



M761E M761EA

PRELIMINARY DATA

DUAL TONE MULTIFREQUENCY GENERATOR

- 2.4 TO 5V SUPPLY RANGE
- VERY LOW POWER CONSUMPTION
- INTERNAL PULL-UP OR PULL-DOWN RESISTOR WITH DIODE PROTECTION ON ALL KEYBOARD INPUTS
- ON-CHIP CRYSTAL CONTROLLED OSCILLATOR ($f_o = 4.433619\text{MHz}$) WITH INTEGRATED FEEDBACK RESISTOR AND LOAD CAPACITORS
- LOW HARMONIC DISTORTION ($\leq 2\%$)
- FIXED PRE-EMPHASIS ON HIGH-GROUP TONES
- FAST START-UP TIME
- LOW POWER CONSUMPTION IN STANDBY MODE
- MUTE OUTPUT (M761E ONLY)
- ONE CONTACT PER KEY

DESCRIPTION

The M761E-M761EA provides all the tone frequency pairs required for a DTMF Dialling System. Tones are obtained from an inexpensive TV crystal ($f_o = 4.433619\text{MHz}$) followed by two independent programmable dividers. The dividing ratio is controlled by the selected key. Keyboard format is 4 rows x 4 columns and a key is valid when a column and a row are connected together.

Internal logic prevents the transmission of illegal tones when more than one key is pressed. If no key is selected the oscillator turns off and the linear parts are strobed to decrease the total power consumption.

As any button is pressed row and column inputs are scanned internally, to identify the activated ones. Electrically, row and column inputs are activated on high level voltage.

Single tone output cannot be emitted by a "1" on a row or column only. For single tone emission see "Single tone procedure".

A debounce output is available, for M761E only, to indicate that a key has been selected. D/A conversion is accomplished by a capacitive network allowing very low power consumption, very low



B/F

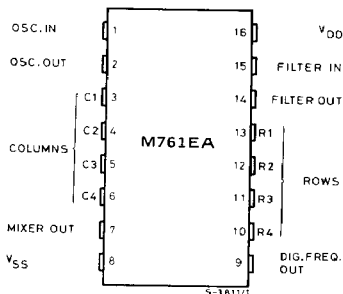
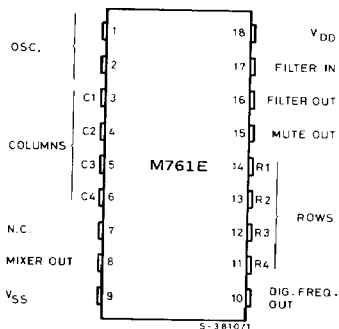
DIP-16 Plastic and Ceramic



B/F

ORDERING NUMBERS: M761EB1
M761EAB1
M761EF1
M761EAF1

PIN CONFIGURATION



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DESCRIPTION (continued)

distortion and an exceptional stability of tone level against temperature variations.

The tones are mixed in a resistive network; a unity gain amplifier is provided to realize a two pole active filter with only four external passive components.

SGS has also developed the LS342, DTMF line interface which provides the stabilized supply

for the M761E-M761EA from the telephone line and amplifies the output tones to the standardized levels. The M761E can also be interfaced with the LS156 speech circuit with MF interface avoiding the need of the common spring set.

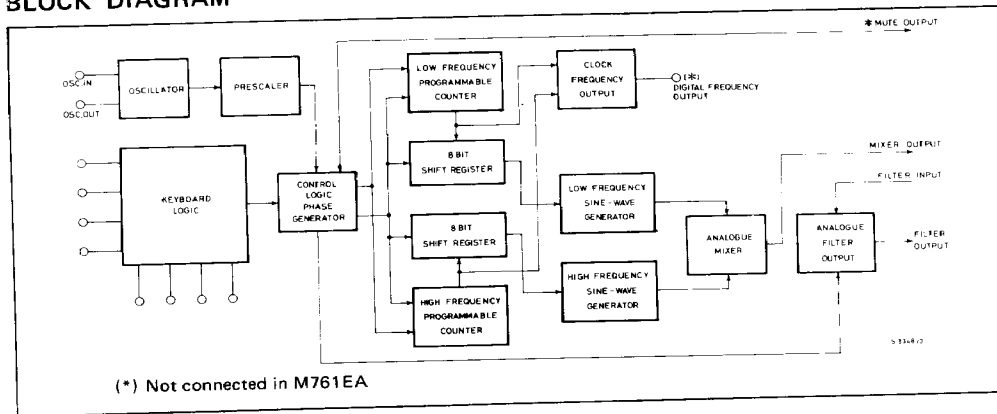
The M761E utilizes low voltage CMOS technology and is available in 18 pin dual in-line plastic ceramic package; the M761EA is available in 16 pin dual in-line package.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{DD}	Supply voltage	-0.5 to + 5.5	V
V_I	Input voltage	-0.3 to $V_{DD} + 0.5$	V
P_{tot}	Power dissipation	400	mW
T_{op}	Operating temperature range	-25 to +70	°C
T_{stg}	Storage temperature range	-55 to +125	°C

