

## LM3189 FM IF System

### General Description

The LM3189N is a monolithic integrated circuit that provides all the functions of a comprehensive FM IF system. The block diagram of the LM3189N includes a three stage FM IF amplifier/limiter configuration with level detectors for each stage, a doubly balanced quadrature FM detector and an audio amplifier that features the optional use of a muting (squelch) circuit.

The advanced circuit design of the IF system includes desirable deluxe features such as programmable delayed AGC for the RF tuner, an AFC drive circuit, and an output signal to drive a tuning meter and/or provide stereo switching logic. In addition, internal power supply regulators maintain a nearly constant current drain over the voltage supply range of +8.5V to +16V.

The LM3189N is ideal for high fidelity operation. Distortion in an LM3189N FM IF system is primarily a function of the phase linearity characteristic of the outboard detector coil.

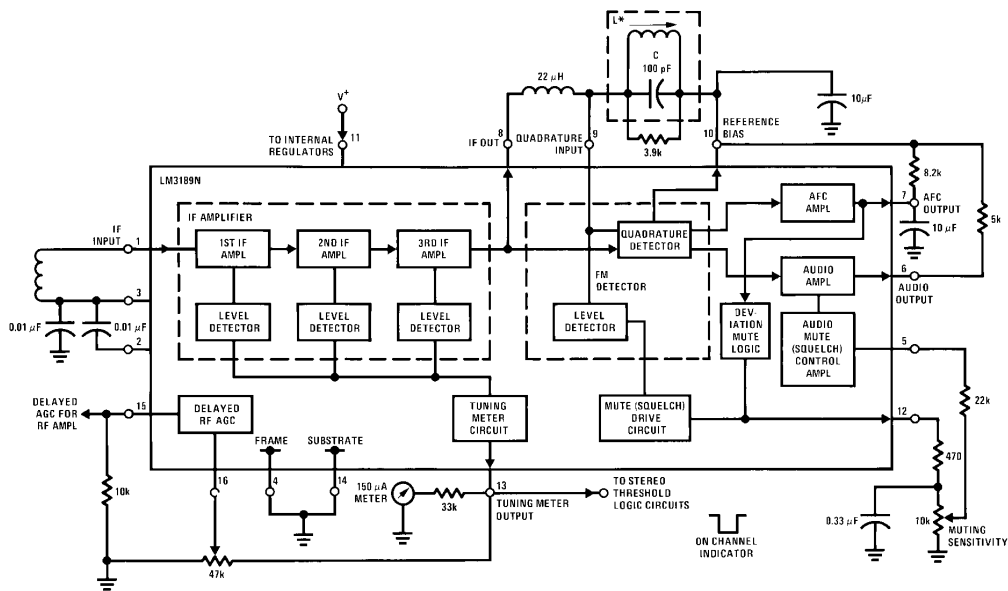
The LM3189N has all the features of the LM3089N plus additions.

The LM3189N utilizes the 16-lead dual-in-line plastic package and can operate over the ambient temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

### Features

- Exceptional limiting sensitivity:  $12\ \mu\text{V}$  typ at  $-3\ \text{dB}$  point
- Low distortion: 0.1% typ (with double-tuned coil)
- Single-coil tuning capability
- Improved (S + N)/N ratio
- Externally programmable recovered audio level
- Provides specific signal for control of inter-channel muting (squelch)
- Provides specific signal for direct drive of a tuning meter
- On channel step for search control
- Provides programmable AGC voltage for RF amplifier
- Provides a specific circuit for flexible audio output
- Internal supply voltage regulators
- Externally programmable ON channel step width, and deviation at which muting occurs

### Block Diagram



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All resistance values are in  $\Omega$

\*L tunes with 100 pF (C) at 10.7 MHz,  $Q_0 \approx 75$   
(Toko No. KACS K586HM or equivalent)

## Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage Between Pin 11 and Pins 4, 14	16V
DC Current Out of Pin 12	5 mA
DC Current Out of Pin 13	5 mA
DC Current Out of Pin 15	2 mA

