

# DUAL TONE MULTI-FREQUENCY OSCILLATOR

**MB4507A**

January 1988  
Edition 2.0

## DUAL TONE MULTI-FREQUENCY OSCILLATOR

The Fujitsu MB4507A is a Dual Tone Multi-Frequency (DTMF) oscillator designed for use with pushbutton telephones. Depending on which pushbuttons are pressed, the MB4507A divides the output of an external crystal oscillator to generate a precise series of synthesized sine waves from an on-chip ROM and digital-to-analog converter. A 3-pole filter with external capacitors is used to provide output sine waves that are nearly distortion-free. By using an external crystal oscillator, the MB4507A can generate very stable frequencies even with an unregulated supply voltage. An inexpensive TV-color crystal (3.58 MHz) can be used for the external oscillator.

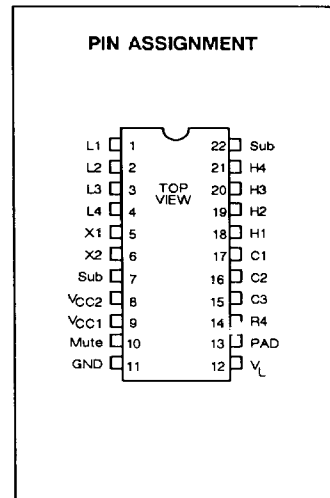
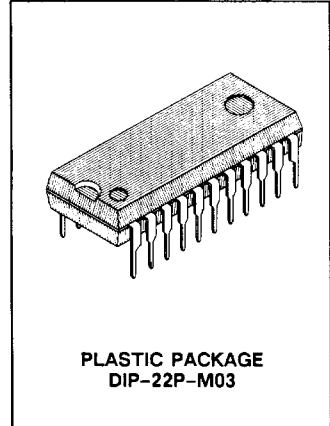
The MB4507A DTMF oscillator is housed in a 22-pin plastic DIP.

- On-chip frequency synthesizer with extremely stable output
- Sine wave outputs that are nearly distortion-free
- Inexpensive color-TV crystal (3.579545 MHz) can be used for external oscillator
- On-chip automatic pad circuit uses line-current detection with external resistor
- On-chip switch debounce circuits
- Precision tracking of key inputs permits wide tuning range of input codes
  - Only lower group oscillates when laterally adjacent buttons are pushed simultaneously
  - Only higher group oscillates when vertically adjacent buttons are pushed simultaneously
  - No oscillation when diagonally adjacent buttons are pushed simultaneously
- Logic circuits decode simultaneous input of two keys:

### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ , see NOTE)

