

MC1355

BALANCED MONOLITHIC FOUR-STAGE HIGH-GAIN FM/IF AMPLIFIER

... designed for use with Foster-Seeley discriminator or ratio detector in high quality FM systems.

- High AM Rejection (60 dB typ)
- Wide Range of Supply Voltages (8 to 18 Vdc)
- Low Distortion (0.5% typ)

LIMITING FM IF AMPLIFIER

MONOLITHIC SILICON
INTEGRATED CIRCUIT



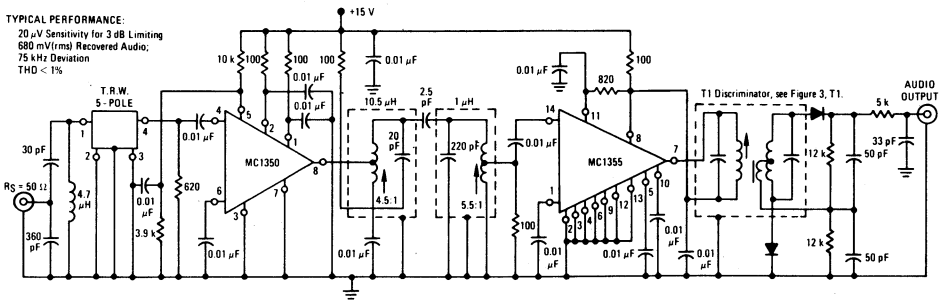
P SUFFIX
PLASTIC PACKAGE
CASE 646
(TO-116)



PQ SUFFIX
PLASTIC PACKAGE
CASE 647

FIGURE 1 - TYPICAL FM-IF APPLICATION

TYPICAL PERFORMANCE:
20 μ V Sensitivity for 3 dB Limiting
680 mV(rms) Recovered Audio;
75 kHz Deviation
THD < 1%



When using the device as a non-saturating limiter the load must be chosen to prevent voltage saturation of the output stage. The load impedance can be calculated from:

$$R_L \leq \frac{2(V^+ - 5.3)}{5.0} \text{ kilohms}$$

MC 1355 (continued)

MAXIMUM RATINGS ($T_A = +25^\circ\text{C}$ unless otherwise noted)

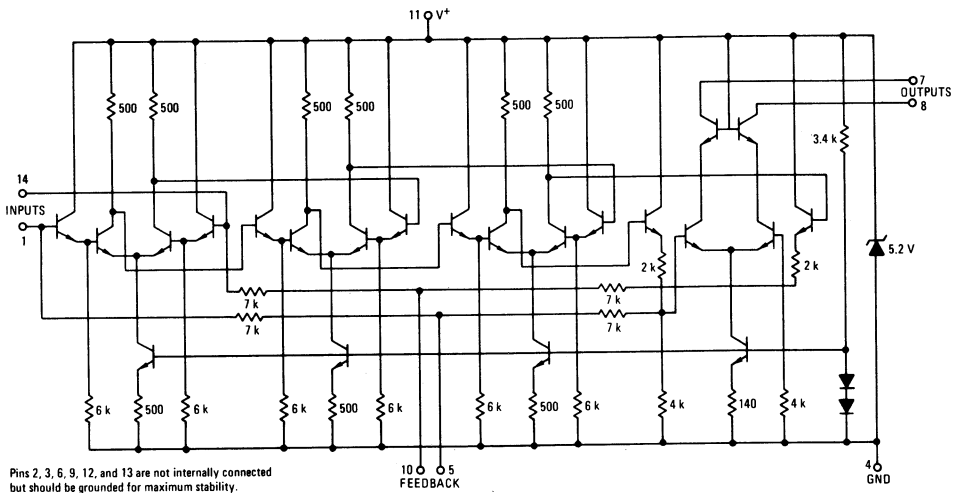
Rating	Value	Unit
Output Voltage (pins 7 & 8)	40	Vdc
Supply Current to pin 11	20	mA
Input Signal Voltage (single-ended)	5.0	Vp-p
Input Signal Voltage (differential)	10	Vp-p
Power Dissipation (package limitation) Derate above $T_A = +25^\circ\text{C}$	625 5.0	mW mW/ $^\circ\text{C}$
Operating Temperature Range (Ambient)	0 to +75	$^\circ\text{C}$
Storage Temperature Range	-65 to +150	$^\circ\text{C}$

Maximum Ratings as defined in MIL-S-19500, Appendix A.

ELECTRICAL CHARACTERISTICS ($V^+ = 15\text{ Vdc}$, $f = 10.7\text{ MHz}$, $T_A = +25^\circ\text{C}$, $R_S = 820\text{ ohms}$ unless otherwise noted)

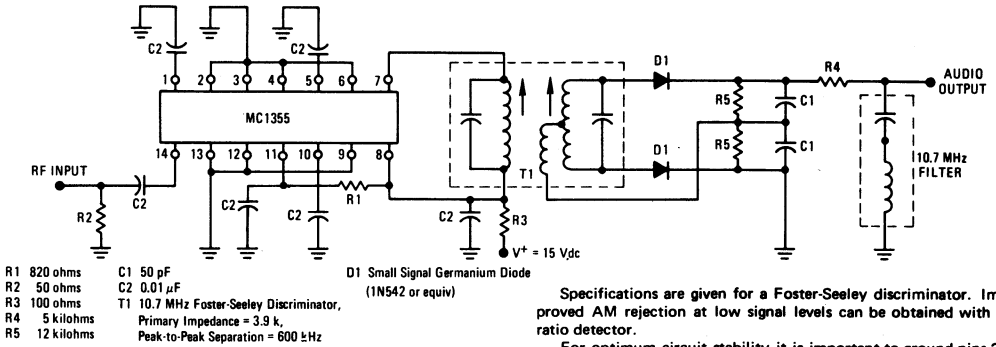
Characteristic	Min	Typ	Max	Units
Power Supply Voltage Range	8.0	15	18	Vdc
Total Circuit Current	—	16	—	mA _{dc}
Total Output Stage Current	—	4.2	—	mA
Device Dissipation	—	125	—	mW
Internal Zener Voltage	—	5.2	—	Vdc
Input Signal for 3 dB Limiting	—	175	250	$\mu\text{V(rms)}$
Output Current Swing	3.5	4.2	5.0	mA p-p
AM Rejection (10 mv to 1.0 v (rms) input, FM @ 100%, AM @ 80%, Foster Seeley detector)	—	60	—	dB
Maximum AM Signal before Breakup (FM @ 100%, AM @ 80%)	—	—	1.4	V(rms)
Admittance Parameters				
Y_{11}	—	$120 + j320$	—	μmhos
Y_{12}	—	$j0.6$	—	μmho
Y_{21}	—	$8 + j5.9$	—	mhos
Y_{22}	—	$15 + j230$	—	μmhos

FIGURE 2 — CIRCUIT SCHEMATIC



TYPICAL CHARACTERISTICS

FIGURE 3 - TEST CIRCUIT



Specifications are given for a Foster-Seeley discriminator. Improved AM rejection at low signal levels can be obtained with a ratio detector.
 For optimum circuit stability it is important to ground pins 2, 3, 4, 6, 9, 12, and 13.

