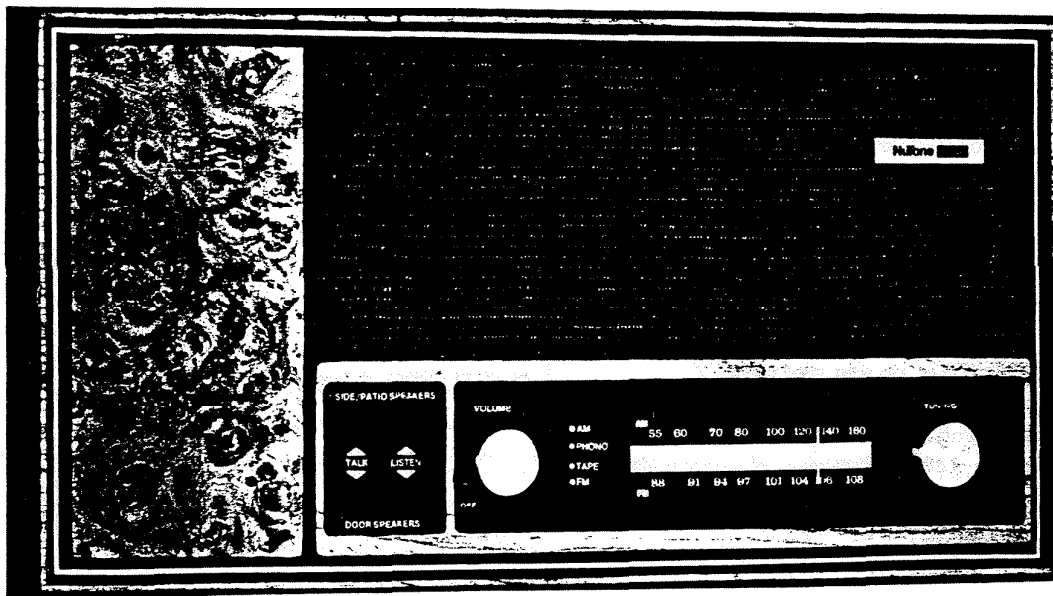


SERVICE MANUAL

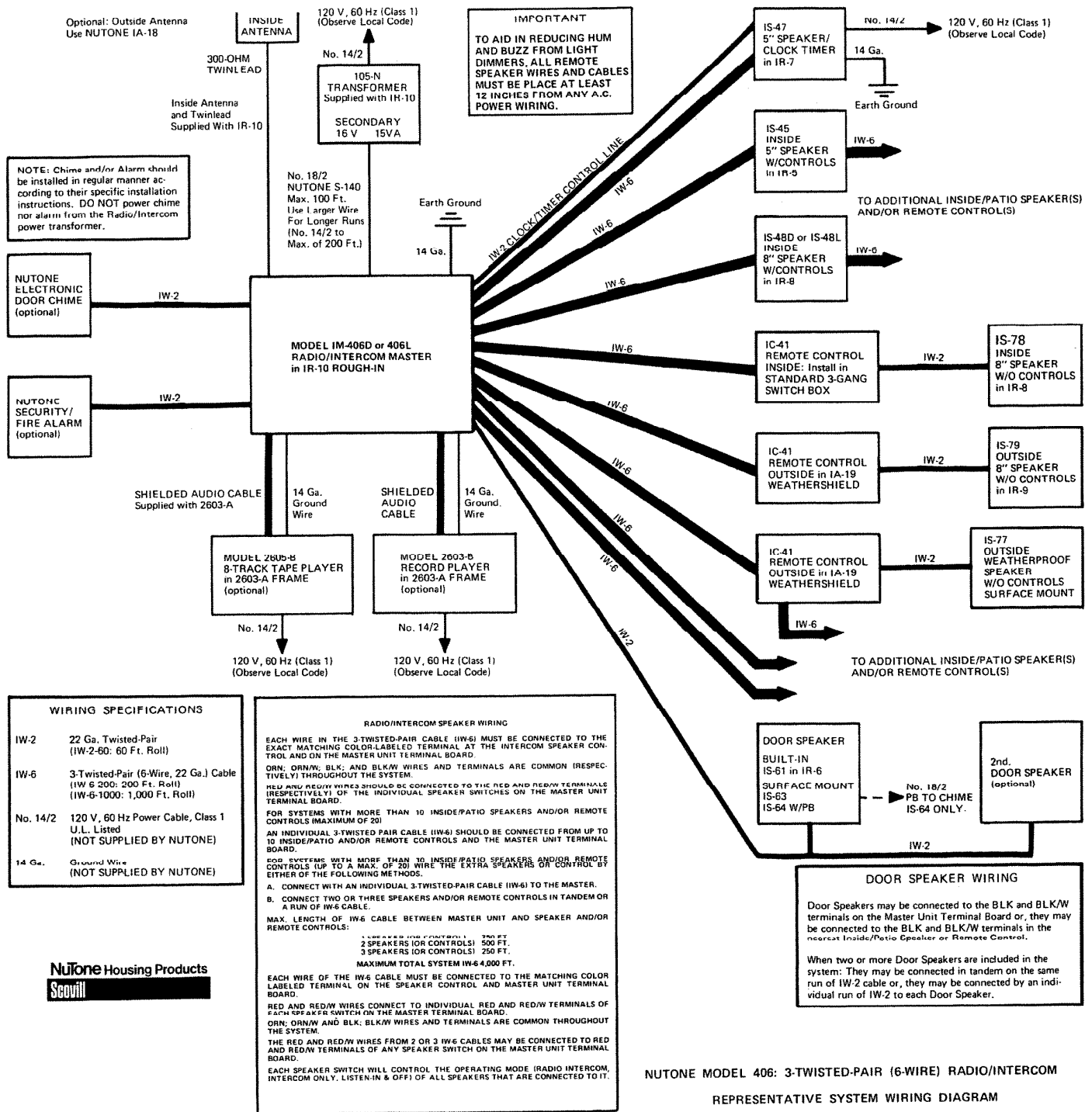
NUTONE MODEL IM-406

3-Twisted-Pair (6-Wire)
Built-In Centralized Radio Intercom System



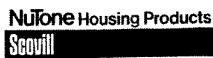
NuTone Housing Products

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NUTONE MODEL 406: 3-TWISTED-PAIR (6-WIRE) RADIO/INTERCOM
REPRESENTATIVE SYSTEM WIRING DIAGRAM

THIS SYSTEM IS DESIGNED TO USE NUTONE WIRE/CABLE TO ELIMINATE HUM-FEEDBACK ETC.



OPERATIONAL CHECKOUT

THE SYSTEM MUST BE CAPABLE OF COMPLETING THE ENTIRE CHECKOUT PROCEDURE LISTED BELOW. FAILURE TO COMPLETE ANY STEP INDICATES A MALFUNCTION IN PART(S) OF THE SYSTEM. SEE: TROUBLE SHOOTING, PAGE 32.

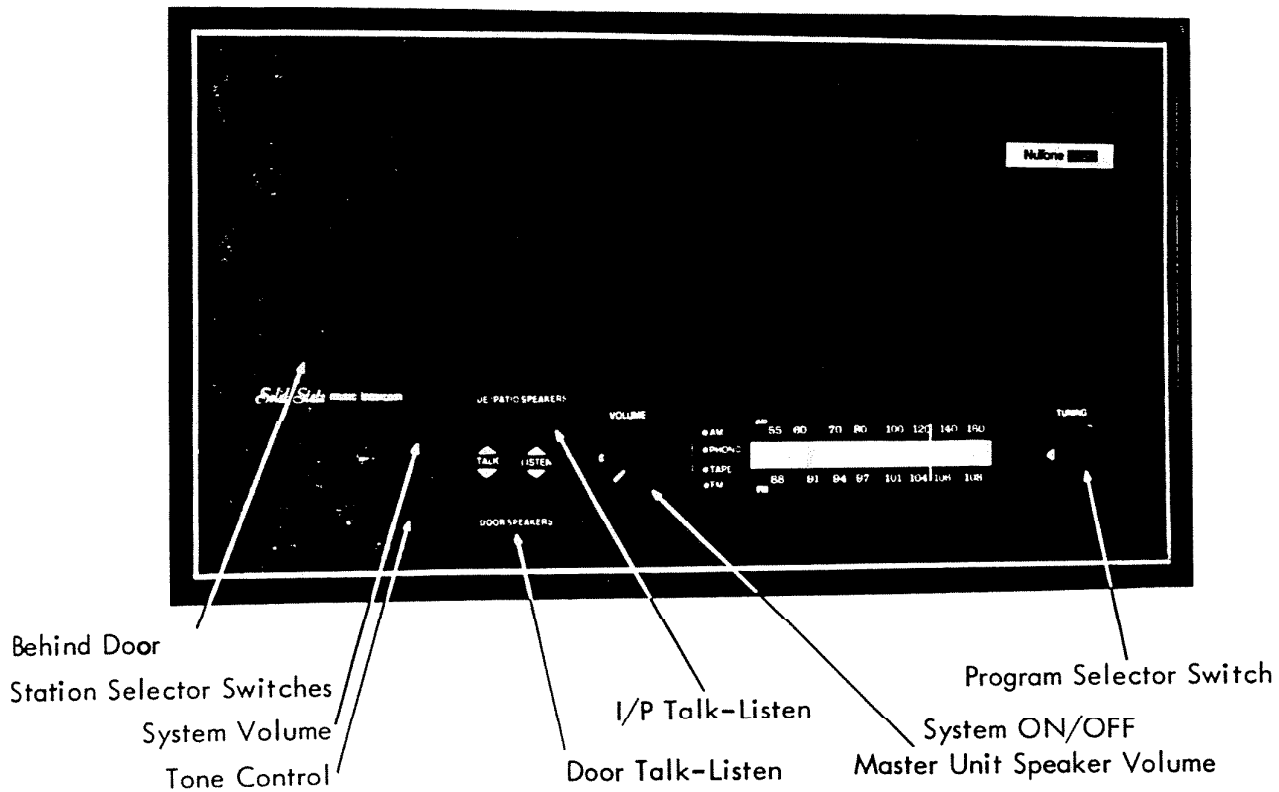


FIGURE 2: IM-406 MASTER UNIT

MASTER UNIT (Figure 2)

(1) The TUNING KNOB; ON/OFF-MASTER VOLUME CONTROL (master unit speaker only); PROGRAM SELECTOR SWITCH; & INTERCOM CONTROL SWITCHES are located on the front panel for accessibility.

(1.1) The STATION SELECTOR SWITCHES (control operating mode of Inside/Patio Speakers); ALL SPEAKER VOLUME CONTROL; and TONE CONTROL are located behind the door at the left of the front panel.

(2) Turn master unit ON: Rotate the ON/OFF-MASTER VOLUME CONTROL clockwise — pilot lights should be turned ON.

(3) Set PROGRAM SELECTOR SWITCH to AM or FM.

(4) Using TUNING KNOB, tune radio to a familiar station.

(5) Open door and set all STATION SELECTOR SWITCHES to RADIO/INTERCOM.

(6) The MASTER VOLUME CONTROL and the VOLUME CONTROL at every Inside/Patio Speaker should be set for maximum volume, i.e. full clockwise.

(7) Adjust the ALL SPEAKER VOLUME CONTROL

(behind the door) for sufficient loudness at all locations. The volume in the area requiring the greatest sound level should be sufficient for that locale.

(7.1) Adjust remaining Inside/Patio and Master Unit speakers for desired volume at their locales.

(7.2) NOTE: If I/P Speakers' VOLUME CONTROLS are set too low and the Master Unit's VOLUME/ALL SPEAKERS CONTROL is set too high, distortion will result.

(8) Adjust TONE CONTROL to personal preference.

(9) Rotate TUNING KNOB through the band on AM and FM to check radio reception.

(10) When record player and/or tape player is included in system: Use the PROGRAM SELECTOR SWITCH, select the unit being checked and play record or tape of known quality.

MUTING

(1) Except as noted in the following INTERCOM DISCUSSION, MUTING of the entertainment program occurs when any Inside/Patio or Door, Talk or Listen switch is activated.

(1.1) The entertainment program is immediately silenced when one of the switches is pressed in.

(1.2) When the switch is released, the entertainment program fades back in; to full volume in approximately one-half second.

INTERCOM OPERATION

(1) Press the **INSIDE/PATIO TALK SWITCH** and speak into the master unit speaker. Message should be heard at every Inside/Patio Speaker.

(2) Press the **INSIDE/PATIO LISTEN SWITCH**. Have another member of the family answer "Hands-Free" from any Inside/Patio Speaker. "Hands-Free" answering should be checked at each Inside/Patio Speaker.

(3) Repeat steps (1) and (2) above: Originating the call (in-turn) at each Inside/Patio Speaker.

(4) At the Master Unit and at each Inside/Patio Speaker (in-turn), press the **DOOR TALK SWITCH** and talk to the door speaker(s). Press the **DOOR LISTEN SWITCH** to receive "Hands-Free" answer from the door speaker(s).

(5) Set **STATION SELECTOR SWITCHES** (behind door in master unit) for each Inside/Patio Speaker, in-turn or all at same time, to **OFF**. An Inside/Patio Speaker with its switch in **OFF** will not:

- Receive entertainment program.
- Receive nor answer intercom calls originated by the Master Unit or other Inside/Patio Speakers.
- Receive signals from electronic chime and/or alarm system.
- Transmit or receive signals from door speaker(s).

(5.1) With switch in **OFF**, Inside/Patio Speaker can:
 Using **INSIDE/PATIO TALK** switch send signals to Master Unit and to other Inside/Patio Speakers that are in **RADIO/INTERCOM** mode. No **MUTING** function during this operation.

Using **INSIDE/PATIO LISTEN** switch to receive "Hands Free" answer from Master Unit and other Inside/Patio Speakers that are in **RADIO/INTERCOM** or **INTERCOM ONLY** mode. **MUTING** functioning in this operation.

(6.1) Set **STATION SELECTOR SWITCHES** for each Inside/Patio Speaker, in-turn or all at same time, to **INTERCOM ONLY**. Inside/Patio Speaker(s) in this mode will not receive entertainment program nor signals from electronic chime and/or alarm systems, but will be able to perform all intercom functions as described in steps 1 thru 4 above.

(7) Set **STATION SELECTOR SWITCH** for each Inside/Patio Speaker, in-turn or all at same time, to **LISTEN IN**. Speakers in this mode will not receive entertainment program; signals from electronic chime and/or alarm system; nor, intercom calls originated at the Master Unit and other Inside/Patio Speakers.

(7.1) All sounds in the locale of this speaker(s) will be heard, over-riding the entertainment program, at the Master Unit and other Inside/Patio Speakers that are in **RADIO/INTERCOM** mode.

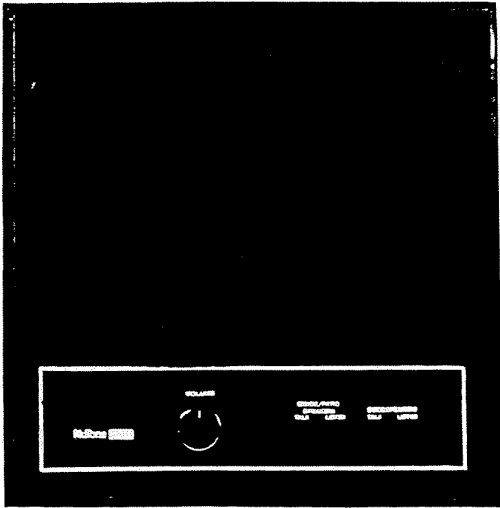


FIGURE 3: IS-48 INSIDE 8 INCH SPEAKER

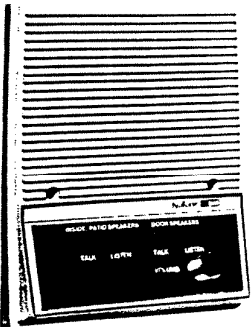
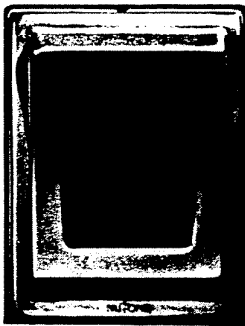
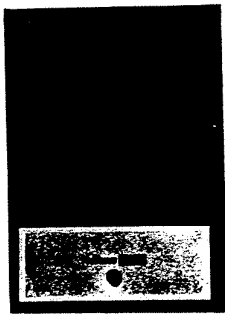


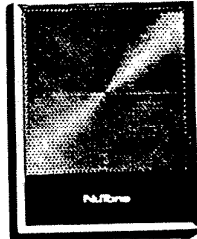
FIGURE 4: IS-45 INSIDE 5 INCH SPEAKER



IS-61



IS-65



IS-63

FIGURE 5: DOOR SPEAKERS

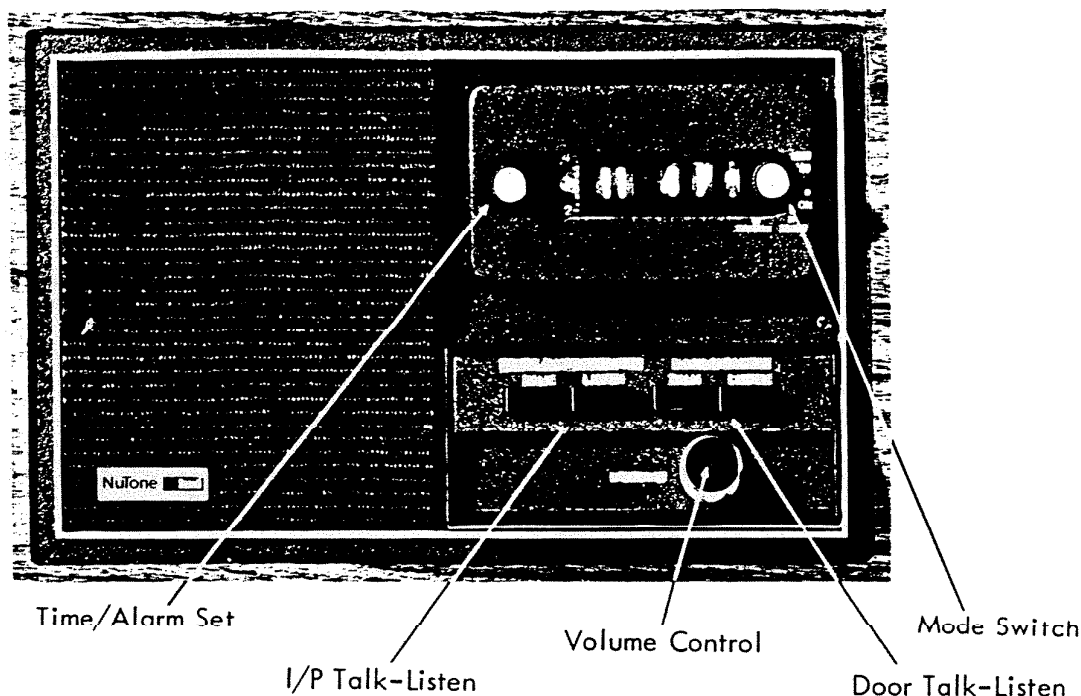


FIGURE 6: IS-47 INSIDE 5 INCH SPEAKER/CLOCK TIMER

(7.2) Inside/Patio TALK/LISTEN functions are present with the Master Unit and other Inside/Patio Speakers that are in RADIO/INTERCOM mode. With MUTING.

(8) The Master Unit speaker is not controlled by a STATION SELECTOR SWITCH. It can be turned OFF by turning the MASTER UNIT SPEAKER VOLUME CONTROL to full counter clockwise position (but not past "Click" to OFF). When the control is set to its operating level, the Master Unit speaker will operate the same as Inside/Patio Speakers that are in RADIO/INTERCOM mode.

IS-47 I/P SPEAKER/CLOCK TIMER

(1) Operation of the Volume Control and the Talk-Listen Switches is the same as that for any I/P Speaker.

(2) MODE SWITCH:

(2.1) OFF: Entertainment program muted through entire system. Intercom operation normal, as determined by the setting of its STATION SELECTOR SWITCH in the Master Unit.

(2.2) ON: Full normal operation, determined by the setting of the STATION SELECTOR SWITCH.

(2.3) AUTO: Entertainment program muted. Normal intercom operation. This setting used to automatically turn the entertainment program ON at a predetermined time.

(2.3.1) TIME/ALARM SET CONTROL: Rotate control clockwise (the alarm dial will turn counter-clockwise) to the time desired for entertainment program to resume.

(2.3.2) When clock has advanced to desired time, muting of the entertainment program will be removed, and the music will resume through all speakers that are in RADIO/INTERCOM mode.

(2.3.3) For continuous normal radio/intercom operation, the mode switch should be returned to ON: IF not, the entertainment program will be on for approximately 30 minutes and then be automatically muted.

(2.4) ALARM: Same as AUTO operation except when the entertainment program is resumed, the alarm buzzer in the IS-37 will be turned ON and will continue to sound until the MODE switch is thrown to ON or until the approximate 30 minutes of automatic operation is terminated.

(3) TIME/ALARM SET CONTROL: Push-in and turn in either direction until clock is reading correct time.

BACKGROUND MUSIC

(1) The IM-406 can be used as a background music source. Its "Low-Level Radio Output" can be connected to NuTone's IM-516 Amplifier, and the IM-516 used to drive speakers whose entertainment program will not be interrupted when the IM-406's intercom capability is being used. (See IM-516 Installation Instructions)

(2) Connecting the IM-406 to the IM-516:

(2.1) IM-516 within 25-feet of IM-406: Connect a No. 22/2 twisted-pair (NuTone IW-2-60) between the BLUE/BLACK "Low Level Radio Output" wires in the IM-406 and the BLUE/BLACK "Low-Level Radio Connection" wires in the IM-516. Match the color-coded wires.

(2.2) When the IM-516 is more than 25-feet from the IM-406 (maximum of fifth-feet): Use a shielded audio cable between the units. Connect the shield between the BLACK wires and the center conductor between the BLUE wires.

(3) If the IM-406 is to be used with other amplifiers in "Background Music" systems, NuTone's Field Engineering Department should be contacted for specific details.

(4) The LEVEL SET CONTROL R237 on the Amplifier/Power Supply Module is generally operated at maximum level, i.e. full-clockwise. Turn this control 10° to 15° counter-clockwise to prevent MUTING of background music during intercom operation.

(5) Adjust volume level of IM-516 (or other auxiliary amplifier) for desired background music level.

(6) Readjust intercom master unit ALL SPEAKER VOLUME CONTROL as required.

THEORY OF OPERATION

POWER SUPPLY

(1) The NuTone Model 105-N is supplied with the IR-10 rough-in housing and is remotely located from the Master Unit.

(1.1) The 105-N is rated at 120Vac, 60 Hz. primary input and 16Vac @ 15VA output.

(2) The secondary of the power transformer may be connected to Master Unit by 100 feet (maximum) of No. 18/2 cable (NuTone S-141). For runs up to 200 feet, use No. 14/2 cable (not supplied by NuTone).

(3) NOTE: If greater audio volume is desired (still using a maximum of 20 speakers), NuTone's Model 301-N, 16Vac, 30VA transformer may be used. If the 301-N is used, No. 18/2 cable may be used for runs up to 50 feet and No. 14/2 for maximum of 100 feet.

(4) Terminal 2 of J4 should be connected to earth ground.

(5) The 16Vac is turned ON (or OFF) by the ON/OFF SWITCH S101 (operated by the shaft of the master unit speaker VOLUME CONTROL R101).

(6) When S101 is ON, 16Vac is applied to the pilot lights PL101; PL102 and PL103 which are connected in series across the 16Vac.

(7) The 16Vac is applied to Z201 (Z201 includes D209; D210; D211 and D212) full-wave bridge rectifier. The output of the bridge is filtered by C220 resulting in V_{cc} of +22.5Vdc.

(8) The +22.5Vdc is connected to the voltage regulator circuit: R232; Zener diode D213; and Q209. This circuit supplies a regulated +11.5Vdc to the Radio Module.

(9) The regulated 11.5Vdc is switched by SELECTOR switch S102 to the AM or FM tuner and is open ended when S102 is in PHONO or TAPE position.

RADIO MODULE

(1) The Radio Module includes the complete AM and FM tuners.

(2) When S102 is in AM position, the regulated +11.5Vdc is fed through P1-2/J1-2 to the AM tuner.

(3) When S102 is in FM position, the regulated +11.5Vdc is fed through P1-3/J1-3 to the FM tuner.

FM TUNER

(1) The FM signal is fed through the coaxial antenna lead-in to the balanced primary of the antenna transformer L301. The transformer primary is center tapped to FM RF ground through C301.

(2) The RF amplifier Q302 (Dual gate MOSFET) is operated tuned-gate, tuned-drain — resulting in high-gain at low noise.