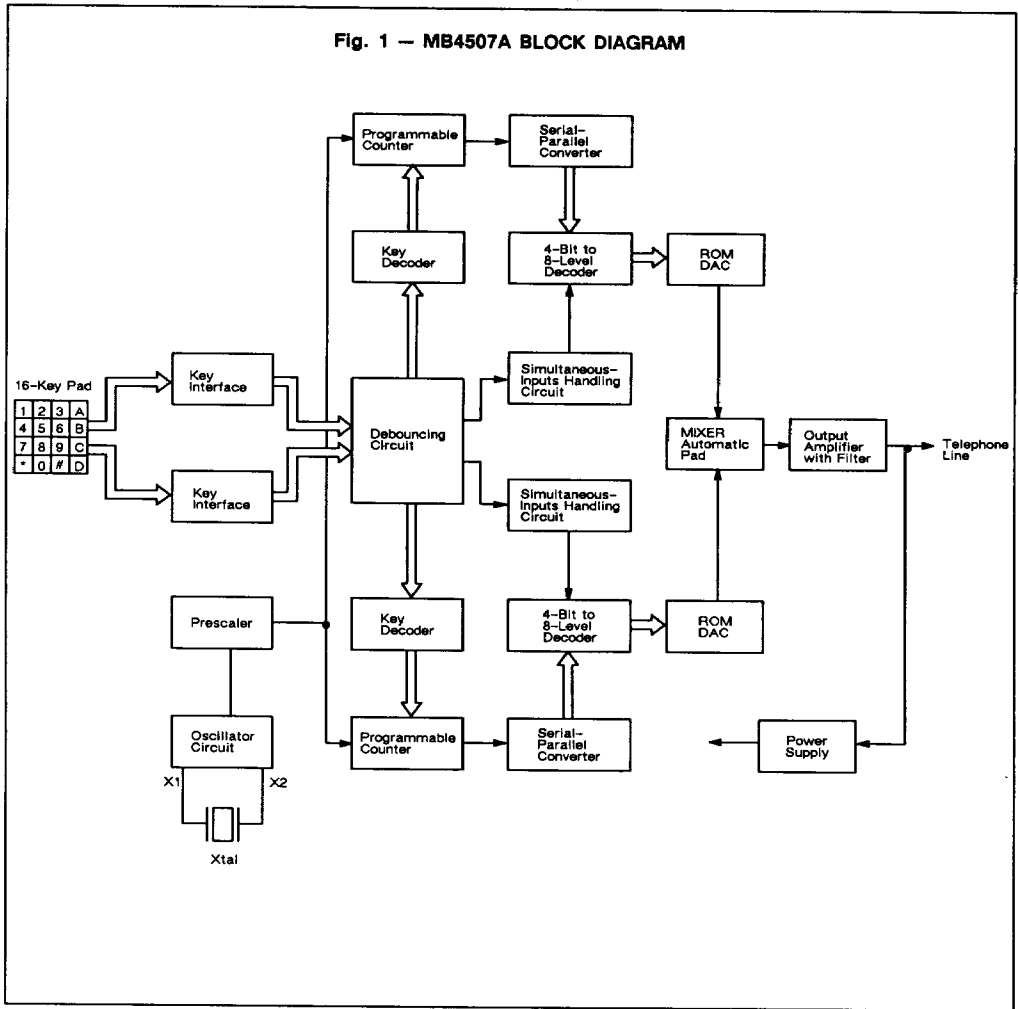
| Parameter                     | Symbol               | Value       | Unit             |
|-------------------------------|----------------------|-------------|------------------|
| Supply Voltage                | $V_L$                | +20         | V                |
| Supply Current                | $I_L$                | +110        | mA               |
| Input Voltage                 | $V_{L1}$ to $V_{L4}$ | +7          | V                |
| Input Current                 | $I_{H1}$ to $I_{H4}$ | 0.5         | mA               |
| Operating Ambient Temperature | $T_A$                | -35 to +65  | $^\circ\text{C}$ |
| Storage Temperature           | $T_{STG}$            | -55 to +125 | $^\circ\text{C}$ |

**NOTE:** Permanent device damage may occur if the above Absolute Maximum Ratings are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.



This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields. However, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit.

**Fig. 1 — MB4507A BLOCK DIAGRAM**



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## RECOMMENDED OPERATING CONDITIONS

(Referenced to GND)

| Parameter                        | Symbol   | Value       | Unit         |
|----------------------------------|----------|-------------|--------------|
| Supply Current                   | $I_L$    | +20 to +105 | mA           |
| Crystal Frequency                | $f_o$    | 3.579545    | MHz          |
| Input Voltage ( $L_1$ to $L_4$ ) | $V_{IH}$ | $\geq 3$    | V            |
|                                  | $V_{IL}$ | 0.5 to 1.0  | V            |
| Input Current ( $H_1$ to $H_4$ ) | $I_{IH}$ | 50 to 200   | $\mu$ A      |
|                                  | $I_{IL}$ | $\leq 5$    | $\mu$ A      |
| Ambient Temperature              | $T_A$    | -30 to +60  | $^{\circ}$ C |

## ELECTRICAL CHARACTERISTICS

( $I_L = 20$  to 70mA,  $T_A = 25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ )

