actually the fractional megahertz counter) may be programmed by logical zeroes and ones on the lines AO - A5.) For fractional values from .00 to .95 MHz, the following table shows the logical signal on each of the lines AO - A5 (Note:

.35=001110 means that for a setting of .35 MHz on the fractional megahertz switch, A0 is connected to zero volts, A1, A2, and A3 are connected to +10, A4 and A5 are connected to zero volts.

.00=000000 .02=000001 .05=000010 .07=000011 .10=000100 .12=000101  
 .15=000110 .17=000111 .20=001000 .22=001001 .25=001010 .27=001011  
 .30=001100 .32=001101 .35=001110 .37=001111 .40 010000 .42=010001  
 .45=010010 .47=010011 .50=010100 .52=010101 .55=010110 .57=010111  
 .60=011000 .62=011001 .65=011010 .67=011011 .70=011100 .72=011101  
 .75=011110 .77=011111 .BO=100000 .82=100001 .85=100010 .87=100011  
 .90=100100 .92=100101 .95=100110 .97=100111

The end result of all this dividing is to compare the frequency and phase of the COM UCO local oscillator (in receive) or the transmitter VCO (in transmit) signal with the crystal-controlled 25 kHz reference frequency. This comparison is performed in a phase/frequency detector internal to LSI U607.

If the divided COM UCO frequency is greater than the reference, or if the phase of the UCO leads the reference, then U607 pin 7 will remain at logic 1 and pin 8 is a variable duty cycle square wave. Conversely, if reference is higher in frequency than VCO, or if reference phase leads UCO, then U607 pin 8 goes logical high, and pin 7 is the square wave. If the reference and variable are locked in frequency and phase, then both 7 and B are high except for some very, very fast needle-width pulses at a 25 kHz repetition rate pulsing low. If these two phase detector outputs are integrated and compared in a high-impedance operational amplifier (U610), then the output of this amplifier will drive the COM UCO (transmit or receive) to the proper phase-locked frequency. The time constant of this integrator is somewhat critical, in that too long a time constant will cause the UCO to take a very long time to come to the correct frequency, while too short a time constant will allow the needle-width pulses of

the phase detector to modulate the COM VCO, causing undesirable 25 kHz sidebands on the COM UCO local oscillator signal and on the transmitter output. The lock time of this loop has been calculated and measured as 10 milli-seconds to go from one end of the band to the other, and the undesired 25 kHz sidebands of the UCO are down approximately 80 dB.

The COM synthesizer is powered by the +10 constant (unswitched) line, so that the synthesizer is active during both receive and transmit functions. However, power is removed from the COM transmitter - during receive, and from the COM receive local oscillator UCO during transmit, so that the synthesizer can only receive signals from one source at a time.

It is possible that an illegal frequency code might be selected by the thumbwheel switches. For example, it is quite possible to select 115.0 MHz with the COM thumbwheels. To prevent transmission on an illegal frequency, and to prevent reception of unwanted signals, U604 is connected as an "illegal code detector". The output of U604 to J6 pin 5 is an inhibit signal passed to the transmitter board PC035. This signal prevents the transmitter from being activated when an illegal code is selected. Similarly, should the synthesizer not lock to the reference frequency, U607 pin 28 will cause U605/U604 to inhibit the transmitter.

## 6. NAVIGATION SYNTHESIZER

The function of the navigation synthesizer is to input a signal from the navigation receiver UCO on PC052, compare it to both the reference and the thumbwheel code, and output a tuning signal to the UCO to lock the UCO to the thumbwheel frequency selected. Almost all the components for the synthesizer are on PC031.

The navigation synthesizer is very similar to the communications synthesizer, with the following exceptions:

- a. There is no switchable offset adder circuitry. The code from the nav switches is encoded directly to the synthesizer. N values from 142 (108 MHz + 34 MHz) to 151 (117 MHz + 34 MHz) are converted directly by discrete diode (CR501-504) and Q501.
- b. The master crystal oscillator for the entire synthesis scheme is on PC031. Y501 causes internal oscillator of synthesizer U501 to generate the 3.2 MHz. master clock signal. C510-512 form a temperature compensating circuit to keep the crystal frequency within .002% from -30 to + degrees C.

## 7. NAVIGATION RECEIVER

The function of the navigation receiver is identical to the communications receiver described above. While the communication receiver is optimized for the voice signals in the 118-136 MHz COM band, the navigation receiver is designed to select signals in the 108-118 MHz NAV band. Most of the components of the navigation receiver are on PC052.

Signals intended for the NAV receiver come in to the transceiver through RCA-type connector J13 located on the chassis rear. The signal is brought onto PC034 point NI, is filtered by a similar arrangement to the COM filter, and is output at point NF.

From point NF, the filtered signal is routed to PC052 pin 16. From pin 16, the signal undergoes the exact same processing as the COM signal, except for the IF frequency, which is 34 MHz. There are a number of small component value changes between the COM and the NAV receivers. The intent of these component changes is to allow the audio frequencies emphasized by the receiver to optimize the COM and NAV audio frequencies. For example, the lowest COM frequency that has to be passed is 300 Hz, while the NAV receiver has to have a frequency response down in the 1 Hz range in order to pass the 30 Hz VOR frequency with no phase shift. Conversely, the NAV receiver must have an upper frequency response of over 10 kHz in order to pass the UOR reference frequency, while the COM receiver must be band-limited to 3 kHz to reduce the amount of noise present in the receiver output.



In addition, the squelch amplifier is deactivated and a separate DC coupled output from the amplifier is provided for the NAV receiver.

## B. NAVIGATION CONVERTER/DRIVER

The function of the NAU converter/driver is to take audio signals from the NAU receiver (PC052) and convert them into voltages necessary to drive the TO-FROM lamps and LEFT-RIGHT meter on the front panel. All of the components necessary for this conversion are contained on PC boards 033 and 024.

PC024, commonly called the converter board, inputs a signal from the NAU receiver board PC052 (J9 pin - ZO). This signal, nominally 1.5 volts peak to peak, is made up of either the composite UOR signal (30 Hz variable phase and 9960 Hz reference) or the composite LOC signal (90 and 150 Hz). This 1.5 volt

signal comes into PC024 at pin 20. The signal is attenuated in R901 so that the output of amplifier U902C (a x5 amplifier) is 5 volts p-p. This 5 volt signal is then applied to U902 B end D (VOR), and U903 C and D (LOC).

Assuming that a VOR signal is present, U902D is a highpass filter that removes the 30 Hz UAR component of the composite VOR signal and passes the 9960 REF signal with a voltage amplification of 30 (29 dB). Since the input to U902D is 5 volts p-p, this amplifier will saturate to both ground and the +10 supply, clipping this reference voltage at the output of U902D. The reference signal at this point is an "almost square" wave at 9960 Hz being frequency modulated plus and minus 480 Hz at a 30 Hz rate. This almost-square wave then goes to U901 which is a 9960 Hz phase locked loop ("PLL") FM detector. The output of U901 pin 10 is the 30 Hz FM modulation on the 9960 Hz reference carrier. This 30 Hz REF signal then goes through 30 Hz filter U902A, which makes a clean sine wave out of the relatively dirty PLL output, and then goes to comparator U906A which makes a very clean 30 Hz square wave from the filtered sine wave. U905A is connected as a differentiator such that it gives one 15 microsecond pulse every time the square wave transitions from low to high. Thus, the output of this board at pin 2 is a 15 microsecond pulse that occurs once every 33 milliseconds. This is the REF 30 Hz pulse. A second output of the PLL comes from U901 pin 1, and is a DC voltage that goes high whenever the loop has sufficient input signal to become locked. This voltage goes to gate U905D which will give a VOR LOCK signal at board pin 16 if both this REF and the UAR signals are both present.

The 30 Hz VAR component of the composite VOR signal goes through 30 Hz filter U9028 where the 9960 component is stripped from the signal and a clean 30 Hz sine wave is output at U9028 pin 7. This sine wave then goes to comparator U9068 where the sine wave is converted to a square wave. This signal is then differentiated in U9058 to become a 15 microsecond VAR pulse output at board pin 13. The squared VAR signal at U9068 pin 1 also goes to U908, a 108 kHz PLL. This loop takes the 30 Hz, VAR signal at pin 1 and compares it with the 30 Hz signal generated by

taking the 108 kHz square wave at U908 pin 4 and dividing it by 3600 in U907. This 30 Hz pulse from the anodes of CR907-910 is applied to the second input of the phase detector in U908 (pin 3). Thus, the 108 kHz signal at U908 pin 4 is phase-locked to the 30 Hz VAR signal, and each cycle of the 108 kHz signal represents 0.1 degree of phase. Q903 buffers this 108 kHz signal and outputs it at board pin 4. The phase lock detect voltage at U908 pin 1 goes to the second input of gate U905D for the UOR LOCK output at board pin 16. This lock signal also turns Q901 and Q902 on to prevent any unwanted output of the LOC amplifiers U903 C and D.

The VOR outputs of this board, then, consist of a 15 usec pulse that represents the reference phase point, or 0 degrees, or magnetic north (all the same point). There is a second 15 usec pulse that represents where the VOR station is relative to this board. It occurs a time after the REF pulse equivalent in degrees to the magnetic heading from the UOR station. Each degree of change clockwise from north is equivalent to 93 microseconds of time, so that a VAR signal that lagged the REF by 15 degrees would be about 1.4 milliseconds lag, at due south (180 degrees) the lag would be 16 milliseconds, and so on. The third VOR signal is a 108 kHz square wave, with each cycle of the wave equivalent in time to 0.1 degrees of phase.

If the signal is localizer instead of VOR, filters U903C passes the 90 Hz and U903D passes the 120 Hz. These filters are adjusted with no input by means of R933 and R940 so that the output of U9038 (5v +/- LOC) is exactly 5 volts referenced to board pin 3 (+5 NAU). If one tone predominates, indicating an off-runway-centerline condition, the d.c. voltage detected by CR905 or CR906 will rise and the output of U903 will go up or down, depending upon which tone is greater. If both tones are present, U905C gives a logic high output at board pin 17 (LOC LOCK).

The LOC output of this board, then, is a voltage that is above or below 5 volts by an amount equivalent to the difference in the level of the 90 and 150 Hz components of the localizer signal. If the 90 and 150 Hz tones are equal, the d.c. voltage at board pins 3 and 19 are equal.

PC033, commonly called the omni decoder board, takes the VOR reference pulse, the VOR variable pulse, the phase-locked 108 kHz squarewave, and digitally determines the phase relationship of the two pulses along with the phase difference between them. In addition, the omni decoder board also electronically calculates the amount of phase the aircraft is in deviation from a thumbwheel selected phase (OmniBearing Selector), OR the amount of amplitude deviation of the aircraft from the localizer centerline, and displays these errors on a standard left-right panel meter.

