COS/MOS INTEGRATED CIRCUITS

M 761
M 761A

PRELIMINARY DATA

DUAL TONE MULTIFREQUENCY GENERATOR

- 2.5 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 MHz) WITH INTEGRATED FEEDBACK RESISTOR AND LOAD CAPACITORS
- LOW HARMONIC DISTORTION
- FIXED PRE-EMPHASIS ON HIGH-GROUP TONES
- FAST START-UP TIME
- LOW POWER CONSUMPTION IN STAND-BY MODE
- MUTE OUTPUT (M761 ONLY)
- ONE CONTACT PER KEY

The M761-M761A provides all the tone frequency pairs required for a DTMF Dialling System. Tones are obtained from an inexpensive TV crystal (f_o= 4.433619 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. Individual tones can be obtained by grounding a column input or connecting a row input to V_{DD}. If no key is selected the oscillator turns off and the linear parts are strobed to decrease the total power consumption.
A debounce output is available, for M761 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 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-ATES has also developed the LS342, DTMF line interface, which provides the stabilized supply for the M761-M761A from the telephone line and amplifies the output tones to the standardized levels.
The M761 can also be interfaced with LS156 speech circuit with MF interface avoiding the need of the common spring set.
The M761 utilizes low voltage COS/MOS technology and is available in 18 pin dual in-line plastic or ceramic package; the M761A is available in 16 pin dual in-line package.

ABSOLUTE MAXIMUM RATINGS*

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 +50	°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.

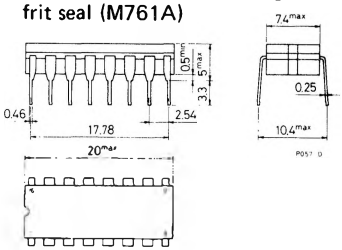
** All voltages are referred to V_{SS} pin voltage.

ORDERING NUMBERS: M761 B1, M761A B1 } for dual in-line plastic package

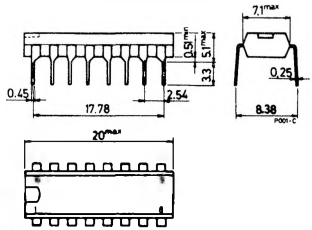
M761 F1, M761A F1 } for dual in-line ceramic package (frit seal)

MECHANICAL DATA (dimensions in mm)

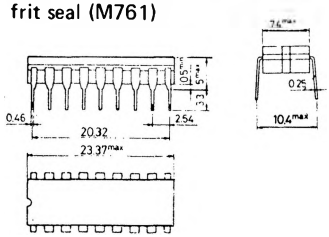
Dual in-line ceramic package frit seal (M761A)



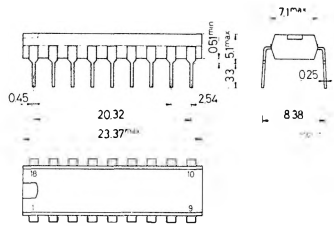
Dual in-line plastic package (M761A)



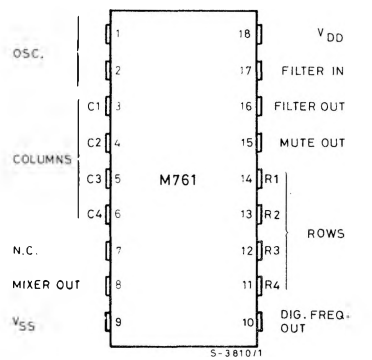
Dual in-line ceramic package frit seal (M761)

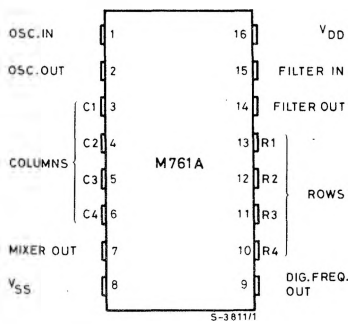


Dual in-line plastic package (M761)

