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# LA1837M

Monolithic Linear IC

## Single-Chip AM/FM Tuner IC for Home Stereo Systems

### Overview

The LA1837M is a single-chip AM/FM tuner IC that provides AM and FM IF and multiplex decoding circuits for electronic tuning and was developed for use in home stereo systems. It provides both SD and IF counting techniques for optimal implementation of automatic station selection.

### Features

- On-chip MPX VCO circuit (no external components required).
- Adjacent channel interference rejection function (third order and fifth order).
- Supports both the SD and IF counting technique (built-in SD speedup function).
- The AM and FM SD sensitivity can be set independently.
- The AM and FM output levels can be set independently.
- Improved basic FM reception performance.

### Functions

- AM: RF amplifier, mixer, oscillator, IF amplifier, detector, AGC, oscillator buffer, S-meter, narrow band SD, IF buffer
- FM IF: IF amplifier, quadrature detector, S-meter, SD, S curve detection, IF buffer output
- Multiplex stereo decoding: PLL stereo decoder, stereo indicator, forced monaural, VCO stop function, post amplifier, audio muting, adjacent channel interference rejection function

### Specifications

**Maximum Ratings** at  $T_a = 25^\circ\text{C}$

| Parameter                   | Symbol        | Conditions                    | Ratings     | Unit             |
|-----------------------------|---------------|-------------------------------|-------------|------------------|
| Maximum supply voltage      | $V_{CC\ max}$ |                               | 12          | V                |
| Allowable power dissipation | $P_d\ max$    | $T_a \leq 70^\circ\text{C}^*$ | 550         | mW               |
| Operating temperature       | $T_{opr}$     |                               | -20 to +70  | $^\circ\text{C}$ |
| Storage temperature         | $T_{stg}$     |                               | -40 to +125 | $^\circ\text{C}$ |

\*: Mounting board: 114.3×76.1×1.6mm glass epoxy board

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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## Operating Conditions at $T_a = 25^\circ\text{C}$

| Parameter                      | Symbol             | Conditions | Ratings     | Unit |
|--------------------------------|--------------------|------------|-------------|------|
| Recommended supply voltage     | $V_{CC}$           |            | 9           | V    |
| Operating supply voltage range | $V_{CC\text{ op}}$ |            | 7.0 to 11.0 | V    |

