SERVICE MANUAL SUPPLEMENT

NUTONE AM/FM TUNER MODULE

USED IN

MODEL SM-428

NuTone Housing Products

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REFER TO SM-428 SERVICE MANUAL

MODEL SM-428
AM/FM TUNER MODULE
(Production after July 1, 1981)

(1) When available, NuTone will supply the new AM/FM Tuner Module for use in the Model SM-428 Built-In Stereo Radio/Intercom System. Production of these new Tuner Modules is scheduled for some time after July 1, 1981. They can be identified by:

(1.1) PC Board, Part No. 37751-(suffix)

(1.2) Complete Assembly, Part No. 42568-000

(2) These new Tuner Modules are direct replacement for the original Tuner Modules used in the SM-428 Master Unit.

(3) When the SM-428 Master Unit's PROGRAM SELECTOR SWITCH S111R is in the FM position, the regulated 12Vdc is connected from the Voltage Regulator Z101-2, on the Master Unit Parent Board, through S111R-6 and S111R-4: and P101/J1-3 to the FM Section on the Tuner Module. The AM Section is not powered.

(3.1) The FM recovered audio — NOT DE-EMPHASIZED — is fed from IC301-6, through R318; J1/P101-4; and J103/P701-5 to the FM Multiplex Decoder.

(3.2) The FM Tuning Signal Voltage is fed from IC301-13, through R322; J6/P107-2; and jumper ⓐ — ⓐ to one side of the TUNING METER I103. The other side of the meter is connected through jumper ⓑ — ⓑ and P107/J6-3 to ground.

(4) When S111R is in the AM position, the regulated +12Vdc is fed from Voltage Regulator Z101-2, through S111R-6 and S111R-5; and P101/J1-2 to the AM Section of the Tuner Module. The FM Section is not powered.

(4.1) The recovered preamplified AM audio is fed from IC302-15, through J1/P101-1 to channel B's S111R-11, and to channel A's S111F-10.

(4.1.1) Channel B's AM signal is fed from S111R-11, through S111R-12; and J107/P602-28 to the channel B audio preamplifier.

(4.1.2) Channel A's AM signal is fed from S111F-10, through S111F-3; and J105/P601-5 to the channel A audio preamplifier.

(4.2) The AM Tuning Signal Voltage if fed from IC302-12, through R341; J6/P107-2; and jumper ⓐ — ⓐ to one side of the TUNING METER I103. The other side of the meter is connected through jumper ⓑ — ⓑ and P107/J6-3 to ground.

(5) When the PROGRAM SELECTOR SWITCH S111 is in the AUX, PHONO, or TAPE position, neither the AM nor FM tuner sections will be powered.

(6) When measuring operating voltages, at J1-2 for AM, or at J1-3 for FM, make certain that these terminals are not shorted to other terminals nor to ground. If shorted, the Voltage Regulator Z101, on the SM-428 Master Unit Parent Board, may be damaged.

(7) Use the same care when measuring signal levels at J1-2 (AM) or J1-4 (FM) during checking and/or alignment procedure.

(8) FM TUNER:

(8.1) The FM signal is fed from the antenna, through the coaxial lead-in to the primary of the antenna transformer T301.

(8.1.1) The transformer is center-tapped to FM RF ground through C301, and at FM frequencies (88-108 MHz.), the transformer T301, when properly adjusted, acts as a balanced input, matching the impedance (Zo) of the antenna lead-in.

(8.2) The FM RF amplifier Q301 (Dual-gate MOSFET) is operated tuned-gate, tuned drain — resulting in a high-gain, low-noise stage.

(8.3) The FM RF signal is fed from a tapped section of the FM antenna transformer secondary, through C304 to G1 of Q301. The gate tuned circuit is varied, between 88-108 MHz., by tuning section C303A of the ganged tuning capacitor.

(8.3.1) C303B is the high-frequency trimmer, and tuning slug of T301 is adjusted for transformer coupling and low-frequency padding.

(8.4) The FM RF signal is amplified through Q301 and loaded by the drain's RF tank circuit. The tank's resonant frequency is adjusted between 88 and 108 MHz. by adjusting section C303E of the ganged tuning capacitor. C303F is the high-frequency trimmer.

(8.4.1) The RF transformer T305 supplies inductance for the tank circuit and it is tuned for coupling and low-frequency padding by adjusting its tuning slug.

(8.4.2) The ferrite bead, L302 on Q301's drain lead help to suppress parasitic signals.

(8.5) The tuned RF signal is coupled by the secondary of T305, through C356, to the base of the FM mixer Q302.

(8.6) Q303 and its associated circuit is the FM local oscillator, whose frequency should be 10.7 MHz. (the FM IF frequency) higher than that of the FM RF carrier signal to which the FM RF stage is tuned.

(8.6.1) The oscillator frequency is adjusted by tuning section C303I of the ganged tuning capacitor.

(8.6.2) C330 is adjusted for high-frequency trimming, and the oscillator coil L309's slug is adjusted for low frequency padding.

(8.6.3) The oscillator output is coupled through C331 to the base of the FM Mixer Q302.

(8.7) The mixer Q302 beats the FM RF signal and the local oscillator signal, and its collector is loaded by the 10.7 MHz. IF tank circuit T301A.

(8.8) Q302's output is coupled through C315 to the tuned (10.7 MHz.) circuit T301B and fed to the input of the ceramic filter CF301-1.

(8.9) The ceramic filter CF301 is rated at 10.7 MHz. with a 3 db bandwidth of 200-280 KHz, which is 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.

(8.10) The output of the ceramic filter CF301-3 is connected to the input pins 1 and 2 of the first (of three) differential IF amplifier/limiters on-board the FM integrated circuit IC301.

(8.11) 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 detection; a delayed AGC control voltage (pin 15); an audio amplifier and noise squelch circuit; and when desired an FM tuning voltage (pin 13).

(8.11.1) A complete explanation of this device (RCA Type CA3089E) is available in the linear integrated circuit technical literature that is published by the manufacturer.

(8.12) Pin 3 is DC Feedback from output of the 3rd IF amplifier/limiter.

(8.13) The delayed AGC voltage at pin 15 is constant until the input to the chip is high enough so that the first IF stage approaches limiting.

