

MC1304

MC1305

MONOLITHIC FM MULTIPLEX STEREO DEMODULATORS

... derive the left and right audio information from the detected composite signal. The MC1304 eliminates the need for an external stereo-channel separation control. The MC1305 is similar to the MC1304 but permits the use of an external stereo-channel separation control for maximum separation.

- Operation Practicable Over Wide Power-Supply Range, 8-14 Vdc
- Built-in Stereo-Indicator Lamp Driver
- Total Audio Muting Capability
- Automatic Switching – Stereo-Monaural
- Monaural Squelch Capability

FM MULTIPLEX STEREO DEMODULATOR

SILICON MONOLITHIC INTEGRATED CIRCUIT

P SUFFIX
PLASTIC PACKAGE
CASE 646
TO-116



PQ SUFFIX
PLASTIC PACKAGE
CASE 647

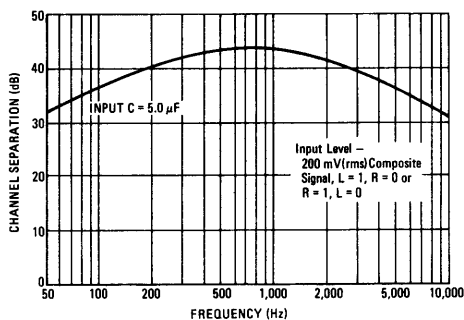
MAXIMUM RATINGS (T_A = +25°C unless otherwise noted)

Rating	Value	Unit
Power Supply Voltage (Pins 1, 6, 9, 11, 12) (Pin 7 is grounded)	+22	Vdc
Lamp Driver Current	40	mAdc
Power Dissipation (Package Limitation) (Both Packages) Derate above T _A = 25°C	625 5.0	mW mW/°C
Operating Temperature Range (Ambient)	0 to +75	°C
Storage Temperature Range	-65 to +150	°C

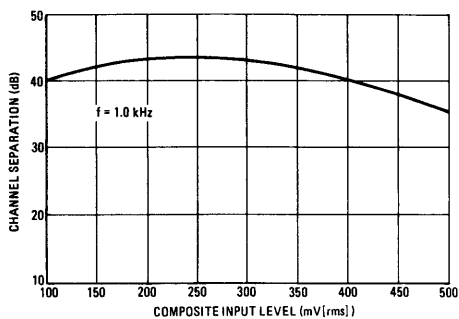
*Pin 8 for MC1305

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

CHANNEL SEPARATION versus FREQUENCY



CHANNEL SEPARATION versus COMPOSITE INPUT LEVEL



ELECTRICAL CHARACTERISTICS [V+ = 12 Vdc, TA = +25°C unless otherwise noted. Test made with 75 μs de-emphasis network (3.9 kΩ, 0.02 μF) unless otherwise noted]

Characteristics	Min	Typ	Max	Unit
Input Impedance (f = 20 Hz)	12	20	—	kΩ
Stereo Channel Separation (See Notes 1 and 2) (f = 100 Hz) (f = 1.0 kHz) (f = 10 kHz)	— — —	35 45 30	— — —	dB
Channel Balance (Monaural Input = 200 mV(rms)), (Monaural, Left and Right Outputs)	—	0.5	—	dB
Total Harmonic Distortion (See Notes 1 and 3) (Modulation frequency - 1.0 kHz)	—	0.5	1.0	%
Ultrasonic Frequency Rejection (See Note 4) (19 kHz) (38 kHz)	— —	25 20	— —	dB
Inherent SCA Rejection (without filter) @ 60 kHz, 67 kHz and 74 kHz	—	50	—	dB
Lamp Indicator (RA = 120Ω) Minimum 19 kHz Input Level for lamp on Maximum 19 kHz Input Level for lamp off	— 5.0	16 14	25 —	mV(rms)
Audio Muting Mute on (Voltage required at pin 5) Mute off (Voltage required at pin 5) Attenuation in Mute Mode (Note 5)	0.6 1.3 —	— — 55	1.0 2.0 —	Vdc Vdc dB
Stereo-Monaural Switching Stereo (Voltage required at pin 4) Monaural (Voltage required at pin 4)	1.3 —	— —	2.0 1.0	Vdc
Power Dissipation (V+ = 10 V) (Without lamp) (With lamp)	— —	150 180	300 300	mW

Note 1 - Measurement made with 200 mV(rms) Standard Multiplex Composite Signal and L = 1, R = 0 or R = 1, L = 0. Standard Multiplex Composite signal is here defined as a signal containing left and/or right audio information with a 10% (19 kHz) pilot signal in accordance with FCC regulations.

Note 2 - Stereo channel separation is adjustable for the MC1305 with a resistor from pin 9 to ground.

Note 3 - Distortion specification also applies to Monaural Signal.

Note 4 - Referenced to 1 kHz output signal with Standard Multiplex Composite Input Signal.