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS (All parameters are tested at $T_{amb} = 25^{\circ}\text{C}$)

Parameter	Test Conditions (see note 1)	Min.	Typ.	Max.	Unit
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DC CHARACTERISTICS

Supply	V_{DD}	Voltage Supply Voltage		2.4	3	5	V
	I_{DD}	Operating Supply Current	$V_{DD} = 2.4\text{V}$			1.8	mA
	I_{DDO}	Stand-by Supply Current	$V_{DDO} = 2.55\text{V}$			0.3	mA
Row and Column Inputs		Input Voltage Levels					
	V_{IH}	Logical "1"			80% of $(V_{DD}-V_{SS})$	$V_{DD} + 0.3$	V
	V_{IL}	Logical "0"			$V_{SS} - 0.3$	20% of $(V_{DD}-V_{SS})$	V
	C_{IN}	Input Capacitance Any Pin				7.5	pF
Oscillator	I_{IH}	High Level Input Current	$V_{DD} = 2.5\text{V}$ $V_{IN} = 2.5\text{V}$			1	μA
	I_{IL}	Low Level Input Current	$V_{DD} = 2.5\text{V}$ $V_{IL} = 0\text{V}$			1	μA
	I_{OH}	High Level Output	$V_{DD} = 2.5\text{V}$ $V_{OH} = 2\text{V}$	-100	-500		μA
	I_{OL}	Low Level Output Current	$V_{DD} = 2.5\text{V}$ $V_{OL} = 0.5\text{V}$	100	500		μA
Digit. Freq. Outp.	I_{OL}	Low Level Output Current (open drain output)	$V_{DD} = 2.5\text{V}$ $V_{OL} = 1\text{V}$	100			μA
Filter	V_O	Output DC Voltage Without Tones	$V_{DD} = 2.5\text{V}$			200	mV
	V_O	Output DC + AC Voltage With 2 Tones	$V_{DD} = 2.5\text{V}$ (see note 2) (see fig. 1)	0.63	0.84	1.05	V
Mute Output	I_{OH}	Output Drive Current	$V_{DD} = 2.5\text{V}$ $V_{OH} = 1.5\text{V}$	-100			μA
	I_{OL}	Output Sink Current	$V_{DD} = 2.5\text{V}$ $V_{OL} = 1\text{V}$	20			μA

AC CHARACTERISTICS

Oscillator	R_F	Feedback Oscillator Resistance		4	4.5		M Ω
	C_I	Input Capacitance to V_{DD}			9.5	10.5	pF
	C_O	Output Capacitance to V_{DD}			10.5	11.5	pF
Filter/Mixer	Z_{O1}	Output Dynamic Impedance with 2 tones	$V_{DD} = 2.5\text{V}$		10		K Ω
	Z_{O2}	Output Dynamic Impedance with 2 Tones	$V_{DD} = 2.5\text{V}$		2.5		K Ω
Tone characteristics	$\frac{\Delta F}{F}$	Max. Output Tone Deviation from standard R1 697Hz R2 770Hz R3 852Hz R4 941Hz C1 1209Hz C2 1336Hz C3 1477Hz C4 1633Hz	At crystal frequency $f = 4.433619\text{MHz}$			+0.5 -0.2 +0.5 -0.6 +0.6 -0.4 -0.3 +1.1	% % % % % % % %
	V_{LF}	Low Frequency Tones Amplitude at Filter Out	$V_{DD} = 2.5\text{V}$ (see note 3) (see fig. 2)	124		148	mVpp
	V_{HF}	High Frequency Tones Amplitude at Filter Out	$V_{DD} = 2.5\text{V}$ (see note 3) (see fig. 2)	157		187	mVpp

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ELECTRICAL CHARACTERISTICS (continued)

