PLESSEY
Semiconductors

PRELIMINARY INFORMATION



# SL9009EXP

## ADAPTIVE CANCELLATION FILTER

The SL9009 is a bipolar integrated circuit designed for use in duplex modems on 600Ω telephone lines. It automatically optimises the duplexer such that the transmitted signal is cancelled at the input to the receiver.

- Automatically Simulates Impedance Characteristic of Line
- Independently Variable L,C,R Impedance Components
- Achieves Typical 40dB Rejection of Transmitted Signal
- Requires Only 2 External Op-Amps for Complete Adaptive Duplexer
- 16 Pin DIL Package
- ±4.5 to ±7V Supply Range

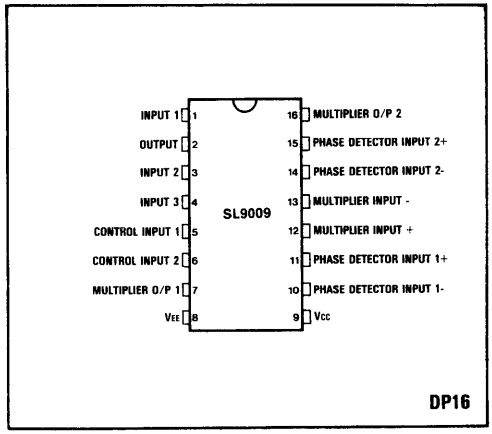


*Fig.1 Pin connections - top view*

### ABSOLUTE MAXIMUM RATINGS

| | |
|---|---|
| Operating temperature range | 0°C to 70°C |
| Storage temperature range | -10°C to +125°C |
| Supply voltage range | ±4.5V to ±10V |
| Input voltage range | |
| Pins 1,2,3,4,5,6,10,11,12,13,14,15 | V- to V+ |
| Output voltage range | |
| Pins 16,7 | V- to V+ |
| Input voltage range | |
| Pins 1,3 and 4 relative to Pin 2 | ±5V |
| Supply voltage range | |
| For specified parameters | ±4.5V to ±7V |

