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MA5883

20 MEMORY LD/DTMF SWITCHABLE DIALLER CHIP

The MA5883 is a keypad switchable LD/DTMF dialler device with Last Number Redial facility and 20, 24-digit memories, 10 accessible via dedicated keys.

Three operating modes are available: LD mode, with the ability to temporarily switch to DTMF mode from the keypad during a call, LD only mode and DTMF mode. The former mode enables users to access services such as home banking. Mixed LD and DTMF numbers can also be stored in memory.

The MA5883 is pin compatible with the MA5413, MA5453 and MA5473 LD/DTMF switchable diallers.

Metal mask and pin selectable options are available to service the specific technical requirements of particular countries and for customers preferred features and circuit configurations.

FEATURES

- Selectable Loop-Disconnect or DTMF dialling modes
- Keypad switchable LD to DTMF
- 24 digit Last Number Redial
- 20 x 24 digit Memories (10 dedicated keys)
- Selectable Break/Make Ratios 2:1 and 3:2
- Uses inexpensive 560 kHz ceramic resonator
- Battery-less operation: Low Power CMOS
- PIN (Personal Identification Number) confidentiality feature
- Timed Break Recall (Flash) and Earth Recall

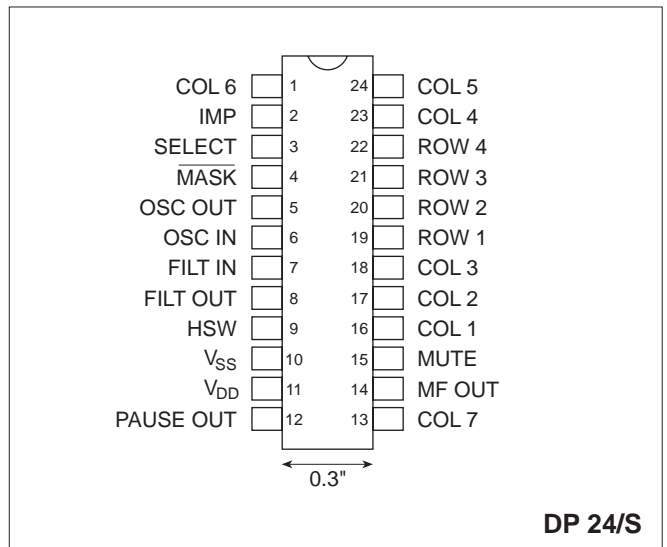


Figure 1. Pin connections - top view

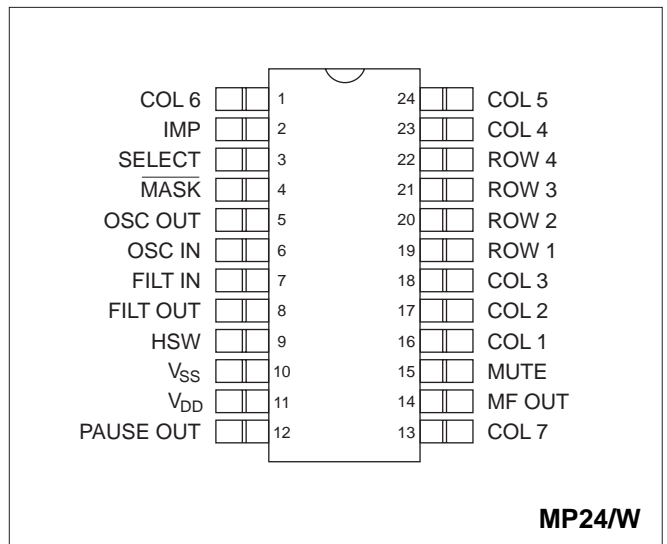


Figure 2. Pin connections - top view

PIN FUNCTIONS

Pin number (Figure 1)	Pin name	Function
2 3 4	IMP SELECT MASK	'Loop disconnect' dialling output LD/DTMF selection, IDP and B/M ratio programming Output to disable speech circuit during pulse dialling and recall (see note 1)
5 6	OSC OUT OSC IN	Connections for 560kHz ceramic resonator
7 8	FILT IN FILT OUT	Unity gain amplifier input and output for DTMF tone filtering
9 10 11 12 14 15	HSW V _{SS} V _{DD} PAUSE OUT MF OUT MUTE	Hookswitch input - a logic 1 at this pin is used to indicate 'Off-Hook' Negative supply Positive supply Active high output indicating a pause when dialling from memory Unfiltered DTMF output Output active during keying and tone transmission (see note 2)
16 17 18 23 24 1 13 19 20 21 22	COL1 COL2 COL3 COL4 COL5 COL6 COL7 ROW1 ROW2 ROW3 ROW4	Connections for 28 key single contact keypad

Table 1. Pin functions

NOTES:

1. The MASK output may be used to disconnect the whole speech circuit in order to maintain the break condition whilst on-hook, during a TBR (Timed Flash) operation or for LD dialling.
2. The MUTE output is provided to disable the microphone while maintaining the loop condition during DTMF transmission.

