

July, 1990

DESCRIPTION

The SSI 75T957/957A combines switched-capacitor and digital frequency measuring techniques to decode Dual-Tone Multifrequency (DTMF) signals to four bit binary data. Dial tone rejection and 60 Hz noise rejection filters are built in. Fabricated as a monolithic integrated circuit using low power CMOS processing, the SSI 75T957/957A is packaged in a 22-pin DIP or 24-pin SO. The SSI 75T957A will operate with a supply range of 5 to 12 volts; the 75T957 is for 5V-only operation. An inexpensive 3.58 MHz television crystal and a resistor are the only external components required. High system density may be achieved by using the clock output of one crystal-connected receiver to drive the time bases of additional receivers.

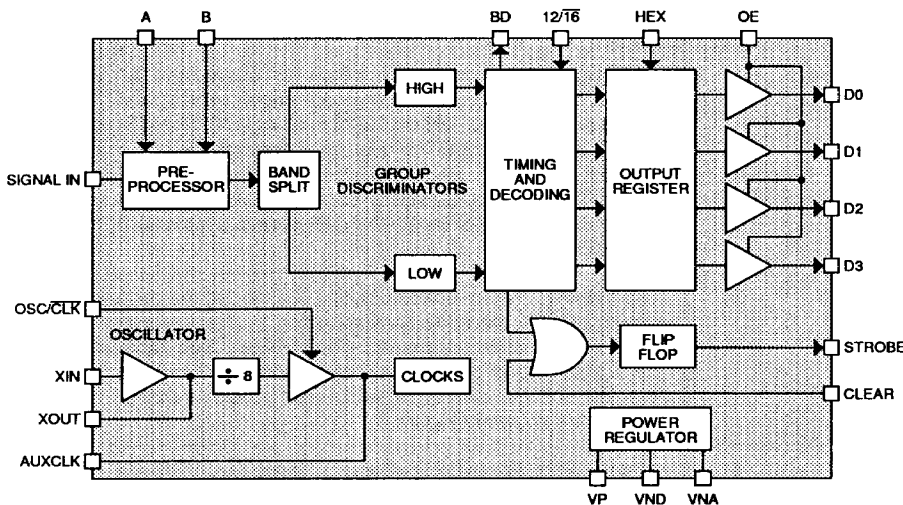
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FEATURES

- Complete DTMF receiver in 22-pin DIP or 24-pin SO
- Decodes all 16 DTMF digits
- Excellent dial tone and speech immunity
- Meets telephone impulse noise immunity standards
- Digitally selectable sensitivity to -38 dBm
- Selectable 4-bit hexadecimal or binary-coded 2-of-8 output
- Fabricated using low-power CMOS technology
- Operates at 5V (75T957) or 12V (75T957A)
- Second source of Teltone M-957

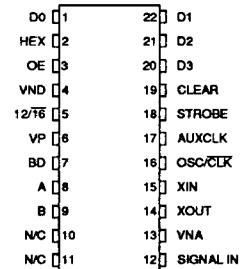
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BLOCK DIAGRAM

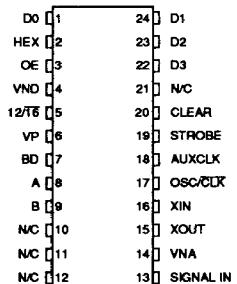


CAUTION: Use handling procedures necessary for a static sensitive component.

PIN DIAGRAMS



22-pin DIP



24-pin SO

SSI 75T957/957A

DTMF Receiver with Dial Tone Reject Filter

DESCRIPTION (Continued)

The SIGNAL IN input to the SSI 75T957/957A interfaces readily to telephone lines, radio receivers, tape players and other DTMF signal sources. Inputs A and B control sensitivity to a maximum of -38 dBm, while the 12/16 input determines the signals to be detected. The pre-processing stages of the SSI 75T957/957A filter out dial tone and noise, split the signal into its high frequency group and low frequency group components, and hard limit each component to provide automatic gain control. Four discriminators in each group

then detect the individual tones. Post-processing stages of the SSI 75T957/957A time the tone durations and store binary data for outputting as determined by the HEX input. The STROBE output is activated by the presence of valid data in the output register and cleared by the detection of a valid end-of-signal pause or by the CLEAR input. An early signal presence indicator, BD, facilitates applications requiring tone blocking. The data outputs operate with simple logic circuits or microprocessors and are three-state enabled to facilitate bus-oriented architectures.

