MOTOROLA
SEMICONDUCTORS
P.O. BOX 20912 • PHOENIX, ARIZONA 85036

MC3362

Advance Information

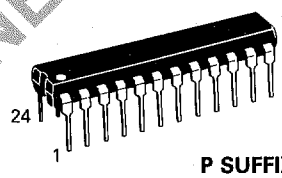
LOW POWER NARROWBAND FM RECEIVER

. . . includes dual FM conversion with oscillators, mixers, quadrature detector, and meter drive/carrier detect circuitry. The MC3362 also has buffered first and second local oscillator outputs and a comparator circuit for FSK detection.

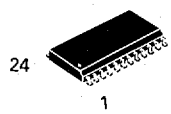
- Wide Input Bandwidth:
  - — 200 MHz using Internal Local Oscillator
  - — 450 MHz using External Local Oscillator
- Complete Dual Conversion Circuitry
- Low Voltage: V_{CC} = 2.0 to 7.0 Vdc
- Low Drain Current (3.6 mA (Typ) @ V_{CC} = 3.0 Vdc)
- Excellent Sensitivity: Input 0.7 μV (Typ) for 12 dB SINAD
- Data Shaping Comparator
- Received Signal Strength Indicator (RSSI) with 60 dB Dynamic Range
- Low Number of External Parts Required
- Manufactured in Motorola's MOSAIC Process Technology

LOW-POWER DUAL CONVERSION FM RECEIVER

SILICON MONOLITHIC INTEGRATED CIRCUIT



P SUFFIX
PLASTIC PACKAGE
CASE 724-02



DW SUFFIX
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CASE 751E-02
SO-24

FIGURE 1 — TYPICAL APPLICATION IN A PLL FREQUENCY SYNTHESIZED RECEIVER

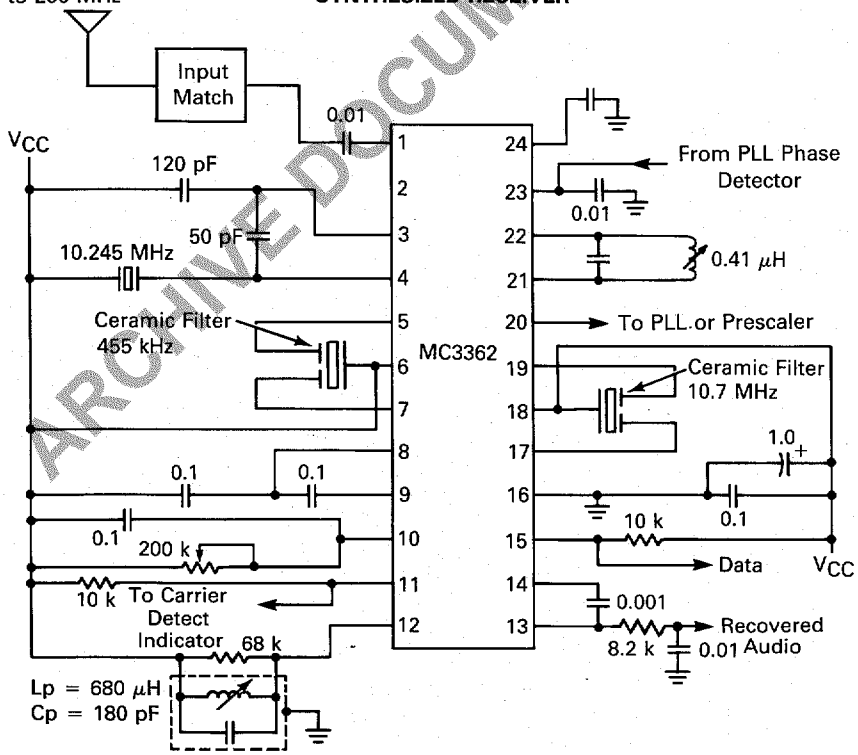
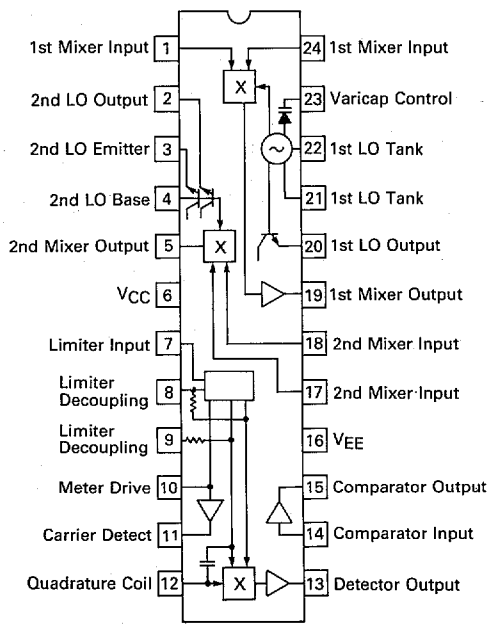