(8.13.1) When the input to the RF stage Q301 increases to where the first IF stage on the chip is limiting, the AGC voltage to G2 of Q301 changes in a negative direction, decreasing the forward bias on G2, which reduces Q301's output.

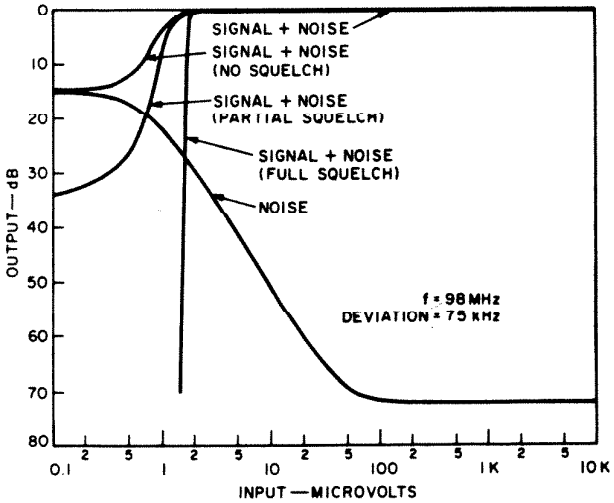
(8.13.2) Until the signal voltage to the chip reaches this threshold (approximately 100 mV), no AGC action occurs. The on-board level-set and limiting in conjunction with the AGC will maintain a minimum of 35 db a-m rejection.

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

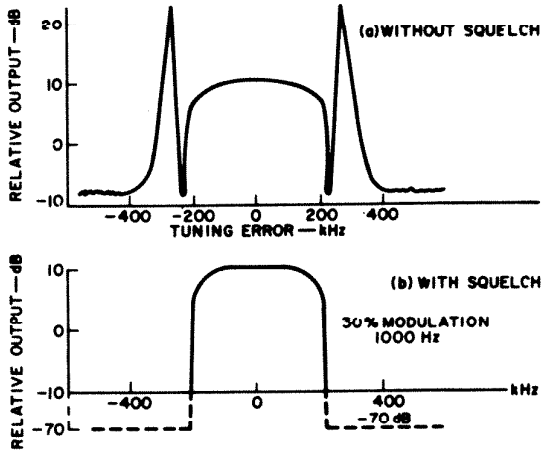
(8.15) A meter output voltage is available from pin 13. The meter voltage maintains approximately uniform sensitivity over the entire signal input range to provide a linear-log display of the signal strength. (See paragraph (3.2) above.)

(8.16) The recovered audio is not de-emphasized in order to provide the left and right channel pilot tones to the FM multiplex decoder circuit when FM stereo signals are received.

(8.16.1) The FM Multiplex Decoder Module circuit automatically switches between stereo and monaural FM operation.



S + N AND N FOR NO SQUELCH; PARTIAL SQUELCH; AND FULL SQUELCH PLOTTED AGAINST RF INPUT



TYPICAL TUNING CHARACTERISTIC: (a) WITHOUT SQUELCH; AND (b) WITH SQUELCH, SHOWING THE SUPPRESSION OF SIDE RESPONSE CHARACTERISTIC OF LIMITER – DISCRIMINATOR RECEIVERS

(9) FM SQUELCH CONTROL R315:

(9.1) The Receiver is supplied, from the factory, with the SQUELCH CONTROL R315 set at maximum position, i.e. with full squelch.

(9.2) When sufficient (normally excess of 5 microvolts) FM broadcast band RF signal is fed to the input of the FM tuner, it will operate with full limiting and the setting of R315 will not effect the quantity nor quality of the recovered audio signal, and the signal-to-noise ratio will be in the order of 45 db. As the input increases, the signal-to-noise ratio will rise to the order of 70 db.

(9.3) When there is sufficient RF signal and the squelch can be operated at maximum, the sideband response that is characteristic of limiter-discriminator FM operation will be eliminated. The receiver will be quiet when tuned between stations, and the tuning is as easy and unambiguous as in an AM receiver, and this is without resorting to AFC. This eliminates AFC pull from a strong station when attempting to tune to a weak station.

(9.3.1) The FM oscillator in this system has been designed with quality components and with the use of the regulated voltage supply, should be practically free of drift under normal operating conditions, and AFC is not required.

(9.3.2) Since AFC is not required, the on-board AFC transistors' collectors are connected through pin 7 to the quadrature reference at pin 10. This increases stability and will assist in eliminating any distortion that may result if the AFC collectors are allowed to float.

(9.4) When the RF input is below 5 microvolts, due to: distance from transmitter (fringe area); poor receiving antenna; shielded RF area; etc., there may not be sufficient signal to drive the set to limiting, and it will require that the squelch control be set to a lower point.

(9.4.1) This may improve listening satisfaction, but conversely, the receiver may be operating at a point where the signal-to-noise ratio has deteriorated and the recovered audio is not acceptable.

(9.5) 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.

(9.6) Adjustment of the SQUELCH CONTROL R315 primarily changes 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 AM/FM Tuner Module.

(9.7) IN THE FIELD ADJUSTMENT OF THE SQUELCH CONTROL R315: (See paragraphs (12.3) through (12.4.3.1) below.)

(9.7.1) On the Master Unit's front panel, set the VOLUME ALL SPEAKERS CONTROL R101/R102 and the TONE CONTROLS for normal operation.

(9.7.2) Set SQUELCH CONTROL R315 to MINIMUM, i.e. no squelch.

(9.7.3) Tune the Receiver to the weakest FM station that the homeowner would normally be expected to receive.

(9.7.4) If the weak station's reception is acceptable, advance the SQUELCH CONTROL R315 until it interferes with reception of the station, then, back the control until reception is again acceptable.

(9.7.5) When in normal operation the FM tuner is properly aligned and the received signal is too weak to permit full squelch operation, if possible the RF signal input to the receiver should be increased.

(9.7.5.1) This may be accomplished by changing the position of the inside antenna that is supplied with the Receiver; installation of an outside antenna, and if required, a directional antenna with an antenna rotor. In some cases, increasing the height of the existing antenna will increase the input sufficiently.

(9.7.6) REMEMBER, WITH A PROPERLY ALIGNED FM TUNER, SUB-PAR OPERATION OF THE SQUELCH CIRCUIT IS GENERALLY DUE TO INSUFFICIENT FM SIGNAL INPUT.