FIGURE 4 - AM REJECTION TEST BLOCK DIAGRAM

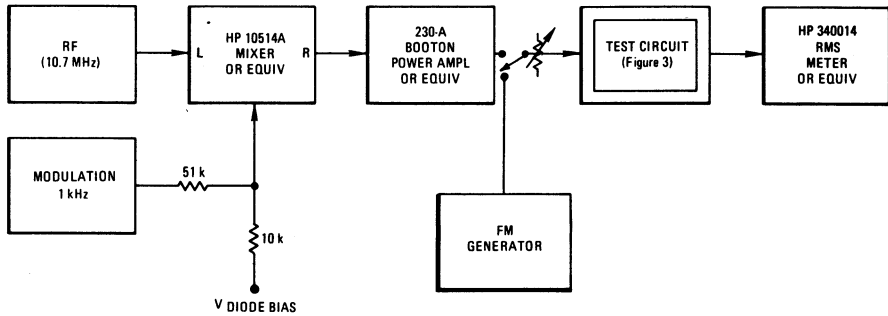


FIGURE 5 - LIMITING

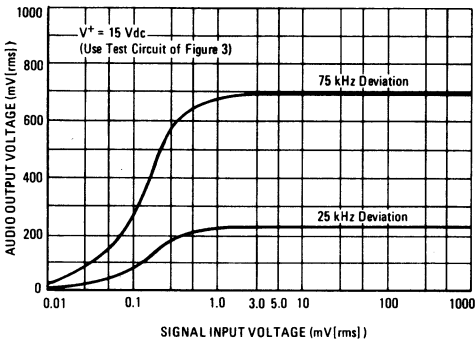
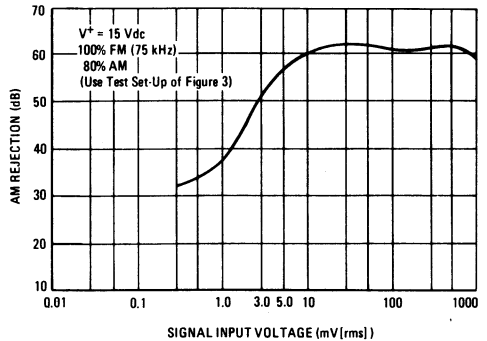


FIGURE 6 - AM REJECTION



TYPICAL CHARACTERISTICS (continued)

FIGURE 7 - OUTPUT DISTORTION

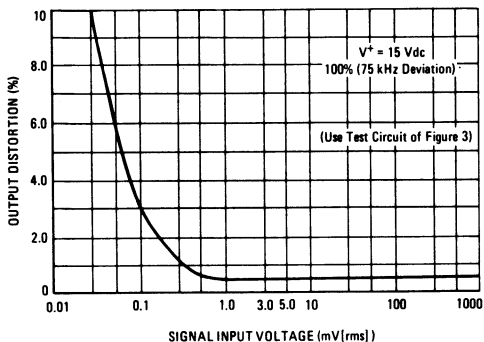


FIGURE 8 - SIGNAL-TO-NOISE RATIO SIGNAL

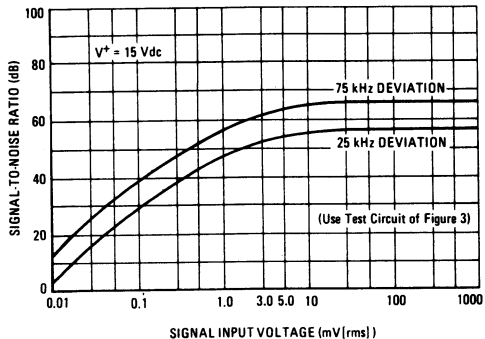
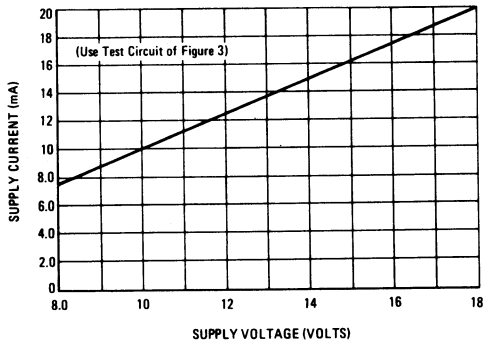
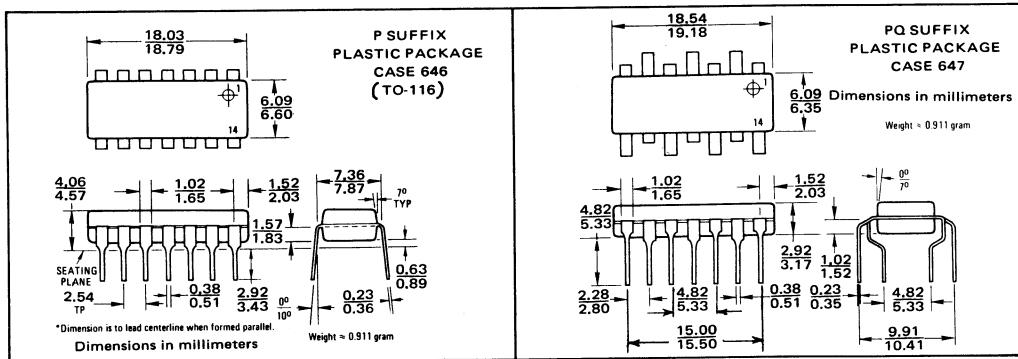


FIGURE 9 - TOTAL SUPPLY CURRENT



OUTLINE DIMENSIONS



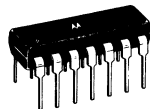
MC1357

MONOLITHIC TV SOUND IF OR FM IF AMPLIFIER WITH QUADRATURE DETECTOR

- A Direct Replacement for the ULN2111A
- Greatly Simplified FM Demodulator Alignment
- Excellent Performance at $V^+ = 8.0 \text{ Vdc}$

IF AMPLIFIER AND QUADRATURE DETECTOR

MONOLITHIC SILICON INTEGRATED CIRCUIT

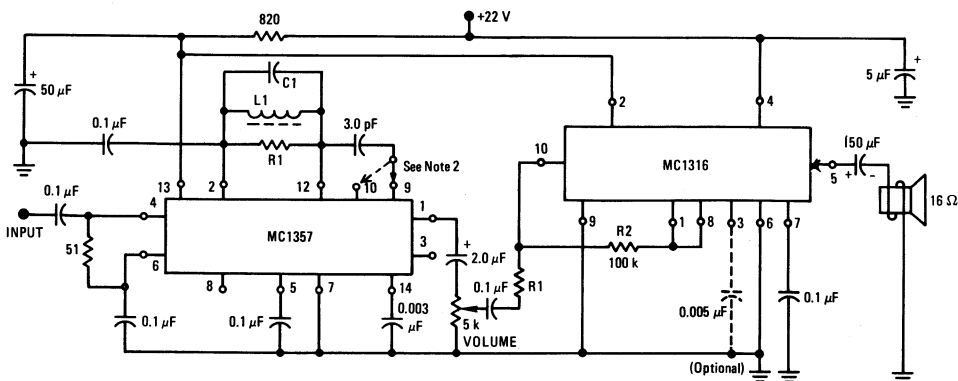


P SUFFIX
PLASTIC PACKAGE
CASE 646
TO-116



PQ SUFFIX
PLASTIC PACKAGE
CASE 647

FIGURE 1 - TV TYPICAL APPLICATION CIRCUIT



Typical Performance:
2 Watts Output
2% Distortion
250 μV Sensitivity (3 dB Lim.)