Note 5 - This is referenced to 1.0 kHz output signal with either Standard Multiplex Composite Signal or Monaural Input Signal.

FIGURE 1 - DISTORTION COMPONENTS IN AUDIO SIGNAL

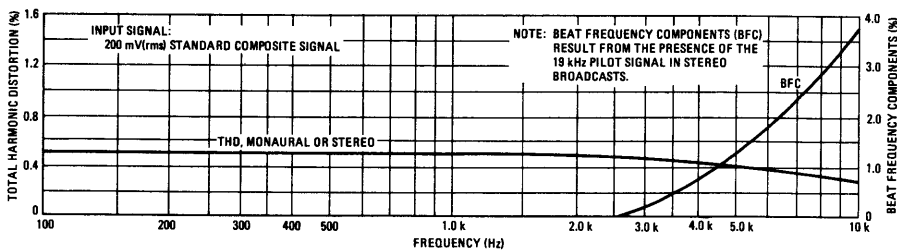


FIGURE 2 - TOTAL HARMONIC DISTORTION

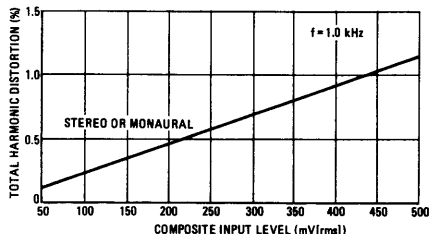
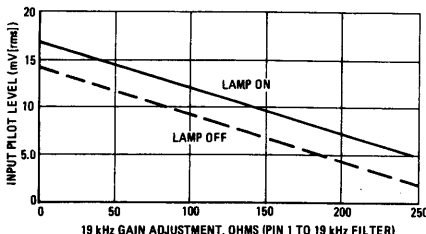


FIGURE 3 - MULTIPLEX SENSITIVITY



MC 1304, 1305 (continued)

FIGURE 4 - MC1304 CIRCUIT SCHEMATIC

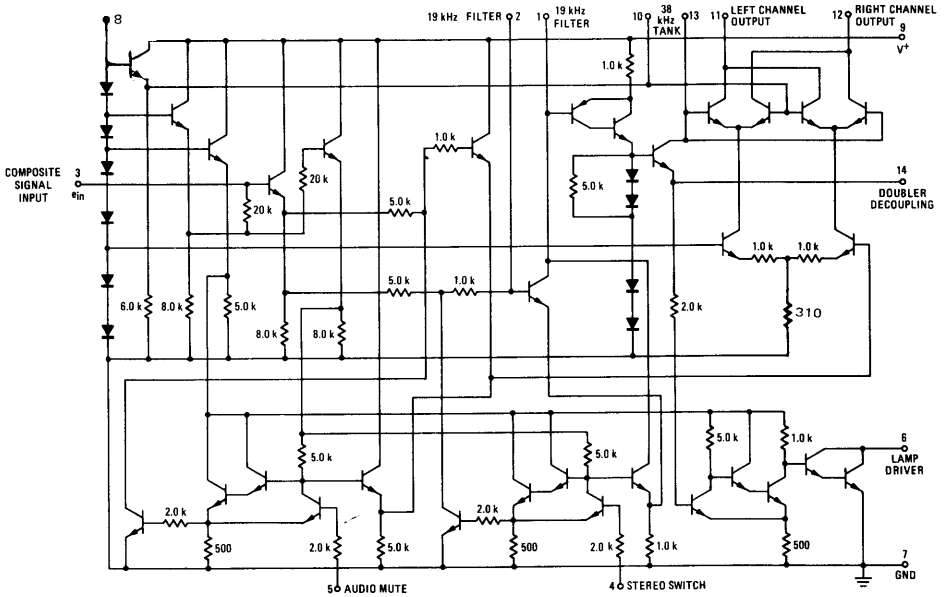
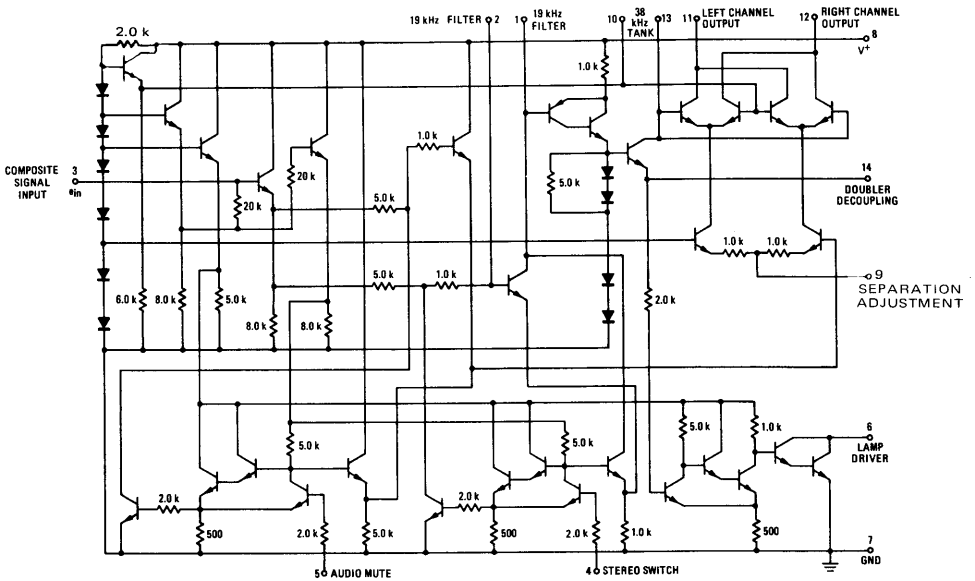
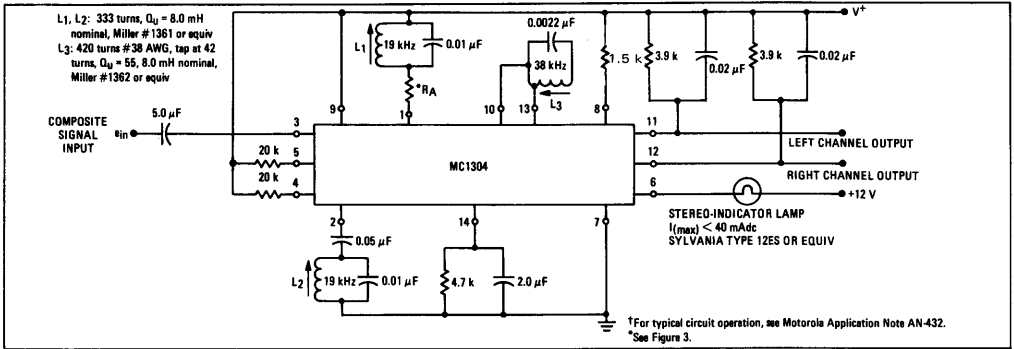


