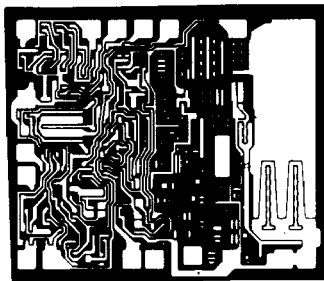


ULN-3804A

A-M/F-M SIGNAL PROCESSOR

FEATURES

- Good Sensitivity
- Low Harmonic Distortion
- Wide Operating Voltage Range
- Excellent A-M Rejection
- Low Power Drain
- D-C A-M/F-M Switching
- 30 μ V Limiting Threshold
- 16-Pin Dual In-Line Plastic Package



DESIGNED for use in battery-powered portable radios or line-driven table radios. Type ULN-3804A works well in low-cost applications requiring high performance with few external parts. An entire A-M/F-M stereo receiver can be built with a Type ULN-3804A, a Type ULN-3809A stereo decoder, and two Type ULN-2283B audio amplifiers, for operation over a supply range of 4.5 to 12 V.

The signal processor includes the A-M oscillator and mixer and the A-M/F-M I-F amplifier and detector from the popular radio system, Sprague Type ULN-2204A. Radio designs using Type ULN-2204A can be revised for greater power output or for stereo operation (without reworking the printed wiring board layout) by replacement of Type ULN-2204A with Type ULN-3804A and addition of appropriate stereo decoders and audio power amplifiers.

In the A-M mode of operation, Type ULN-3804A provides all high-frequency circuitry, including AGC and envelope peak detection, for a single-conversion superheterodyne broadcast or shortwave receiver. In the F-M mode, the signal processor operates as a high-gain amplifier/limiter and phase-shift detector. A d-c switch is used to change modes.

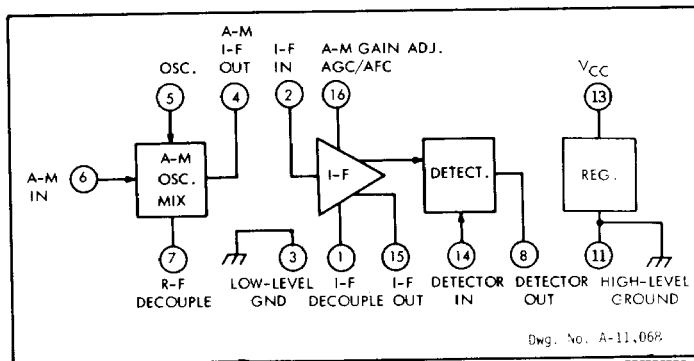
A single external capacitor at pin 16 provides the A-M AGC time constant, the F-M AFC time constant, and R-F decoupling.

ABSOLUTE MAXIMUM RATINGS

| | |
|--|-----------------|
| Supply Voltage, V_{CC} | 16 V |
| Package Power Dissipation, P_D | 640 mW* |
| Operating Temperature Range, T_A | -20°C to +85°C |
| Storage Temperature Range, T_S | -65°C to +150°C |

*Derate at the rate of 8.0 mW/°C above $T_A = +70^\circ\text{C}$.

FUNCTIONAL BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS at $T_A = +25^\circ\text{C}$ **$V_{CC} = 6.0\text{ V}$, $R_B = \infty$, $R_{I6} = 1.2\text{ k}\Omega$ (unless otherwise noted)**

| Characteristic | Symbol | Test Conditions | Limits | | | |
|--|----------|--|--------|------|------|------------------|
| | | | Min. | Typ. | Max. | Units |
| F-M MODE: $f_0 = 10.7\text{ MHz}$, $f_m = 400\text{ Hz}$, $f_d = \pm 75\text{ kHz}$, Peak Separation = 550 kHz | | | | | | |
| Input Limiting Threshold | V_{th} | | — | 30 | 60 | μV |
| Detector Recovered Audio | V_o | | — | 250 | — | mV |
| Detector Output Distortion | THD | $V_m = 10\text{ mV}_{rms}$ | — | 1.0 | — | % |
| A-M Rejection | AMR | $V_{in} = 10\text{ mV}_{rms}$, 30% A-M, $f_{am} = 400\text{ Hz}$ | 35 | 50 | — | dB |
| I-F Input Impedance | Z_2 | | — | 40 | — | $\text{k}\Omega$ |
| I-F Input Capacitance | C_2 | | — | 4.0 | — | pF |
| Quiescent Terminal Voltage | V_1 | | — | 2.1 | — | V |
| | V_8 | | — | 1.7 | — | V |
| Quiescent Supply Current | I_{CC} | | — | 10 | 15 | mA |