Power Dissipation (Note 2)	1500 mW
Operating Temperature Range	-40°C to +85°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	260°C

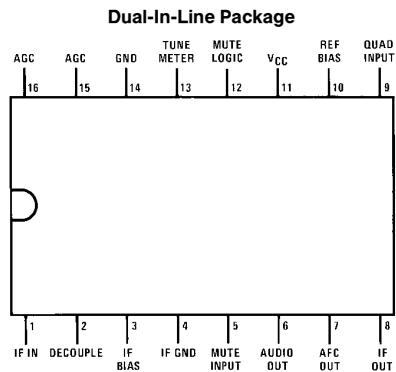
## Electrical Characteristics $T_A = 25^\circ\text{C}$ , $V^+ = 12\text{V}$

Symbol	Parameter	Conditions (See Single-Tuned Test Circuit)	Min	Typ	Max	Units
<b>STATIC (DC) CHARACTERISTICS</b>						
$I_{11}$	Quiescent Circuit Current	No Signal Input, Non Muted	20	31	44	mA
V1	DC Voltages: Terminal 1 (IF Input)		1.2	2.0	2.4	V
V2	Terminal 2 (AC Return to Input)		1.2	2.0	2.4	V
V3	Terminal 3 (DC Bias to Input)		1.2	2.0	2.4	V
V15	Terminal 15 (RF AGC)		7.5	9.5	11	V
V10	Terminal 10 (DC Reference)		5	5.75	6	V
<b>DYNAMIC CHARACTERISTICS</b>						
$V_i(\text{lim})$	Input Limiting Voltage (-3 dB Point)	$V_{IN} = 0.1\text{V}$ AM Mod. = 30%		12	25	$\mu\text{V}$
AMR	AM Rejection (Term. 6)		45	55		dB
$V_O(\text{AF})$	Recovered AF Voltage (Term. 6)		325	500	650	mV
THD	Total Harmonic Distortion (Note 1) Single Tuned (Term. 6) Double Tuned (Term. 6)	$V_{IN} = 0.1\text{V}$	$f_o = 10.7\text{ MHz}$ , $f_{\text{mod}} = 400\text{ Hz}$ , Deviation $\pm 75\text{ kHz}$	0.5	1	%
S + N/N	Signal Plus Noise to Noise Ratio (Term. 6)			65	80	
$f_{\text{DEV}}$	Deviation Mute Frequency		$f_{\text{mod}} = 0$	$\pm 40$		kHz
V16	RF AGC Threshold			1.25		V
V12	On Channel Step	$V_{IN} = 0.1\text{V}$	$f_{\text{DEV}} < \pm 40\text{ kHz}$ $f_{\text{DEV}} > \pm 40\text{ kHz}$	0 5.6		V

**Note 1:** THD characteristics are essentially a function of the phase characteristics of the network connected between terminals 8, 9, and 10.

**Note 2:** For operation in ambient temperatures above 25°C, the device must be derated based on a 150°C maximum junction temperature and a thermal resistance of 80°C/W junction to ambient.

## Connection Diagram



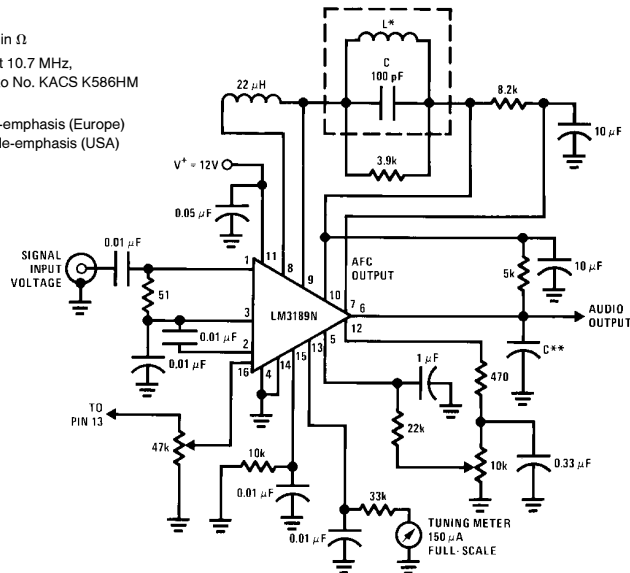
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Order Number LM3189N  
See NS Package Number N16E