(3) The FM RF signal is fed through a section of the antenna transformer secondary through C304 to G1 of Q301. The gate tuned circuit is varied by tuning one section of the ganged tuning capacitor C303A. C303B is the high frequency trimmer. Tuning slug in L301 is tuned for low frequency padding. (Figure 6)

(4) The MOSFET drain is loaded by the tuned RF tank circuit. The tank's resonant frequency is varied by C303F. C303E is high-frequency trimmer and L302 is low-frequency padder.

(5) The output of the tank circuit is coupled through C310 to the base of the Mixer Q302.

(6) The oscillator Q303 resonant frequency is tuned by C303J. C328 is high-frequency trimmer and L303 is adjusted for low-frequency padding.

(7) The output of the oscillator is coupled through C327 to the base of Mixer Q302.

(8) The Mixer Q302 beats the RF and oscillator signals and is loaded by T301A tuned to the 10.7 Mhz. IF frequency.

(9) For additional selectivity, the output of T301A is coupled through C314 to T301B.

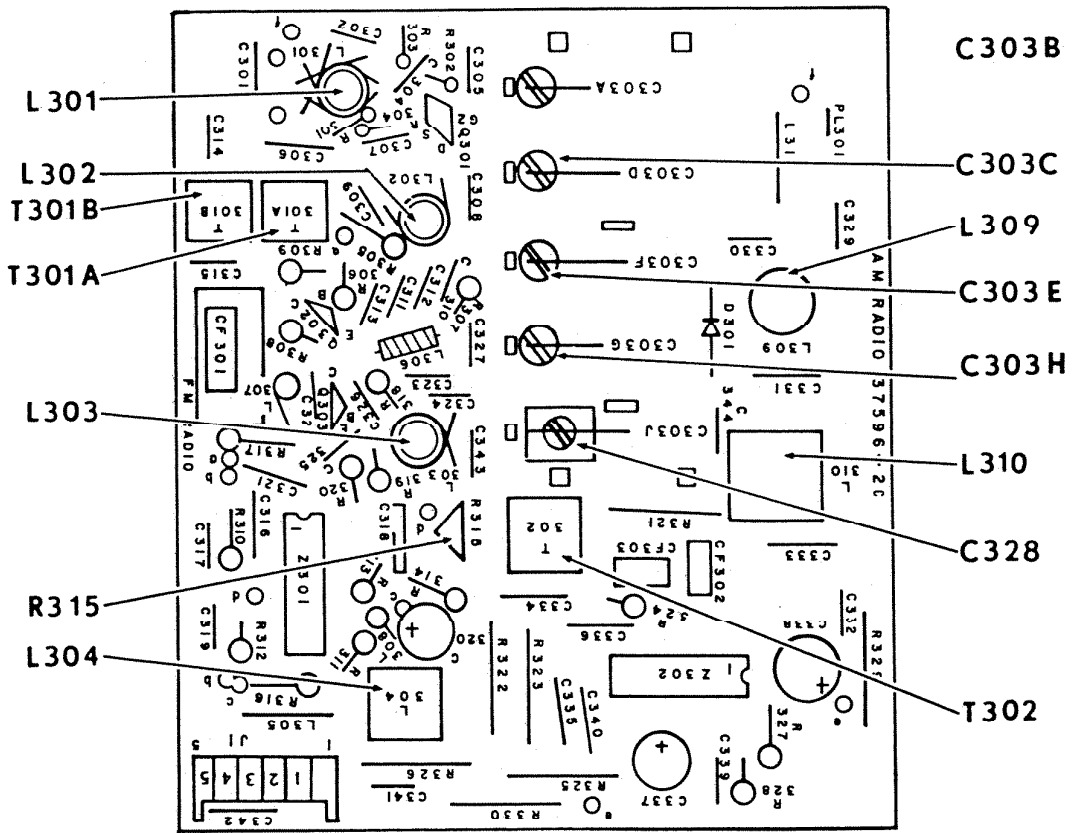
(10) The output of T301B is coupled from the high-side of C315 to the Ceramic Filter CF301.

(11) CF301 is rated at 10.7 Mhz. with a 3 db bandwidth of 200 to 280 KHz. — more than sufficient for the FM broadcast band. The filter has a very high rejection of all other RF frequencies, eliminating the need of additional IF transformer for high-selectivity.

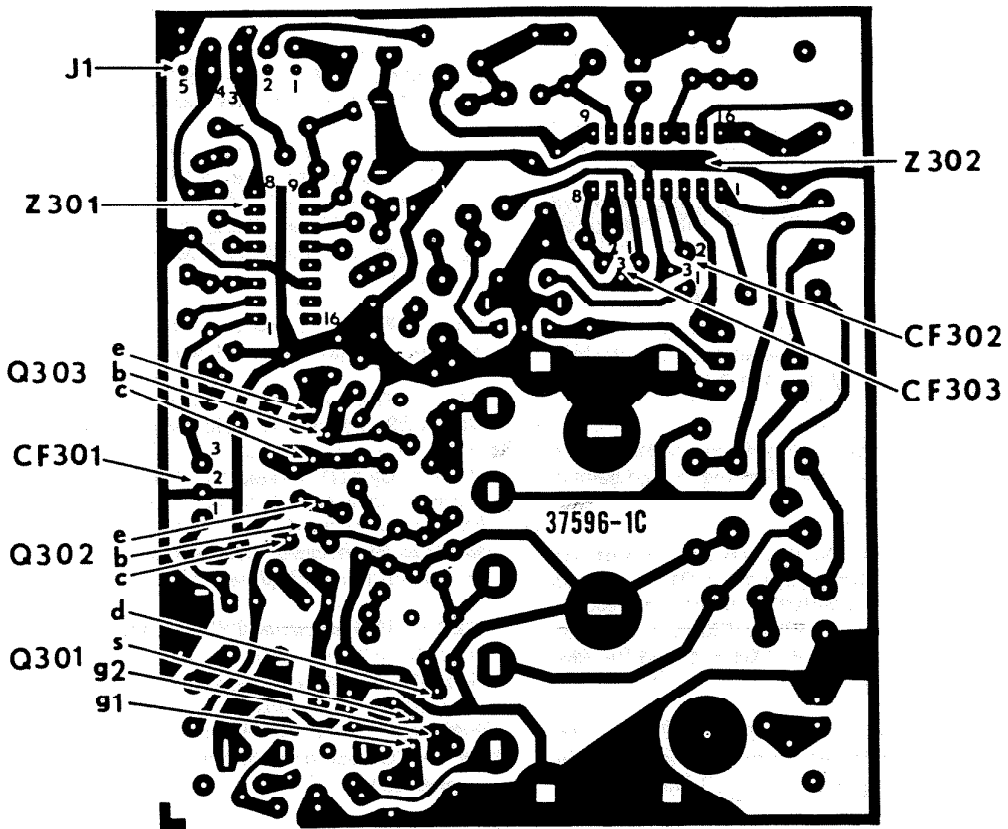
(12) The output of CF301 is fed to terminal 1 of Z301.

(13) Z301 is a monolithic integrated circuit that provides all the functions of a comprehensive FM IF system, including 3-stage FM IF amplifier/limiter with level detector and an audio amplifier that features use of a noise squelch circuit.

(14) The quadrature detector is tuned by the outboard coil L304.



COMPONENT SIDE (Viewed from top, chassis opened out from wall installation)



FOIL SIDE

FIGURE 7: RADIO MODULE

(15) The squelch circuit is adjusted by R315. Use of the squelch circuit helps to eliminate side responses that are characteristic of limiter-discriminator type FM receivers.

(16) Suppression of these side responses permit the design of an FM receiver that tunes as easily as an AM tuner without resorting to AFC — where AFC is not required to correct for oscillator drift.

(17) The FM oscillator in this system has been designed with quality components and by the use of the regulated 11.5Vdc supply should be practically free of drift under normal operating conditions.

(18) The magnitude of the squelch control voltage depends only on the signal-to-noise ratio at the tuner input and is essentially independent of the front-end gain because the quadrature signal is fully limited.

(19) Adjustment of the "Squelch Threshold" control affect primarily the degree of noise suppression rather than the threshold. Control R315 is generally operated at maximum value, i.e. full-clockwise as viewed from the FM side of the Radio Module PC Board.

(20) VR301 protects the FM and AM front end from static discharge and nearby lightning. It will not protect the set from a direct lightning strike.

AM TUNER

(1) The AM signal is fed from the center tap of the FM antenna transformer primary, through R331 to the tuned RF circuit.

(2) The RF circuit is tuned by gang capacitor C303D. C303C is the high-frequency trimmer and coupling of L309 is adjusted for low-frequency padding.

(3) Delayed AGC is supplied from pin 15 of Z302, through R329 and across D301 to ground. When the signal increases beyond desired level, the diode will conduct, changing the impedance of the input circuit and tend to swamp the AM signal.

(4) The output of the tuned RF circuit is fed through C333 to pin 2 of Z302.

(5) Z302 is a monolithic integrated circuit providing AM convertor; IF amplifier and detector. In this application it also supplies AGC to the first IF stage and delayed AGC to the RF tuned circuit.

(6) Pin 2 of Z302 is the base of the oscillator/convertor stage.

(7) The oscillator tank is tuned by varying C303G. C303H is the oscillator trimmer and L310 oscillator collector coupling is adjusted for low frequency padding.

(8) The oscillator/convertor output is loaded by the 455 KHz. IF transformer T302. The output of T302 is fed through Ceramic Filter CF302 to the input of the first IF stage in the IC Z302.

(9) The amplified output of the first IF stage is fed from Pin 6 through CF303 to the input of the second IF amplifier and second detector.

(10) CF302 and CF303 Ceramic Filters' center frequency is 455 KHz. \pm 2 KHz. with a 3 db band width of 10 KHz. \pm 3 KHz. with a frequency stability within 0.4% from -10°C to $+80^{\circ}\text{C}$.

(11) Use of these filter provides improved selectivity; the elimination of IF transformers and the resulting small space.

(12) C337 is the internal AGC filter.

(13) The received audio is fed from the detector output through R326; J1-1/P1-1 and R235 to the AM terminal on S102.

ALIGNMENT

(1) The Master Units are shipped from the factory completely aligned.

(2) Alignment should be performed by qualified personnel ONLY WHEN ABSOLUTELY NECESSARY.

(3) Use the alignment method recommended in this manual.

AUDIO CONTROLS; INPUTS AND OUTPUTS

(1) SELECTOR SWITCH S102; One side of this switch selects the audio entertainment program that is fed to the audio amplifier.

(1.1) The other side of the switch controls the regulated 11.5Vdc to the AM and FM RF and IF stages — driving the tuner that is being used. When the switch is in PHONO or TAPE, the +11.5Vdc is open ended and, neither the AM nor FM tuner has voltage applied.

(2) The AM program, from P1-1 through R235, is selected when S102 is in number 1 (top) position. The +11.5Vdc is fed to the AM tuner through P1-2.

(3) The PHONOGRAPH signal is fed through PHONO INPUT J104 and is loaded by C102 and R106 to the number 2 position of S102. C102 and R106 supply the correct load for the cartridges used in NuTone record changers.

(4) The TAPE PLAYER signal is fed through TAPE INPUT J105 and is loaded by R105 through the number 3 position of S102. The TAPE input matches the NuTone Tape Players.

(5) The FM program, through P1-4 and R236 is selected when S102 is in the number 4 (bottom) position. The regulated +11.5Vdc is fed to the FM tuner through P1-3.

(6) The common audio terminal of S102 feeds the audio program to the LOW LEVEL RADIO OUTPUT and through C206 to the 2.2 Megohm LEVEL CONTROL R237.

(6.1) The LOW-LEVEL RADIO OUTPUT may be used to drive the IM-516 Amplifier in "Background Music Systems." See BACKGROUND MUSIC page 4 for details.

TUNER ALIGNMENT

This receiver should be aligned **ONLY WHEN ABSOLUTELY NECESSARY** and **ONLY BY QUALIFIED PERSONNEL**. Use non-inductive, low-capacity alignment tool when making adjustments.

F. M. ALIGNMENT

MASTER UNIT SETTINGS:

1. SELECTOR SWITCH S102 in FM.
2. ALL SPEAKER VOLUME CONTROL R103 set to desired level.
3. SEQUELCH CONTROL R315 (located on Radio Module board) set to minimum (full counter-clockwise position as viewed from F.M. Side of PC board).

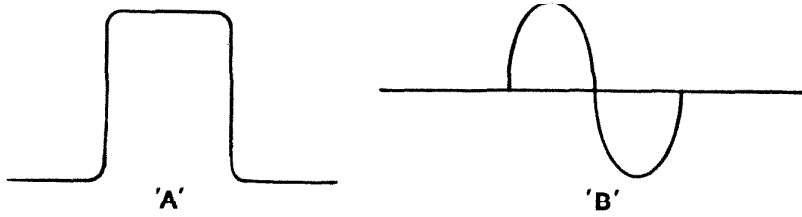
INSTRUMENTS REQUIRED:

1. CATHODE RAY OSCILLOSCOPE
 - 1.1 High side of vertical input connected through a 15K ½ watt resistor to tuner's F.M. Audio output, J/P1-4.

NOTE: DO NOT TOUCH THE REGULATED +11.5 Vdc TERMINAL J/P1-3. DO NOT SHORT THE VOLTAGE TO GROUND. SHORTING THE +11.5 Vdc MAY RESULT IN DESTROYING THE VOLTAGE REGULATOR Q209 AND THE 12V ZENER DIODE D213.

- 1.2 Low (ground) side of vertical input connected to Radio Module ground.
- 1.3 Use 60 Hz. horizontal sweep. If scope does not have own 60 Hz. horizontal, use exterior source.
2. FM SIGNAL GENERATOR
 - 2.1 Modulate RF output with 60 Hz. at 400 KHz. sweep width.
 - 2.2 Connect 60 Hz. to scope's horizontal input if required.
 - 2.3 Connect a 50 ohm resistor across RF output of signal generator.
 - 2.4 Connect high-side from generator to center conductor of coax antenna lead-in.
 - 2.5 Connect low-side (ground) from signal generator to shield (braid) of coax.

Step	Signal Generator Setting	Receiver Setting	Adjust	Tune For
1.	106 MHz. @ 2 to 5 microvolts. (If generator does not have calibrated output, use lowest level consistent with good trace on scope.)	Tune receiver (ganged tuning capacitor to pick up signal generator).	L304 Quadrature coil. Detune coil to get wave form as shown in "A" below. If wave is negative, reverse direction of slug detuning.	Maximum trace on scope as shown in "A" below. Sacrifice gain for linearity and flat top. If necessary, reduce output from signal generator to prevent receiver limiting.
2.	108.5 MHz.	F.M. Tuning Dial to 108.5 MHz. (Ganged Tuning Capacitor fully opened.)	C328 Oscillator Trimmer	do
3.		F.M. Tuning Dial to 87.5 MHz. (Ganged Tuning Capacitor fully closed.)	Frequency of RF output from Signal Generator. (Should be in neighborhood of 87.5 MHz.)	do
IF, IN STEP 3 ABOVE, FREQUENCY OF SIGNAL GENERATOR IS VERY CLOSE TO 87.5 MHz.				
4(a)	87.5 MHz.	F.M. Tuning Dial to 87.5 MHz. (Ganged tuning Capacitor fully closed.)	L303 Oscillator Coil	do
IF, IN STEP 3 ABOVE, FREQUENCY OF SIGNAL GENERATOR IS BELOW 87.5 MHz. (87 MHz or lower)				
4(b)	Slightly decrease the inductance of L303: Turn tuning slug approximately 1/8 turn counter clockwise. Repeat steps 2 and 3 above.			
IF, IN STEP 3 ABOVE, FREQUENCY OF SIGNAL GENERATOR IS ABOVE 87.5 MHz. (88 MHz. or higher)				
4(c)	Slightly increase the inductance of L303: Turn turning slug approximately 1/8 turn clockwise. Repeat steps 2 and 3 above.			
5.	Repeat 2 and 3 above until oscillator is rocked in at both ends of dial.			
6.	106 MHz.	F.M. Tuning Dial to 106 MHz.	C303B RF Input Transformer 303E RF Output Trimmer T301A and T301B, Mixer 10.7 MHz. IF Output.	do
7.	90 MHz.	F.M. Tuning Dial to 90 MHz.	L301 Antenna Input Transformer: Two peaks may be noted while adjusting this slug. USE THE PEAK WITH THE SLUG POSITIONED NEAR THE BOTTOM OF THE COIL. L302 RF Amplifier Tank Coil	do
8.	Repeat steps 6 and 7 until no further improvement in scope trace is noted at either setting. As the set is aligned, it may be necessary to reduce output of Signal Generator to prevent receiver limiting.			
9.	90 MHz. @ 10 microvolts. (If uncalibrated, use sufficient signal strength to drive receiver into limiting.	F.M. Tuning Dial to 90 MHz.	L304 Quadrature Coil.	Maximum symmetrical "S" curve. See "B" below. Curve should be linear and equal distance above and below the reference line on scope.
10.	Step 9 should be checked for various frequencies across the F.M. band. Check limiting by increasing the output of the signal generator, the "S" curve's amplitude should remain the same.			
11.	Disconnect signal generator and (if used) external sweep to scope. Scope should use regular horizontal sweep. Tune receiver between stations. Note noise at J/P1-4 (as seen on scope). Turn R315 full clockwise for maximum squelch. Noise should disappear and straight line horizontal trace be seen on scope.			



A. M. ALIGNMENT

MASTER UNIT SETTINGS:

1. SELECTOR SWITCH S102 in AM.
2. ALL SPEAKER VOLUME CONTROL R103 set to desired level.

INSTRUMENTS REQUIRED:

1. CATHODE RAY OSCILLOSCOPE

1.1 High side of vertical input connected through a 15K ½ watt resistor to tuner's A.M. Audio output, J/P-1.

NOTE: DO NOT TOUCH THE REGULATED +11.5 Vdc TERMINAL J/P1-2. DO NOT SHORT THE VOLTAGE TO GROUND. SHORTING THE +11.5 Vdc MAY RESULT IN DESTROYING THE VOLTAGE REGULATOR Q209 AND THE 12V ZENER DIODE D213.

1.2 Low (ground) side of vertical input connected to Radio Module ground.

1.3 VTVM may be used but, recommend Oscilloscope so that linearity as well as amplitude of the audio signal may be observed.

2. AM SIGNAL GENERATOR

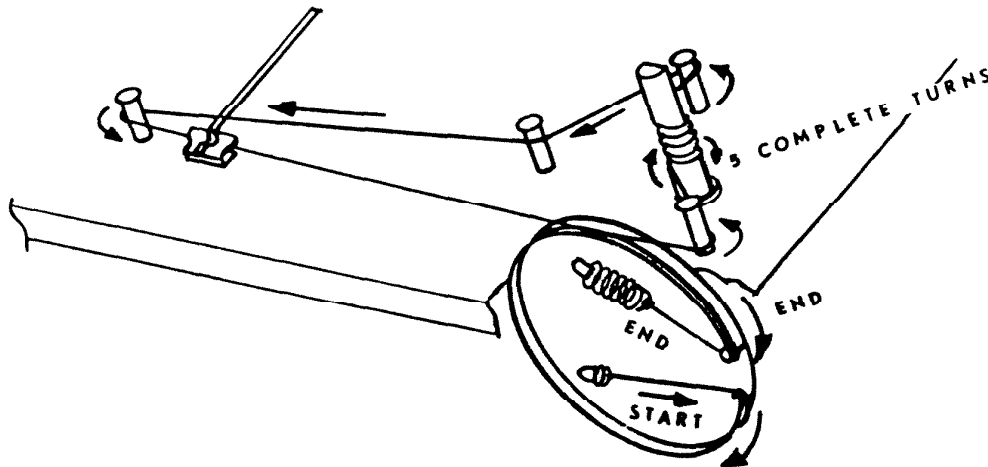
2.1 Modulate RF output with 400 Hz. @ 30%.

2.2 Connect high-side of generator output through 200 pf. (ceramic or mica) capacitor to shield (braid) of coax antenna lead-in.

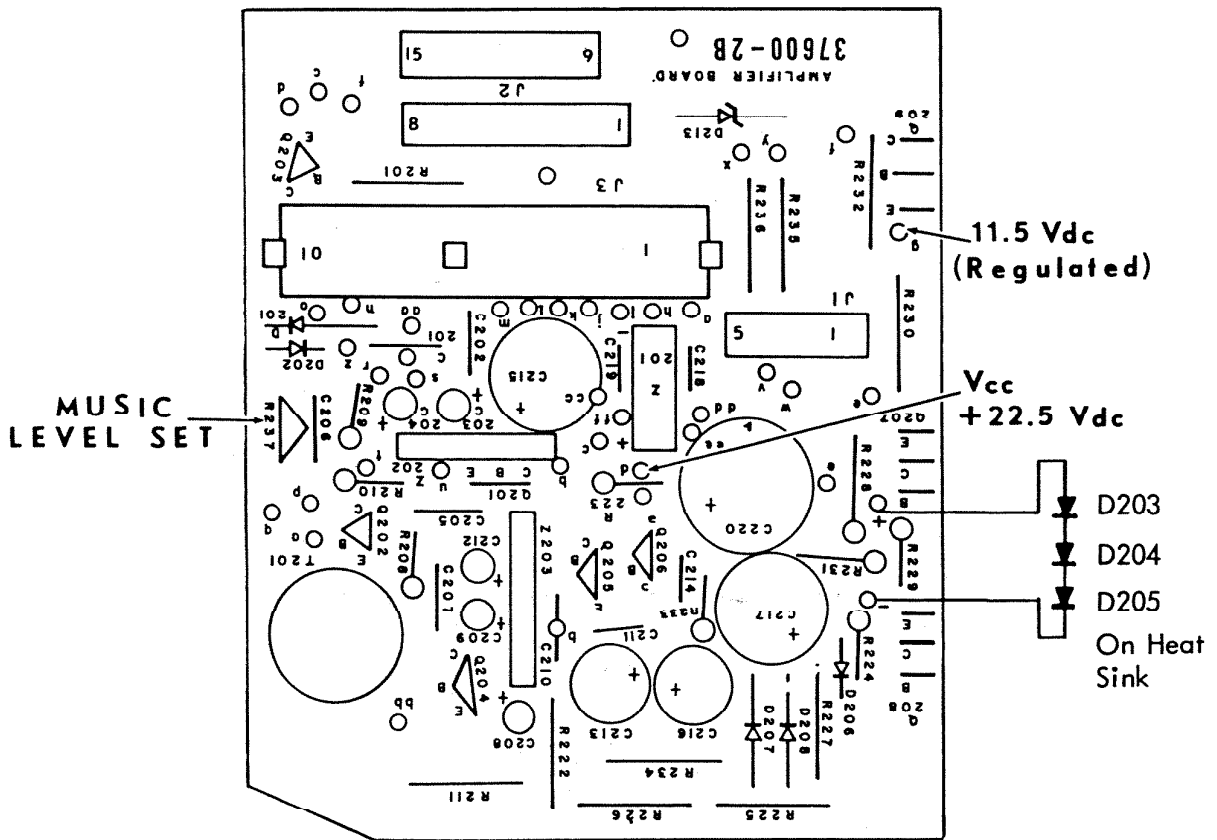
2.3 Connect low-side (ground) of generator output to Radio Module ground.