FIGURE 2 — PIN CONNECTIONS AND FUNCTIONAL BLOCK DIAGRAM



MAXIMUM RATINGS (T_A = 25°C, unless otherwise noted)

Rating	Pin	Symbol	Value	Unit
Power Supply Voltage	6	$V_{CC(max)}$	8.0	Vdc
Operating Supply Voltage Range (Recommended)	6	V_{CC}	2.0 to 7.0	Vdc
Input Voltage ($V_{CC} \geq$ 5.0 Vdc)	1, 24	V_{1-24}	1.0	Vrms
Junction Temperature	—	T_J	150	°C
Operating Ambient Temperature Range	—	T_A	−40 to +85	°C
Storage Temperature Range	—	T_{stg}	−65 to +150	°C

ELECTRICAL CHARACTERISTICS (V_{CC} = 5.0 Vdc, f_o = 49.7 MHz, Deviation = 3.0 kHz, T_A = 25°C, Test Circuit of Figure 3 unless otherwise noted)

Characteristic	Pin	Min	Typ	Max	Units
Drain Current (Carrier Detect Low — See Figure 5)	6	—	4.5	7.0	mA
Input for −3.0 dB Limiting	—	—	0.7	2.0	μVrms
Recovered Audio (RF signal level = 10 mV)	13	—	350	—	mVrms
Noise Output (RF signal level = 0 mV)	13	—	250	—	mVrms
Carrier Detect Threshold (below V_{CC})	10	—	0.64	—	Vdc
Meter Drive Slope	10	—	100	—	nA/dB
Input for 20 dB (S+N)/N (See Figure 7)	—	—	0.7	—	μVrms
First Mixer 3rd Order Intercept (Input)	—	—	−22	—	dBm
First Mixer Input Resistance (Rp)	—	—	690	—	Ω
First Mixer Input Capacitance (Cp)	—	—	7.2	—	pF
First Mixer Conversion Voltage Gain	—	—	18	—	dB
Second Mixer Conversion Voltage Gain	—	—	21	—	dB
Detector Output Resistance	13	—	1.4	—	kΩ