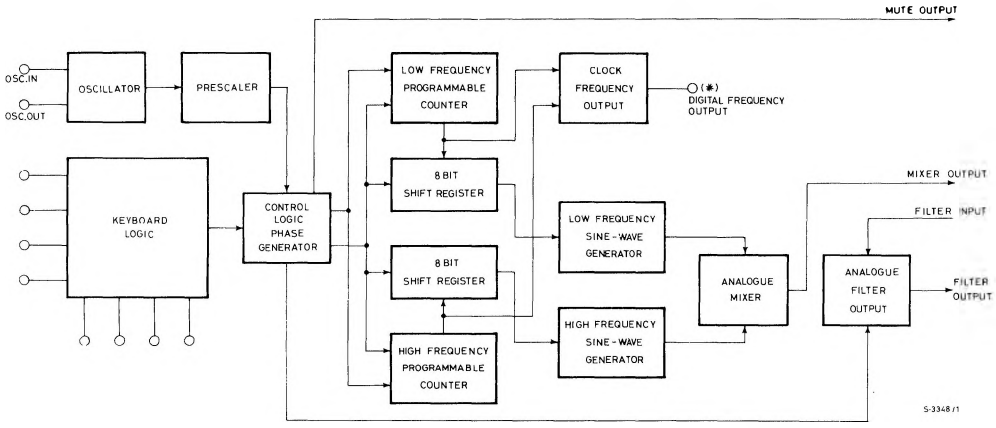


PIN CONNECTIONS





BLOCK DIAGRAM



(*) Not connected in M761A.

ELECTRICAL CHARACTERISTICS (All parameters are tested at T_{amb}= 25°C)

	Parameter		Test conditions (see note 1)		Min.	Typ.	Max.	Unit
DC CHARACTERISTICS								
Supply	V_{DD}	Voltage supply voltage			2.5	3	5	V
	I_{DD}	Operating supply current	V_{DD}= 2.5V				2	mA
	I_{DDO}	Stand-by supply current					0.5	mA
Row inputs	I_{IH}	High level input current	V_{DD}= 2.5V	V_{IH}= 2.5V		60	80	µA
	I_{IL}	Low level input current	V_{DD}= 2.5V	V_{IL}= 0V			1	µA
	V_{IH}	High level input threshold voltage			1			V
Column inputs	I_{IH}	High level input current	V_{DD}= 2.5V	V_{IN}= 2.5V			1	µA
	I_{IL}	Low level input current	V_{DD}= 2.5V	V_{IL}= 0V		-60	-80	µA
	V_{IL}	Low level input threshold voltage					V_{DD}-1V	V
Oscillator	I_{IH}	High level input current	V_{DD}= 3V	V_{IN}= 3V			1	µA
	I_{IL}	Low level input current	V_{DD}= 3V	V_{IL}= 0V			1	µA
	I_{OH}	High level output	V_{DD}= 2.5V	V_{OH}= 2V	-300	-500		µA
	I_{OL}	Low level output current	V_{DD}= 2.5V	V_{OL}= 0.5V	300	500		µA
Digit. freq. outp.	I_{OL}	Low level output current (open drain output)	V_{DD}= 3V	V_{OL}= 1V	200			µA
Filter	V_O	Output DC voltage without tones	V_{DD}= 2.5V				200	mV

ELECTRICAL CHARACTERISTICS (continued)

		Parameter	Test conditions (see note 1)	Min.	Typ.	Max.	Unit
Filter	V_O	Output DC voltage with 2 tones	V_{DD}= 2.5V (see note 2)	0.81	0.84	0.87	V
Mute outputs	I_{OH}	Output drive current	V_{DD}= 2.5V V_{OH}= 1.5V	-100			µA
	I_{OL}	Output sink current	V_{DD}= 2.5V V_{OL}= 1V	20			µA

AC CHARACTERISTICS

Oscillator	R_F	Feedback oscillator resistance		4	4.5		MΩ
	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}= 2.5V		10		kΩ
Filter Mixer	Z_{O2}	Output dynamic impedance with 2 tones	V_{DD}= 2.5V		2.5		kΩ
Tone characteristics	$\frac{\Delta F}{F}$	Max. output tone deviation from standard R_1 697 Hz R_2 770 Hz R_3 852 Hz R_4 941 Hz C_1 1209 Hz C_2 1336 Hz C_3 1477 Hz C_4 1633 Hz	At crystal frequency f = 4.433619 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}= 2.5V (see note 3)	150	175	200	mVpp
	V_{HF}	High frequency tones amplitude at filter out	V_{DD}= 2.5V (see note 3)	195	220	245	mVpp
		Pre-emphasis		1	2	3	dB
		Unwanted frequency components at f = 3.4 kHz at f = 50 kHz				 -33 -80	 dBm dBm
		Total harmonic distortion for a single frequency	V_{DD}= 2.5V			2	%
	t_s	Start up time	V_{DD}= 2.5V (see fig. 1) (see fig. 2)		3	5	ms
	t_r	Supply voltage rise time	V_{DD}= 2.5V			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}= 2.5V min. therefore many parameters are tested at this value.

