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MK53721

TONE/PULSE WORLD DIALER WITH LNR

- TWO SELECT PINS ALLOW THE USER TO SELECT 16 DIFFERENT COUNTRY OPTIONS
- SINGLE CHIP MIXED MODE DIALER ALLOWS DIALING IN EITHER TONE OR PULSE MODES. A * OR "SOFTSWITCH" KEY INPUT CAN ALSO BE USED TO SWITCH FROM PULSE TO TONE MODE OPERATION AND IS STORED IN MEMORY
- 28 DIGIT STORAGE WITH LNR (last number redial)
- P.I.N. (personal identify number) PROTECTION METHOD
- SLIDING CURSOR METHOD TO SIMPLIFY PABX DIALING
- HOOKSWITCH DEBOUNCE, TRANSIENTS DUE TO LINE REVERSALS AND DROP-OUTS CAN BE MASKED FOR A PERIOD DETERMINED BY EXTERNAL RC
- POWERED FROM TELEPHONE LINE, LOW STANDBY CURRENT AND OPERATING VOLTAGE
- DTMF SIGNAL CONSISTENT WITH KEY ENTRY PERIOD
- MINIMUM DTMF SIGNAL DURATION/SEPARATION GUARANTEED
- TIMED PABX PAUSE MAY BE STORED IN MEMORY
- TIMED FLASH FOR EXTENDED TIMED BREAK RECALL

DIP20

ORDER CODE : MK53721N00

PIN CONNECTION

V_{DD}	1	20	PULSE OUT
MODE	2	19	HKS
$\overline{C1}$	3	18	$\overline{R1}$
$\overline{C2}$	4	17	$\overline{R2}$
$\overline{C3}$	5	16	$\overline{R3}$
V_{SS}	6	15	$\overline{R4}$
OSC1	7	14	MUTE OUT
OSC2	8	13	MASK OUT
$\overline{C4}$	9	12	DTMF OUT
SELA	10	11	SELB

DESCRIPTION

The MK53721 is a 20 pin CMOS mixed mode dialer IC. This dialer provides signalling for both TONE (DTMF) and PULSE (LD) modes of operation. All digits entered are stored in a 28-digit buffer and can be recalled with a single LNR (last number redial) command entry.

The MK53721 can be switched from PULSE to TONE mode operation through the keypad with a */# key input or softswitch (SS) key input. All key inputs following a softswitch command will generate DTMF signals.

KEYPAD CONFIGURATION

1	2	3	FLASH
4	5	6	SS
7	8	9	PAUSE
★	0	#	LNR

DESCRIPTION (continued)

Two select pins (SELA, SELB) have been provided which allow the part to be customized for various markets. Rather than selecting and modifying individual parameters which would take many pins or mask options each select pin will select groups of options which have been identified for particular markets.

The MK53721 features a Sliding Cursor, Auto-Pause insertion (on some options), manual Pause, and Flash. The DTMF tone output has a guarenteed minimum duty cycle and extends to match the duration of key inputs.

ABSOLUTE MAXIMUM RATINGS*

Parameter	Value	Unit
DC Supply Voltage	6.5	V
Operating Temperature	0 to 60	°C
Storage Temperature	− 55 to + 125	°C
Maximum Power Dissipation (25°C)	500	mW
Maximum Voltage on any Pin	(VDD) +.3, (VSS) −.3	V

DC ELECTRICAL CHARACTERISTICS(Ta = 25°C unless otherwise specified)

Symbol	Parameter	Value			Unit	Notes
		Min.	Typ.	Max.		
VDDT	DC Operating Voltage Tone Mode	2.5		6.0	V	
VDDP	DC Operating Voltage Pulse Mode	2.0		6.0	V	
VMR	Memory Retention Voltage	1.5	1.3		V	4,5
VMT	Mute Operation	1.8			V	
IDDP	Operating Current Pulse Mode		.800	1.2	mA	2
IDDT	Operating Current Tone Mode		.900	1.2	mA	2
ISS	Standby Current		0.4	1.0	µA	1
IMR	Memory Retention Current		0.2	0.8	µA	1,5
ISINK	Pulse/Mute/Mask Output Sink Current	1.0			mA	3
VOL	Output Low Voltage (ISINK = 1mAMP)			0.5	V	
KRU	Keyboard Pullup Resistance	50	100	200	kΩ	
KRD	Keyboard Pulldown Resistance	100	500	1000	Ω	
VIL	Input Level Low			.2VDD	V	
VIH	Input Level High	.8VDD			V	