Step	Signal Generator Setting	Receiver Setting	Adjust	Tune For
1.	537 KHz. Use signal level required. Do not overdrive.	AM Tuning Dial to 537 KHz. (Ganged Tuning Capacitor fully closed)	L310 Oscillator Padder Coil	Maximum sine wave trace on scope. (or maxi-voltage on VTVM)
2.	1620 KHz.	AM Tuning Dial to 1600 KHz. (Ganged Tuning Capacitor fully opened)	C303H Oscillator Trimmer	do
3.	Repeat steps 1 and 2 until no further improvement can be made and oscillator tunes at both ends.			
4.	600 KHz.	AM Tuning Dial Set to 600 KHz.	L309 AM Antenna Transformer	do
5.	1500 KHz.	AM Tuning Dial Set to 1500 KHz.	C303C Antenna Tuning Trimmer	do
6.	Repeat steps 1 and 2 until no further improvement can be made and RF tuning tracks across the band.			
7.	1500 KHz.	AM Tuning Dial Set to 1500 KHz.	T302 AM IF (455 KHz.) Transformer	do

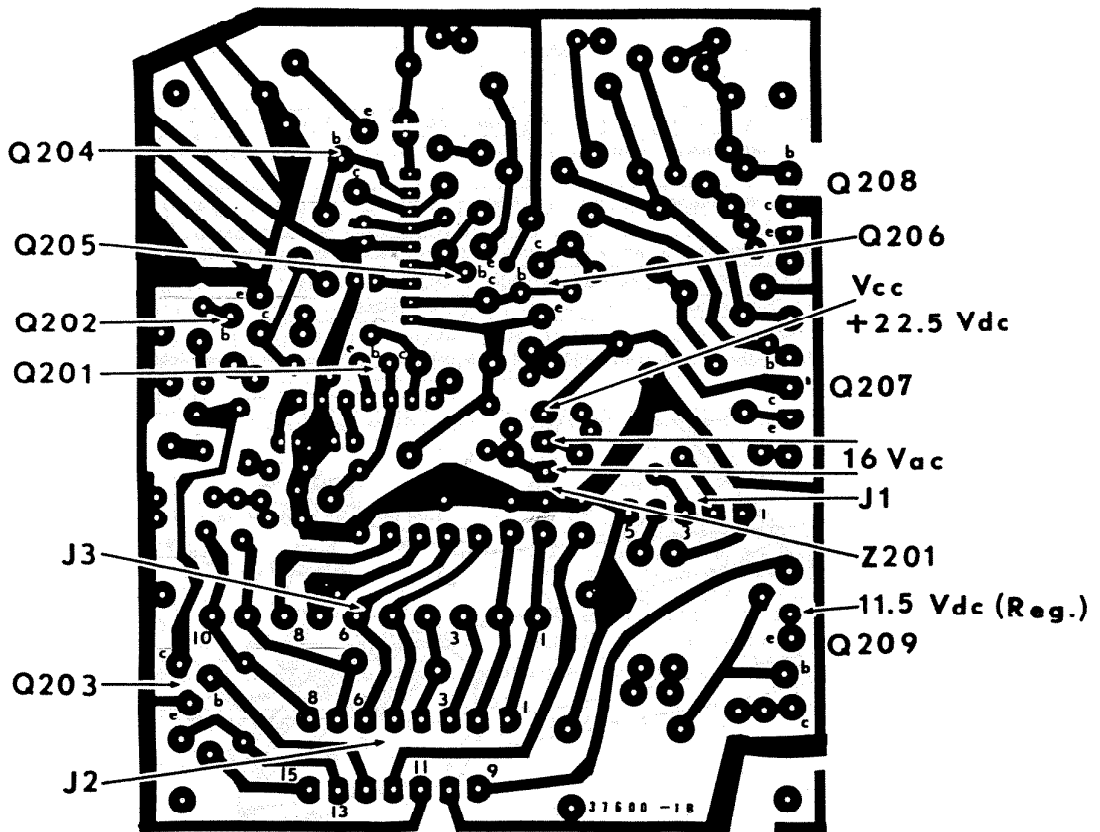
(*) May be tuned to two peaks: One peak with slug at top of coil and other peak with slug near bottom of coil. Recommend use of peak with slug near bottom of coil.



DIAL CORD INSTALLATION



COMPONENT SIDE (VIEWED FROM TOP, chassis opened out from wall installation)



FOIL SIDE

FIGURE 8: AMPLIFIER/POWER SUPPLY MODULE

(6.2) The wiper terminal of R237 is connected to the collector of muting transistor Q203. The audio signal is shorted to ground when Q203 is turned on. Q203 is turned on by applying a positive voltage — from the control module — to its base.

(7) The audio signal from wiper of R237 is also fed through R209 to the TONE CONTROL circuit C101 and R102; and to the ALL SPEAKER VOLUME CONTROL R103.

(8) The wiper terminal of R103 is fed through a shielded cable and C207 to the base of the first audio amplifier Q204.

(9) The intercom signal, from door speaker(s); Inside/Patio Speaker(s); Master Unit Speaker, security/fire alarm

and electronic chime is fed through the Intercom Input Transformer T201 and C201 to the base of the intercom preamplifier Q201.

(10) The diodes D201 and D202 will short to ground high voltages developed (particularly those generated during intercom switching) across the secondary of T201.

(11) The amplified intercom signal is coupled from the collector of Q201 through C205, R208 and C207 to the base of the first audio amplifier Q204.

(12) The collector of Q202 is connected to junction of R208 and C207 and will short the audio signal to ground when Q202 is turned on by the positive "Key Click" suppression voltage supplied from the control module.

AUDIO AMPLIFIER

(1) Vcc is furnished by +22.5Vdc supply.

(2) The audio signal from intercom preamp or from R103 is fed through the first audio voltage amplifier Q204. This stage has a gain of 6.

(3) The amplified output of Q204 is coupled through C210 to the base of Q205.

(4) High-frequency roll-off is accomplished at the base of Q205 by C211.

(5) Q205 has a very high input impedance and the signal on its collector will be approximately 70% less than that on its base. Q205 determines the AC fidelity and DC stability.

(6) The output of Q205 is direct coupled to the base of Q206. Q206 has a gain of approximately 475 and is the driver of the output stage.

(7) The output stage includes NPN Darlington Q207 and PNP Darlington Q208 — complimentary connected — with a resulting high-current gain supplying the high load current required for the recommended maximum twenty speakers.

(8) The complimentary output stage Q207 and Q208 are operated class AB. Their forward bias is supplied by Q206's no signal collector current. This biasing current is partially controlled by the temperature tracking diodes D203, D204 and D205. These diodes; Q207; and Q208 are mounted on the heat sink.

(9) If the output transistors Q207 and Q208 draw extra current (resulting in greater heat dissipation) they raise the temperature of the heat sink. This rise in temperature is coupled to the temperature tracking diodes D203, D204 and D205.

(10) When D203, D204 and D205 operating temperature increases, their cathode to anode voltage decreases. With the decrease in diode voltage drop, the no signal forward bias on D207 and D208 decreases, resulting in a decrease in collector current — thus tending to stabilize the operating condition of the output transistors.

(11) C216 is a bootstrapping capacitor, connected between the junction of the output transistors and the junction of R225 and R226, to assist in driving the Q208 to its full negative peak.

(12) AC degeneration is fed from the output through R234 to the emitter of Q205.

(13) Short circuit protection for Q207 is accomplished by D207 and D208 which limits the peak current through the transistor.

(14) Short circuit protection for Q208 results from its high base driving impedance which limits its peak current.

(15) DC STABILITY: R219, R218 and R220 form a voltage divider from Vcc to ground and the base of Q205. The voltage on base of Q205 is very near one half of Vcc.

(15.1) When Q205 conducts, Q206 collector voltage rises toward the emitter voltage (approximately Vcc). The resulting collector current generates a forward bias on Q207 and Q208.

(15.2) When Q207 and Q208 conduct, the voltage at the junction of their emitter resistors R228 and R229 rises toward Vcc.

(15.3) This voltage is fed back through R234 to the emitter of Q205. If the output center point voltage rises higher than Q205's base voltage, Q205 will be turned off and the above action will be reversed.

(15.4) If the output center point voltage would tend to stabilize below the base voltage of Q205, Q205 would conduct harder and force the output center point voltage to rise.

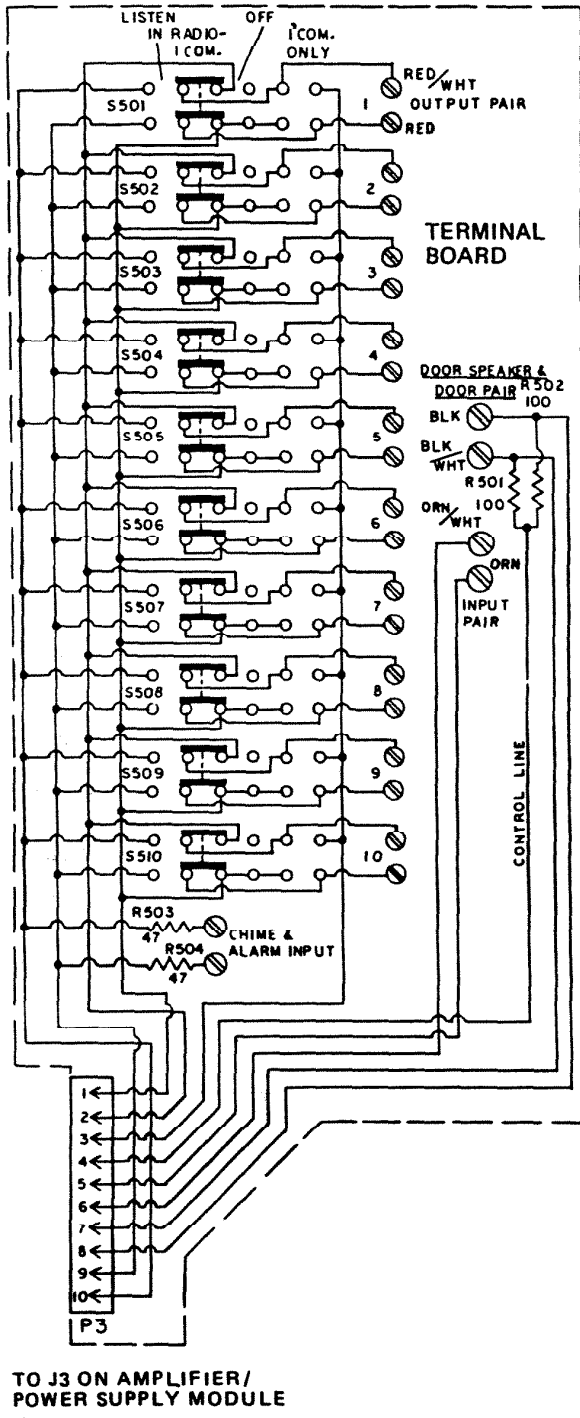
(15.5) This 100% DC feedback will lock the DC voltages at their proper level

(16) The 100% DC feedback prohibits instability in the d-c voltages, but in case of component failure, the voltage changes will be very great.

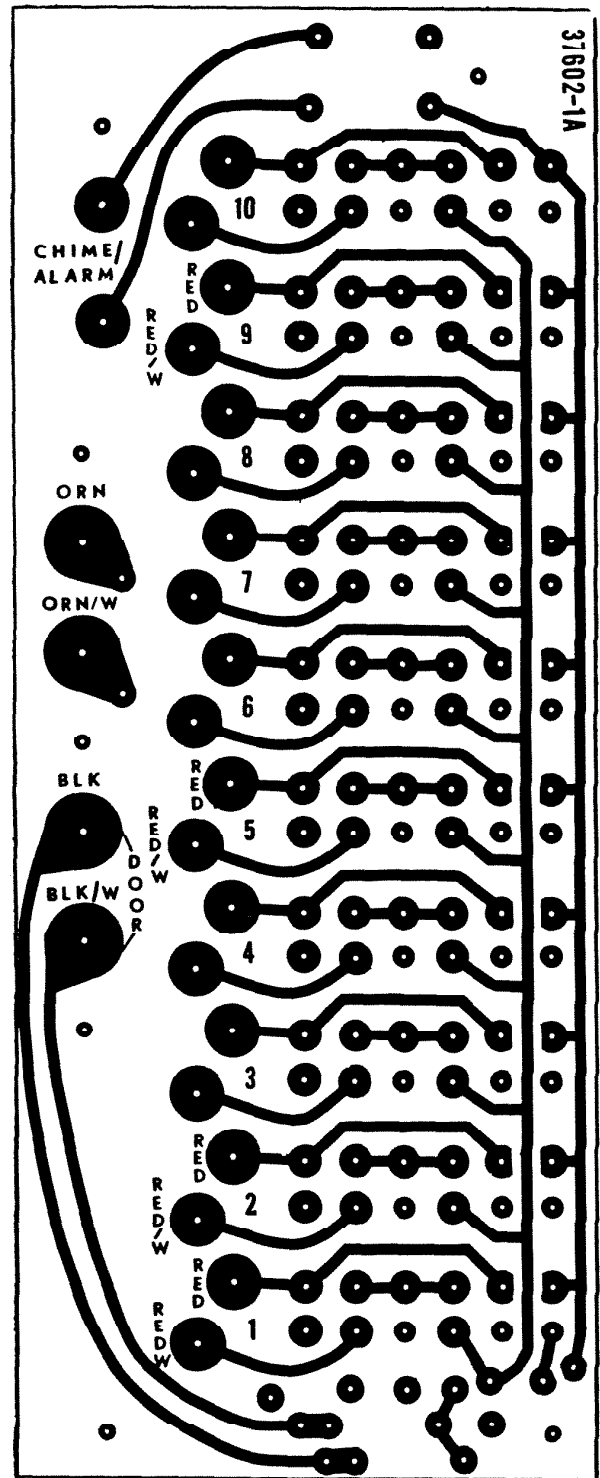
(16.1) EXAMPLE: Q206 has an emitter-collector short. The collector voltage rises to approximately Vcc, and this high positive voltage is applied to the base of Q207, driving Q207 into saturation and bringing the output center point voltage to near Vcc. This very high positive voltage is coupled to the emitter of Q205, resulting in a reverse emitter-base junction bias and turning Q205 off. The voltages now measured at the terminals of the various elements will be very different from their normal operating values.

(17) The ratio of R234 to R222 determines the gain of the direct coupled stages. Shorting out R222 will cause the output to increase by a factor of 16. It may be desirable to short R222 when trouble shooting some problems. The signal can be observed at various points without the influence of the negative feedback.

OBSERVE EXACT COLOR CODE



SCHMATIC DIAGRAM



PC BOARD TERMINAL SIDE

FIGURE 9: INSIDE/PATIO INTERCOM SPEAKER SWITCHING AND TERMINAL BOARD CONNECTIONS

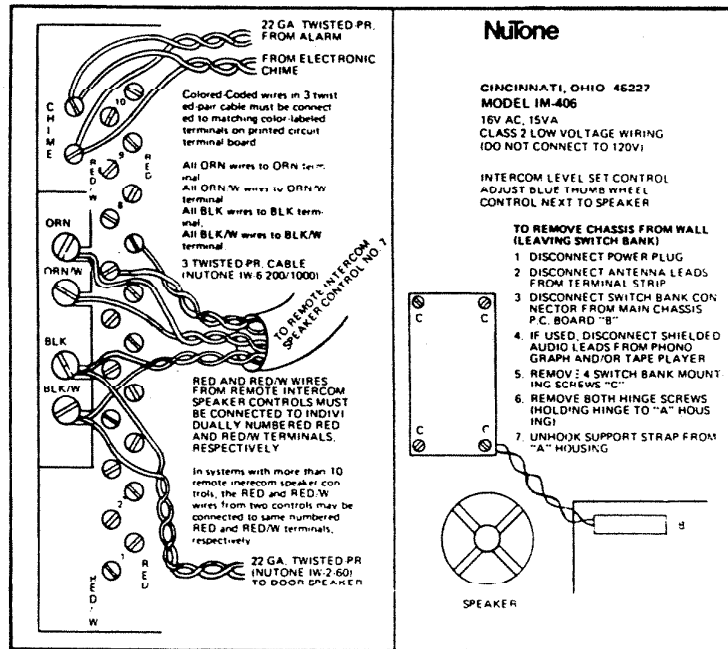


FIGURE 10: INSTRUCTION LABEL INCLUDED WITH IM-406 MASTER UNIT

TERMINAL BOARD

SPEAKER WIRING

(1) The 3-twisted-pair cable (NuTone IW-6-200/1000) between the Model IS-45 and IS-48 Inside/Patio Speakers and/or the IC-41 Remote Control(s) must be connected to the EXACT MATCHING COLOR-LABELED TERMINALS at each speaker and control and at the Master Unit's Terminal Board.

(1.1) The Instruction Label (Figure 10) is included with each IM-406. These instructions must be followed exactly.

(2) The RED and RED/WHITE pair of the 3-twisted-pair cable from two or more I/P speakers and/or controls may be connected to the same STATION SELECTOR SWITCH.

(2.1) Two or three remote intercom speakers and/or controls may be loop connected on one run of cable:

1 Speaker or Control	750 ft. (maximum)
2 Speakers and/or Controls	500 ft. (maximum)
3 Speakers and/or Controls	250 ft. (maximum)

(2.2) It is recommended that a maximum of 4,000 ft. of IW-2 cable be used in an IM-406 system.

(3) The 22 ga. twisted-pair cable (IW-2-60) from the door speaker(s) should be connected to the BLK and BLK/W terminals on the Master Unit's Terminal Board or, to the BLK and BLK/W terminals in a nearby I/P Speaker or Control.

(4) The 100 ohm resistors R501 and R502 isolate the Control Line from input and output circuits during intercom operation of the door speakers. They have very little effect on the control operation.

CHIME/ALARM WIRING

(1) When an electronic chime and/or alarm system signal is fed through the intercom system, the IW-2 cable from these units should be connected to the CHIME/ALARM TERMINALS.

(2) NOTE: THE CHIME AND/OR ALARM MUST BE INSTALLED AND POWERED IN THE MANNER PRESCRIBED BY THEIR INDIVIDUAL INSTALLATION INSTRUCTIONS. DO-NOT USE THE RADIO/INTERCOM MASTER UNIT'S 16 VOLT TRANSFORMER TO POWER ANY ADDITIONAL EQUIPMENT.

(3) The 47 ohm resistors R503 and R504 isolate the chime/alarm wiring and pickups from the Intercom Input Transformer T201. They also attenuate the signal from the chime and/or alarm.

STATION SELECTOR SWITCHES S101-S110

(1) The four-position switches control the operating mode of the Inside/Patio Speakers.

(1.1) NOTE: A complete description of the selector switch operation is included with the section, SYSTEM INTERCOM SWITCHING & CONTROL.

(2) The Master Unit Speaker is always in the RADIO/INTERCOM mode. It can be silenced by turning the MASTER SPEAKER VOLUME CONTROL R101 to minimum (full counterclockwise).

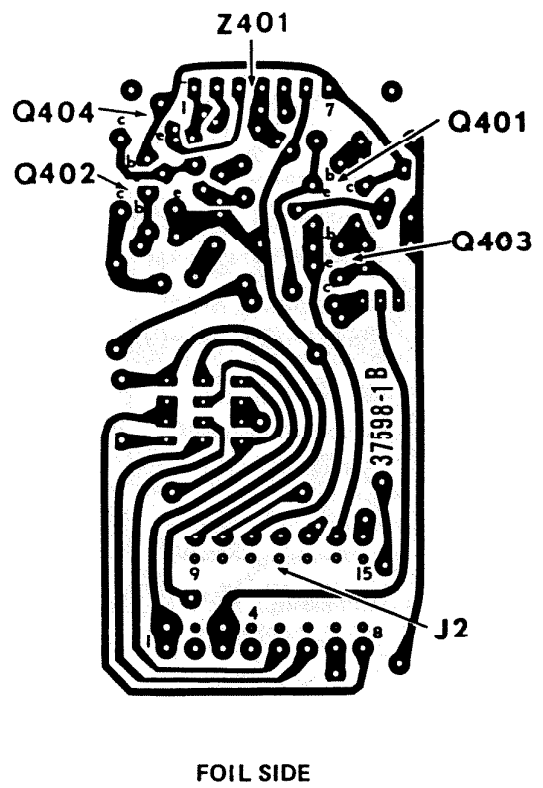
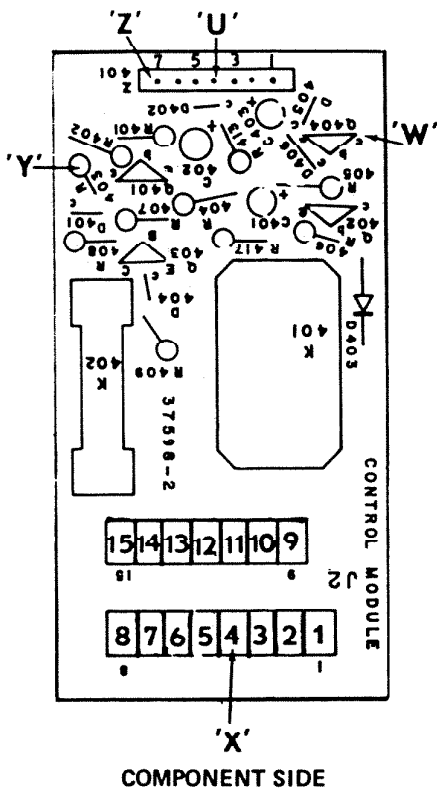
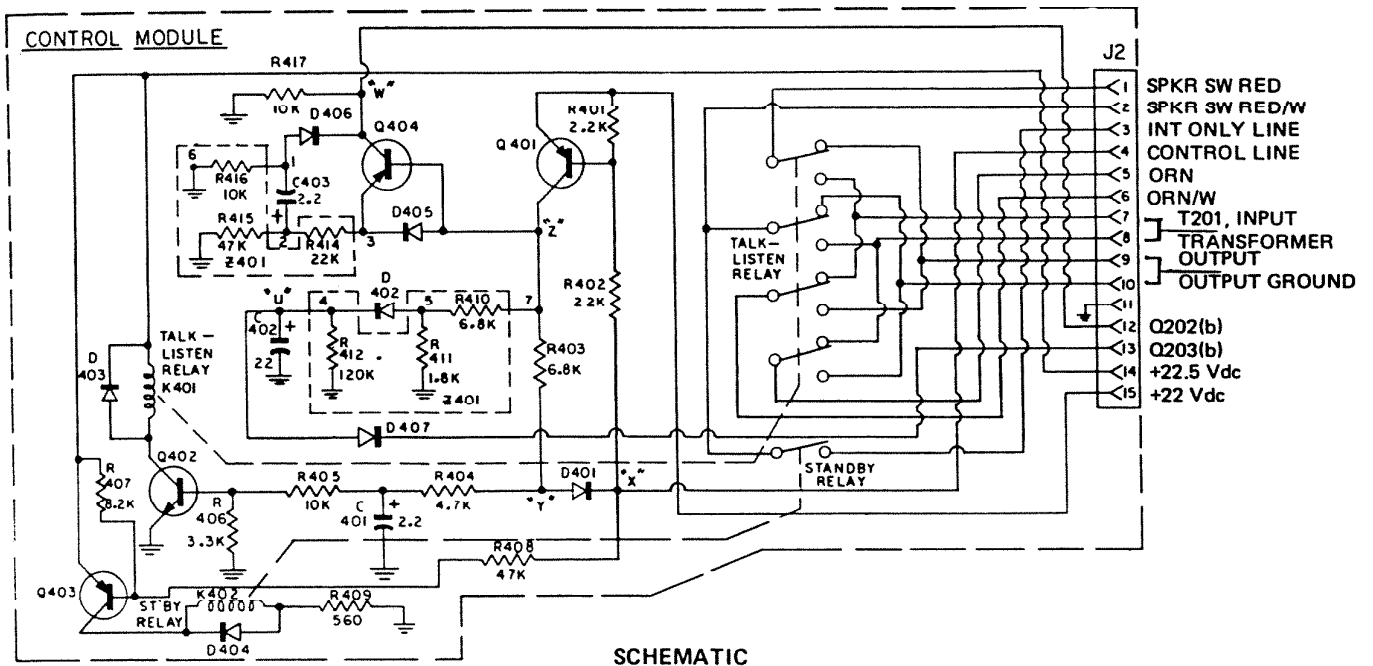


FIGURE 11: CONTROL MODULE

CONTROL MODULE

- (1) IM-406 system's intercom switching is controlled by this module in conjunction with the Talk/Listen intercom controls in the Master Unit and Inside/Patio speakers.
- (2) The Control Module includes 4 transistors and their associate circuits:
 - (2.1) Q401: Control Transistor in association with part of Z401 (R410, R411, R412); D402; and C402 provides MUTING of the entertainment program during intercom operation and, operating voltage to Q404 and its associated circuit for "Key Click" suppression.
 - (2.2) Q402: Operates the TALK/LISTEN Relay K401.
 - (2.3) Q403: Operates the STANDBY (ST'BY) Relay K402.
 - (2.4) Q404: Key-Click (switching noise) suppression.
- (3) All transistors on the Control Module are turned OFF when the system is in normal mode, i.e. no intercom function being used.
- (4) The CONTROL LINE is connected from junction of R402; R408; and cathode of D401 (point "X" on schematic) through J/P2-4, J/P3-4 and R501 and R502 to the BLK/W and BLK terminals.
- (5) When point "X" is connected direct (or through 50–100 ohms) to ground, as is done when Inside/Patio Talk; Door Talk; or Door Listen functions are utilized, current will flow through R401 and R402, putting a forward bias on the base of Q401.
 - (5.1) With this forward bias, Q401 is turned ON and its collector voltage rises to near V_e (+22V). Collector current is limited by the Control line resistance, D401 and R403.
- (6) Point "X" being grounded also causes current flow through R407 and R408, putting a forward bias on the base of Q403, turning Q403 ON. Q403 collector voltage will be switched to near V_e (+22.5V). This 22.5V will energize ST'BY Relay K402. Current through K402's coil is limited by its own resistance and R409.
 - (6.1) D404 protects Q203 from excessive reverse voltage that may be developed across the coil when Q403/K402 is turned OFF.
- (7) D401 maintains point "Y" approximately +0.5 volts above point "X". This voltage will not draw enough current through Q402's base bias resistor R406 to turn Q402 ON. TALK/LISTEN Relay K401 remains deenergized.
- (8) Assuming Q401 V_c goes to +21.5V. The voltage divider R410 and R411 results in a +2.1V on anode of D402. With a drop of 0.5 to 0.7 volts across the diode the voltage at high-side of C402 (point "U") is approximately 1.4 volts. This voltage is fed through D407 and J/P2-13 to the base of Q203, turning it ON.
 - (8.1) MUTING: When Q203 is turned ON, its collector goes to emitter potential (in this case ground) shorting any audio signal present on the wiper contact of LEVEL SET CONTROL R237. This occurs when any TALK or LISTEN switch in the system is activated (pushed in).
 - (8.2) When Q401 is turned OFF (as happens when the TALK or LISTEN switch is released), the voltage at point "Z" goes to zero. C402 has been charged to the 1.4V muting voltage. This voltage decreases at an exponential rate depending of the RC constant of C402 and the emitter-base junction in series with D407. (R412 is so large in respect to the other discharge paths that it has very little effect on the time constant.)
 - (8.3) The voltage on C402 decreases from +1.4V through Q203's saturation and then through Q203's cutoff. The audio voltage on wiper of R237 starts coming back when the voltage drops through saturation and is at full level when Q203 is turned OFF. (The music fades back to full volume in something less than ½ second.)
 - (9) KEY CLICK SUPPRESSION: When Q401 is turned ON, the 21.5 volts at point "Z" is applied to the base of PNP transistor Q404, with a drop of approximately 0.7 volts across D405. The transistor emitter-base junction is reverse biased and Q404 is clamped OFF.
 - (9.1) The 20.8V at the emitter of Q404 is divided by R414 and R415 and 14.2 volts is applied to the positive side of C403.
 - (9.2) This positive pulse is coupled through C403 and with a 0.7V drop across D406 appears instantaneously as 0.8V at point W and then immediately starts to decay toward zero. (Measurable at 0.8V with scope at J/P2-12.)
 - (9.3) This decaying voltage is connected from point "W" through J/P2-12 to the base of Q202, turning it ON. When Q202 is turned ON, its collector goes to approximately the emitter ground potential, shorting the audio output of the intercom preamp Q201 and the audio at the base of the first audio amplifier Q204.
 - (9.4) The base voltage decays very rapidly (approximately 150 milliseconds) and the audio at this point is shorted only during switching operation, eliminating most of the key clicks.
 - (9.5) All of the key click will not be eliminated. The noise should be just enough to allow the operator to know that the switching system is functioning.
 - (10) When the TALK or LISTEN switch is released, the voltage at point "Z" goes to zero.
 - (10.1) The positive voltage on the high side of C403 is now connected through R414 to the emitter of Q404. This results in a forward bias on Q404, turning it ON, and its collector voltage going to near V_e .
 - (10.2) This positive voltage at "W" is the key-click voltage applied to the base of Q202 and disappears in approximately 150 milliseconds.
 - (11) INSIDE/PATIO LISTEN OPERATION: When S3A/B in any Inside/Patio Speaker Control or S103 in the Master Unit is activated, the Control Line is connected through a 10K resistor (R2 in I/P Speakers or R104 in Master Unit) to ground.
 - (12) Current flow through R401; R402; and the Control Line resistance results in a forward bias on Q401, turning it ON.
 - (12.1) At the same time the voltage at point "X" goes to approximately +12V and the voltage at point "Y" goes to near +12.5 volts.