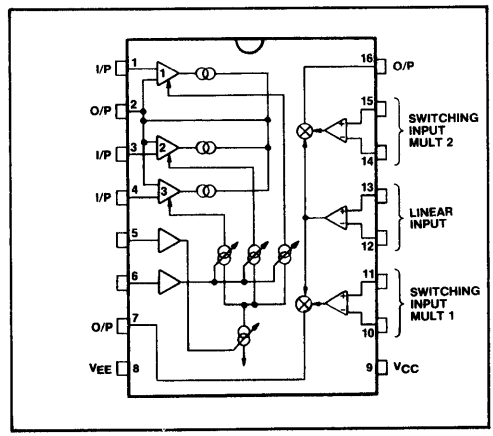


*Fig.2 Block diagram*

## ELECTRICAL CHARACTERISTICS

**Test conditions (unless otherwise stated):**
±4.5V to ±7V supply, 0° C to 70° C

| Characteristic | Value | | | Units | Conditions |
|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | |
| Supply currents | 0.8 | 1.3 | 2.0 | mA | Pin 5 at V-, all other inputs and outputs at 0V |
| **4-Quadrant multipliers** | | | | | |
| Input offset voltage multiplier switching inputs | | | 9 | mV | Pins 14,15 and 10,11 |
| Input offset voltage multiplier linear input | | | 13 | mV | Pins 12,13 |
| Input bias current | | 0.1 | 0.7 | μA | Pins 10 to 15 |
| Input offset currents | | | ±0.15 | μA | Pins 10,11,12,13,14 and 15 |
| Input common-mode range | V- +2.7 | | V + -2.7 | V | Pins 10 to 15 |
| Output offset current pin 7(16) | | | ±1.2 | μA | $V_{12} = V_{13} = 0V$ $V_{10} - V_{11}$ ($V_{14} - V_{15}$) = 200mV p-p sine wave |
| Transconductance $V_{12} - V_{13}$ to pin 7(16) | 250 | 500 | 1000 | μohm | $V_{10} - V_{11}$ ($V_{14} - V_{15}$) switched (±100mV) |
| Output voltage compliance | V- +2.5 | | V + -2 | V | <0.2μA change in output current, pin 7 or 16 |
| **Transconductance cells** | | | | | |
| Offset current pin 2 | | | ±12 | μA | Cell under test set for gain = 4, other cells for gain 0, $V_2 = 0V$ |
| Input impedance | | | | | Pin 2 = 0V |
| Pin 1 | 3 | | 10 | kΩ | |
| Pins 3 and 4 | 4 | | 14 | kΩ | |
| Operating voltage range | | | | | |
| Pins 1,2,3,4 | V- +2.7 | | V +-2 | V | |
| Gain range, each cell | | 0.05-10 | | | |
| Input current range Pins 1,3,4 | ±10 | | | μA | For <1 % non-linearity |
| Control inputs | | | | | |
| Input current $I_5$, $I_6$ | | | 0.12 | μA | $V_5$, $V_6$ = +V |
| Control voltage input range Pin 5 | V- +2.7 | | V- +6 | V | Cell gain 0.05-10 |
| Input range Pin 6 | -2 | | +1.8 | V | For cell 2 or 3 gain ≤2 x cell 1 gain, V + = -(V-) |

## PRINCIPLES OF OPERATION

The cancellation principle is to use the conductance cells to simulate the characteristics of the line, in a bridge circuit to separate out the received signal from the transmitted signal. The bridge output goes to two phase-sensitive detectors which detect the out-of-balance signal components in phase and in quadrature with the cancellation signal, derived from the transmit signal. These out-of-balance currents are integrated and fed back to the conductance cells, to adjust the effective resistance and capacitance or inductance until the bridge is balanced and the transmit signal is completely cancelled out. The current source characteristics are arranged to keep the loop stable for all normal line characteristics.

### Description of Conductance Cell

Each conductance cell is effectively a variable-gain current amplifier with a gain approximately equal to

$$\frac{\text{CONTROL CURRENT}}{20\mu A}$$

The input roughly follows the output voltage, with an effective input series resistance of about 5kΩ. Therefore, with an impedance Z connected from the input to ground, the impedance seen at the output is approximately