FIGURE 5 - MC1305 CIRCUIT SCHEMATIC



MC 1304, 1305 (continued)

FIGURE 6 - MC1304 TYPICAL CIRCUIT CONFIGURATION†



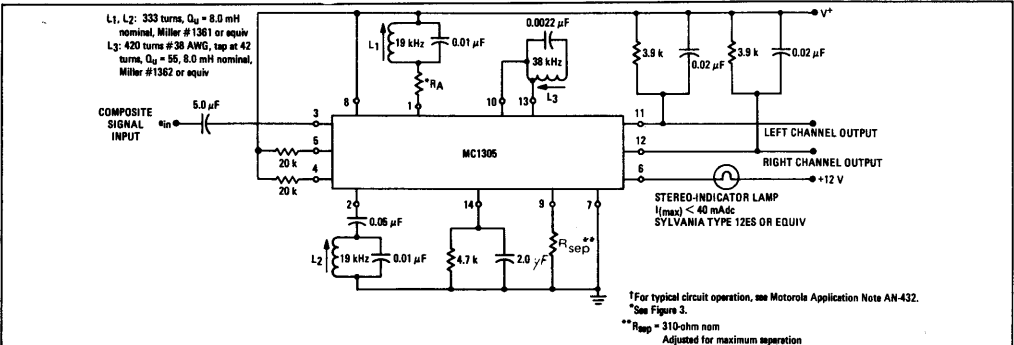
Typical dc voltages (All voltages measured with respect to ground, Pin 7, $R_A = 0$)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
$V_{CC} = 8.5$ Vdc	8.5	2.0	2.8	1.6	1.6	0.8	0	4.6*	8.5	3.9	6.3	6.3	3.9	1.9
$V_{CC} = 12$ Vdc	12	2.0	2.8	1.9	1.9	0.8	0	4.6**	12	3.9	9.7	9.7	3.9	1.9

*1.5 k Ω in series with pin 8

**2.7 k Ω in series with pin 8

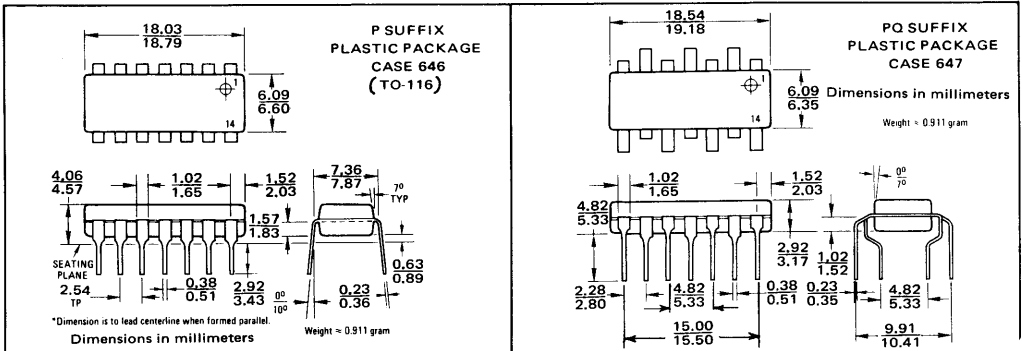
FIGURE 7 - MC1305 TYPICAL CIRCUIT CONFIGURATION†