## Electrical Characteristics at $T_a = 25^\circ\text{C}$ $V_{CC} = 9.0\text{V}$ , in the specified circuit.

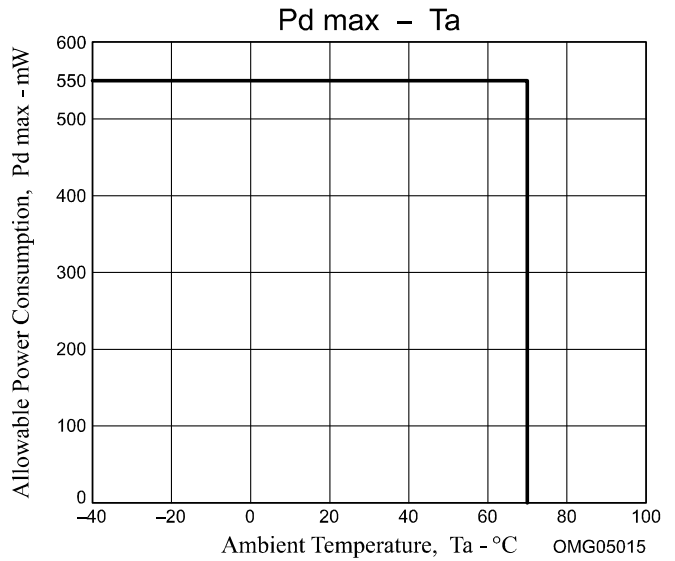
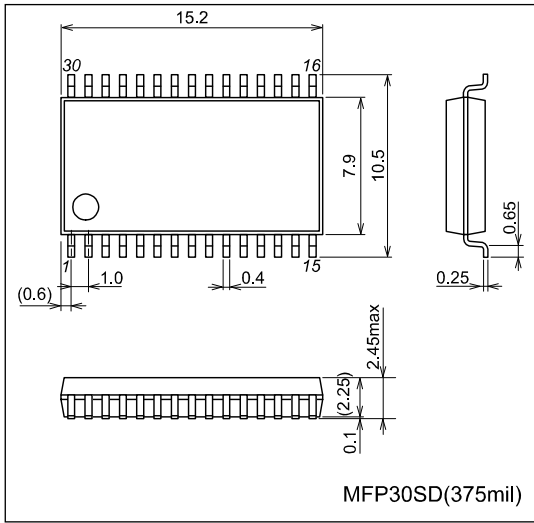
| Parameter   | Symbol                 | Conditions   | Ratings |      |      | Unit     |
|---|------------------------|--|---------|------|------|----------|
|   |                        |  | min     | typ  | max  |          |
| [FM Mono Characteristics] $f_c = 10.7\text{MHz}$ , $f_m = 1\text{kHz}$ , with the coil adjusted so that $V_{AFC} - V_{REG} = 0\text{V}$ . |                        |  |         |      |      |          |
| Current drain   | $I_{CCO-FM}$           | No input   | 18      | 31   | 44   | mA       |
| Demodulator output  | $V_{OFM}$              | 100dB $\mu$ , 100% mod, pin 16 output  | 730     | 1100 | 1460 | mVrms    |
| Channel balance   | C.B-mono               | 100dB $\mu$ , 100% mod, pin 16 output / pin 17 output  | -1.5    | 0    | +1.5 | dB       |
| Total harmonic distortion (mono)  | THD <sub>FM1</sub>     | 100dB $\mu$ , 100% mod, pin 16 output  |         | 0.3  | 1.3  | %        |
|   | THD <sub>FM2</sub>     | 100dB $\mu$ , 200% mod, pin 16 output  |         | 1.0  | 5.0  | %        |
| Signal-to-noise ratio   | S/N <sub>FM</sub>      | 100dB $\mu$ , 100% mod, pin 16 output  | 72      | 80   |      | dB       |
| AM rejection ratio  | AMR                    | 100dB $\mu$ , AM 30% mod, pin 16 output  | 45      | 65   |      | dB       |
| Input limiting voltage  | -3dB <sub>L.S</sub>    | Referenced to 100dB $\mu$ , 100% mod, the input for output is -3dB down.                                     | 26      | 32   | 38   | dB $\mu$ |
| LED on sensitivity  | SD <sub>ON-FM</sub>    |  | 51      | 60   | 69   | dB $\mu$ |
| LED on bandwidth  | SD <sub>BW</sub>       | 100dB $\mu$  | 85      | 120  | 170  | kHz      |
| IF counter buffer output  | V <sub>IFBUFF-FM</sub> | 100dB $\mu$ , pin 13 output  | 80      | 120  | 160  | mVrms    |
| S-meter output  | V <sub>SM FM1</sub>    | 0dB $\mu$ , pin 11 output  | 0       | 0.1  | 0.5  | V        |
|   | V <sub>SM FM2</sub>    | 100dB $\mu$ , pin 11 output  | 3.6     | 4.3  | 5.0  | V        |
| Muting attenuation  | Mute Alt               | 100dB $\mu$ , 100% mod, the pin 16 output  | 75      | 85   |      | dB       |
| [FM Stereo Characteristics] $f_c = 10.7\text{MHz}$ , 100dB $\mu$ , $f_m = 1\text{kHz}$ , L+R = 90%, pilot = 10%                           |                        |  |         |      |      |          |
| Separation: L   | Sep <sub>L</sub>       | Lmod. pin 16 output / pin 17 output  | 30      | 45   |      | dB       |
| Separation: R   | Sep <sub>R</sub>       | Rmod. pin 17 output / pin 16 output  | 30      | 45   |      | dB       |
| Stereo on level   | ST <sub>ON</sub>       | The pilot mod such that $V_7 < 0.7\text{V}$  | 1.3     | 2.7  | 5.0  | %        |
| Stereo off level  | ST <sub>OFF</sub>      | The pilot mod such that $V_7 > 4.5\text{V}$  |         | 1.5  |      | %        |
| Total harmonic distortion (main)  | THD main               | L+R mod. Pin 16 output   |         | 0.3  | 1.3  | %        |
| Adjacent channel interference rejection ratio   | Brej-3rd               | $f_s = 113\text{kHz}$ , $V_s = 90\%$ , Pilot = 10%<br>Pin 16 output, versus L-R mod. 1kHz demodulator output |         | 40   |      | dB       |
|   | Brej-5th               | $f_s = 189\text{kHz}$ , $V_s = 90\%$ , Pilot = 10%<br>Pin 16 output, versus L-R mod. 1kHz demodulator output |         | 40   |      | dB       |
| [AM Characteristics]  |                        |  |         |      |      |          |
| Current drain   | $I_{CCO-AM}$           | No input   | 15      | 25   | 35   | mA       |
| Output detector   | V <sub>OAM1</sub>      | 23dB $\mu$ , 30% mod, pin 16 output  | 100     | 180  | 360  | mVrms    |
|   | V <sub>OAM2</sub>      | 80dB $\mu$ , 30% mod, pin 16 output  | 200     | 320  | 500  | mVrms    |
| Signal-to-noise ratio   | S/N <sub>AM1</sub>     | 23dB $\mu$ , 30% mod, pin 16 output  | 18      | 22   |      | dB       |
|   | S/N <sub>AM2</sub>     | 80dB $\mu$ , 30% mod, pin 16 output  | 49      | 55   |      | dB       |
| Total harmonic distortion   | THD <sub>AM1</sub>     | 80dB $\mu$ , 30% mod, pin 16 output  |         | 0.4  | 1.2  | %        |
|   | THD <sub>AM2</sub>     | 80dB $\mu$ , 80% mod, pin 16 output  |         | 1.0  | 4.0  | %        |
| LED-ON sensitivity  | SD <sub>On-AM</sub>    |  | 17      | 27   | 37   | dB $\mu$ |
| Oscillator buffer output  | V <sub>OSC-AM</sub>    | No input, pin 30 output  | 110     | 160  | 220  | mVrms    |
| IF counter buffer output  | V <sub>IFBuff-AM</sub> | 80dB $\mu$ , non-mod, pin 13 output  | 160     | 220  | 300  | mVrms    |
| ST IF output  | V <sub>STIF-AM</sub>   | 80dB $\mu$ , non-mod, pin 7 output   | 16      | 34   | 48   | mVrms    |
| S-meter output  | V <sub>SM-AM</sub>     | 0dB $\mu$ , non-mod  | 0       | 0    | 0.2  | V        |