PIN DESCRIPTION

| NAME | 22-pin DIP | 24-pin SO | TYPE | DESCRIPTION |
|------------------|-----------------|-----------------|------|---|
| SIGNAL IN | 12 | 13 | I | DTMF input. Timings are shown in Figure 1. Internally biased so that the input signal may be AC coupled. SIGNAL IN also permits DC coupling as long as the input voltage does not exceed the positive supply. Proper coupling is shown in Figure 3. See Table 1 for the frequency pairs associated with each DTMF signal. |
| 12/16 | 5 | 5 | I | DTMF signal detection control. When 12/16 is at logic "1," the SSI 75T957 detects the 12 most commonly used DTMF signals (1 through #). When 12/16 is at logic "0," the SSI 75T957 detects all 16 DTMF signals (1 through D). |
| A, B | 8, 9 | 8, 9 | I | Binary DTMF signal sensitivity control inputs. A and B select the sensitivity of the SIGNAL IN input to a maximum of -38 dBm. |
| D3, D2 D1, D0 | 20, 21 22, 1 | 22, 23 24, 1 | O | Data outputs. When enabled by the OE input, the data outputs provide the code corresponding to the detected digit in the format programmed by the HEX pin. See Table 1. The data outputs become valid after a tone pair has been detected and are cleared when a valid pause is timed. Timings are shown in Figure 1. |
| OE | 3 | 3 | I | Output enable. When OE is at logic "1," the data outputs are in the CMOS push/pull state and represent the contents of the output register. When OE is driven to logic "0," the data outputs are forced to the high-impedance or "third" state. Timings are shown in Figure 1. |

SSI 75T957/957A

DTMF Receiver with Dial Tone Reject Filter

PIN DESCRIPTION (Continued)

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| NAME | 22-pin DIP | 24-pin SO | TYPE | DESCRIPTION |
|------------------------------|---------------|--------------|------|---|
| HEX | 2 | 2 | I | Binary output format control. When HEX is at logic "1" the output of SSI 75T957 is full, 4-bit binary. When HEX is at logic "0," the output is binary coded 2-of-8. Table 1 shows the output codes. |
| STROBE | 18 | 19 | O | Valid data indication. STROBE goes to logic "1" after a valid tone pair is sensed and decoded at the data outputs. STROBE remains at logic "1" until a valid pause occurs or the CLEAR input is driven to logic "1," whichever is earlier. Once cleared, STROBE will not rise to a logic "1" until a new valid tone (preceded by a valid pause) is detected. Timings are shown in Figure 1. |
| CLEAR | 19 | 20 | I | STROBE control. Driving CLEAR to logic "1" forces the STROBE output to logic "0." When CLEAR is at logic "0," STROBE is forced to logic "0" only when a valid pause is detected. Tie to VNA or VND when not used. |
| BD | 7 | 7 | O | Button down. A logic "1" BD indicates a signal has been detected and is being validated. BD precedes STROBE and data outputs. |
| XIN, XOUT | 15, 14 | 16, 15 | I | Crystal connections. When an auxiliary clock is used, XIN should be tied to logic "1." See Figure 4. |
| OSC/ $\overline{\text{CLK}}$ | 16 | 17 | I | Time base control. When OSC/ $\overline{\text{CLK}}$ is at logic "1," the output of the SSI 75T957's internal oscillator is selected as the time base. When OSC/ $\overline{\text{CLK}}$ is at logic "0" and XIN is at logic "1," the AUXCLK input is selected as the time base. |
| AUXCLK | 17 | 18 | O | Auxiliary clock input. When OSC/ $\overline{\text{CLK}}$ is at logic "0" and XIN is at logic "1," the AUXCLK input is selected as the SSI 75T957's time base. The auxiliary input must be 3.58 MHz divided by 8 for the SSI 75T957 to operate to specifications. If unused, AUXCLK should be left open. |
| VNA, VND | 13, 4 | 14, 4 | - | Negative analog and digital power supply connections. Separated on the chip for greater system flexibility, VNA and VND should be at equal potential. |
| VP | 6 | 6 | - | Positive power supply connection. |
| N/C | 10, 11 | 10-12, 21 | - | Not connected. These pins have no internal connection and may be left floating. |

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DTMF Receiver with

Dial Tone Reject Filter

SSI 75T957/957A TIMING ($-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$; $4.5\text{V} \leq V_P \leq 13.2\text{V}$. Refer to Figure 1.)