The VOR circuits will be described first. The VOR reference pulse comes in PC033 pin 7. This pulse resets flip-flop (FF) U802A Q output low. This point going low removes the inhibiting action of the preset input on UBO1/807-809 and these down-counters begin to count the pulses of the 108 kHz clock input to PC033 pin 15. When the counter chain reaches the number set in by the thumbwheel switches (pins 3,4,12,13 of the down-counters), then CR802-B05 are all forward biased, resulting in a positive pulse from U8028 Q output. This positive pulse resets all the down-counters back to zero, sets U8128 Q output high, clocks in a reset pulse to U802A FF, which in

turn, presets the down-counters with the thumbwheel switch information, and thus resets U802A Q output low. The net result of all this digital runaround is a pulse from U802A Q output differing from the UOR ref pulse by exactly the number of degrees of phase set in by the thumbwheel switches. If you like, you can think of the down-counters U801/B07-809 and their associated gating to be nothing more than a very accurate digital phase shifter. For example, if 087 are the digits set in to the OBS switches on the front panel, then the pulse at U8028 Q output will lag the VOR ref phase pulse by EXACTLY B7 electrical degrees of phase. If you are measuring this on an oscilloscope, you should see the two pulses differ by 8.05 milliseconds. (one degree of phase at 30 Hz is about 93 microseconds).

Meanwhile, the VOR var pulse has come in to PC033 pin 17, and has set the Q output of U812A high. This output will stay high for about 180 degrees of phase and then go low. This sets the 'FROM hemisphere' of phase; if the (REF phase plus thumbwheel delay) signal from U812A goes high any time during this FROM hemisphere, the UAR and REF+DELAY pulses are in the same 180 degree hemisphere, and the aircraft is on a FROM heading. If these two pulses are not in the same hemisphere, and the aircraft is on a TO course. Gates U813 decode this information, and output through Q802-803 to the appropriate T-F lamps. The second input of these AND gates comes from the VOR-LOC lock gate U811. If either the VOR nor the LOC have achieved sufficient amplitude to assure reliable readings, neither TO nor FROM lamp gate will be on, and U805 will light the red OFF lamp. If the signal is LOC rather than VOR, then the logic will see what appears to be a FROM signal and light the FROM lamp, no matter what the relationship of the aircraft to the localizer signal.

The VOR VAR and VOR REF+DELAY pulses have also been input to a chain of digital logic U812, 805, 806, 813, 811, 812, 804, and 803. The end result of this series of logic is to output pulses at U803 pins 10 and 11, the pulse width of each of these AND gate outputs being proportional to the difference in phase between VOR VAR and VOR REF+DELAY. In addition, the output pulses of U803 are phase-sign dependent. That is, (on FROM headings) if UAR lags DELAY, then U803 pin 10 outputs a pulse proportional to the phase error, with pin 11 remaining at zero, and if DELAY lags VAR, then pin 11 has the pulse, and pin 10 is zero. Finally, this AND gate output logic must reverse for TO headings -- pin 10 going low when pin 11 had gone low for FROM headings and vice versa.

U810 integrates (i.e. makes a DC signal from the AC pulses) these pulses and outputs the result to the L-R meter on the front panel. In addition, during LOC operation the '5v +-LOC' signal coming in PC033 pin 8 deflects the L-R meter proportional to the amplitude of the localizer signal unbalance.

This concludes the theory of operation of the RST-571/572 NAVCOM Transceivers.

## G. INSTALLATION

This section will detail the installation of this device in an aircraft. Any other installation (ground vehicle, portable/base use, etc.) will require the installer to follow these general procedures also.

If installed in a standard certificated aircraft, a licensed airframe mechanic must perform a logbook entry for a minor modification of the aircraft, and a notation made in the airframe logbook of this minor modification. An airframe logbook entry of the weight and balance change must also be performed at this

time. (Mechanic's note: CG of the RST-571 or RST-572 radio is 15 cm (6 inches) aft of the faceplate surface, and the weight is 2 kg (4.5 lbs).)

When applying for an aircraft station license on FCC form 404 or a ground station license on FCC form 406, this device must be referenced as the BSBYCRSTS71 (360 channel version) or the BSBYCRSTS72 (720 channel version).

### 1. Mechanical Installation

a. Mount the tray into the radio rack using 6-32 hardware in accordance with the procedures outlined in AC 43-13-1A and 43-13-2.

b. Slip the radio into the rack from the front after making sure that the small locking ear on the radio chassis bottom is flush with the chassis bottom.

c. Secure the radio to the rack by inserting a screwdriver into the small hole between the "ON" and "XMIT" lamps and rotating the screw clockwise until it tightens the radio against the airframe. If you are ABSOLUTELY SURE that you will not have to take the radio out during this installation, you may cover the screwdriver hole with the black hole plug provided. Please note that to remove the radio it is mandatory to destroy this hole plug -- this was done as a thief-deterrent.

d. To remove the radio for service, drill the hole plug out with a 7 mm (1/4 inch) drill bit, and loosen the chassis to tray clamp by inserting a screwdriver into the hole between "ON" and "XMIT" lamps and rotating the screw counterclockwise until the tab on the clamp assembly rotates back up into the chassis. The radio may then be removed by disconnecting J1, J12 and J13 and sliding the radio forward out of the tray.

### 2. Electrical Installation -- Connector J1 (See Drawing #571-3060).

a. The following require #18 AWG or heavier wire:

1. Pin 6 (+13.6 from the battery bus) through a 2 ampere fusible device.
2. Pin B (Airframe ground and speaker ground).

3. Pin 11 (Speaker output).

b. The following should be wired with shielded cable:

1. Pin 14 (Pilot's mic audio).
2. Ground of this shielded cable to pin 9.

c. The following may be wired with #24 or heavier wire:

1. Pin 1 (12 volt dimmer input).
2. Pin 12 (Headphone output).
3. Pin 13 (Pilots mic key -- PTT line).

NOTE: If this radio is being used from a battery supply in excess of 14.3 volts, a voltage regulator will be necessary.

### 3. Electrical Installation - Antennas

a. NAV Antenna. The NAV antenna connected to J13 must be a horizontal dipole fed with 50 ohm coaxial cable of any length necessary and an RCA (male) connector. There are no "critical" or "magical" lengths of cable, providing that a proper balun is used at the antenna end of the coaxial cable. Failure to use a truly horizontal antenna or failure to use a proper balun will cause VOR/LOC needle wander and other strange operation of the NAV receiver.

b. COM Antenna. The COM antenna connected to J12 must be a vertical antenna of either ground-plane or dipole-style construction. The ground plane type of antenna will not require a balun, but the dipole antenna will require a balun. In either case, the antenna must be connected to the transceiver with 50 ohm coaxial cable and a BNC (male) connector. As with the NAV antenna, there are no critical cable lengths.

c. If neither you nor your installer are as familiar with antennas as you need to be for a good installation, RST recommends that you consult a reference text (such as the RST-801) prior to the installation of your radio.

### 4. Electrical Installation - Accessories (required but not supplied)

a. Microphones. Any standard CIVILIAN carbon or amplified dynamic microphone is approved for use with this radio.

b. Earphones. Any standard CIVILIAN aircraft earphone may be used. This radio will drive up to 4 sets of 150 ohm headsets with less than 2 dB drop over an open circuit.

c. Speaker. Any permanent magnet speaker with voice coil ratings of at least 5 watts and impedances above 3 ohms may be used. Do NOT hardwire another radio in parallel with this radio

and run both to the speaker without going through an isolation amplifier or isolating audio panel (for example -- RST-502, 503, 504, 564) of some sort. Damage to the speaker amplifier will most probably result from directly paralleling two speaker outputs directly.

d. Dimmer. Any aircraft dimmer circuit capable of going from zero volts (daytime operation) to 12 volts (or 24 volts, if so wired) for nighttime lighting is acceptable.