Note 2: The value of DC output component at two different conditions of supply voltages, 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:

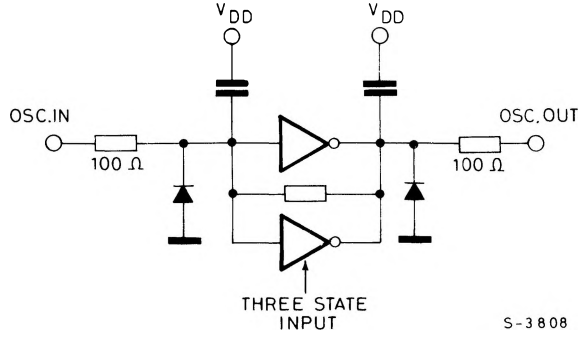
$$V_{LF'} = V_{LF} \frac{V_{DD'}}{V_{DD}} \qquad V_{HF'} = V_{HF} \frac{V_{DD'}}{V_{DD}}$$

The values are measured with one tone at the output.

FUNCTIONAL DESCRIPTION

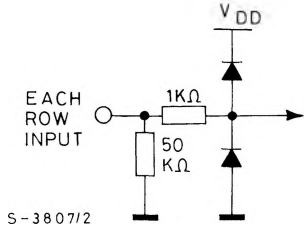
Oscillator (OSC. IN – OSC. OUT)

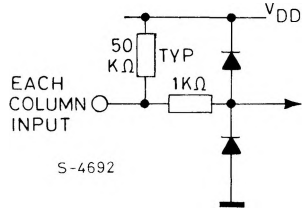
The oscillator circuit has been designed to work with a 4.433619 MHz crystal ensuring both fast start-up time and low current consumption.
When V_{DD} is applied and a key is activated two inverters are paralleled (see fig. below) to decrease the total r_{on} resistance.
After oscillations have started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



Keyboard inputs ($C_1, C_2, C_3, C_4 – R_1, R_2, R_3, R_4$)

Each keyboard input has an internal protection circuit; columns have pull-up resistances while rows have pull-down resistances.
If a column input is grounded the corresponding single tone is generated; the same applies when a row input is connected to V_{DD}. When a single column input is connected to a single row input a dual tone is generated.
When two or more column or row inputs are activated no tone is generated.

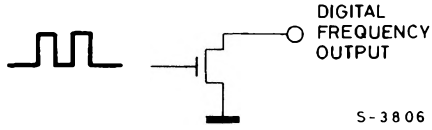




FUNCTIONAL DESCRIPTION (continued)

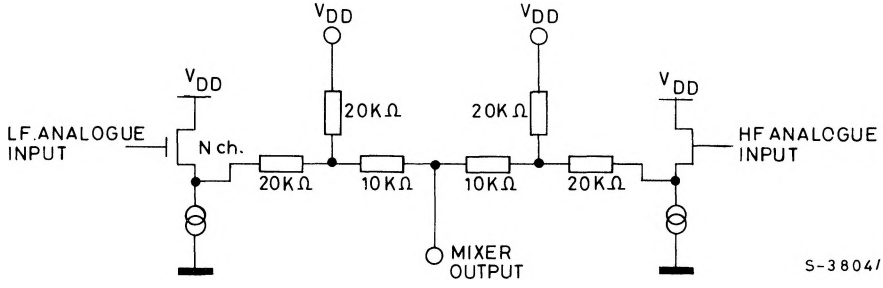
Digital frequency output

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.



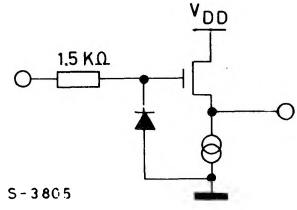
Mixer output

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



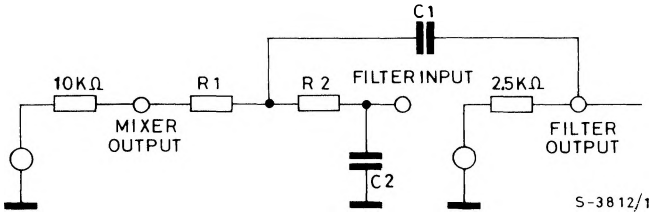
Filter (Filter input, filter output)

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 than 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 inteface and LS156 speech circuit with MF interface.