(12.2) When Q401 is turned ON, the collector voltage goes to the positive emitter voltage and the MUTING and KEY CLICK operation is the same as noted above.

(13) The positive voltage at "Y" is coupled through R404 and R405 to the base of Q402 and through R406 to ground. The transistors Veb will equal approximately +1.33 volts and it will be turned ON.

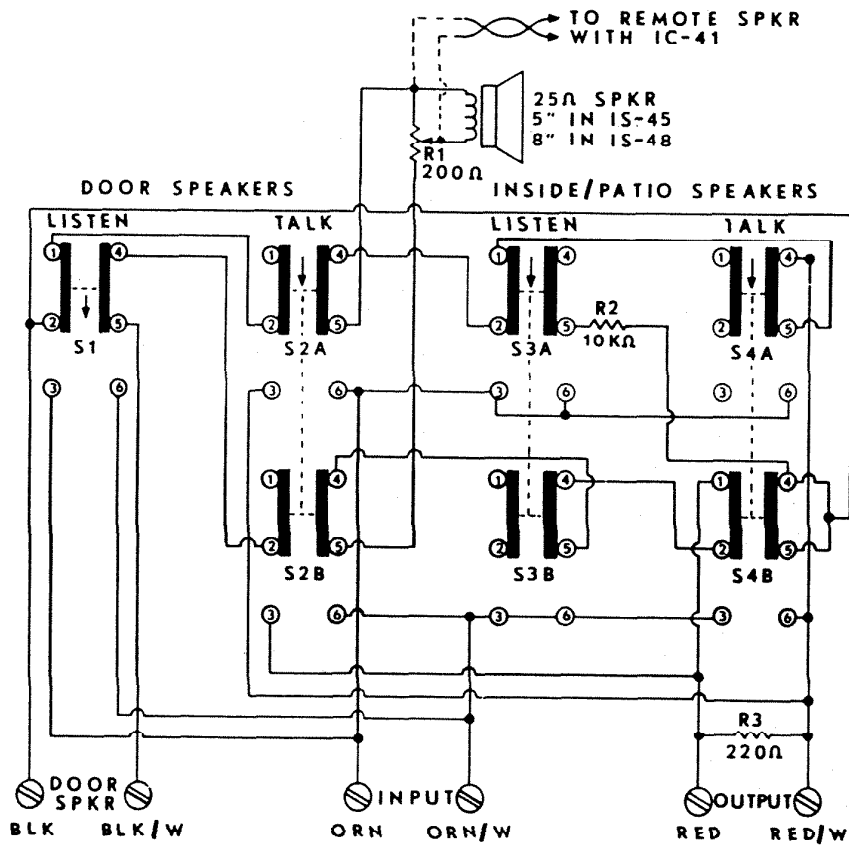
(14) When Q402 is turned on, its collector goes to near ground potential, and the TALK/LISTEN Relay K401 is energized.

(14.1) D403 protects Q402 from excessive reverse voltages that may be generated by K401's coil when Q402/K401 is turned OFF.

(15) When K401 is energized, the RED and RED/W leads from the speakers that are normally connected to the audio amplifier output are now connected to the input transformer and, the ORN and ORN/W leads that are normally connected to the Input Transformer are now connected to the audio amplifier output.

(16) The STANDBY Relay K402 operated the same as described above.

INSIDE/PATIO SPEAKERS



MATCHING COLOR-CODED WIRES IN 3-TWISTED-PAIR CABLE (NUTONE IW-6-200 OR IW-6-1000) MUST BE CONNECTED TO EXACT MATCHING COLOR-CODED TERMINALS ON CONTROL PC BOARD.
USE 22 GA. TWISTED-PAIR (NUTONE IW-2-60) BETWEEN IC-41 CONTROL AND REMOTE SPEAKER.

FIGURE 12: SCHEMATIC DIAGRAM: IC-41; IS-45; & IS-48 (IS-47 SPEAKER CONTROL)

(1) All Inside/Patio Speakers in the IM406 System use the same controls and operate in the same manner.

(2) VOLUME CONTROL R1 will turn the speaker OFF during intercom operation, and when listening to the entertainment program if it is set to minimum (full counter-clockwise) position.

(3) DOOR TALK SWITCH S2A/S2B and DOOR LISTEN SWITCH S1 control the operation of the door speaker(s). When these switches are in their normal position, the

door speaker(s) are not connected to the input or output of the Master Unit's audio amplifier, regardless, of whether they are connected to the BLK and BLK/W terminals in the Master or in an I/P Speaker.

(4) The Control Line is fed from the Master to the I/P Speakers through the BLK and BLK/W wires and terminals at all times.

(4.1) The BLK and BLK/W wires and terminals carry the DC Control Line current, and when a DOOR SWITCH is

activated, the audio signal to or from the Door Speaker(s). The DC Control Line current has little or no effect on the audio signal.

(5) 10K ohm Resistor R2 is in series with the Control Line when I/P LISTEN SWITCH S3A/S3B is activated. This serves to keep point "X" in the Control Module approximately 12 volts above ground, thus energizing the TALK/LISTEN RELAY K401.

(6) When the originating I/P Speaker is in the INTERCOM ONLY mode (as determined by its STATION SELECTOR SWITCH S501-S510) in the Master Unit, Resistor R3 supplies the Control Line return path. The line is connected to ground through R231 to ground on the Master Amplifier/Power Supply Module. When the intercom has been activated, the RED/W wire will be connected direct to output ground through the closed STBY RELAY contacts.

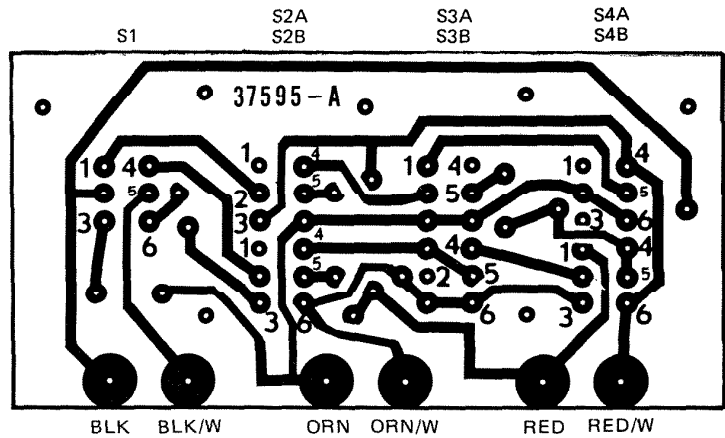


FIGURE 13: I/P SPEAKER CONTROL PC BOARD – FOIL SIDE

IS-47 SPEAKER/CLOCK TIMER

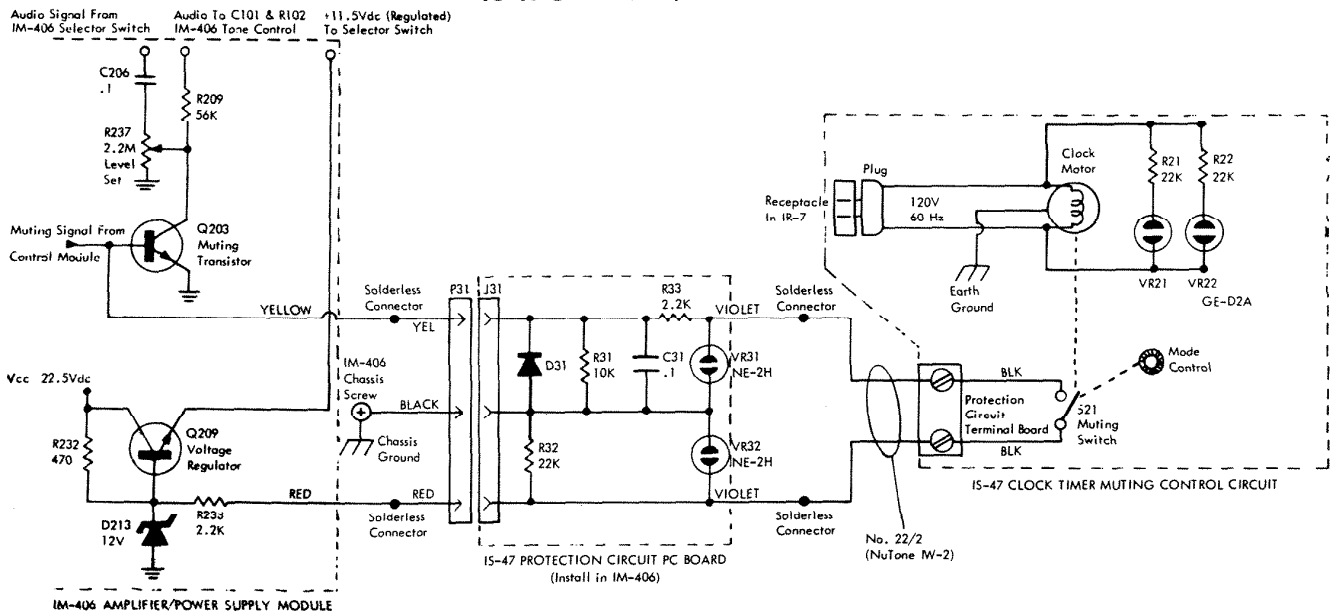


FIGURE 14: IS-47 CLOCK TIMER MUTING CONTROL CIRCUIT

(1) IS-47 audio operation is the same as for the other I/P Speakers.

(2) When the IS-47 is installed according to its Installation Instructions, the Clock/Timer Muting will be in accordance with the diagram, Figure 14.

(3) When Muting Switch S21 is closed, the positive voltage at the junction of Q209 and D213 is fed to the base of Q203, turning it ON. When Q203 is ON, the audio signal at the wiper terminal of R237 is shorted to ground.

(3.1) S21 can be closed by setting Mode Control in OFF, or by setting to AUTO or ALARM. When the clock has advanced to the pre-set alarm time, the switch will open and the entertainment program will be resumed. If the Mode Control is in ALARM, the clock alarm signal will be turned on when the entertainment program is resumed.

(3.2) Throwing the Mode Control to ON will turn the alarm OFF while allowing the entertainment program to continue.

(4) D31 protects Q203 from excess Vebo. This voltage may be built up on the YELLOW line due to a static charge etc. that is not enough to fire VR31.

(4.1) VR31 and VR32 protect the YELLOW and RED lines from excessive voltages, that may be due to static charges or nearby lightning strikes.

(5) RF signals that may be picked up on the YELLOW line are shorted to ground by C31.

(6) Resistor R33 protects Q203 base, and R238 protects the 12V at D213, in case of a short in the muting line between the Protection Circuit PC Board and the Clock/Timer Muting Control Board.

OPERATING VOLTAGES

INPUT: 120 Vac, 60 Hz.
 AC TO BRIDGE Z201: 17 Vac, 60 Hz.
 BRIDGE DC OUTPUT: V_{cc} = 23 Vdc (Measure at J/P2-14)
 Regulated = 11.5 Vdc (Measure at J/P1-2)
 R 103 VOLUME CONTROL: Minimum
 S102 SELECTOR SWITCH: AM (No Signal, Tune Off Station.)

DEVICE	PIN NUMBER															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Z302	0.9	1.5	10.9	0.7	0	8	1.5	0.8	5.5	0.64		1	1	0	11	

S1-2 SELECTOR SWITCH: FM (No Signal, Tune Off Station.)
 Regulated = 11.5 Vdc (Measure at J/P1-3)

DEVICE	PIN NUMBER															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Z301	2.1	2.1	2.1	0	2.4*	5.4		5.9	6	6	10	5.3*		0		

(*) Must be measured by Oscilloscope or by meter with Hi-Z input.

DEVICE	ELEMENT				
	FUNCTION	SOURCE	GATE 1	GATE 2	DRAIN
Q301	R.F. Amplifier	1.7	1.85	3.6	8.6
		EMITTER	BASE	COLLECTOR	
Q302	F.M. Mixer	0.25	0.9	10	
Q303	F.M. Oscillator	4.5	5.2	10	
Q201	I.C. Preamp	2.0	2.5	4.9	
Q202	Key Click Suprsn.	0	0*	0	
Q203	Muting	0	0**	0	
Q204	1st. Audio Amp.	0.26	0.80	3.30	
Q205	Audio Amp.	12.4	12.9	23.0	
Q206	Audio Driver	23	22.7	13.9	
Q207	NPN Audio Output	12.2	13.3	23	
Q208	PNP Audio Output	12.1	11.1	0	
Q209	Voltage Regulator	11.5	12.0	23.0	
Q401/OFF	CONTROL	23	22.9	0	
Q401/ON		22	21	21.7	
Q402/OFF	T/L Relay	0	0	22.5	
Q402/ON		0	1.33	0.7	
Q403/OFF	Standby Relay	23	22.5	0	
Q403/ON		23	21.8	22.5	
Q404/OFF	Key Click Suprsn.	0	0	0	
Q404/ON		21	21.7	0.3***	

(*) Goes to 0.3 on meter (0.8 on scope) when "Key Click" suppression voltage is ON.

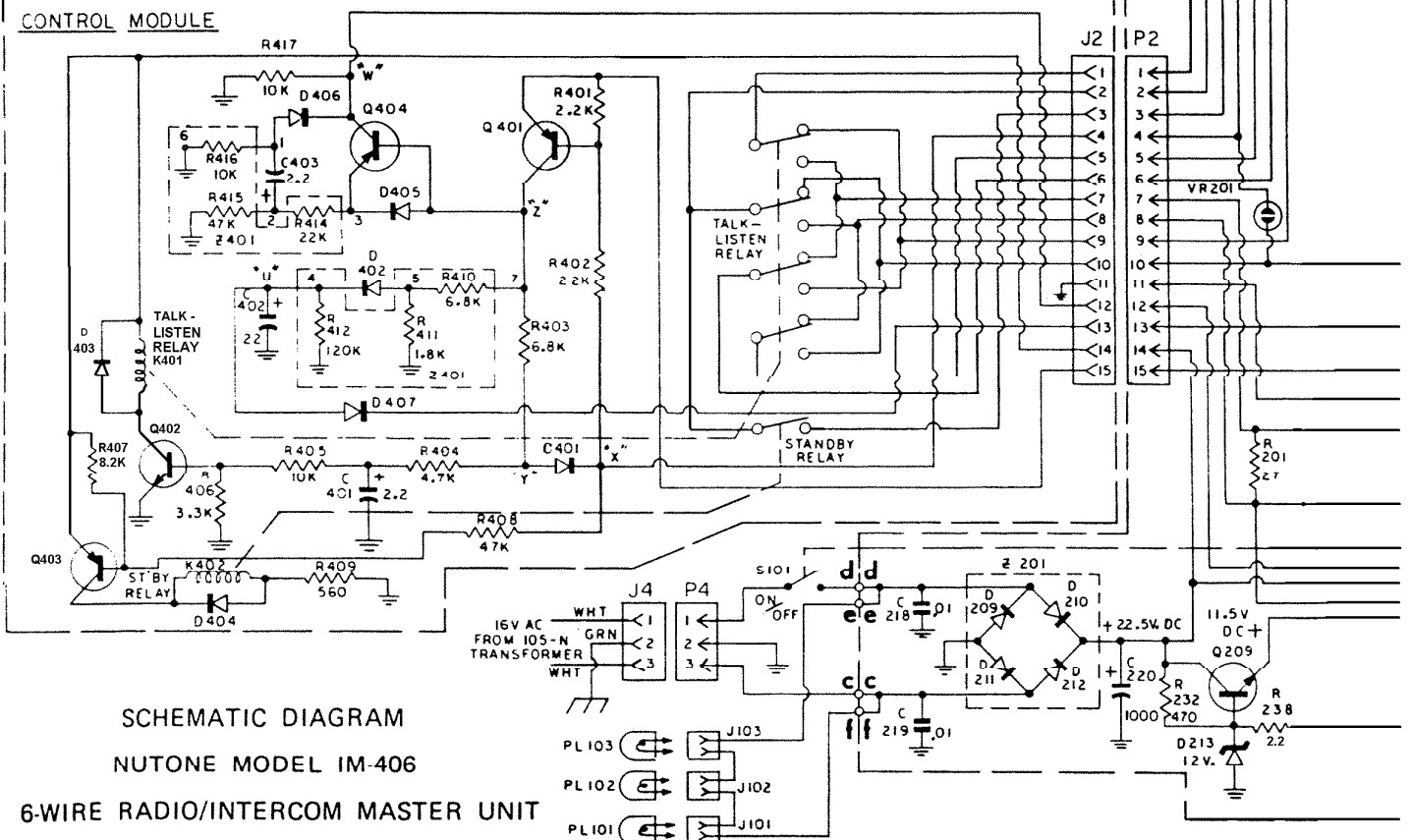
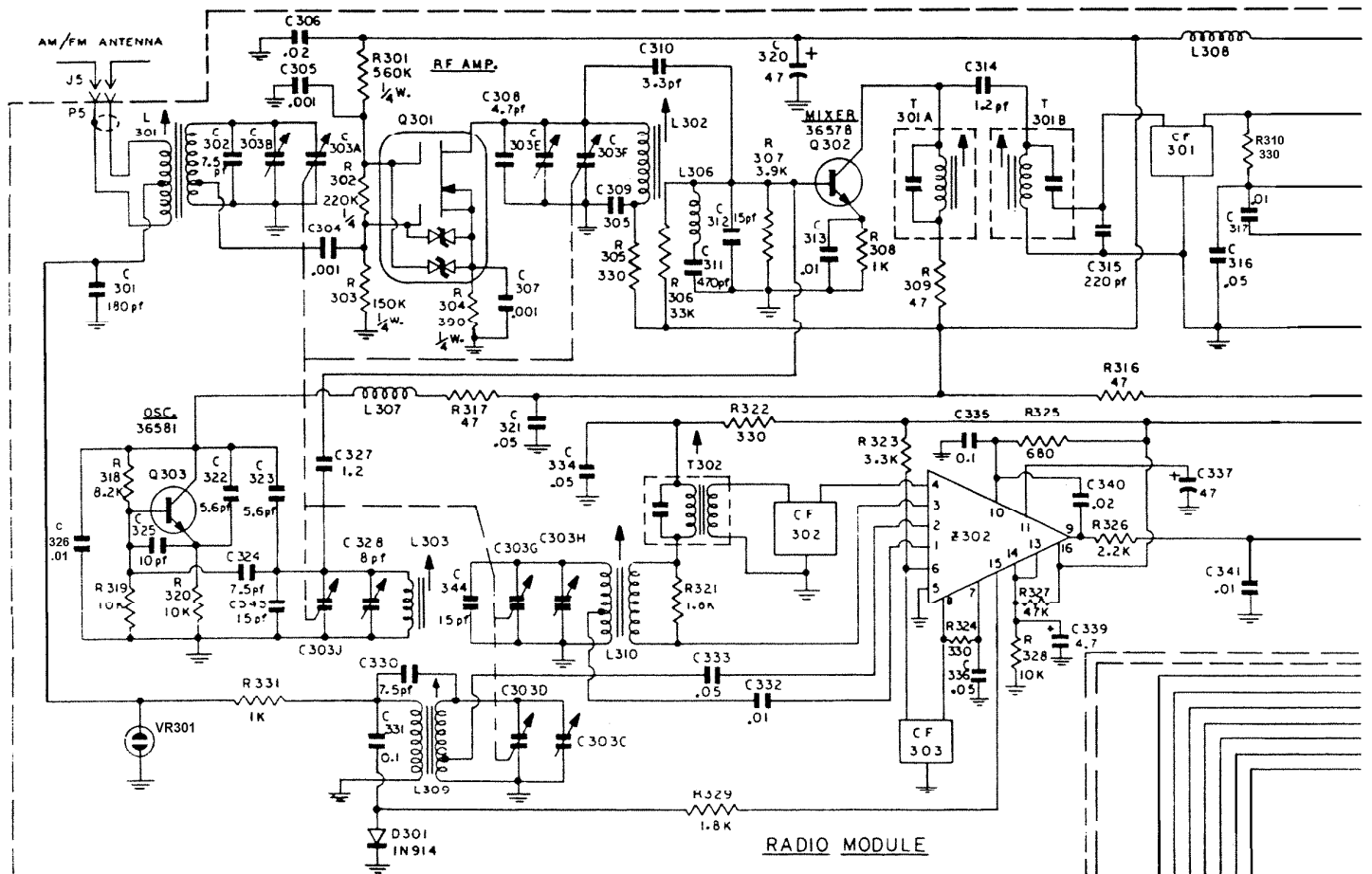
(**) Goes to 0.7 when "Muting" is ON.

(***) Measured with meter. Actual voltage measured on scope equal 0.8 volts maximum; discharging to zero in 150 200 milliseconds when depressing or releasing any TALK or LISTEN switch.

