# CA3089

November 1996

## FM IF System

### Features

- **For FM IF Amplifier Applications in High-Fidelity, Automotive, and Communications Receivers**
- **Includes: IF Amplifier, Quadrature Detector, AF Preamplifier, and Specific Circuits for AGC, AFC, Muting (Squelch), and Tuning Meter**
- **Exceptional Limiting Sensitivity at -3dB Point. . . . . 12μV (Typ)**
- **Low Distortion: (with Double-Tuned Coil). . . . . 0.1% (Typ)**
- **Single-Coil Tuning Capability**
- **High Recovered Audio. . . . . 400mV (Typ)**
- **Provides Specific Signal for Control of Interchannel Muting (Squelch)**
- **Provides Specific Signal for Direct Drive of a Tuning Meter**
- **Provides Delayed AGC Voltage for RF Amplifier**
- **Provides a Specific Circuit for Flexible AFC**
- **Internal Supply-Voltage Regulators**

### Ordering Information

| PART NUMBER (BRAND) | TEMP. RANGE ($^{o}$C) | PACKAGE | PKG. NO. |
|---|---|---|---|
| CA3089E | -40 to 85 | 16 Ld PDIP | E16.3 |
| CA3089M1 (3089M) | -40 to 85 | 20 Ld SOIC | M20.3 |

### Description

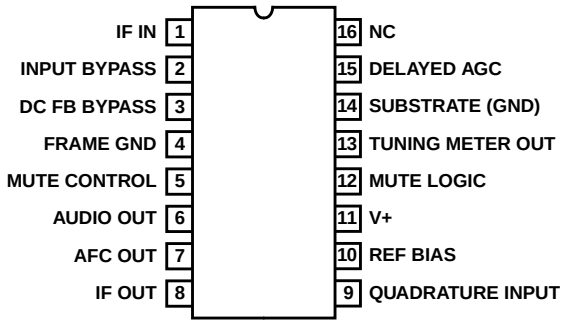
Intersil CA3089 is a monolithic integrated circuit that provides all the functions of a comprehensive FM-IF system. The block diagram shows the CA3089 features, which include a three-stage FM-IF amplifier/limiter configuration with level detectors for each stage, a doubly-balanced quadrature FM detector 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 delayed AGC for the RF tuner, and 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.

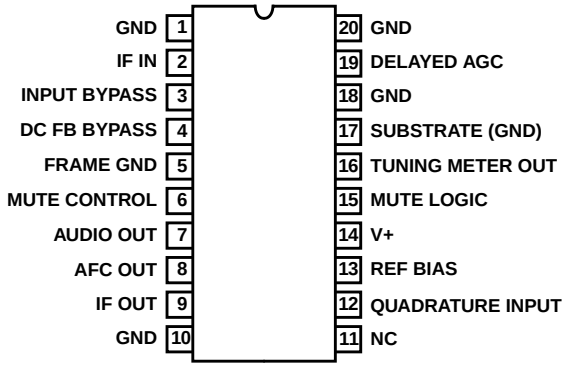
The CA3089 is ideal for high-fidelity operation. Distortion in a CA3089 FM-IF System is primarily a function of the phase linearity characteristic of the outboard detector coil.

### Pinout

**CA3089**
**(PDIP)**
TOP VIEW




**CA3089**
**(SOIC)**
TOP VIEW




CAUTION: These devices are sensitive to electrostatic discharge; follow proper IC Handling Procedures.
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## Absolute Maximum Ratings

Supply Voltage
- Between V+ and Frame GND . . . . . 16V
- Between V+ and Substrate GND . . . . . 16V

DC Current (Out of Delayed AGC) . . . . . 2mA

## Operating Conditions

Temperature Range . . . . . $-40^oC$ to $85^oC$

## Thermal Information

| Thermal Resistance (Typical, Note 1) | $\theta_{JA}$ ($^oC/W$) |
|---|---|
| PDIP Package | 90 |
| SOIC Package | 80 |

Maximum Junction Temperature (Plastic Package) . . . . . $150^oC$

Maximum Storage Temperature Range . . . . . $-65^oC$ to $150^oC$

Maximum Lead Temperature (Soldering 10s) . . . . . $300^oC$
(SOIC - Lead Tips Only)

*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

NOTE:

1. $\theta_{JA}$ is measured with the component mounted on an evaluation PC board in free air.