$$(Z + 5k\Omega) \times \frac{20\mu A}{\text{CONTROL CURRENT}}$$

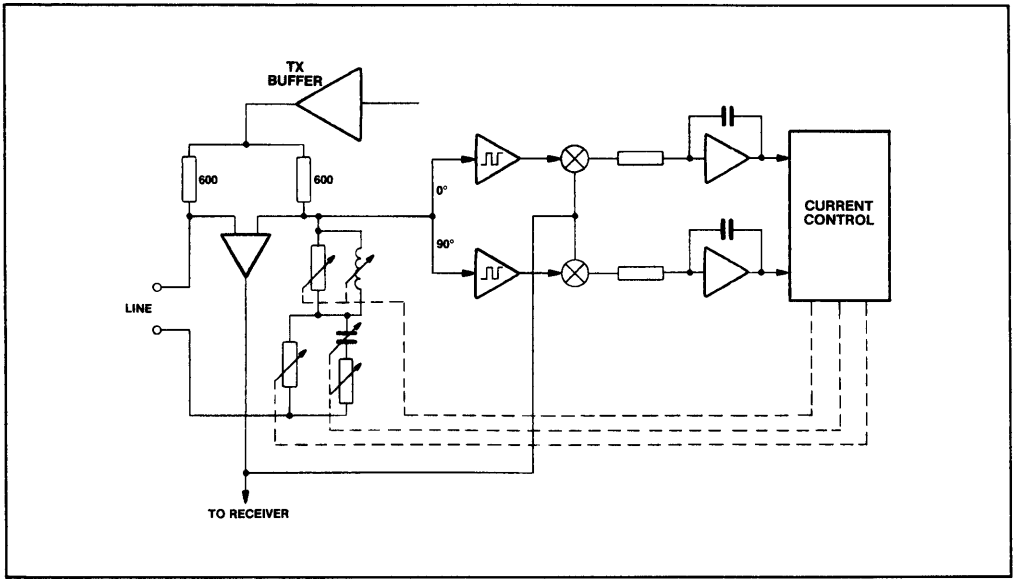


*Fig.3 Simplified circuit illustrating cancellation principle*

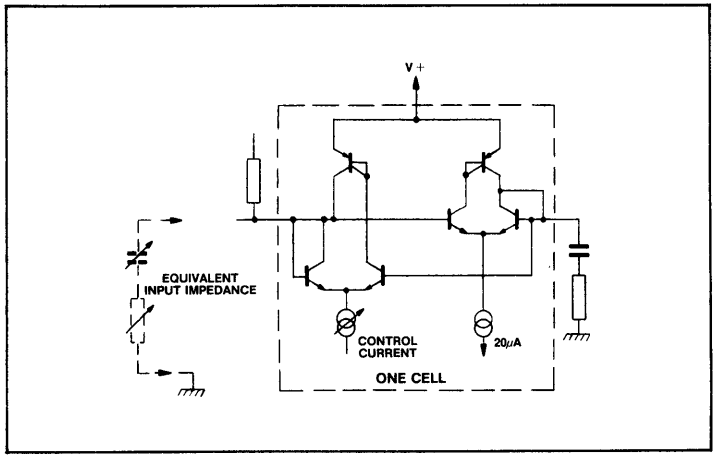


*Fig.4 Conductance cell schematic*

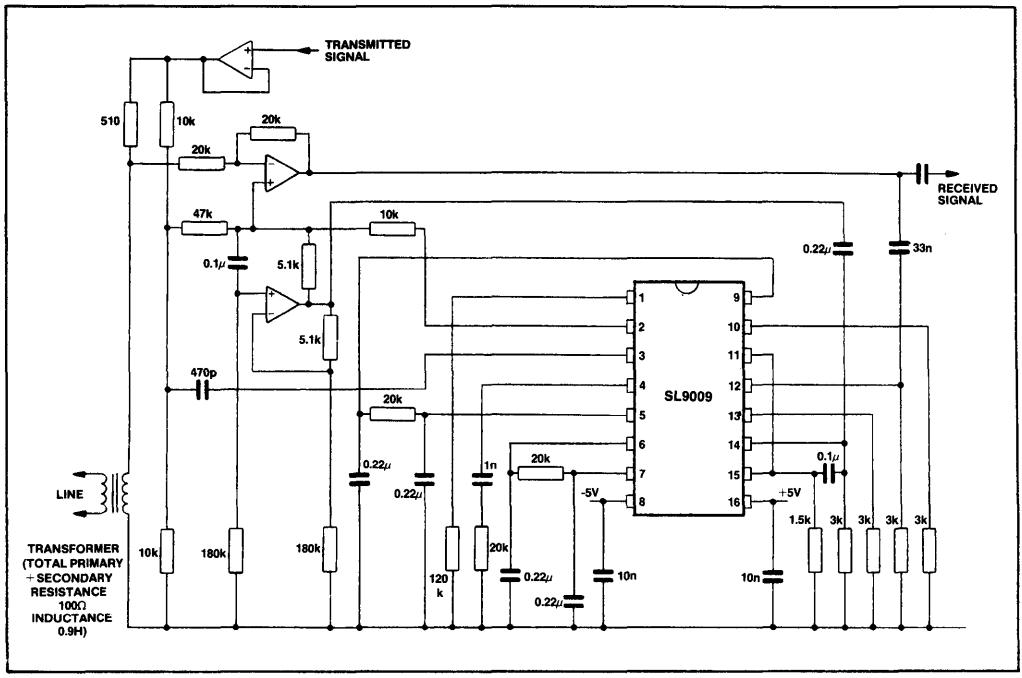


*Fig.5 Typical line circuit for modem (900-3000Hz transmit frequency)*