

ELECTRICAL CHARACTERISTICS

Test Conditions:

SYMBOL	PARAMETERS	MIN	TYP	MAX	UNIT	CONDITIONS
DC CHARACTERISTICS 0 °C ≤ T ≤ 70 °C, V _{DD} = 3.5 V						
V _{DD}	DC Operating Voltage	2.5		6	V	
V _{REF}	Magnitude of (V _{DD} -V _{REF})	1.5	2.5	3.5	V	
V _M	Memory Retention Voltage	1.5			V	
I _{OP}	DC Operating Current			4.2	mA	V _{DD} = 3.5 V, Outputs Unloaded
I _S	DC Standby Current			1.5 500	μA nA	V _{DD} = 3.5 V, Outputs Unloaded V _{DD} = 2.5 V, Outputs Unloaded
I _{ML}	Mute Sink Current			10	mA	V _{DD} = 3.5 V, V _{OUT} = .5 V
I _P	Pulse Sink Current			20	mA	V _{DD} = 3.5 V, V _{OUT} = .5 V
K _L	Keyboard "0" Logic Level	V _{SS}		20% of V _{DD}	V	
K _H	Keyboard "1" Logic Level	80% of V _{DD}		V _{DD}	V	
K _{PU}	Keyboard Pull-up Resistance		100		kΩ	
K _{PD}	Keyboard Pull-down Resistance		4		kΩ	
H _{SRU}	Hookswitch Pull-up Resistance		100		kΩ	
C _{fosc}	Oscillator Stability			.05	%	V _{DD} 2.5 to 3.5 V
S _F	Keyboard Scanning Frequency		932		Hz	
d _{BCR}	Ration of Column to Row Tone		2	3	dB	
%DIS	Distortion		6	7	%	
V _{OR}	Single Tone Row Frequency Amplitude		212		mVR _{rms}	R _L = 330Ω
V _{OC}	Single Tone Column Frequency Amplitude		311		mVR _{rms}	R _L = 330Ω
T _{DB}	Keyboard Debounce Time	11.8			ms	
K _T	Keydown	40			ms	
R _T	Tone Load Resistor	120		400	Ω	

PIN AND FUNCTION DESCRIPTIONS

Pin **Number**

Supplies V_{DD} , V_{SS} 1,13

Power Supply Inputs – The device is designated to operate from 2.5 to 6 volts.

V_{REF} 2

The V_{REF} output provides a negative reference voltage relative to V_{DD} , which defines minimum operating voltage. In a typical application, this pin is simply tied to V_{SS} .

Keyboard Inputs

C_1, C_2, C_3 4,5,6
 R_1, R_2, R_3, R_4, R_5 24,23,22,21,20

These inputs are open when the keyboard is inactive. When a key is pushed, an appropriate row to column input must go to V_{SS} or connect with each other.

Oscillator

OSC_{IN}, OSC_{OUT} 11,12

These pins are provided to connect external crystal or ceramic resonator. The device contains the necessary parasitic capacitances and feedback resistor on chip so that is is only necessary to connect a standard 3.58 MHz TV crystal.

Dialing Rate 9

DRS

Dialing Rate is programmable by connecting this pin to V_{DD} or V_{SS} . The rate is 20 pps when connected to V_{DD} and 10 pps when connected to V_{SS} .

Mark/Space 19

M/S

Mark/Space ratio may be selected by connecting the pin to V_{DD} or V_{SS} .

M/S Pin (19)	MARK	SPACE
V_{SS}	37%	63%
V_{DD}	34%	66%

Mute 10

This N-channel open drain output is designed to drive external bipolar transistor to mute the receiver during dialing.

Dial Pulse Out 16

An output drive is provided to turn on a transistor at the dial pulse rate. The normal output will be "low" during "space", and "high" otherwise.

Mode Select 17

State of this pin selects the proper dialing mode. Tone dialing is selected by connecting this pin to V_{SS} .

Hookswitch 18

HS

This input detects the state of the hookswitch contact. The XR-T5990 will accept key inputs when this pin is at low state (off hook).

Single Tone Inhibit 8

STI

Single tone output can be inhibited when this pin is connected to V_{SS} .

Tone Out 3

This N-channel open drain output is designed to drive external transistor.

