National Semiconductor



# AF132 Dual PCM Transmit/Receive Filter

## General Description

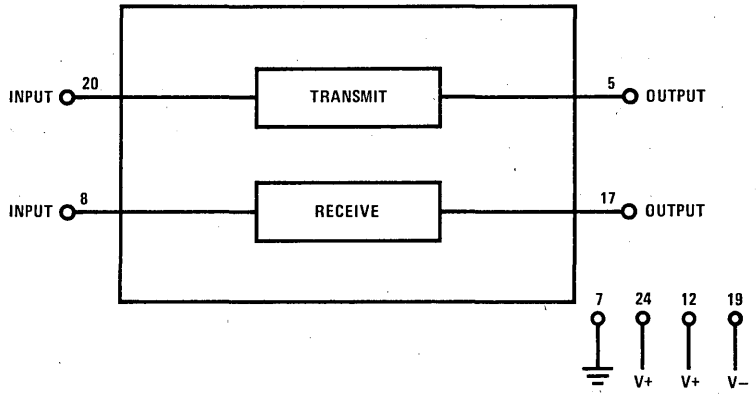
The AF132 filter circuits are specifically designed to meet the less stringent requirements of the PBX and PABX telephone industry. Special attention has been given not only to the electrical filtering requirements, but also to the physical size, environmental, life, and cost requirements.

The filters are manufactured using a well understood and dependable thick film technology using laser trimmed resistors and the highest quality components.

## Features

- No external components required
- Consistent uniform product
- Insensitive to time and temperature
- Wide power supply range ±9.0V to ±15V

## Connection Diagram




Ceramic Dual-In-Line
Package HY24A
AF132CJ

## Absolute Maximum Ratings

| | |
|---|---|
| Supply Voltage | ±18 V |
| Power Dissipation | 1 W/Package |
| Input Voltage | ±18 V |
| Output Short-Circuit Duration | Continuous |
| Operating Temperature Range | 0° to +70°C |
| Storage Temperature Range | −25°C to +100°C |
| Lead Temperature (Soldering, 10 seconds) | 300° |

## Electrical Characteristics

Unless otherwise noted, these specifications apply over the temperature range from 0°C to +70°C and are tested using ±12° V power supplies, but are guaranteed for any symmetrical power supply operating between ±9.0 V to ±15 V.

| Parameter | | Conditions | Transmit | | | Receive | | | Units |
|---|---|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| $A_O$ | Voltage Gain | f = 800 Hz | −0.5 | 0 | 0.5 | −0.36 | 0.14 | 0.64 | dB |
| ΔA | Ripple | 300 Hz ≤ f ≤ 3000 Hz, (Note 1) | | ±0.35 | ±0.5 | | ±0.35 | ±0.5 | dB |
| A | Gain (Stop Band) | f > 5.3 kHz | −20 | | | | | | dB |
| A | Gain (Stop Band) | f > 4.6 kHz | | | | −20 | | | dB |
| $e_O$ | Output Voltage Swing | $V_{CC}$ ± 12 V, $R_L$ = 2k | | 20 | | 20 | | | $V_{P-P}$ |
| $V_{OS}$ | Output DC Offset | | −100 | | 100 | −100 | | 100 | mV |
| $Z_{IN}$ | Input Impendance | DC to 10 kHz, $T_A$ = 25°C | 90 | 100 | | 90 | 100 | | kΩ |
| $Z_O$ | Output Impedance | DC to 10 kHz, $T_A$ = 25°C | | 0.5 | 1.0 | | 0.5 | 1.0 | Ω |
| PSRR | Power Supply Rejection | 120 Hz to 3.4 kHz | | 97 | | | 97 | | dB |
| | | 3.4 kHz to 25 kHz | | 90 | | | 90 | | dB |
| $P_D$ | Power Dissipation | $V_{CC}$ = ±12 V | | 135 | 220 | | | | mW |
| | | $V_{CC}$ = ±15 V | | 190 | 270 | | | | mW |

**Note 1:** For the receive section, ripple is specified as the deviation from the ideal pass band response that would result if the $\frac{\text{SIN}\frac{\pi f}{8000}}{\frac{\pi f}{8000}}$ roll-off characteristics were compensated perfectly, and assumes the inclusion of a sample and hold.

## Applications Information

### GENERAL

The transmit and receive filters are both third order elliptic low pass filters that have been specifically designed for 8 kHz sampled data systems found in telephone PCM communication systems and some military systems, *(Figure 1)*.

The transmit filter is designed to provide a flat band pass response from DC to 3.0 kHz and attenuate signals above 4.5 kHz to prevent these signals from occuring in the sampled data.

The receive filter is designed to receive the sampled data in order to reconstruct the original analog signal. Because the information has been processed through a sample and hold technique, the amplitude information in the band pass has a characteristic SIN X/X response. The purpose of the receive filter is to provide the necessary response to compensate for the input signal frequency response and restore the amplitude information to a flat band pass characteristic.

The block diagram in *Figure 2*, indicates the basic construction of the AF132.

All other pins not shown connected should be left open.