(10) AM TUNER:

(10.1) The AM signal is fed from the center-tap of T301, through C354, to the primary of the AM antenna RF transformer T302, where it is coupled to the AM RF amplifier Q304's tuned-gate (G1) circuit.

(10.2) G1's tuned circuit is adjusted by tuning section C303C of the ganged tuning capacitor. C303D is the high-frequency trimmer, and the tuning slug of T302 is adjusted for transformer coupling and low-frequency padding.

(10.3) The AM signal is amplified by Q304 and fed through C339 to the input (pin 2) of the AM integrated circuit IC302. Pin 2 is to the base of the on-board oscillator/converter.

(10.3.1) The ferrite bead L311, on Q304's drain lead, helps to suppress parasitic signals.

(10.4) IC302 is a monolithic integrated circuit (RCA CA3088E) which provides: AM conversion; and two (2) stages of IF amplification and detection. In this application it also supplies internal AGC to the first on-board IF stage and delayed AGC to the RF amplifier. The detector's recovered audio is preamplified.

(10.4.1) Complete specifications of the IC's operation can be found in the RCA LINEAR INTEGRATED CIRCUITS MANUAL NO. SSD-201C (and subsequent publications).

(10.5) The AM local oscillator is operated at 455 KHz. (the AM IF frequency) above the frequency of the signal to which the RF amplifier Q304's gate (G1) circuit is tuned.

(10.6) The local oscillator's frequency is adjusted by tuning section C303G of the ganged tuning capacitor.

(10.6.1) C303H is the high-frequency trimmer, and the tuning slug of T303 is adjusted for low-frequency padding and oscillator feedback coupling.

(10.6.2) The oscillator signal is fed through C348 and IC302-1 where it is injected to the emitter of the AM converter.

(10.7) The converter's 455 KHz. difference frequency is fed from IC302-3 and R339 to the IF transformer T304.

(10.8) Both primary and secondary of T304 should be adjusted to 455 KHz. There are two tuning slugs in the coil form, and both are reached from the top. Go through the top slug to the bottom slug when tuning.

(10.9) The output of the secondary of T304 is fed through C353 to IC302-4, the base of the first IF amplifier.

(10.9.1) The output of the first IF amplifier is fed from IC302-6 to the input of the ceramic filter CF302 1.

(10.10) CF302 is a ceramic filter, whose center frequency is 455 KHz. ± 2 KHz. with a 3 db bandwidth of 10 KHz. ± 3 KHz., whose frequency stability is within 0.4% from −10°C to +80°C.

(10.11) The output of the filter CF302-2 is fed to the base of the second IF amplifier at IC302-8. The second IF amplifiers feedback connects IC302-7, through R332 to the amplifiers base at IC302-8.

(10.12) The detector's output at pin 9 is fed to its AM filter, and the recovered audio is coupled through R334 and C345 to the on-board audio amplifier's base at pin 14.

(10.13) The audio signal is amplified through one stage and coupled from an emitter follower to the audio output pin 15.

(10.14) The detector's output controls the on-board first IF's AGC, and the AGC output at pin 13, to G2 of the RF amplifier Q304.

(10.14.1) As the detector conducts, pin 13 goes toward ground, the forward bias to G2 of Q304 decreases, and Q304's output decreases.

(10.15) The detector controlled AGC bus on-board the chip also controls the voltage to pin 12, which may be used to drive a tuning meter.

(10.16) Positive operating voltages (Vc) is fed to various terminals of IC302:

(10.16.1) Vcc to pin 16 is connected through on-board resistors in order to supply Vc to the audio amplifier transistors.

(10.16.2) Vcc is connected through R338 and pin 6 to the collector of the first IF amplifier.

(10.16.3) Vcc is connected through R340; the primary of T304; R339 and pin 3 to the AM mixer's collector.

(10.16.4) The RF amplifier Q304's G2 forward bias at junction of R327, R326, and R325 is connected to pin 13. This voltage at pin 13 decreases as the RF AGC is activated.

(10.16.5) Vcc is connected through R344 to pin 10. On-board, the voltage at pin 10 is regulated to 5.6V by a Zener diode. This regulated voltage (5.6V) supplies the mixer's bias level-set network, the AGC level to the first IF; and metering voltage (through a control transistor) to pin 12.

(10.16.5.1) The regulated 5.6V also supplies the second IF amplifier and the detector.

(11) RANDOM VOLTAGE PROTECTION: The 220 microhenry coil L301 has minimal d-c resistance and will drain static charges, on the antenna and lead-in, to ground.

(12) ALIGNMENT:

(12.1) The Master Unit is shipped from the factory with the AM/FM tuner completely aligned and the FM SQUELCH CONTROL R315 is set at maximum, i.e. at full squelch.

(12.2) Alignment should be checked, and if necessary, realignment attempted by qualified personnel ONLY WHEN ABSOLUTELY NECESSARY.

(12.2.1) The procedure shown for LATER PRODUCTION UNITS alignment chart is recommended for "In shop" alignment.

(12.3) The surge impedance (Zo) of different antennae and their associated transmission lines may vary.

(12.3.1) The antenna transformer L301 must be relatively broad-band to allow for the variations of Zo, and when the FM is aligned with the 50 ohm dummy antenna according to the instructions in the alignment chart, it may not exactly match the system antenna to the FM RF input.

(12.4) If FM signal appears weak when checking the squelch circuit as described in paragraphs (9.7) through (9.7.6) above, it may be possible to increase the input to the RF amplifier Q301.

(12.4.1) Tune the Receiver to an FM station.