CONTROL MODULE INTERCOM OPERATION

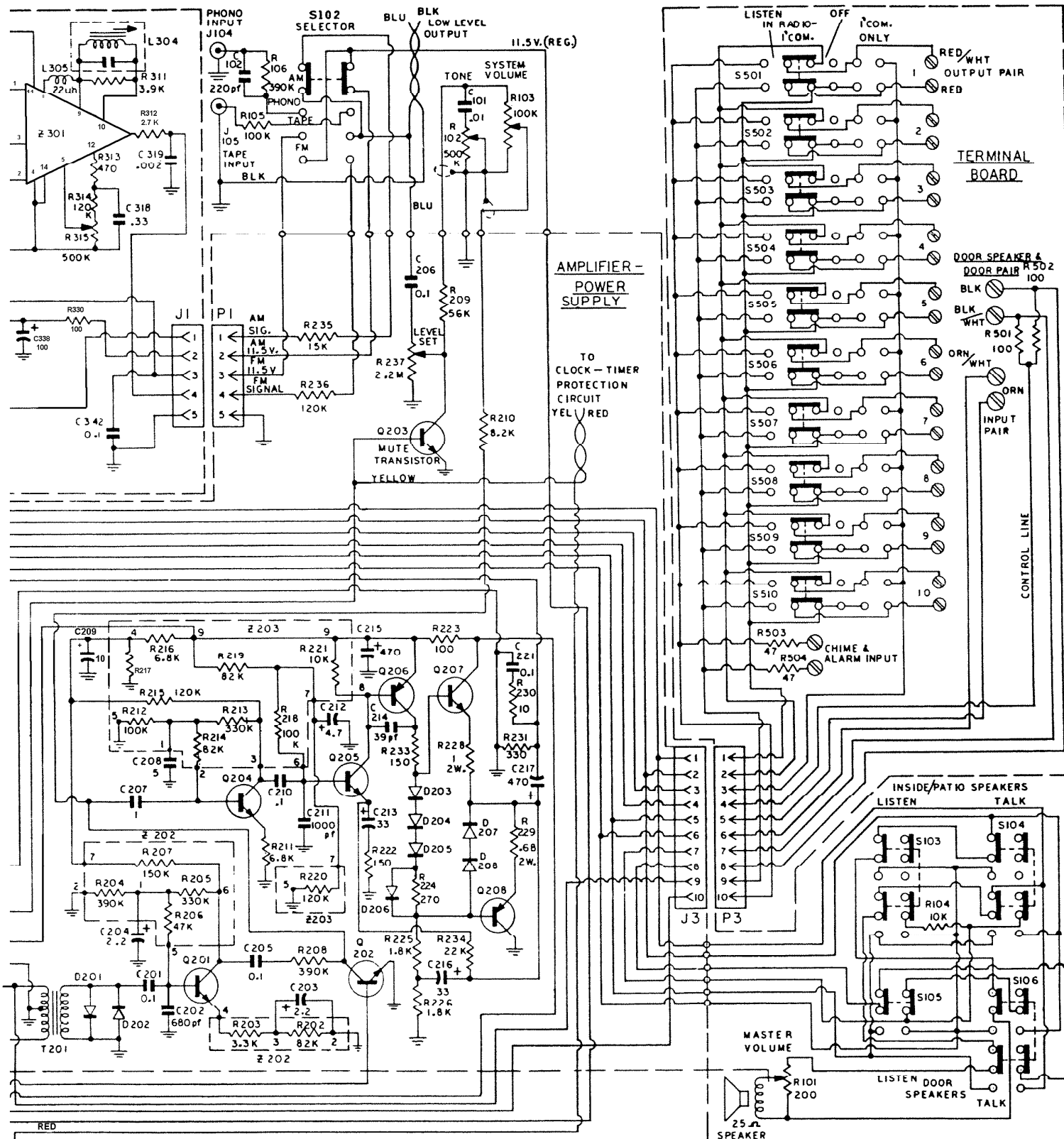
INTERCOM FUNCTION	RESISTANCE AT POINT X	VOLTAGE POINT X	VOLTAGE POINT Y	Q401	K401 Q402	K402 Q403	Q404	
							T/L ON	T/L RELEASED
OFF	25K → 0.5	22.5	0	OFF	OFF	OFF		
I/P TALK	70	0.3	0.91	ON	OFF	OFF	OFF	MOMENTARY ON *
I/P LISTEN	7.5K	12.0	12.5	ON	ON	ON	OFF	do
DOOR TALK	58	0.25	1.71	ON	OFF	ON	OFF	do
DOOR LISTEN	52	0.23	1.68	ON	OFF	ON	OFF	do

(*) ON for approximately 150 milliseconds, during "Key Click" suppression.



SCHEMATIC DIAGRAM
 NUTONE MODEL IM-406
 6-WIRE RADIO/INTERCOM MASTER UNIT

FIGURE 15



NOTE:

1. ALL RESISTORS: VALUES IN OHMS: 10% TOLERANCE; 1/4 WATT, UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUE IN MFD., UNLESS OTHERWISE SPECIFIED.

COMPONENT IDENTIFICATION:

100 SERIES	CHASSIS MOUNTED COMPONENTS
200 SERIES	AMPLIFIER/POWER SUPPLY MODULE
300 SERIES	RADIO MODULE
400 SERIES	CONTROL MODULE
500 SERIES	TERMINAL BOARD

FIGURE 15

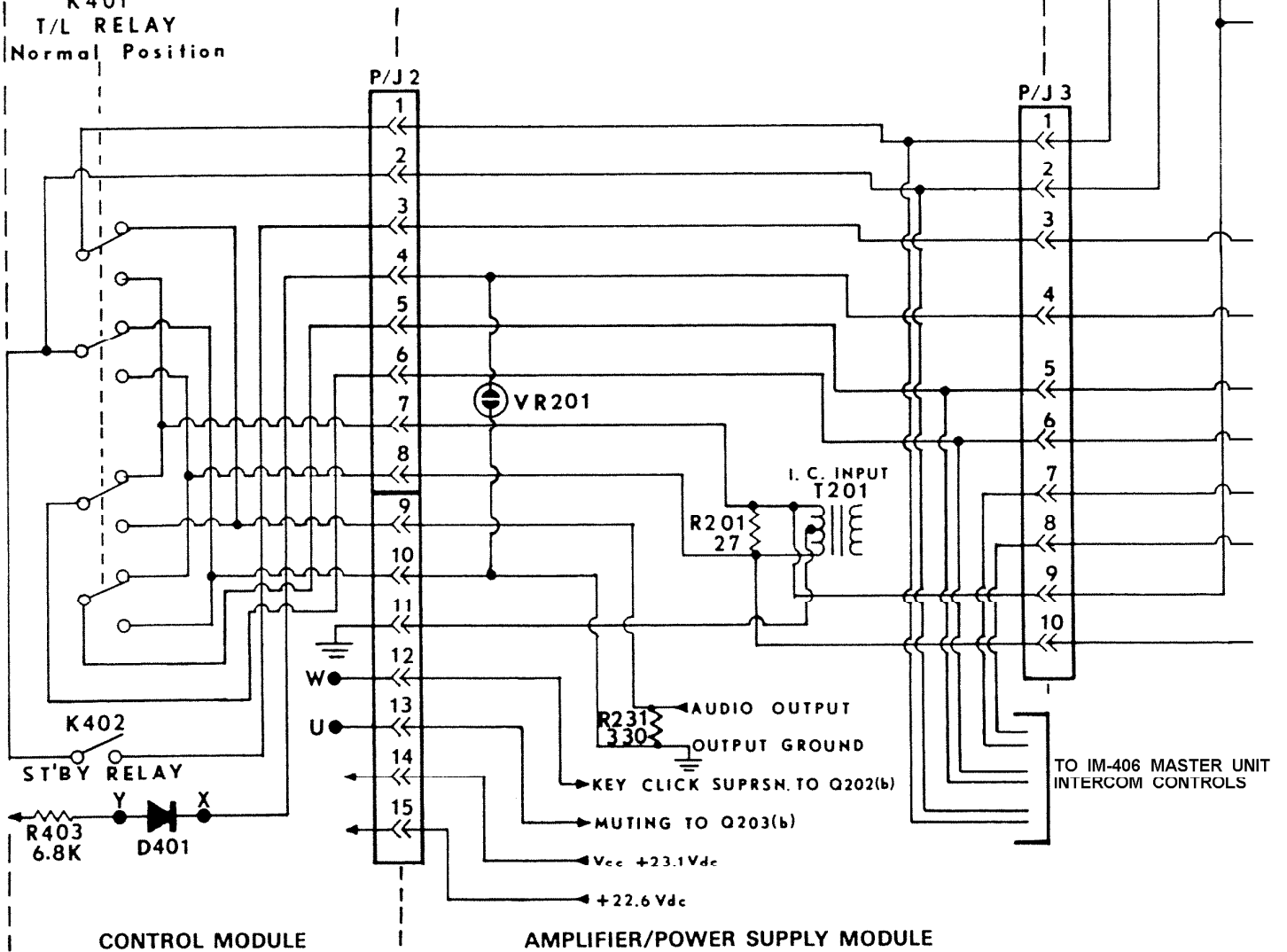
S501/S502 STATION SELECTOR	
POSIT.	FUNCTION
1	LISTEN IN.
2	RADIO/INTERCOM
3	OFF
4	INTERCOM ONLY

OPERATION

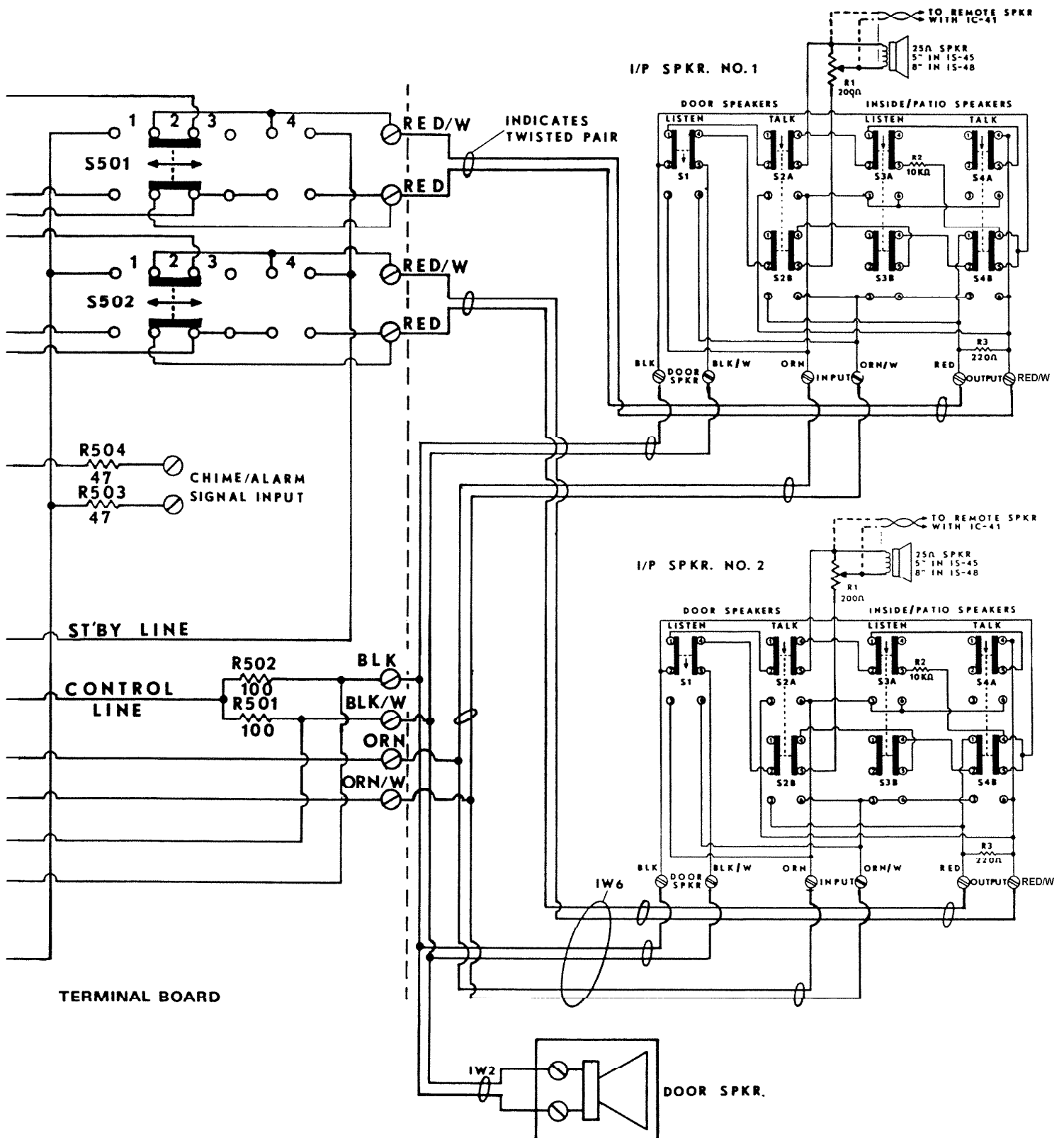
INTERCOM FUNCTION	VOLTAGE				K401 T/L RELAY	K402 ST'BY RELAY
	POINT X (P/J2-4)	POINT Y (TOP R403)	POINT U (P/J2-13)	POINT W (P/J2-12)		
OFF	22	0	0	0	NORMAL	OPEN
DOOR LISTEN	0.23	0.84	4.1	*	NORMAL	ON (CLOSED)
DOOR TALK	0.25	0.86	4.1	*	NORMAL	ON
I/P LISTEN	12	12.5	4.1	*	ON	ON
I/P TALK	0.3	0.9	4.1	*	NORMAL	ON

(*) Key Click Suppression Voltage to base of Q202
 Measured with meter: 0.25V instantaneous when switch is closed.
 0.35 instantaneous when switch is opened.
 Measured with scope: Approximately 0.8V when switch is opened or closed.

K401
T/L RELAY
Normal Position



IM-406 SYSTEM INTERCOM



SWITCHING & CONTROL

FIGURE 16

INTERCOM OPERATION

Use IM-406 SYSTEM INTERCOM SWITCHING & CONTROL diagram; Figure 16 as reference for the following discussion.

(1) BOTH I/P SPEAKERS IN RADIO/INTERCOM MODE.

(1.1) Set S501 and S502 in position 2.

(1.2) The entertainment program will be fed from the amplifier output through J/P2-9 (high-side) and J/P2-10 (output ground); J/P3-9 and J/P3-10; through S501 and S502 to the RED and RED/W terminals and then individually to each I/P Speaker.

(1.3) Each I/P Speaker's volume may be individually controlled by its own 200 ohm potentiometer R1.

(2) BOTH SPEAKERS IN RADIO/INTERCOM. I/P SPKR. NO. 1 ORIGINATES CALL TO DOOR SPKR.

(2.1) Activate DOOR TALK SWITCH S2A/S2B.

(2.2) Door Speaker(s) will be connected through the BLK lead; S1-2 to S1-1; S2A-2 to S2A-3 and then through the RED/W terminal to output ground. The other side of the Door Speaker(s) will be connected through the BLK/W lead, S1-5 to S1-4; S2B-2 to S2B-3 and then through the RED terminal to high-side of the audio output.

(2.3) The I/P Spkr. No. 1 will be connected through S2A-5 to S2A-6 and then through the ORN lead to one side of T201. The other side of the speaker will be connected through R1; S2B-5 to S2B-6 and the ORN/W lead to other side of T201.

(2.4) The Control Line will be connected through R502 and the RED/W lead to ground.

(2.5) The voltage at point "x" will go to 0.25Vdc and the control transistor Q401 will be turned ON, and MUTING and KEY CLICK SUPPRESSION will be activated as shown in CONTROL MODULE, pages 14 and 15. Q403 and STBY RELAY K402 will also be turned ON.

(2.6) Talk into I/P Speaker No. 1, and the signal will be heard at the door speaker(s) and at I/P Spkr. No. 2 (and at the Master Unit Speaker and at all other I/P Speakers that are in RADIO/INTERCOM or INTERCOM ONLY mode). I/P Speakers in OFF or LISTEN IN will not receive the signal.

(3) Activate the DOOR LISTEN SWITCH S1.

(3.1) One side of the door speaker(s) will be connected through the BLK lead; S1-2 to S1-3 and then through the ORN lead to one side of T201. The other side of the door speaker(s) will be connected through BLK/W lead; S1-5 to S5-6 and then through ORN/W lead to other side of T201.

(3.2) At the same time the Control Line will be connected through R501/R502 and center tap of T201 to ground.

(3.3) Q401 will be turned ON and MUTING and KEY CLICK will be in operation.

(3.4) Speak into any door speaker and the signal will be heard at I/P Speakers No. 1 and 2; at the Master Unit Speaker and at all other I/P speakers that are in RADIO/INTERCOM or INTERCOM ONLY mode.

(3.5) The door's answer will not be heard at I/P Speakers that are in OFF or LISTEN IN.

(4) I/P SPKR. NO. 1 ORIGINATES I/P INTERCOM CALL.

(4.1) Press I/P TALK SWITCH S4A/S4B.

(4.2) One side of the speaker will be connected through S2A-5 to S2A-4; S3A-2 to S3A-1; S4A-5 to S4A-6 and then through the ORN lead to one side of T201. The other side of the speaker will be connected through S2B-5 to S2B-4; S3B-5 to S3B-4; S4B-2 to S4B-3 and then through the ORN/W lead to the other side of T201.

(4.3) The Control Line will be connected through R502; the BLK lead; S4B-5 to S4B-6 and then through the RED/W lead to ground, activating Q401, MUTING and KEY CLICK suppression.

(4.4) Speak into I/P Speaker No. 1 and it will be heard at all I/P speakers in RADIO INTERCOM OR INTERCOM only and, at the Master Unit Speaker. The signals will not be heard at I/P Speakers in OFF or LISTEN IN.

(5) Press I/P LISTEN SWITCH S3A/S3B.

(5.1) Speaker at I/P station No. 1 will have one side connected through S2A-5 to S2A-4; S3A-2 to S3A-3 and then through the ORN lead to one side of T201.

(5.2) The other side of the speaker will be connected through R1; S2B-5 to S2B-4; S3B-5 to S3B-6 and then through the ORN/W lead to other side of T201.

(5.3) The Control Line point "X" will be connected through R502 and the BLK lead to S4B-4 and then, through 10K ohm resistor R2 and S3A-5-S3A-6 to the ORN lead and through one side of T201 to center tap ground.

(5.4) When point "X" is connected to ground through R2, the voltage at point "Y" goes to approximately 12.5 volts. This voltage is connected to the base of Q403 (reduced through R404 and R405), turning it ON, and thus energizing the TALK/LISTEN Relay K401.

(5.5) With K401 energized, the ORN and ORN/W leads from the I/P and Master Unit speakers will be connected through P/J2-5 and P/J2-6 and the Talk/Listen Relay will switch these leads to P/J2-10 and P/J2-9, i.e. output ground and high-side of audio amplifier output.

(5.6) At the same time, the RED and RED/W leads from I/P and Master Unit speakers will be connected through P/J2-1 and P/J2-2 and the Talk/Listen Relay will switch these leads to P/J2-7 and P/J2-8 and then all speakers connected to the RED and RED/W leads will be across the Input Transformer T201.

(5.7) I/P Spkr. No. 1 will hear any message transmitted by Master Unit Speaker or by any I/P speaker that is in the RADIO/INTERCOM or INTERCOM ONLY mode.

(5.8) After the Talk/Listen Relay is energized, the Control Line will be connected through R2 in I/P Spkr. No. 1 through the ORN lead to the output ground.

(5.9) Q401, Q403, MUTING and KEY CLICK suppression will be operated normally.

(6) **I/P SPKR. NO. 1 IN INTERCOM ONLY MODE.**

(6.1) Switch S501 to position 4.

(6.2) I/P Spkr. No. 1 will not hear the entertainment program nor receive signals from electronic chime/alarm.

(6.3) When any speaker in RADIO/INTERCOM or INTERCOM ONLY mode activates a talk or listen switch, the Control Line is connected to ground (through 10K R1 during I/P LISTEN) and Q403/K402 will be turned ON. When K402 is energized the ST'BY RELAY contacts will close, connecting the ST'BY LINE to the normal RED/W contacts in the Talk/Listen relay and then to output ground.

(6.4) When S501 is in position 4, the normal RED/W lead path is open and the RED/W wire is connected to the ST'BY LINE.

(6.5) When the ST'BY LINE is connected as in (6.3) above, I/P Spkr. No. 1 (or any other I/P Spkr. in INTERCOM ONLY mode) will have full intercom capability.

(7) **I/P SPKR. NO. 1 IN LISTEN IN.**

(7.1) Throw S501 to position 1.

(7.2) The speaker will be connected through the RED and RED/W leads; S501's position 1 contacts; P/J3-9 and P/J3-10 and then direct across T201.

(7.3) Speakers in this mode will not receive the entertainment program; signals from a chime or alarm, cannot talk nor listen to the door speaker(s), and they cannot hear intercom signals from the Master Unit nor signals from other I/P Speakers.

(7.4) Any sound in the vicinity of I/P Spkr. No. 1 will be transmitted through the Intercom Input Transformer TR201; Intercom Preamp Q201 and amplified through the audio amplifier and fed to the Master Unit Speaker and to all I/P Speakers that are in RADIO/INTERCOM mode. THERE WILL BE NO MUTING.

(7.5) If necessary, to insure "Intercom Override" of the entertainment program, I/P Speaker No. 1's Volume Control R1 can be set to maximum (full clockwise).

(7.6) If further override is necessary, decrease the setting of LEVEL SET CONTROL R237. This will decrease the amplitude of the entertainment program that is fed to the audio amplifier and thus, increase the intercom signal to entertainment program ratio. The level of both signals may be readjusted with the ALL SPEAKER VOLUME CONTROL R103.

(7.7) Activating I/P Spkr. No. 1's door listen or talk switches will mute the entertainment program in the system, but no intercom communications between Spkr. No. 1 and the door speaker(s) is possible.

(7.8) Full I/P talk and listen functions are possible with the Master Unit and all I/P Speakers that are in RADIO/INTERCOM or INTERCOM ONLY mode.

(8) **I/P SPKR. NO. 1 IN OFF.**

(8.1) Throw S501 to position 3.

(8.2) The speaker will be open at both the RED and RED/W terminals.

(8.3) The I/P Speaker in this mode will not receive the entertainment program nor signals from the Chime/Alarm. It cannot talk or listen to the door speaker; and it cannot receive nor answer calls initiated by the Master Unit or by other I/P Speakers

(8.4) By activating its I/P TALK SWITCH, I/P Speakers in OFF can talk to the Master Unit and to other I/P Speakers that are in RADIO/INTERCOM or INTERCOM ONLY mode. Talk signal must override the entertainment program as there will be no muting.

(8.5) By activating its I/P LISTEN SWITCH, I/P Speakers in OFF can hear "Hands Free" answer from the Master Unit and other I/P Speakers that are in RADIO/INTERCOM or INTERCOM ONLY mode. There will be muting.

SERVICING THE IM-406 SYSTEM GENERAL

(1) The modular construction employed in the IM-406 Master Unit encourages servicing of the system at its location.

(2) The Control Module; Terminal Board; and Tuner Module may be replaced without soldering of wires and connections.

(2.1) The replacement Tuner Module supplied by NuTone will be pre-aligned.

(3) Remove the Locking Pin holding the Master Unit in place.

(3.1) Tip the complete chassis down and hold in a horizontal position with the support strap.

(4) The plugs/jacks connecting the various assemblies will be exposed for easy access.

(5) Many of the operating voltages referred to in this manual can be measured at these points with a standard 20K ohm/volt multi-meter.

