

# SERVICE MANUAL SUPPLEMENT

## FOR MODELS

### IMA-303, IMA-313 & IMA-323

REVISED CIRCUIT AND PARTS LIST.



MODEL IMA - 313



MODEL IMA - 323



MODEL IMA - 303

#### SPECIAL NOTE TO SERVICEMAN

This Supplemental information contains a REVISED circuit and parts listing. Refer to Basic Service Manual for RF-IF Alignment, Cassette Service and Security Service.

**NuTone Housing Products**

**Scovill**

MADISON & RED BANK ROADS

CINCINNATI, OHIO 45227

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## THEORY OF OPERATION

SEE SCHEMATIC DIAGRAM PAGE 12 — P/C LAYOUT PAGE 8 & 9

### POWER SUPPLY

- (1) The Power Transformer is supplied with the rough-in housing and should be located remotely from the Master Unit — near fuse panel, basement, etc.
- (2) The Power Transformer in the IR-10 rough-in housing is rated at 120V AC 60Hz primary and 16V AC 15VA secondary.
- (3) The Power Transformer in the IR-10A rough-in housing is rated at 120V AC 60Hz primary and 16V AC 17VA secondary. This transformer is mainly used when it is impossible to mount the transformer in a low ambient temperature area as in (1) above.
- (4) The secondary of the Power Transformer may be connected to the Master Unit by 100 feet (Maximum) of No. 18/2 cable (NuTone S-142). For runs up to 200 feet, use No. 14/2 cable — Not supplied by NuTone.
- (5) The GREEN wire of the Master Unit power input must be connected to earth ground.
- (6) The 16V AC is turned ON (or OFF) by the ON/OFF SWITCH — S101 (operate by the shaft of the Master Unit Speaker Volume Control R101).
- (7) When S101 is ON, the 16V AC is applied to the series circuit of PL101, R221, PL102, R222, and PL103, R221 and R222 limit the current through the lamps and are mounted on the Amplifier/Power Supply P/C Board.
- (8) The 16V AC is applied to diodes D203, D204, D205 and D206 full wave bridge rectifier. The output of the bridge is filtered by C221 and results in Vcc of +22.5V DC.
- (9) Capacitors C217, C218, C219 and C220 bypass the high frequency switching noise that may be generated by the diode rectifiers.
- (10) The +22.5V DC is connected to the voltage regulator circuits R224, Q205, D208 and IC202. Although Q205 is a heavy duty device, shorting of the regulated 16V DC must be avoided. The 16V DC powers the Audio Amplifier Circuit.
- (11) The 12V DC output from the Voltage Regulator, IC202, is connected through R225 to supply muting voltage to the Muting Switch of the IS-37 and through the Inside Patio LISTEN SWITCH, S103, to Q204 when set is bench checked and the Control Module is not installed.
- (12) The regulated +12V DC is switched by the SELECTOR SWITCH, S102, to the AM or FM Radio Circuits and is open ended when 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 + 12 Vdc is fed through P1-2/J1-2 to the AM tuner.
  - (3) When S102 is in FM position, the regulated + 12 Vdc 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 Q301 (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.
  - (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 highside 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 transformers for high-selectivity.

(12) The output of CF301 is fed to terminal 1 of IC301.

(13) IC301 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.

(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 with the use of the regulated +12Vdc 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 affects 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. (Refer to IM-303 Service Manual, Part No. 46646, page 34).

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

#### AM TUNER

(1) The AM signal is fed from the center tap of the FM antenna transformer primary, through C345 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.

#### 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 12 Vdc 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 +12 Vdc is open ended, and neither the AM nor FM tuner has voltage applied.

(3) Delayed AGC is supplied from pin 15 of IC302, 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 IC302.

(5) IC302 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 IC302 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 IC302.

(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  $-10^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$ .

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

(12) C337 is the internal AGC filter.

(13) The recovered audio is fed from the detector output through R326; J1-1/P1-1 and R228 to the AM terminal on S102.

#### ALIGNMENT (see IM-303, IM-313 or IM-323 Service Manual).

(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 above Service Manual.

(2) The AM program, from P1-1 through R228, is selected when S102 is in number 1 (top) position. The +12 Vdc is fed to the AM tuner through P1-2.

(3) The PHONOGRAPH signal is fed through PHONO INPUT J4 and is loaded by C224 and R227 to the number 2 position of S102. C224 and R227 supply the correct load for the cartridges used in NuTone record changers.

(4) The TAPE PLAYER signal is fed through TAPE INPUT J5 and is loaded by R226 through the number 3 position of S102. The tape input matches the NuTone Tape Players.

(5) The FM program through P1-4 and R229 is selected when S102 is in the number 4 (bottom) position. The regulated +12 Vdc 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 connection, and through C208 to the high side of the 2.2 Megohm LEVEL SET CONTROL R216.

(7) The LOW LEVEL RADIO OUTPUT may be used to drive NuTone's Model 516 background music amplifier. This entertainment program will not be interrupted when the system is being used for intercommunications through the standard speakers (ISA-35, IS-35, etc.) (see paragraph 9).

(7.1) The LOW LEVEL RADIO OUTPUT is engineered for use with NuTone's Model 516 Audio Amplifier. When it is to be used to drive other amplifiers, consult NuTone's Field Engineering Department for specific details.

(8) The wiper contact of R216 is fed through R215 and a shielded cable to the TONE CONTROL CIRCUIT, C101/R102, and the SYSTEM VOLUME CONTROL, R103, back through the shielded cable and through R214 and the coupling capacitor, C204, to the base of the first audio amplifier, Q203.

(8.1) The wiper of R216 is also connected to the collector of the muting transistor, Q204. When Q204 is turned ON (Veb "sat"), its collector is effectively at ground potential and the audio on R216's wiper will be shorted out.

(9) When the LOW LEVEL RADIO OUTPUT is used to drive a background music amplifier, R216, should be backed off 10° to 15° from its maximum (normal) setting. This will prevent muting of the entertainment program at high side of R216.

(10) THE INTERCOM SIGNAL: from Door Speaker(s); Inside/Patio Speaker(s); Master Unit Speaker, and when used, chime and/or alarm is fed through the intercom input Transformer T201 and C201 to the base of intercom preamp Q201.

(11) T201 has a voltage step-up of 84 and Q201 has a voltage gain of 18. The amplified intercom signal is coupled through C203/R206 to the first audio amplifier.

(11.1) Q201's primary function is to determine the frequency characteristic of the intercom signal and to isolate the input transformer from the first audio amplifier Q203.

(12) The collector of Q202 is connected to the audio input at the junction of R206 and C204. When the positive "Key Click" suppression voltage - from the Control Module - is applied to the base of Q202, it will be turned ON and short the audio signal (that is present on its collector) to ground momentarily (approx. 150ms).

(13) The diodes, D201 and D202 protect the circuitry on the secondary side of T201 from excessive transient voltages that may be generated during intercom switching.

## AUDIO AMPLIFIER

(1) The amplifier is powered by the +16Vdc supply (Vcc).

(2) The audio signal(s) from the intercom pre-amp Q201 and/or the volume control R103 is fed through C204 to the base of the first audio voltage amplifier Q203. This stage has a gain of 14. Its output is coupled to PIN8 of IC201 through C207.