Typical dc voltages (All voltages measured with respect to ground, Pin 7)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
$V_{CC} = 8.5$ Vdc	8.5	2.0	2.8	1.6	1.6	0.8	0	8.5	0.32	3.9	6.3	6.3	3.9	1.9
$V_{CC} = 12$ Vdc	12	2.0	2.8	1.9	1.9	0.8	0	12	0.36	3.9	9.7	9.7	3.9	1.9

Portions of the circuits shown within the blue-tinted areas pertain to the MC1304 or MC1305 as indicated by the titles of the circuits.



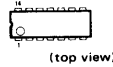
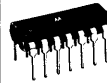
MC1307

MONOLITHIC FM MULTIPLEX STEREO DEMODULATOR

... designed to derive the left and right channel audio information from the detected composite signal.

- Capable of Operation Over a Wide Power Supply Range – 8.0 – 14 Vdc
- Built-in Stereo-Indicator Lamp Driver

FM MULTIPLEX STEREO DEMODULATOR SILICON MONOLITHIC INTEGRATED CIRCUIT

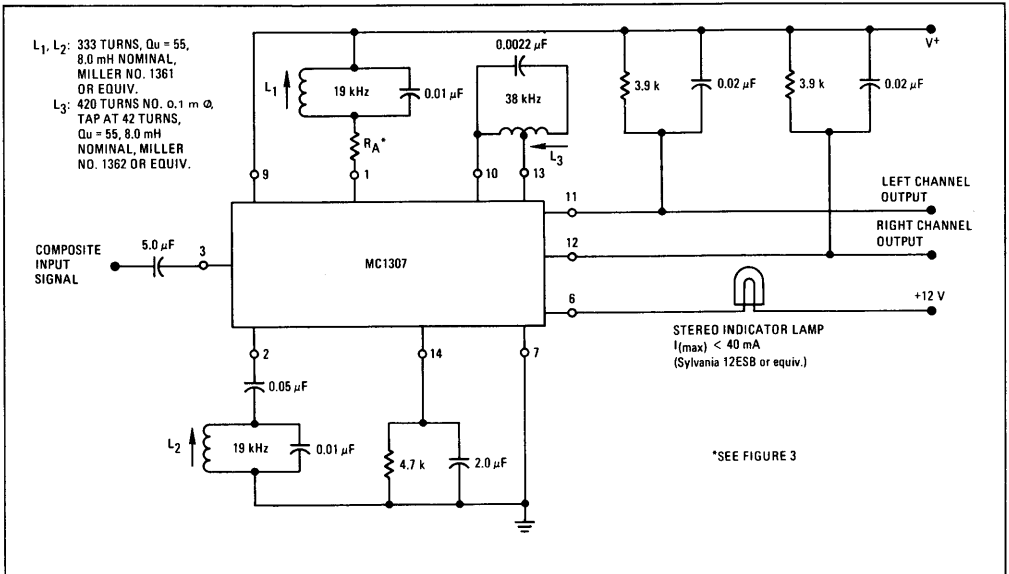


P SUFFIX
PLASTIC PACKAGE
CASE 646
(TO - 116)