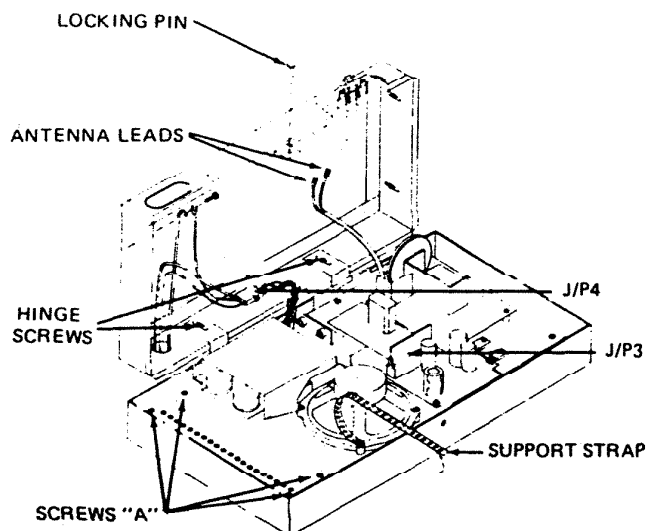


FIGURE 17: IM-406 MASTER IN IR-10 ROUGH-IN

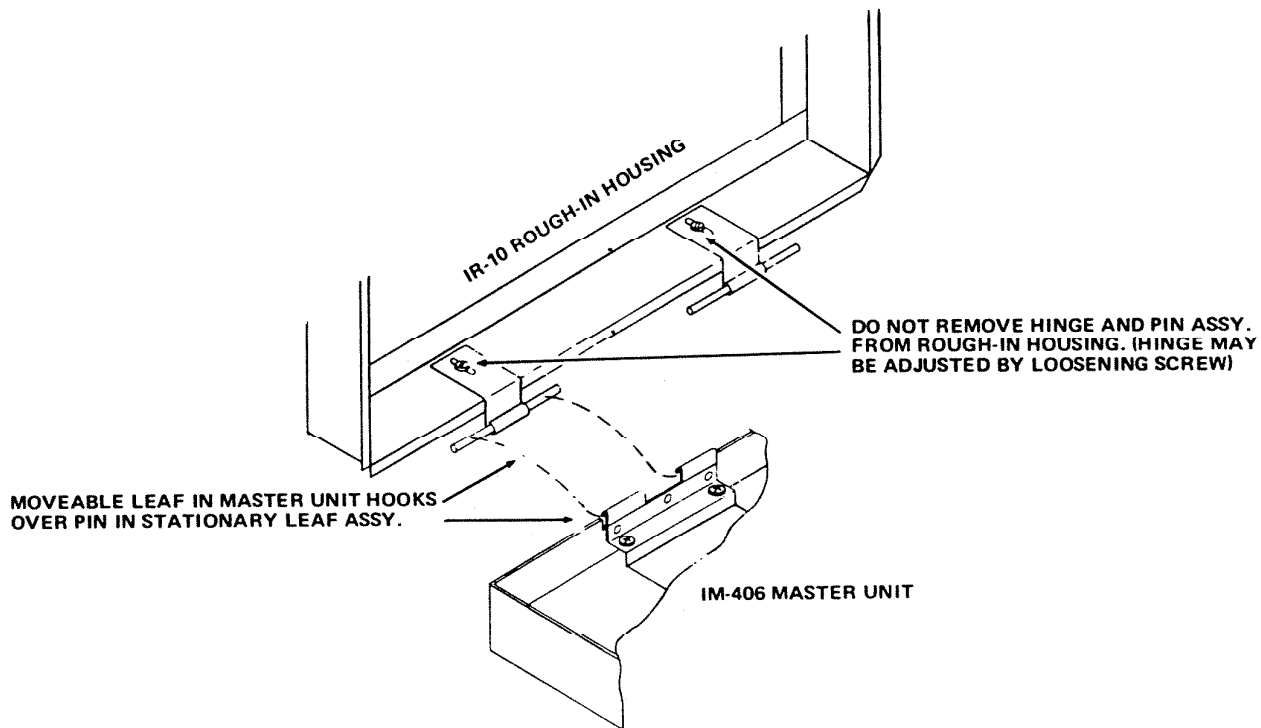


FIGURE 18: LATER PRODUCTION IM-406/IR-10 HINGE DETAIL

DISASSEMBLY

REMOVING MASTER UNIT FROM ROUGH-IN HOUSING (Figure 17 & 18)

- (1) Disconnect: Power plug P4 from J4; and tuner's coax antenna lead from the antenna terminal strip.
- (2) If the following optional equipment is included in system:
 - (2.1) Phonograph and/or Tape Player: Disconnect their shielded audio leads from J104 and/or J105.
 - (2.2) IS-47 Speaker/Clock Timer: Disconnect the Protection Circuit J31 from P31.
 - (2.3) Background Music Amplifier: Disconnect the Blue and Black "Low Level Output" wires from the audio line (twisted-pair or shielded cable) that is feeding the background music amplifier.
- (3) Disconnect the Terminal Board from Amplifier/Power Supply Module, i.e. P3 from J3.
- (4) REMOVING MASTER UNIT WITHOUT DISCONNECTING THE INTERCONNECTING WIRES AT THE TERMINAL BOARD. (Omit step (5) below)
 - (4.1) Remove the four Terminal Board Phillips head mounting screws ("A" Figure 14) and lift complete assembly with the wires and cables intact. Carefully stow the Terminal Board and attached wires in the rough-in housing.
- (5) REMOVING THE MASTER UNIT COMPLETE WITH THE TERMINAL BOARD. (Omit step (4) above)
 - (5.1) Remove the I/P Speaker Controls' three-twisted-pair cable from their respective terminals. The RED and RED/W wires of each cable should be labelled so that they can be reconnected to their respective terminals. (Figure 9)
 - (5.2) Remove the Door Speaker wiring and the Chime/Alarm wiring from their respective terminals. Label these wires so that they can be reconnected to their respective terminals.
- (6) Remove Master Unit from rough-in housing:
 - (6.1) Original Production Units, Figure 17 (omit step (6.2) below): Remove screws holding the fixed leaf of each hinge in the rough in housing; unhook the support strap and remove unit.
 - (6.2) Later Production Units, Figure 18 (Omit step (6.1) above): Unhook support strap from rough-in housing and lift unit and moveable leaf up and away from the fixed leaf of each hinge fastened to the rough-in housing.
- (7) The Master Unit, less the Terminal Board (step (4) above) must be removed when replacing pilot lights or when repairing or replacing the Amplifier/Power Supply Module.

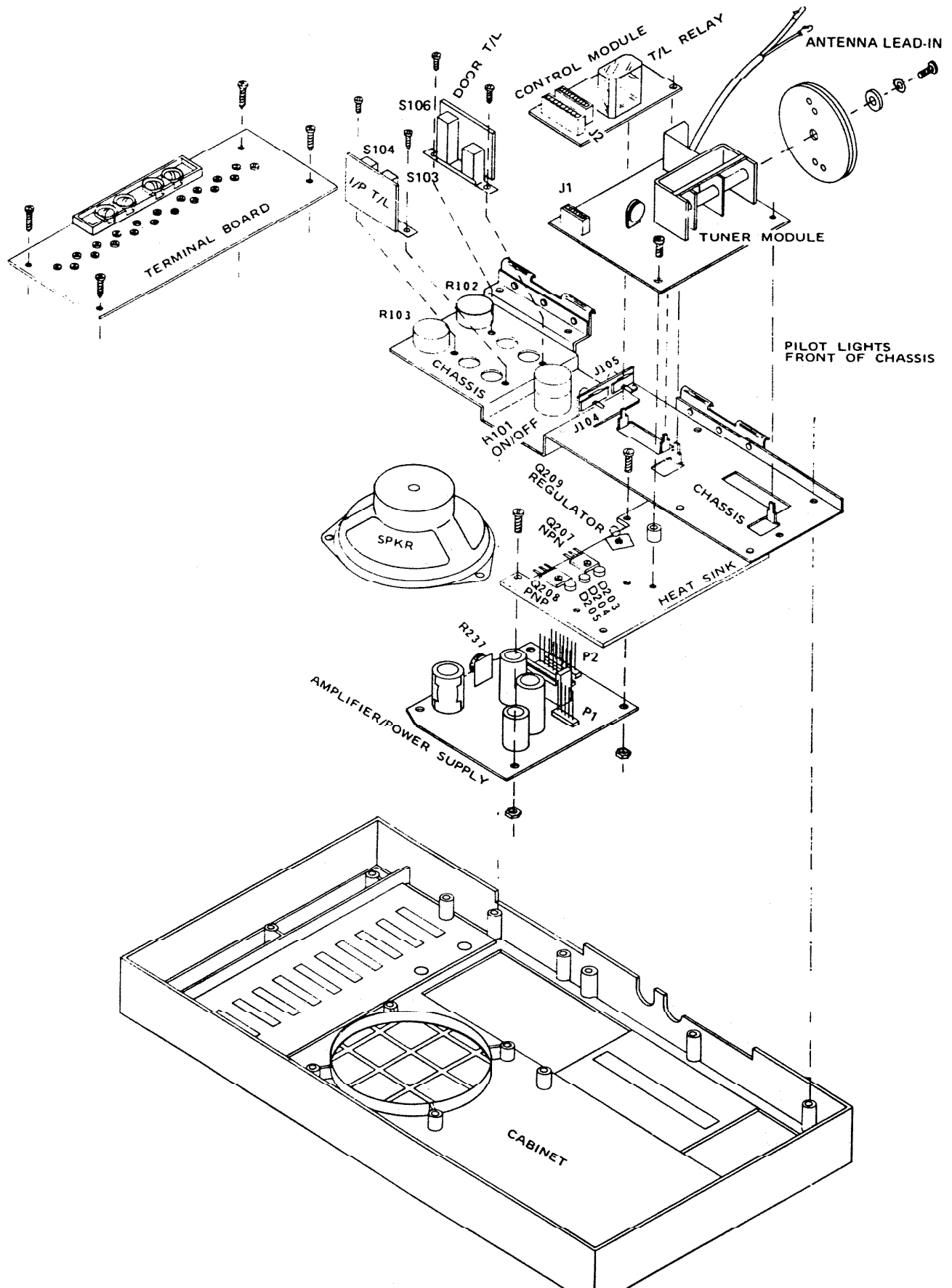


FIGURE 19: EXPLODED VIEW IM-406 MASTER UNIT

IN THE FIELD REPLACEMENT OF CONTROL MODULE (Figure 11 & 19)

- (1) The Control Module may be replaced with the Master Unit supported in-place – in a horizontal position – with the support strap or when the Unit is completely removed from the rough-in housing.
- (2) Grasp Control Module gently but firmly and lift straight up, disconnecting J2 from P2.
- (3) Insert new module by fitting J2 to P2, and the front mounting holes on the chassis standoffs and press module gently but firmly in place. Do not press module

down until touches the chassis, but just far enough to rest on the standoffs' shoulders and to make good contact between J2 and P2.

- (4) When the Control Module is removed from the set, all speakers will be silent. The amplifier audio output can be fed to the Master Unit Speaker and to the I/P speakers that are in Rdo/Int mode by shorting P2-9 to P2-1; and P2-10 to P2-2, but none of the intercom functions of the Control Module-muting, etc. – are possible.

IN THE FIELD REPLACEMENT OF TUNER MODULE (Figure 7 & 19)

- (1) The Tuner Module may be replaced with the Master Unit supported in-place – in a horizontal position – with the support strap, or when the Unit is completely removed from the rough-in housing.
- (2) Tune radio dial to lowest frequency – completely closing tuning capacitor C303.
- (3) To eliminate the necessity of restringing the dial cord when new Tuner Module is installed (which can only be performed when chassis assembly is out of cabinet): Using masking tape, secure the dial cord in-place around the pulley and secure the dial spring and connecting points on front of pulley.
- (4) Remove the Phillips head machine screw: the retaining cap; and lock washer securing the pulley and then gently slide the pulley off the tuning capacitor shaft. Tape the pulley, with dial cord in-place, to the chassis.
- (5) Remove the screw holding the tuner grounding strap at the front left corner of the module.
- (6) Remove the retaining screw and standoff at the right rear of the module.

- (7) Gently but firmly lift the Tuner Module straight up, disconnecting J1 from P1.

- (8) Insert the new module by fitting J1 to P1 and the front mounting holes on the chassis standoffs and press gently but firmly in place. Do not press module down so that it touches the Amplifier/Power Supply or the chassis.

- (9) Insert plastic standoff between right rear corner of module and chassis, and secure in place with screw that was removed in step (6) above.

- (10) Secure the module grounding strap with the screw that was removed in step (5) above.

- (11) Make certain that the ganged tuning capacitor C303 is completely closed and gently install pulley (with dial cord intact). Secure the pulley in place with cap; lockwasher; and screw that were removed in step (4) above.

- (12) Remove masking tape from pulley and check tuning dial pointer tracking by rotating tuning knob.

- (13) The Tuner Module must be removed when replacing the Amplifier/Power Supply Module or when repairing or replacing board and/or components that are under the left rear end of the Tuner Module.

IN THE FIELD REPLACEMENT OF TERMINAL BOARD (Figure 9, 17 & 19)

- (1) Remove the I/P Speaker Controls' three-twisted-pair cable from their respective terminals. The Red and Red/W wires of each cable should be labelled so that they can be reconnected to their respective terminals.
- (2) Remove the Door Speaker wiring and the Chime/Alarm wiring from their respective terminals. Label these wires so that they can be reconnected to their respective terminals.
- (3) The Terminal Board may be replaced with the Master Unit supported in-place, in a horizontal position – with the support strap or when the Unit is completely removed from the rough-in housing.
- (4) Disconnect the Terminal Board from Amplifier/Power Supply Module, i.e. P3 from J3.

- (5) Remove the Terminal Board's four Phillips head mounting screws ("A" Figure 17) and lift Terminal Board out of cabinet.

- (6) Install new Terminal Board, make certain that black guards are over switches and that the switches move freely. Secure in place the four screws removed in step (5) above.

- (7) Connect wiring assembly, P3 to J3.

- (8) Connect the door speaker wiring; alarm/chime wiring; and I/P Speaker Control cables. Follow original hook up. See labelling used in steps (1) and (2) above.

- (8) When the terminal board is removed from the rough-in housing, the Station Selector Switches; resistors; and P3/wiring assembly may be serviced and repaired or replaced as required.

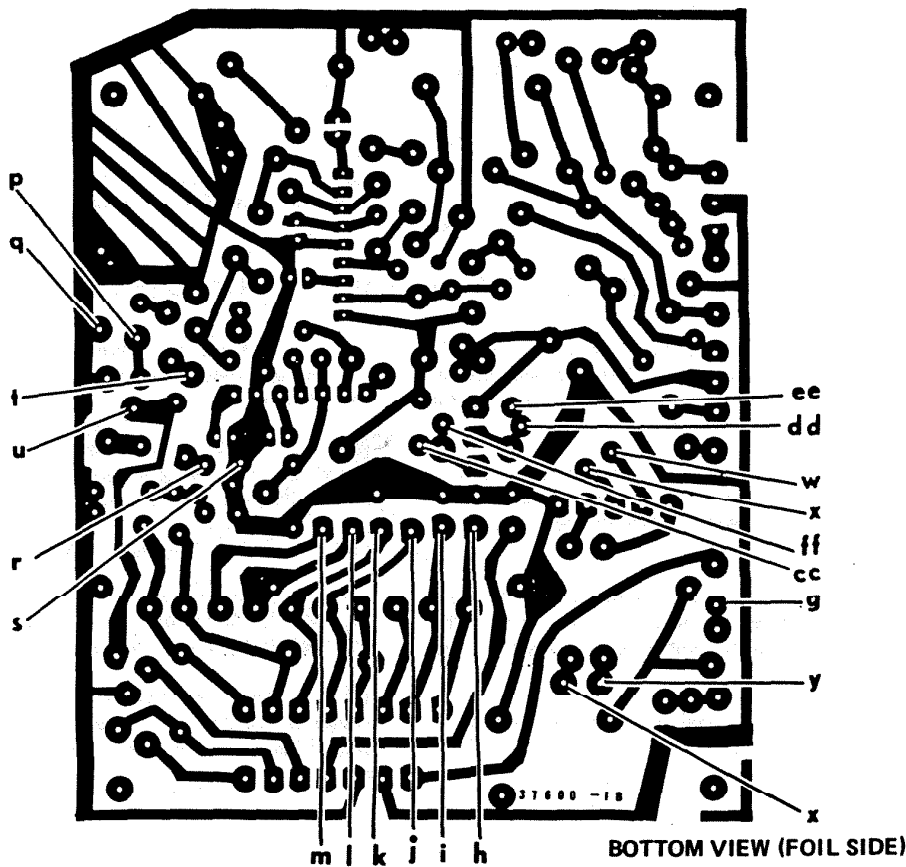
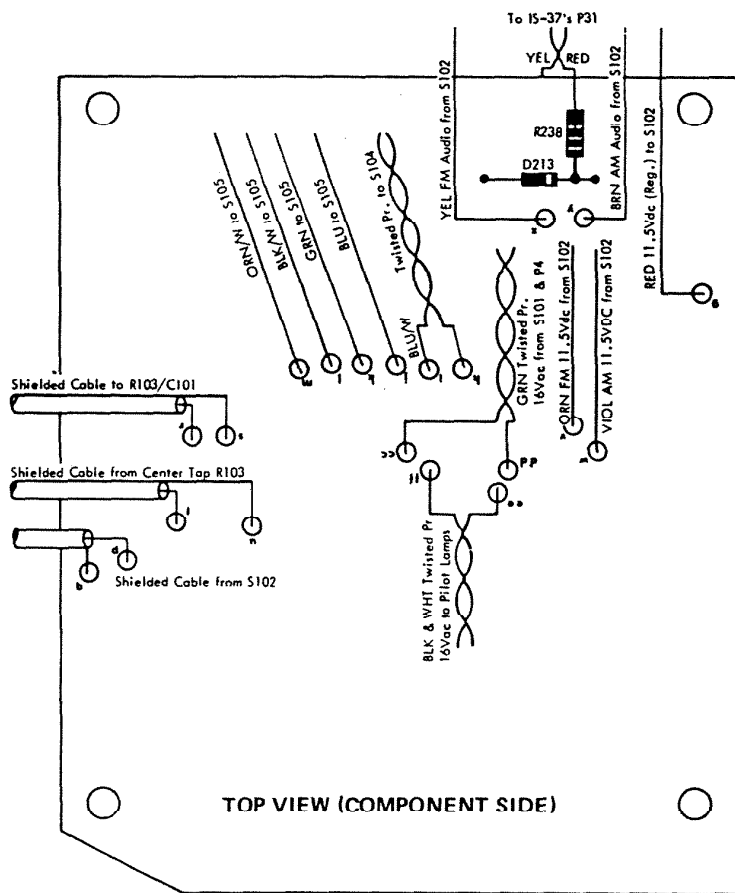


FIGURE 20: AMPLIFIER/POWER SUPPLY MODULE INTERCONNECTING WIRES

BENCH SERVICING THE COMPLETE CHASSIS ASSEMBLY

(1) IT SHOULD BE DETERMINED WHETHER IT IS BETTER TO REPLACE THE DEFECTIVE PRINTED CIRCUIT MODULE(S) OR TO REPLACE (OR REPAIR) THE DEFECTIVE COMPONENT(S).

(1.1) THE TUNER MODULE, CONTROL MODULE & TERMINAL BOARD CAN BE EASILY REPLACED — IN THE FIELD.

(1.2) THE AMPLIFIER/POWER SUPPLY MODULE WILL REQUIRE BENCH SERVICING, AND IT WILL GENERALLY BE EASIER AND QUICKER TO REPLACE (OR REPAIR) THE DEFECTIVE COMPONENT(S) ON THIS BOARD.

(2) Remove the Master Unit from the rough-in housing. (See REMOVING MASTER UNIT FROM ROUGH-IN HOUSING, page 25.)

(2.1) If a replacement Terminal Board is available for bench checking, remove the Master Unit without disconnecting the Terminal Board wiring. [See step (4) and (4.1), page 25.]

(2.2) If no spare Terminal Board is available, remove the Master complete with the Terminal Board. [See steps (5) through (5.2), page 25.]

(3) Remove the Master Unit's Speaker Volume Control and Tuning knobs.

(4) When working on the Master Unit on a work bench, etc., protect the front panel.

(5) Disconnect the Orange and Black speaker wires.

(6) Remove the screw and cable clamp that secures the power plug P4's wiring assembly (16 Vac and ground).

(7) Remove the seven No. 8 Truss-Phillips-head machine screws that hold the chassis assembly in cabinet.

(7.1) If system includes an IS-47 Speaker/Clock Timer, the protection circuit connector P31 will be freed when the mounting screws are removed. At this time, the Red and Yellow wires from the PC board may be left connected to the P31 assembly.

(8) Lift the complete Chassis Assembly out of cabinet.

(9) With the Chassis Assembly removed, the Control and Tuner Modules; and the Terminal Board may be replaced (see page 27) or repaired as desired.

(10) AMPLIFIER/POWER SUPPLY

(10.1) Complete steps (1) through (8) above.

(10.2) REPLACEMENT ON COMPLETE PC BOARD

(10.2.1) If Terminal Board was removed with Master Unit, disconnect from Amplifier/Power Supply Board, P3 from J3.

(10.2.2) Remove the Control Module. [See REPLACING CONTROL MODULE, steps (1) and (2), page 27.]

(10.2.3) Remove the Tuner Module. [See REPLACING TUNER MODULE, steps (1) through (7), page 27.]

(10.2.4) Following directions in figure 20 unsolder the interconnecting wires on the PC Board as follows:

The nine single wires at solder points: g; j; k; l; m; v; w; x; and y.

The three twisted-pairs at solder points: h/i; cc/dd; and ee/ff.

The three shielded cables at solder points: s (ground)/r; t/u(ground); and p/q(ground).

(10.2.5) Disconnect the Red and Yellow 12Vdc muting wires from the IS-47 protection circuit P31 assembly.

(10.2.6) USE GREAT CARE WHEN MAKING OR BREAKING SOLDER CONNECTIONS ON THE PC BOARD. SUGGEST THAT A SOLDER-SUCKER TYPE IRON BE USED WHEN UNSOLDERING COMPONENT LEADS OR WIRES FROM THE PC BOARD. PROTECT FOIL PATHS. DO NOT OVERHEAT THE BOARD NOR COMPONENTS, ESPECIALLY SOLID STATE DEVICES.

(10.2.7) Remove Q207; Q208; and Q209 mounting screws. Save the screws, centering washers, nuts and mica insulating washers.

(10.2.8) Extract the two mounting screws and remove PC Board from the heat sink and chassis assembly.

(10.2.9) Install new PC Board; secure in place with screws that were removed in step (10.2.7) above. Make certain that Q207; Q208; Q209; D203; D204; and D205 are aligned with their respective mounting holes.

(10.2.10) Fasten Q207; Q208; and Q209 in place. Use screws, centering washers, nuts and mica insulating washers that were removed in (10.2.6) above. All components including the heat sink must be clean. Use new heat transfer lubricant.

(10.2.11) Use new heat transfer lubricant around D203; D204; and D205 and insert them in heat sink.

(10.2.12) Reconnect the nine single wires; three twisted-pairs; and three shielded cables that were removed in step (10.2.4) above. (Figure 20)

(10.2.13) If required, connect the RED and YELLOW 12Vdc muting wires to IS-47's P31 assembly.

(10.3) REPLACEMENT OF DEFECTIVE COMPONENT(S) ON AMPLIFIER/POWER SUPPLY MODULE.

(10.3.1) If the defective component(s) are located under the Tuner or Control Modules, these Modules must be removed while repairing or replacing the defective component(s). (See page 25)

(10.3.2) Location of the various components will be expedited by referring to figure 8, page 10.

(11) REPLACEMENT OF PILOT LIGHTS

(11.1) Complete steps (1) through (8) above.

(11.2) Make certain that radio dial pointer is at low end of dial, i.e. tuning capacitor C303 should be completely closed.

(11.3) With chassis resting on work bench, remove the two No. 6 hex-head screws that hold the rear lens assembly in place.

(11.4) Carefully work the lens assembly from behind the dial pointer and remove. DO NOT BEND NOR OTHERWISE DAMAGE THE POINTER. Save the black guard on SELECTOR SWITCH S102.

(11.5) The pilot lamps are connected in series. If one lamp is burnt out, all lamps will be OFF.

(11.6) Because of the time and labor involved, it may be desirable to replace all three lamps when the unit is disassembled for pilot lamp replacement. Use G.E. No. 259 or equivalent lamp (NuTone Part No. 39330-000).

(11.7) Good lamps will measure approximately 20 ohms and burnt out lamps will measure "Open."

(11.8) Slide lamps into wedge bases, making certain that wire contact on each side of bulb engages its base contact.

(11.9) Before reassembly, connect 16Vac (secondary of NuTone 105-N transformer) to P4; turn set ON with S101 and check that lamps are ON.

(11.10) Install rear lens assembly: Make certain that black guard is on SELECTOR SWITCH S102 and that dial pointer is in place in front of lens. Secure in place with the two No. 6 hex-head screws that were removed in step (11.3) above.

(12) REPLACEMENT OF I/P AND DOOR TALK/LISTEN SWITCHES

(12.1) Remove the four rectangular switch knobs. Pull straight forward.

(12.2) Using solder-sucker irons, unsolder contacts of defective switch on its PC Board.

(12.3) Remove the four screws holding the two T/L switch PC boards to chassis and lift both boards away from chassis.

(12.4) Remove the defective switch.

(12.5) Reassemble the new switch and solder in place on its PC board. Replace PC Boards in chassis and install knobs.

(13) Install the Control and Tuner Modules if they were removed for servicing. (See page 27).

(14) BENCH CHECKING THE CHASSIS ASSEMBLY

(14.1) Connect power plug P4 to 16Vac (NuTone 105-N transformer).

(14.2) Connect Antenna lead-in to test antenna.

(14.3) Connect Terminal Board (spare or one supplied with Master Unit) to Amplifier/Power Supply PC Board, P3 to J3.

(14.4) Connect Orange and Black speaker leads from R101 to a 25 ohm speaker. (Use speaker in Master Unit Cabinet or spare, and splice in extra wire as needed.)

(14.5) If available, connect an IS-45 or IS-48 Inside/Patio Speaker to the Terminal Board. Use 3-twisted-pair cable (NuTone IW-6) according to figure 9, page 12.

(14.6) Connect a 25 ohm speaker to the Door Terminal on the Terminal Board. (Figure 9, page 12)

(14.7) Turn the Master Unit ON and follow the OPERATIONAL CHECKOUT procedure, pages 2-4.