## Electrical Specifications V+ = 12V (See Figures 3 and 4)

| (NOTE 3) PARAMETER | | TEST CONDITIONS | | TEMP. ($^oC$) | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | | | |
| Quiescent Circuit Current | | No signal input, Non muted | | 25 | 16 | 23 | 30 | mA |
| DC Voltages | Terminal 1 (IF Input) | | | 25 | 1.2 | 1.9 | 2.4 | V |
| | Terminal 2 (AC Return to Input) | | | 25 | 1.2 | 1.9 | 2.4 | V |
| | Terminal 3 (DC Bias to Input) | | | 25 | 1.2 | 1.9 | 2.4 | V |
| | Terminal 6 (Audio Output) | | | 25 | 5.0 | 5.6 | 6.0 | V |
| | Terminal 10 (DC Reference) | | | 25 | 5.0 | 5.6 | 6.0 | V |
| **DYNAMIC CHARACTERISTICS** | | | | | | | | |
| Input Limiting Voltage (-3dB point), $V_1$ (lim) | | - | $f_O$ = 10.7MHz, $f_{MOD}$ = 400Hz, Deviation = ±75kHz | 25 | - | 12 | 25 | µV |
| AM Rejection (Terminal 6), AMR | | $V_{IN}$ = 0.1V, AM Mod. = 30% | | 25 | 45 | 55 | - | dB |
| Recovered AF Voltage (Terminal 6) $V_O$ (AF) | | $V_{IN}$ = 0.1V | | 25 | 300 | 400 | 500 | mV |
| Total Harmonic Distortion, THD (Note 2) | Single Tuned (Terminal 6) | | | 25 | - | 0.5 | 1.0 | % |
| | Double Tuned (Terminal 6) | | | 25 | - | 0.1 | - | % |
| Signal Plus Noise to Noise Ratio (Terminal 6) | | | | 25 | 60 | 67 | - | dB |

NOTES:

2. THD characteristics are essentially a function of the phase characteristics of the network connected between Terminals 8, 9, and 10.
3. Terminal numbers refer to 16 Lead PDIP.