FUNCTIONAL DESCRIPTION (continued)

The output dynamic impedance of the filter is about 2.5 kΩ.
The following equivalent circuit should be applied during filter design:



It is evident that R_1 and R_2 should be kept high to avoid undue influence of Mixer and Filter output impedances.
The following values are suggested:

R_1= 430 kΩ ± 2% – R_2= 82 kΩ ± 2% – C_1= 820 pF ±10% – C_2= 120 pF ±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.

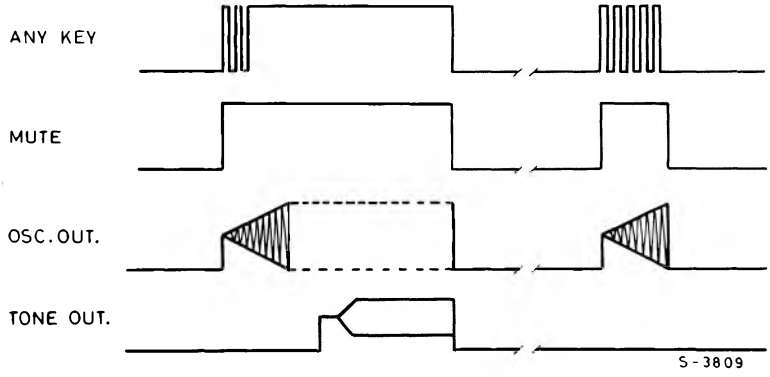


Fig. 1 - Start-up time measurement test set

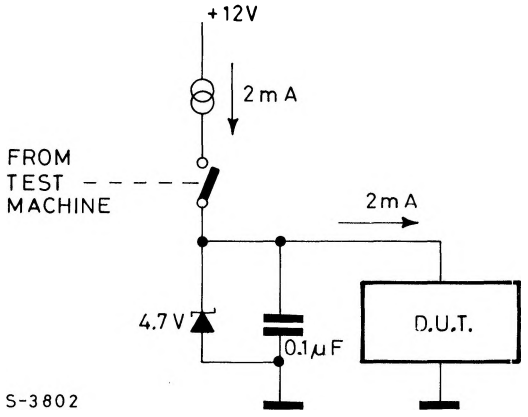
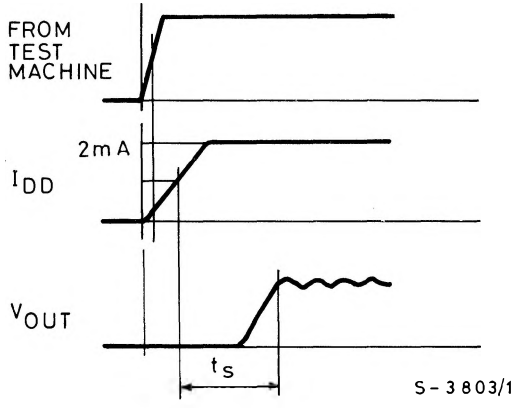
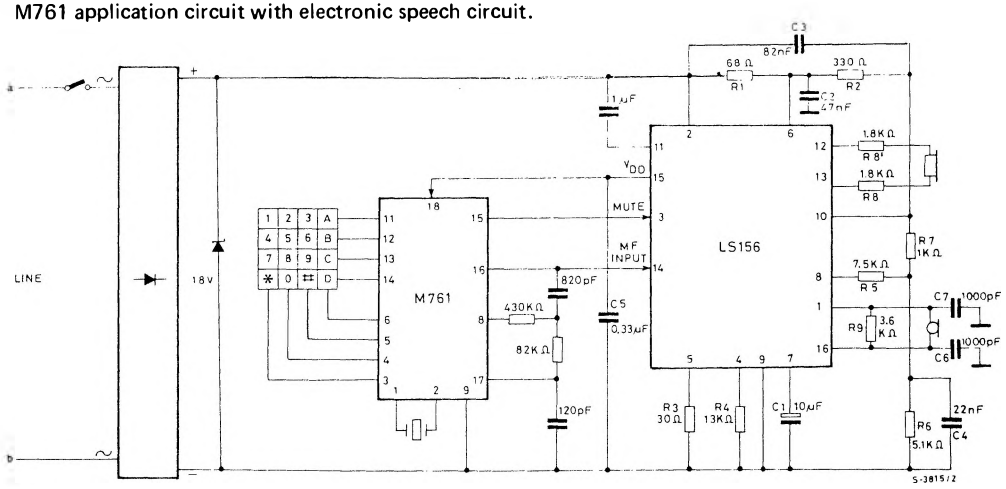


Fig. 2 - Start-up time definition



TYPICAL APPLICATIONS

M761 application circuit with electronic speech circuit.



M761A application circuit with LS342 line interface