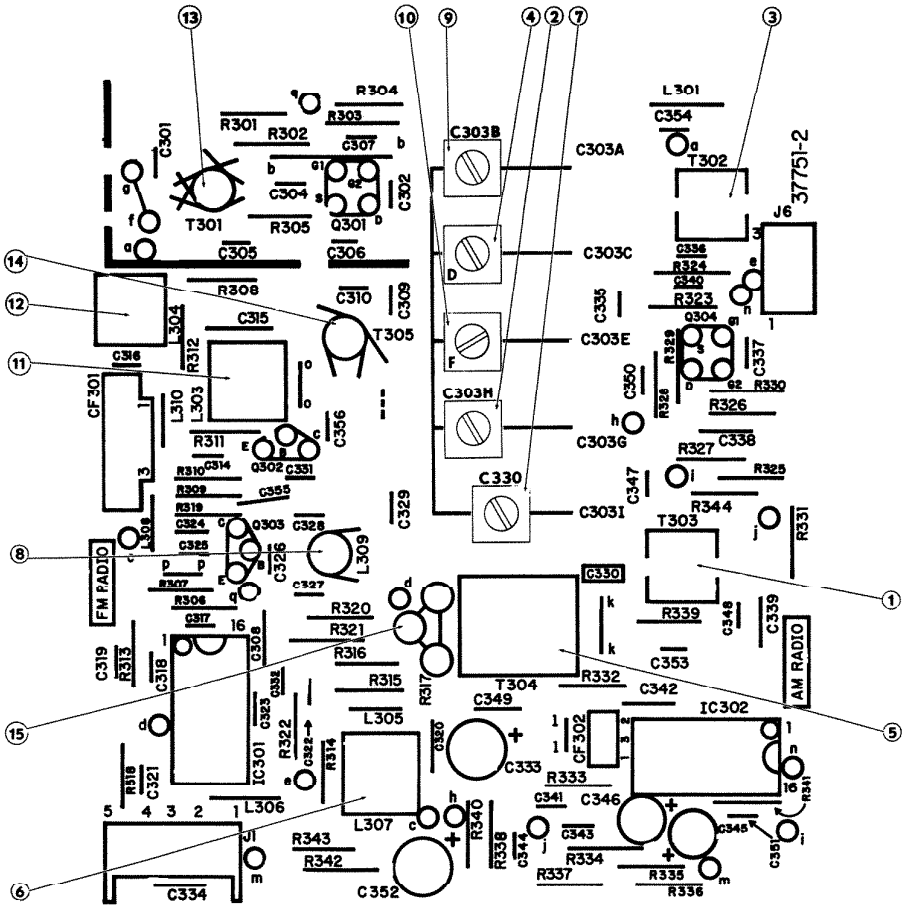
(12.4.2) Observe the TUNING METER I103 from front of SM-428 Master Unit.

(12.4.2.1) Pin 13 of IC301 supplies voltage to this meter, the voltage at pin 13 will increase with an increase of signal to the input of the RF amplifier Q301.

(12.4.3) Adjust the tuning slug of L301 for maximum reading on the TUNING METER I103.

(12.4.3.1) Only very slight adjustment should be required. If tuning seems to be too far off, realign "In shop" according to the alignment chart.

AM ALIGNMENT



TUNER (TOP OF BOARD)

LATER PRODUCTION UNITS

MASTER UNIT SETTINGS:

1. SELECTOR SWITCH S111 AM position.
2. VOLUME ALL SPEAKERS CONTROL R101/R102 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 AM audio output at J1/P1-1.
   - 1.2 Low-side (ground) of vertical input connected to receiver's circuit ground at J1/P1-5.
   - 1.3 VTVM (or other high-impedance input meter) may be used, but recommend oscilloscope so that linearity as well as amplitude of the recovered 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 a 200 pf (ceramic or mica) capacitor to shield (braid) of the coax antenna lead-in.
   - 2.3 Connect low-side (ground) of generator output to tuner module ground at RF shield.

TO PREVENT ACTIVATION OF AGC, KEEP RF SIGNAL GENERATOR OUTPUT AT MINIMUM LEVEL THROUGHOUT ALIGNMENT PROCEDURE

STEP	SIGNAL GENERATOR SETTING	RECEIVER SETTING	ADJUST	TUNE FOR
1.	537 KHz. use minimum signal level required. Do not drive tuner to AGC.	AM Tuning Dial to 537 KHz. (Ganged tuning capacitor C303 fully closed.)	(1) T302, oscillator low-frequency padder; and mixer to oscillator feedback coupling.	Maximum linear sine wave trace on scope; or maximum voltage on meter.
2.	1620 KHz. (Check level)	AM Tuning Dial to 1620 KHz. (Ganged tuning capacitor C303 fully open).	(2) C303H oscillator high frequency trimmer.	do
3.	Reducing signal generator as required: Repeat steps 1 and 2 until no further improvement can be made and oscillator tunes at both ends of AM band.			
4.	600 KHz. (Check level)	AM Tuning Dial to 600 KHz.	(3) T302 AM Antenna to RF Amplifier input Transformer.	do
5.	1500 KHz. (Check level)	AM Tuning Dial to 1500 KHz.	(4) C303D AM antenna to RF Amplifier input trimmer.	do
6.	Reducing signal generator as required. Repeat steps 3 and 4 until no further improvement can be made and RF tuning tracks across the band.			
7.	1500 KHz. (Check level)	AM Tuning Dial to 1500 KHz.	(5) T304 AM IF (455 KHz.) Transformer: primary and secondary (top and bottom slug).	do

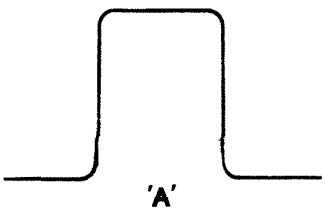
FM ALIGNMENT

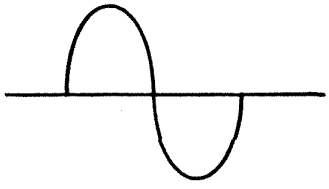
MASTER UNIT SETTINGS

1. SELECTOR SWITCH S111 in FM position.
2. VOLUME ALL SPEAKERS CONTROL R101/R102 set to desired level.
3. SQUELCH CONTROL R315 (On Tuner Module) set to minimum.