FIGURE 3 — TEST CIRCUIT

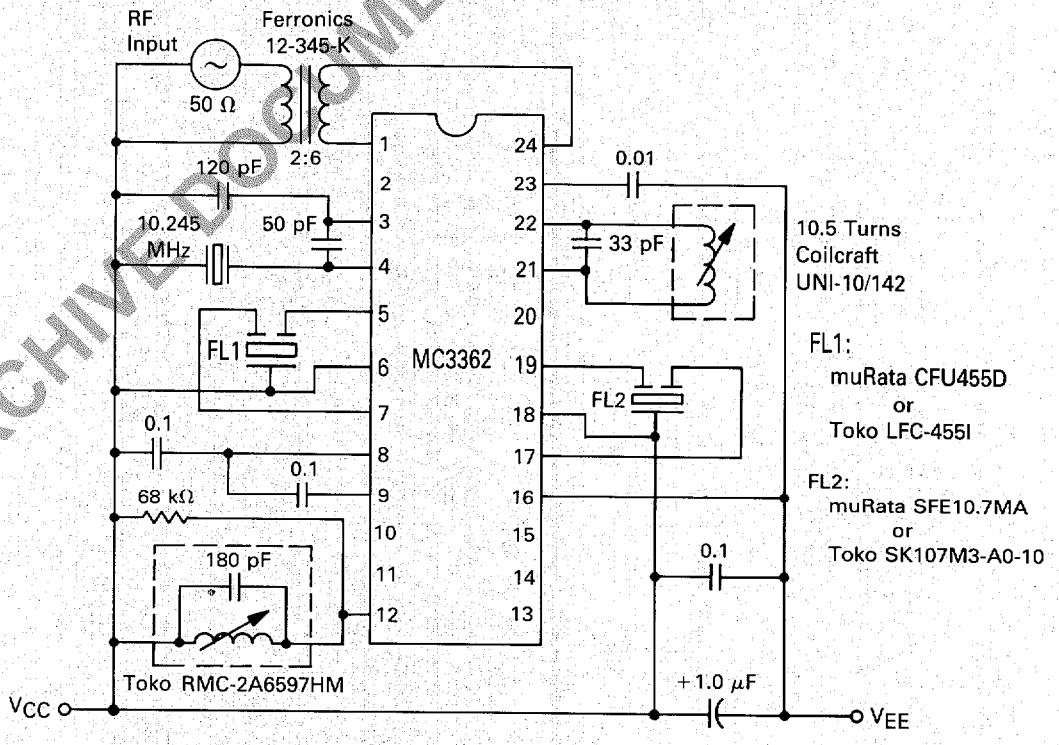


FIGURE 4 — I_{METER} versus INPUT

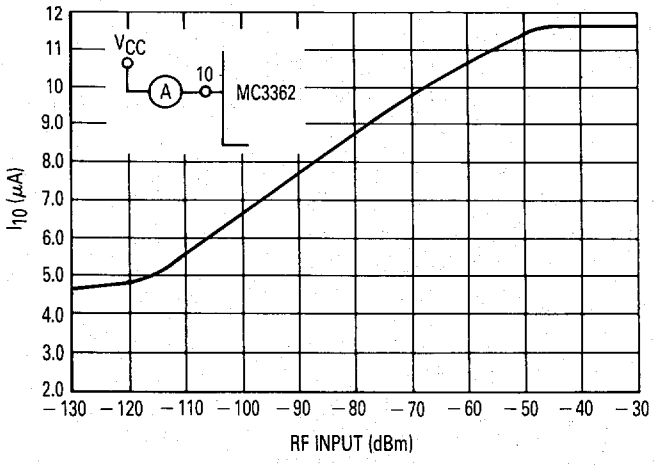


FIGURE 5 — DRAIN CURRENT, RECOVERED AUDIO versus SUPPLY