	Parameter	Test Conditions (see note 1)	Min.	Typ.	Max.	Unit
Tone characteristics	Pre-emphasis		1.25	2	2.75	dB
	Unwanted Frequency Components at $f = 3.4\text{KHz}$ at $f = 50\text{KHz}$				-33 -80	dBm dBm
	Total Harmonic Distortion for a Single Frequency	$V_{DD} = 2.5\text{V}$			5	%
	t_s Start-up Time	$V_{DD} = 2.5\text{V}$ (see fig. 4) (see fig. 5)		3	5	ms
	t_r Supply Voltage Rise Time	$V_{DD} = 2.5\text{V}$			250	ms

Note 1: This device has been designed to be connected to LS342 MF tone dialler line interface, from which it takes a $V_{DD} = 2.4\text{V}$ min. therefore many parameters are tested at this value.

Note 2: The value of DC output component at two different conditions of supply voltage, with two tones activated, can be related as follows:

$$V_{DC'} = V_{DC} \frac{V_{DD'}}{V_{DD}}$$

Note 3: The value of AC output components (V_{LF} , V_{HF}) at two different conditions of supply voltages can be related as follows:

$$V_{LF'} = V_{LF} \frac{V_{DD'}}{V_{DD}} \quad V_{HF'} = V_{HF} \frac{V_{DD'}}{V_{DD}}$$

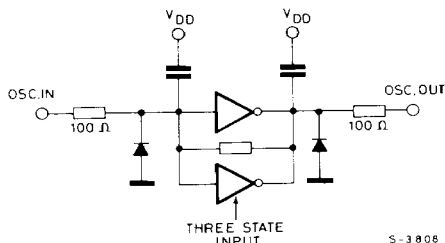
The values are measured with two tone at the output.

FUNCTIONAL DESCRIPTION

OSCILLATOR (OSC. IN — OSC. OUT)

The oscillator circuit has been designed to work with a 4.433619MHz crystal ensuring both fast start-up time and low current consumption. When V_{DD} is applied and a key is activated two inverters are paralleled (see fig. below) to decrease the total r_{ON} resistance. After oscillations have started one of the two

buffers is switched off and the current consumption is reduced to 2/3 of the initial value. Feedback resistance and load capacitances are integrated on the chip ensuring good temperature performance. When the device is supplied but no key is activated, the oscillator is in the stand-by mode to minimize power consumption.



FUNCTIONAL DESCRIPTION (continued)

KEYBOARD INPUTS

(C1, C2, C3, C4 – R1, R2, R3, R4)

Each keyboard input has an internal protection circuit; when a button is pressed, the oscillator starts and dynamic scanning of keyboard is realised.

This allows to the detection of which button has been pressed.

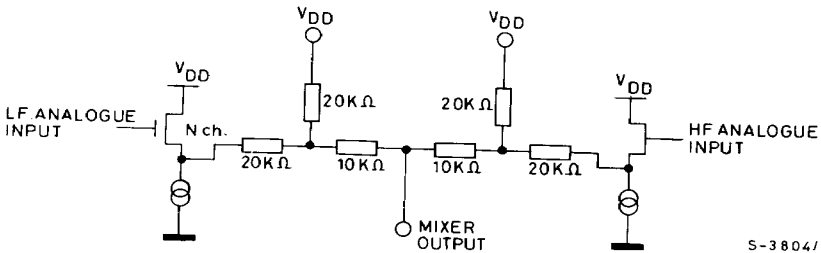
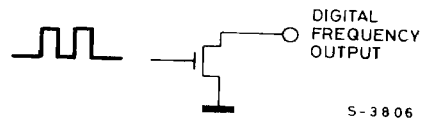
When two or more column or row inputs are activated no tone is generated.

DIGITAL FREQUENCY OUTPUT

This output is intended for testing only; when a single tone is activated, at this output is available a digital signal whose frequency is 16 times the selected output tone frequency. This output is an open collector N-channel transistor.

MIXER OUTPUT

The two reconstructed sine waves are buffered then mixed in a resistive array network that also restores the DC output level.

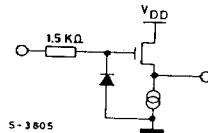


FILTER (Filter Input, Filter Output)

A unity gain amplifier is available to realize a two pole active filter (see fig. below). The output of this amplifier is held low until tones are valid, it then rises to about 0.85V at $V_{DD} = 2.5V$. Tones are superimposed on this DC.