$C1 = 120 \text{ pF}$
 $L1 = 14 \mu\text{H}$
 $R1 = 20 \text{ k}\Omega$
 $Q = 30$

MC 1357 (continued)

MAXIMUM RATINGS ($T_A = +25^\circ\text{C}$ unless otherwise noted)

Rating	Value	Unit
Power Supply Voltage	16	Vdc
Input Voltage (Pin 4)	3.5	V_p
Power Dissipation (Package Limitation) Plastic Packages Derate above $T_A = +25^\circ\text{C}$	625 5.0	mW mW/ $^\circ\text{C}$
Operating Temperature Range (Ambient)	0 to +75	$^\circ\text{C}$
Storage Temperature Range	-65 to +150	$^\circ\text{C}$

Maximum Ratings as defined in MIL-S-19500, Appendix A.

ELECTRICAL CHARACTERISTICS ($V^+ = 12\text{ Vdc}$, $T_A = +25^\circ\text{C}$ unless otherwise noted)

Characteristic	Pin	Min	Typ	Max	Units
Drain Current $V^+ = 8\text{ V}$ $V^+ = 12\text{ V}$	13	10 —	12 15	19 21	mA
Amplifier Input Reference Voltage	6	—	1.45	—	Vdc
Detector Input Reference Voltage	2	—	3.65	—	Vdc
Amplifier High Level Output Voltage	10	1.25	1.45	1.65	Vdc
Amplifier Low Level Output Voltage	9	—	0.145	0.2	Vdc
Detector Output Voltage $V^+ = 8\text{ V}$ $V^+ = 12\text{ V}$	1	—	3.7 5.4	—	Vdc
Amplifier Input Resistance	4	—	5.0	—	k Ω
Amplifier Input Capacitance	4	—	11	—	pF
Detector Input Resistance	12	—	70	—	k Ω
Detector Input Capacitance	12	—	2.7	—	pF
Amplifier Output Resistance	10	—	60	—	ohms
Detector Output Resistance	1	—	200	—	ohms
De-Emphasis Resistance	14	—	8.8	—	k Ω

DYNAMIC CHARACTERISTICS (FM Modulation Freq. = 1.0 kHz, Source Resistance = 50 ohms, $T_A = +25^\circ\text{C}$ for all tests.)

($V^+ = 12\text{ Vdc}$, $f_0 = 4.5\text{ MHz}$, $\Delta f = \pm 25\text{ kHz}$, Peak Separation = 150 kHz)

Characteristics	Pin	Min	Typ	Max	Units
Amplifier Voltage Gain ($V_{in} \leq 50\ \mu\text{V[rms]}$)	10	—	60	—	dB
AM Rejection* ($V_{in} = 10\text{ mV[rms]}$)	1	—	36	—	dB
Input Limiting Threshold Voltage	4	—	250	—	$\mu\text{V[rms]}$
Recovered Audio Output Voltage ($V_{in} = 10\text{ mV[rms]}$)	1	—	0.72	—	V(rms)
Output Distortion ($V_{in} = 10\text{ mV[rms]}$)	1	—	3	—	%

($V^+ = 12\text{ Vdc}$, $f_0 = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$, Peak Separation = 260 kHz)

Amplifier Voltage Gain ($V_{in} \leq 50\ \mu\text{V[rms]}$)	10	—	60	—	dB
AM Rejection* ($V_{in} = 10\text{ mV[rms]}$)	1	—	40	—	dB
Input Limiting Threshold Voltage	4	—	250	—	$\mu\text{V[rms]}$
Recovered Audio Output Voltage ($V_{in} = 10\text{ mV[rms]}$)	1	—	1.2	—	V(rms)
Output Distortion ($V_{in} = 10\text{ mV[rms]}$)	1	—	5	—	%

($V^+ = 8.0\text{ Vdc}$, $f_0 = 10.7\text{ MHz}$, $\Delta f = \pm 75\text{ kHz}$, Peak Separation = 550 kHz)

Amplifier Voltage Gain ($V_{in} \leq 50\ \mu\text{V[rms]}$)	10	—	53	—	dB
AM Rejection* ($V_{in} = 10\text{ mV[rms]}$)	1	—	37	—	dB
Input Limiting Threshold Voltage	4	—	600	—	$\mu\text{V[rms]}$
Recovered Audio Output Voltage ($V_{in} = 10\text{ mV[rms]}$)	1	—	0.30	—	V(rms)
Output Distortion ($V_{in} = 10\text{ mV[rms]}$)	1	—	1.4	—	%

($V^+ = 12\text{ Vdc}$, $f_0 = 10.7\text{ MHz}$, $\Delta f = \pm 75\text{ kHz}$, Peak Separation = 550 kHz)

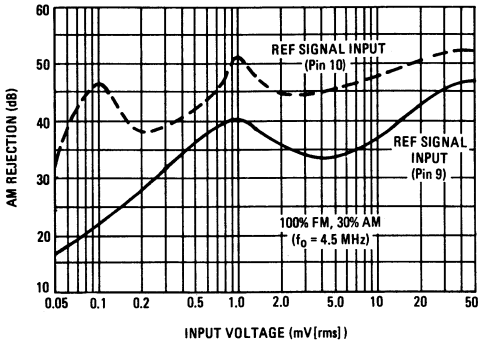
Amplifier Voltage Gain ($V_{in} \leq 50\ \mu\text{V[rms]}$)	10	—	53	—	dB
AM Rejection* ($V_{in} = 10\text{ mV[rms]}$)	1	—	45	—	dB
Input Limiting Threshold Voltage	4	—	600	—	$\mu\text{V[rms]}$
Recovered Audio Output Voltage ($V_{in} = 10\text{ mV[rms]}$)	1	—	0.48	—	V(rms)
Output Distortion ($V_{in} = 10\text{ mV[rms]}$)	1	—	1.4	—	%