INSTRUMENTS REQUIRED:

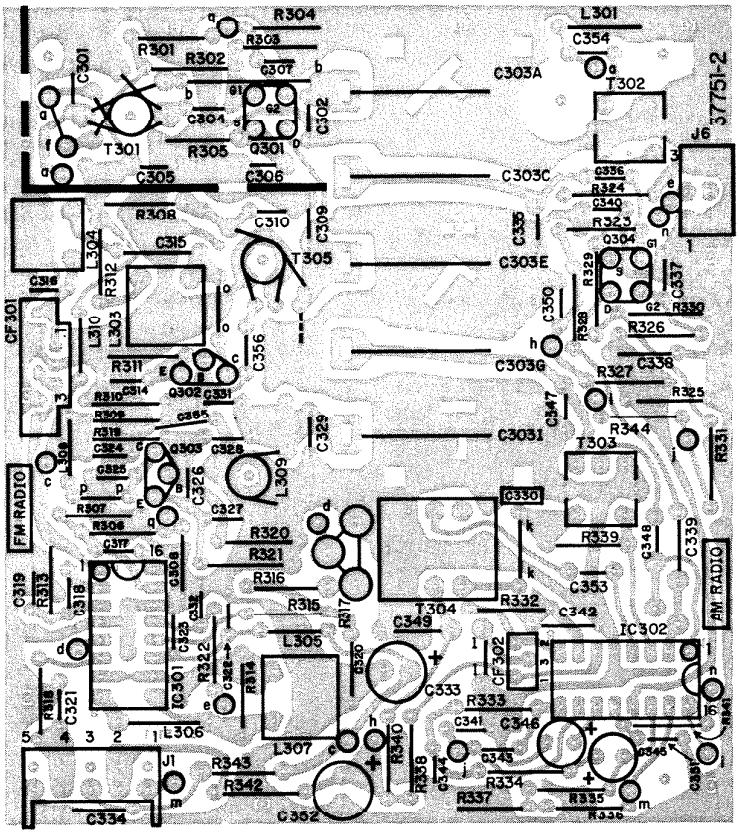
1. CATHODE RAY OSCILLOSCOPE:
   - 1.1 High-side of vertical input connected through a 15K, ½-watt resistor to tuner's FM audio output at J1/P1-4.
   - 1.2 Low-side (ground) of vertical input connected to receiver's circuit ground at J1/P1-5.
   - 1.3 Use 60 Hz. horizontal sweep. If scope does not have own 60 Hz. horizontal sweep, use exterior source.
2. FM SIGNAL GENERATOR:
   - 2.1 Modulate RF output with 60 Hz. at 400 KHz. sweep width.
   - 2.2 Connect a 50-ohm resistor across RF output of signal generator.
   - 2.3 Connect high-side of generator's output to center conductor of coax antenna lead-in.
   - 2.4 Connect low-side (ground) of signal generator's output to shield (braid) of coax lead-in.





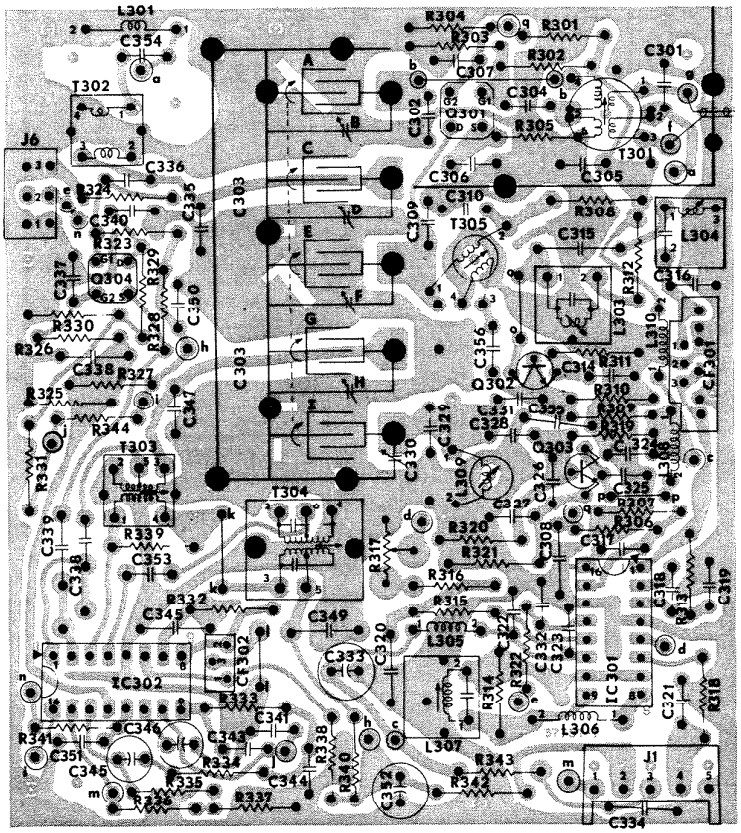
TO PREVENT LIMITING, SIGNAL GENERATOR OUTPUT LEVEL SHOULD BE AS LOW AS POSSIBLE CONSISTENT WITH GOOD TRACE ON SCOPE

STEP	SIGNAL GENERATOR SETTING	TUNER SETTING	ADJUST	TUNE FOR
1.	106 MHz. @ 2 to 5 micro-volts. (If generator does not have a calibrated output, use lowest level consistent with good trace on scope.)	Tune receiver time receiver to pick up signal generator.	(6) L307 quadrature coil. Detune coil to get wave-form "A" above. If wave is negative, reverse direction of slug detuning.	Maximum trace on scope as shown in "A" above. Sacrifice gain for linearity and flat-top. If necessary, reduce signal generator output to prevent limiting.
2.	108.5 MHz. (Check level)	FM tuning dial to 108.5 MHz. (ganged tuning capacitor C303 full open.)	(7) C330 oscillator trimmer.	do
3.	87.5 MHz. (Check level)	FM tuning dial to 87.5 MHz. (Ganged tuning capacitor C303 full close.)	(8) L309 oscillator coil. Use extreme care, adjust in small increments.	do
4.	Repeat steps 2 and 3. Oscillator should be "Rocked-in" at both ends of dial.			
5.	106 MHz. (Check level)	FM tuning dial to 106 MHz.	(9) C303B RF input trimmer. (10) C303F RF amplifier output trimmer. (11) L303 FM Mixer tank to 10.7 MHz. IF. (12) L304 FM mirer 10.7 MHz. IF coupler.	do
6.	90 MHz. (Check level)	FM tuning dial to 90 MHz.	(13) T301 antenna input transformer. Two peaks may be noted when adjusting this slug. USE THE PEAK WITH THE SLUG POSITIONED NEAR THE BOTTOM OF THE COIL. (14) T305 RF amplifier drain tank and mixer coupler.	do
7.	Repeat steps 5 and 6 until no further improvement in scope trace is noted at either setting. As the set is aligned, it may be necessary to reduce signal generator output in order to prevent FM tuner limiting.			
8.	90 MHz. (Check level, do not drive tuner to limiting.)	FM tuning dial to 90 MHz.	(6) L307 quadrature coil.	Maximum symmetrical "S" curve. See "B" above. Curve should be linear and equal distance above and below the scope's horizontal reference line.
9.	90 MHz.	FM tuning dial to 90 MHz.	Increase signal generator output until tuner goes into limiting. Should occur before signal generator output reaches 10 microvolts.	Maximum symmetrical "S" curve that does not increase in amplitude after tuner limiting is reached.
10.	Check limiting action across band: With output set at 10 microvolts tune signal generator to various frequencies across the FM broadcast band (88-108 MHz.). Adjust FM tuning dial to receive these frequencies. Linear "S" curve should remain constant in amplitude at every frequency.			
11.	Disconnect signal generator and, if used, external sweep to scope. Scope should use regular horizontal sweep. Tune receiver between stations and note noise at J1/P1-4 as seen on scope. Turn FM SQUELCH CONTROL R317 (15) clockwise to full squelch. Noise should disappear from scope and horizontal trace should be a straight line.			