| PARAMETER | CONDITIONS | MIN | NOM | MAX | UNITS |
|----------------------------|---|-----|-----|-----|---------------|
| t_{ON} Tone Time | for detection | 40 | - | - | ms |
| | for rejection | - | - | 20 | ms |
| t_{OFF} Pause Time | for detection | 40 | - | - | ms |
| | for rejection | - | - | 20 | ms |
| t_D Detect Time | | 25 | - | 46 | ms |
| t_R Release Time | | 35 | - | 50 | ms |
| t_{SU} Data Setup Time | | 7 | - | - | μs |
| t_H Data Hold Time | | 4.2 | - | 5.0 | ms |
| t_{CL} Strobe Clear Time | | - | 160 | 250 | ns |
| t_{PW} Clear Pulse Width | | 200 | - | - | ns |
| t_{BD} BD Detect Time | | 7 | - | 22 | ms |
| t_{BR} BD Release Time | | 2 | - | 18 | ms |
| Output Enable Time | $C_L = 50\text{pF}$, $R_L = 1\text{k}\Omega$ | - | 200 | 300 | ns |
| Output Disable Time | $C_L = 35\text{pF}$, $R_L = 500\Omega$ | - | 150 | 200 | ns |
| Output Rise Time | $C_L = 50\text{pF}$ | - | 200 | 300 | ns |
| Output Fall Time | $C_L = 50\text{pF}$ | - | 160 | 250 | ns |

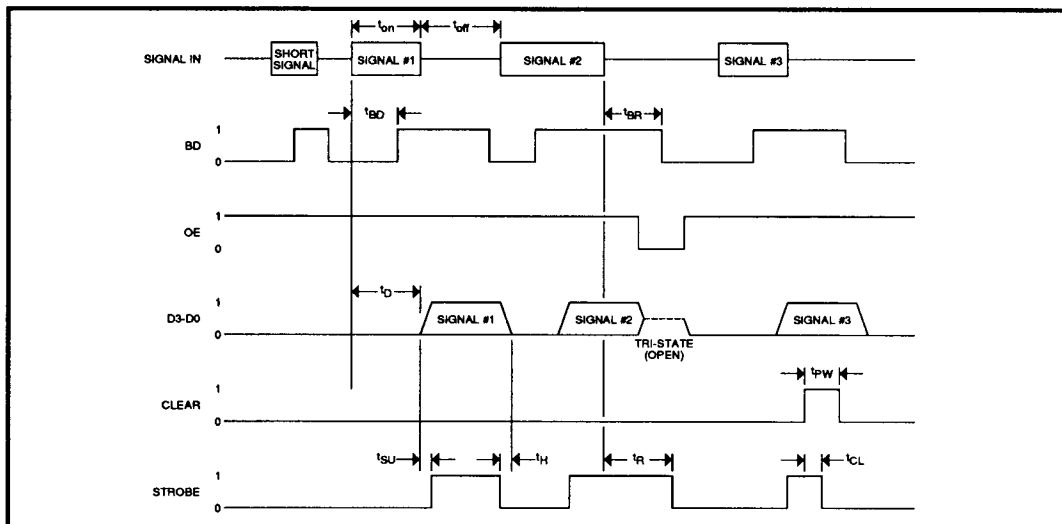


FIGURE 1: Timing Diagram

SSI 75T957/957A

DTMF Receiver with

Dial Tone Reject Filter

TABLE 1: DTMF TO BINARY DECODING

| DIGIT | LOW-FREQUENCY COMPONENT (Hz) | HIGH-FREQUENCY COMPONENT (Hz) | HEX OUTPUT | | | | BINARY CODED 2-OF-8 OUTPUT | | | |
|-------|------------------------------|-------------------------------|------------|----|----|----|----------------------------|----|----|----|
| | | | D3 | D2 | D1 | D0 | D3 | D2 | D1 | D0 |
| 1 | 697 | 1209 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 2 | 697 | 1336 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| 3 | 697 | 1477 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| 4 | 770 | 1209 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 5 | 770 | 1336 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| 6 | 770 | 1477 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| 7 | 852 | 1209 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |
| 8 | 852 | 1336 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 9 | 852 | 1477 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 0 | 941 | 1336 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| * | 941 | 1209 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| # | 941 | 1477 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| A | 697 | 1633 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| B | 770 | 1633 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| C | 852 | 1633 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| D | 941 | 1633 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

Note: The SSI 75T957 detects signals A through D when the $12/\overline{16}$ input is at logic "0."