PQ SUFFIX
PLASTIC PACKAGE
CASE 647

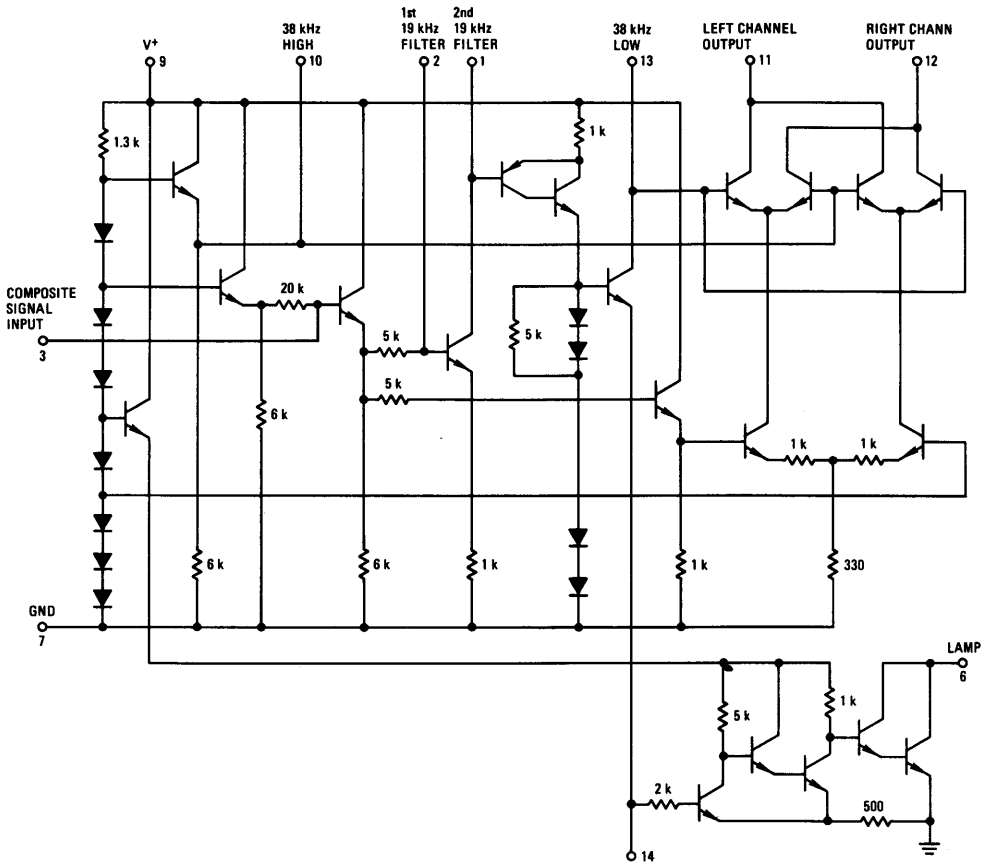
FIGURE 1 – TYPICAL CIRCUIT CONFIGURATION



TYPICAL DC VOLTAGES (All measured using a VTVM with respect to Pin 7 (lamp on), R_A = 180 ohms, see Figure 3)

Pin Numbers	1	2	3	4	5	6	7	8	9	10	11	12	13	14
V ⁺ = 8.5 Vdc	8.5	2.7	3.6	—	—	0.8	0	—	8.5	4.4	6.2	6.2	4.4	1.5
V ⁺ = 12 Vdc	12	2.9	3.9	—	—	0.9	0	—	12	4.7	9.7	9.7	4.7	1.7

FIGURE 2 – CIRCUIT SCHEMATIC



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

Rating	Value	Unit
Power Supply Voltage (Pins 1, 6, 9, 11, 12) (Pin 7 is grounded)	+22	Vdc
Lamp Driver Current	40	mAdc
Power Dissipation (Package Limitation)	625	mW
Derate above $T_A = +25^{\circ}\text{C}$	5.0	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.

MC 1307 (continued)

ELECTRICAL CHARACTERISTICS ($V^+ = 12 \text{ Vdc}$, $T_A = +25^\circ\text{C}$, tests made with a $75 \mu\text{s}$ de-emphasis network ($3.9 \text{ k}\Omega$, $0.02 \mu\text{F}$) unless otherwise noted)

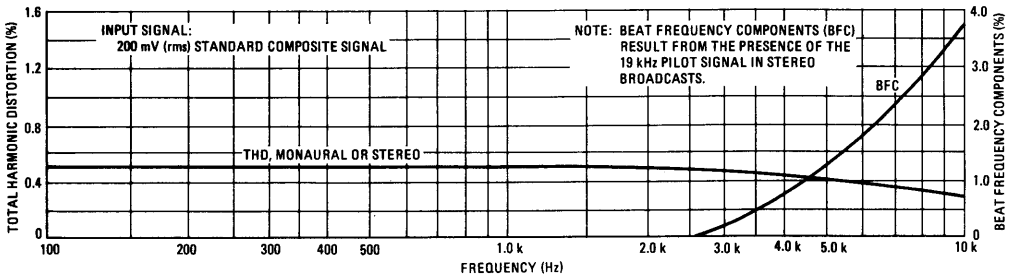
Characteristic	Min	Typ	Max	Unit
Input Impedance ($f = 1.0 \text{ kHz}$)	12	20	—	$\text{k}\Omega$
Stereo Channel Separation (See Note 1) ($f = 100 \text{ Hz}$) ($f = 1.0 \text{ kHz}$) ($f = 10 \text{ kHz}$)	— 20 —	35 40 30	— — —	dB
Total Harmonic Distortion (See Notes 1 and 2) (Modulation Frequency = 1.0 kHz)	—	0.5	1.0	%
Channel Balance (Monaural Input = 200 mV (rms)) (Monaural, Left and Right Outputs)	—	0.5	—	dB
Ultrasonic Frequency Rejection (See Note 3) (19 kHz) (38 kHz)	— —	25 20	— —	dB
Inherent SCA Rejection (without filter) ($f = 60 \text{ kHz}$, 67 kHz and 74 kHz) (See Note 3)	—	50	—	dB
Lamp Indicator ($R_A = 180 \Omega$) (Minimum 19 kHz input level for lamp "on") (Maximum 19 kHz input level for lamp "off")	— 5.0	16 14	25 —	mV (rms)
Power Dissipation ($V^+ = 12 \text{ V}$) (Without lamp) (With lamp)	— —	140 170	300 300	mW