Notes : 1. All inputs unloaded. Quiescent mode (oscillator off).
2. All outputs unloaded, single key input.
3. Vout = 0.4 Volts.
4. Memory retention voltage is the point where memory is guaranteed but circuit operation is not.
5. Proper memory retention is guaranteed if either the minimum Imr is provided or the minimum Vmr. Both are not needed simultaneously.

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AC ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise specified)

Symbol	Parameter	Value			Unit	Notes
		Min.	Typ.	Max.		
TNK	Tone Output no Key Down			– 80	dBm	6
TO	Tone Output (low group)	– 13 173	– 12 194	– 11 218	dBm mVrms	6, 7, 8
VPE	Pre-emphasis 20 log [VCOL/VROW]	2.0		2.75	dBm	
TDC	Tone DC Bias		1.6		V	
TLOAD	Tone Output Load			10	kΩ	
TRIS	Tone Output Rise Time		1.0		msec	9
TDIS	Tone Distortion		5.0	8.0	%	8

Notes : 6. 0 dBm equals 1 mWatt into 600Ω or 775mV. The MK53721 is designed to drive a 10kOhm load. The 600Ω load is only for reference.
   7. Single tone (low group), as measured at pin 12.
   8. Supply voltage from 2.5 to 6.0V. Rload = 10kOhms.
   9. Time from beginning of tone output waveform to 90% of final magnitude.

TIMING SPECIFICATIONS (TA = 25°C unless otherwise noted)

Symbol	Parameter	Value			Unit	Notes
		Min.	Typ.	Max.		
TKD	Keyboard Debounce Time		24		mSEC	
FKS	Keyboard Scan Frequency		250		Hz	
TPSD	Tone Presignal Delay			40	mSEC	
THFP	Hookflash Break Period				mSEC	
TISD	Tone Intersignal Delay				mSEC	10
TDUR	Tone Burst Duration		See table "A-Options"		mSEC	10
PPS	Pulses per Second (pulse rate)				PPS	10
PDP	Predigital Pause				mSEC	10
IDP	Interdigital				mSEC	10
TMO	Mute Overlap Pulse		TM		mSEC	10/11

Notes : 10. The values of these parameters are dependent upon the option selected by SELA and SELB pins, see option tables A and B for timing values.
   11. TM = Make Time ; 32 mS or 40 mS depending upon option selected.

PIN DESCRIPTIONS

Pin #	Pin Name	Description
1	VDD	Positive Supply
6	VSS	Negative Supply (ref for all voltages)
8	OSC1	Oscillator Input for 3.579545MHz Crystal
9	OSC2	Oscillator Output
2	MODE	Selects TONE or PULSE Default Operation
10	SELA	Select Option Group A1-A16 by Connecting this Pin to the Appropriate Row or Col
11	SELB	Selects Option Group B1-B8
19	HKS	Hookswitch Detect, Logic 1 = 'off-hook'
12	DTMF OUT	DTMF Output NPN Emitter Follower
13	MASK OUT	Mask Output for Pulse Mode Operation, Nch Open Drain,Active High
14	MUTE OUT	Mute Output for Tone Mode Operation, Nch Open Drain, Active High
20	PULSE OUT	PULSE Output for Precise Break Timing, Nch Open Drain, Active High
3	-COL1-	Column Keypad Connections
4	-COL2-	
5	-COL3-	
9	-COL4-	
18	-ROW4-	Row Keypad Connections
17	-ROW3-	
16	-ROW2-	
15	-ROW1-	

TIMING DIAGRAMS

Figure 1 : Tone Mode Timing.