Pacifier Tone Output 7

PT

The XR-T5990 provides a pacifier tone output to provide audio feedback to the user that a key has been depressed. The output is a 1800 Hz tone that can be capacitively coupled into the telephone receiver.

This option is provided in dial pulse mode only.

FUNCTIONAL DESCRIPTION

Keyboard

The XR-T5990 employs a scanning technique to determine a key closure. This permits interface to DPCT keyboard with common connected to V_{SS} or SPST switch matrix connecting row to column.

A logic interface is also possible as shown in Figure 1.

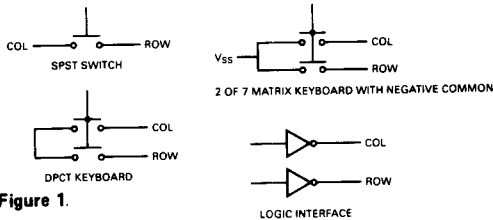


Figure 1.

Hookswitch

The XR-T5990 will enter in off hook mode when hook-switch is pulled low. This state enables the device to accept a valid key and enable the oscillator.

Mute Output

The mute output turns on (pulls to the V_{SS} supply) at the beginning of the mark, and turns off (goes to an open circuit) following the last interdigit pause. A small delay is provided to overlap mute output from the end of the last interdigit pause.

Redial

The last number dialed is retained in the memory, and therefore can be redialed out by going off hook and pressing the redial key.

Dialing will start when the key is depressed and finish after the entire number is dialed out unless an access pause is detected. If this is the case, the dialing will stop, and resume again after 3.5 seconds. During redial mode, tone will be on for 70 ms and off for 70 ms.

Normal Dialing

Normal dialing can start after going off hook, since the device is designed in a FIFO arrangement, digits can be entered at a rate considerably faster than the output rate. Digits can be entered approximately once every 65 ms. Pauses may be entered when required in the dial sequences by pressing pause key which provides access pause for future redial.

During normal tone dialing, tone will go out at 70 ms burst. Continuance single tone can be generated by depressing two digit keys in the appropriate row or appropriate column.

CIRCUIT DESCRIPTION

The XR-T5990 is capable of generating 12 standard tones in the tone mode. Low group frequencies consist of 697, 770, 852, 941 Hz and the high group consists of three frequencies 1209, 1336, and 1477 Hz

A keyboard arranged in a row, column format is used for number entry. When a push button corresponding to a digit is pushed, one appropriate row frequency, and one appropriate column frequency are selected. The appropriate row and column frequencies in the keyboard arrangement are shown below.

Active Input	Specified Frequency
R1	697
R2	770
R3	852
R4	941
C1	1209
C2	1336
C3	1477

Table 1.

C1	C2	C3	
1	2	3	R1
4	5	6	R2
7	8	9	R3
*	0	#	R4

Table 2.

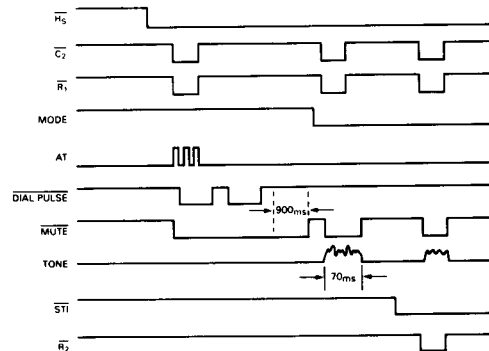


Figure 2. XR-T5990 Timing Diagram

OPERATING DESCRIPTION

Normal Dialing

Off Hook, **D1**, **D2**, **DN**

Tone or Dial Pulse Output

D1 **D2** **D3** **DN**

Normal Dialing using Pause Function

Off Hook, **D1** **PA** **D2**, **DN**

D1 **D2** **D3**, **DN**

Redial

On Hook, Off Hook, **RD**

D1 **D2** **D3**, **DN**

Dialing will halt for 3.5 seconds when a pause is detected.