## *Application Information*

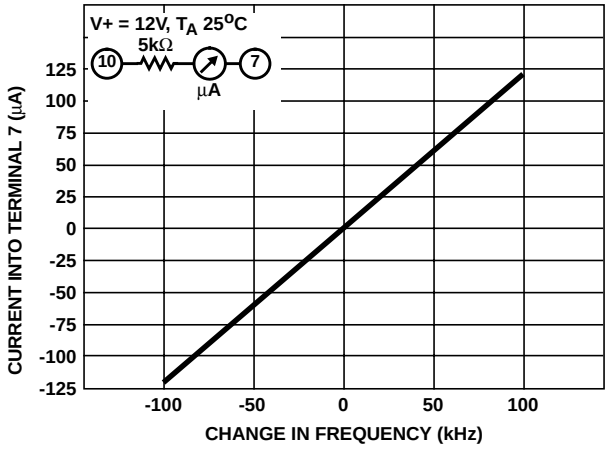



**FIGURE 1. AFC CHARACTERISTICS (CURRENT AT TERMINAL 7) vs CHANGE IN FREQUENCY. (SEE TEST CIRCUIT FIGURE 3.)**

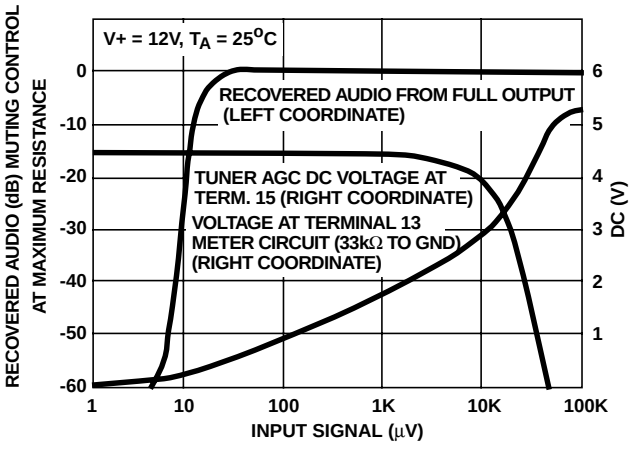
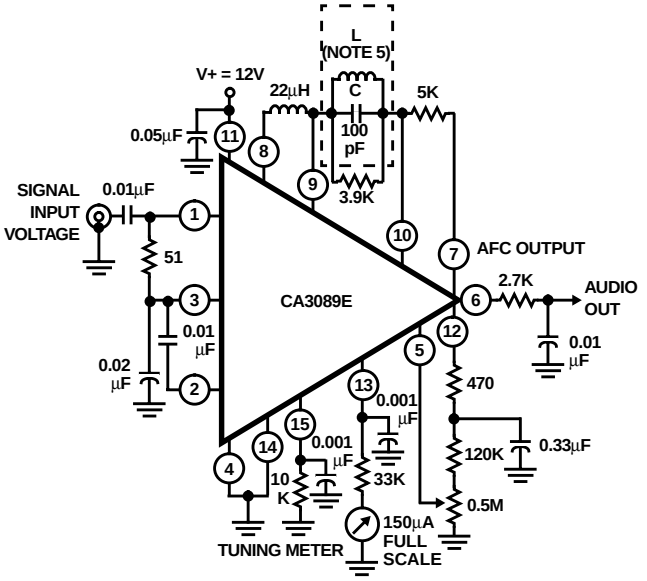



**FIGURE 2. MUTING ACTION, TUNER AGC, AND TUNING METER OUTPUT vs INPUT SIGNAL VOLTAGE. (SEE TEST CIRCUIT FIGURE 3.)**

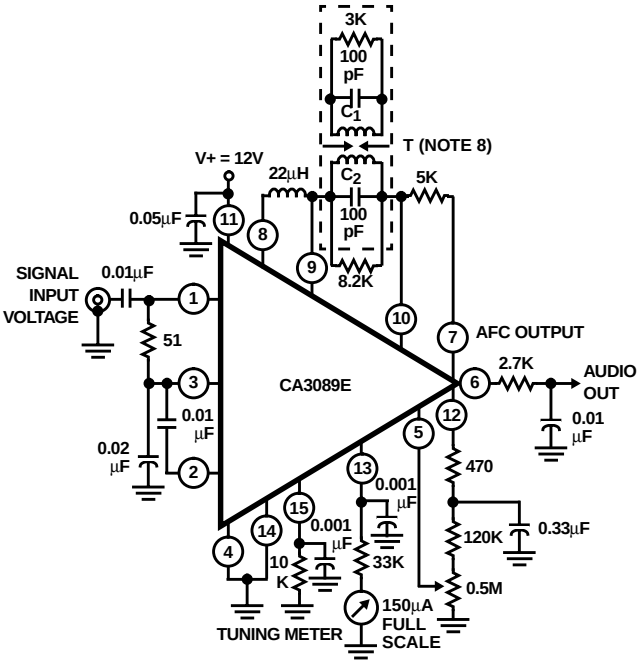
## Test Circuits




NOTES:

4. All resistance values are in ohms.
5. L tunes with 100pF (C) at 10.7MHz.
6. $Q_0$ (unloaded) ≅ 75 (G.I. Automatic Mfg. Div. EX22741 or equivalent).