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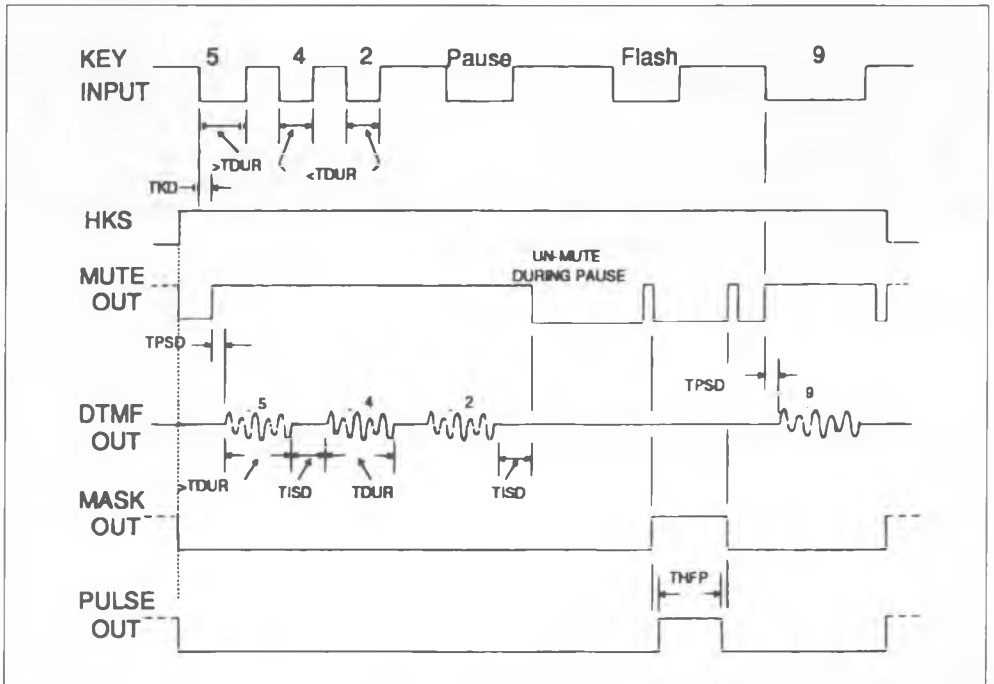
Figure 2 : Pulse Mode Timing.
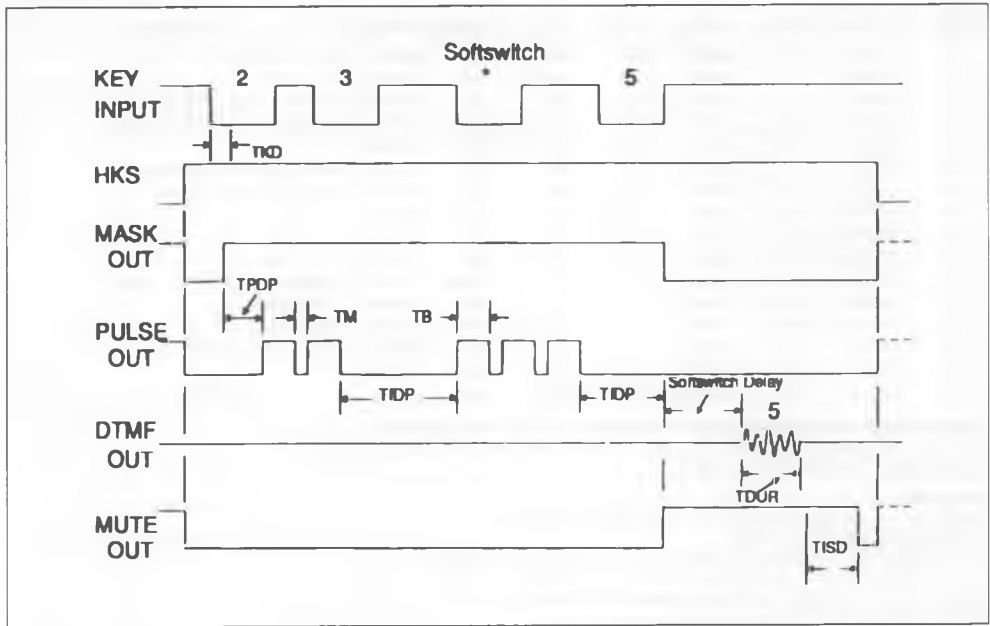
GENERAL DESCRIPTION