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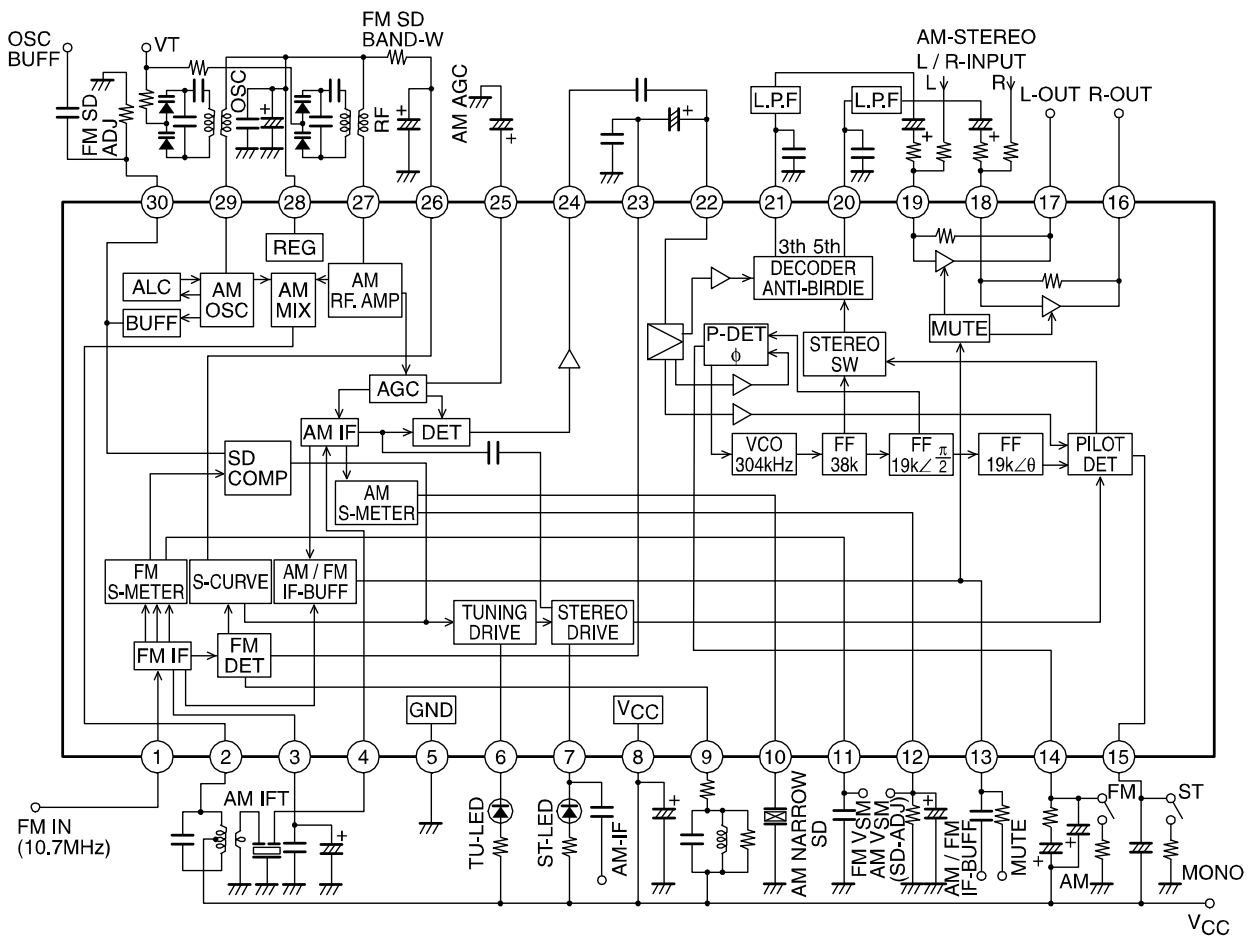
## Package Dimensions

unit : mm

3073C

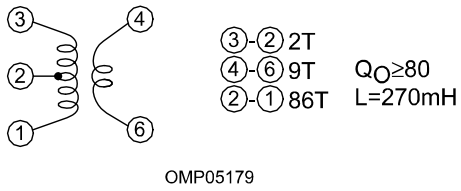


## Block Diagram

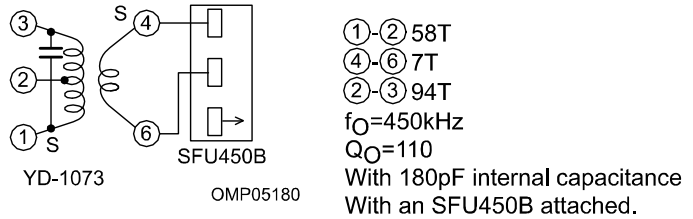


Coil Specifications

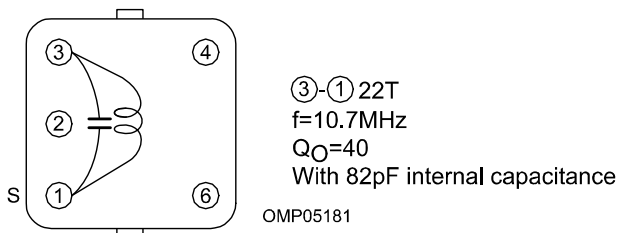
- AM oscillator (for the DUT)  
HW-50425 (Mitsumi Electric Co., Ltd.)