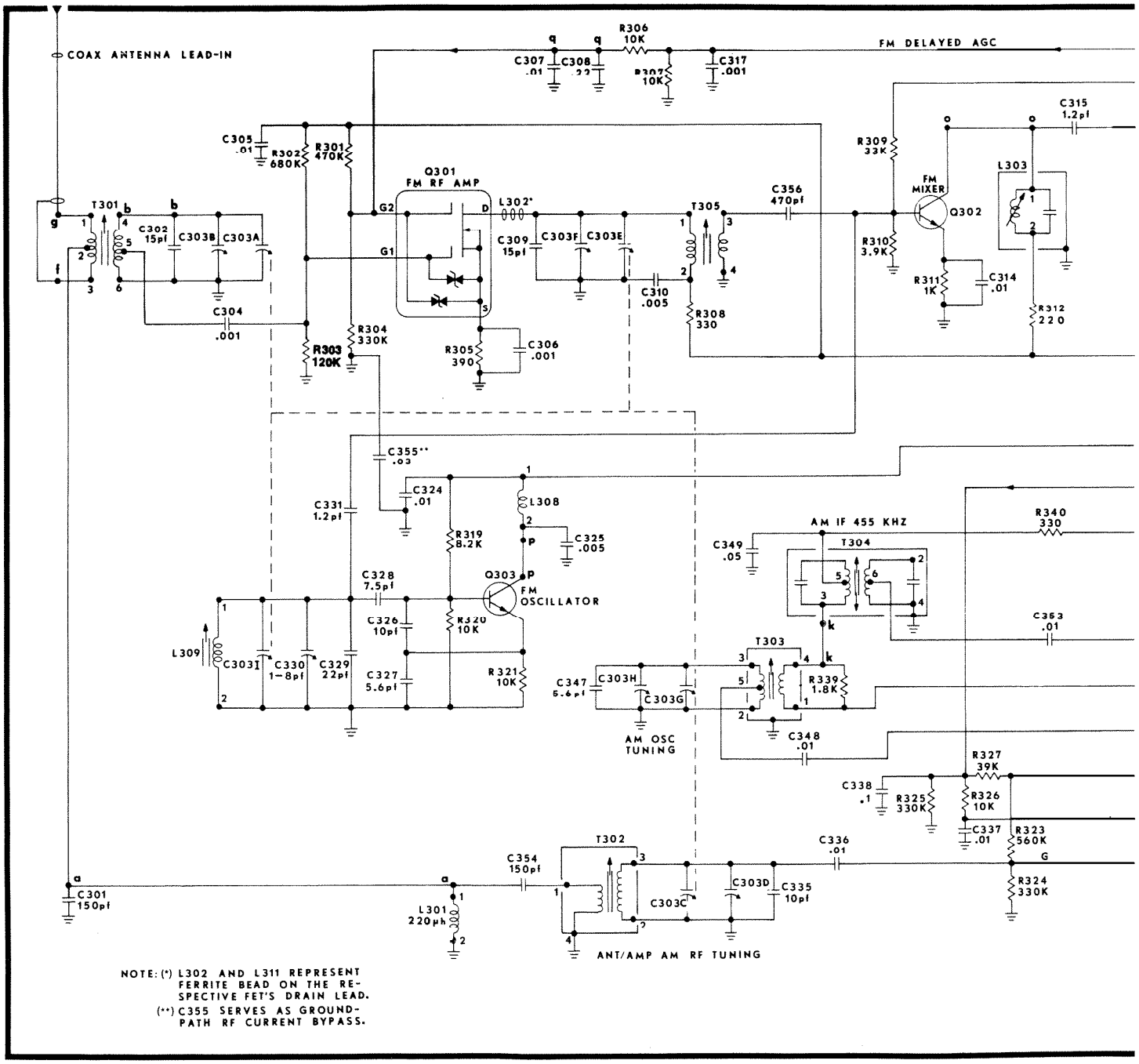


TUNER (TOP OF BOARD)