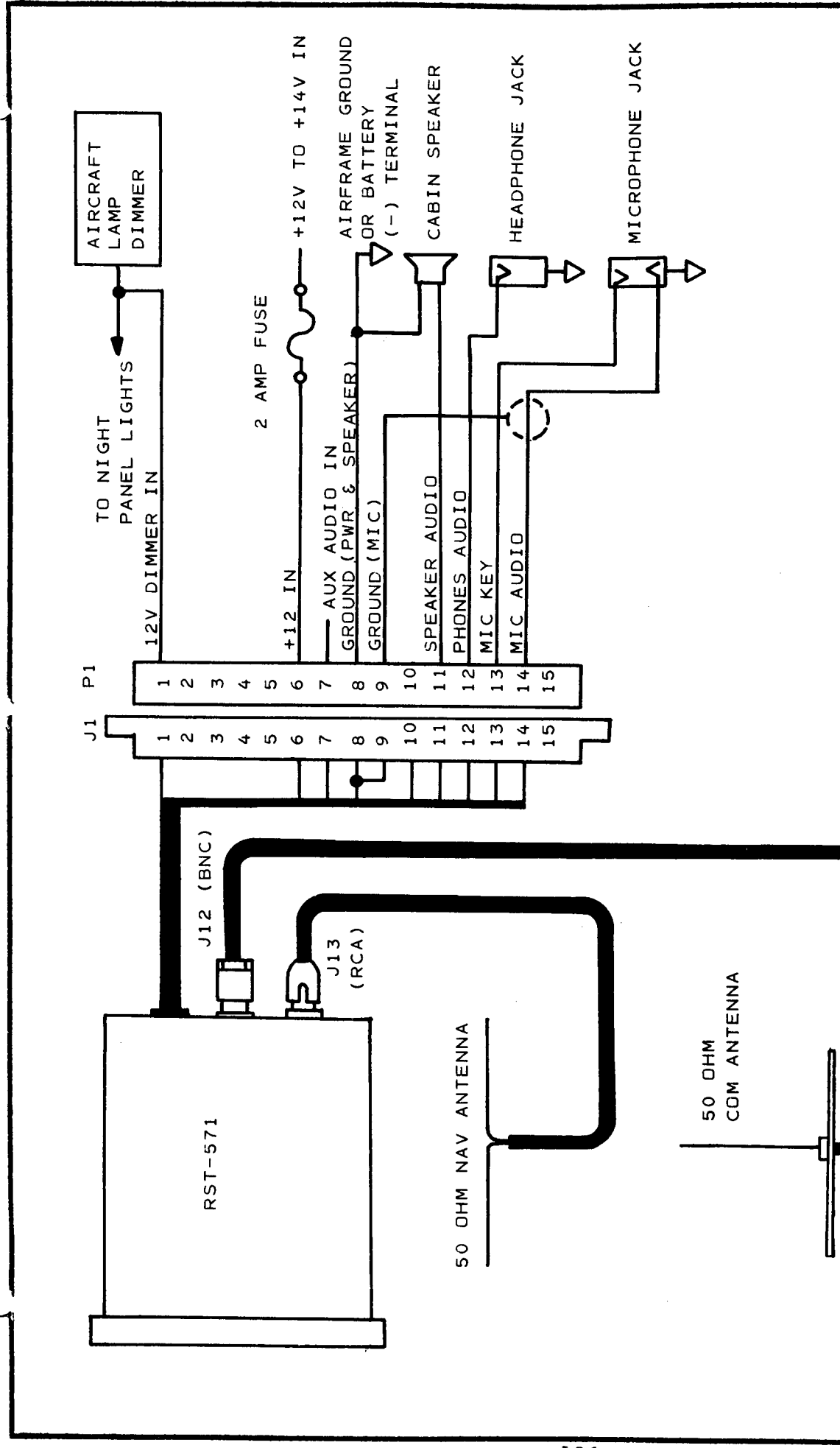
## H. OPERATION

### 1. Communications Transceiver.

Rotating the COM SQUELCH control clockwise activates the radio's main power switch providing power to the COM transmitter, illuminating the green ON light, and allowing the COM and NAV receivers to be turned on. Turning the COM VOLUME control clockwise activates a switch which turns on the COM receiver power. Additional clockwise rotation of this control increases the COM audio level. Additional clockwise rotation of the COM SQUELCH increases the sensitivity of the COM receiver from a nominal 20 uV to a point where the squelch is always "broken", and the characteristic hiss of a sensitive receiver is heard continuously. Frequencies from 118 to 135.97 MHz are selected by the COM thumbwheel switches. NOTE -- it is possible to command the transceiver below 118 and above 136 MHz by mis-setting the thumbwheels, but the receiver will not receive out-of-band, and the transmitter will be deactivated. When transmitting on a legal channel, the white XMIT light indicates proper transmitter operation.

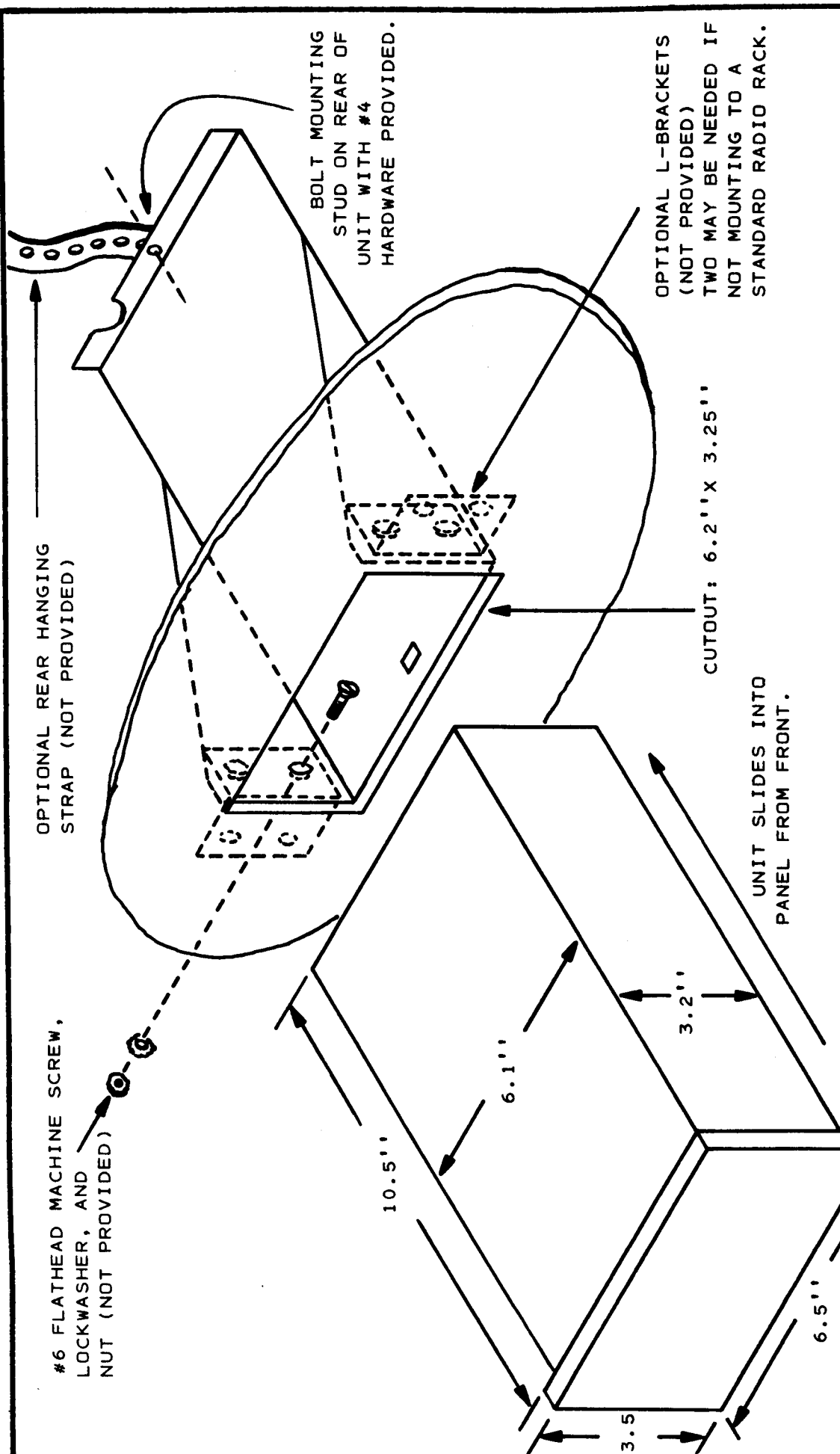
### 2. Navigation Receiver.

Once the main power switch (on the COM SQUELCH control) has been activated, the NAV receiver may be turned on by rotating the NAV VOLUME control clockwise. The red "off" will be illuminated until the receiver AGC settles and a navigation station is tuned in. Additional clockwise rotation of this control increases the NAV audio level allowing the ident signal of navigation stations to be heard. The desired receive frequency is set with the NAV switches, and the desired course is set with the OBS thumbwheel switches. Course direction is given with the blue TO or yellow FROM lamps, and deviation from course is given by the meter. There is no switching necessary to go from VOR to LOC mode, and when a localizer signal is received with sufficient amplitude to ensure reliable course indication, the FROM light will light and the OBS thumbwheels will have no effect on the left-right meter. (Most experienced IFR pilots, though, usually set the inbound localizer course on the OBS as a reminder).



RST-571/572 AIRCRAFT BAND NAVCOM TRANCEIVER	
SCALE: NTS	APPROVED BY:
DATE: 20DEC82	DRAWN BY: VEA
REVISED: SDEC84LP	
ELECTRICAL CONNECTION DETAILS	
RADIO SYSTEMS TECHNOLOGY	DRAWING NUMBER
GRASS VALLEY, CALIFORNIA 95945	571-3060

NOTES: 1. AREV REF ECO#51.



NAVCOM INSTALLATION DETAILS

SCALE: NTS	APPROVED BY: <i>[Signature]</i>	DRAWN BY: TLP
DATE: 30MAY84		REVISED

**RADIO SYSTEMS TECHNOLOGY**  
**GRASS VALLEY, CALIFORNIA 95945**

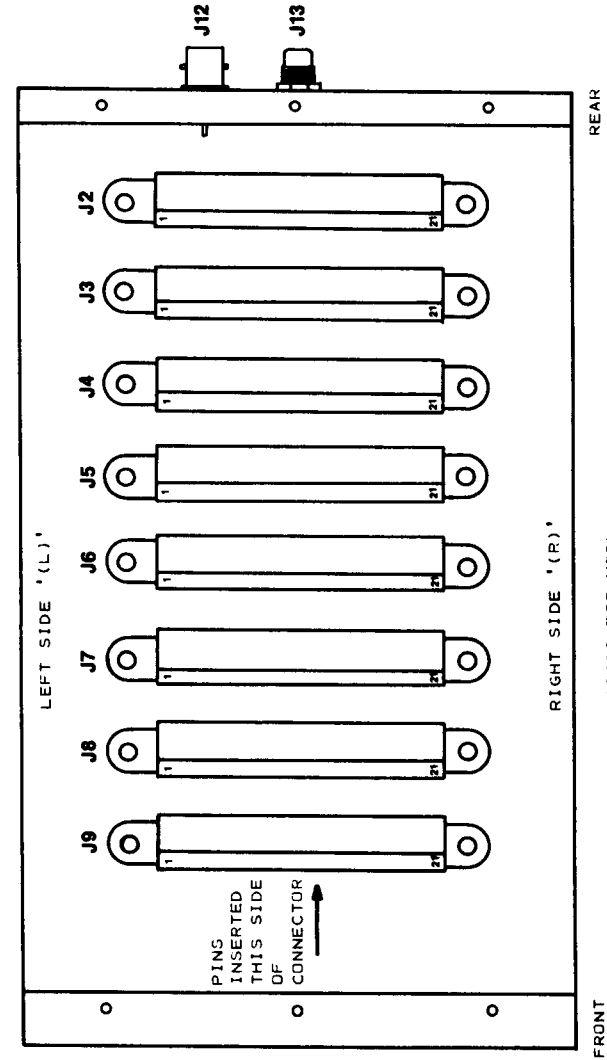
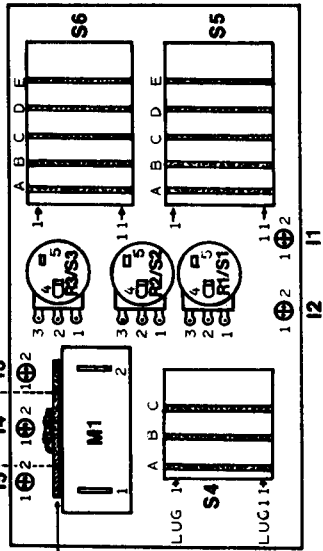
DRAWING NUMBER  
 571-3900

NOTE: A MINIMUM OF 12" CLEARANCE BEHIND THE INSTRUMENT PANEL IS NECESSARY FOR PROPER CONNECTION OF ANTENNA CABLES.