A-OPTIONS

The SELA pin is used to select groups of parameters and modify the operation of some of the special features. These groups are tailored for specific users. A major benefit of this approach simplifies the design of telephones for the international market. The option groups are selected by connecting the SELA pin (number 10) to one of the row or column pins for a total of eight possible choices. The Sel-B option pin further defines an additional group of A-options by connecting the Sel-B pin to either a column, for options A1-A8, or to a row, for options A9-A16. Options can only be changed while "on-hook".

Table 1 : A Options.

OPT	PIN	PPS	M/B	PDP	IDP	FLSH	TONE	Functions
A1	-ROW4-	10	40/60	840	840	100	80/80	API, SS★SS, FT = True
A2	-ROW3-	10	32/68	240	840	100	98/98	FT = True
A3	-ROW2-	10	32/68	240	840	300	80/80	SS★# = True, ★#PIN = True
A4	-ROW1-	10	32/68	240	840	100	80/80	SS★# = True, ★#PIN = True
A5	-COL1-	16	40/60	240	840	600	98/98	
A6	-COL2-	10	32/68	240	840	100	80/80	New Zealand Style Keypad
A7	-COL3-	10	40/60	240	540	100	80/80	Swedish Style Keypad
A8	-COL4-	10	40/60	240	840	600	80/80	
A9	-ROW4-	10	40/60	240	840	100	80/80	
A10	-ROW3-	20	32/68	240	840	100	98/98	FT = True
A11	-ROW2-	10	32/68	540	540	100	70/140	DM, SS★#, ★#PIN = True
A12	-ROW1-	10	32/68	240	540	300	80/80	DM = True
A13	-COL1-	10	32/68	240	840	100	80/80	API, FT = T
A14	-COL2-	10	40/60	240	840	300	98/98	Flash Option = F2
A15	-COL3-	10	40/60	840	840	100	80/80	
A16	-COL4-	20	40/60	240	540	600	80/80	

The default settings for any group, unless specified otherwise in the FUNCTIONS column is :
API = False, DM = False, SS*# = False, PIN = True, FT = False, Flash Option = F1, D*#P = False.
Sweden keypad = False, New Zeland = False.

DEFINITIONS
TONE xx/yy : xx = Tone duration (TDUR), yy = Tone intersignal delay (TISD)
API = autopause insertion (True, False)
DM = data mode, memory bypassed and part xmits tones as simple DTMF generator.
SS*# = transmit * or # key on input, even in pulse mode (True, False).
SS*SS = Softswitch sequence [bi-directional] required by Germany (True, False).
PIN = personal id number protection (True, False)
*#PIN = PIN protection is ignored if * or # is the first digit (True, False).
FT = flash can only be used in Tone mode (True, False)
F1 = flash option 1, keys following a flash will begin new sequence
F2 = flash option 2, keys following flash will be appended to current sequence and cannot be recalled.

The first group of A-Options are selected by B-options B1 through B4.

A1 : OPEN
A2 : UK
A3 : FRANCE (PUBLIC)
A4 : FRANCE (PRIVATE)
A5 : PANAMA/COLOMBIA (S. AMERICAN COUN-TRIES)
A6 : NEW ZEALAND
A7 : SWEDEN/SOME OF NORWAY
A8 : USA - 10PPS

The second group of A-Options are selected by B-options B5 through B8.