- IFT  
YD-1073-1 (Mitsumi Electric Co., Ltd.)



- FM-DET  
600BEAS-9715Z (Toko Electric Corporation)



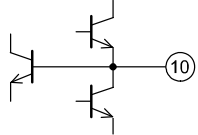
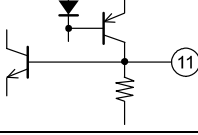
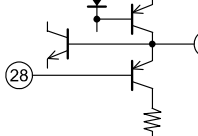
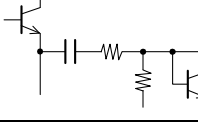
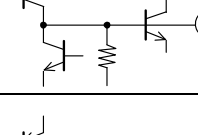
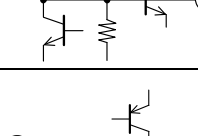
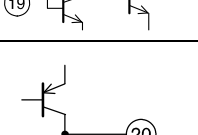
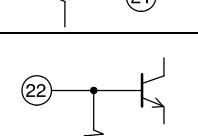
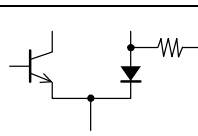

Pin Function

| Pin No. | Pin                                  | Pin voltage | Equivalent circuit | Pin function   |
|---------|--------------------------------------|-------------|--------------------|--|
| 1       | FM IF input                          | Vreg        | OMP05156           | Input impedance $r_i = 330 \Omega$   |
| 2       | AM mixer output                      | VCC         | OMP05157           | Connect the mixer coil between this pin and VCC.   |
| 3       | FM IF input bypass                   | Vreg        | See pin 1          | Also used for the multiplex regulator filter   |
| 4       | AM IF input                          | Vreg        | OMP05158           | Input impedance $r_i = 2 \text{ k}\Omega$  |
| 5       | GND                                  | 0V          |                    |  |
| 6       | TU-LED,<br>ST-LED,<br>AM - IF output | VCC<br>VCC  | OMP05159           | Active low<br>Open collector<br>AM stereo IF output (pin 7)<br>This pin must be set up with an influx current under 150μA. |
| 8       |                                      | VCC         |                    |  |
| 9       | FM detector                          | VCC         | OMP05160           | Recommended detector coil<br>600BEAS-9715Z (The Toko Electric Corporation)   |