(3) The power amplifier, IC201 is a class AB audio amplifier capable of approximately 4.5 watts output into a 5 speaker load (5 ohms) at 10% total harmonic distortion.

(3.1) This IC has a built-in circuit to provide thermal overload protection in cases of shorted output loads. However, the output of the IC, pin 12, should not be shorted. After IC201 heats up in excess 100°C, the amplifier shuts itself down to prevent any damage to it caused by the excessive temperature. After the short is removed and the IC cools down, normal operation is resumed.

(3.2) Bias for the input amplifier is provided by R217.

(3.3) The sensitivity of the IC201 Amplifier and the closed loop gain is set by R219. The low frequency response is determined by C212.

(3.4) Decoupling of the driver stages from the output stages is provided by the bypass capacitor, C213.

(3.5) AC feedback is provided through C214 and together with C215, set the high frequency response and amplifier stability.

(3.6) A "bootstrap" circuit is provided by R218 and C210 to insure the symmetry of the upper part of the output voltage waveform.

(3.7) R220 and C216 serve to further increase stability of the amplifier at high frequencies.

(4) The amplified audio output is coupled through C211 to the load. The circuit is protected against shorts on the speaker side of C211 by the built-in thermal overload protection of IC201.

(5) Unless there is a failure of component(s), the DC feedback will lock the DC operating voltages at their designed values.

## CONTROL MODULE & INTERCOM SWITCHING

### FOR THE FOLLOWING DISCUSSION, SEE THE SCHEMATIC DIAGRAM AND THE IMA-303 SYSTEM INTERCOM SWITCHING & CONTROL DIAGRAM

(1) The Control Module is powered by the 22.5Vdc supply (Vcc) that is fed through J/P2-2 from the Amplifier/Power Supply Module.

(2) The Quad Amplifier Integrated Circuit IC401 is operated as four individual voltage comparators: IC401A; IC401B; IC401C; and IC401D. They control the intercom switching operation.

(3) A positive (+) reference voltage is applied to the positive (+) input terminal of each comparator. These potentials are derived from the voltage divider network: R404; R403; R402; and R401 (all part of resistor pack Z403). The actual voltages on the positive terminals of the comparators will be somewhat less than those measured at the divider resistor terminals. The 1 Megohm resistors: R408—R415 limit the input current of their respective comparator:

The resistor pack voltages:

Terminal 5	14.5V
Terminal 6	9.4V
Terminal 7	3.9V
Terminal 4	17.5V (Control Line Point "X")

(4) The CONTROL LINE'S normal voltage, i.e. when no intercom function is being used, is +17.5V. This voltage is connected to the negative (-) terminals of the comparator amplifiers (through 1 Meg resistors), keeping them clamped OFF.

(5) When the DOOR LISTEN switch in an I/P Speaker is activated, point "X" is connected through R502 and D505, and then through the originating I/P Speaker Control's R2 (8.2K) and common to INPUT GROUND. The voltage at point "X" goes to 9.9V; IC401A is turned ON and its terminal 10 goes to 13.5V. The other three comparators remain OFF.

(5.1) The 13.5V from terminal 10 is fed through D408 to the base of Q402. The diode D411 between base and emitter keeps a reverse bias on Q402 and it is clamped OFF. The voltage charges C404 and this charging voltage is fed through D412 to point "W". The voltage at "W" is fed through J/P2-3 to the base of KEY CLICK SUPPRESSION transistor Q202, turning it ON. When Q202 is turned ON, the collector goes to approximate ground (emitter potential), and the audio on Q203's base will be shorted out.

(5.2) This voltage appears at "W" only during the charging time through C404, and keeps Q202 turned ON for approximately 150 milliseconds. This is sufficient to eliminate most of the switching noises, allowing just enough "Click" to keep the operator aware that intercom switching is taking place.

(5.2.1) When the Door Listen switch is released, the voltage through D408 and D411 is eliminated, and the capacitor C404 discharges through the now forward biased Q402. This discharging voltage is coupled to Q202's base and suppresses "Key Clicks" when switch is opened.

(5.2.2) The KEY CLICK SUPPRESSION VOLTAGE can be measured at J/P2-3 on a standard 20K ohm/volt multimeter, and it will read between .25 and .35 volts. The actual voltage as seen on a scope will be approximately .8 volts @ 150 to 200 millisecond pulse width.

(5.3) The 13.5V from terminal 10 will also be fed through R419 and D407 to "U". The voltage "U" is fed through J/P2-5 and D207 to the base of Q204, turning it ON. When Q204 is ON, its collector is at ground and the entertainment program is MUTED. This voltage will remain on "U" while the DOOR LISTEN switch is held closed. This voltage is .7 on Q204 base and 1.4 at J/P2-5.

(5.4) When the switch is released, the voltage at "U" will decay at an RC rate and the voltage on Q204's base will fall through saturation to turn OFF, and the entertainment program will fade-back, in something less than 1/2 second.

(5.5) The 13.5V from IC401A terminal 10 is also fed through R418 and the Audio Switching diode D410; then through J/P2-6 and Input Transformer T201 to INPUT GROUND.

(5.6) When D410 is turned ON, the DOOR SPEAKER LINE'S audio, coupled through normal contacts of K401 and C403; superimposed on the forward biased D410 to the Intercom Input Transformer T201. The audio signal from the Door Speaker will be amplified and heard by the Master Unit Speaker and all I/P Speakers that are in RADIO/INTERCOM mode.

(5.6.1) (NOTE) The I/P Speakers mode of operation is controlled by the Station Selector Switches: S501—S508, located on the Terminal Board in the Master Unit.

(5.7) When the DOOR LISTEN switch is released, D410 is turned OFF and an audio signal that may be picked up by the Door Speaker(s) will be blocked from the Input Transformer T201.

(6) When the DOOR TALK switch in an I/P Speaker is activated, point "X" is connected through R502 and D505; through R1 and the speaker voice coil; and through common to INPUT GROUND. The voltage at "X" goes to approximately 5V. IC401B and IC401D are turned ON. Quad comparator terminal 4 goes to 11.5V and terminal 9 goes to 11.5V.

(6.1) The 11.5V from terminal 4 is fed through D405 to terminal 11 keeping IC401A turned OFF. Voltage at "X" is still too high positive to allow IC401C to be turned ON.

(6.2) The 11.5V at terminal 4 is also fed through D405 and R425 to the base of Q401, turning it ON which activates DOOR RELAY K401, which now connects the high side of the Door Speaker(s) through the relay contacts and J/P2-4 to the Audio Output. The other side of the Door Speakers will be connected through common to OUTPUT GROUND.

(6.3) The 11.5V at terminal 9 is fed through D409 to the MUTING and KEY CLICK SUPPRESSION circuits. These circuits operate as described in (5) above.

(6.4) The 11.5V from terminal 9 is also fed through R416; J/P2-9 and to Audio Switching diode D501 — turning it ON. Talking into the originating I/P Speaker, will result in the audio signal bypassing R1 through C1; through the turned on diode D501; J/P3-1; J/P2-9; C402; and J/P2-6 to the high side of T201. The common from the originating I/P Speaker is connected to the INPUT GROUND.