*100% FM, 30% AM Modulation

TYPICAL CHARACTERISTICS
 (V+ = 12 V, T_A = +25°C unless otherwise noted)
 (Use Test Circuit of Figure 13)

(f₀ = 4.5 MHz)

FIGURE 2 – AM REJECTION



(f₀ = 5.5 MHz)

FIGURE 3 – AM REJECTION

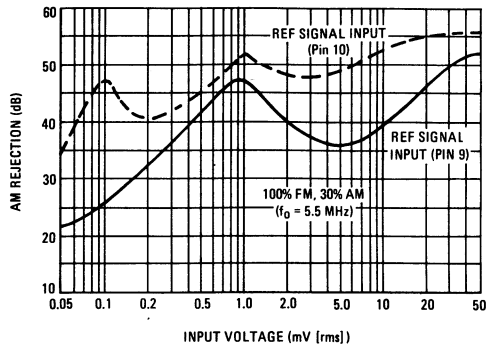


FIGURE 4 – DETECTED AUDIO OUTPUT

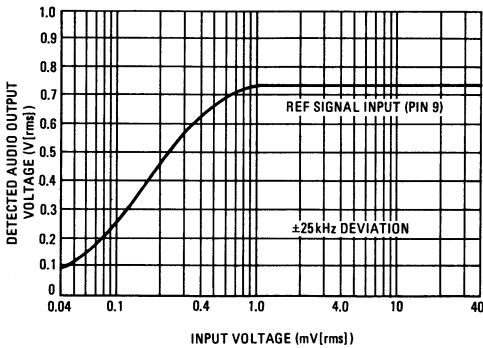


FIGURE 5 – DETECTED AUDIO OUTPUT

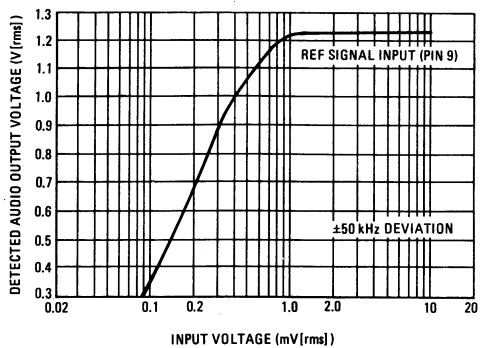


FIGURE 6 – DETECTOR TRANSFER CHARACTERISTIC

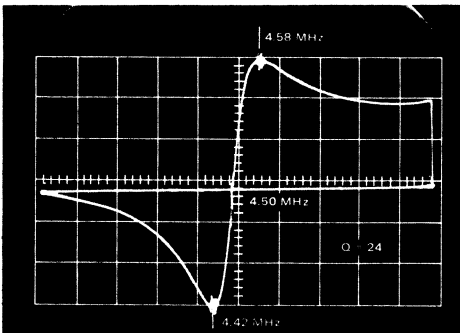
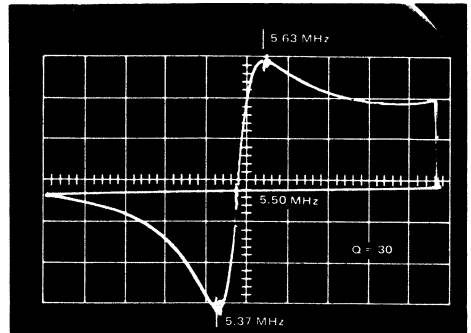


FIGURE 7 – DETECTOR TRANSFER CHARACTERISTIC



TYPICAL CHARACTERISTICS (continued)
 ($f_o = 10.7 \text{ MHz}$, $T_A = +25^\circ\text{C}$ unless otherwise noted.)
 (Use Test Circuit of Figure 13)

FIGURE 8 – AM REJECTION

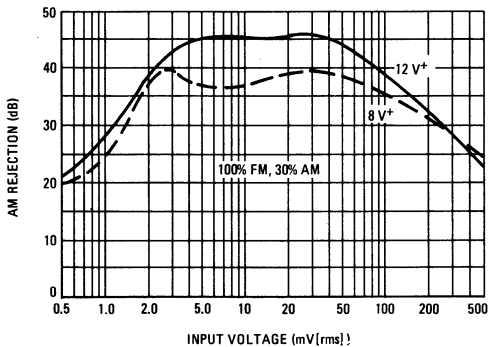


FIGURE 9 – AFC VOLTAGE DRIFT
 (1.0 mV INPUT CARRIER @ 10.7 MHz)

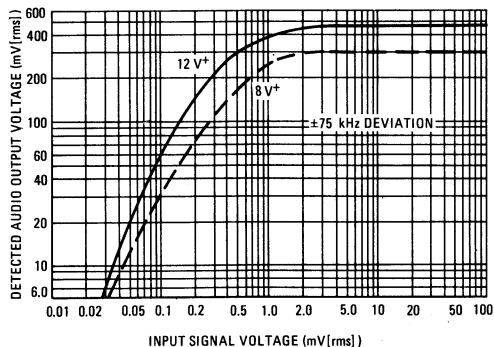


FIGURE 10 – LIMITING

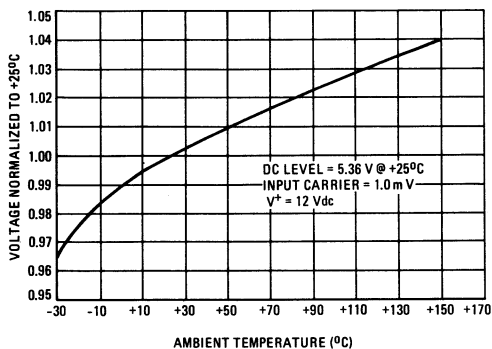


FIGURE 11 – SIGNAL-TO-NOISE RATIO

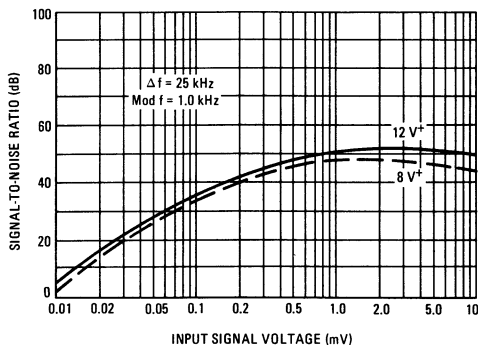


FIGURE 12 – DETECTOR TRANSFER CHARACTERISTIC

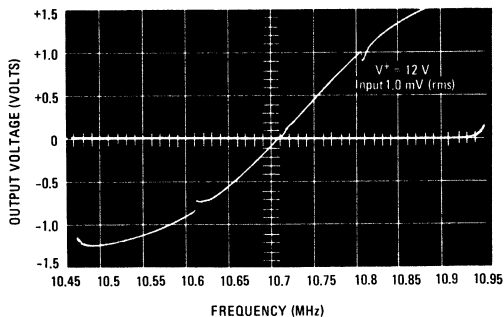
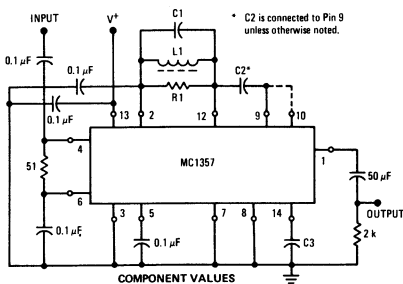