(14.8) If Chassis Assembly is operating properly, disconnect the 16Vac; Antenna lead-in; speakers; Terminal Board from Amplifier/Power Supply PC Board, P3 from J3.

(15) REASSEMBLE MASTER UNIT

(15.1) Install chassis assembly in cabinet and fasten in place with the seven truss head screws. If IS-47 Speaker/Clock Timer is included, make certain that protection circuit connector P31 is fastened in place.

(15.2) If support strap was secured with one of the truss head screws, make certain that it is fastened at screw holding rear left corner of Amplifier/Power Supply Module. This strap may be secured under one of the speaker mounting screws.

(15.3) Using the screw and cable clamp that were removed in step (6) above, secure the power plug P4 and wire assembly to chassis.

(15.4) Connect the Orange and Black wires from R101 to the speaker.

(15.5) Install Master Unit's Speaker Volume Control and Tuning knobs.

(16) At installation: Install IM-406 in IR-10: Early production units, screw fixed leaf of each hinge to rough-in housing as shown in figure 17.

(16.1) Later production units, install IM-406 with moveable leaf of each hinge connected to its fixed leaf as shown in figure 18.

(17) Fasten support strap to top of rough-in housing and support Master Unit in a horizontal position during hook-up. (Figure 17)

(18) If Terminal Board was removed with Master Unit, connect P3 to J3.

(18.1) If Terminal Board was left in rough-in housing, install the Board and fasten in place with four phillips head mounting screws that were removed in step (2.1) above.

(19) Connect the 16Vac power plug P4 into J4 and the tuner antenna leads to the antenna terminal strip. (Figure 17)

(20) If applicable: Insert Phono and/or Tape Player shielded audio cables in J104 and/or J105; reconnect "Background Music" leads; and IS-47's protection circuit J31 to P31.

(21) Close unit and hold in place with locking pin.

(21.1) If unit does not fit flush against the wall, the stationery leaf of the hinges may be loosened in the rough-in housing and unit adjusted accordingly. When best adjustment is reached, tighten screws.

TROUBLESHOOTING

(1) SYSTEM DEAD — NO PILOT LIGHTS

CHECK: ON/OFF Switch S101
Connections at P4/J4
16Vac secondary from 105-N Transformer
120Vac supply to 105-N

(2) SYSTEM ON — NO PILOT LIGHTS

CHECK: Connections between terminals ee and ff on Amplifier/
Power Supply Module and lamp sockets J103 and J101.
Lamps making contact in sockets.
Individual lamps

(3) NO FM — INTERCOM, AM AND AUXILIARY NORMAL

CHECK: FM antennae must be installed and connected to tuner
module. Should not be shorted on PC board.
Program Selector Switch S102. FM connections between
switch and Amplifier/Power Supply Module.
Regulated DC voltage (11.5) on P1-3, and at S102.
J1 to P1 Connections
Voltages on Z301, Q301, and Q302. (See Schematic
Diagram, and Voltage Chart, page 18)
Alignment of FM Section. (Pages 8 & 9)

(4) NO AM — INTERCOM, FM AND AUXILIARY NORMAL

CHECK: Check Antennae connections: at terminal strip and on
Tuner Module.
Program Selector Switch S102. AM connections between
switch and Amplifier/Power Supply Module.
Regulated 11.5Vdc on P1-2, and at S102.
J1 to P1 Connections
Voltages on Z302; and Q303. (See Schematic Diagram,
page 19/20; and Voltage Chart, page 18)
Alignment of AM Tuner, page 18.

**(5) NO SOUND FROM MASTER UNIT SPEAKER — ALL
REMOTE SPEAKERS OPERATING NORMALLY**

CHECK: Master Unit speaker and connections.
R101
S103, S104 and S106

**(6) NO SOUND FROM I/P SPEAKER(S) — MASTER UNIT
SPEAKER OPERATING NORMAL**

CHECK: Station Selector Switches, S501 — S510.
I/P Speaker(s) cable connections at Master Unit's Terminal
Board.
Controls and connections at individual I/P Speakers.
Cable between I/P Speaker(s) and Terminal Board.
Connections at terminals 1 and 2 at J3/P3.
Wiring between P3 and Terminal Board.

(7) DISTORTION AT ALL SPEAKERS

CHECK: Setting of Master Unit Speaker Volume Control and
Volume Control at all I/P Speakers. (See Paragraph (7.2),
page 2)

**(8) RECORD PLAYER AND/OR TAPE PLAYER SILENT —
AM, FM AND INTERCOM NORMAL**

CHECK: Program Selector Switch S102.
Record Player and/or Tape Player
Shielded audio leads between record and/or tape player
and Master Unit's auxiliary input jacks J104 and J105.

**(9) MASTER UNIT ON — NO SOUND FROM ANY SPEA-
KER**

CHECK: Make certain that Control Module is firmly connected to
Amplifier Module, i.e. J2 to P2.
22.5Vdc at J2/P2 terminal 14
11.5Vdc at J1/P1 terminals 2 and 3.
Operating voltages on transistors in Amplifier/Power Sup-
ply Module.
Individual level set controls at Master Unit Speaker and
at I/P Speakers.
System Volume Control R103.

**(10) AM AND FM OK — NO MUTING DURING INTERCOM
OPERATION AT MASTER UNIT OR ANY I/P SPEAKER**

CHECK: DC voltage at terminals 14 and 15 of J2/P2.

Change in voltage at point "x" on Control Module when
talk or listen switch is activated (see Control Module
Operating Voltage Chart, page 18)
"401, D407, D401 (D408 and D214 — see Addendum,
pages 32-34).
Muting transistor Q203
Muting voltage at terminal 13 of J2/P2

**(11) MUTING ON — WHEN NO TALK OR LISTEN SWITCH
IS BEING ACTIVATED**

CHECK: Leakage voltage between terminal 13 and 14 of J2/P2
(See Addendum, pages 32-34)
Control Module point "x" impedance to ground should be
very high, near infinity, when no talk or listen switch is
activated.
If system includes IS-47 Clock Timer, check that Mode
Switch is in ON position, (see page 4) and check Clock
Timer protection circuit PC board and Muting Switch S21
(see diagram page 17)
For emitter/collector short in Q203.
Talk or listen switch shorted in Master Unit or in one of
the I/P Speakers.
For short on the Black or Black/White control lines.

**(12) SIGNALS FROM CHIME AND/OR ALARM AND FROM
SPEAKERS IN "LISTEN IN" MODE IS TOO LOW.**

CHECK: Setting of Level Set Control R237. Lower volume of
entertainment program, and increase the over-all volume
of the system with System Volume Control R103.

**(13) NO INTERCOM SIGNALS FROM ANY SPEAKER OR
FROM CHIME AND/OR ALARM — ALL OTHER FUNC-
TIONS NORMAL**

CHECK: Intercom Input Transformer T201; D201; D202; Q201
and Q202.
Check for "Key Click Suppression" voltage at terminal 12
of J2/P2 and at base of Q202.
For base/emitter short in Q404.
D405, C403
S501, S510
J2 to P2 and J3 to P3 connections.

**(14) DOOR SPEAKERS CANNOT RECEIVE NOR TRANS-
MIT INTERCOM SIGNALS — ALL OTHER FUNCTIONS
NORMAL**

CHECK: Door Speaker and wiring between door speaker and Black
and Black/White terminals at Master Unit (or at I/P Spea-
ker, if Door Speaker is connected to nearest I/P Speaker)
Door Talk and Listen switches at Master Unit, or if call is
originated at I/P Speaker, at the originating I/P Speaker's
Door Talk and Listen Switches S1 and S2.

**(15) ALL I/P SPEAKERS AND MASTER UNIT CAN TRANS-
MIT INTERCOM CALLS BUT CANNOT RECEIVE
HANDS FREE ANSWER FROM ANY OTHER I/P (OR
MASTER) STATION**

CHECK: TALK/LISTEN RELAY K401
Q402; R406; R405; C401; R404; and D401.
Check Voltage at point "y" — should be approximately
12Vdc when I/P LISTEN switch is activated.

**(16) WHEN I/P SPEAKER IS IN "I'COM ONLY" MODE, IT
CANNOT RECEIVE NOR TRANSMIT INTERCOM SIG-
NALS — OTHER OPERATIONS NORMAL**

CHECK: Station Selector Switch (S501-S510) on Terminal Board.
Terminal 3 at J3/P3 and terminal 3 at J2/P2.
Standby Relay K402
Q403; R408, and R409

(17) HIGH PITCH SQUEAL

CHECK: Shorts between one of the Red wires and one of the
Orange wires. (Input to Output short)

**(18) LOW FREQUENCY FEEDBACK BETWEEN SPEAKERS
DURING INTERCOM OPERATION**

CHECK: Volume setting of the offending speakers.
Speakers must not be installed back to back on a common
wall. Reduce volume of different speakers to determine
acoustic feedback between individual speakers.

ADDENDUM: IM-406 POWER SUPPLY AND MUTING CONTROL CIRCUIT

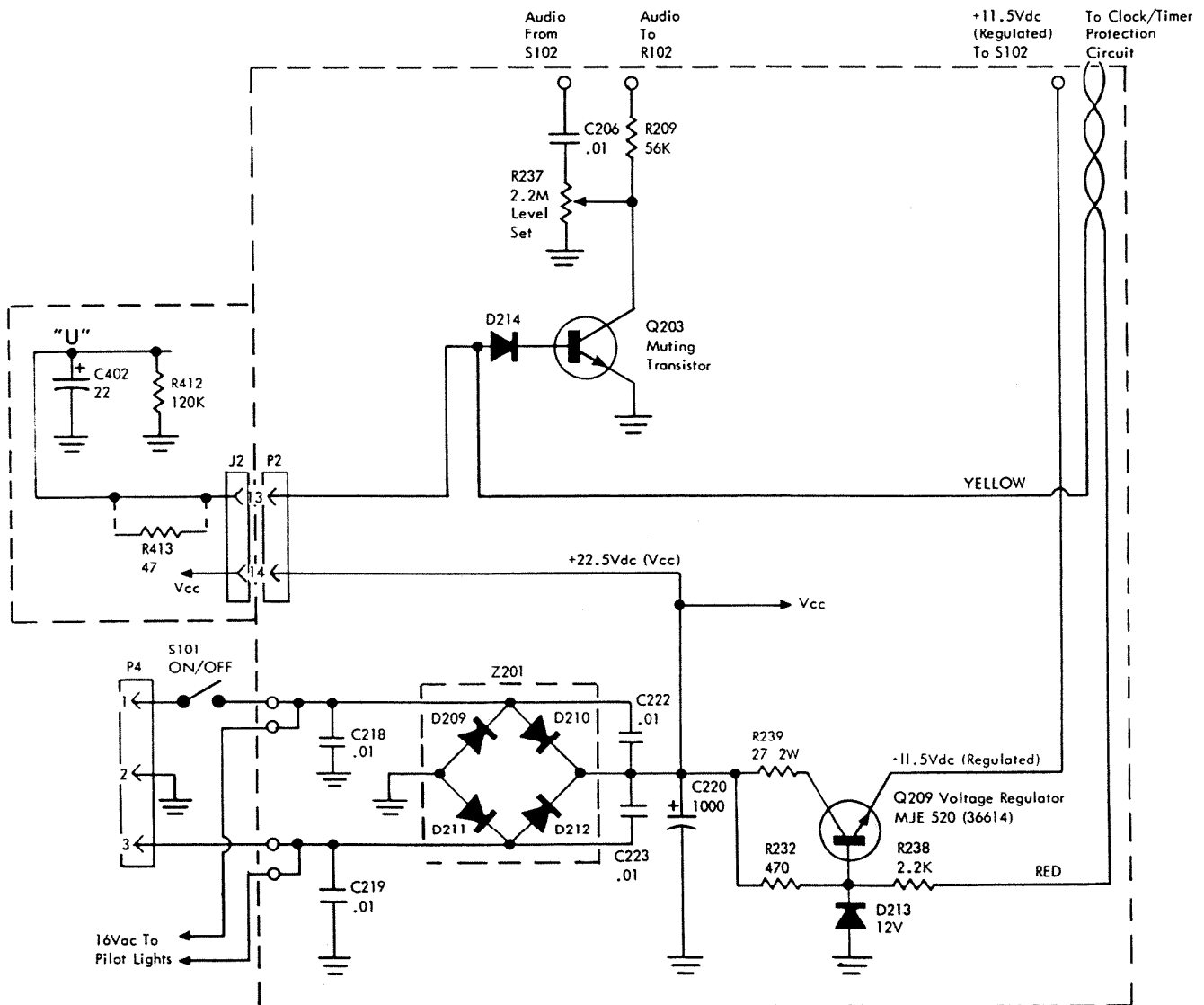


FIGURE A1: MODIFICATIONS TO AMPLIFIER/POWER SUPPLY MODULE

POWER SUPPLY

(1) To aid in reducing diode rectifier switching noise, C218 and C219 – bypassing D209 and D211 respectively – were included in the original production units. Later Production units will include C222 and C223 – bypassing D210 and D212 respectively. (Figure A1)

(2) To prevent instantaneous destruction (open or short) of the voltage regulator Q209, later production units will use a heavier-duty device, i.e. Motorola MJE520 (Nu-Tone Part No. 36614-000)

(3) To further protect against short circuiting, the 27-ohm; 2-watt; wire-wound resistor R239 has been added to limit the short-circuit collector current.

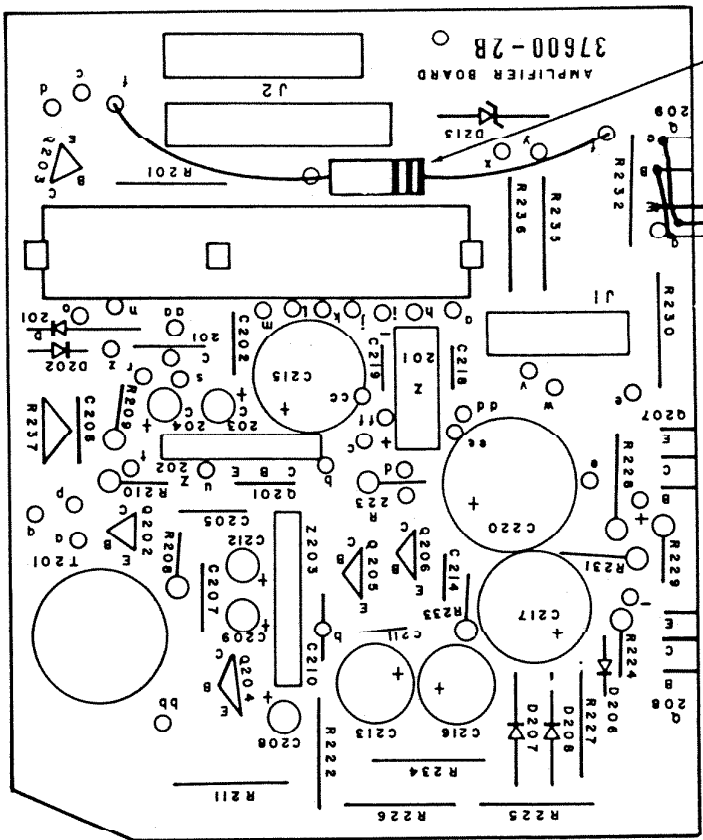
(3.1) R239 (NuTone Part No. 33028-270) IS A 2-WATT RESISTOR. Being wire-wound, its physical size is approximately that of a 1-watt carbon composition resistor.

(4) PROLONGED SHORT CIRCUITING OF THE REGULATED 11.5VDC SUPPLY WILL DESTROY THE VOLTAGE REGULATOR Q209. DO NOT SHORT TO GROUND WHEN MEASURING VOLTAGE OR WHEN ALIGNING THE TUNER.

(5) Original production units may be modified so as to agree with schematic diagram, Figure A1. The Tuner Module must be removed from the unit and the complete chassis removed from the cabinet to gain access to the Amplifier/Power Supply Module. (See page 29)

(6) The new voltage regulating transistor Q209 (MJE520) and R239 can be added by following instructions in Figure A2.

(7) Capacitors C222 and C223 can be added to foil side of PC board by following instructions in Figure A3.



Remove Yellow Wire Between f and f
 Install R239; 27 ohm; 2 watt;
 Wire Wound (33028-270).
 Insulate Resistor Leads

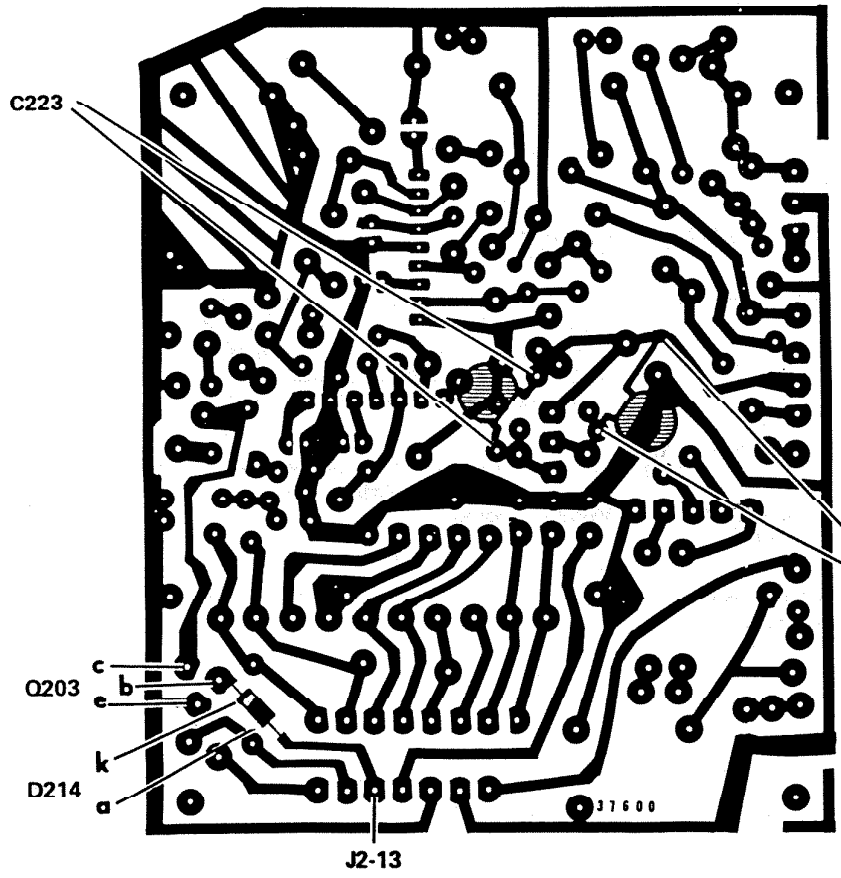
Mica Insulating Washer
 Use Heat Transfer Lubricant

Install on Heat Sink
 Q209 Voltage Regulator
 MJE520

Use Insulated No. 22 Wire Between
 Base and Collector Leads On
 Transister and Base and Collector
 terminals on PC Board

**ORIGINAL PRODUCTION
 AMPLIFIER/POWER SUPPLY
 COMPONENT LAYOUT**

FIGURE A2



Power Supply Modification:
 Add C223 and C222, Solder Leads
 at Points Shown. Insulate Capacitor
 Leads From PC Foil Paths.

Muting Control Modification:
 Break Foil Path Between Q203 Base (b)
 and J2-13. Connect D214 as Shown.
 D214 Cathode End (k) MUST Be Con-
 nected to Q203 Base (b).

C222

**ORIGINAL PRODUCTION
 AMPLIFIER/POWER SUPPLY
 FOIL PATTERN**

FIGURE A3

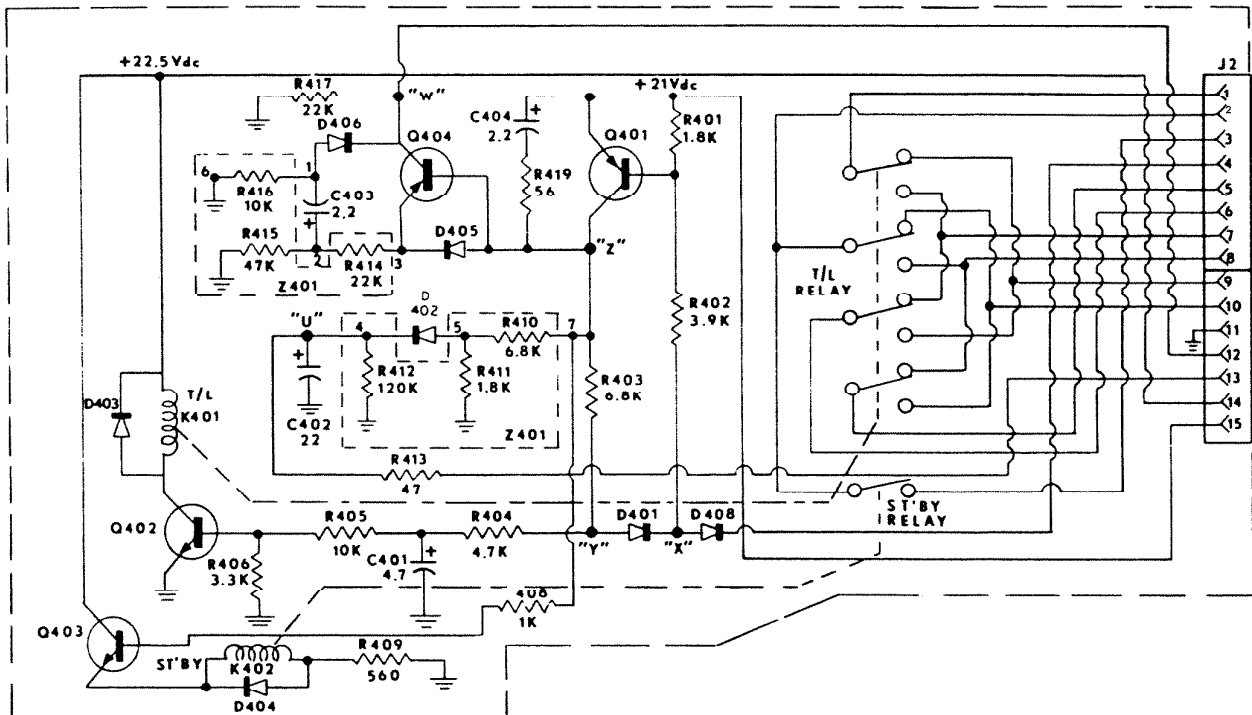


FIGURE A4: LATER PRODUCTION CONTROL MODULE SCHEMATIC

MUTING CIRCUIT

(1) A high resistant short (due to foreign matter such as grease, dirt, etc.) between terminals 13 and 14 of P2/J2 can cause a low positive voltage at terminal 13 and at the base of Q203. This voltage may surpass $V_{eb(sat)}$ of Q203 resulting in its muting of the entertainment program.

(1.1) Insertion of D214 in series with Q203 base will generally limit this voltage to a value below that required for muting. (Figure A1)

(1.2) D214 (1N4002, NuTone Part No. 36549-000) may be added to the Amplifier/Power Supply Module by following the directions in Figure A3.

CONTROL MODULE

(1) Later production units' Control Module will be modified as follows: (see Figure A4)

C404 and R419 added between emitter and collector of Q401.

D408 added.

D407 replaced by R413 (or by short length of wire).

R408 changed from 47K to 1K; removed from point "Y" and connected at junction of R410/R403/emitter of Q401.

Q403 PNP transistor replaced by NPN transistor (Motorola MPS A20; Texas Instruments T1S-98; NuTone Part No. 36613-000).

(2) These changes eliminated the audio amplification capability of Q401; oscillations picked up on extra long remote speaker leads due to inadvertent turning ON or OFF of Q401; and provided a more stable positive control of Q403 and the STANDBY RELAY K402.

(3) Older boards should be modified or replaced only if oscillations or unstable performance of the Control Module is noted.

REPLACEMENT PARTS LIST

IM-406 3-TWISTED-PAIR (6-WIRE) BUILT-IN RADIO/INTERCOM SYSTEM

All Resistors: Value in ohms. ½ Watt Carbon Composition unless otherwise noted.

All Capacitors: Value in farads. 500 WVDC Ceramic unless otherwise noted.