(6.5) Both the Door Speaker and I/P audio signal will be heard at all other I/P Speakers when they are in RADIO/INTERCOM mode, and at the Master Unit Speaker.

(7) When the I/P TALK switch in an I/P Speaker is activated point "X" is connected through R502 and D505; through the I/P TALK switch and the speaker voice coil; and then through common to the INPUT GROUND. The voltage at "X" goes to 2 volts and IC401C and IC401D are turned ON. The voltage at IC401 terminal 5 goes to 13.5 volts and at terminal 9 goes to 13 volts.

(7.1) The 13.5 volts from terminal 5 is fed through D402 and R426 to the negative (-) terminal of IC401B and through D404 and R425 to the negative terminal of IC401A keeping these amplifiers clamped OFF.

(7.2) The 13 volts from terminal 9 is fed through D409 to the MUTING and KEY CLICK circuit as described in (6.3) and (5) above. It is also fed to D501 turning it ON.

(7.3) The audio signal from the originating speaker is fed through the SILVER and CENTER (INPUT and COMMON) leads and through the turned on D501 to the Intercom Input Transformer T201.

(7.4) Audio signals sent from the I/P Speaker will be heard at all other IP Speakers in RADIO/INTERCOM mode and through the Master Unit Speaker.

(8) The Master Unit's DOOR LISTEN: DOOR TALK: and I/P TALK operations are the same as for an I/P Speaker, EXCEPT: Its control line is fed through control diode D508; and its "Talk" path is through Audio Switching diode D504.

(9) The Master Unit Speaker is always in RADIO/INTERCOM mode. It can be silenced both for talking and listening by turning its volume control R101 to minimum (full counter-clockwise). Do Not turn past "Click" except when turning entire system OFF.

(10) MASTER UNIT INSIDE LISTEN: When S103 is activated, all I/P Speakers that are in RADIO/INTERCOM mode will have one side (OUTPUT SILVER) connected through J/P3-7; one side of S103; J/P3-5 to Audio Switching diode D504 and the I/P TALK INPUT LINE; J/P2-9; C402; and J/P2-6 to the high side of T201.

(10.1) D504 is turned ON by the CONTROL LINE being connected through R502 and D508; J P3-5; S103; J/P3-7; out the SILVER lead to the I P Speakers and then through common to INPUT GROUND. This causes point "X" to go to approximately 2 volts-turning ON IC401C and IC401D. (S103 in effect acts as an I/P TALK switch in the I/P Speakers. The I/P Speaker(s) will now talk back through the INPUT, SILVER wire through S103.

(10.2) The MUTING and KEY CLICK SUPPRESSION acts the same as in any other intercom function.

(10.3) The Master Unit Speaker remains connected between audio output and OUTPUT GROUND.

(10.4) If the Control Module is removed from the chassis, the MUTING operation can be checked by depressing S103. The MUTING LINE (B) will be connected through S103 to the base of Q204-silencing the entertainment program.

(10.5) When S21 in the IS-37 Clock Timer Control is closed the MUTING LINE (B) voltage will be connected to base of Q204.

## TERMINAL BOARD

SEE SCHEMATIC DIAGRAM PAGE 12

(1) Provides convenient connecting points for wires and cables from auxiliary equipment.

(1.1) CHIME/ALARM INPUT: One wire to this terminal and other wire to one of the COMMON terminals. The high side is connected through isolating resistor R501; and J/P3-3 to the high side of T201. The common side is connected to INPUT GROUND.

(1.2) DOOR SPEAKER: One side to DOOR terminal and other side to one of the COMMON terminals. The high side is connected through J/P3-6; and J/P2-7 to the common terminal of DOOR RELAY K401. The common side is connected to INPUT GROUND or OUTPUT GROUND, depending on its operation.

(1.2.1) Two or three Door Speaker(s) may be connected to the DOOR terminal and the same COMMON terminal. All Door Speakers are operated in the same mode at any one instant.

(1.3) I/P SPEAKERS: Maximum of 12 I/P Speaker Controls may be connected in the system.

(1.3.1) EACH I/P SPEAKER CONTROL'S COMMON (CENTER) CONDUCTOR MUST BE CONNECTED TO AN INDIVIDUAL COMMON TERMINAL. IN INSTALLATIONS REQUIRING MORE THAN (8) EIGHT REMOTE SPEAKERS, (2) TWO COMMON (CENTER) CONDUCTORS MAY BE PLACED UNDER ANY OF THE TERMINALS LABELED C1 THROUGH C4.

(1.3.2) The OUTPUT (SILVER) conductor from each I/P Control should be connected to an individually numbered OUTPUT (SILVER) terminal. In systems with more than 8 I/P Controls, the SILVER leads from two I/P Controls may be connected to the same OUTPUT terminal. Speakers connected to the same terminal will be operated in the same mode as determined by the setting of the corresponding Station Selector Switch (S501—S508).

(1.3.3) The INPUT (COPPER) wire from each I/P Control should be connected to an individual INPUT terminal.

(1.3.4) When four or less I/P Controls are used, connect the COPPER wires to only one of each pair of COPPER terminals. Divide the load.

(1.3.5) When more than eight I/P Controls are used, connect the COPPER wire from two I/P Controls to the same terminal, again dividing the load.

(2) STATION SELECTOR SWITCHES S501—S508: Control the operating mode of the I/P Speakers connected to the corresponding OUTPUT terminal.

(2.1) Position 1, LISTEN IN: Connects the I/P Speaker's OUTPUT (SILVER) wire through J/P 3-3 to the high side of T201. The common side will be connected to INPUT GROUND.

(2.1.1) Any sounds in the vicinity of speaker(s) in this mode will be amplified through the system and will be heard by the Master Unit Speaker; and by other I/P Speakers that are in RADIO/INTERCOM mode. Signal should override the entertainment program.

(2.1.2) For Additional override, decrease the volume of the entertainment program by adjusting LEVEL SET CONTROL R216 on the Amplifier/Power Supply Module. This will increase the intercom to entertainment volume ratio. The level of both signals may be readjusted with the ALL SPEAKER VOLUME CONTROL R103.

(2.1.3) Speakers in this mode will not hear: Chime/Alarm signals; the entertainment program; nor messages sent by the Master Unit and by other I/P Speakers.

(2.1.4) Activating the TALK and LISTEN switches of speakers in the LISTEN IN mode will activate the comparator amplifiers, muting and key click

suppression the same as when speaker is in RADIO/INTERCOM mode.

(2.1.5) The I/P Speaker will be able to talk to the Door Speaker with muting, but will not be able to hear the Door Speaker answer.

(2.1.6) The LISTEN IN speaker will be able to talk to the Master Unit and to other I/P Speakers that are in RADIO/INTERCOM mode but, will not be able to hear their answer.

(2.2) Position 2, OFF: I/P Speakers in this mode will not be able to hear any signals from any source.

(2.2.1) These I/P Speakers can activate the comparator amplifier(s), muting and key click suppression, and can talk to: The Door Speaker(s); the Master Unit Speaker; and to other I/P Speakers that are in RADIO/INTERCOM mode. BUT, THEY CANNOT HEAR ANY REPLY.