| Parameter           | Conditions          | Symbol   | Values |       |      | Unit |
|---------------------|---------------------|----------|--------|-------|------|------|
|                     |                     |          | Min    | Typ   | Max  |      |
| Frequency Deviation | $I_L = 20\text{mA}$ | $f_{L1}$ | -0.9   | -0.32 | +0.9 | %    |
|                     |                     | $f_{L2}$ | -0.9   | +0.02 | +0.9 | %    |
|                     |                     | $f_{L3}$ | -0.9   | +0.03 | +0.9 | %    |
|                     |                     | $f_{L4}$ | -0.9   | -0.11 | +0.9 | %    |
|                     |                     | $f_{H1}$ | -0.9   | -0.24 | +0.9 | %    |
|                     |                     | $f_{H2}$ | -0.9   | -0.32 | +0.9 | %    |
|                     |                     | $f_{H3}$ | -0.9   | +0.64 | +0.9 | %    |
|                     |                     | $f_{H4}$ | -0.9   | +0.37 | +0.9 | %    |
| Output Frequency    |                     | $f_{L1}$ |        | 695   |      | Hz   |
|                     |                     | $f_{L2}$ |        | 770   |      | Hz   |
|                     |                     | $f_{L3}$ |        | 852   |      | Hz   |
|                     |                     | $f_{L4}$ |        | 940   |      | Hz   |
|                     |                     | $f_{H1}$ |        | 1206  |      | Hz   |
|                     |                     | $f_{H2}$ |        | 1332  |      | Hz   |
|                     |                     | $f_{H3}$ |        | 1487  |      | Hz   |
|                     |                     | $f_{H4}$ |        | 1639  |      | Hz   |

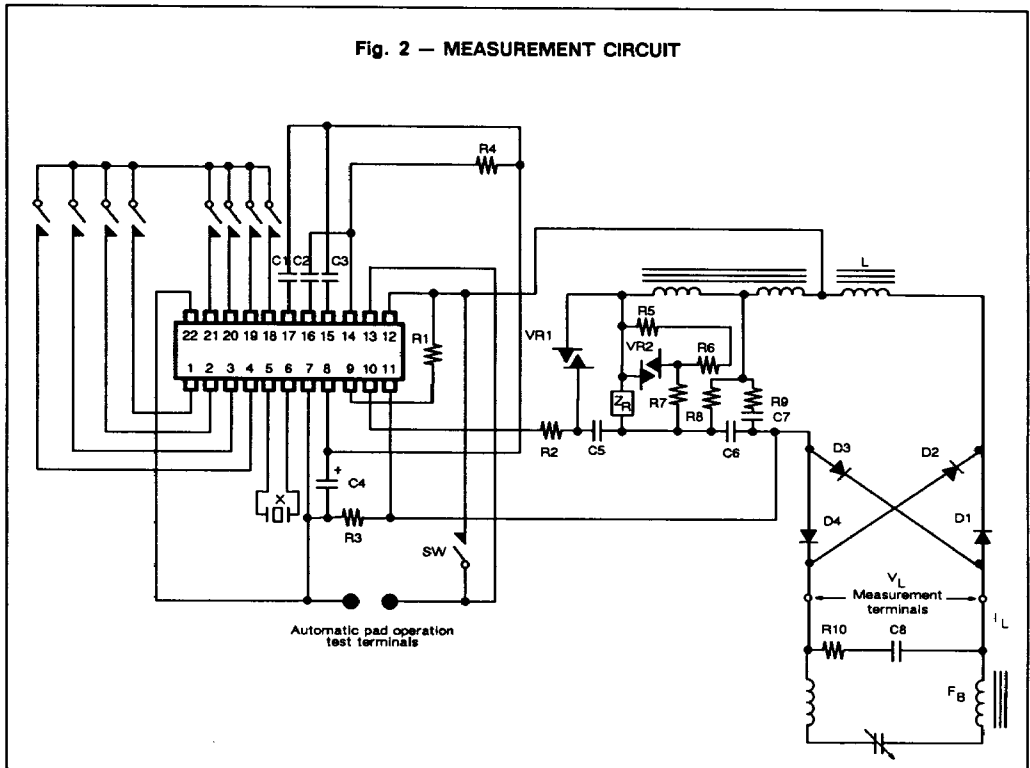
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## ELECTRICAL CHARACTERISTICS (Continued)