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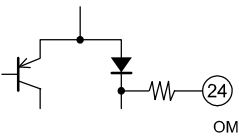
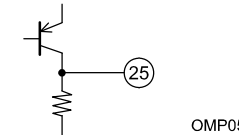
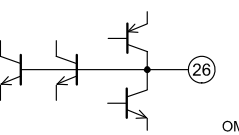
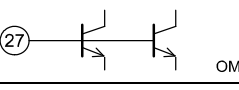
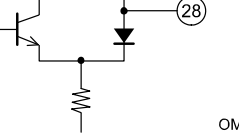
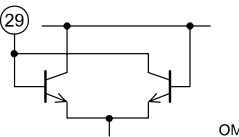
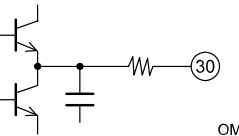
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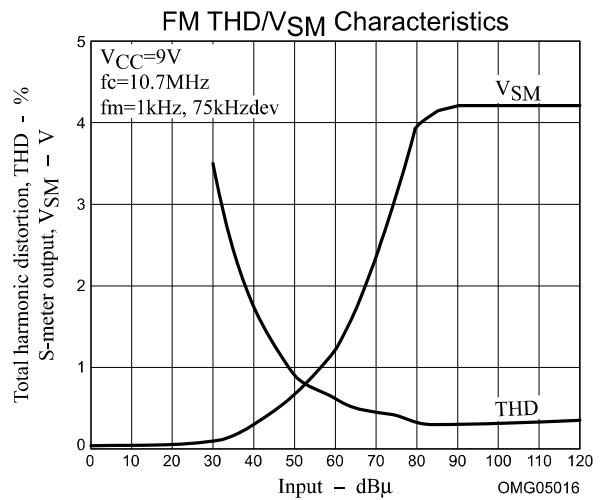
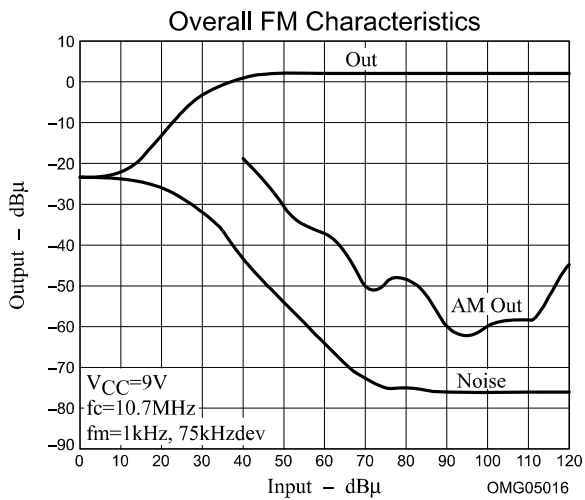
| Pin No.              | Pin   | Pin voltage                  | Equivalent circuit  | Pin function   |
|----------------------|---|------------------------------|---|--|
| 10                   | AM narrow band ceramic filter connection                      | 1.3V                         | <br>OMP05161   | Recommended narrow band ceramic filter<br>BFU450C4N (Murata Mfg. Co., Ltd.)<br>When the narrow band SD function is not used, bypass this circuit by connecting a 50Ω resistor and a 0.047μF capacitor in series. |
| 11                   | FM S-meter output   | 0V                           | <br>OMP05162   | $R_L = 8k\Omega$   |
| 12                   | AM S-meter output, AM SD sensitivity adjustment               | 0V (AM)                      | <br>OMP05163   | The AM SD sensitivity can be adjusted with an external resistor between this pin and ground.   |
| 13                   | AM/FM IF buffer output, Output control switch (muting switch) | 0V                           | <br>OMP05164   | $V_{13} \leq 0.5V$ : Reception state<br>$1.4V \leq V_{13} \leq 2.2V$ : IF buffer output on<br>$V_{13} \geq 3.5V$ : IF buffer output and muting on  |
| 14                   | Phase comparator low-pass filter (FM/AM switching)            | $V_{CC}-1.4$ (FM)<br>0V (AM) | <br>OMP05166  | The IC switches to AM mode when this pin is connected to ground through a resistor.<br>Resistor value limits: 2.7kΩ (when $V_{CC} = 7V$ )<br>3.9kΩ (8V) 5.1kΩ (9V)<br>6.2kΩ (10V) 7.5kΩ (11V)                    |
| 15                   | Pilot detector low-pass filter (Forced monaural) (VCO stop)   | $V_{CC}-1.0$                 | <br>OMP05167 | When a current of over 50μA is sourced by this pin, the IC switches to forced monaural mode.<br>The VCO is stopped if this pin is connected to ground.<br>The resistor value limits are the same as for pin 14.  |
| 16<br>17<br>18<br>19 | Post amplifier I/O  | Verg<br>Verg                 | <br>OMP05168 | Output impedance $r_O = 200\Omega$<br>Pin 16: right output, pin 17: left output<br>Inverting input pins<br>Pin 18: right input, pin 19: left input<br>$R_{NF} = 33k\Omega$                                       |
| 20<br>21             | Multiplex output  | 3.5V<br>3.5V                 | <br>OMP05169 | Output impedance $r_O = 3.3k\Omega$<br>Pin 20: Right channel deemphasis<br>Pin 21: Left channel deemphasis   |
| 22                   | Multiplex input   | 2.9V                         | <br>OMP05170 | Input impedance $r_i = 20k\Omega$  |
| 23                   | FM demodulated output   | 2.8V (FM)<br>2.8V (AM)       | <br>OMP05171 | Output impedance $r_O = 3.0k\Omega$<br>The separation can be adjusted with an external capacitor connected between this pin and ground.<br>The $V_{Osub}/V_{Omain}$ ratio is set to be approximately 0dB.        |

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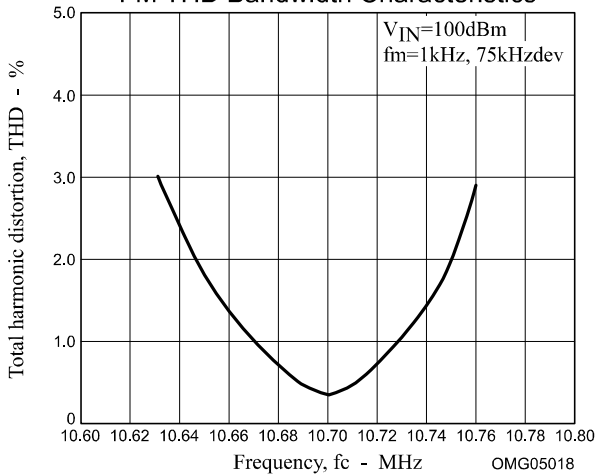
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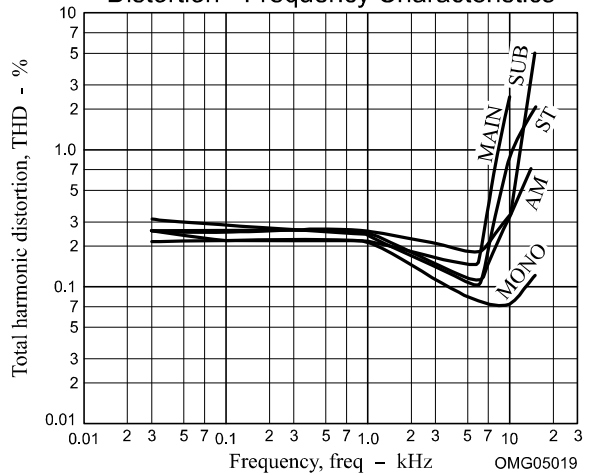
| Pin No. | Pin  | Pin voltage            | Equivalent circuit  | Pin function   |
|---------|--|------------------------|---|--|
| 24      | AM detector output                                     | 0V (FM)<br>0.5V (AM)   | <br>OMP05172   | Output impedance $r_o = 3.3k\Omega$ The AM frequency characteristics can be adjusted with an RC circuit connected between pin 22 and ground. |
| 25      | AM AGC   | 0V (FM)<br>0.5V (AM)   | <br>OMP05173   | Internal load resistance $R = 11k\Omega$   |
| 26      | AFC  | Vreg                   | <br>OMP05174   | The FM SD bandwidth can be adjusted with an external resistor connected between this pin and pin 28.   |
| 27      | AM RF input  | Vreg                   | <br>OMP05175   | This pin must be held at the same potential as pin 28  |
| 28      | REG  | Vreg                   | <br>OMP05176   | Vreg = 3.6V  |
| 29      | OSC  | Vreg                   | <br>OMP05177  | Connect the oscillator coil between this pin and pin 28.   |
| 30      | Oscillator buffer output, FM SD sensitivity adjustment | 1.6V (FM)<br>1.3V (AM) | <br>OMP05177 | The FM SD sensitivity can be adjusted with an external resistor connected between this pin and ground.<br>Output impedance $r_o = 20\Omega$  |