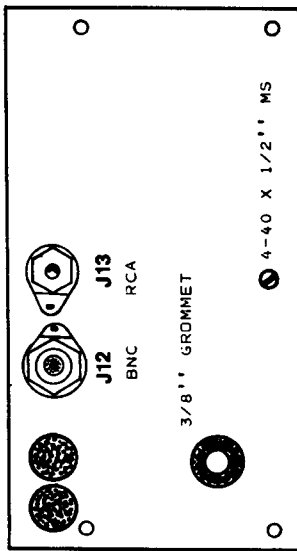


2-56 X 1/2" MS

CHASSIS FRONT (INSIDE VIEW)



CHASSIS TOP VIEW



CHASSIS REAR (INSIDE VIEW)

RST-571 MECHANICAL ASSEMBLY DRAWING

SCALE: NTS

APPROVED BY:

DRAWN BY VEA

DATE: 17DEC82

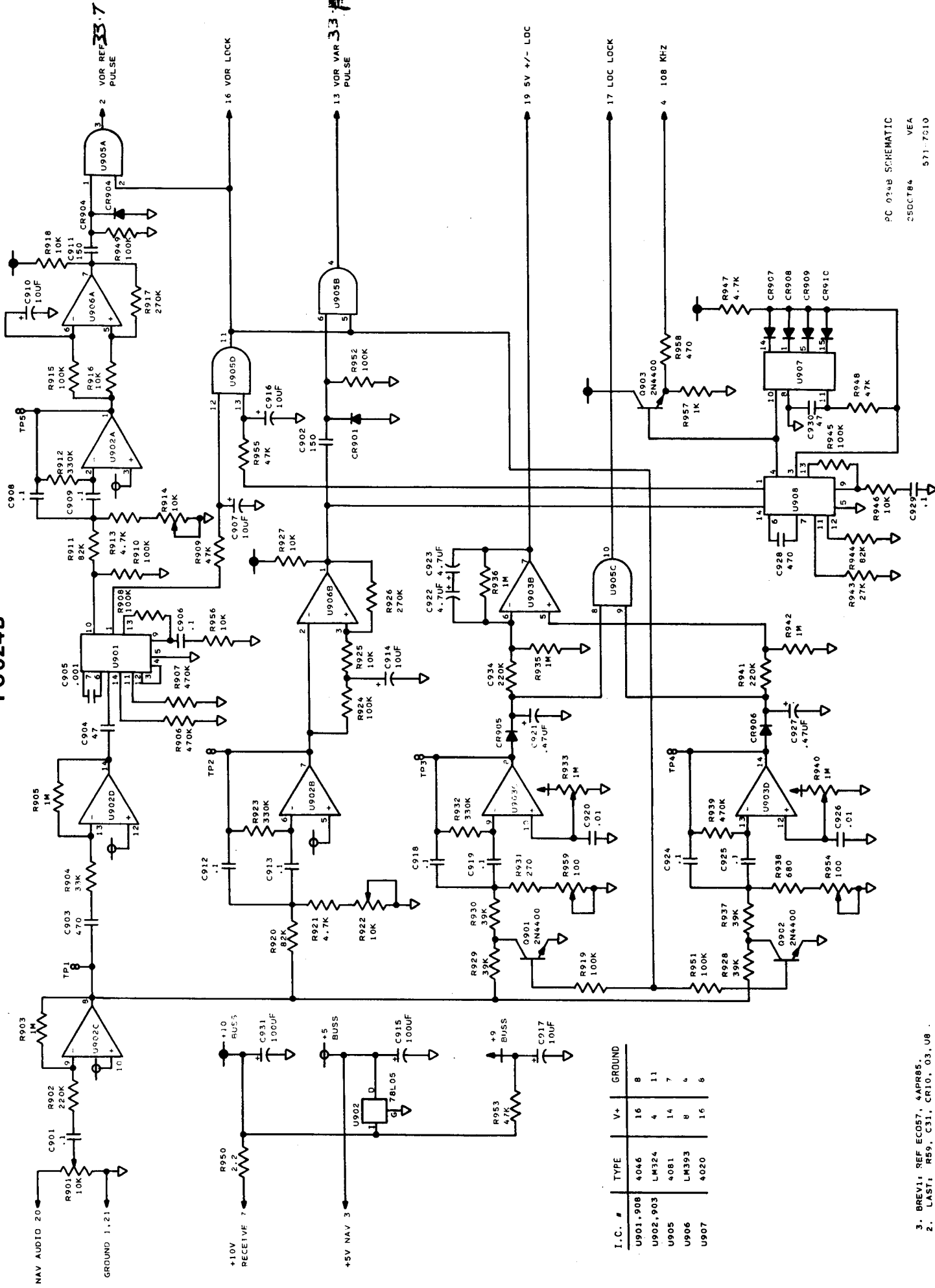
REVISED ATSP

RADIO SYSTEMS TECHNOLOGY  
GRASS VALLEY, CALIFORNIA 95945

DRAWING NUMBER  
571-4000

A REV: ECO 2T.

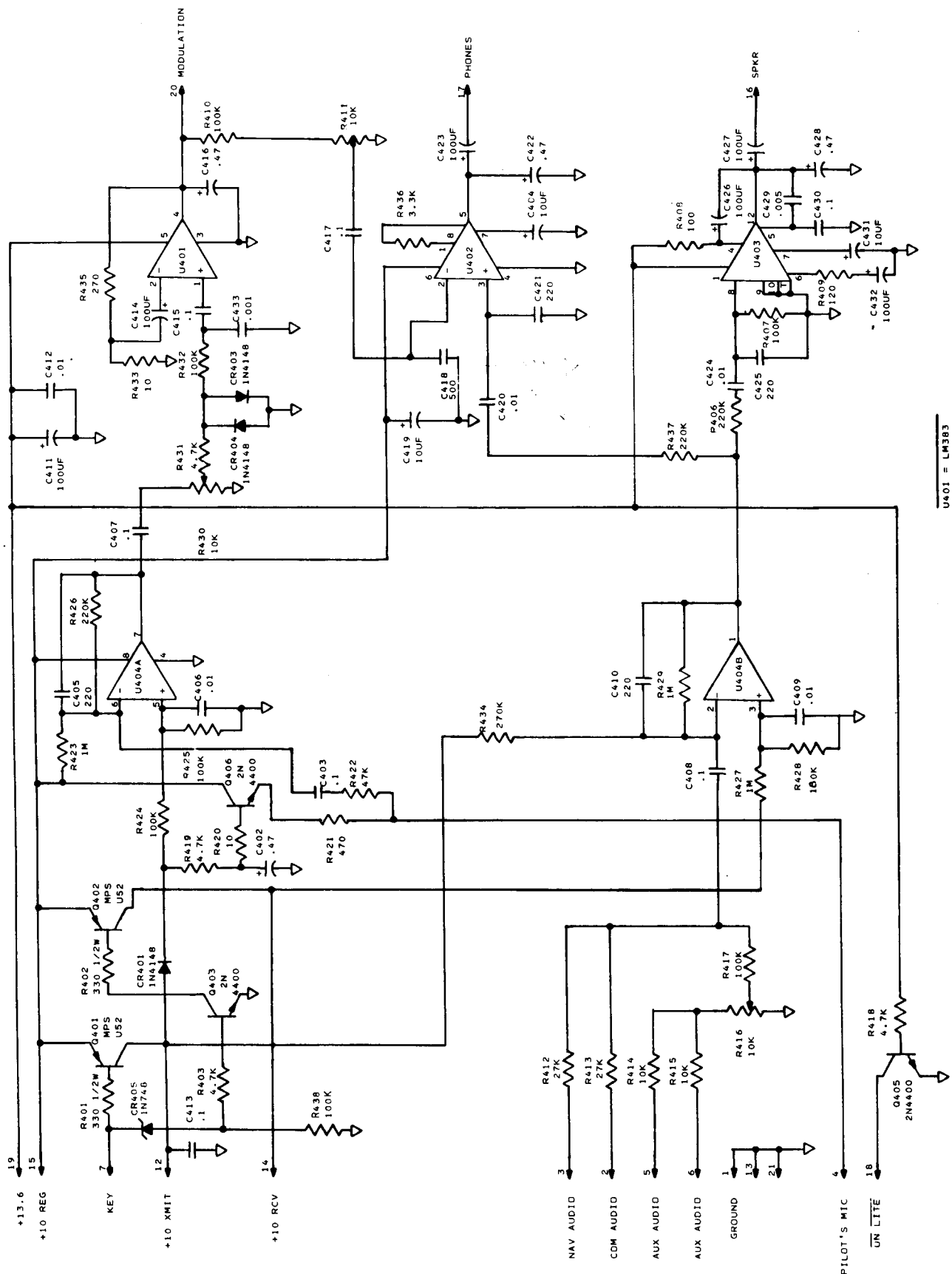
PC024B



I.C. #	TYPE	V+	GROUND
U901, 908	4046	16	8
U902, 903	LM324	4	11
U905	4081	14	7
U906	LM353	8	6
U907	4020	16	8

PC 024B SCHEMATIC  
25C0CT84 VEA  
571-7510

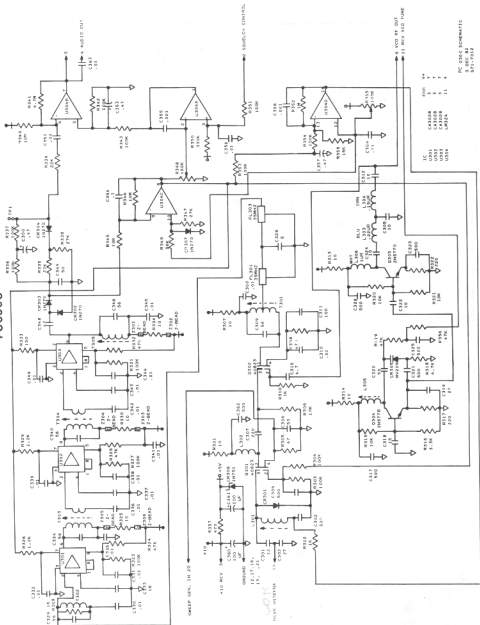
3. BREV1; REF EC057, 4APR85.  
2. LAST; R59, C31, CR10, 03, U8  
NOTES: 1. ALL DIODES IN4148.  
REV1