**FIGURE 3. TEST CIRCUIT FOR CA3089E USING A SINGLE-TUNED DETECTOR COIL**



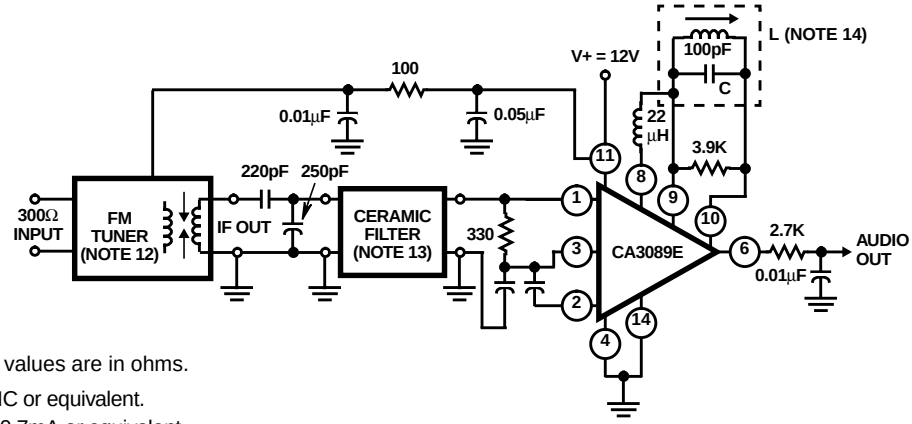

NOTES:

7. All resistance values are in ohms.
8. T PRI. - $Q_0$ (unloaded) ≅ 75 (tunes with 100pF ($C_1$) 20↑ of 34e on $^7/_{32}$" dia. form).
9. SEC. - $Q_0$ (unloaded) ≅ 75 (tunes with 100pF ($C_2$) 20↑ of 34e on $^7/_{32}$" dia. form).
10. kQ (percent of critical coupling) ≅ 70%.
    (Adjusted for coil voltage $V_C$) = 150mV.

Above values permit proper operation of mute (squelch) circuit "E" type slugs, spacing 4mm.

**FIGURE 4. TEST CIRCUIT FOR CA3089E USING A DOUBLE-TUNED DETECTOR COIL**

## Typical Applications




NOTES:

11. All resistance values are in ohms.
12. Waller 4SN3FIC or equivalent.
13. Murata SFG 10.7mA or equivalent.
14. L tunes with 100pF (C) at 10.7MHz $Q_0$ unloaded ≅ 75 (G.I. EX22741 or equivalent).

Performance Data at $f_O$ = 98MHz, $f_{MOD}$ = 400Hz, Deviation = ±75kHz:

-3dB Limiting Sensitivity . . . . . 2µV (Antenna Level)
20dB Quieting Sensitivity . . . . . 1µV (Antenna Level)
30dB Quieting Sensitivity . . . . . 1.5µV (Antenna Level)