## Test Circuits

### Test Circuit for LM3189N Using a Single-Tuned Detector Coil

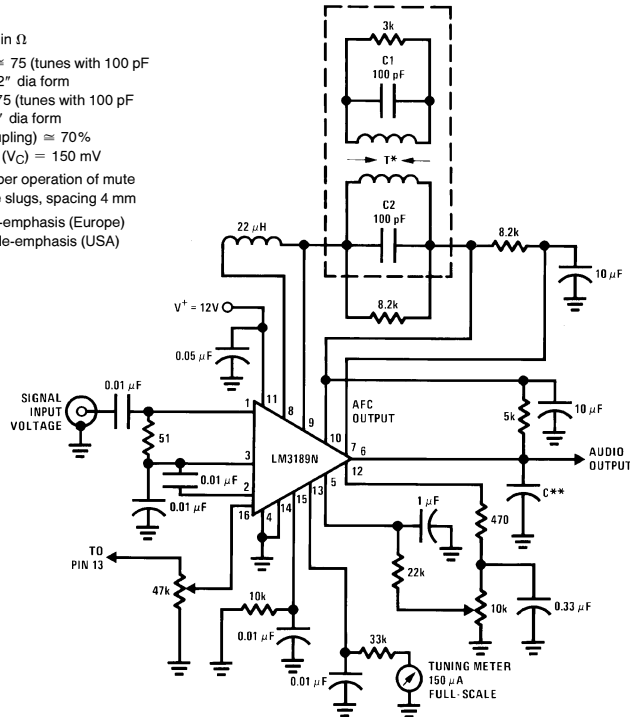
- All resistance values are in  $\Omega$
- \*L tunes with 100 pF (C) at 10.7 MHz,  
 $Q_0(\text{unloaded}) \approx 75$  (Toko No. KACS K586HM  
 or equivalent)
- \*\*C = 0.01  $\mu\text{F}$  for 50  $\mu\text{s}$  de-emphasis (Europe)  
 = 0.015  $\mu\text{F}$  for 75  $\mu\text{s}$  de-emphasis (USA)



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### Test Circuit for LM3189N Using a Double-Tuned Detector Coil

- All resistance values are in  $\Omega$
- \*T:PRI— $Q_0(\text{unloaded}) \approx 75$  (tunes with 100 pF  
 (C12)) 20t of 34e on 7/32" dia form  
 SEC— $Q_0(\text{unloaded}) \approx 75$  (tunes with 100 pF  
 (C2)) 20t of 34e on 7/32" dia form  
 $kQ$ (percent of critical coupling)  $\approx 70\%$   
 (adjusted for coil voltage ( $V_C$ ) = 150 mV)
- Above values permit proper operation of mute  
 (squelch) circuit "E" type slugs, spacing 4 mm
- \*\*C = 0.01  $\mu\text{F}$  for 50  $\mu\text{s}$  de-emphasis (Europe)  
 = 0.015  $\mu\text{F}$  for 75  $\mu\text{s}$  de-emphasis (USA)

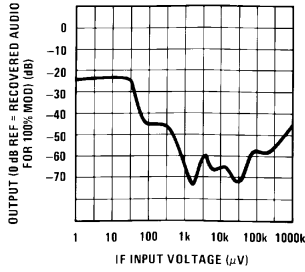


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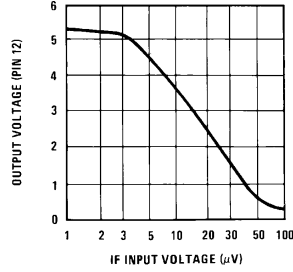