(Recommended operating conditions unless otherwise noted,  $T_A = 25^\circ\text{C}$ )

| Parameter                 | Conditions                            | Symbol    | Values |     |      | Unit |
|---------------------------|---------------------------------------|-----------|--------|-----|------|------|
|                           |                                       |           | Min    | Typ | Max  |      |
| Output Level              | $I_L = 70\text{mA}$ , button 8        | $V_{L3}$  | -11.7  | -10 | -8.3 | dBm  |
|                           |                                       | $V_{H2}$  | -10.7  | -9  | -7.3 | dBm  |
| Total Harmonic Distortion | $I_L = 28\text{mA}$ , L3, H2          | THD       | 26     | 30  |      | dB   |
| ON Threshold Current      | when no signal                        | $I_{ON}$  |        | 55  | 60   | mA   |
| OFF Threshold Current     |                                       | $I_{OFF}$ | 28     | 35  |      | mA   |
| Attenuation               | $I_L = 28\text{mA}/I_L = 70\text{mA}$ | Loss      | 1.5    | 2.5 | 3.5  | dB   |
| Supply Voltage            | $I_L = 20\text{mA}$                   | $V_L$     |        | 7.8 | 8.5  | V    |

Fig. 2 — MEASUREMENT CIRCUIT



**MEASUREMENT CIRCUIT PARTS LIST**

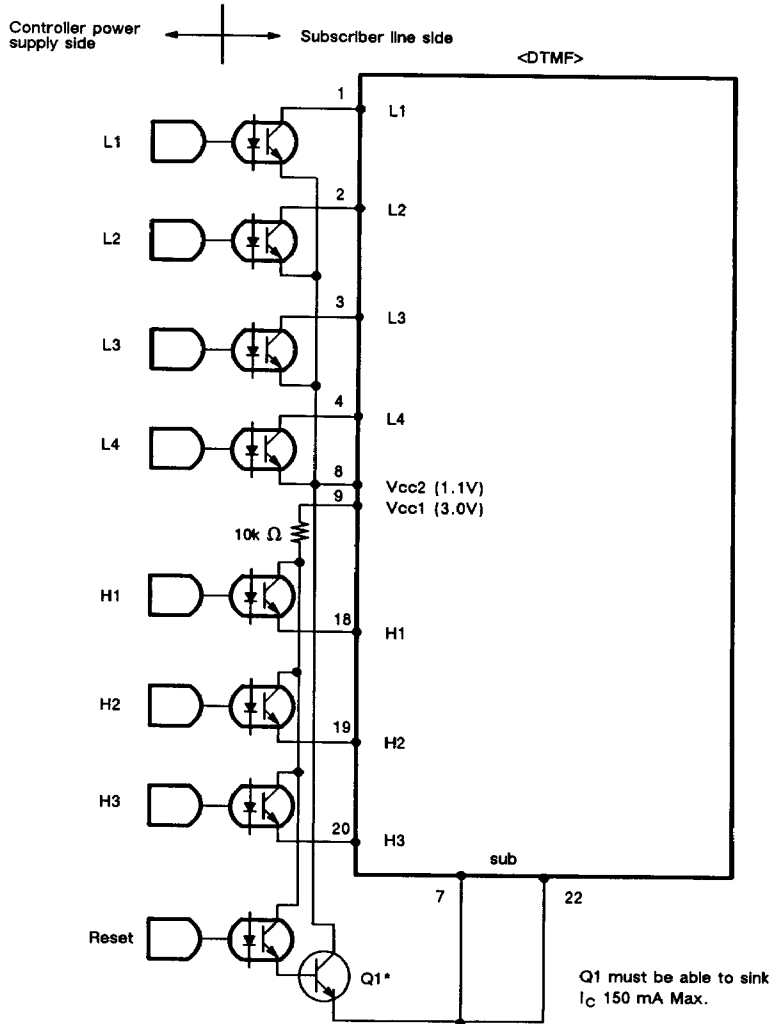
| Symbol         | Value                                   | Symbol | Value         |
|----------------|---|--------|---------------|
| X              | 3.579545 MHz                            | R8     | 130 OHMS      |
| D1 to D4       | SD-60P equiv.                           | R9     | 20 OHMS       |
| VR1 to VR2     | VR-60 equiv.                            | R10    | 600 OHMS      |
| L              | L62 equiv.                              | C1     | 0.015 $\mu$ F |
| Z <sub>R</sub> | NTT R62 standard<br>reference impedance | C2     | 0.022 $\mu$ F |
| R1             | 510 OHMS                                | C3     | 1500 pF       |
| R2             | 100 OHMS                                | C4     | 0.33 $\mu$ F  |
| R3             | 11 OHMS                                 | C5     | 4.7 $\mu$ F   |
| R4             | 30 OHMS                                 | C6     | 2 $\mu$ F     |
| R5             | 560 OHMS                                | C7     | 1.1 $\mu$ F   |
| R6             | 620 OHMS                                | C8     | 1 $\mu$ F     |
| R7             | 160 OHMS                                | FB     | WJ-139 equiv. |