FIGURE 13 – TEST CIRCUIT



COMPONENT VALUES							
	L1	C1	R1	10/R1	L1	C2	C3
	MHz	μH	pF	kΩ	pF	pF	μF
	4.5	14	120	20	30	3.0	0.003
	5.5	8.0	100	20	30	3.0	0.003
	10.7	2.0	120	8.9	20	4.7	0.01

MC 1357 (continued)

FIGURE 14 – FM RADIO TYPICAL APPLICATION CIRCUIT

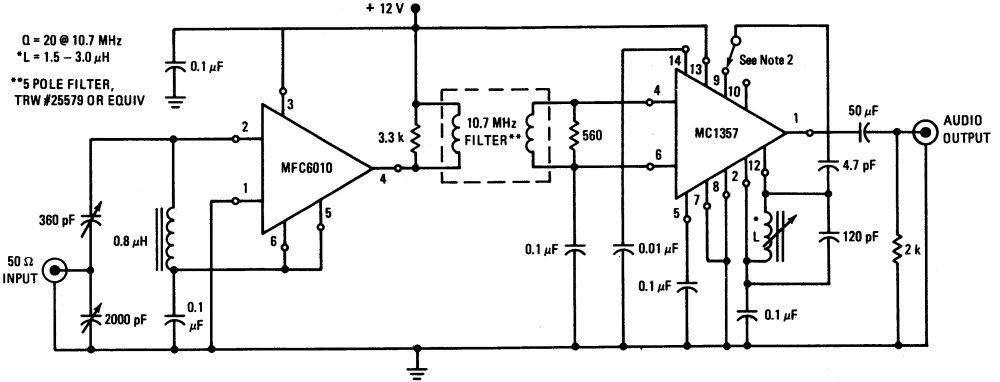
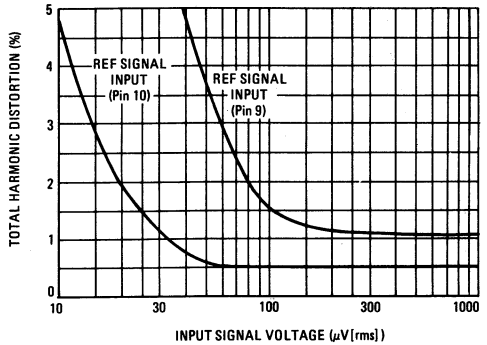


FIGURE 15 – OUTPUT DISTORTION



Note 1: Information shown in Figures 15, 16, and 17 was obtained using the circuit of Figure 14.

Note 2: Optional input to the quadrature coil may be from either pin 9 or pin 10 in the applications shown. Pin 9 has commonly been used on this type of part to avoid overload with various tuning techniques. For this reason, pin 9 is used in tests on the preceding pages (except as noted). However, a significant improvement of limiting sensitivity can be obtained using pin 10, see Figure 17, and no overload problems have been incurred with this tuned circuit configuration.

FIGURE 16 – SIGNAL-TO-NOISE RATIO

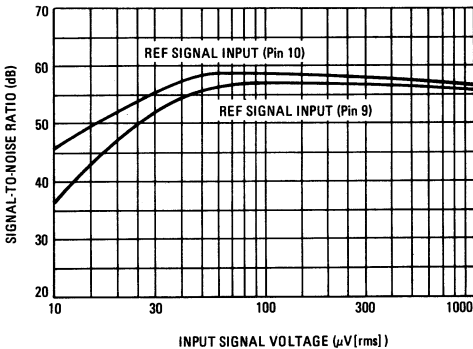


FIGURE 17 – RECOVERED AUDIO OUTPUT

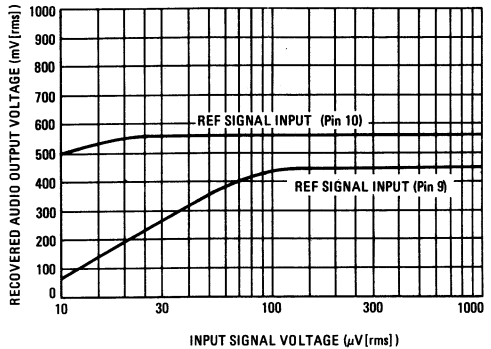
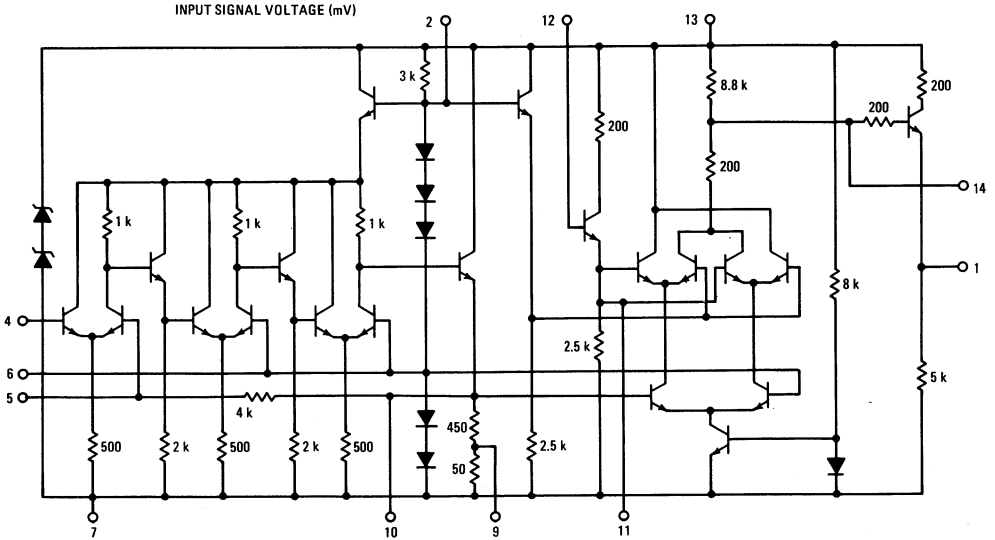
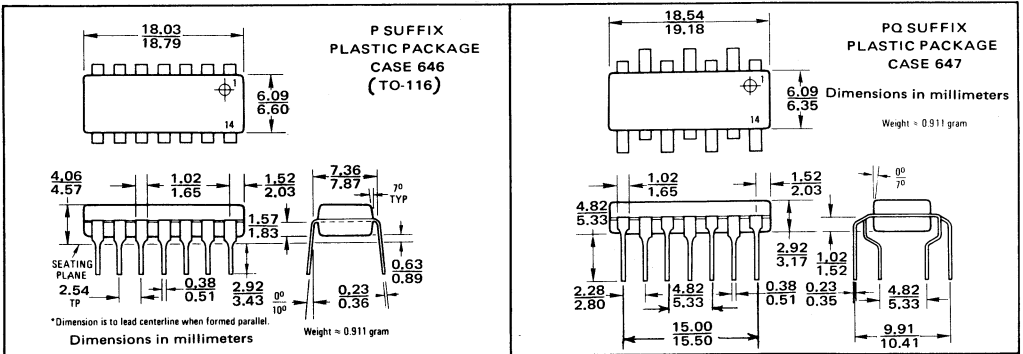