### PROVIDING LOW FREQUENCY ROLL-OFF

In most systems, it is necessary to have a low frequency high pass filter in front of the transmit filter to attenuate 60 Hz and 120 Hz. Some attenuation can be achieved by capacitively coupling the input signal, with the proper value of capacitor, C, selected to trade off 60 Hz attenuation with the amount of band pass

## Applications Information (Continued)

flatness near 300 Hz. The capacitor is easily selected since the input impedance (resistive only) is specified. A second, and more desirable solution, is shown in *Figure 4*. This filter makes use of the AF100 as a second order high pass filter. It provides 22 dB of attenuation of 60 Hz, and has less than 0.03 dB effect on the band pass characteristics at 300 Hz.

### TESTING

The circuit in *Figure 5* is typical of that used by National Semiconductor to test the active filters. In testing and in actual application, the filter must be driven from a low impedance source ($R_S \leq 50\Omega$).

### CODEC

National Semiconductor presently manufactures two monolithic circuits designed to perform the entire companding coder/decoder function. Before proceeding with your design, please contact National for information about these devices, the MM58100 and the LF2700.

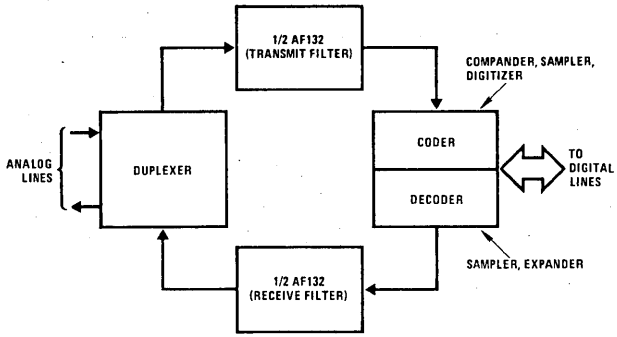



FIGURE 1. PCM Block Diagram

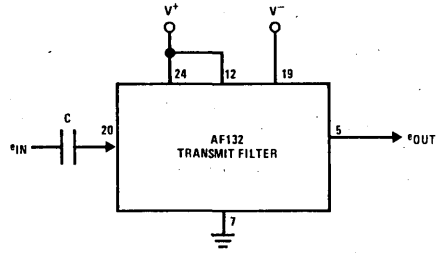
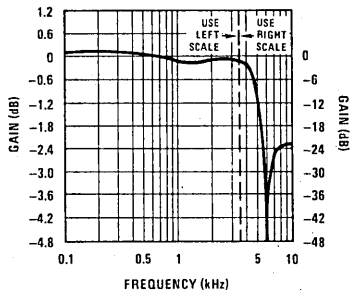



FIGURE 2. Capacitive Coupling to Provide Low Frequency Roll-Off

### AF132 TRANSMIT FILTER SECTION

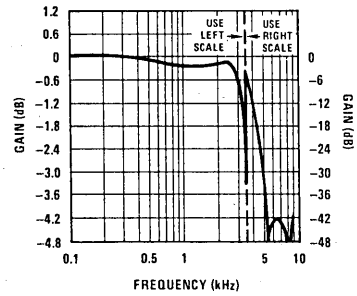
The transmit section is a third order elliptic low pass filter designed to provide a flat amplitude response from 300 Hz to 3.0 kHz, and 20 dB or more attenuation of signals above 4.5 kHz.




Transmit Filter

### AF132 RECEIVE FILTER SECTION

The receive section is a third order elliptic low pass filter designed to receive PCM information. Because this information has been transmitted in a sampled data PCM system, the amplitude information has been degraded by the inherent SIN X/X sampling function. The receive filter approximates the required function that is necessary to compensate the frequency response and restore a flat band pass response.




Receive Filter

## Applications Information (Continued)

| FREQUENCY | ATTENUATION |
|---|---|
| 60 Hz | −22 dB |
| 120 Hz | - 6 dB |
| 180 Hz | −1.5 dB |
| 300 Hz | −0.03 dB |

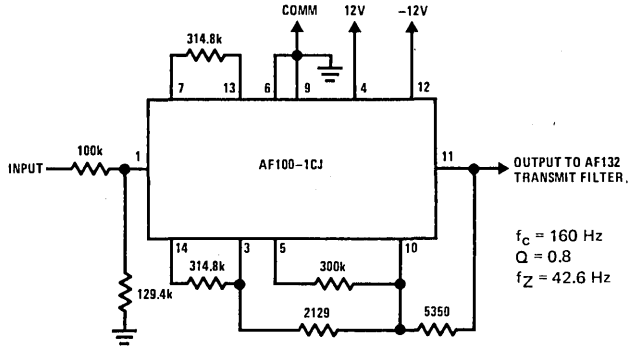



FIGURE 3. Providing 60 Hz Attenuation

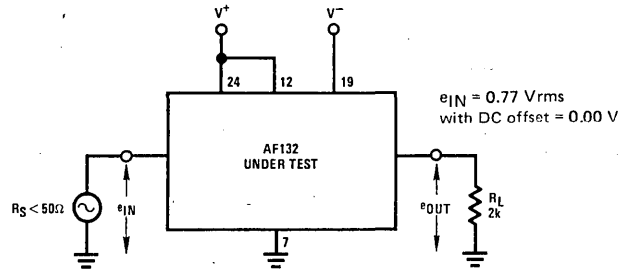



FIGURE 4. Test Circuit

14