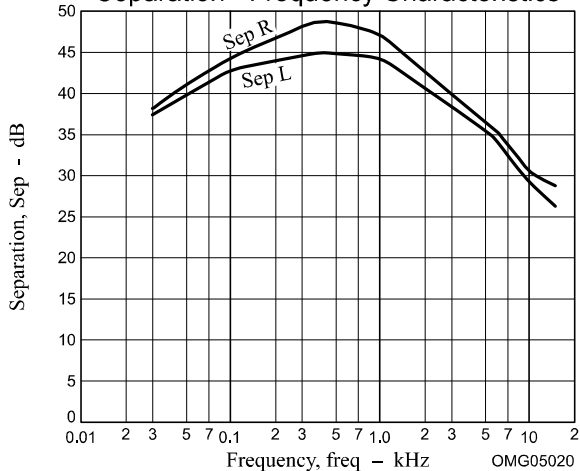
FM THD Bandwidth Characteristics



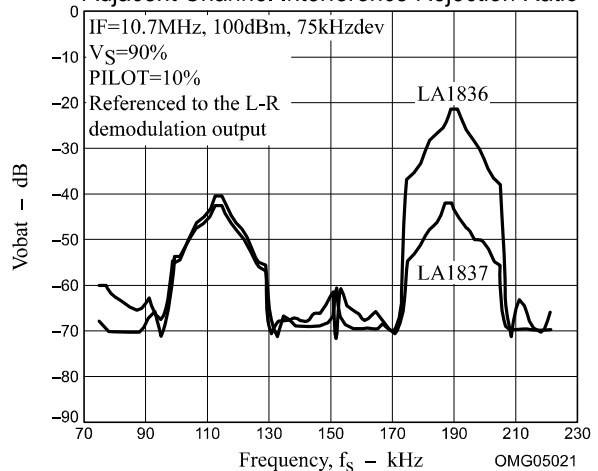
Distortion - Frequency Characteristics



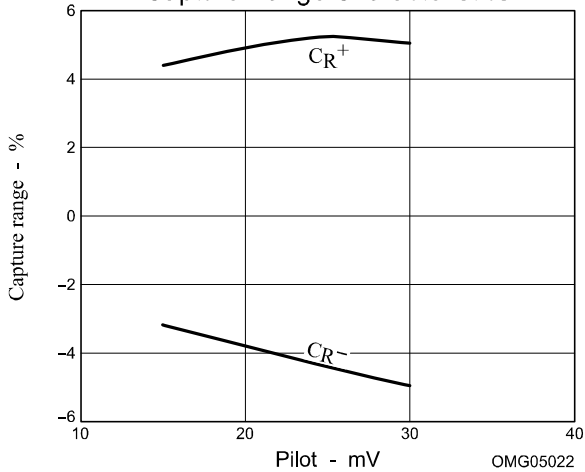
Separation - Frequency Characteristics



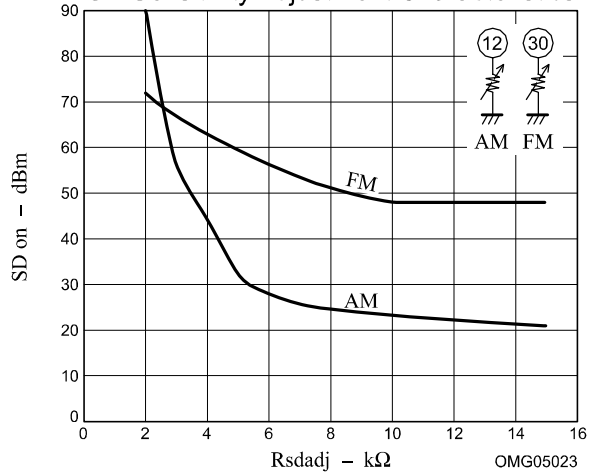
Adjacent Channel Interference Rejection Ratio