A9   : HOLLAND/DENMARK
A10 : BELGIUM
A11 : SPAIN
A12 : FRANCE (Data mode)
A13 : AUSTRALIA
A14 : ISRAEL
A15 : ITALY
A16 : USA - 20PPS

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B-OPTIONS

SELB pin is used to select a default pulse rate and also determine the fixed delay time used for the PAUSE command.

There are four alternatives to choose from. Options can be changed only when "on-hook".

Table 2 : B Options.

Option	Pin	A- OptionsGroup	Pause Duration(sec)
B1	-COL1-	A1-A8	IDP + 1.1 + IDP
B2	-COL2-		IDP + 3.1 + IDP
B3	-COL3-		IDP + 6.0 + IDP
B4	-COL4-		Indefinite
B5	-ROW1-	A9-A16	IDP + 1.1 + IDP
B6	-ROW2-		IDP + 3.1 + IDP
B7	-ROW3-		IDP + 6.0 + IDP
B8	-ROW4-		Indefinite

KEYBOARD INTERFACE

The MK53721 has eight keyboard interface pins which are to connected to a 4 x 4 keypad with FORM A (SPST) switches. A 2-of-8 keyboard with negative common may also be used.

The keyboard is disabled while "on-hook". Off-hook, the column and row keys assume opposite logical states. Keyboard scan is enabled when a valid input is detected. The scan frequency is 250Hz.

On hook, the keypad inputs are disabled eliminating possible current draw in this state. Off hook, the keypad inputs are enabled. A key entry, connecting a single column pin to a single row pin, is detected and the oscillator is activated. The keypad is scanned and debounced to verify the key input and the data is then stored into the LNR buffer (if storable).

HOOKSWITCH INPUT

The HKS INPUT (HOOKSWITCH) informs the MK53721 of the state of the telephone. A logic "1" (connected to VDD) indicates the telephone set is in the "off-hook" state and dialing is enabled. A logic "0" (connected to VSS) indicates the telephone set is "on-hook", dialing is disabled, and the chip will not draw extra current if keys are depressed. This ensures that only the memory retention current is required while on hook.

The HKS INPUT is level sensitive which simplifies the implementation of hookswitch debounce. Transients caused by interruptions in loop current during exchange operations will not cause inadvertant "on-hook" detection. The length of debounce is determined by the value of a the pullup resistor and capacitor connected externally. The suggested debounce periods range from 50msec to 500msec. A valid hookswitch transition will terminate signalling in progress and reset the dialing mode to the default mode determined by the MODE INPUT (pin 2). The HKS debounce time is determined by the following equation :

$$T(HSDB) = 0.75 \times REXT \times CEXT$$

EARTH LOOP RECALL (ELR OR GND KEY)

Earth loop recall is not generated by the MK53721 but can be detected by applying a logic "0" level directly to the hookswitch. The hookswitch debounce is bypassed by applying logic levels directly to the HKS pin (input not connected through external resistor). The ELR or GND KEY detect is identical to a hookswitch input without the debounce. Any digits dialed after ELR or GND key will reset the memory and be treated as a new number in the LNR buffer.

LAST NUMBER REDIAL

LNR (last number redial) command causes the contents of the LNR buffer to be dialed. Numbers which include a softswitch are limited by P.I.N. protection described below. LNR does not have to be the initial key input since the MK53721 features a "sliding cursor" dialing method.

The LNR buffer can store 28 digits but any number of digits may be dialed manually. The memory storage will wrap-around after the first 28 digits have been entered and the additional inputs will be stored beginning in the first memory location. After wrap-around has occured the LNR command will be disabled to prevent misdials.

FLASH

The FLASH command is stored in the LNR buffer and when signaled it initiates a timed break. This ti-

ming is determined by the options selected. Flash option F1 will reset the memory after a flash and additional inputs will begin a new number sequence. If this option is selected new digits will not be accepted until the FLASH is completed.

Flash option F2 will continue accepting inputs and storing these sequentially in the buffer. These digits cannot be redialed.

In both cases, signalling will revert to the default dialing mode determined by the MODE INPUT following the FLASH command execution and the FLASH itself is never redialed.