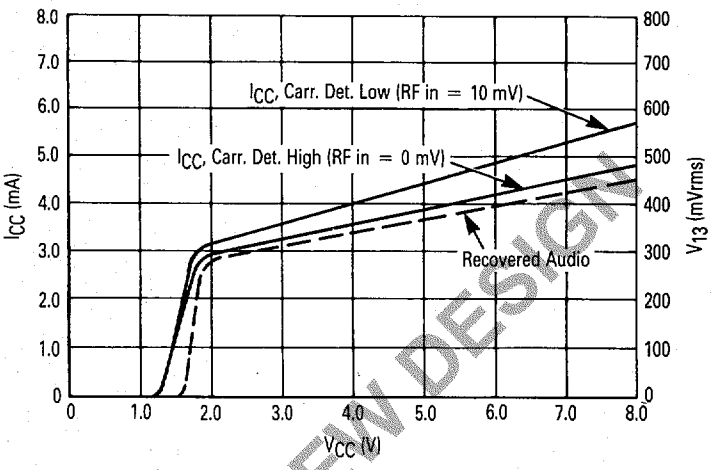


FIGURE 6 — SIGNAL LEVELS

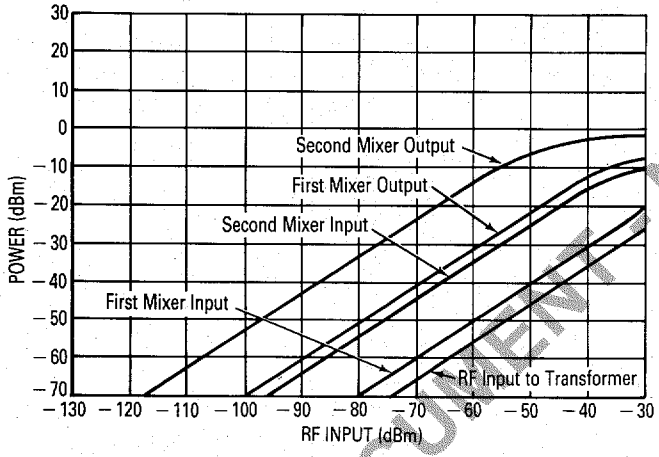


FIGURE 7 — S+N, N, AMR versus INPUT

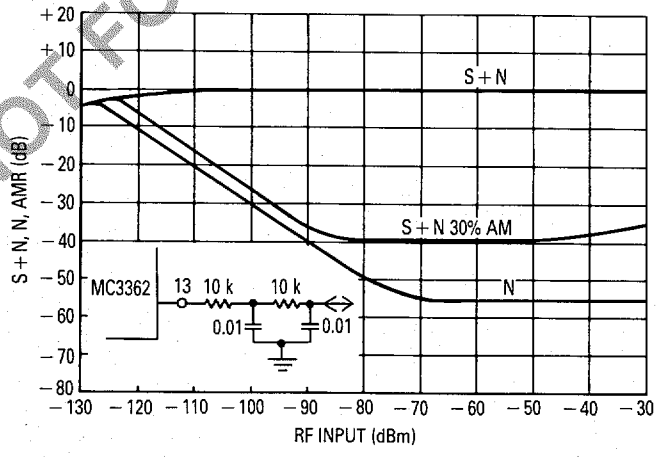