(2.3) Position 3, RADIO/INTERCOM: I/P Speakers in this mode have full intercom capability; can hear Chime/Alarm Signals; and can hear entertainment program.

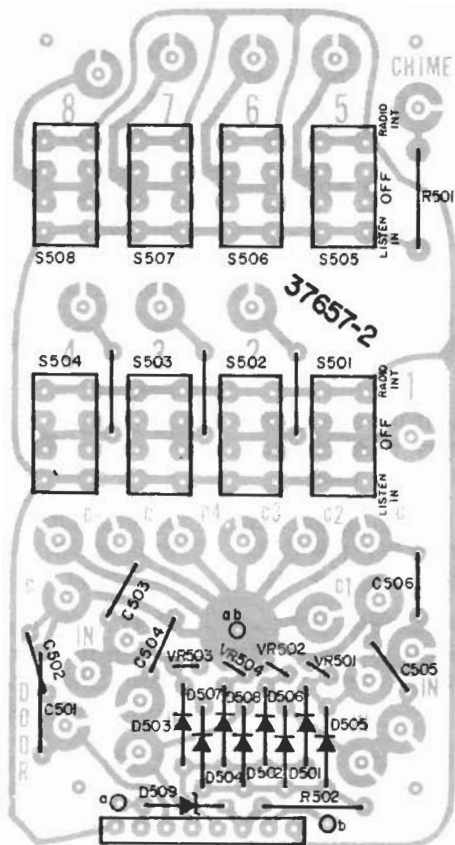
(2.3.1) They will receive signals from other I/P Speakers that are in the LISTEN IN mode or OFF mode.

(3) The Control Line is protected from high voltages, that may be built up by static etc., by 36V Zener diode D509.

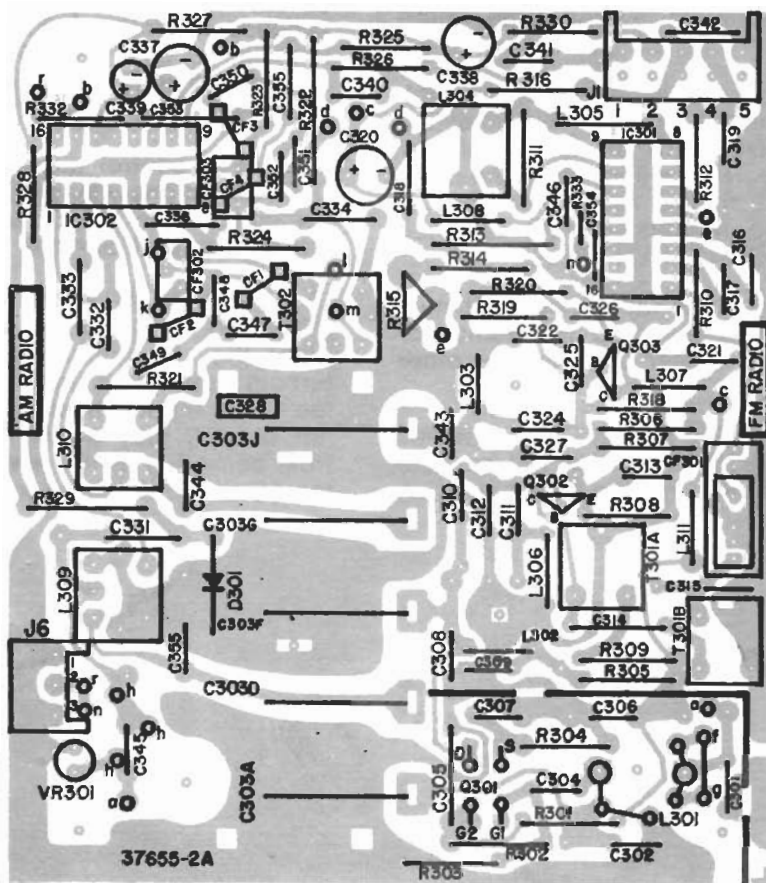
(3.1) The INPUT (COPPER) line is protected from voltages in excess of 90 volts by the voltage regulator lights VR501—VR504. This will protect the control and audio switching diodes D501 and D508 from excessive reverse voltages.

(3.2) The control diodes D505, D506, D507 and D508 act as one-way switches for the Control Line voltages to the I/P Speakers D508 also serving the Master Unit Speaker.

(3.3) The audio switching diodes, D501, D502, D503 and D504 act as one-way audio switches. When they are forward biased, they allow the intercom signal from the various I/P speakers to be fed to the Input Transformer T201. When they are not biased, they prevent any noise on the line from being fed to the amplifier. D504 also serves the Master Unit Speaker.