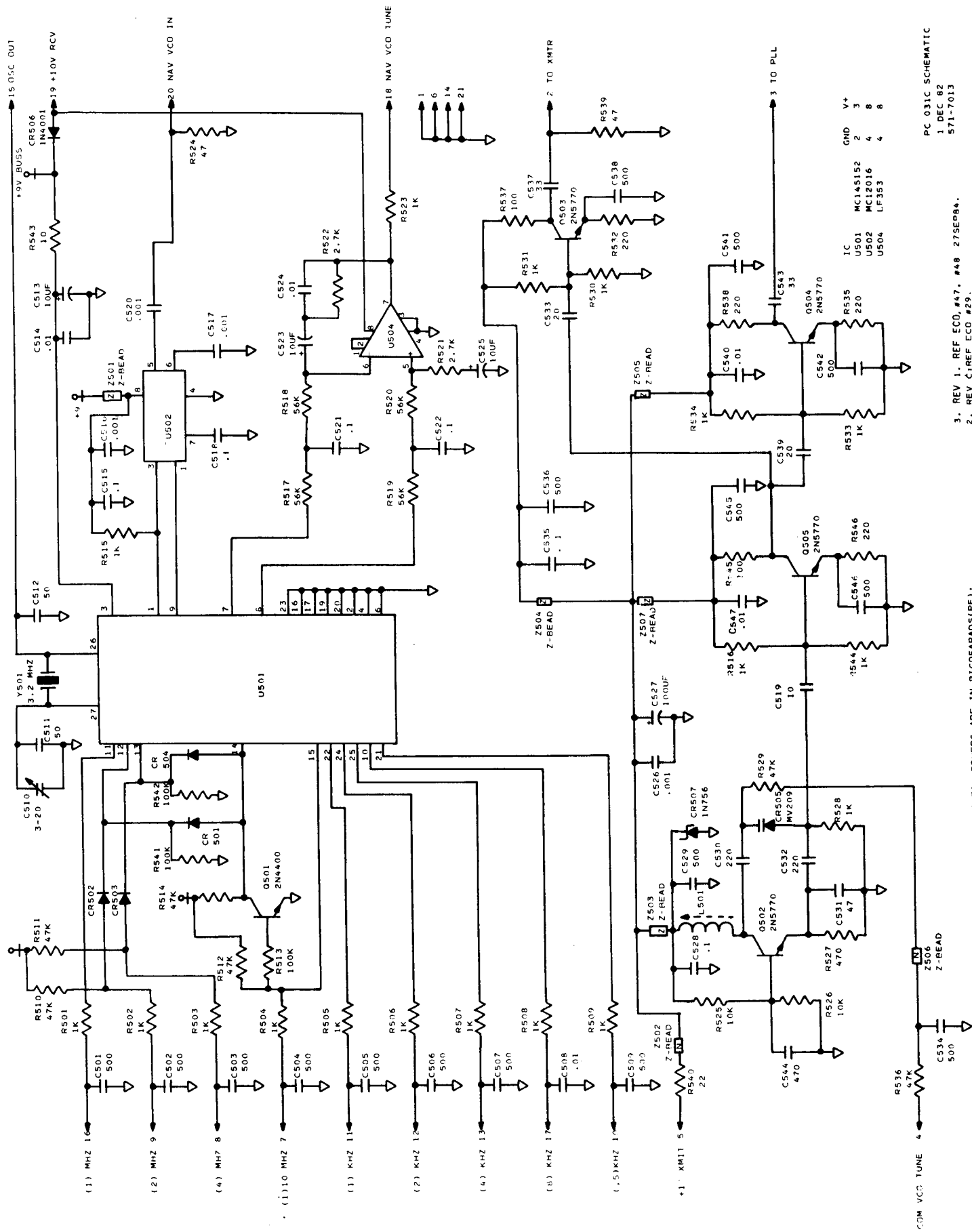


- U401 = LM383
- U402 = LM386
- U403 = TB810
- U404 = LM358

EXCEPT AS INDICATED, DECIMAL VALUES OF CAPACITANCE ARE IN MICROFARADS(UF); OTHERS ARE IN PICOFARADS(PF); RESISTANCES ARE IN OHMS.

C REV. REF. ECO #45, #46 27SEP84.  
 B REV11, REF ECO 33.  
 B REF, ECO 19.

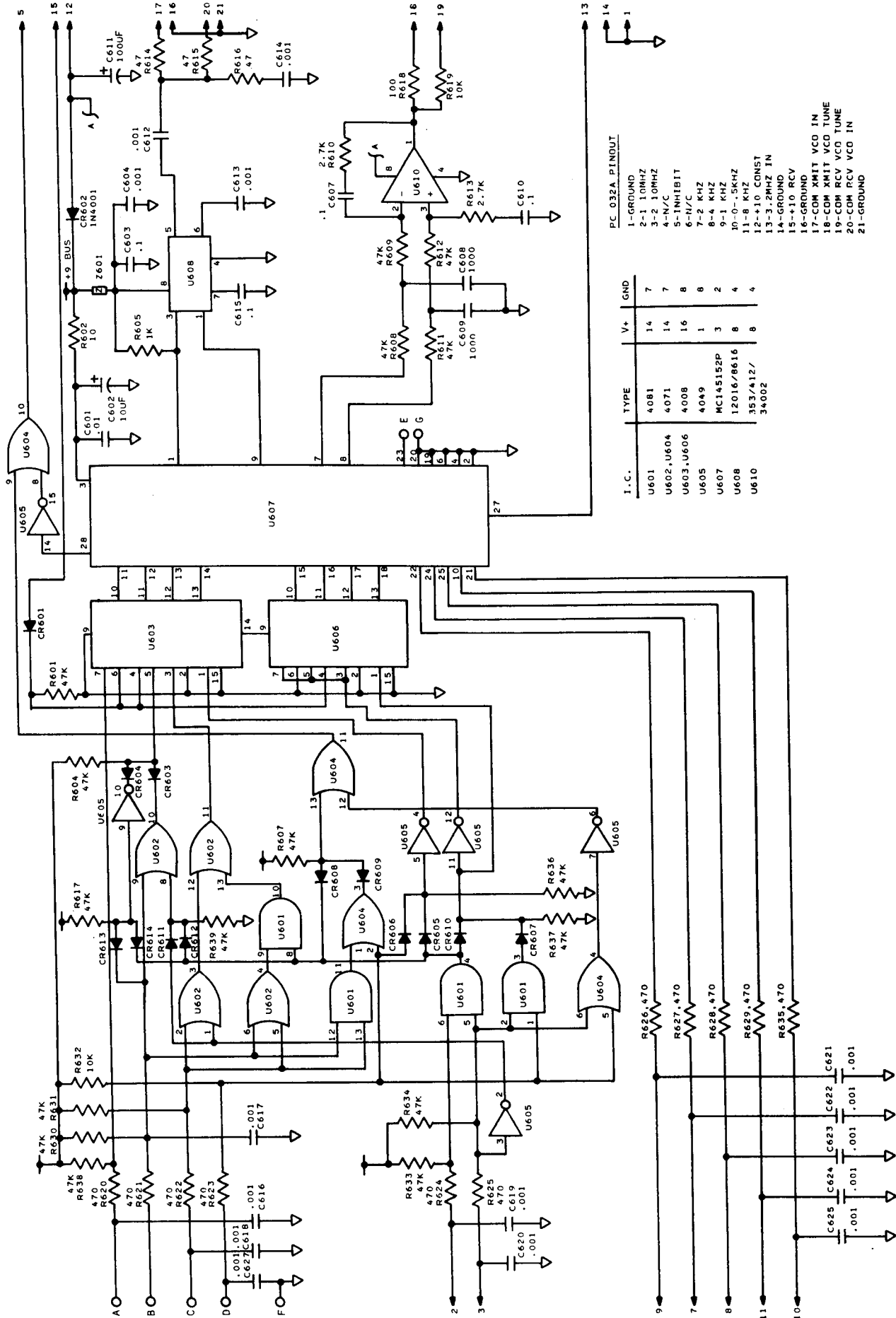




PC 031C SCHEMATIC  
 1 DEC 82  
 571-7013

3. REV 1. REF ECO #7, #8 27SEP84.  
 2. REV 1. REF ECO #29.  
 NOTES: 1. REV B: ADDRMC12016 CIRCUIT 16APR83.

EXCEPT AS INDICATED, DECIMAL VALUES OF CAPACITANCE ARE IN MICROFARADS (UF); OTHERS ARE IN PICOFARADS (PF); RESISTANCES ARE IN OHMS; ALL DIODES 1N4148, NOT USED: U503. LAST: R546, C546, Q505, Z507, CR507, U504, Y501.



I.-C.	TYPE	V+	GND
U601	4081	14	7
U602, U604	4071	14	7
U603, U606	4008	16	8
U605	4049	1	8
U607	MC145152P	3	2
U608	12016/R616	8	4
U610	353/412/ 34002	8	4

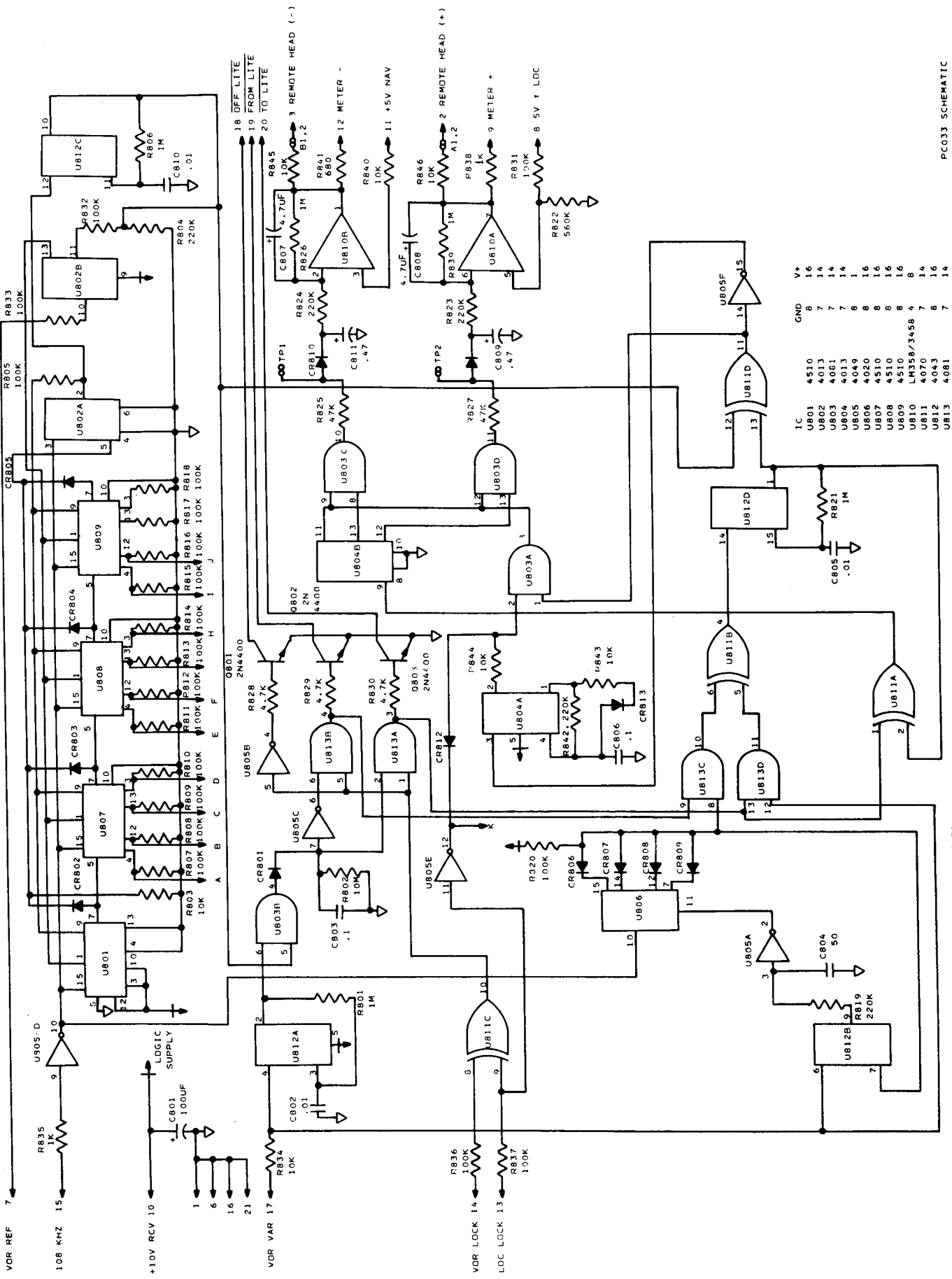
- PC 032A PINOUT
- 1-GROUND
  - 2-1 10MHZ
  - 3-2 10MHZ
  - 4-N/C
  - 5-INHIBIT
  - 6-N/C
  - 7-2 KHZ
  - 8-4 KHZ
  - 9-1 KHZ
  - 10-0-.5KHZ
  - 11-8 KHZ
  - 12-+10 CONST
  - 13-3.2MHZ IN
  - 14-GROUND
  - 15-+10 RCV
  - 16-GROUND
  - 17-COM XMIT VCO IN
  - 18-COM XMIT VCO TUNE
  - 19-COM RCV VCO TUNE
  - 20-COM RCV VCO IN
  - 21-GROUND