**DTMF OPERATION**

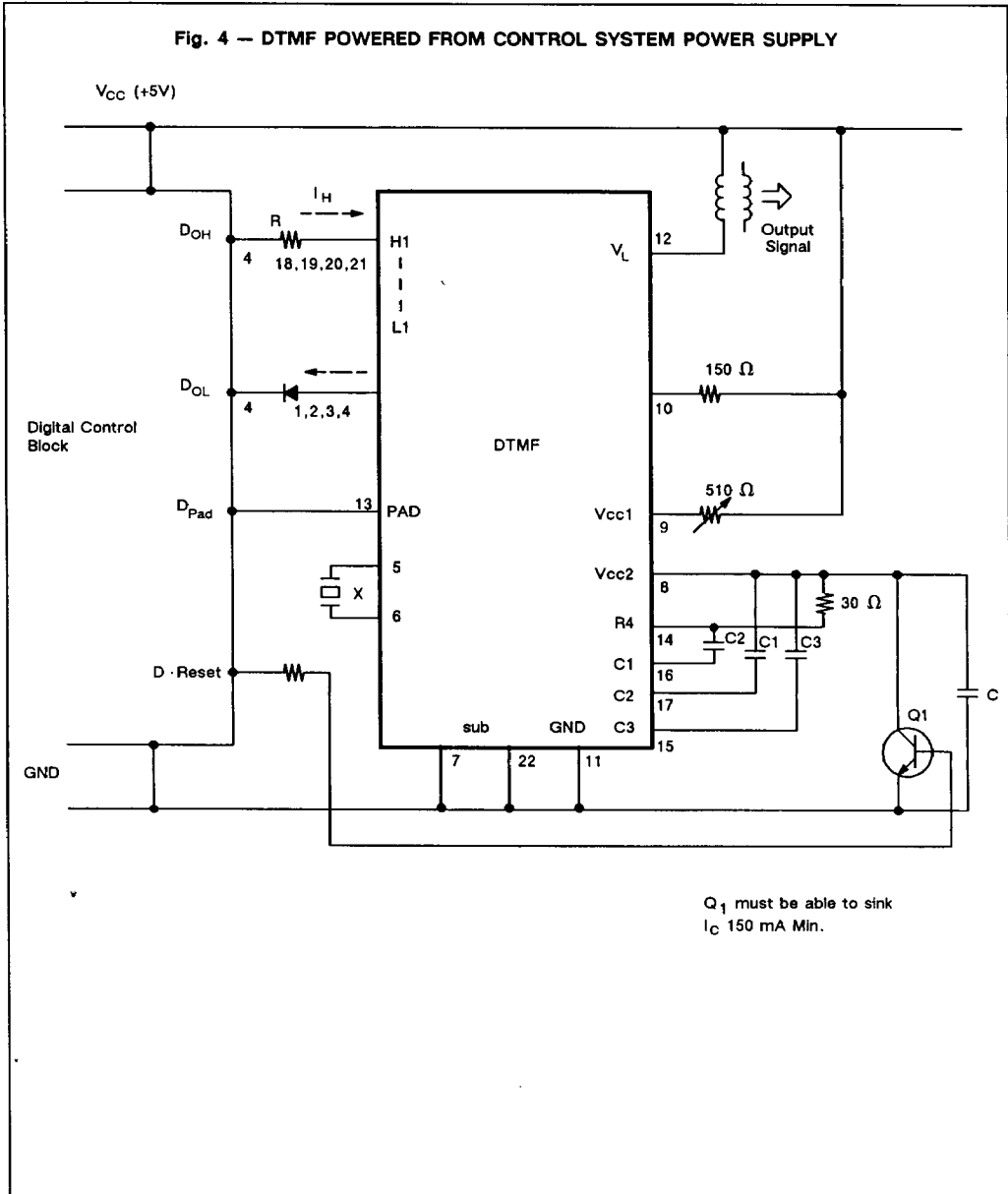
The DTMF is designed to allow input control (key input) from either push buttons (telephone keypad) or microcomputer logic signals.