NOT USED: C321

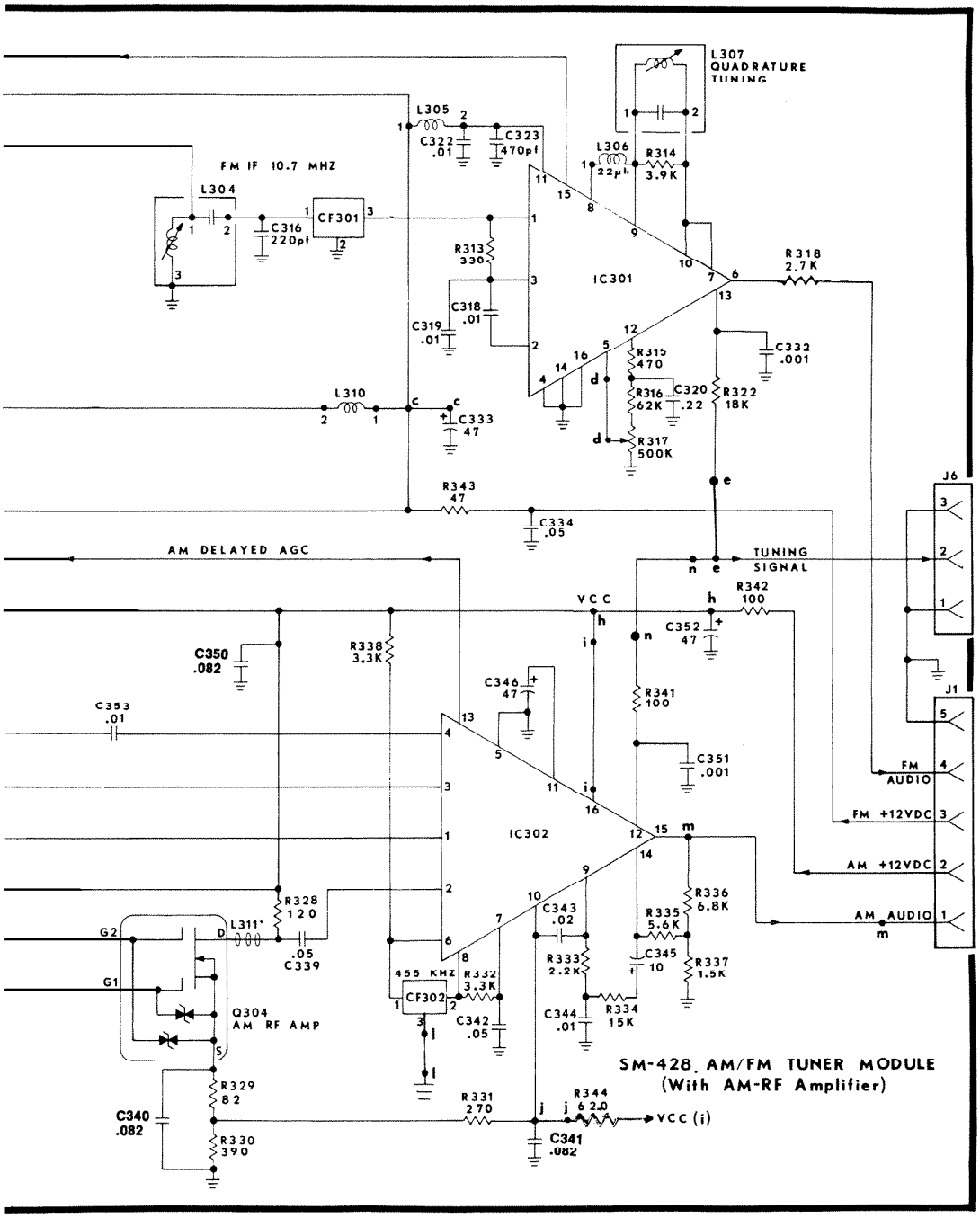


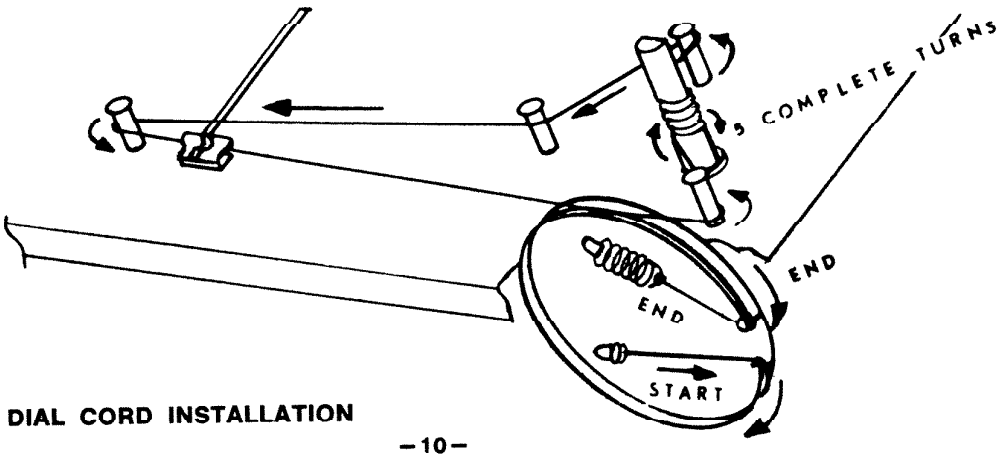
TUNER (BOTTOM OF BOARD)



NOTE: (*) L302 AND L311 REPRESENT FERRITE BEAD ON THE RESPECTIVE FET'S DRAIN LEAD.

(**) C355 SERVES AS GROUND-PATH RF CURRENT BYPASS.





DIAL CORD INSTALLATION

REPLACEMENT PARTS LIST

MODEL SM-428

TUNER MODULE
(Later Production Units)

RESISTORS: Value in Ohms ± 5%, ¼-watt, Carbon Film, unless otherwise noted.
K = Kilo = 10^3 M = Mega = 10^6

CAPACITORS: Value in micro farads (10^{-6}) ± 10%, 500Vdc, Ceramic Disc, unless otherwise noted.
p = pico = 10^{-12}