ALL DIODES EXCEPT CR602 = 1N4148 ; CR602 = 1N4001

2. REV A1; ECO# 571-8240;  
 NOTES, 1. REV. A; MC12016 CIRCUIT MOD. 22APR83.  
 EXCEPT AS INDICATED, DECIMAL VALUES OF CAPACITANCE ARE IN MICROFARADS(UF);  
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PC 032 SCHEMATIC  
 29NDV82  
 571-7014

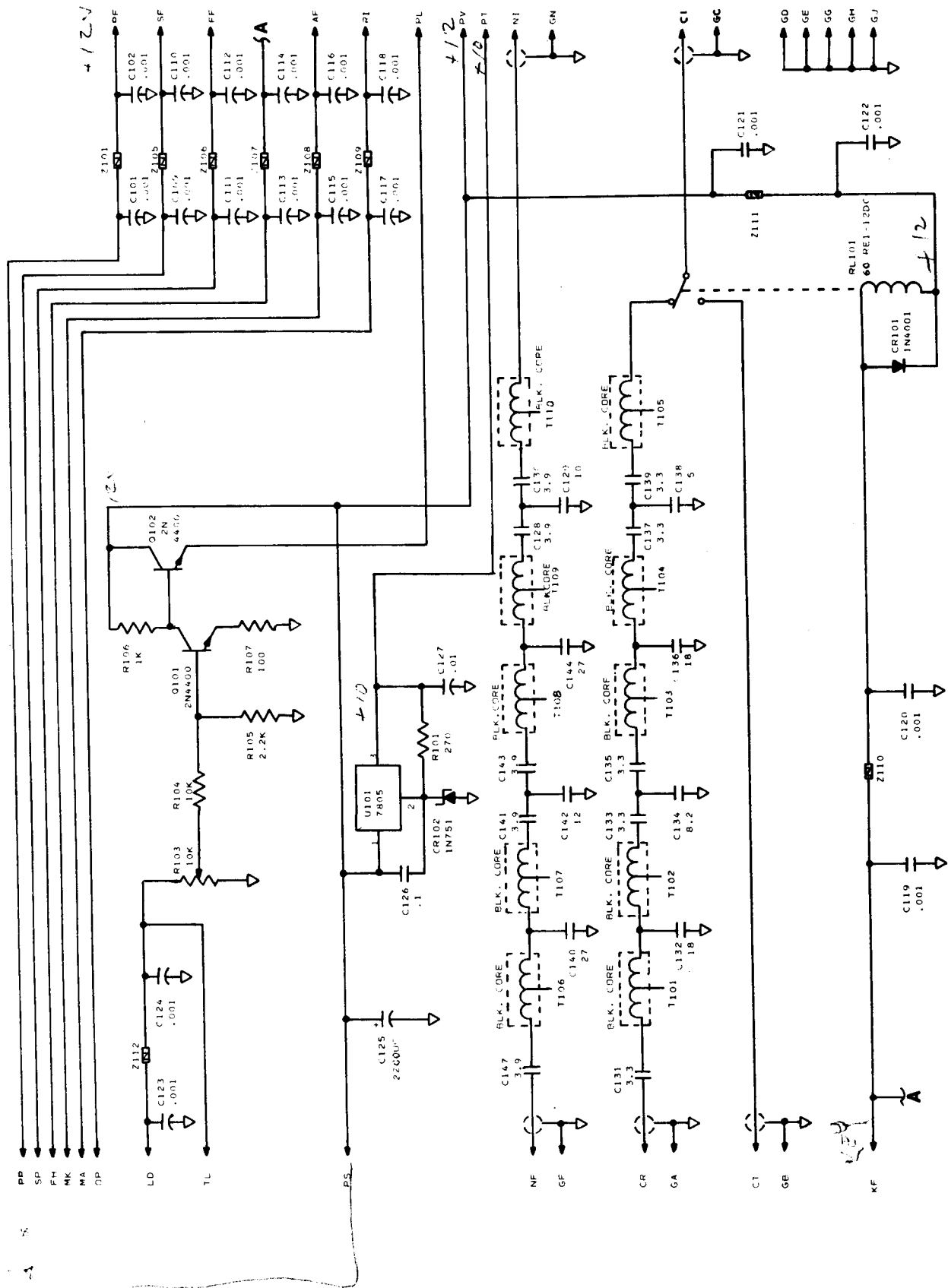
# PC033B



PC033 SCHEMATIC  
1 DEC 82  
571-7015

EXCEPT AS INDICATED, DECIMAL VALUES OF CAPACITANCE ARE IN MICROFARADS (UF) ;  
OTHERS ARE IN PICOFARADS (PF) ; RESISTANCES ARE IN OHMS ; ALL DIODES ARE 1N4148  
3. REV BY REF ECO #50, 4OCT84.  
2. REV. 1, REF ECO#02, 06, 13.  
1. REV. A U801-5 TO GND VS. V+ .23APR83.

# PC034A



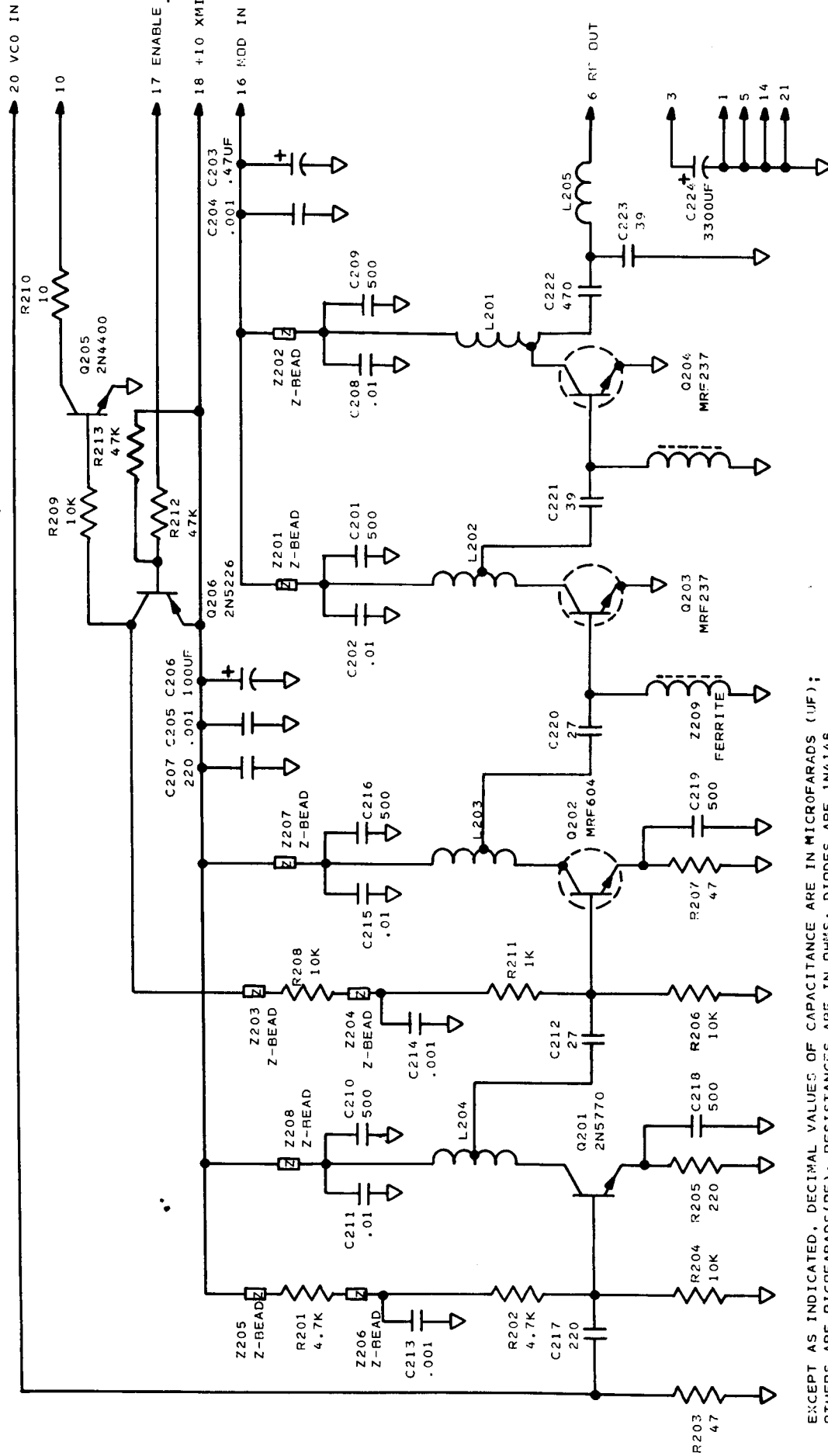
PC034A SCHEMATIC  
17 SEPT 1982  
571-7-116

EXCEPT AS INDICATED, DECIMAL VALUES OF CAPACITANCE ARE IN MICROFARADS (UF);  
OTHERS ARE IN PICOFARADS (PF); RESISTANCES ARE IN OHMS.