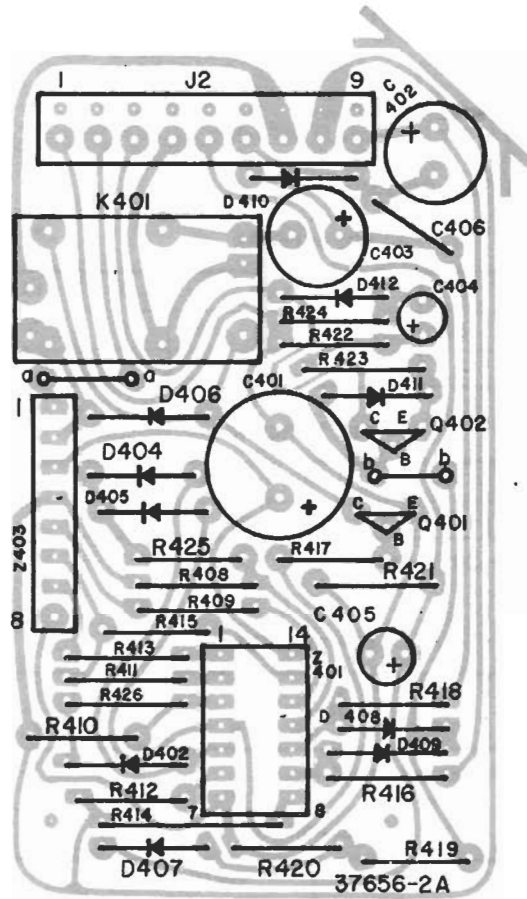


TERMINAL BOARD COMPONENT LAYOUT

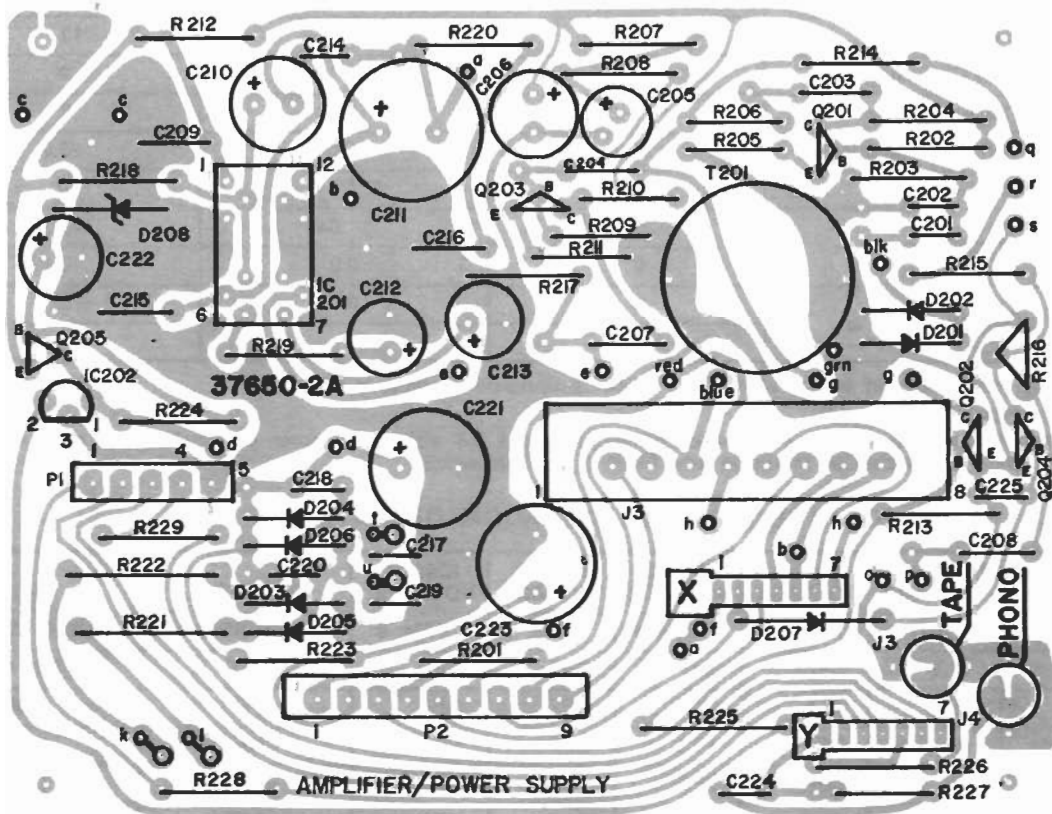


A-M/F-M TUNER COMPONENT LAYOUT





CONTROL MODULE COMPONENT LAYOUT



AMPLIFIER/POWER SUPPLY COMPONENT LAYOUT

### OPERATING VOLTAGES

INPUT: 120 Vac, 60 Hz.  
 AC TO BRIDGE Z201: 17 Vac, 60 Hz.  
 BRIDGE DC OUTPUT: Vcc = 23 Vdc (Measure at J/P2-2)  
 Regulated = 11.5 Vdc (Measure at J/P1-2)  
 R103 VOLUME CONTROL: Minimum  
 S102 SELECTOR SWITCH: AM (No Signal, Tune Off Station.)

#### PIN NUMBER

DEVICE	1	2	3	4	5	6	7	8	9	10	11	12	TABS
IC201	15.5	15.2	0	15.2	.75	1.3	8.1	.02	0	0	0	7.75	0
IC202	23	12.0	0										

#### PIN NUMBER

DEVICE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
IC302	0.9	1.5	10.9	0.7	0	8	1.5	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)

#### PIN NUMBER

DEVICE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
IC301	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.

#### ELEMENT

DEVICE	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		4.2
Q201	I.C. Preamp	.09		0.6		13
Q202	Key Click Suprsn.	0		0*		0
Q203	1st Audio Amp.	.45		1.0		8
Q205	Voltage Regulator	15.5		16.0		23.0
Q204	Muting	0		0**		0
Q401/OFF	Door Relay	0		.049		20.1
Q401/ON		0		0.9		0.19
Q402/OFF	Key Click Suprsn.	0		0		0
Q402/ON		9.5		10		.25