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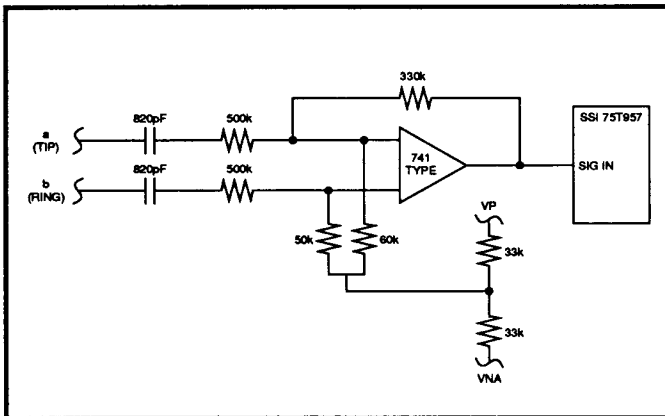
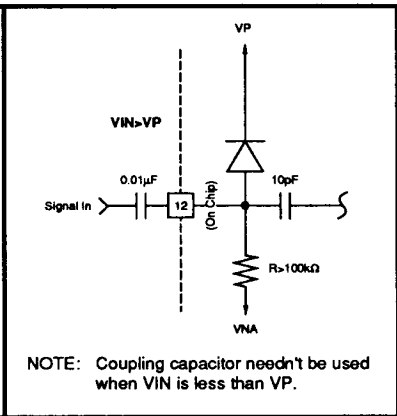


FIGURE 2: Telephone Line Differential Input Interface



NOTE: Coupling capacitor needn't be used when VIN is less than VP.

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DTMF Receiver with Dial Tone Reject Filter

ABSOLUTE MAXIMUM RATINGS

(Operation above absolute maximum ratings may permanently damage the device.)

| PARAMETER | CONDITIONS | RATING |
|---------------------------|-----------------------------|-------------------------------------|
| DC Supply Voltage - V_P | $V_{ND}=V_{NA}=0V$ | 16.0V |
| Input Voltage | All inputs except SIGNAL IN | $(V_P + 0.5V)$ to $(V_{ND} - 0.5V)$ |
| SIGNAL IN Voltage | | $(V_P + 0.5V)$ to $(V_P - 22V)$ |
| Storage Temperature | | -65° to 150°C |
| Operating Temperature | | -40° to 85°C |
| Lead Temperature | Soldering, 5 sec. | 260°C |
| Power Dissipation | | 1W |

ELECTRICAL CHARACTERISTICS

(-40°C ≤ T_A ≤ +85°C)

| PARAMETER | CONDITIONS | MIN | NOM | MAX | UNITS | |
|---|-----------------------------|-----------------|-------------|------|-------|-----|
| SIGNAL IN Input Requirements | | | | | | |
| Signal Level (per tone) (See Note 1) | $V_P=12V$ | A=0, B=0 | -24 | - | +6 | dBm |
| | | A=1, B=0 | -27 | - | +3 | dBm |
| | | A=0, B=1 | -30 | - | 0 | dBm |
| | | A=1, B=1 | - | -32 | - | dBm |
| | $V_P=5V$ | A=0, B=0 | -32 | - | -2 | dBm |
| | | A=1, B=0 | -35 | - | -5 | dBm |
| | | A=0, B=1 | -38 | - | -8 | dBm |
| | | A=1, B=1 | - | -40 | - | dBm |
| Signal Frequency Deviation with Detection | | $\pm(1.5\% +2)$ | $\pm 2.5\%$ | | Hz | |
| Signal Frequency Deviation without Detection | | $\pm 3.5\%$ | $\pm 3.0\%$ | - | Hz | |
| Twist | See Note 2 - | - | ± 10 | | dB | |
| Gaussian Noise | See Note 3 - | 12 | A-7 | | dB | |
| Dial Tone Level (per tone) | $F \leq 480$ Hz; see Note 4 | - | - | A+22 | dB | |
| Digital Input Requirements (See Note 5) | | | | | | |
| Logic 0 Voltage | $V_P=12V$ | 0 | - | 3.6 | V | |
| | $V_P=5V$ | 0 | - | 1.5 | V | |
| Logic 1 Voltage | $V_P=12V$ | 8.4 | - | 12.0 | V | |
| | $V_P=5V$ | 3.5 | - | 5.0 | V | |

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DTMF Receiver with Dial Tone Reject Filter