# Typical Performance Characteristics

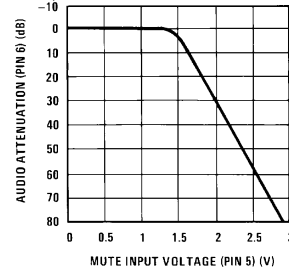
**AM Rejection (30% Mod) vs IF Input Signal**



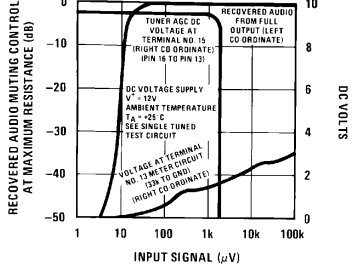
**Mute Control Output (Pin 12) vs IF Input Signal**



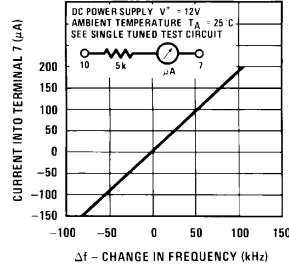
**Typical Audio Attenuation (Pin 6) vs Mute Input Voltage (Pin 5)**



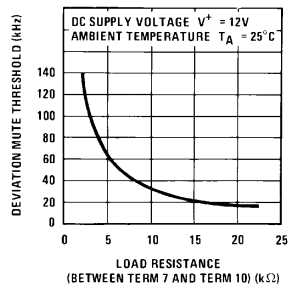
**Muting Action, Tuner AGC, and Tuning Meter Output as a Function of Input Signal Voltage**



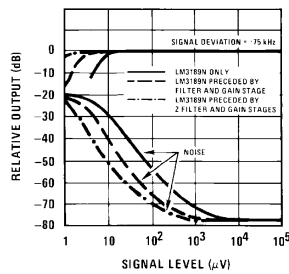
**AFC Characteristics (Current at Term 7 as a Function of Change in Frequency)**