D1 **3.5 sec** **D2**, **DN**

Redial and Normal Dialing Combination

On Hook, Off Hook, **RD**, **D18**, **D19**, **D20**, **DN**

D1 **D17** **D18**, **DN**

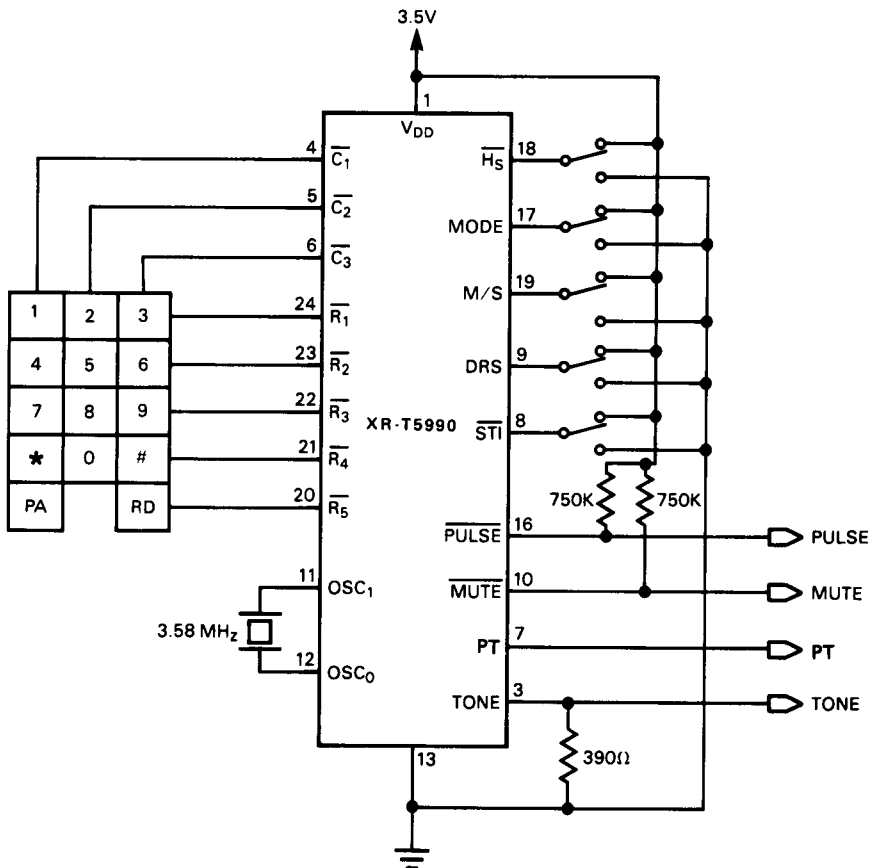


Figure 3. XR-T5990 Test Circuit

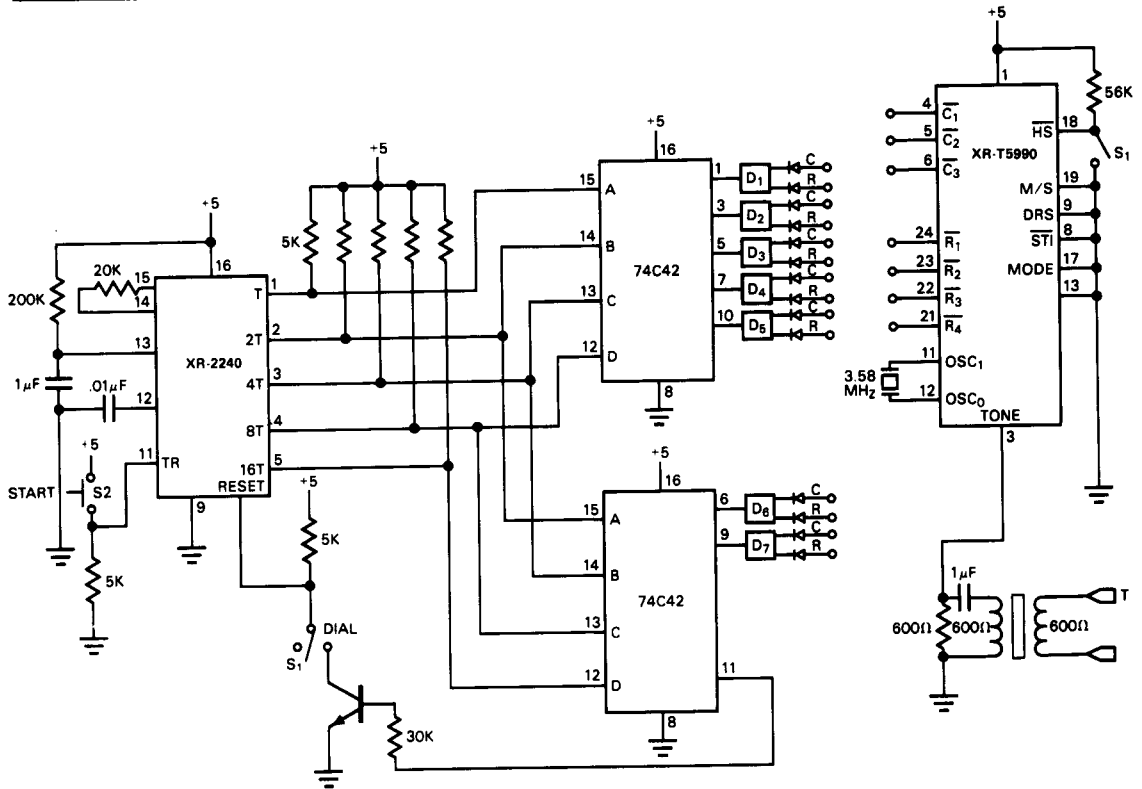


Figure 4. Typical Application Circuit for Auto Dialer Modem

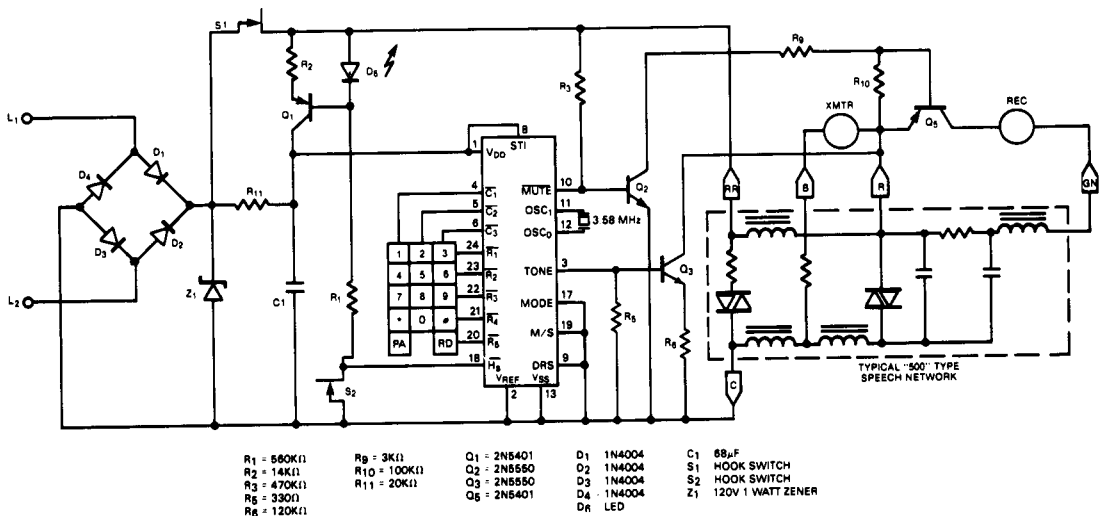


Figure 5. Typical Tone Dialing Application Circuit

- | | | | | |
|--------------------------|---------------------------|-------------------------|-------------------------|------------------------------------|
| R ₁ = 560K(1) | R ₉ = 3K(1) | Q ₁ = 2N5401 | D ₁ = 1N4004 | C ₁ = 68µF |
| R ₂ = 14K(1) | R ₁₀ = 100K(1) | Q ₂ = 2N5550 | D ₂ = 1N4004 | S ₁ = HOOK SWITCH |
| R ₃ = 470K(1) | R ₁₁ = 20K(1) | Q ₃ = 2N5550 | D ₃ = 1N4004 | S ₂ = HOOK SWITCH |
| R ₄ = 330(1) | | Q ₅ = 2N5401 | D ₄ = 1N4004 | Z ₁ = 120V 1 WATT ZENER |
| R ₆ = 120K(1) | | | D ₅ = LED | |