Note 1 — Measurement made with 200 mV (rms) Standard Multiplex Composite Signal where $L = 1$, $R = 0$ or $R = 1$, $L = 0$. Standard Multiplex Composite Signal is here defined as a signal containing left and/or right audio information with a 10% (19 kHz) pilot signal in accordance with FCC regulations.

Note 2 — Distortion specification also applies to Monaural Signal.

Note 3 — Referenced to 1.0 kHz output signal with Standard Multiplex Composite Input Signal.

FIGURE 3 — DISTORTION COMPONENTS IN AUDIO SIGNAL



MC 1307 (continued)

FIGURE 4 – TOTAL HARMONIC DISTORTION

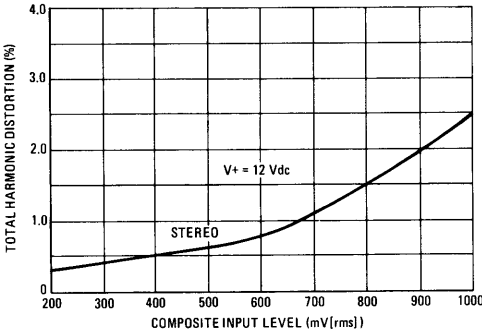


FIGURE 5 – MULTIPLEX SENSITIVITY

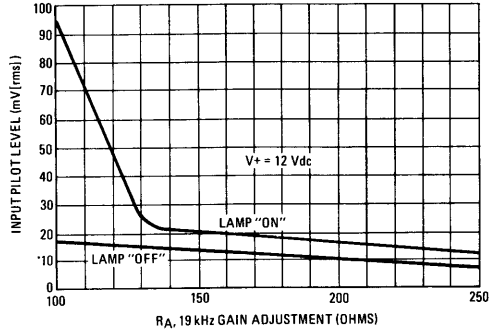


FIGURE 6 – CHANNEL SEPARATION

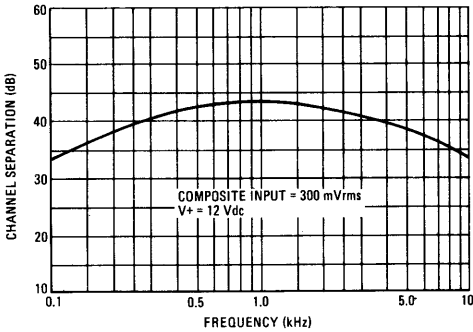
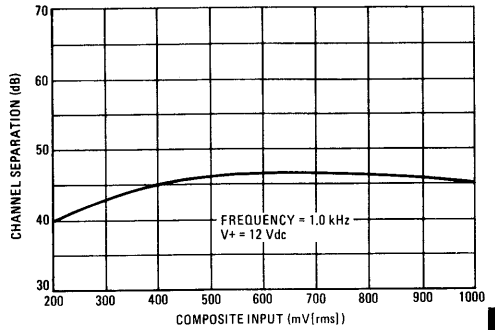
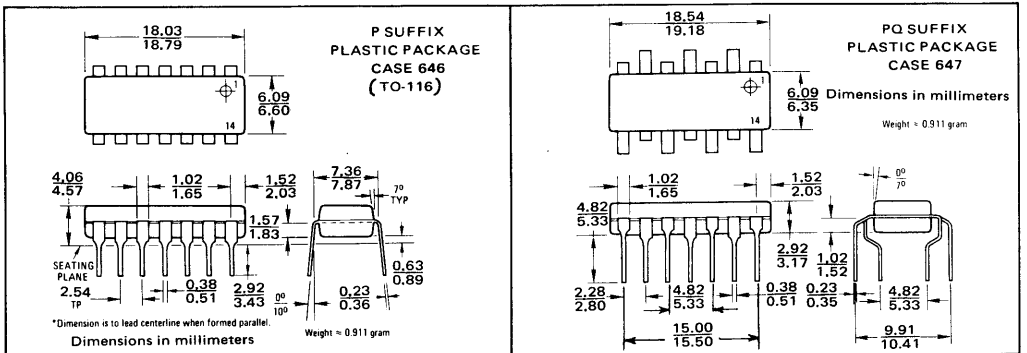