**FIGURE 5. TYPICAL FM TUNER USING THE CA3089E WITH A SINGLE TUNED DETECTOR COIL**

## Typical Applications (Continued)

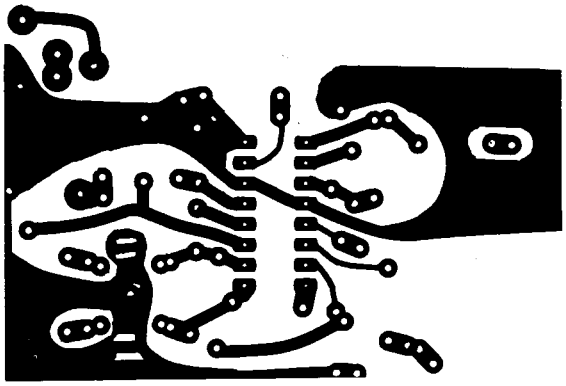


FIGURE 6A. BOTTOM VIEW OF PRINTED CIRCUIT BOARD

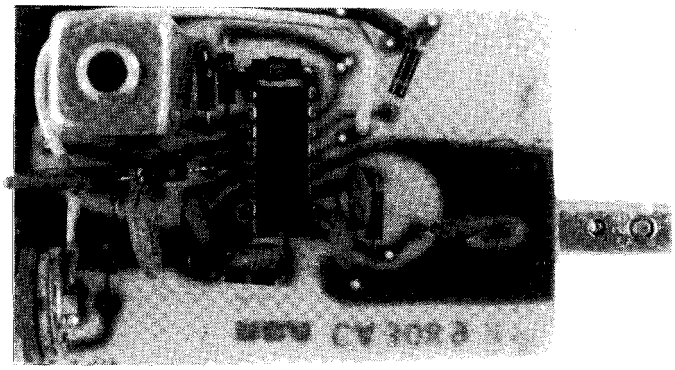
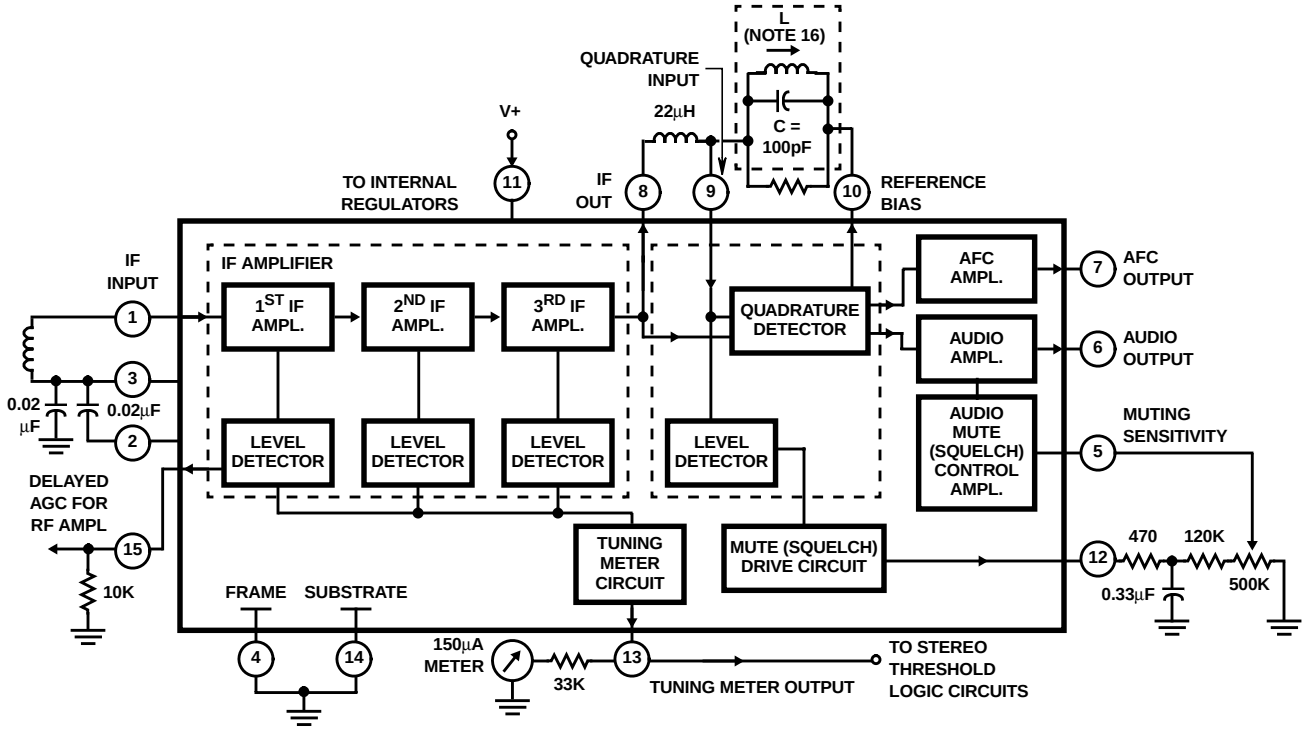