FIGURE 18 - CIRCUIT SCHEMATIC



OUTLINE DIMENSIONS



MC1358

TV SOUND IF AMPLIFIER

... a versatile monolithic device incorporating IF limiting, detection, electronic attenuation, audio amplifier, and audio driver capabilities.

- Direct Replacement for the CA3065
- Differential Peak Detector Requiring a Single Tuned Circuit
- Electronic Attenuator Replaces Conventional ac Volume Control – Range > 60 dB
- Excellent AM Rejection @ 4.5 and 5.5 MHz
- High Stability
- Low Harmonic Distortion
- Audio Drive Capability – 6.0 mApp
- Minimum Undesirable Output Signal @ Maximum Attenuation

**IF AMPLIFIER, LIMITER,
FM DETECTOR, AUDIO DRIVER,
ELECTRONIC ATTENUATOR**

**MONOLITHIC SILICON
INTEGRATED CIRCUIT**

**P SUFFIX -
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**PQ SUFFIX
PLASTIC PACKAGE
CASE 647**

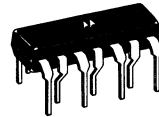
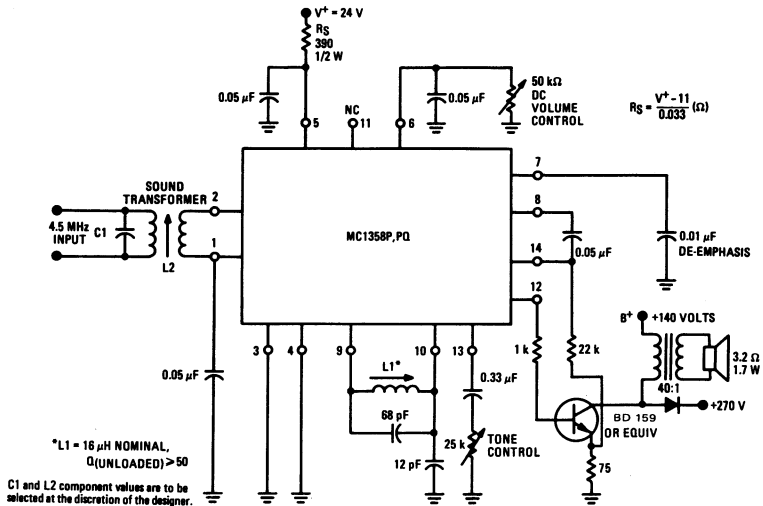


FIGURE 1 – TYPICAL TV APPLICATION CIRCUIT



MC 1358 (continued)

MAXIMUM RATINGS ($T_A = +25^\circ\text{C}$ unless otherwise noted)

Rating	Value	Unit
Input Signal Voltage (Pins 1 and 2)	± 3.0	Vdc
Power Supply Current	50	mA
Power Dissipation (Package Limitation)		
Plastic Packages	625	mW
Derate above $T_A = +25^\circ\text{C}$	5.0	mW/ $^\circ\text{C}$
Operating Temperature Range (Ambient)	-20 to +75	$^\circ\text{C}$
Storage Temperature Range	-65 to +150	$^\circ\text{C}$

Maximum Ratings as defined in MIL-S-19500, Appendix A.

ELECTRICAL CHARACTERISTICS ($V^+ = 24\text{ Vdc}$, $T_A = +25^\circ\text{C}$ unless otherwise noted)

Characteristic	Pin	Min	Typ	Max	Unit
Regulated Voltage	5	10.3	11	12.2	Vdc
DC Supply Current ($V^+ = 9\text{ Vdc}$, $R_S = 0$)	5	10	16	24	mA
Quiescent Output Voltage	12	—	5.1	—	Vdc

DYNAMIC CHARACTERISTICS ($V^+ = 24\text{ Vdc}$, $T_A = +25^\circ\text{C}$ unless otherwise noted)

Characteristic	Min	Typ	Max	Unit
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IF AMPLIFIER AND DETECTOR

$f_0 = 4.5\text{ MHz}$, $\Delta f = \pm 25\text{ kHz}$

AM Rejection* ($V_{in} = 10\text{ mV [rms]}$)	40	51	—	dB
Input Limiting Threshold Voltage	—	200	400	$\mu\text{V [rms]}$
Recovered Audio Output Voltage ($V_{in} = 10\text{ mV [rms]}$)	0.5	0.70	—	V[rms]
Output Distortion ($V_{in} = 10\text{ mV [rms]}$)	—	0.4	2.0	%

$f_0 = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$

AM Rejection* ($V_{in} = 10\text{ mV [rms]}$)	40	53	—	dB
Input Limiting Threshold Voltage	—	200	400	$\mu\text{V [rms]}$
Recovered Audio Output Voltage ($V_{in} = 10\text{ mV [rms]}$)	0.5	0.91	—	V[rms]
Output Distortion ($V_{in} = 10\text{ mV [rms]}$)	—	0.9	—	%
Input Impedance Components ($f = 4.5\text{ MHz}$, measurement between pins 1 and 2)				
Parallel Input Resistance	—	17	—	k Ω
Parallel Input Capacitance	—	4.0	—	pF
Output Impedance Components ($f = 4.5\text{ MHz}$, measurement between pin 9 and GND)				
Parallel Output Resistance	—	3.25	—	k Ω
Parallel Output Capacitance	—	3.6	—	pF
Output Resistance, Detector				
Pin 7	—	7.5	—	k Ω
Pin 8	—	250	—	Ω

ATTENUATOR

Volume Reduction Range (See Figure 8) (dc Volume Control = ∞)	60	—	—	dB
Maximum Undesirable Signal (See Note 1) (dc Volume Control = ∞)	—	0.07	1.0	mV

AUDIO AMPLIFIER

Voltage Gain ($V_{in} = 0.1\text{ V (rms)}$, $f = 400\text{ Hz}$)	17.5	20	—	dB
Total Harmonic Distortion ($V_o = 2.0\text{ V (rms)}$, $f = 400\text{ Hz}$)	—	2.0	—	%
Output Voltage (THD = 5%, $f = 400\text{ Hz}$)	2.0	3.0	—	V[rms]
Input Resistance ($f = 400\text{ Hz}$)	—	70	—	k Ω
Output Resistance ($f = 400\text{ Hz}$)	—	270	—	Ω

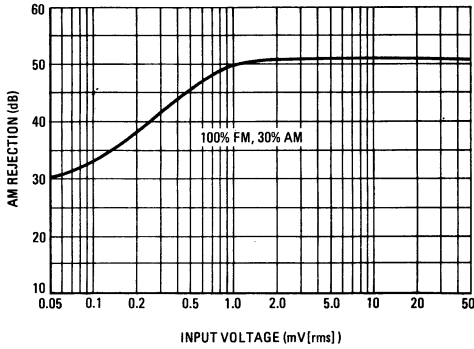
* 100% FM, 30% AM Modulation.