**Deviation Mute Threshold as a Function of Load Resistance (Between Term 7 and Term 10)**

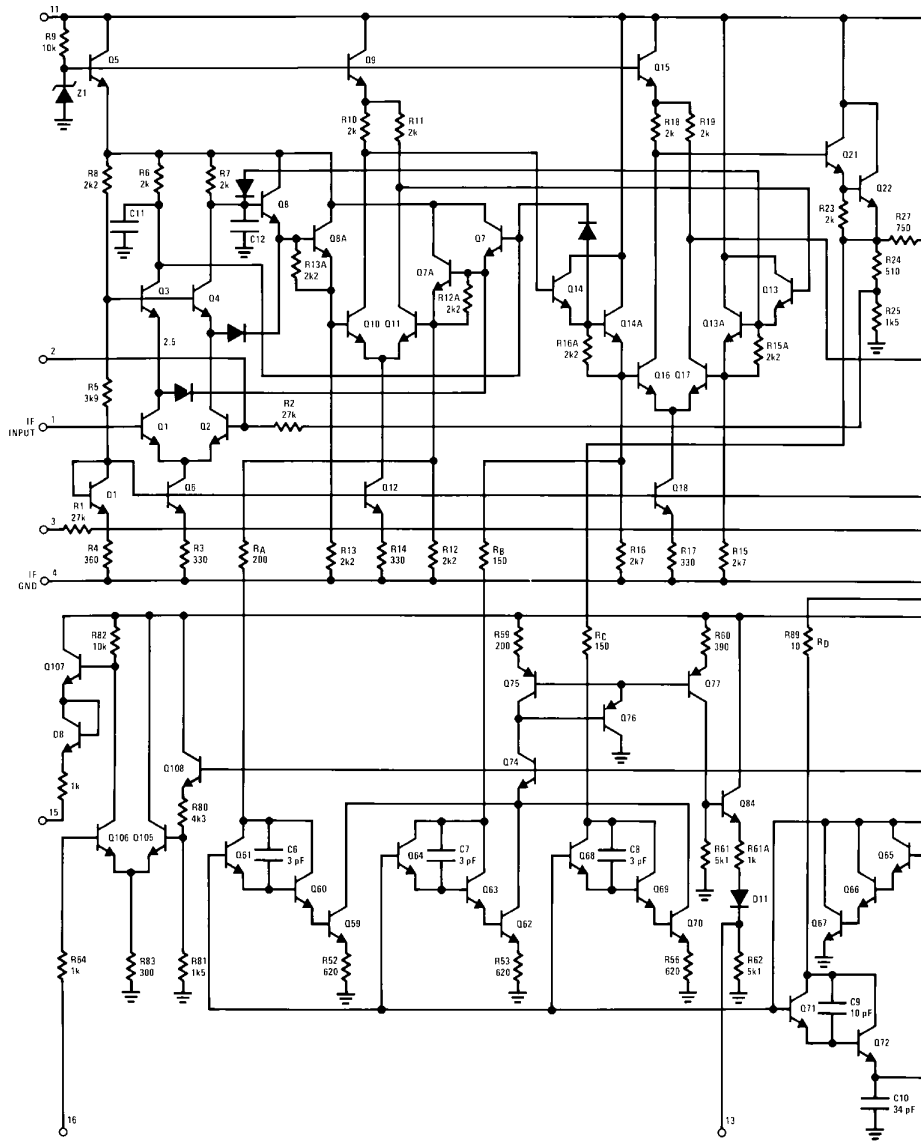


**Typical Limiting and Noise Characteristics**



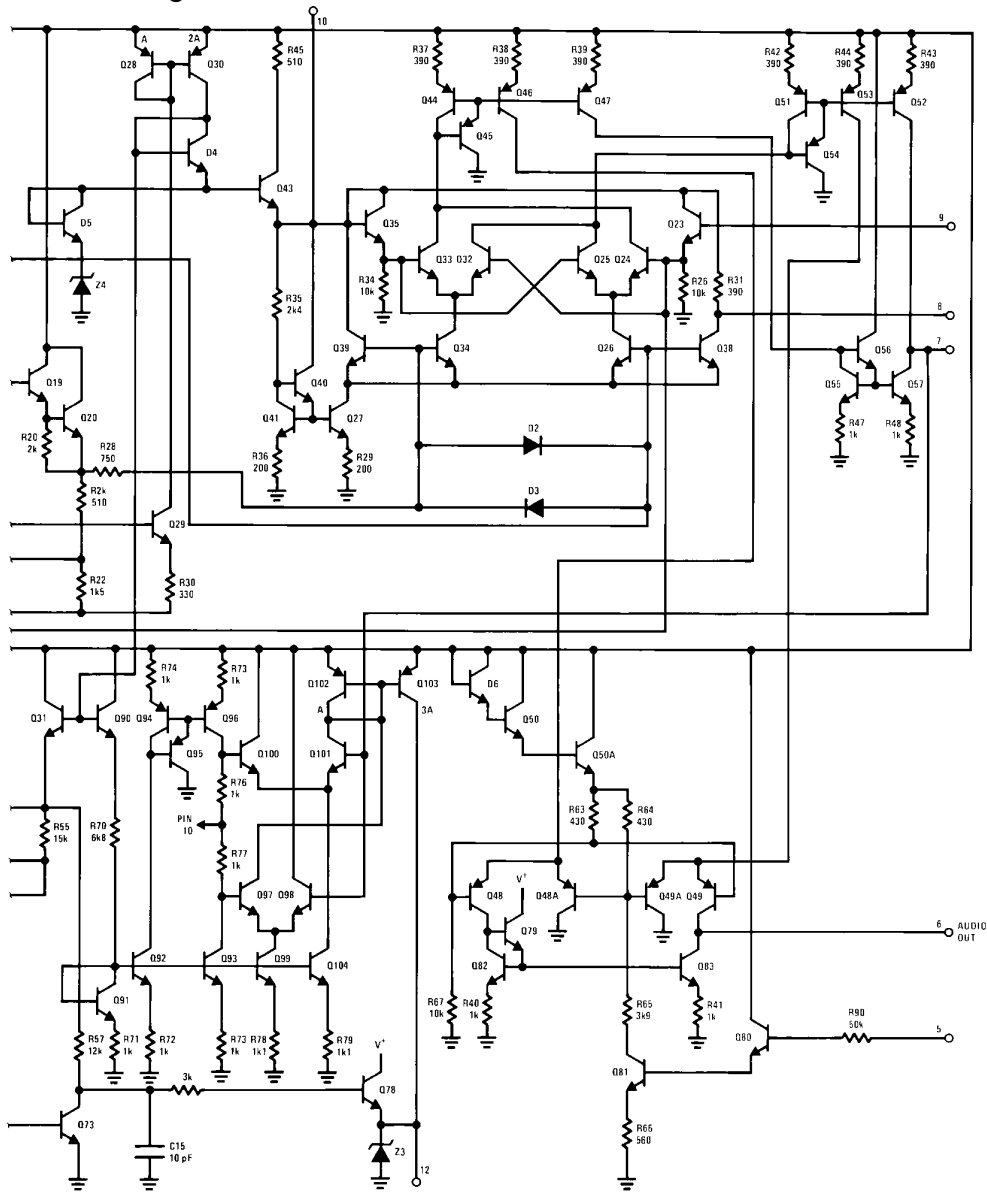
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# Schematic Diagram