FIGURE 6B. COMPONENT SIDE - TOP VIEW

FIGURE 6. ACTUAL SIZE PHOTOGRAPHS OF THE CA3089E AND OUTBOARD COMPONENTS MOUNTED ON A PRINTED-CIRCUIT BOARD

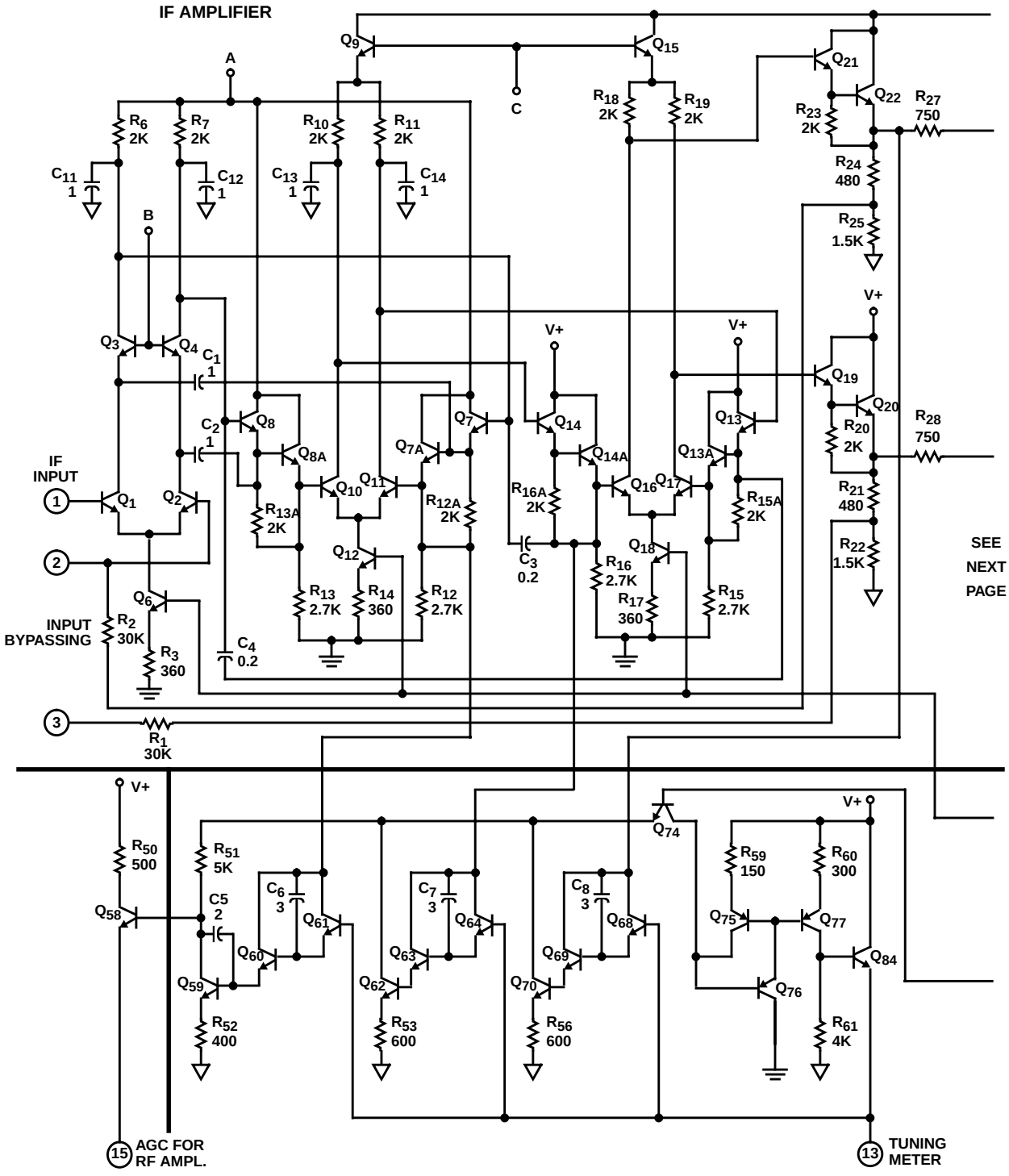
## Block Diagram




NOTES:

15. All resistance values are in ohms.
16. L Tunes with 100pF (C) at 10.7MHz.
17. $Q_O \cong 75$ (G.I. EX22741 or equivalent).
18. Pin numbers refer to 16 lead DIP.