Mask out during Flash = Tpdp + Flash duration + Tidp.

Table 3 : Flash Key Options.

Mode	Key Input	Output	Description
T/P	1 2 3 F 4 5	1 2 3 F 4 5	Manual Dial, Flash Key
T/P	LND	4 5	Redial, Flash Option F1
T/P	LND	1 2 3	Redial, Flash Option F2
T/P	1 2 3 4 5	1 2 3 4 5	Normal Dial
T/P	F	F	Flash Dial
T/P	LND	1 2 3 4 5	Redial, Flash Option F1, F2
T/P	1 2 3 4 5 F	1 2 3	1 2 3 4 5
T/P	LND	1 2 3 4 5 F	Manual Dial, Flash Key Term

SLIDING CURSOR

The sliding cursor feature simplifies PABX access and redial. The MK53721 will compare all digits as they are entered to the previous memory contents.

If all digits entered equal the memory contents the LNR command can be activated at any point in the dialing sequence and the remaining data will be redialed. LNR is inhibited if there is a digit mismatch.

Table 4 : Sliding Cursor Operation.

Mode	Key Input	Output	Description
T/P	1 2 3 4 5	1 2 3 4 5	Normal Dial
T/P	LND	1 2 3 4 5	Redial
T/P	1 2 3 LND	1 2 3 4 5	Sliding Cursor
T/P	1 2 4 LND	1 2 4	Sliding Cursor, Invalid
T/P	12	1 2	Normal Dial
T/P	LNR	1 2	Redial of Last Number Dialed

SOFTSWITCH, P.I.N. PROTECTION

Softswitch feature allows the dialing mode of the dialer to be switched from Pulse Mode to Tone Mode operation with a key input. Two methods are available to accomplish this, first is the SS key and second is the * or # key while in Pulse mode.

The P.I.N. (PERSONAL IDENTIFY PROTECTION) feature of the MK53721 will protect numbers which

are likely to be used in confidential transactions. Digits entered after a * or # key in TONE mode, or "softswitch" command (either a * input or SS input while in PULSE mode) are considered private. These digits cannot be redialed and therefore the users privacy is not compromised. The exception to this is a * or # key at the beginning of a sequence, in this case redial of the entire sequence is allowed.

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Table 5 : Softswitch Operation.

Mode	Key Input	Output	Description
PULSE	1 2 3 ★ 4 5	1 2 3 <TDMF> 4 5	Softswitch, SS ★ # = False
PULSE	1 2 3 ★ 4 5	1 2 3 <TDMF>★ 4 5	Softswitch, SS ★ # = True
PULSE	1 2 3 SS 4 5	1 2 3 <TDMF> 4 5	Softswitch
PULSE	LNR	1 2 3	PIN = True
PULSE	★ 1 2 3 ★ 4 5	<TDMF> 1 2 3 ★ 4 5	Softswitch, SS ★ # = False
PULSE	LNR	<TDMF> 1 2 3	PIN invalid for ★ key first, SS★ # = False
PULSE	★ 1 2 3 ★ 4 5	<TDMF>★ 1 2 3 ★ 4 5	Softswitch, SS ★ # = True
PULSE	LNR	<TDMF>★ 1 2 3 ★ 4 5	PIN invalid for ★ key first, SS★ # = True
TONE	1 2 3 ★ 4 5	1 2 3 ★ 4 5	Manual Dial ★ Key
TONE	LNR	1 2 3	PIN =True
TONE	★ 1 2 3 ★ 4 5	★ 1 2 3 ★ 4 5	If firest key is ★ or # , then ★ , # is redialed
TONE	LNR	★ 1 2 3 ★ 4 5	SS★ # = True
TONE	LNR	★ 1 2 3	SS★ # = False

PAUSE

The PAUSE command is used to insert a fixed time delay into a number sequence. The dialer will delay a fixed time when redialing the number. The delay is programmable with the SELB option pin. If an indeterminate delay is selected the dialer will stop during redial at the point where the PAUSE function was entered. Auto-dialing is resumed by entering the PAUSE key.