ELECTRICAL CHARACTERISTICS (Continued)

| PARAMETER | CONDITIONS | MIN | NOM | MAX | UNITS |
|---|--|------|-----|------|-------|
| Digital Output Characteristics (See Note 5) | | | | | |
| Logic 0 Voltage | V _P =12V, I _o = 1.0mA | 0 | - | 1.2 | V |
| | V _P =5V, I _o = 0.4mA | 0 | - | 0.5 | V |
| Logic 1 Voltage | V _P =12V, I _o = -0.5mA | 10.8 | - | 12.0 | V |
| | V _P =5V, I _o = -0.2mA | 4.5 | - | 5.0 | V |
| Three-State Leakage | | - | - | 10.0 | μA |
| Miscellaneous Characteristics | | | | | |
| CMOS Latch-up Voltage | See Note 7 | 20 | - | - | V |
| SIGNAL IN Input Impedance | F=1kHz 15pF | 100k | - | - | Ω |
| Power Requirements | | | | | |
| Supply Current | V _P =12V | - | 20 | 40 | mA |
| | V _P =5V | - | 9 | 18 | mA |
| Power Dissipation (outputs open) | V _P =12V, see Note 6 | - | 204 | 480 | mW |
| | V _P =5V, see Note 6 | - | 30 | 90 | mW |
| Power Supply Wide Band Noise | A=0, B=0 | | | | |
| | V _P =12V | - | - | 25 | mVpp |
| | V _P =5V | - | - | 10 | mVpp |
| Notes: 1. With an ambient temperature of 25°C, the signal duration and signal interval are at minimum, and the signal frequency deviation and twist are at maximum. The unit "dBm" refers to decibels above or below a reference power of one milliwatt into a 600-ohm load. (For example, -24dBm equals 49mVrms.) 2. Twist is defined as the ratio of the level of the high-frequency DTMF component to the level of the low-frequency DTMF component. 3. With an ambient temperature of 25°C, the signal level is at A+5, the signal frequency deviation and twist are at 0, and the signal applied is 50ms off and 50ms on. The A level is the minimum detect level selected. 4. The signal duration and signal interval are at minimum, and the signal frequency deviation and twist are at maximum. The A level is the minimum detect level selected. 5. Logic levels shown are referenced to VND. 6. For an ambient temperature of 25°C. 7. Power supply excursions above this value can cause device damage. | | | | | |

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DTMF Receiver with

Dial Tone Reject Filter

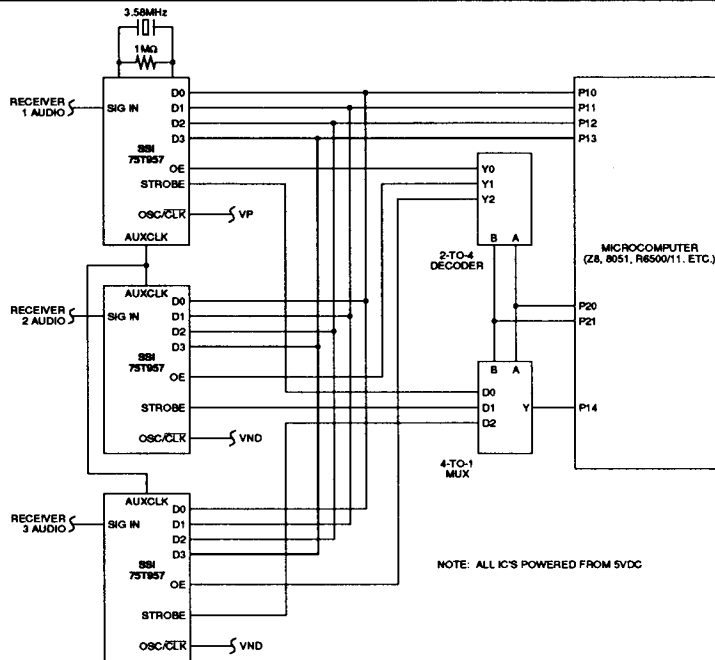


FIGURE 4: Multiple Receiver/Microprocessor Interface

ORDERING INFORMATION

| PART DESCRIPTION | ORDER NO. | PKG. MARK |
|---|----------------|------------|
| SSI 75T957 22-pin Plastic DIP, 5V-only | SSI 75T957-IP | 75T957-IP |
| SSI 75T957 24-pin SOL, 5V-only | SSI 75T957-IL | 75T957-IL |
| SSI 75T957A 22-pin Plastic DIP, 5-12V operation | SSI 75T957A-IP | 75T957A-IP |
| SSI 75T957A 24-pin SOL, 5-12V operation | SSI 75T957A-IL | 75T957A-IL |

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