- Subscriber's line isolated from the control system.

**Fig. 3 — UTILIZING PHOTOISOLATION TECHNIQUES**



**Fig. 4 — DTMF POWERED FROM CONTROL SYSTEM POWER SUPPLY**

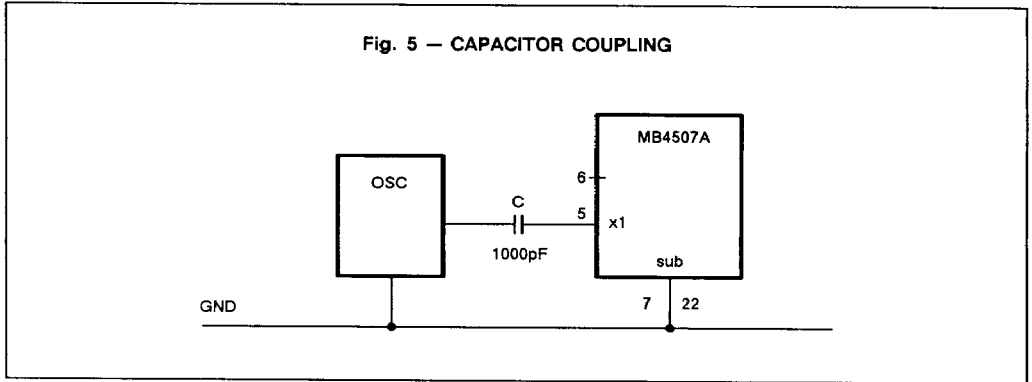




### EXAMPLE USING EXTERNAL CLOCK SIGNAL

An external 3.58 MHz clock signal may be applied to Input X1. However, care must be taken to properly isolate the external

clock to prevent coupling to the on-chip bias levels of the DTMF IC. Three methods are shown below to accomplish this.



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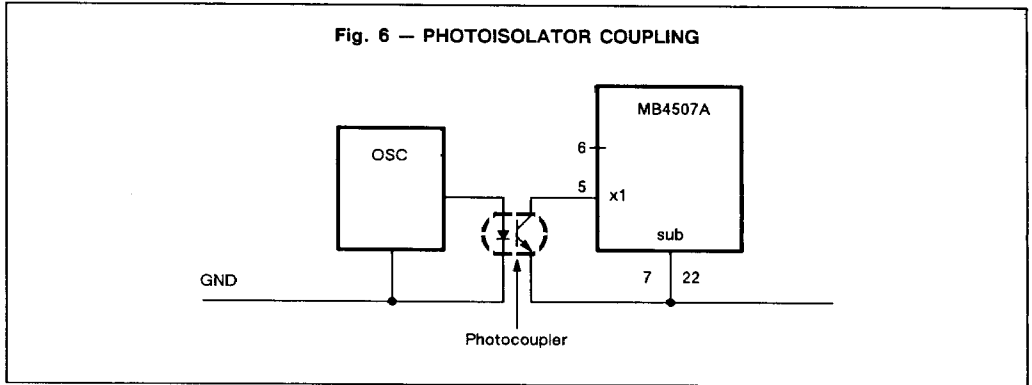