FIGURE 8 — 1ST MIXER 3RD ORDER INTERMODULATION

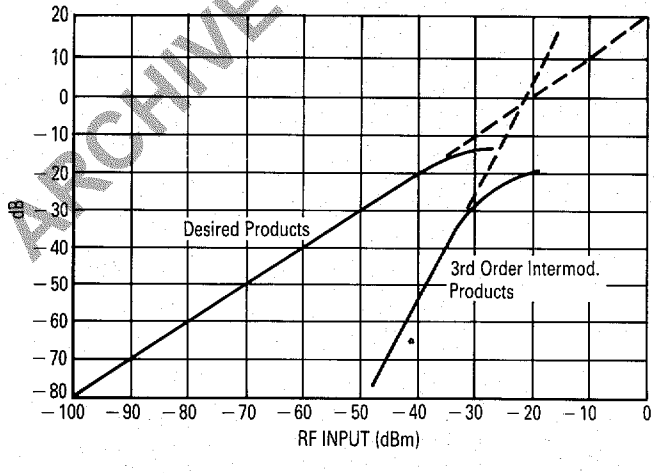


FIGURE 9 — DETECTOR OUTPUT versus FREQUENCY

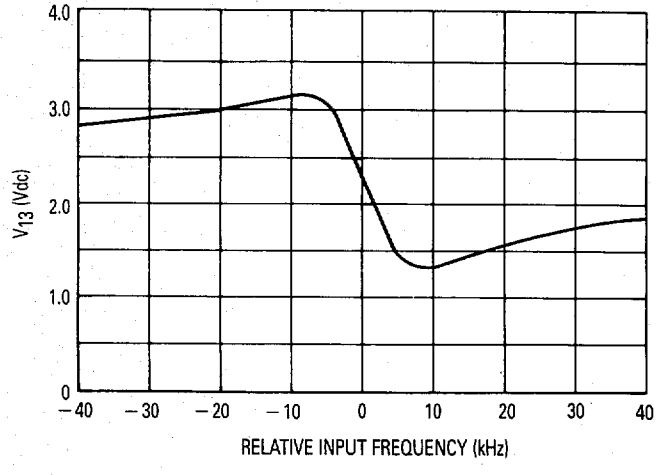
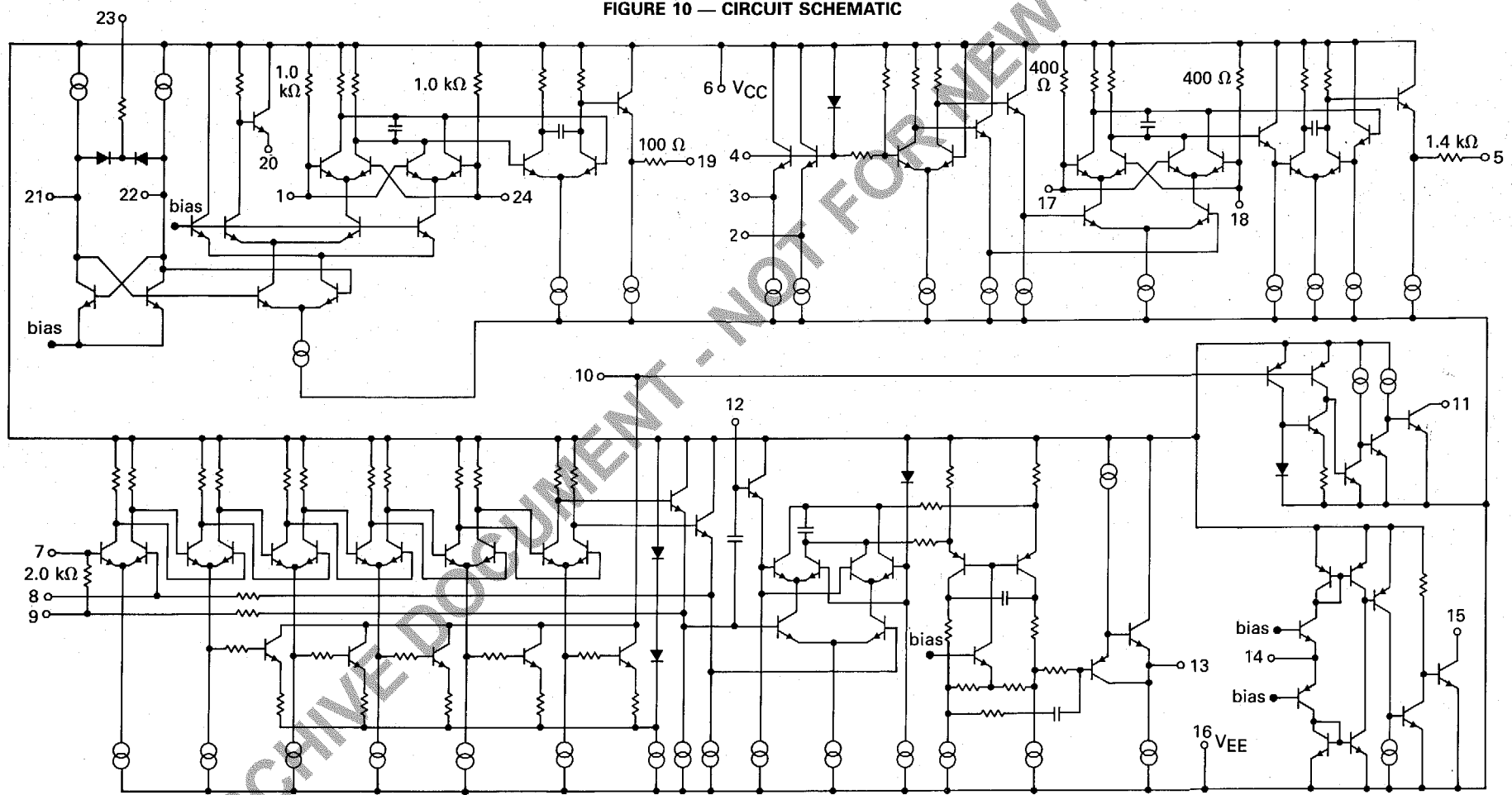