(\*) 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

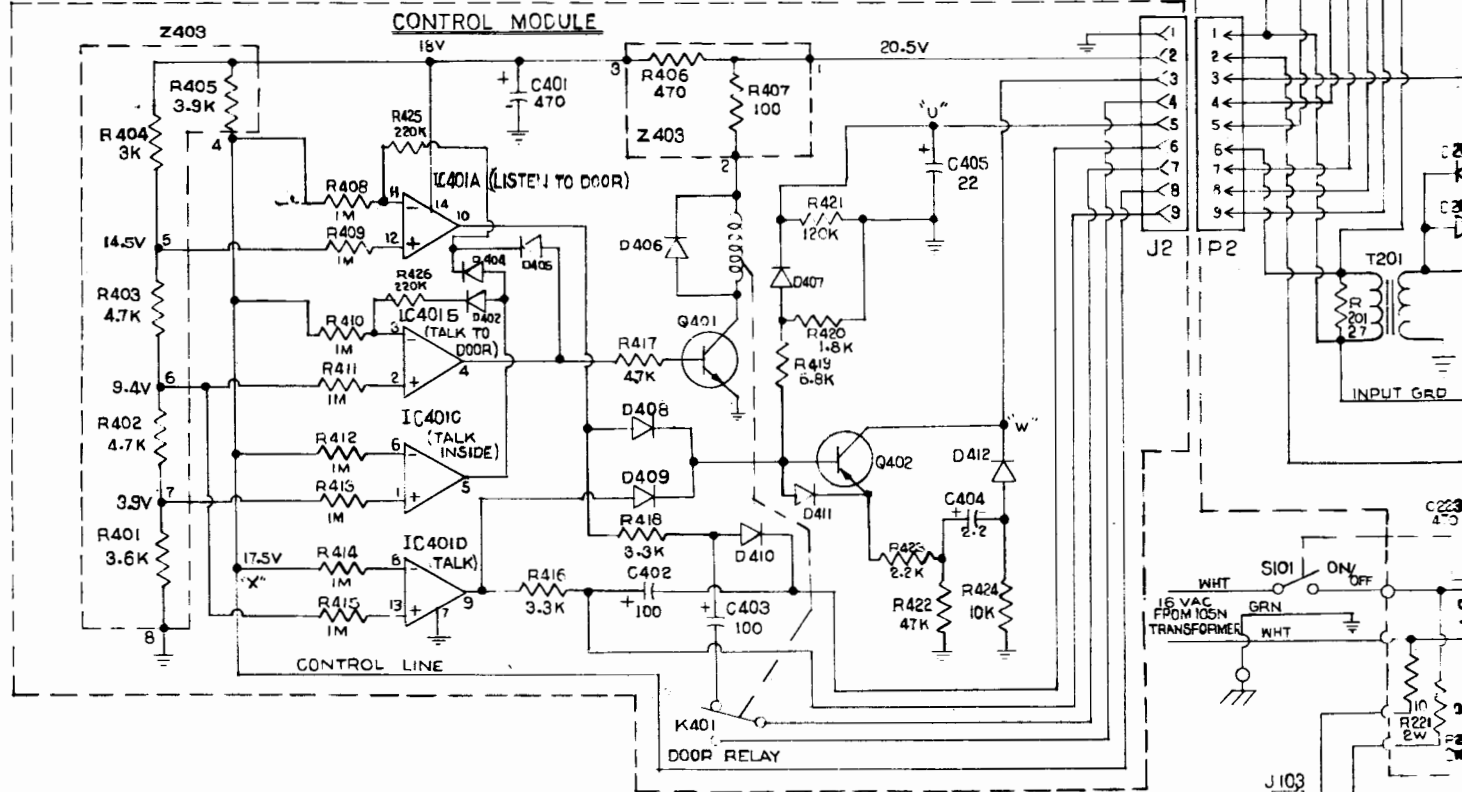
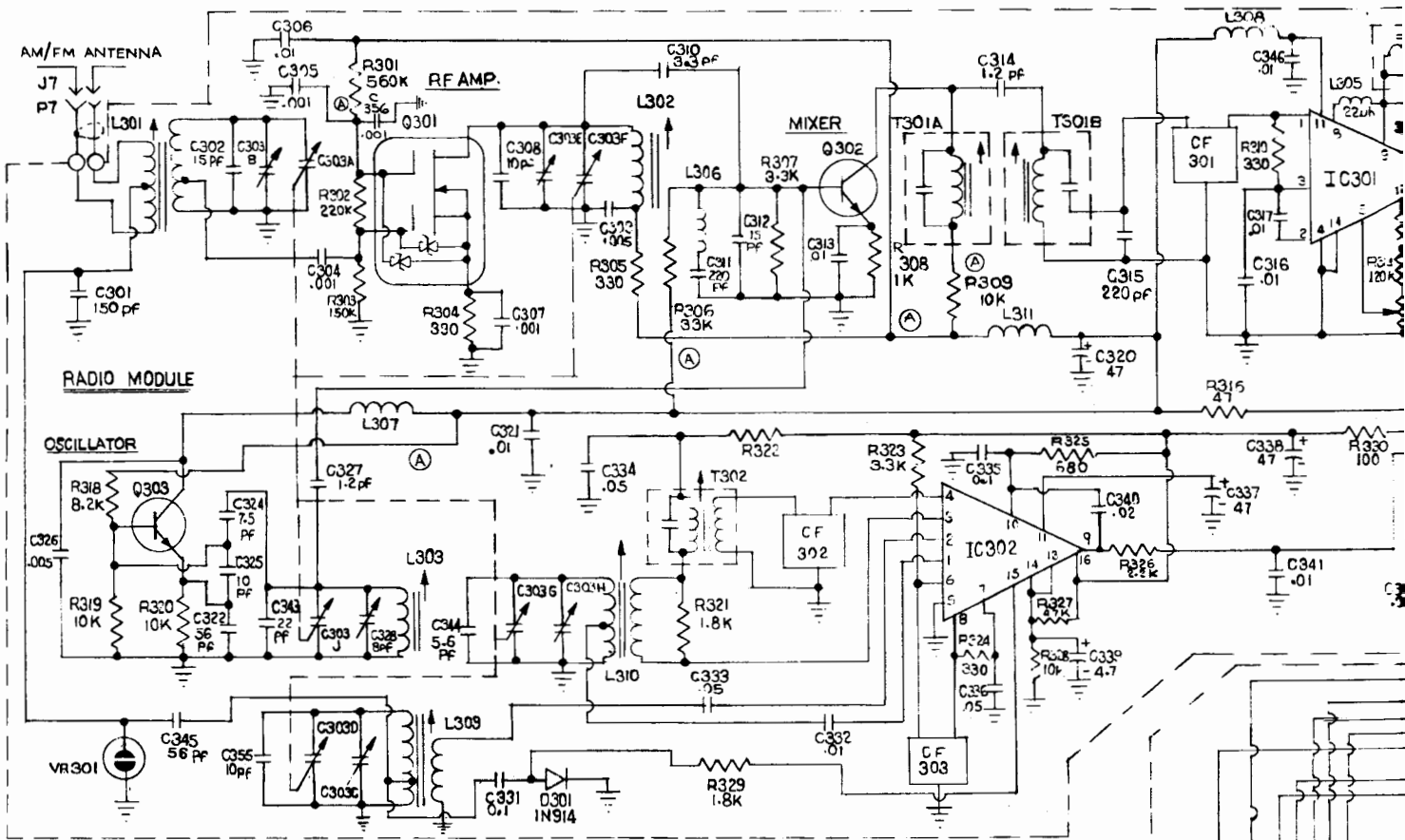
INTERCOM OPERATING	CONTROL VOLTAGE	IC401A VOLTAGE	IC401B VOLTAGE	IC401C VOLTAGE	IC401D VOLTAGE	Q401/K401	D410
MODE	POINT X	TERM. 10	TERM. 4	TERM. 5	TERM. 9	DOOR RELAY	AUDIO SWITCH
OFF	17.5	OFF	OFF	OFF	OFF	OFF	OFF
DOOR LISTEN	9.9	13.5	OFF	OFF	OFF	OFF	ON
DOOR TALK	5	OFF	11.3	OFF	11.3	ON	OFF
I/P TALK	2	OFF	OFF	13.5	13	OFF	OFF
I/P LISTEN (MASTER ONLY)	OFF	OFF	OFF	OFF	OFF	OFF	OFF
MUTING VOLTAGE AT J2-5 = 1.4V; at Q204 Base = 0.7V							

**PARTS LIST - IMA - 303 - 313 - 323  
MASTER UNIT**

ALL RESISTORS ARE CARBON FILM UNLESS OTHERWISE SPECIFIED. ¼ WATT CARBON RESISTORS MAY BE SUBSTITUTED AND ARE AVAILABLE FROM LOCAL ELECTRONIC OUTLETS.

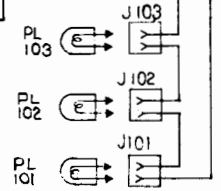
Schematic Symbol	NuTone Part No.	Description
<b>AM/FM TUNER MODULE</b>		
	41881-000	Complete Ass'y
<b>DIODES</b>		
D301	36651-000	Silicon Switching, 50ma DC 75PIV 1N914(TI-1N4148)
<b>RESISTORS</b>		
R301	33082-564	560K ¼ Watt
R302	33082-224	220K ¼ Watt
R303	33082-154	150K ¼ Watt
R304	33082-391	390 ¼ Watt
R305, R310, R322, R324	33082-331	330 ¼ Watt
R306	33082-333	33K ¼ Watt
R307, R311	33082-392	3.9K ¼ Watt
R308	33082-102	1K ¼ Watt
R309	33082-103	10K ¼ Watt
R312	33082-272	2.7K ¼ Watt
R313	33082-471	470 ¼ Watt
R314	33082-124	120K ¼ Watt
R315	34043-000	500K Trim Pot FM Squelch
R316	33082-470	47 ¼ Watt FM Squelch
R318	33082-822	8.2K ¼ Watt
R319, R320, R328	33082-103	10K ¼ Watt
R321, R329	33082-182	1.8K ¼ Watt
R323	33082-332	3.3K ¼ Watt
R325	33082-681	680 ¼ Watt
R326	33082-222	2.2K ¼ Watt
R327	33082-473	47K ¼ Watt
R330	33082-101	100 ¼ Watt
<b>CAPACITORS</b>		
C301	35100-174	150pf
C302, C312	35101-142	15 pf
C303A-J	35092-000	Variable AM/FM Tuning Gang
C304, C307	35100-120	.001mfd
C305	35100-173	.001mfd
C306, C313, C316, C317, C321, C332, C341, C346	35100-139	.01 mfd
C308, C325, C355	35101-140	10pf
C309, C326	35100-138	.005mfd
C310	35101-134	3.3pf
C311, C315	35100-125	220pf
C314	35101-147	1.2pf