Note 1. Undesirable signal is measured at pin 8 when volume control is set for minimum output.

TYPICAL CHARACTERISTICS
 ($V^+ = 24\text{ V}$, $T_A = +25^\circ\text{C}$ unless otherwise noted)

($f_o = 4.5\text{ MHz}$)

FIGURE 2 – AM REJECTION



($f_o = 5.5\text{ MHz}$)

FIGURE 3 – AM REJECTION

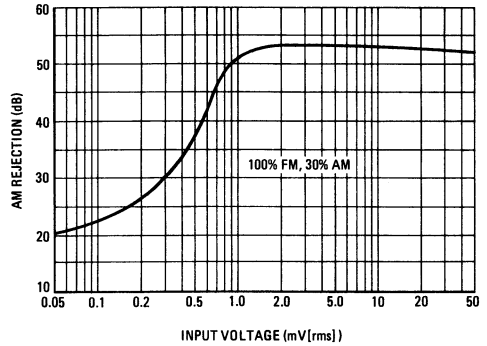


FIGURE 4 – DETECTED AUDIO OUTPUT

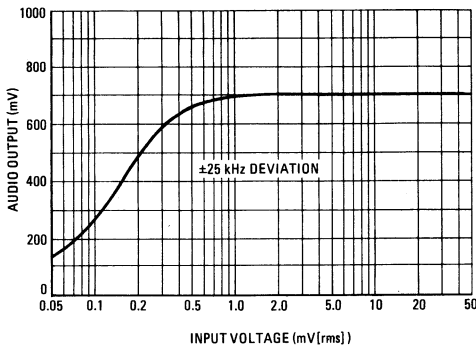


FIGURE 5 – DETECTED AUDIO OUTPUT

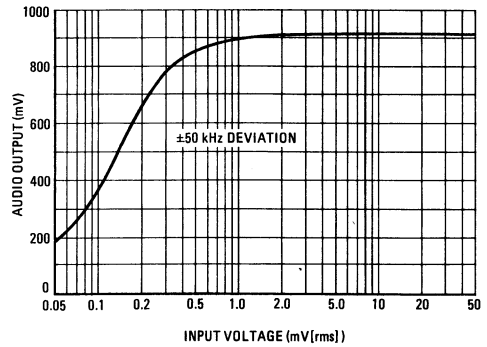


FIGURE 6 – IF AMPLIFIER AND DETECTOR THD

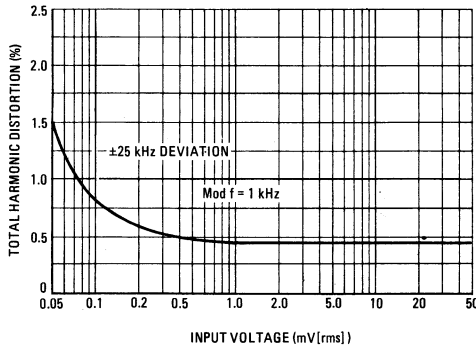
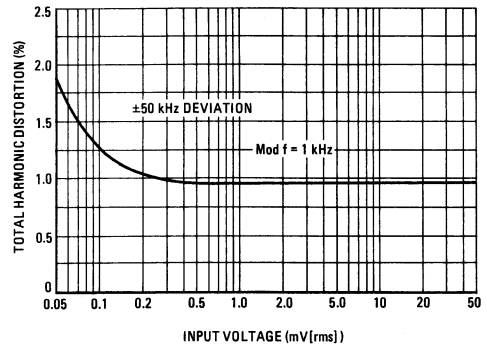


FIGURE 7 – IF AMPLIFIER AND DETECTOR THD



TYPICAL CHARACTERISTICS (continued)