The output DC component is very precise and stable to allow DC coupling with the LS342 DTMF line interface and LS156 speech circuit with MF interface.

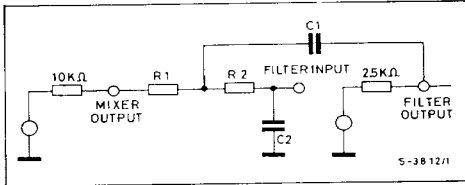
The output dynamic impedance of the filter is about $2.5K\Omega$.



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FUNCTIONAL DESCRIPTION (continued)

The following equivalent circuit should be applied during filter design:



It is evident that R1 and R2 should be kept high to avoid undue influence of Mixer and Filter output impedances.

The following values are suggested:

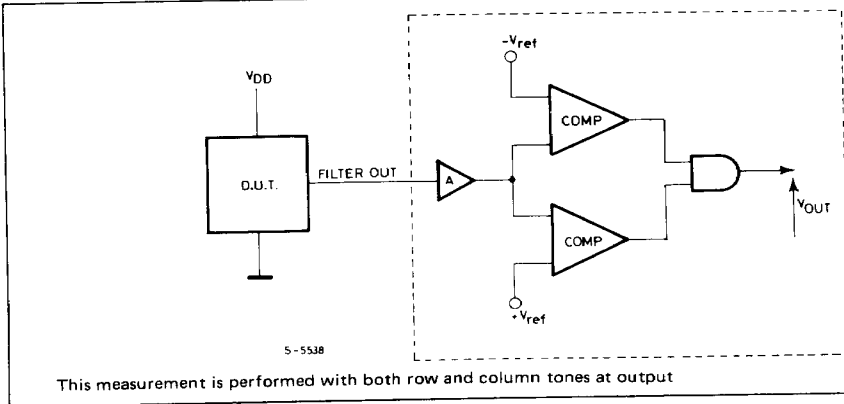
R1 = $430K\Omega \pm 2\%$
 R2 = $82K\Omega \pm 2\%$
 C1 = $820pF \pm 10\%$
 C2 = $120pF \pm 10\%$

MUTE OUTPUT

Mute output becomes active when a key is activated eliminating keyboard bounces and remains active for all the duration of tone transmission.

If the key is released before the oscillator produces the correct control signals, mute output is disabled.

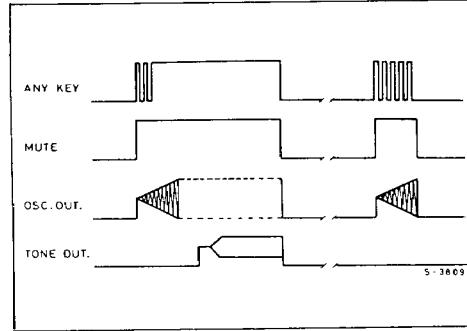
Fig. 1 — DC + AC out level measurement test set



SINGLE TONE PROCEDURE

This is accomplished through the following steps:

- 1) Activate simultaneously 1, A, D inputs applying logic 1'S. This implies the use of logic level sources. The single contact keyboard does not allow this procedure.
- 2) The device enters the "test mode" Now any single row or column frequency (or both) can be activated at out put applying logic "1" to correspondant input (inputs).
- 3) To get out from "test mode" reply 1, A, D activation (or though) power off power on.



FUNCTIONAL DESCRIPTION (continued)