An AUTO-PAUSE INSERTION (API) feature is also available as an option. The pause is inserted automatically into a number sequence if manual dialing is interrupted by a delay of more than one second following the signaling of the last digit entered if in tone mode operation. In Pulse mode operation, the delay will be inserted automatically if a manual digit has not been entered within an IDP time following the completion of the previous digit. Not more than two APIs' will be entered for each number sequence.

Table 6 : Pause Operation.

Mode	Key Input	Output	Description
T/P	1 2 3 _ 4 5	1 2 3 4 5	Manual Dial with Delay
T/P	LNR	1 2 3 _ 4 5	Redial, Pause Inserted if Autopause = True
T/P	1 2 3 P 4 5	1 2 3 P 4 5	Manual Dial, Pause Key Input
T/P	LNR	1 2 3 P 4 5	Redial, PAUSE <> Ind
T/P	LNR	1 2 3	Redial, PAUSE = Ind
T/P	PAUSE	4 5	Complete Redial

DATA MODE

The DATA MODE feature allows the MK53721 to be put into a mode where it operates just like a simple tone dialer, for entering long sequences of tones to a remote service without disturbing the LNR buffer. If the DM option is selected, all digits entered after a * or # key will be toned out with no minimum tone duration, and will not clear the LNR buffer regardless of how many digits are output.

Table 7 : Data Mode Option.

Mode	Key Input	Output	Description
T	1 2 3 ★ 4 5 ... N	1 2 3 ★ 4 5 ... N	Data Mode (DM) Active After ★ or #
T	LNR	1 2 3	Digits before DM are redialed.
T	★ 1 2 3 ★ 4 5 ... N	★ 1 2 3 ★ 4 5 ... N	DM activated on first ★ entry.
	LNR	★	Only ★ is redialed.
P	1 2 3 ★ 4 5 ... N	1 2 3 <T> ★ 4 5 ... N	Softswitch to DM on ★ or #, SS ★ # = True
P	1 2 3 ★ 4 5 ... N	1 2 3 <T> ★ 4 5 ... N	Softswitch to DM, SS ★ # = False
P	LNR	1 2 3	Digits before DM are redialed.
P	★ 1 2 3 ★ 4 5 ... N	<T> 1 2 3 ★ 4 5 ... N	SS ★# = False
P	LNR	<T>	SS ★ # = False, softswitches but nothing redialed.
P	★ 1 2 3 ★ 4 5 ... N	<T> ★ 1 2 3 ★ 4 5 ... N	SS ★ # = True
P	LNR	<T> ★	SS ★ # = True

DTMF OPERATION

The DTMF OUTPUT is driven by a bipolar (NPN) emitter follower with the collector tied to VDD. The DTMF OUT signal is a summation of the keyboard selected High group (column) and Low group (row) tones. The amplitude of these tones is determined internal to the chip and is independent of supply.

The tones are synthesized using a resistor tree with sinusoidally weighted taps. The frequency and accuracy of the synthesized tones is listed in the table 8. Note, variations in the oscillator frequency (using the 3.579545MHz crystal) will be reflected in the frequency of the synthesized tones.

Single tone may be generated when using options A8 or A16, by symultaneously pressing two buttons in the same row or column.

Table 8 : DTMF Output Frequencies.

Key Input	Standard Frequency	Actual Frequency	% Deviation from Standard
-ROW1-	697	699.1	+ 0.31
-ROW2-	770	766.2	− 0.49
-ROW3-	852	847.4	− 0.54
-ROW4-	941	948.0	+ 0.74
-COL1-	1209	1215.9	+ 0.57
-COL2-	1336	1331.7	− 0.32
-COL3-	1477	1471.9	− 0.35

PULSE OPERATION

In Pulse operation the MK53721 converts keypad inputs into a series of pulses to simulate a rotary dialer. The Pulse Output becomes active following the debounce period and a short predigital pause period. A Mask Output is provided to remove the speech network form the line or to attenuate the current spikes which reach the receiver when Pulse dialing. The Mask output goes active a predigital pause prior to the first break and remains active until an IDP period following the output of the last digit from the buffer. The nominal pulse output rate is 10pps although this is selectable by the Select Option pins.