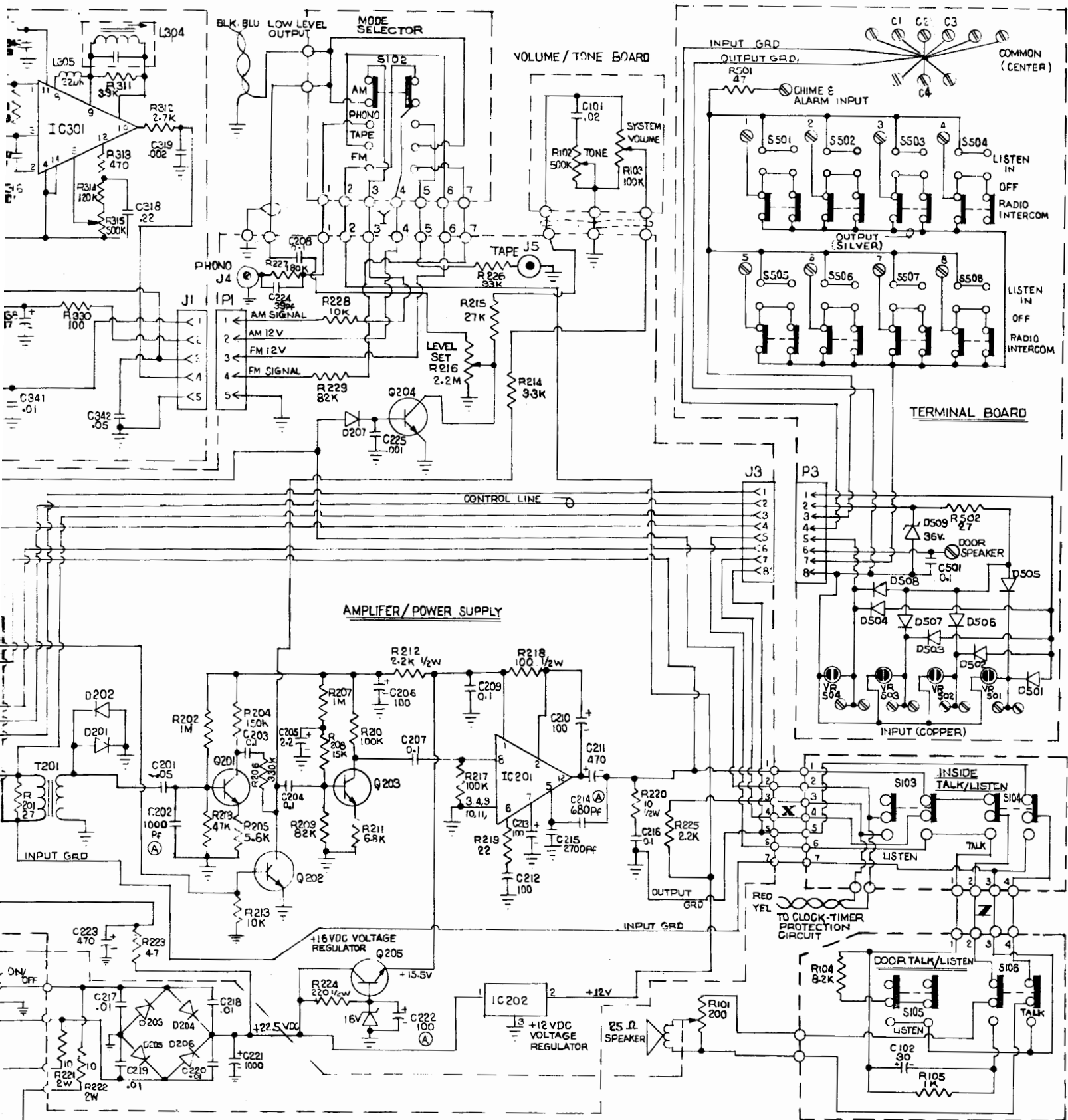
Schematic Symbol	NuTone Part No.	Description
C318	35076-101	.22mfd
C319	35100-156	2200pf
C320, C337, C338	35091-109	47mfd @ 16V, Electrolytic
C322, C344	35101-141	5.6pf
C324	35101-135	7.5pf
C327	35101-126	1.2pf
C328	35090-000	1-8pf Variable Osc. Hi Freq. Trimmer
C331, C335	35076-106	.1mfd
C333, C334, C336, C342	35100-141	.05mfd
C339	35091-103	4.7mfd @ 25V Electrolytic
C340	35076-108	.02mfd @ 16V
C343	35101-148	22pf
C345	35100-175	56pf
C356	35100-120	.001 mfd. (on Foil Side of P/C Board)
<b>COILS AND TRANSFORMERS</b>		
L301	30087-000 30086-000 30096-000	FM Ant. Primary FM Ant. Tap FM Ant. Secondary
L302	30097-000	FM RF
L303	30088-000	FM Osc
L304	30092-000	10.7MHz Quadrature
L305	30091-101	22µh RF Coil
L306, L307, L308, L311	30062-000	10.7MHz Trap Coil
L309	30597-000	AM Ant
L310	30598-000	AM Osc
	Alternate 30599-000	Alternate
T301A	30590-000	10.7MHz FM IF Primary
T301B	30591-000	10.7MHz FM IF Secondary
T302	30589-000	455KHz AM IF
<b>FILTERS</b>		
CF301	36088-000	10.7MHz FM IF Ceramic
CF301 (Alternate)	36102-000	10.7MHz FM IF Ceramic
<b>CONNECTOR</b>		
J1	39339-101	5 Pin Receptacle
<b>LAMPS</b>		
VR301	39438-000	105-125V DC/AC ¼ Watt, 1.9ma Neon - GE "Glow Lamp" C2A-ET (NE-2H3T) or Equiv.