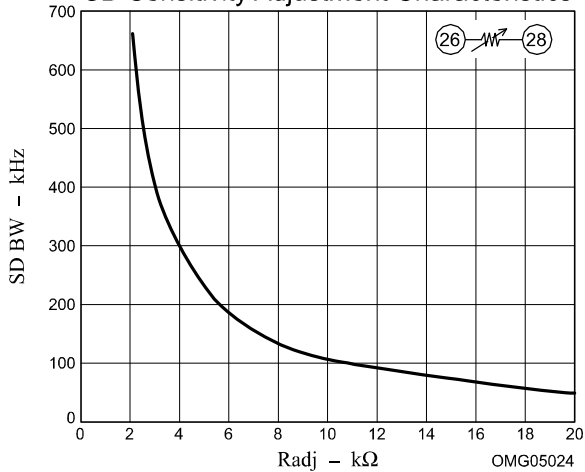
Capture Range Characteristics



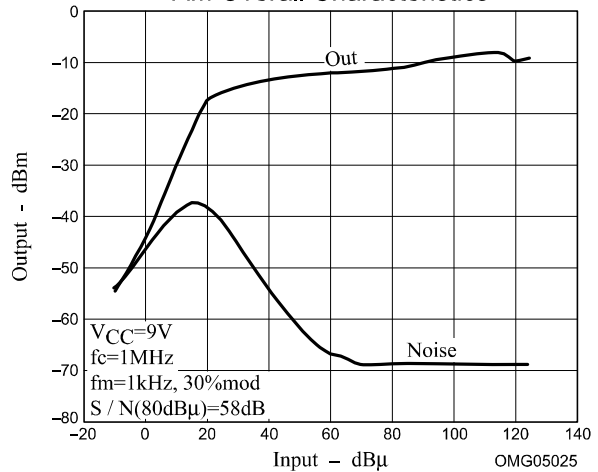
SD Sensitivity Adjustment Characteristics



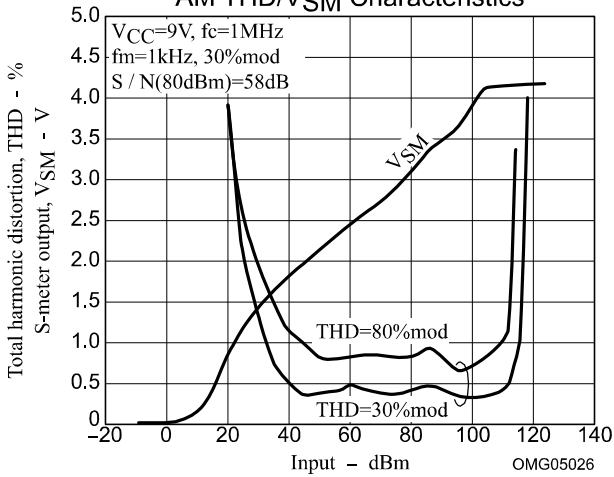
SD Sensitivity Adjustment Characteristics