FIGURE 8 - GAIN REDUCTION OF ATTENUATOR

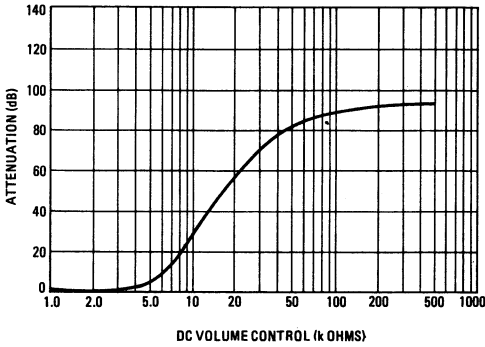


FIGURE 9 - AUDIO AMPLIFIER THD

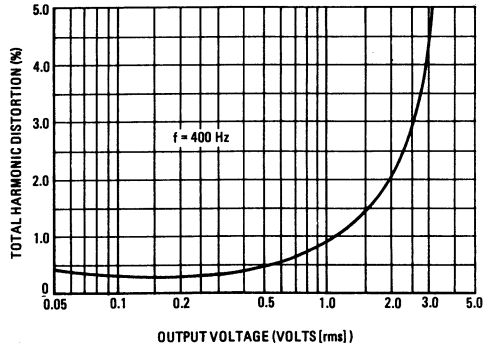


FIGURE 10 - IF FREQUENCY RESPONSE

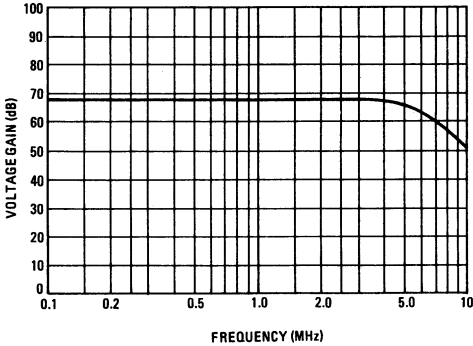


FIGURE 11 - IF FREQUENCY RESPONSE TEST CIRCUIT

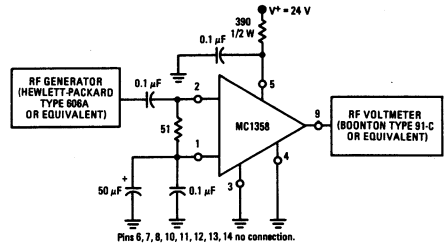


FIGURE 12 - AM REJECTION, DETECTED AUDIO, THD, ATTENUATION TEST CIRCUIT

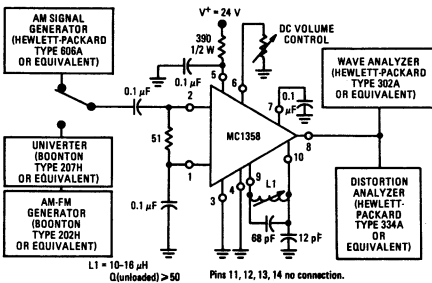


FIGURE 13 - AUDIO VOLTAGE GAIN, AUDIO THD TEST CIRCUIT

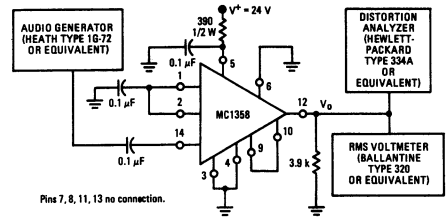


FIGURE 14 - CIRCUIT SCHEMATIC

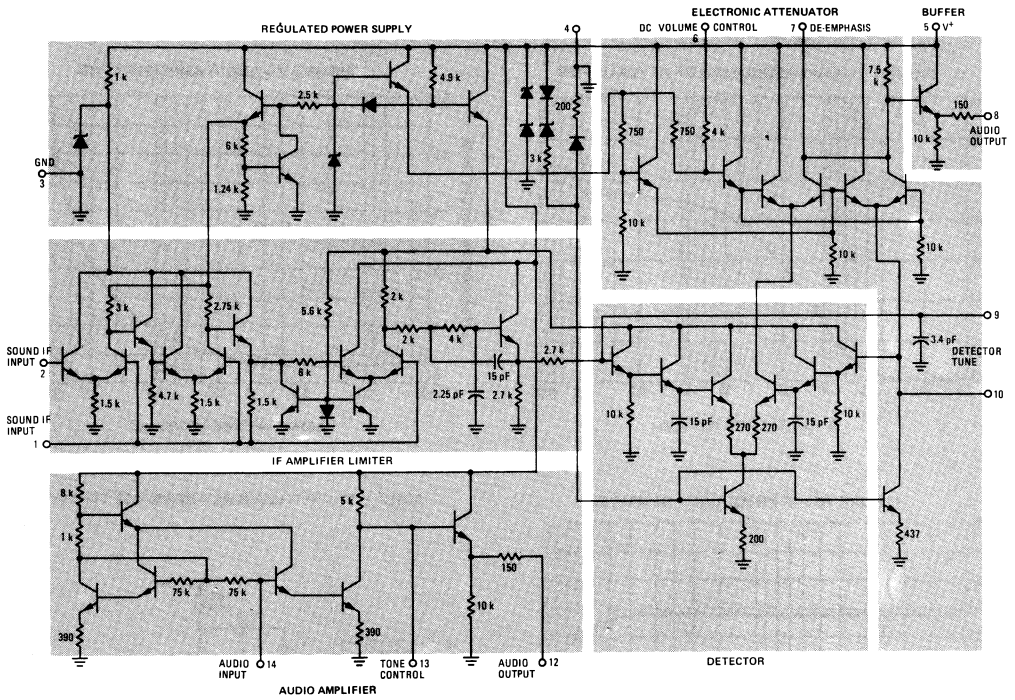


FIGURE 15 - ALTERNATE APPLICATION CIRCUIT

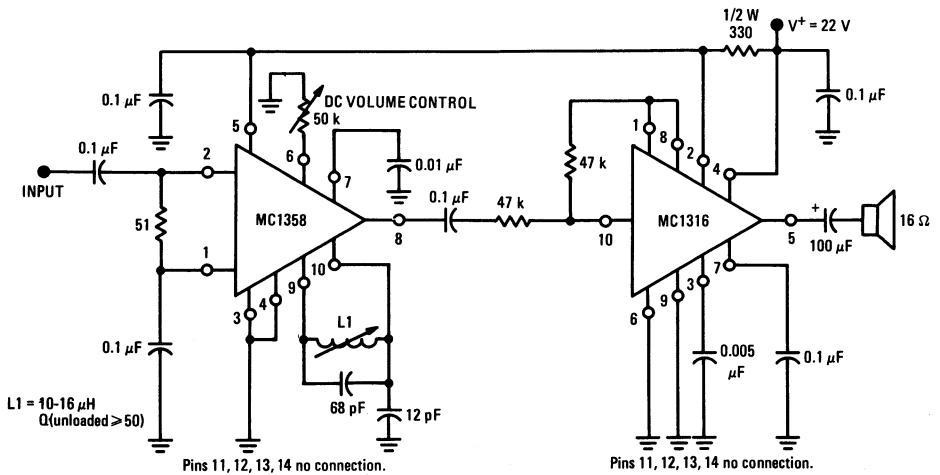
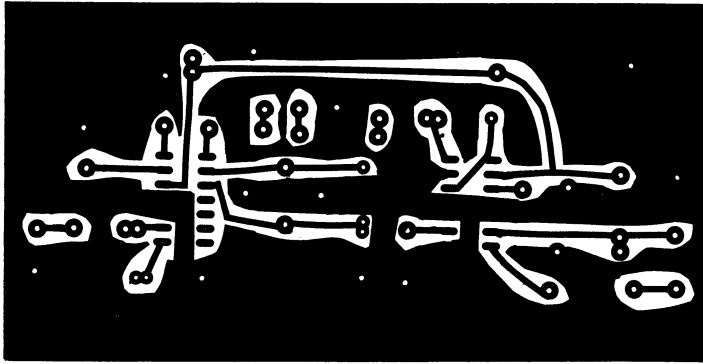
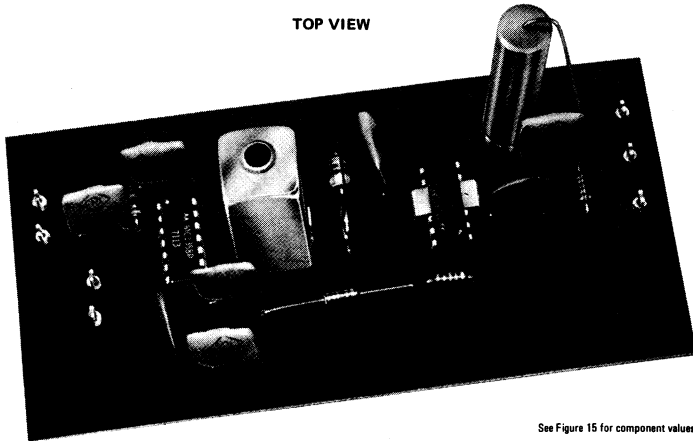


FIGURE 16 – MC1358/MC1316 PRINTED CIRCUIT BOARD

COPPER SIDE



TOP VIEW



See Figure 15 for component values.

OUTLINE DIMENSIONS