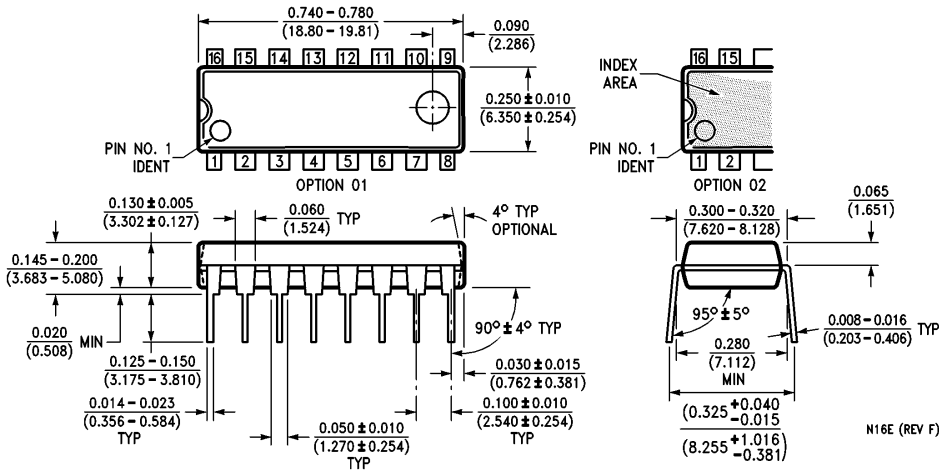


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### Schematic Diagram (Continued)



**Physical Dimensions** inches (millimeters)



**Dual-In-Line Package (N)**  
**Order Number LM3189N**  
**See NS Package Number N16E**

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**National Semiconductor Corporation**  
 1111 West Bardin Road  
 Arlington, TX 76017  
 Tel: 1(800) 272-9959  
 Fax: 1(800) 737-7018

**National Semiconductor Europe**  
 Fax: (+49) 0-180-530 85 86  
 Email: cnjwge@tevm2.nsc.com  
 Deutsch Tel: (+49) 0-180-530 85 85  
 English Tel: (+49) 0-180-532 78 32  
 Français Tel: (+49) 0-180-532 93 58  
 Italiano Tel: (+49) 0-180-534 16 80

**National Semiconductor Hong Kong Ltd.**  
 19th Floor, Straight Block,  
 Ocean Centre, 5 Canton Rd.  
 Tsimshatsui, Kowloon  
 Hong Kong  
 Tel: (852) 2737-1600  
 Fax: (852) 2736-9960

**National Semiconductor Japan Ltd.**  
 Tel: 81-043-299-2309  
 Fax: 81-043-299-2408

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