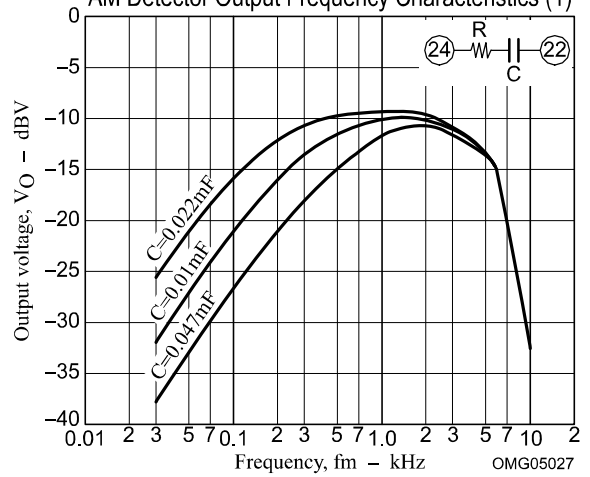
AM Overall Characteristics



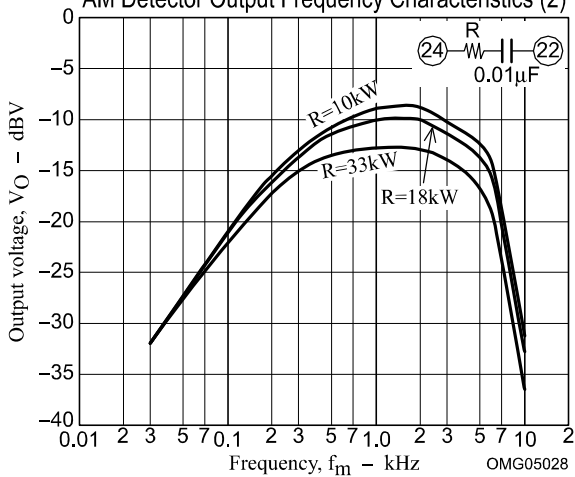
AM THD/V<sub>SM</sub> Characteristics



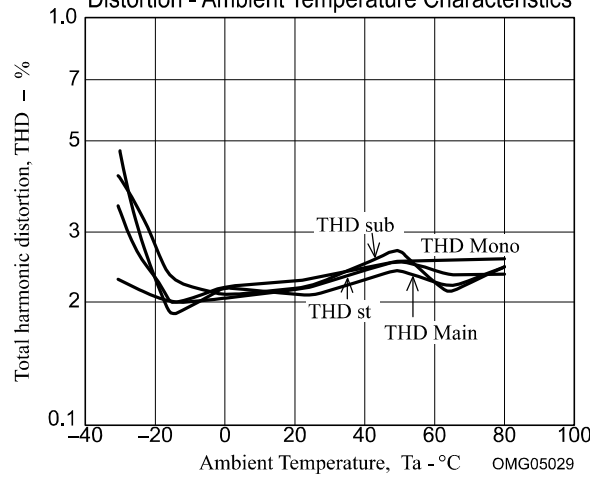
AM Detector Output Frequency Characteristics (1)



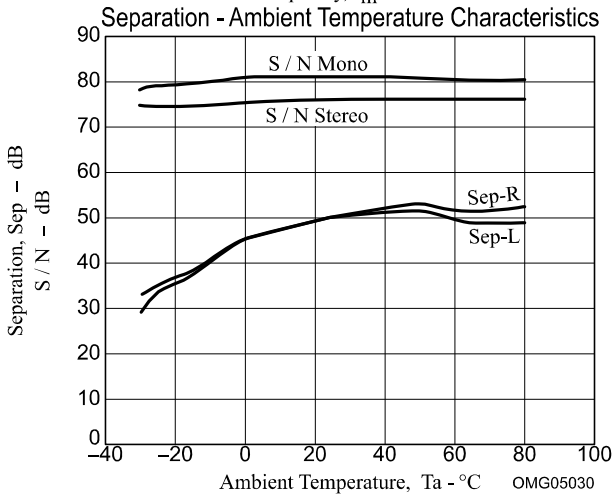
AM Detector Output Frequency Characteristics (2)



Distortion - Ambient Temperature Characteristics



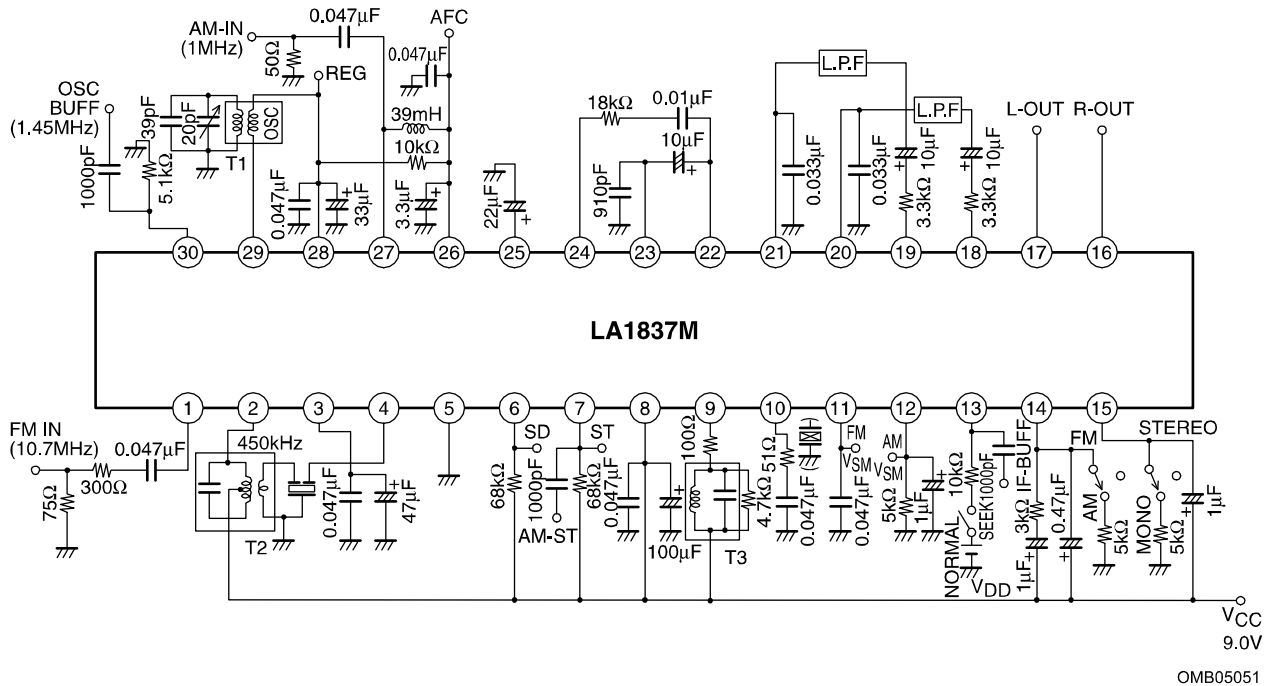
Separation - Ambient Temperature Characteristics





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## Test Circuit



OMB05051

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