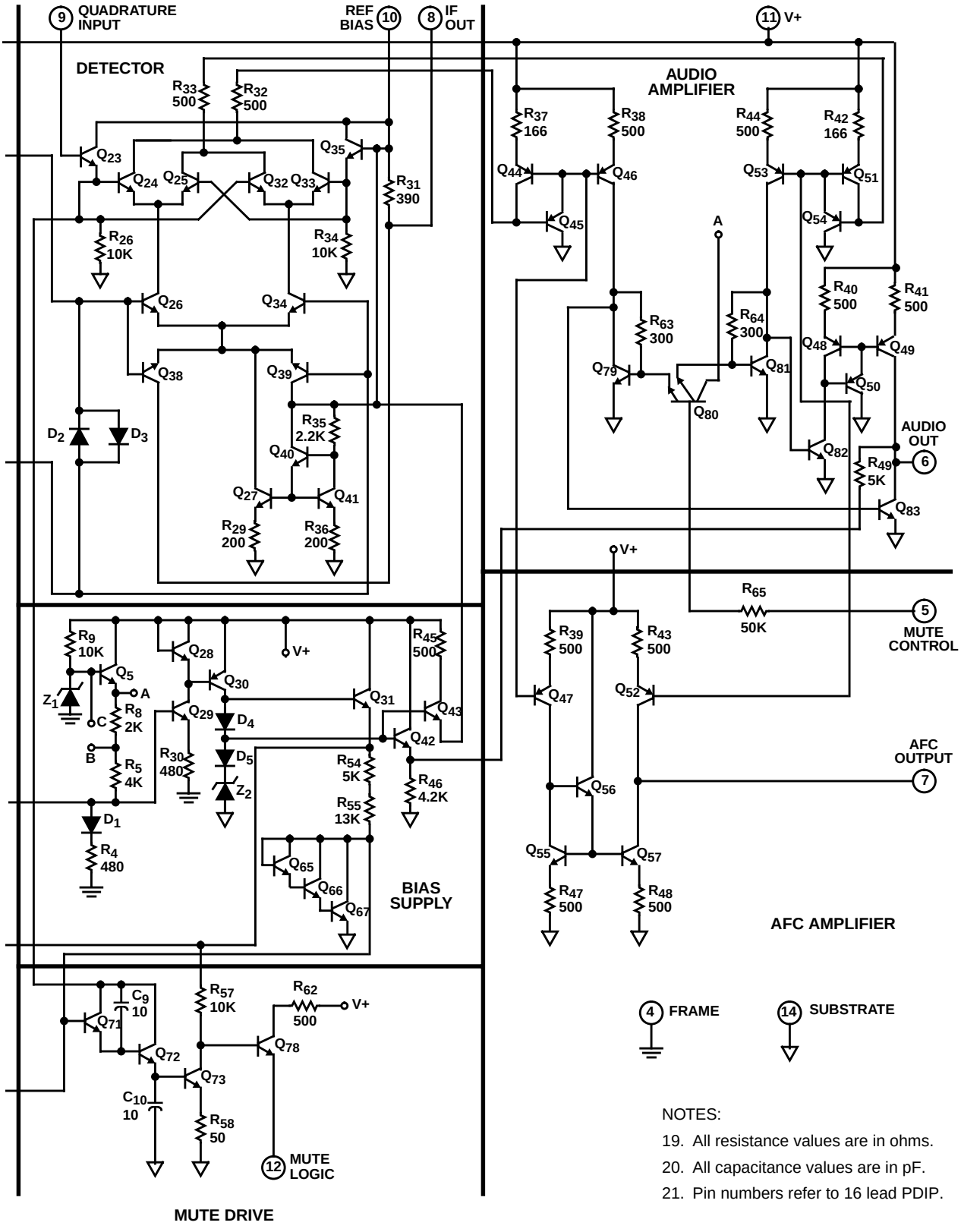
## Schematic Diagram




NOTE: Pin numbers refer to 16 lead PDIP.

**LEVEL DETECTOR AND METER CIRCUIT**

## Schematic Diagram (Continued)




NOTES:

19. All resistance values are in ohms.
20. All capacitance values are in pF.
21. Pin numbers refer to 16 lead PDIP.

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