**NOTES:**

1. ALL RESISTORS 1/4 WATT, UNLESS OTHERWISE SPECIFIED, VALUE IN OHMS, TOLERANCE ±5%.
2. ALL CAPACITOR VALUES IN MFD, UNLESS OTHERWISE SPECIFIED.
3. COMPONENT IDENTIFICATION: 100-CHASSIS MOUNTED COMPONENTS  
200-AMPLIFIER/POWER SUPPLY  
300-RADIO MODULE  
400-CONTROL MODULE  
500-TERMINAL BOARD





Schematic Symbol	NuTone Part No.	Description
<b>TRANSISTORS</b>		
Q301	36624-000	Dual Gate, FET, FM RF Amp. (3N201, 3N202, 3N203)
Q302	36578-000	NPN Epitaxial Planer Silicon FM Mixer
Q303	36581-000	NPN Planer Silicon FM Osc
<b>INTEGRATED CIRCUITS</b>		
IC301	36623-000	FM IF Detector (RCA CA3089E)
IC302	36622-000	AM Mixer, IF Detector (RCA CA3088E)
<b>CONTROL MODULE</b>		
	41883-000	Complete Ass'y
<b>RESISTORS</b>		
R408 to R415	33082-105	1 Meg ¼ Watt
R416, R418	33082-332	3.3K ¼ Watt
R417	33082-472	4700 ¼ Watt
R419	33082-682	6.8K ¼ Watt
R420	33082-182	1.8K ¼ Watt
R421	33082-124	120K ¼ Watt
R422	33082-473	47K ¼ Watt
R423	33082-223	22K ¼ Watt
R424	33082-103	10K ¼ Watt
R425, R426	33082-224	220K ¼ Watt
<b>DIODES</b>		
D402, D404 to D412	36617-000	Silicon Switching, 50ma DC 75PIV, 1N914 or 1N4148
<b>INTEGRATED CIRCUITS</b>		
IC401	36625-000	Quad Amp (Comparator) (National LM3900N-Motorola MC3301P)
<b>RESISTOR PACK</b>		
Z403	33042-000	Resistor Pack, Includes R401 to R407
<b>CONNECTOR</b>		
J2	39339-104	9 Pin Receptacle
<b>RELAY</b>		
K401	39381-000	SPDT Door Relay
<b>TRANSISTORS</b>		
Q401	36613-000	NPN Silicon (Motorola MPS-A20)
Q402	36606-000	PNP Silicon (Motorola MPS-A70)

Schematic Symbol	NuTone Part No.	Description
<b>INTERCOM SWITCHBOARD ASSEMBLY</b>		
	41887-000	Complete Assembly
<b>CONNECTOR</b>		
P3	37658-000	8 Pin Connector
<b>RESISTORS</b>		
R501	33082-470	47 ¼ Watt
R502	33082-270	27 ¼ Watt
<b>DIODES</b>		
D501 to D508	36549-000	Silicon Rectifier 1 Amp DC 100PIV IN4002
D509	36611-000	Silicon Zener 36V 1N5258
<b>LAMPS</b>		
VR501 to VR504	39438-000	105-125 AC/DC GE "Glow Lamp" C2A-T (NE-2H)
<b>SWITCHES</b>		
S501 to S508	34650-000	DP3T Slide Switch Stackpole - POS-1003
	34620-000	Alternate
<b>CAPACITORS</b>		
C501	35076-106	.1mfd.
<b>AMPLIFIER/POWER SUPPLY MODULE</b>		
		Complete Assembly (Includes the following): Door T/L Switch Ass'y, I/P Switch Ass'y, Function Switch, I/P All Speakers Volume Control, Tone Control and Pilot Lamp Sockets. Mounted on Sub Assembly Frame.
	<b>For Model</b>	<b>Order Part No.</b>
	IMA-303	1512-A
	IMA-313	1513-A
	IMA-323	1514-A
<b>DIODES</b>		
D201 to D207	36549-000	Silicon Rectifier, 1 Amp DC 100PIV 1N4002
D208	39594-000	Zener, 16V @ 15.5 ma. DC, 1 watt (1N4745)
<b>RESISTORS</b>		
R201	33082-270	27 ¼ Watt
R202, R207	33082-105	1 Meg ¼ Watt
R203	33082-473	47K ¼ Watt
R204	33082-154	150K ¼ Watt
R205	33082-562	5.6K ¼ Watt
R206	33082-334	330K ¼ Watt
R208	33082-153	15K ¼ Watt
R209	33082-823	82K ¼ Watt
R210, R217	33082-104	100K ¼ Watt

Schematic Symbol	NuTone Part No.	Description
R211	33082-682	6.8K ¼ Watt
R212, R225	33082-222	2.2K ¼ Watt
R213, R228	33082-103	10K ¼ Watt
R214	33082-332	3.3K ¼ Watt
R215	33082-273	27K ¼ Watt
R216	34023-000	2.2M Potentiometer Level Set
R218	33101-101	100 ½ Watt Carbon
R219	33082-220	22 ¼ Watt
R220	33101-100	10 ½ Watt Carbon
R221, R222	33028-100	10 2 Watt Wire Wound
R223	33082-470	47 ¼ Watt
R224	33101-221	220 ½ Watt Carbon
R226	33082-333	33K ¼ Watt
R227	33082-184	180K ¼ Watt
R229	33082-823	82K ¼ Watt
<b>CAPACITORS</b>		
C201	35076-105	.05mfd @ 25V
C202	35100-120	1000pf
C203, C204, C207, C208, C209, C216	35076-106	.1mfd @ 25V
(Alternate)	35100-127	.1mfd @ 100V
C205	35091-111	2.2mfd @ 25V Electrolytic
C206, C210, C212, C213, C222	35091-108	100mfd @ 25V Electrolytic
C211, C223	35091-105	470mfd @ 25V Electrolytic
C214	35100-164	680pf
C215	35100-169	2700pf
C217, C218, C219, C220	35076-107	.01mfd @ 50V
(Alternate)	35100-139	.01mfd @ 50V
C221	35091-107	1000 @ 35V Electrolytic
C224	35100-172	39pf
C225	35100-120	1000pf
<b>TRANSISTORS</b>		
Q201, Q203	36580-000	NPN Planar Silicon
Q202, Q204	36613-000	NPN Silicon (Motorola MPS-A20)
Q205	36614-000	NPN Power, Silicon (Motorola MJE-520)
<b>INTEGRATED CIRCUITS</b>		
IC201	36647-000	Power Amplifier SGS-ATES TBA 810S RCA CA810Q
IC202	36648-000	Voltage Regulator Fairchild 78L12 WC Motorola MC78L12CP

Schematic Symbol	NuTone Part No.	Description
<b>TRANSFORMER</b>		
T201	30593-000	Intercom Input
	32159-003	Mounting Bracket for T201
<b>PLUGS AND CONNECTORS</b>		
J4, J5	39595-000	Tape/Phono Jacks
J3	39333-101	Connector End Block 4 Pin Blue (Left).
	39333-102	Connector End Block 4 Pin Blue (Right).
P1	39338-101	Connector Post 5 Pin
P2	39338-104	Connector Post 9 Pin
<b>LAMP SOCKET ASSEMBLY</b>		
J6, J7, J8	41833-000	Socket Housing, Less Lamps
<b>SWITCHES</b>		
S103, S104	41877-000	I/P Talk/Listen Switch Complete Assembly
S105, S106	41878-000	Door Talk/Listen Switch Complete Assembly
<b>VOLUME/TONE CONTROL</b>		
R102, R103, C101	41879-000	Complete Assembly
<b>MODE SWITCH - AM/FM/TAPE/PHONO</b>		
S102	41880-000	Complete Assembly
<b>CHASSIS MOUNTED PARTS</b>		
<b>PILOT LAMPS</b>		
PL101, PL102, PL103	39330-000	Pilot Lamps - GE #259 or Equiv.
<b>DIAL CORD</b>		
	41535-000	Complete Assembly
	39262-000	Spring, Dial Pointer
	39335-000	Dial Pointer
	38603-000	Lens, Rear