Fig. 7 — TRANSFORMER COUPLING

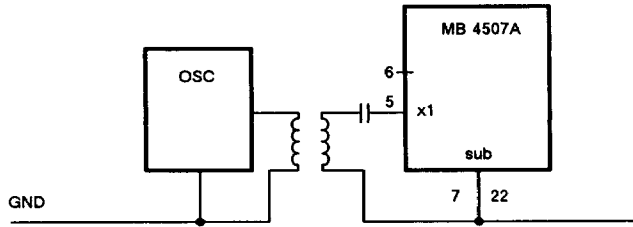
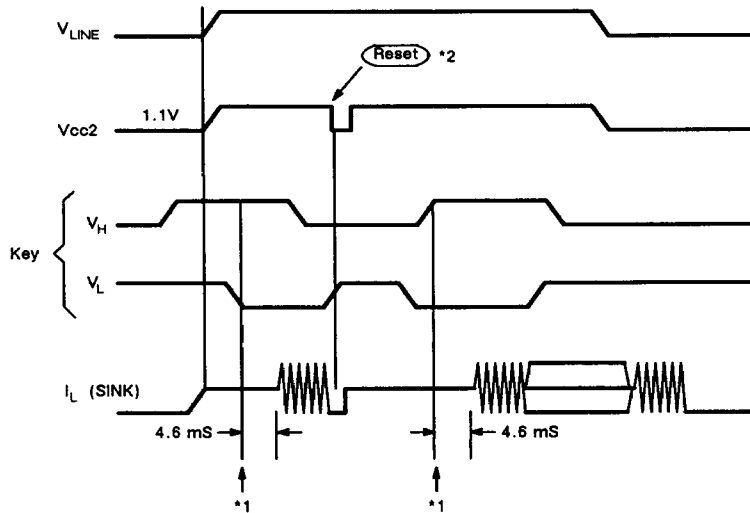


Fig. 8 — TIMING DIAGRAM



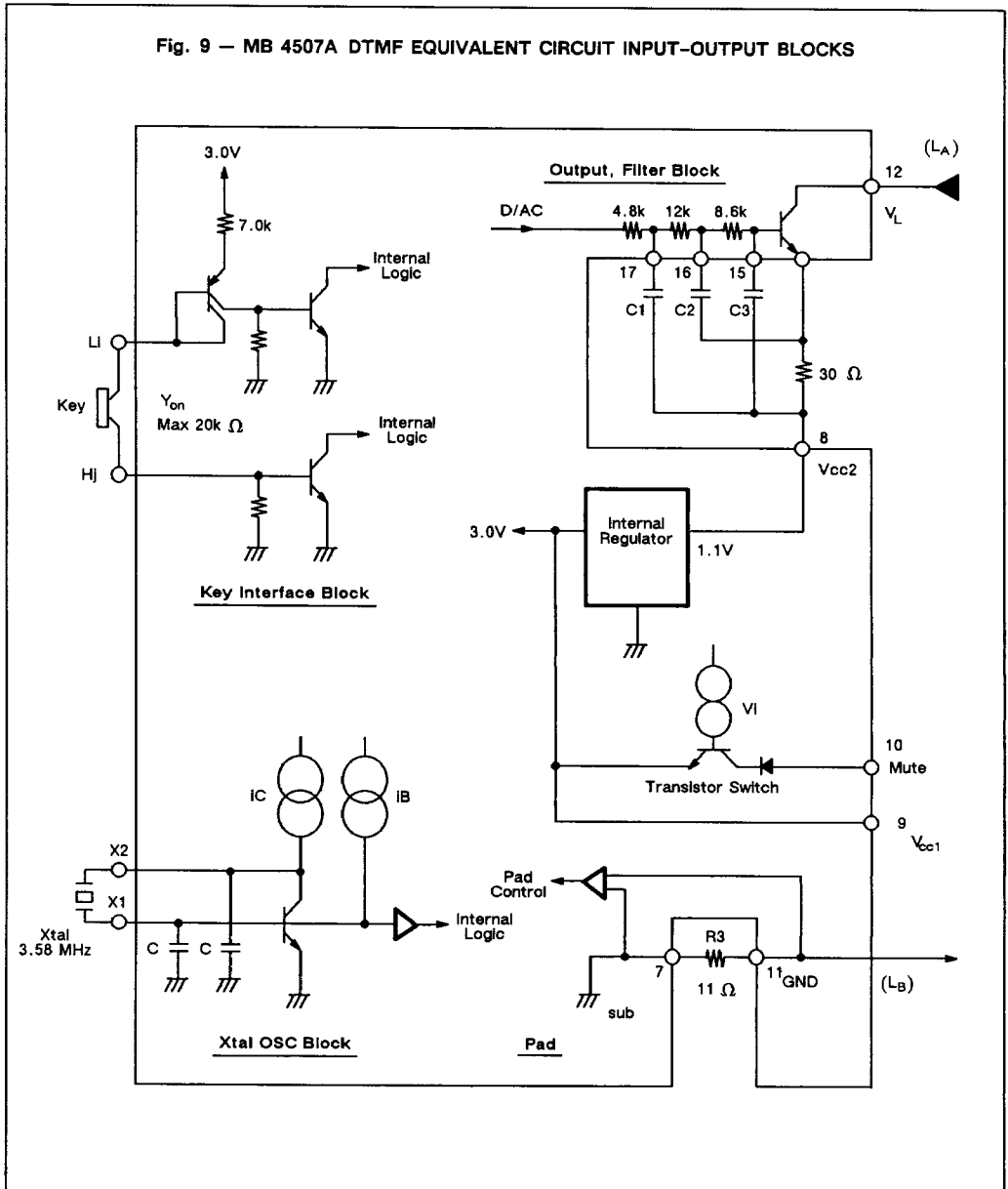
Notes:

- \*1.  $V_H$  ..... H
- $V_L$  ..... L
- $V_{LINE}$ ...Power -on  
( $V_{CC2}=1.1V$ )

Calling starts after 4.6mS. During this 4.6mS interval, the previous conditions must be maintained.

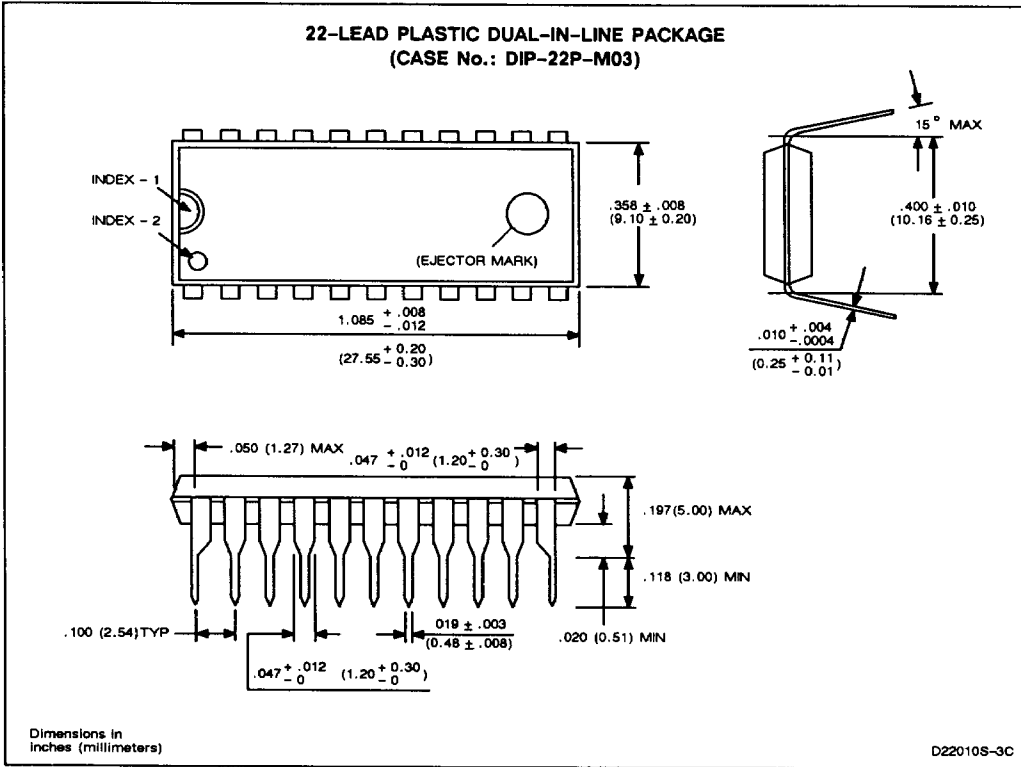
- \*2. The DTMF can be reset by externally shorting  $V_{CC2}$  to GND.

**Fig. 9 — MB 4507A DTMF EQUIVALENT CIRCUIT INPUT-OUTPUT BLOCKS**



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# PACKAGE DIMENSIONS



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