NOTES: 1. REV A, REF ECO#31,44,50. 27SEP84.



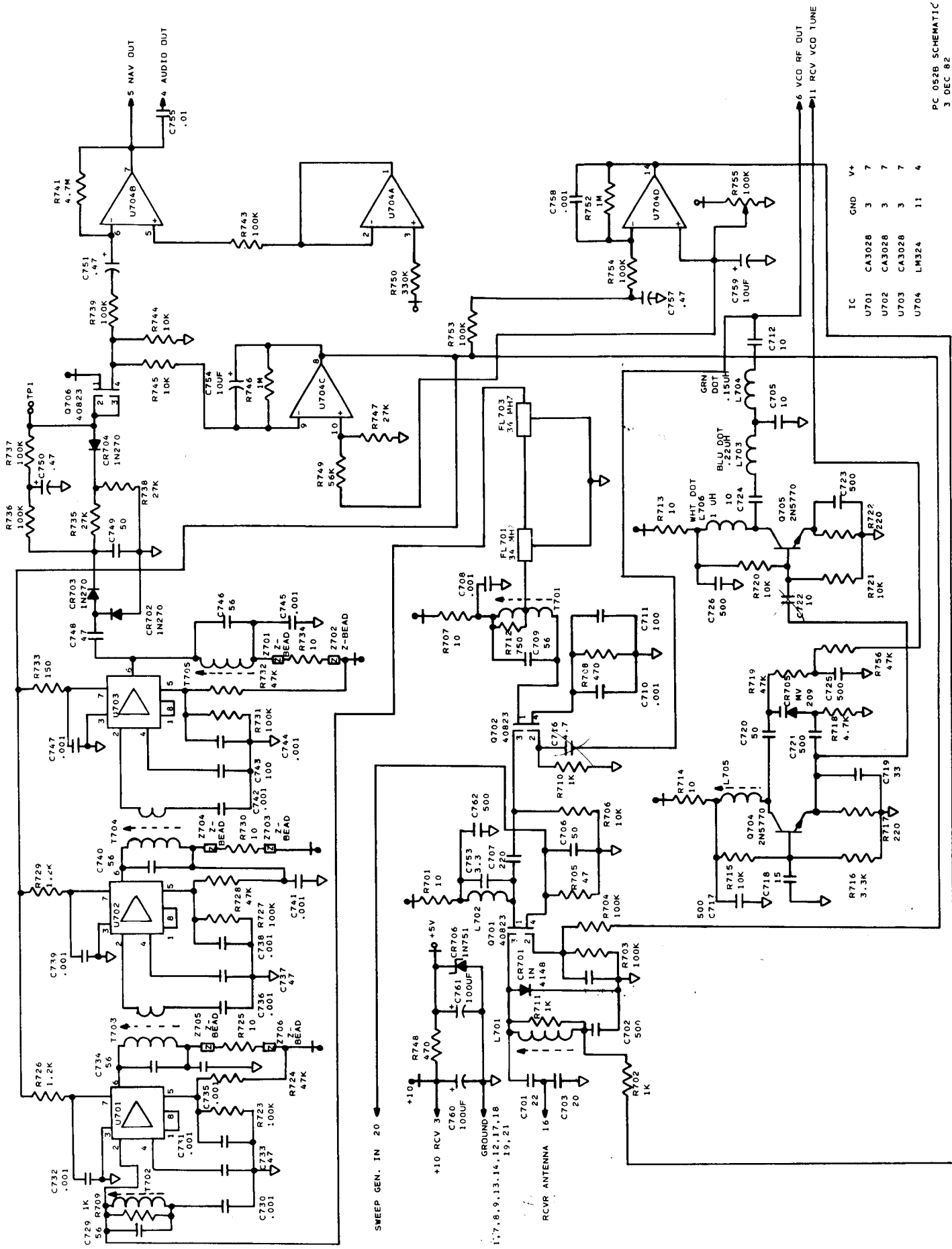
PC035C



EXCEPT AS INDICATED, DECIMAL VALUES OF CAPACITANCE ARE IN MICROFARADS (UF); OTHERS ARE PICOFARADS(PF); RESISTANCES ARE IN OHMS; DIODES ARE 1N4148.

PC 035C SCHEMATIC  
3 DEC 82  
571-7017

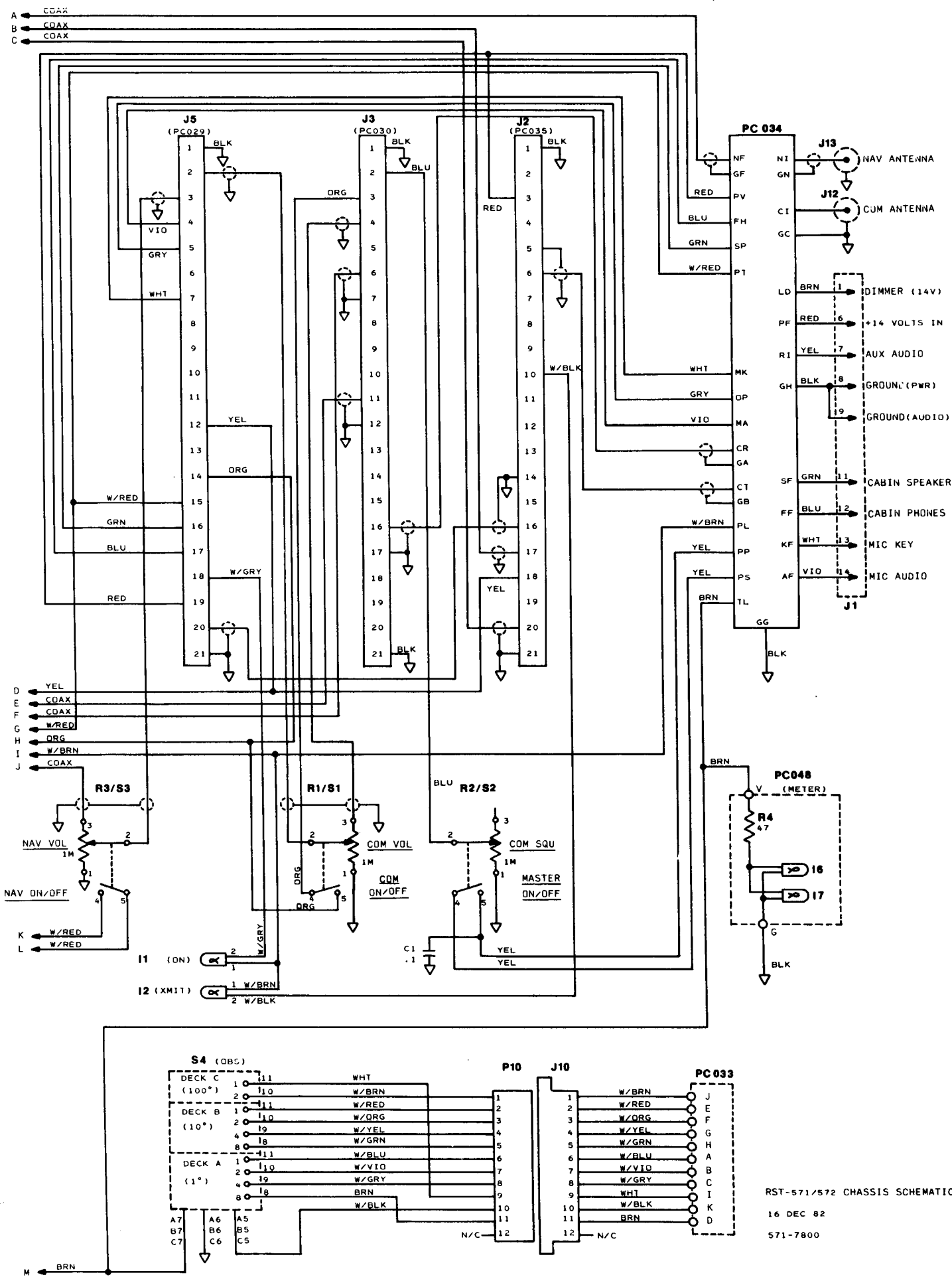
NOTE: ECO 8249, 6 SEPT 84 ECO # 242



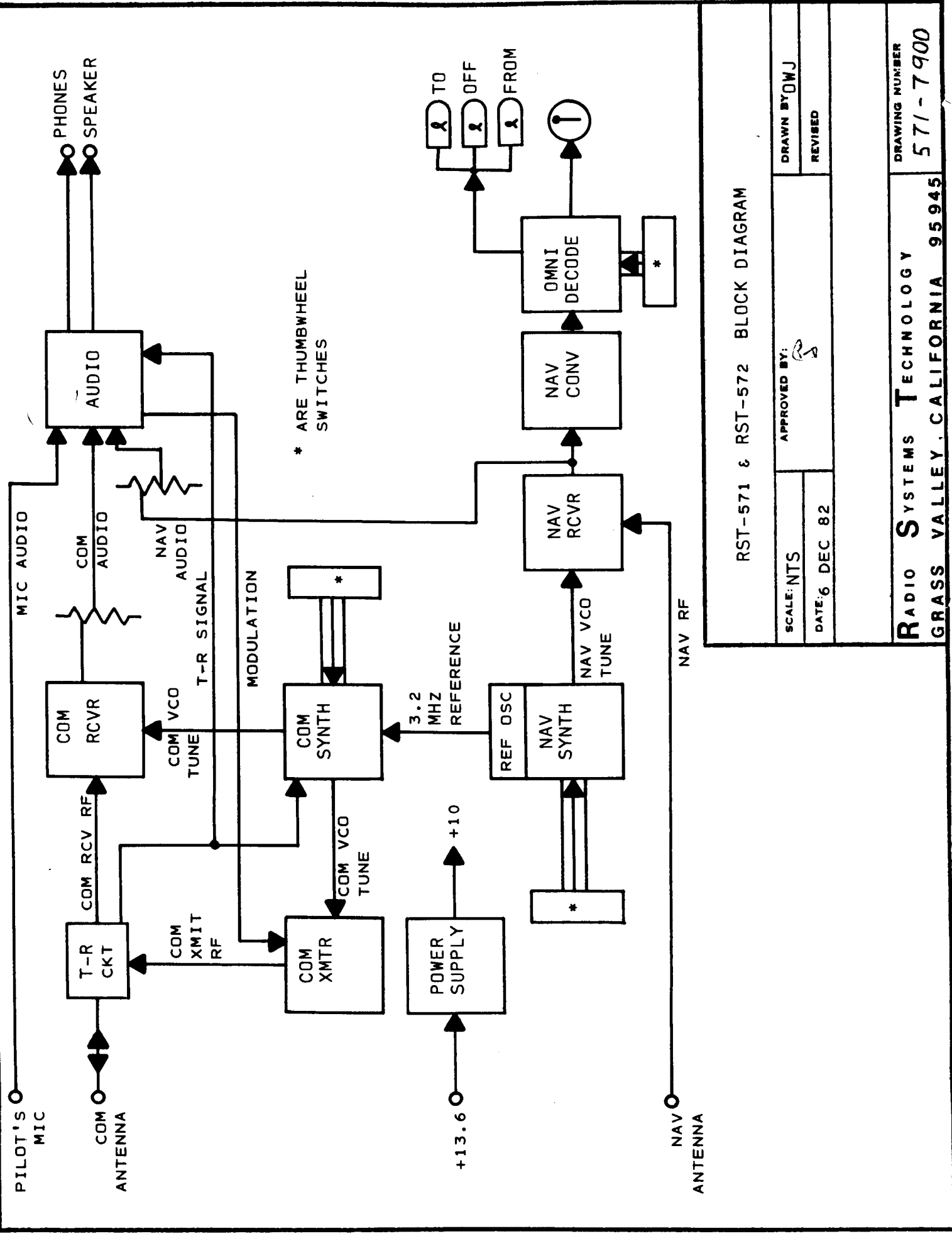
PC 052B SCHEMATIC  
 3 DEC 82  
 571-7019