Fig. 2 — Out tone level measurement test set

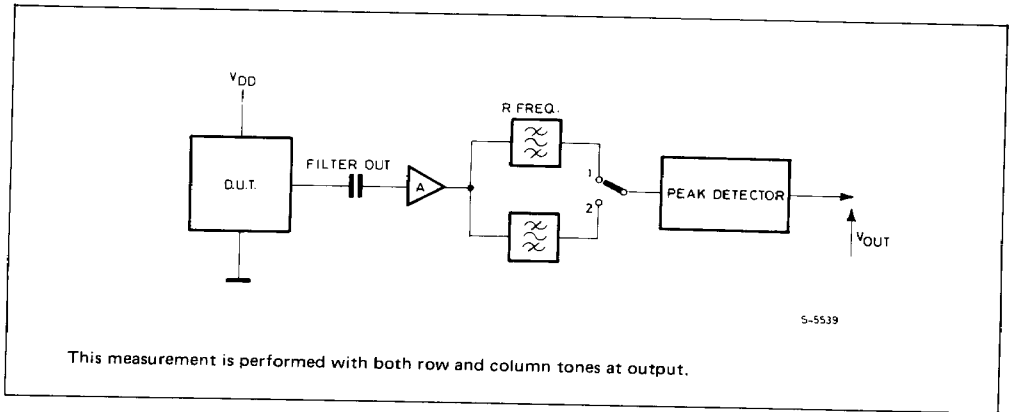
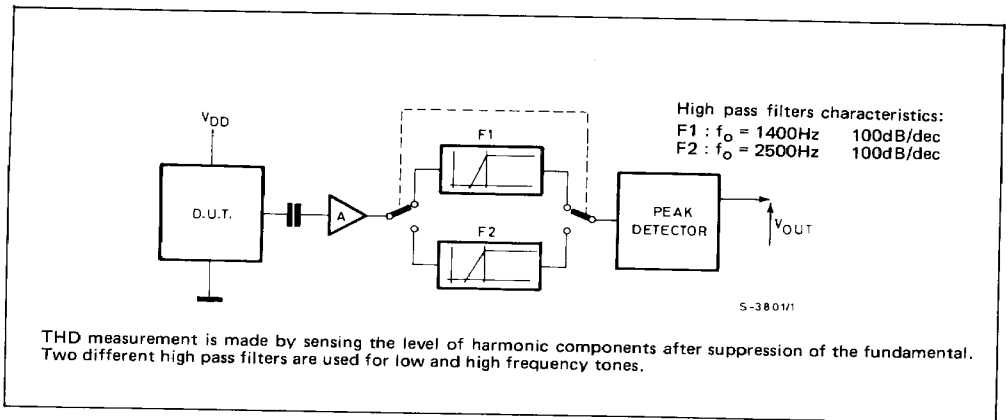


Fig. 3 — THD measurement test set



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FUNCTIONAL DESCRIPTION (continued)

Fig. 4 — Start-up time measurement test set

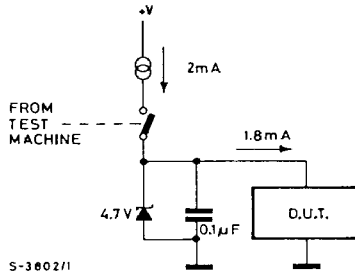
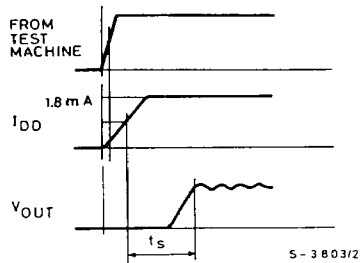
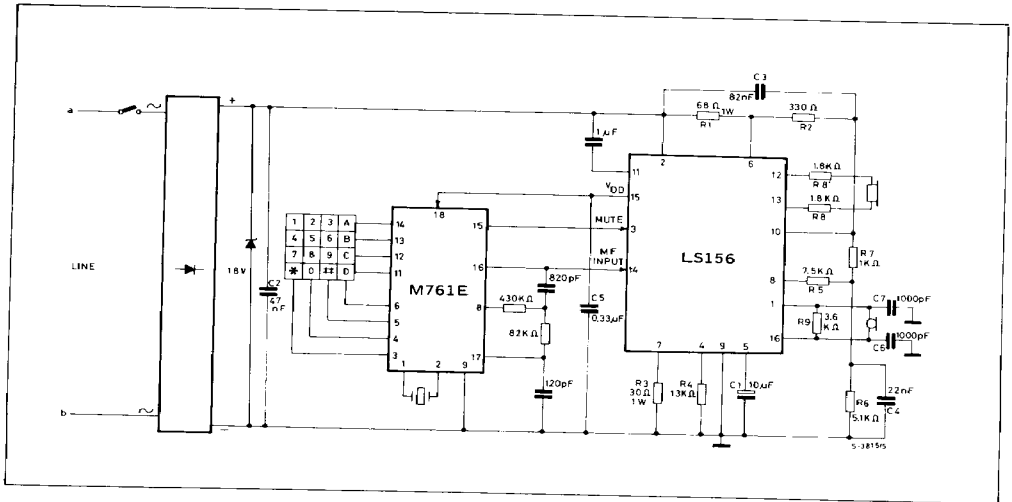


Fig. 5 — Start-up time definition



TYPICAL APPLICATIONS

M761E application circuit with electronic speech circuit



M761EA application circuit with LS342 line interface