FIGURE 7 – CHANNEL SEPARATION



OUTLINE DIMENSIONS



MC1310P

Advance Information

FM STEREO DEMODULATOR

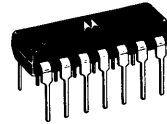
- a monolithic device designed for use in solid-state stereo receivers.
- Requires no Inductors
- Low External Part Count
- Only Oscillator Frequency Adjustment Necessary
- Integral Stereo/Monaural Switch 75 mA Lamp Driving Capability
- Wide Dynamic Range: 560 mV(RMS) maximum Composite Input Signal
- Wide Supply Range: 8-16 Vdc
- Excellent Channel Separation Maintained Over Entire Audio Frequency Range
- Low Distortion: Typically 0.3% THD at 560 mV (RMS) Composite Input Signal
- Excellent SCA Rejection

FM STEREO DEMODULATOR

MONOLITHIC SILICON INTEGRATED CIRCUIT

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

Rating	Value	Unit
Power Supply Voltage	16	Volts
Lamp Current (nominal rating, 12 V lamp)	75	mA
Power Dissipation (Package limitation)	625	mW
Derate above T _A = +25°C	5.0	mW/°C
Operating Temperature Range (Ambient)	-30 to +85	°C
Storage Temperature Range	-65 to +150	°C

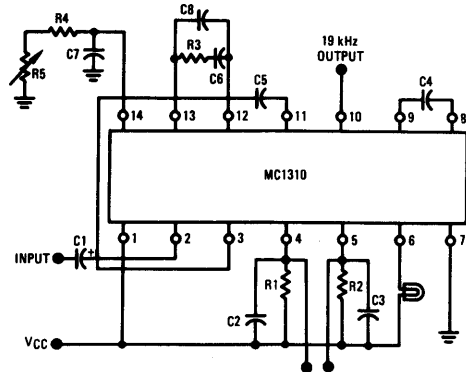


PLASTIC PACKAGE
CASE 646
TO-116

- PIN FUNCTIONS**
- Pin 1 = VCC
 - Pin 2 = Input
 - Pin 3 = Amplifier Output
 - Pin 4 = Left Channel Output
 - Pin 5 = Right Channel Output
 - Pin 6 = Lamp Indicator
 - Pin 7 = Ground
 - Pin 8 = Switch Filter
 - Pin 9 = Switch Filter
 - Pin 10 = 19 kHz Output
 - Pin 11 = Modulator Input
 - Pin 12 = Loop Filter
 - Pin 13 = Loop Filter
 - Pin 14 = Oscillator RC Network

- PARTS LIST**
- C₁ = 2.0 μF
 - C₂ = 0.02 μF
 - C₃ = 0.02 μF
 - C₄ = 0.25 μF
 - C₅ = 0.05 μF
 - C₆ = 0.5 μF
 - C₇ = 470 pF
 - C₈ = 0.25 μF
 - R₁ = 3.9 kΩ
 - R₂ = 3.9 kΩ
 - R₃ = 1.0 kΩ
 - R₄ = 16 kΩ
 - R₅ = 5.0 kΩ

FIGURE 1 - TYPICAL APPLICATION



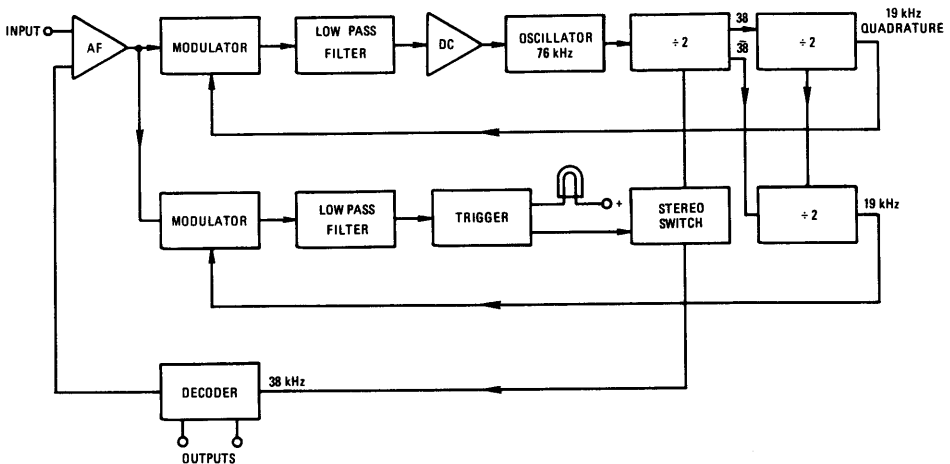
MC1310P (continued)

ELECTRICAL CHARACTERISTICS Unless otherwise noted: $V_{CC} = +12$ Vdc, $T_A = +25^\circ\text{C}$, 560 mV(RMS) (2.8 Vp-p) standard multiplex composite signal with L or R channel only modulated at 1.0 kHz and with 100 mV(RMS) (10%) pilot level, using circuit of Figure 1.