EXCEPT AS INDICATED, DECIMAL VALUES OF CAPACITANCE ARE IN MICROFARADS(UF); OTHERS ARE PICOFARADS(PF);  
 RESISTANCES ARE IN OHMS; DIODES ARE 1N4148.

- NOTES: 1. REV A; VCD OUTPUT MOD. 4JUN83, VEA. C751 POLARITY CORRECTED 25OCT83.  
 2. A1 REV; REF ECO# 34.  
 3. B REV; REF ECO# 56, 12APR85.



RST-571/572 CHASSIS SCHEMATIC  
 16 DEC 82  
 571-7800

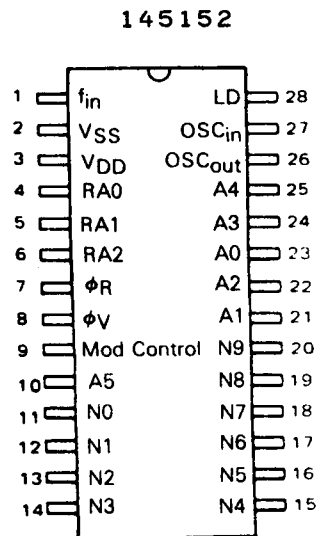
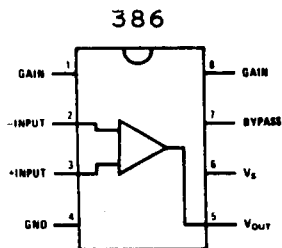
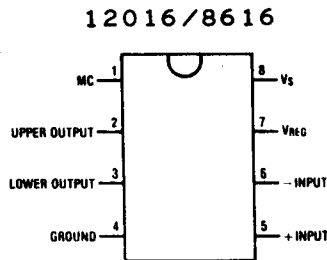
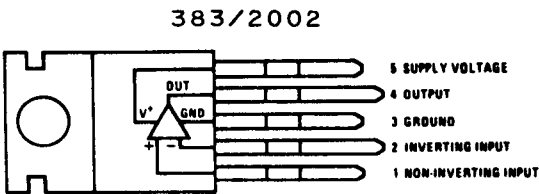
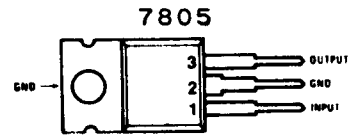
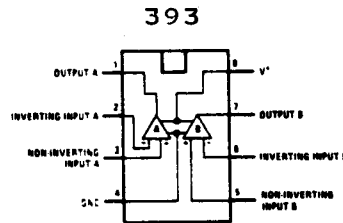
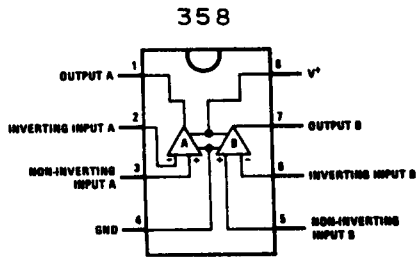
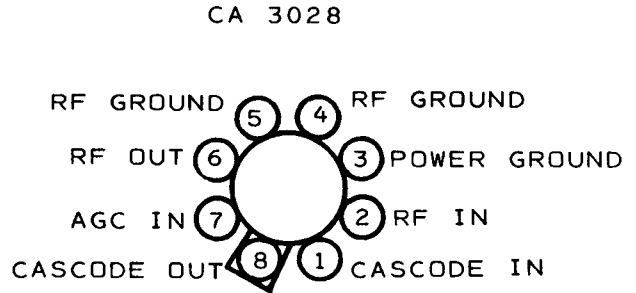
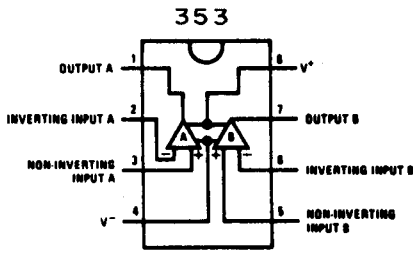
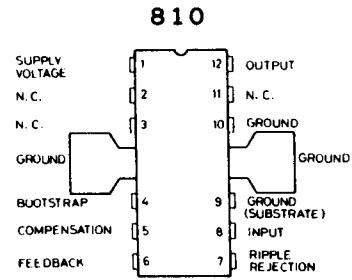
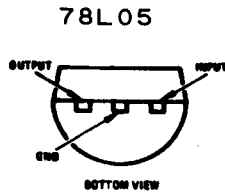
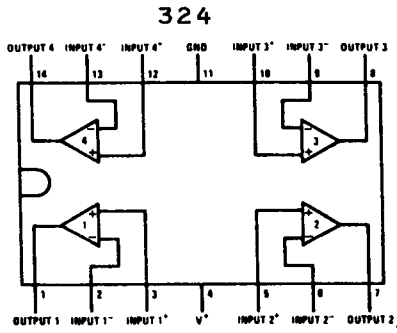


\* ARE THUMBWHEEL SWITCHES

RST-571 & RST-572 BLOCK DIAGRAM

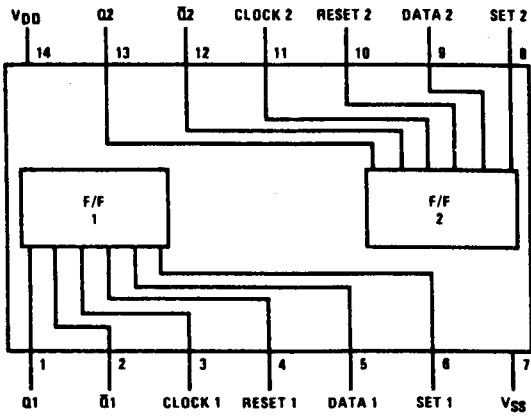
SCALE: NTS	APPROVED BY: <i>RS</i>	DRAWN BY: OWJ
DATE: 6 DEC 82		REVISED
RADIO SYSTEMS TECHNOLOGY		DRAWING NUMBER
GRASS VALLEY, CALIFORNIA 95945		571-7900

# IC PINOUTS (TOP VIEWS ONLY)

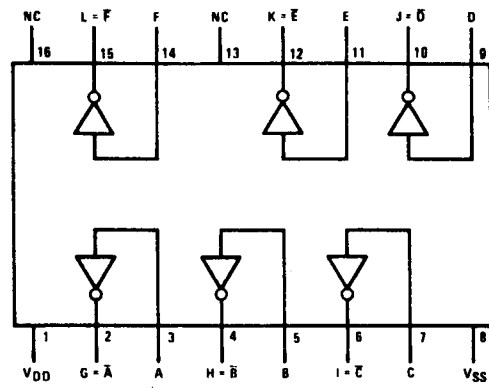


IC PINOUTS  
(TOP VIEW)

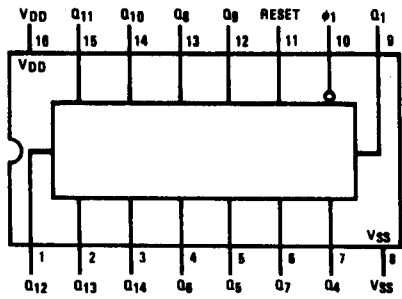
4013



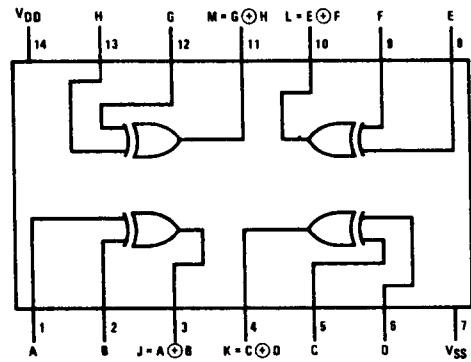
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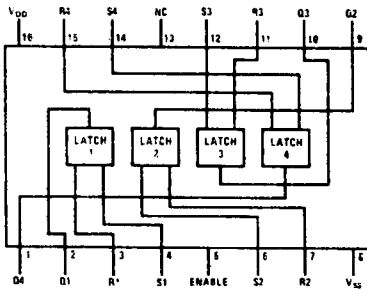
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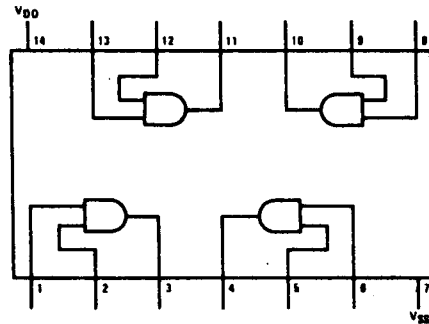
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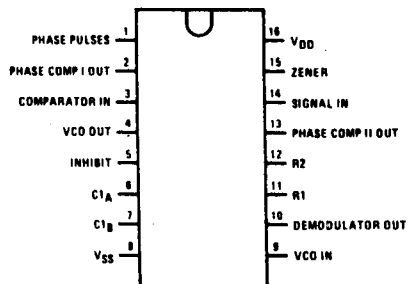
4043



4081



4046



4510