Schematic Symbol	NuTone Part No.	Description
		AM/FM TUNER MODULE
	42568-000	Complete Assembly
	37751-000	PC Board
		CAPACITORS
C301	35100-174	150 pf
C302	35101-142	15 pf
C303A-J	35092-000	Ganged, AM and FM Tuning
C304	35100-120	.001
C305	35100-139	.01 ±20%, 50V
C306	35100-120	.001
C307	35100-139	.01 ±20%, 50V
C308	35076-101	.22 +80%, −20%, 12V
C309	35101-142	15 pf
C310	35100-138	.005 ±20%, 100V
C311, C312, C313	Not Used	
C314	35100-139	.01 ±20%, 50V
C315	35101-147	1.2 pf, 0.25%/pf
C316	35100-125	220 pf
C317	35100-120	.001
C318, C319	35100-139	.01 ±20%, 50V
C320	35076-101	.22 +80%, −20%, 12V
C321	Not Used	
C322	35100-139	.01 ±20%, 50V
C323	35101-139	470 pf
C324	35100-139	.01 ±20%, 50V
C325	35100-138	.005 ±20%, 100V
C326	35101-140	10 pf
C327	35101-141	5.6 pf
C328	35101-135	7.5 pf
C329	35101-148	22 pf, 100V
C330	35090-000	1-8 pf, 100VAC, Oscillator Trimmer ALPS #CTY 114B11
C331	35101-126	1.2 pf, ±0.25%/pf
C332	35100-120	.001
C333	35091-109	47 +100%, −10%, 25WVDC Electrolytic
C334	35100-141	.05 +80%, −20%, 50V
C335	35101-140	10 pf
C336, C337	35100-139	.01 ±20%, 50V
C338	35076-106	.1 ±20%, 25V
C339	35100-141	.05 +80%, −20%, 12V
C340, C341	35076-104	.082 +80%, −20%, 12V
C342	35100-141	.05 +80%, −20%, 50V
C343	35076-108	.02 ±20%, 16V
C344	35100-139	.01 ±20%, 50V
C345	35091-102	10 +100%, −10%, 16WVDC, Electrolytic
C346	35091-109	47 +100%, −10%, 25WVDC, Electrolytic
C347	35101-141	5.6 pf
C348	35100-139	.01 ±20%, 50V
C349	35100-141	.05 +80%, −10%, 50V
C350	35076-104	.082 +80%, −20%, 12V
C351	35100-120	.001
C352	35091-109	47 +100%, −10%, 25WVDC, Electrolytic
C353	35100-139	.01 ±20%, 50V
C354	35100-174	150 pf
C355	35100-193	.03 +80%, −20%, 50V
C356	35101-139	470 pf

Schematic Symbol	NuTone Part No.	Description
		INTEGRATED CIRCUITS
IC301	36623-000	Monolithic IC, FM IF Amplifier, Detector, Audio Preamplifier, etc. RCA CA3089E
IC302	36622-000	Monolithic IC, AM Oscillator/ Mixer, IF Amplifier, Detector, AF Preamplifier, etc. RCA CA3088E
		CONNECTORS
J1	39339-101	5-pin receptacle
J5	Not Used	
J6	39339-105	3-pin receptacle
		COILS
L301	30106-000	22 microh ±10% @ 100 mA
L302	35232-000	Ferrite Bead, FM RF amplifier drain-lead parasitic suppressor
L303	30590-000	10.7 MHz. tank circuit for FM Mixer collector load
L304	30591-000	10.7 Mhz. adjustable coupling between FM Mixer collector and CF301
L305	30062-000	RF Choke (decoupler)
L306	30105-000	220 microH ±10% @ 50 mA
L307	30092-000	10.7 MHz. adjustable quadrature coil
L308	30062-000	RF Choke (decoupler)
L309	30088-000	Coil, FM Oscillator
	30073-000	Form, for oscillator coil L309
	31915-000	Core, powdered iron (Tuning Slug) for oscillator coil
L310	30062-000	RF Choke (decoupler)
L311	35232-000	Ferrite Bead, AM RF amplifier drain-lead parasitic suppressor
		TRANSISTORS
Q301	36624-000	DGFET, FM RF Amplifier General Instruments Corp MEM615A, MEM614 Motorola MFE-130 Texas Inst. 3N203
Q302	36578-000	Silicon, NPN, Epitaxial Planar, FM Mixer Texas Inst. SKA-4231 Motorola SPS 4484 National Semi SM-43-049
Q303	36581-000	Silicon, NPN Planar FM Oscillator Texas Inst. SKA-4230 National Semiconductor SM-43-050
Q304	36624-000	DGFET, AM RF Amplifier (for suppliers, see Q301 above)
		CERAMIC FILTERS
CF301	36109-000	FM 10.7 MHz. IF; Ceramic Murata Corp. SFE10.7MS23 Murata Corp. SFW-10.7Ma
CF302	36087-000	AM 455 KHz. IF; Ceramic Murata Corp. SFB4550

Schematic Symbol	NuTone Part No.	Description
		RESISTORS
R301	33082-474	470K
R302	33082-684	680K
R303	33082-124	120K
R304	33082-334	330K
R305	33082-391	390
R306, R307	33082-103	10K
R308	33082-331	330
R309	33082-333	33K
R310	33082-392	3.9K
R311	33082-102	1K
R312	33082-221	220
R313	33082-331	330
R314	33082-392	3.9K
R315	33082-471	470
R316	33082-623	62K
R317	34043-000	0-500K ±30%, 0.1 watt, linear taper SQUELCH CONTROL CTS Corp. Type X-201
R318	33082-272	2.7K
R319	33082-822	8.2K
R320, R321	33082-103	10K
R322	33082-183	18K
R323	33082-564	560K
R324, R325	33082-334	330K
R326	33082-103	10K
R327	33082-393	39K
R328	33082-121	120
R329	33082-820	82
R330	33082-391	390
R331	33082-271	270
R332	33082-332	3.3K
R333	33082-222	2.2K
R334	33082-153	15K
R335	33082-562	5.6K
R336	33082-682	6.8K
R337	33082-152	1.5K
R338	33082-332	3.3K
R339	33082-182	1.8K
R340	33082-331	330
R341	33082-101	100
R342	33082-101	100
R343	33082-470	47
R344	33082-621	620
		TRANSFORMERS
T301		RF, Antenna/RF-Amplifier input
	30087-000	Primary Winding
	30108-000	Secondary Winding
	30107-000	Tap Section Secondary Winding
	31915-000	Core, powered iron (Tuning Slug)
	30073-000	Coil Form
T302	30597-000	AM, 537-1620 KHz. operating range Antenna/RF-Amplifier input Toko America RHR-42185R G.I. Ex. #27402
T303	30598-000	AM, 992-2075 KHz. operating range Oscillator Tuning/Coupling Toko America RWR-42209N Gen. Inst. Tex #3227
	30599-000	Alternate EL-Filters, Inc. EO #405
T304	30579-000	AM IF, 455 KHz. TRW #50137 Gen. Inst. Corp. #22562
T305		RF, RF Amplifier output/FM Detector input
	30087-000	Primary Winding
	30109-000	Secondary Winding
	31915-000	Core, powered iron (Tuning Slug)
	30073-000	Coil Form
		MISCELLANEOUS
	42491-000	Cable, Coaxial Assembly Complete, Antenna Lead-in
	39598-003	Shield, RF