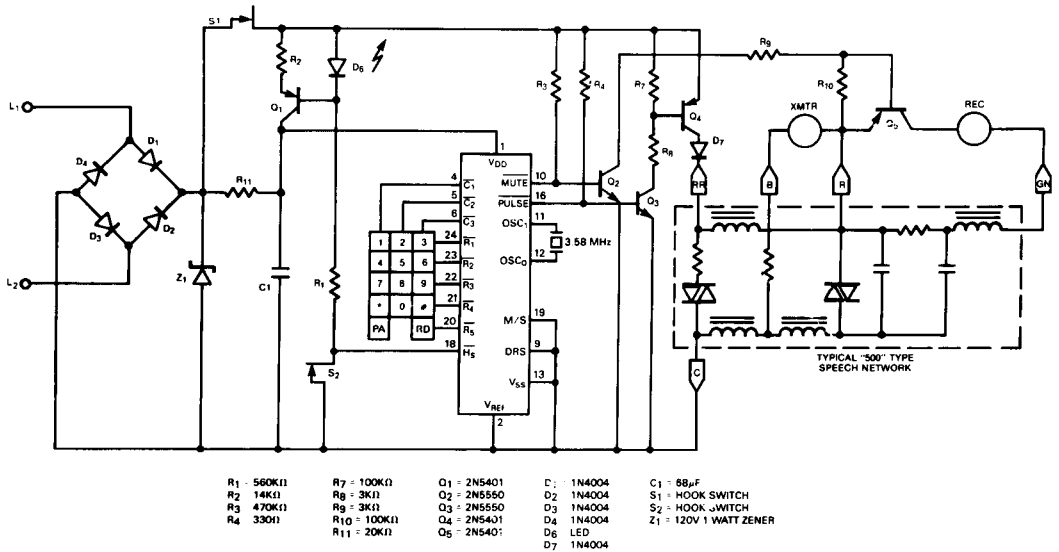


Figure 6. Typical Pulse Dialing Application Circuit

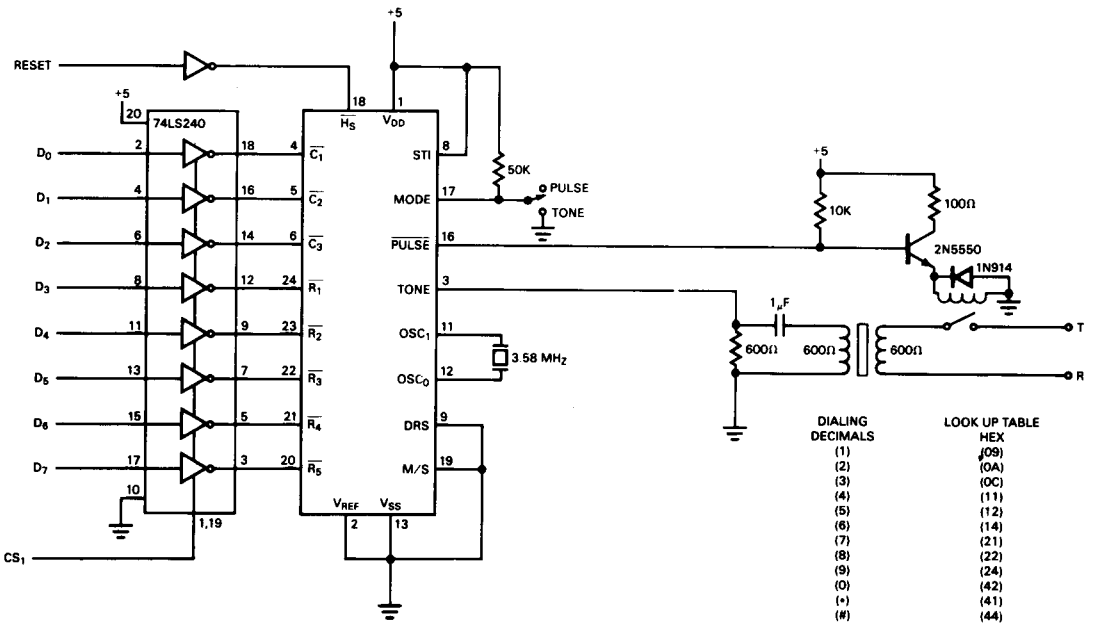


Figure 7. Typical Microprocessor Interface Circuit