In pulse mode operation the number of pulses associated with each key can be modified to meet standards of nations such as Sweden, some of Norway, and New Zealand. These options are available through the SELA and SELB input pins.

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Table 9 : Pulse Output Options.

Normal		Sweden		New Zealand	
0 . . .	10 Pulses	0 . . .	1 Pulse	0 . . .	10 Pulses
1 . . .	1 Pulse	1 . . .	2 Pulses	1 . . .	9 Pulse
2 . . .	2 Pulses	2 . . .	3 Pulses	2 . . .	8 Pulses
3 . . .	3 Pulses	3 . . .	4 Pulses	3 . . .	7 Pulses
4 . . .	4 Pulses	4 . . .	5 Pulses	4 . . .	6 Pulses
5 . . .	5 Pulses	5 . . .	6 Pulses	5 . . .	5 Pulses
6 . . .	6 Pulses	6 . . .	7 Pulses	6 . . .	4 Pulses
7 . . .	7 Pulses	7 . . .	8 Pulses	7 . . .	3 Pulses
8 . . .	8 Pulses	8 . . .	9 Pulses	8 . . .	2 Pulses
9 . . .	9 Pulses	9 . . .	10 Pulses	9 . . .	1 Pulses
★ . . .	Softswitch	★ . . .	Softswitch	★ . . .	Softswitch
# . . .	Ignored	# . . .	Ignored	# . . .	Ignored

TYPICAL APPLICATIONS

The MK53721 is a single chip Tone Pulse World Dialer with 28-digit last number redial, which provides the necessary signals for DTMF (tone) or loop disconnect (pulse) dialing. The typical application circuit shown in figure 3 illustrates one way the MK53721 Tone Pulse dialer can be used with an integrated speech circuit to produce a multi-standard telephone. The circuit is connected to the telephone line through a polarity guard integrated circuit that assures proper voltage polarity to the circuit, regardless of telephone line polarity, as well as limiting the voltage at the polarized side. The 2-to-4 wire conversion, muting of the transmitter and receiver, and provision of regulated supply voltage to the MK53721 is accomplished using an SGS-THOMSON L3280 integrated speech circuit. The L3280 also takes the MK53721 DTMF output and modulates the line with that signal. Because of the various World Dialer timing options selectable with the MK53721, the application can be easily adapted to meet the standards of almost any country.

In this circuit, Pulse dialing (which consists of a series of momentary interruptions of loop current) is achieved by the Pulse output of the MK53721 controlling transistor Q1,Q2 and Q5 to break and make the loop current through the speech network. The MK53721 MASK output provides the logic level to the L3280 MUTE input to cause muting of the loud pops which would otherwise be heard at the receiver due to the pulsing of the loop current through the speech network.

Tone signalling requires that the loop current be modulated with the appropriate DTMF signal. The DTMF output of the MK53721 is coupled to the DTMF driver circuitry of the L3280 via a filter network comprised of C8, C9, R12, R13 and Q3. The jumper J1 allows the user to select whether or not to use the filter network required to meet some country specifications. The MK53721 MUTE output provides the logic level to the L3280 MUTE input to mute the transmitter and reduce to an acceptable level the tone heard at the receiver.

The mode of operation (Tone or Pulse) is controlled by switch S1. In Pulse Mode, the Softswitch key (SS or * key) can be used to change from Pulse to Tone Mode. Going on-hook and back off-hook will cause the MK53721 to revert to the mode selected by the S1, but the Softswitch function can be redialed. The signalling mode may be changed at any time, so as to allow mixed Pulse and Tone dialing.

The current required for long term memory retention with the MK53721 is typically 0.3uA. A battery is therefore not required if a resistor is used to provide the small amount of memory retention from the line when on-hook.

Figure 3 : MK53721 Typical Application.