FIGURE 10 — CIRCUIT SCHEMATIC



CIRCUIT DESCRIPTION

The MC3362 is a complete FM narrowband receiver from antenna input to audio preamp output. The low voltage dual conversion design yields low power drain, excellent sensitivity and good image rejection in narrowband voice and data link applications.

In the typical application (Figure 1), the first mixer amplifies the signal and converts the RF input to 10.7 MHz. This IF signal is filtered externally and fed into the second mixer, which further amplifies the signal and converts it to a 455 kHz IF signal. After external bandpass filtering, the low IF is fed into the limiting amplifier and detection circuitry. The audio is recovered using a conventional quadrature detector. Twice-IF filtering is provided internally.

The input signal level is monitored by meter drive circuitry which detects the amount of limiting in the limiting amplifier. The voltage at the meter drive pin determines the state of the carrier detect output, which is active low.

APPLICATION

The first local oscillator can be run using a free-running LC tank, as a VCO using PLL synthesis, or driven from an external crystal oscillator. It has been run to 190 MHz.* A buffered output is available at Pin 20. The second local oscillator is a common base Colpitts type which is typically run at 10.245 MHz under crystal control. A buffered output is available at Pin 2. Pins 2 and 3 are interchangeable.

The mixers are doubly balanced to reduce spurious responses. The first and second mixers have conversion gains of 18 dB and 22 dB (typical), respectively, as seen in Figure 6. Mixer gain is stable with respect to supply voltage. For both conversions, the mixer impedances and pin layout are designed to allow the user to employ low cost, readily available ceramic filters. Overall sensitivity and AM rejection are shown in Figure 7. The input level for 20 dB (S+N)/N is 0.7 μV using the two-pole post-detection filter pictured.

*If the first local oscillator (Pins 21 and/or 22) is driven from a strong external source (100 mVrms), the mixer can be used to over 450 MHz.

Following the first mixer, a 10.7 MHz ceramic bandpass filter is recommended. The 10.7 MHz filtered signal is then fed into one second mixer input pin, the other input pin being connected to V_{CC}.

The 455 kHz IF is typically filtered using a ceramic bandpass filter then fed into the limiter input pin. The limiter has 10 μV sensitivity for −3.0 dB limiting, flat to 1.0 MHz.

The output of the limiter is internally connected to the quadrature detector, including a quadrature capacitor. A parallel LC tank is needed externally from Pin 12 to V_{CC}. A 68 kΩ shunt resistance is included which determines the peak separation of the quadrature detector; a smaller value will increase the spacing and linearity but decrease recovered audio and sensitivity.

A data shaping circuit is available and can be coupled to the recovered audio output of Pin 13. The circuit is a comparator which is designed to detect zero crossings of FSK modulation. Data rates of 2000 to 35000 baud are detectable using the circuit of Figure 1. Hysteresis is available by connecting a high-valued resistor from Pin 15 to Pin 14. Values below 120 kΩ are not recommended as the input signal cannot overcome the hysteresis.