Characteristic	Min	Typ	Max	Unit
Maximum Standard Composite Input Signal (0.5% THD)	2.8	—	—	V _{p-p}
Maximum Monaural Input Signal (1.0% THD)	2.8	—	—	V _{p-p}
Input Impedance	—	50	—	k Ω
Stereo Channel Separation (50 Hz — 15 kHz)	30	40	—	dB
Audio Output Voltage (desired channel)	—	485	—	mV(RMS)
Monaural Channel Balance (pilot tone "off")	—	—	1.5	dB
Total Harmonic Distortion	—	0.3	—	%
Ultrasonic Frequency Rejection	19 kHz	34.4	—	dB
	38 kHz	45	—	
Inherent SC A Rejection (f = 67 kHz; 9.0 kHz beat note measured with 1.0 kHz modulation "off")	—	80	—	dB
Stereo (19 kHz input level for lamp "on") Hysteresis	12	16	20	mV(RMS)
Capture Range (permissible tuning error of internal oscillator, reference circuit values of Figure 1)	—	± 3.0	—	%
Operating Supply Voltage (loads reduced to 2.7 k Ω for 8.0-volt operation)	8.0	—	16	Vdc
Current Drain (lamp "off")	—	13	—	mAdc

*Symbols conform to JEDEC Engineering Bulletin No. 1 when applicable.

FIGURE 2 — SYSTEM BLOCK DIAGRAM



CIRCUIT OPERATION

Figure 2, on the previous page, shows the system block diagram. The upper line, comprising the 38-kHz regeneration loop operates as follows: the internal oscillator running at 76-kHz and feeding through two divider stages returns a 19-kHz signal to the input modulator. There the returned signal is multiplied with the incoming signal so that when a 19-kHz pilot tone is received a dc component is produced. The dc component is extracted by the low pass filter and used to control the frequency of the internal oscillator which consequently becomes phase-locked to the pilot tone. With the oscillator phase-locked to the pilot the 38-kHz output from the first divider is in the correct phase for decoding a stereo signal. The decoder is essentially another modulator in which the incoming signal is multiplied by the regenerated 38-kHz signal. The regener-

ated 38-kHz signal is fed to the stereo decoder via an internal stereo switch. The stereo switch closes when a sufficiently large 19-kHz pilot tone is received. The pilot tone level is detected and the switch operated by the stereo switch section of the circuit in the following manner:

The 19-kHz signal returned to the 38-kHz regeneration loop modulator is in quadrature with the 19-kHz pilot tone when the loop is locked. With a third divider stage appropriately connected, a 19-kHz signal in phase with the pilot tone is generated. This is multiplied with the incoming signal in the stereo switch modulator yielding a dc component proportional to the pilot tone amplitude. This component after filtering is applied to the trigger circuit which activates both the stereo switch and an indicator lamp.

APPLICATIONS INFORMATION

(Component numbers refer to Figure 1)

External Component Functions and Values

- C₁** Input coupling capacitor; 1.0 μF is recommended but a lower value is permissible if reduced separation at low frequencies is acceptable.
- R₁, R₂, C₂, C₃** Loads and de-emphasis capacitors, maximum permissible load resistors are related to minimum supply voltage as follows:

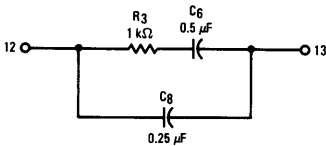
Min Supply	8.0	10	12	Volts
Max Load	2.7	4.3	6.2	Kilohms

 (±10% Tolerance)
- C₄** Filter capacitor for stereo switch level detector; time constant is C₄ × 53 kilohms ±30%, maximum dc voltage appearing across C₄ is 0.25 V (pin 8 positive) at 100 mV(RMS) pilot level. The signal voltage across C₄ is negligible.
- C₅** Internal coupling capacitor to modulators; 0.05 μF is recommended. This gives 1.75° phase lead at 19 KHz
- R₃, C₆, C₈** Phase-lock loop filter components; the following network is recommended:

- R₄, R₅, C₇** Oscillator timing network, recommended values:

C ₇ = 470 pF	1%
R ₄ = 16 kΩ	1%
R ₅ = 5 kΩ	Preset

 These values give ±3% typical capture range. Capture range may be increased by reducing C₇ and increasing R₄, R₅ proportionally but at the cost of increased beat-note distortion (due to oscillator-phase jitter) at high-signal levels.
- Stereo Lamp** Nominal rating up to 75 mA at 12 V; the circuit includes surge limiting which restricts cold-lamp current to approximately 250 mA.
- 19 kHz-Output** A buffered output providing a 3.0 V_{PK} positive-going square wave at 19 kHz is available at pin 10. A frequency counter may be connected to this point to measure the oscillator free-running frequency for alignment.



When less performance is required a simpler network consisting of R₃ = 100 ohms and C₆ = 0.25 μF may be used (omit C₈).