A-M MODE: $f_0 = 1\text{ MHz}$, $f_m = 455\text{ kHz}$, $f_m = 400\text{ Hz}$, 30% A-M

| | | | | | | |
|----------------------------|----------|----------------|---|-----|----|------------------|
| Sensitivity | | Maximum Volume | — | 5.0 | 10 | μV |
| Detector Recovered Audio | V_o | | — | 150 | — | mV |
| Overload Distortion | | 80% A-M | — | 10 | — | mV |
| Usable Sensitivity | | | — | 25 | 35 | μV |
| Mixer Input Impedance | Z_6 | See Note | — | 4.5 | — | $\text{k}\Omega$ |
| Mixer Input Capacitance | C_6 | | — | 5.5 | — | pF |
| Mixer Output Impedance | Z_4 | | — | 25 | — | $\text{k}\Omega$ |
| Mixer Output Capacitance | C_4 | | — | 3.0 | — | pF |
| I-F Input Impedance | Z_2 | | — | 100 | — | $\text{k}\Omega$ |
| I-F Input Capacitance | C_2 | | — | 3.0 | — | pF |
| Quiescent Terminal Voltage | V_1 | | — | 1.3 | — | V |
| | V_8 | | — | 1.7 | — | V |
| Quiescent Supply Current | I_{CC} | | — | 3.8 | — | mA |

NOTE: For optimum noise match, source impedance should be 2.5 $\text{k}\Omega$.

Device Classification and Design Considerations

The A-M/F-M receiver system's operation can be kept within tighter performance limits by matching bias groupings and appropriate external resistors (R8 and R16). With proper matching of parts and lots, consistent device performance can be obtained. The groupings, shown in the table below, are based on A-M and F-M operation. There are three selections for each mode and nine possible combinations:

PIN 16 OUTPUT VOLTAGE, V_{16}

| A-M Operation | Complete Part Number Including Suffix | | |
|------------------|---------------------------------------|--------------|--------------|
| | F-M Operation | | |
| | 2.20—2.65 V | 2.55—3.05 V | 2.95—3.40 V |
| 1.40—1.75 V | ULN-3804A-11 | ULN-3804A-21 | ULN-3804A-31 |
| 1.65—2.00 V | ULN-3804A-12 | ULN-3804A-22 | ULN-3804A-32 |
| 1.90—2.25 V | ULN-3804A-13 | ULN-3804A-23 | ULN-3804A-33 |

Sprague recommends that customers not specify particular selections except in unusual circumstances. All parts manufactured with the Sprague part number will be marked with the complete number, including the appropriate suffix. In addition, any one shipment to a customer will consist of a single selection (single suffix).

The first digit of the suffix (such as the "3" in "-31") applies to F-M performance. It indicates the F-M gain and pin 16 output voltage as functions of the pin 16 load resistance, as shown in the graph on the next page.

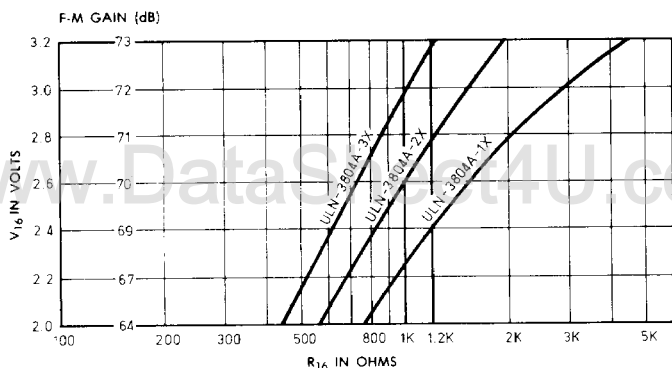
F-M circuit stability is inversely related to gain or sensitivity and is also affected by source and load impedances, decoupling, and printed wiring board layout. After an optimal F-M I-F gain is determined for a particular circuit design, the gain can be controlled with proper matching of the suffix and the pin 16 load.

Design Considerations (Continued)

In addition, certain system designs derive the F-M tuner supply, tuner bias, or AFC voltage at pin 16 of Type ULN-3804A. As an example, if the tuner design requires 2.4 V at 2.0 mA (an equivalent R16 of 1200 Ω), Type ULN-3804A-1X is required. A -2X or -3X device can also be used by paralleling the equivalent 1200 Ω tuner load with a fixed resistor to present an 830 Ω load or a 520 Ω load.

For AFC applications, note that as the frequency is increased, the V_{16} voltage will decrease. The amount of change is a function of load impedance, detector coil characteristics, and part grouping.

TYPICAL F-M I-F GAIN CHARACTERISTICS



(See Fig. 4-11, 4-12)

Stability is seldom a problem with A-M operation. However, large-signal overload can be held to typically 30 mV by matching the particular part group with an appropriate load resistor at pin 8. The A-M grouping is identified by the second digit of the part number suffix (such as the "2" in "-32").

- For -X1, R8 should be an open circuit;
- for -X2, R8 should be 47 k Ω ;
- for -X3, R8 should be 33 k Ω .

Additional loading may raise the overload point slightly, but AGC and sensitivity will be compromised. For any fixed value of R8, the -X3 parts will exhibit slightly higher A-M gain, the -X1 parts slightly lower A-M gain.