The meter drive circuitry detects input signal level by monitoring the limiting of the limiting amplifier stages. Figure 4 shows the unloaded current at Pin 10 versus input power. The meter drive current can be used directly (RSSI) or can be used to trip the carrier detect circuit at a specified input power. To do this, pick an RF trip level in dBm. Read the corresponding current from Figure 4 and pick a resistor such that:

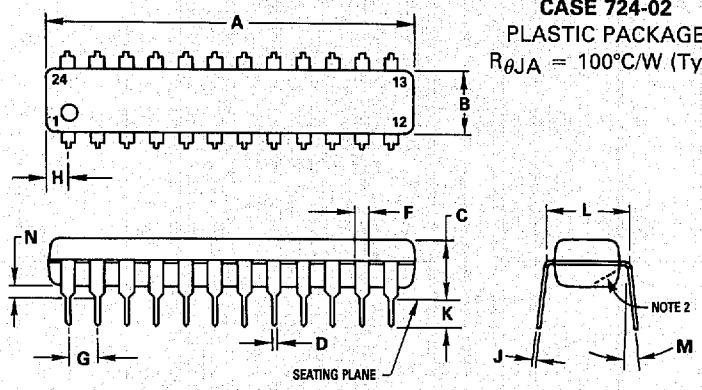
$$R_{10} \simeq 0.64\ \text{Vdc} / I_{10}$$

Hysteresis is available by connecting a high-valued resistor R_H between Pins 10 and 11. The formula is:

$$\text{Hyst.} = V_{CC}/(R_H \times 10^{-7})\ \text{dB}$$

OUTLINE DIMENSIONS

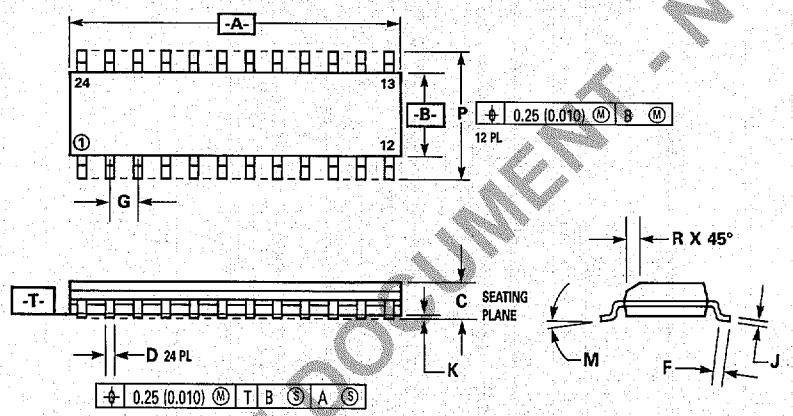
CASE 724-02
PLASTIC PACKAGE
$R_{\theta JA}$ = 100°C/W (Typ)



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	31.24	32.13	1.230	1.265
B	6.35	6.86	0.250	0.270
C	4.06	4.57	0.160	0.180
D	0.38	0.51	0.015	0.020
F	1.02	1.52	0.040	0.060
G	2.54 BSC		0.100 BSC	
H	1.60	2.11	0.063	0.083
J	0.18	0.30	0.007	0.012
K	2.92	3.43	0.115	0.135
L	7.37	7.87	0.290	0.310
M	—	10°	—	10°
N	0.51	1.02	0.020	0.040

NOTES:
1. LEADS, TRUE POSITIONED WITHIN 0.25 mm (0.010) DIA AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION (DIM D).
2. CHAMFERRED CONTOUR OPTIONAL.

CASE 751E-02
PLASTIC PACKAGE
$R_{\theta JA}$ = 130°C/W



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	15.25	15.50	0.601	0.610
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.50	0.90	0.020	0.035
G	1.27 BSC		0.050 BSC	
J	0.25	0.32	0.010	0.012
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

NOTES:
1. DIMENSIONS A AND B ARE DATUMS AND T IS A DATUM SURFACE.
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
3. CONTROLLING DIMENSION: MILLIMETER.
4. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
5. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.

MOTOROLA *Semiconductor Products Inc.*

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