K (Kilo) = 1,000 M (Mega) = 1,000,000 m (micro) = 10⁻⁶ p (pico) = 10⁻¹²

Schematic Symbol	NuTone Part No.	Description
IM-406 MASTER UNIT		
(*) Used in IM-406-D Walnut Only		
(**) Used in IM-406-L Golden Elm Only		
	41526-000	Chassis Assembly Complete
AM/FM TUNER MODULE		
	41533-000	Complete Assembly
	37596-000	PC Board
	38637-003	FM RF Shield
	41524-000	Antenna Coax Lead-in Assy. (with Connectors)
CAPACITORS		
C301, C329	35100-161	180 pf.
C302, C324, C330	35101-135	7.5 pf.
C303A-J	35092-000	Variable. AM/FM Gang Tuning
	31893-000	Tuning Shaft
	31894-000	Bushing, Tuning Shaft
	41535-000	Dial Cord Assembly
	39327-000	Pulley, Tuning Capacitor Dial String
	39135-000	Cap. Pulley, Tuning Capacitor
	31872-000	Lock Washer, Pulley, Tuning Capacitor
	39262-000	Spring, Pulley, Dial Cord
	39335-000	Dial Pointer
C304, C305, C307	35100-120	.001 mf.
C306, C340	35100-140	.02 mf., 50 WVDC
C308	35101-129	4.7 pf.
C309	35100-138	5.000 pf.
C310	35101-134	3.3 pf.
C311, C315	35100-125	220 pf. (C311, Trap)
C312, C343, C344	35101-142	15 pf.
C313, C317, C326, C332, C341	35100-139	.01 mf., 50 WVDC
C314, C327	35101-126	1.2 pf.
C316, C321, C333, C334, C336	35100-141	.05 mf.
C318	35094-000	.33 mf.
C319	35100-156	2200 pf.
C320, C337	35091-109	47 mf. Electrolytic, 16 WVDC
C322, C323	35101-141	5.6 pf.
C325	35101-140	10 pf.
C328	35090-000	1-8 pf., Variable Oscillator Hi-Frequency Trimmer 100 WVDC/AC

Schematic Symbol	NuTone Part No.	Description
C331, C335, C342	35100-127	.1 mf., 100 WVDC
C338	35091-108	100 mf., Electrolytic. 25 WVDC
C339	35091-103	4.7 mf., Electrolytic. 25 WVDC
COILS AND TRANSFORMERS		
L301	30087-000	FM Ant. Primary
	30086-000	FM Ant. Trap
	30085-000	FM Ant. Secondary
L302	30089-000	FM RF
L303	30088-000	FM Oscillator
	30073-000	Coil Form. for L301, L302, L303
	31915-000	Slug, Tuning Core, for L301, L302, L303
L304	30092-000	10.7 MHz. Quadrature Detector Tuning
L305	30091-101	22 mH., RF Choke
L306	30062-000	10.7 MHz. Trap Coil
L307, L308	30090-000	10.7 MHz. Choke
L309	30578-000	AM Ant. Transformer
L310	30093-000	AM Oscillator
T301A	30590-000	10.7 MHz. FM IF Primary
T301B	30591-000	10.7 MHz. FM IF Secondary
T302	30589-000	455 KHz. AM IF
CONNECTOR		
J1	39339-101	5-Pin Receptacle
DIODES		
D301	36617-000	Silicon Switching. 50 ma. DC; 75 PIV 1N914 Texas. Inst. 1N4148
FILTERS		
CF301	36088-000	10.7 MHz., FM IF. Ceramic Vernitron Piezoelectric Div. FM-4 (Preferred) Murata Corp. of America SFG-10.7MA
CF302, CF303	36087-000	455 KHz., AM IF. Ceramic Murata Corp. of America SFB-455D
LAMP		
VR301	39438-000	Neon, 105-125Vdc/ac; ¼ watt 1.9 ma. G.E. "Glow Lamp" #C2A-ET (NE-2H3T) or Equivalent
RESISTORS		
R301	33081-564	560K, ¼ Watt
R302	33081-224	220K, ¼ Watt
R303	33081-154	150K, ¼ Watt
R304	33081-391	390, ¼ Watt
R305, R310, R322, R324	33101-331	330
R306	33101-333	33K
R307, R311	33101-392	3.9K

Schematic Symbol	NuTone Part No.	Description
R308. R331	33101-102	1K
R309. R316 R317	33101-470	47
R312	33101-272	2.7K
R313	33101-471	470
R314	33101-124	120K
R315	34043-000	500K. Potentiometer Trim. FM Squeich
R318	33101-822	8.2K
R319. R320 R328	33101-103	10K
R321. R329	33101-182	1.8K
R323	33101-332	3.3K
R325	33101 681	680
R326	33101-222	2.2K
R327	33101-473	47K
R330	33101-101	100
TRANSISTORS		
Q301	36624-000	Dual Gate FET. FM RF Amplifier. General Inst. Corp. MEM 615A. MEM 614
Q302	36578-000	NPN Epitaxial Planar Silicon FM Mixer Texas Inst. SKA-4231 Motorola Inc., SPS-4448 National Semiconductor. SM-43-049
Q203	36581-000	NPN Planar Silicon FM Oscillator Texas Inst. SKA-4230 National Semiconductor. SM-43-050
INTEGRATED CIRCUITS		
Z301	36623-000	FM IF. Detector RCA CA3089E S.G.S. ATES Co. TDA 1200
Z302	36622-000	AM Mixer. IF. Detector RCA CA3088E
AMPLIFIER/POWER SUPPLY MODULE		
	41530-000	Complete Assembly
	37600-000	Amplifier/Power Supply PC Board
	37607-000	I/P Talk/Listen PC Board
	37608-000	Door Talk/Listen PC Board
CAPACITORS		
C201. C205. C206. C207. C210. C221	35100-127	.1 mf., 100 WVDC
C202	35100-164	680 pf.
C203. C204	35091-111	2.2 mf. Electrolytic. 25 WVDC
C208. C212	35091-103	4.7 mf. Electrolytic. 25 WVDC
C209	35091-102	10 mf. Electrolytic. 16 WVDC
C211	35100-145	1,000 pf.
C213. C216	35091-104	33 mf. Electrolytic. 25 WVDC
C214	35100-158	39 pf., 50 WVDC
C215	35091-101	470 mf. Electrolytic, 55 WVDC
C217	35091-105	470 mf. Electrolytic, 25 WVDC

Schematic Symbol	NuTone Part No.	Description
C218. C219	35100-139	.01 mf., 50 WVDC
C222. C223	35100-139	.01 mf., 50 WVDC (Later Production Only)
C220	35091-107	1,000 mf. Electrolytic 35 WVDC
CONNECTORS		
J3	39333-102	4-Pin End Block Connector
	39333-103	6-Pin End Block Connector
J4	41541-000	Jack and Wire Assembly
P1	39338-101	5-Pin Connector Post Assembly
P2	39338-102	7-Pin Connector Post Assembly
	39338-103	8-Pin Connector Post Assembly
P4	41534-000	Plug and Wire Assembly
DIODES		
D201. D202. D206. D207. D208. D214	36549-000	Silicon Rectifier. 1 Amp. OC. 100 PIV. 1N4002 (D214 used in Later Production Only)
D203- D204. D205	36589-000	Silicon. Temperature Tracking. 120 ma DC; 100 PIV. 1N3754
	41554-000	Diode Assembly. Includes D203. D204 and D205 plus wire and sleeving
D213	36539-000	Silicon Zener. 12 V., 1N4742A
Z201	36618-000	Silicon Bridge Rectifier Assembly. includes D209. D210. D211 and D212; DC Output 1.5 A. PIV 100. General Inst. Corp. KBP02
LAMP		
VR201	39163-000	Lamp. 105-125Vac dc; G.E. "Glow Lamp" #C2A-T (NE-2H) or Equivalent
RESISTORS		
R201	33101-270	27
R208	33101-394	390K (Early Production)
	33101-824	820K (Later Production)
R209	33101-563	56K
R210	33101-822	8.2K
R211	33101-682	6.8K
R222. R233	33101-151	150
R223	33101-101	100
R224	33101-271	270
R225. R226	33101-182	1.8K
R227		(Not Used)
R228	33028-010	1 ohm, 2 Watt
R229	33047-000	0.68 ohm, 2 Watt
R230	33101-100	10
R231	33101-331	330
R232	33101-471	470
R234	33101-223	22K
R235	33101-153	15K
R236	33101-124	120K
R237	34023-000	2.2M Potentiometer Trim, Level Set
R238	33101-222	2.2K

Schematic Symbol	NuTone Part No.	Description
R239	33028-330 33028-270	33 (First Run Later Production) 27 (Designed Run. Later Production)
Z202	33044-000	Resistor Pack. R202-R207
Z203	33043-000	Resistor Pack. R212-R221
TRANSFORMER		
T201	30592-000 32159-003	Intercom Input Mounting Bracket for T201
TRANSISTORS		
Q201, Q204, Q205	36580-000	NPN Planar Silicon. Low Noise. Texas Inst. SKA-4220 Motorola Inc. SPS-1216 National Semiconductor. SMO-7329. 2N5088
Q202, Q203	36613-000	NPN Silicon. Texas Inst. T1S-98; Motorola MPS-A20
Q206	36577-000	PNP Epitaxial Planar Silicon Texas Inst. SKA-4223. 2N5000
Q207	36620-000	NPN Darlington, Output Motorola. MJE 1100
Q208	36621-000 39366-000 38500-000	PNP Darlington. Output Motorola. MJE 1090 Mica Insulator. Output Transistors Heat Sink. Output Transistors. Temperature Tracking Diodes and Voltage Regulator Transistor
Q209	36613-000 38574-000	NPN Silicon. Texas Inst. T1S-98. Motorola, MPS A20. (Voltage Regulator in Original Production) Heat Sink. Voltage Regulator (Use with 36613-000 Only)
Q209	36614-000 39360-000	NPN Silicon, Single Diffused. Motorola MJE 520 (Voltage Regulator Later Production Units) Mica Washer, Voltage Regulator Insulator (Use with 36614-000 Only)
CHASSIS MOUNTED COMPONENTS		
CAPACITORS		
C101	35100-152	.01 mf.
C102	35101-143	220 pf.
CONNECTORS		
J101, J102	41528-000 46388-000	Bracket and Jack Assembly, PHONO and TAPE Inputs Label, Phono-Tape
J103, J104, J105	31451-000	Base, Pilot Lamp
LAMPS		
PL101, PL102, PL103	39330-000	Pilot, G.E. #259 (or Equivalent)
RESISTORS		
R101	34062-000	200 ohm Potentiometer, Master Unit Speaker Volume Control (Ganged with S101 ON/OFF)

Schematic Symbol	NuTone Part No.	Description
R102	34060-000	500K Potentiometer. TONE Control
R103	34061-000	100K ohm. Potentiometer. System VOLUME Control
R104	33101-103	10K
R105	33101-104	100K
R106	33101-394	390K
SWITCHES		
S101	34062-000	ON/OFF (Ganged with Master Unit VOLUME Control R101)
S102	34622-000 39437-000	DP4T Slide. PROGRAM Selector Guard. Black. PROGRAM Selector
S103, S104	34630-000 34627-000	4PDT, Slide, Momentary, I/P TALK-LISTEN Alternate
S105	34631-000 34628-000	DPDT, Slide Momentary. DOOR LISTEN Alternate
S106	34630-000 34626-000	4PDT, Slide, Momentary, DOOR TALK Alternate
KNOBS		
	39355-000*	Master Speaker VOLUME
	39379-000**	Master Speaker VOLUME
	39346-000*	TUNING
	39380-000**	TUNING
	31878-000	Black Rectangular, Push-button, TALK/LISTEN
CONTROL MODULE		
	41532-000	Complete Assembly
	37598-000	PC Board
CAPACITORS		
C401, C403	35091-106	2.2 mf. Electrolytic, 25 WVDC
C402	35091-110	22 mf. Electrolytic, 16 WVDC
DIODES		
D401, D407, D408	36549-000	Silicon Rectifier; 1 A., PIV 100; 1N4002 (D407 used in Early Production Only) (D408 used on Later Production Only)
D402, D403, D404, D405, D406	36617-000	Silicon Switching. 40 milliA., PIV 75; 1N914 Texas Inst. 1N4148
CONNECTOR		
J2	39339-103	8-Pin Receptacle
J2	39339-105	3-Pin Receptacle
J2	39339-106	4-Pin Receptacle
RELAYS		
K401	39336-000	4PDT, Talk/Listen American Zettler AZ429-70-101
K402	39337-000	SPST, Reed, Standby New Products Engineering 118-3-1, F3

Schematic Symbol	NuTone Part No.	Description
RESISTORS (SEE PAGE 34)		
R401	33101-222	2.2K
R402	33101-223	22K
R403	33101-682	6.8K
R404	33101-472	4.7K
R405, R417	33101-103	10K
R406	33101-332	3.3K
R407	33101-822	8.2K
R408	33101-473	47K
R409	33101-561	560
R413	33101-470	47 (Used in some Later Production Units Only)
Z401	33041-000	Resistor Pack. Includes R410, R411, R412, R414, R415 and R416. All Resistors 1/8 Watt.
TRANSISTORS		
Q401, Q403	36577-000	PNP Epitaxial Planar Silicon Texas Inst. SKA-4223. 2N5086
Q402	36590-000	Darlington, NPN Planar Silicon Motorola Inc. MPS A-13
Q404	36606-000	PNP Silicon, Motorola MPS-K71 (Yellow), MPS-A70 (B = 150-300)
INTERCOM SWITCHBOARD ASSEMBLY		
	41539-000	Complete Assembly
	37602-000	PC BOARD
CONNECTOR		
P3	37604-000	10-Pin Plug PC Board
RESISTORS		
R501, R502	33101-101	100
R503, R504	33101-470	47
SWITCHES		
S501-S510	34624-000	DP5T Slide, Intercom Station Selector
	38578-000	4-Connector Terminal Block, Black Bakelite
	37609-000	Terminal Block Back-up board
	39382-003	#8-18 Orn & Blk Terminal Screws
GENERAL PARTS		
	45399-000	Label, FM Ant. Lead
	45407-000	Label, Low Level Output
	46759-000	Label, Instructions
	46402-000	Label, Room Designator for Station Selector Switches
	38614-000	Bracket, Top, Chassis Retaining
	39410-007	Pin, Chassis Retaining
	21018-000	Solderless Wire Connector
	46647-000	Service Manual
	46649-000	Homeowner's Manual
	46651-000	Installation Instructions (Early)

Schematic Symbol	NuTone Part No.	Description
	46800-000	Installation Instructions (Late)
	41578-000	Dial Backing Assembly
	38605-000	Lens, Dial
	38519-000	Reflector, Dial
	41548-000*	Speaker Grille Assembly
	41549-000**	Speaker Grille Assembly
	41544-000*	Front Panel Assembly
	41545-000**	Front Panel Assembly
	39415-000	Hanger Strap, Chassis Support
	31987-000	Hook, Hanger Strap
	36090-000	Speaker, 5-inch; 25-ohm Voice Coil
	41605-000	Hinge, Stationary Leaf and Pin Assembly (Fasten to Rough-in)
	38632-007	Hinge, Stationary Bracket
	39326-000	Hinge Pin
	38635-007	Hinge, Moveable Leaf (Fasten to Chassis)
IR-10 ROUGH-IN HOUSING		
	08525-900	Complete Assembly
	40674-005	Frame Assembly
	39096-000	Antenna Terminal Strip
	46620-000	Caution Label
	41493-000	Power Transformer (105-N): 120Vac; 60 Hz. Primary; 16Vac 15VA Secondary: Assembly complete with Label
	40072-000	FM Antenna Assembly
	29911-000	Transformer, 230Vac Primary For Export Only (X302-N)
IC-41 REMOTE CONTROL		
	13660-000	Complete Assembly
	41500-000	Control Insert Assembly
	38560-000	Control Insert
R1	34063-000	200 ohm, Potentiometer, VOLUME Control
R2	33101-103	10K
R3	33101-221	220
S1	34637-000	Switch, Push, DPDT, Momentary, DOOR LISTEN
S2, S3, S4	34636-000	Switch, Push, 4PDT, Momentary, DOOR TALK I/P TALK and LISTEN
	31878-000	Pushbutton, Black Rectangular, for Talk and Listen Switches
	39344-000	Knob, VOLUME Control
	41598-000	PC Board and Bracket Assembly
	41502-000	PC Board Assembly
	31862-000	"U" Clip
	39088-000	Spacer
	38572-000	Bracket, PC Board
	46523-000	Model Label
	46412-000	Wiring Label
	38571-000	Bezel

Schematic Symbol	NuTone Part No.	Description
IS-45 INSIDE 5 INCH SPEAKER WITH CONTROLS		
	13715-900	Complete Assembly
	38528-000	Speaker Panel, Remote
	30090-000	Speaker, 5 Inch, 25-ohm Voice Coil
R1	34063-000	200 ohm, Potentiometer, VOLUME Control
R2	33101-103	10K
R3	33101-221	220
S1	34637-000	Switch, Push, DPDT, Momentary, DOOR LISTEN
S2 S3, S4	34636-000	Switch, Push, 4PDT, Momentary, DOOR TALK, I/P TALK and LISTEN
	31878-000	Pushbutton, Black Rectangular, for Talk and Listen Switches
	39402-000	Knob, Volume Control
	41474-000	PC Board and Bracket Assembly
	41502-000	PC Board
	38542-000	Bracket, PC Board
	31862-000	"U" Clip
	39088-000	Spacer
	46407-000	Model Label
	46412-000	Wiring Label
IS-47 5-IN. SPEAKER/CLOCK TIMER INTERCOM SPEAKER AND CONTROL		
	13720-900	REMOTE SPEAKER ASSEMBLY COMPLETE
	41581-000	Front Panel Assembly
	38608-000	Front Panel
	36090-000	Speaker, 5-inch, 25-ohm Voice Coil
R1	34063-000	200 ohm potentiometer, VOLUME Control
R2	33101-103	10K
R3	33101-221	220
S1	34637-000	Switch, Push, DPDT, Momentary, DOOR LISTEN
S2, S3, S4	34636-000	Switch, Push, DPDT, Momentary, DOOR TALK, I/P TALK and LISTEN
	31878-000	Pushbutton, Black Rectangular, for Talk and Listen Switches
	39344-000	Knob, Volume Control
	41502-000	PC Board Assembly
	41598-000	PC Board and Bracket Assembly
	38572-000	Bracket
	31862-000	"U" Clip
	39088-000	Spacer
	46781-000	Model Label
	46412-000	Wiring Label
	31128-000	Solderless Wire Connector

Schematic Symbol	NuTone Part No.	Description
CLOCK TIMER PROTECTION CIRCUIT		
	41600-000	Complete Assembly
	37614-000	PC Board
C31	35100-127	.1 mf., 100 WVDC
D31	36549-000	Silicon Rectifier, 1 Amp. UC: 100 PIV, 1N4002
J31	39421-000	Jack, 3-Pin Connector
P31	41601-000	Plug, 3-Pin Connector Complete Assembly
R31	33101-103	10K
R32	33101-223	22K
R33	33101-222	2.2K
VR31, R32	39163-000	Lamp, 105-125 Vac/dc, G.E. "Glow Lamp No. C2A-T (NE-2H) or Equivalent
CLOCK & CONTROL CIRCUIT		
	36094-000	Digital Clock Assembly
	38611-000	Ground Strap
	32603-000	Interlock Plug-Cord
	17351-000	End Connector
	39407-000	Knob, MODE SWITCH, TIME/ALARM SET
R21 VR21, R22 VR22	39405-000	Resistor 10K and Lamp Assembly, G.E. D-2A, 125 Vac, 2.6 ma, 1/3 watt
	41582-000	Lamp/Resistor Assembly Complete
IS-48 INSIDE 8 INCH SPEAKER WITH CONTROLS		
	13723-900	Speaker Panel Assembly IS-48D
	13725-900	Speaker Panel Assembly IS-48L
	38534-000	Speaker Panel Remote IS-48D
	38535-000	Speaker Panel Remote IS-48L
	36089-000	Speaker, 8-inch, 25-ohm Voice Coil
R1	34063-000	200 ohm Potentiometer, VOLUME CONTROL
	41495-000	PC Board and Bracket Assembly
	38543-000	Bracket
	41502-000	PC Board Assembly
	37595-000	PC Board
R2	33101-103	10K
R3	33101-221	220
S1	34637-000	Switch, Push, DPDT, Momentary, DOOR LISTEN
S2, S3, S4	34636-000	Switch, Push, 4PDT, Momentary, DOOR TALK, I/P TALK, I/P LISTEN
	31878-000	Pushbutton, Black Rectangular, for Talk and Listen switches
	39346-000	Knob, Volume, IS-48D
	39380-000	Knob, Volume, IS-48L
	31862-000	"U" Clip
	39088-000	Spacer
	46411-000	Model Label
	46412-000	Wiring Label

Schematic Symbol	NuTone Part No.	Description
IS-77 OUTSIDE WEATHERPROOF SPEAKER		
	13780-900	Complete Assembly
	38423-000	Outdoor Speaker Housing
	36074-000	Speaker, Polyurethane, Weatherproof, 16-ohm, 20-watt Peak, Ceramic Magnet
	41385-000	Hanger Bracket Assembly Complete
	38424-000	Connecting Strap
	39267-000	Bushing
	39297-000	Spacer
	38447-014	Mounting Bracket
	41365-000	Hanger Bracket Assembly
	38427-014	Hanger Bracket
	38425-000	Grille
	38599-000	Nameplate
	31128-000	Solderless Wire Connector
IS-78 INSIDE METAL FRAME SPEAKER		
	13782-900	Panel Assembly
	32180-008	Panel
	32181-032	Panel Back
	36089-000	Speaker, 8-inch, 25-ohm Voice Coil
	46665-000	Model Label
IS-79 OUTSIDE METAL FRAME SPEAKER		
	13784-900	Panel Assy
	32180-008	Panel
	32181-000	Panel Back
	36074-000	Speaker, Polyurethane, Weatherproof, 16-ohm, 20-watt Peak, Ceramic Magnet
	46668-000	Model Label

Schematic Symbol	NuTone Part No.	Description
IS-61 BUILT-IN DOOR SPEAKER		
	13747-900	"B" Unit Assembly
	8454-019	Panel
	41237-000	Mounting Panel Assy (Includes Speaker)
	38391-000	Panel, Speaker Mounting
	36076-000	Speaker, 3½-inch, 16-ohm, Weatherproof cone
IS-63 SURFACE MOUNT DOOR SPEAKER		
	13751-900	Door Speaker Assembly
	38356-202	Box
	38338-000	Grille
	36076-000	Speaker, 3½-inch, 16-ohm, Weatherproof cone
	32268-000	Mounting Plate
	38324-000	Nameplate
IS-64 SURFACE MOUNT DOOR SPEAKER WITH PUSHBUTTON		
	13753-900	Door Speaker Assembly
	38356-202	Box
	38338-000	Grille
	36076-000	Speaker 3½-inch, 16-ohm, Weatherproof cone
	32268-000	Mounting Plate
	38359-000	Switch Insert
	39280-000	Pushbutton Complete
IS-65 BUILT-IN DOOR SPEAKER		
	13755-900	Door Speaker Assembly
	36076-000	Speaker 3½-inch, 16-ohm, Weatherproof cone

NUTONE WARRANTY

NuTone products are warranted to be free from defects in material and workmanship for (12) months from original date of installation unless otherwise stated. Light bulbs, dial lights, record changer needles and batteries (with exception of those specifically designated as rechargeable) are not warranted or guaranteed, in any manner for any length of time.

During this warranty period, NuTone will repair or replace at NuTone's sole option, free of charge, any defective parts returned prepaid to our closest Authorized Service Center. Provide the model number of the product, original date of installation, and nature of difficulty being experienced.

For the name of your nearest NuTone Authorized Service Center residents of the contiguous United States call, toll free, 800-543-8687

Residents of Alaska, Hawaii and all other locations outside the contiguous U.S., except Canada, write: Field Engineering Department, NuTone Division of Scovill Mfg., Madison and Red Bank Roads, Cincinnati, Ohio 45227.

Canadian residents contact: NuTone Electrical, Limited, 2 St. Lawrence Avenue, Toronto, Ontario M8L 5Y3; 416-251-6580.

Our warranty does not cover damage or failure caused by abuse, misuse, abnormal usage, faulty installation, improper maintenance or any repairs other than those provided by an Authorized NuTone Service Center.

There will be charges rendered for product repairs made after our warranty period has expired (12 months after original date of installation).

Specific parts of certain models have an extended warranty period. These are specially noted in the current NuTone Catalog. NuTone is responsible for parts only during the remaining portions of the warranty period after the first 12 months. Labor is extra to be charged to the customer. Your Authorized Service Center can tell you what portions of your particular model may have an extended warranty.

THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, FOR MERCHANTABILITY OR FITNESS, AND THERE ARE NO OBLIGATIONS OR LIABILITIES ON THE PART OF NUTONE OR SCOVILL MANUFACTURING COMPANY FOR CONSEQUENTIAL DAMAGES ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THE PRODUCT OR OTHER INDIRECT DAMAGES WITH RESPECT TO LOSS OF USE, REVENUES OR PROFIT. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. THE WARRANTIES SET FORTH HEREIN MAY NOT BE EXTENDED OR ALTERED EXCEPT BY WRITTEN AMENDMENT.