OPERATION

Power-On

When power is applied to the chip, a power-on reset circuit operates and ensures that the stores are cleared and all logic is reset. On power-up the dialling mode is set to LD until a key is pressed. The power-on reset circuit is designed such that if the chip supply voltage drops to a level at which the stores may be corrupted, it will always, under all conditions, clear the stores when power is restored, so that corrupt data is not retained.

Hookswitch Operation

The HSW input is used to inform the MA5883 of whether the telephone is on or off hook. Logic '0' is recognised as on-hook, Logic '1' is recognised as off-hook. When the HSW input rises from '0' to '1' the off-hook state is recognised immediately and keypad inputs are accepted. However, when the HSW input falls from '1' to '0' the on-hook state is not recognised for 200-300ms. This is so that short line breaks of less than 200ms, such as line reversals applied by the exchange, are

ignored. In this case the MASK and IMP outputs will go low immediately the HSW input goes low in order to conserve current, but will resume normal operation immediately HSW goes high.

On-hook state

In the on-hook state all chip outputs are set low, the oscillator circuit is inhibited and no key inputs are accepted. This conserves supply current so that the memory contents may be retained.

Off-hook state

When the HSW input goes high, the MASK output immediately goes to the logic '1' level and remains there until dialling starts, a TBR (Flash) occurs or the HSW input goes low (see Figs 5 and 6). COLUMN outputs also go high until a key is pressed. The oscillator circuit remains inactive until a key is pressed, and is normally off whenever timing functions are not required.

Keypad Operation

A single contact, normally open keypad is required. When off-hook the COLUMN outputs are normally held high and the ROW inputs are low. When a key is pressed this connects a COLUMN output to a ROW input and the ROW input is pulled high.

This action initiates keyboard scanning. During keyboard scanning, the COLUMN outputs are normally low but generate scanning pulses at 7ms intervals on each output in sequence. A Key is accepted as valid when two successive scanning pulses from the same COLUMN are seen on a ROW input. Hence, the minimum bounce-free key closure period which is necessary to guarantee detection is 14ms (plus the oscillator start up time if it was not already running).

Simultaneous Key Depressions

If two keys are pressed simultaneously (i.e. a second key is pressed before the first has been verified) neither key will be accepted until both keys are released and the correct key is pressed again.

Keypad Layout and Connections

	COL1	COL2	COL3	COL4	COL5	COL6	COL7
ROW1	1	2	3	TBR	S1	S2	S3
ROW2	4	5	6	REDIAL	S4	S5	S6
ROW3	7	8	9	STORE	S7	S8	S9
ROW4	*	0	#	PAUSE/ CONT		S0	LNR

Table 2.

* and # are used to change from LD to DTMF dialling and are available as digits when in DTMF mode.

TBR	Timed Break Recall (Flash)
LNR	Last Number Redial
STORE	Memory Programming
PAUSE/CONT	Insert pause in memory/continue dialling
S0 - S9	10 dedicated memory keys
REDIAL	For dialling the 10 memories not covered by dedicated keys. Can also be used for Last Number Redial.

Dialling Mode Selection

SELECT pin to:	Dialling mode	IDP (ms)	B/M Ratio
V _{SS}	LD + DTMF	800	2:1
COL1	LD + DTMF	500	2:1
COL2	LD + DTMF	500	3:2
COL3	LD + DTMF	800	3:2
COL4	LD ONLY	800	2:1
COL5	LD ONLY	500	2:1
COL6	LD ONLY	500	3:2
COL7	LD ONLY	800	3:2
V _{DD}	DTMF	-	-

Table 3. Dialling mode selection

The dialling mode may be selected via the SELECT pin (pin 3) as detailed in table 3. Four 'Loop-Disconnect + DTMF' options and four 'Loop-Disconnect only' options with different Inter-digit pauses and Make/Break ratios are available and one DTMF mode.

If one of the 'LD only' modes or the DTMF mode is selected, then dialling will remain fixed in LD mode or DTMF mode respectively. However, if one of the 'LD + DTMF' modes is selected, the chip will be in LD mode initially in the off-hook condition but may be switched to DTMF by pressing the ★/# key provided that dialling is not in progress. If either of these keys are pressed during LD dialling they will be ignored.

Only if * or # are pressed subsequent to switching to DTMF, will * or # be dialled. Only digits entered prior to a switch to DTMF will subsequently be available for redialling (see Last Number Redial operation).

Once switched to DTMF, dialling will remain in this mode until either a Recall (Flash) operation or until the chip returns to the on-hook state.

Last Number Redial

The function of the on-chip LNR store is to automatically retain a manually dialled number for redialling later. The capacity of the store is 24 digits. If a number is dialled which is longer than this, redialling will not be allowed with this number. To redial a number in the LNR store, either press the LNR key once or the REDIAL key twice.

The last number redial store has several features designed to assist the user:

Moving Cursor Facility

This allows a user to enter the first digit or digits of the number in the last number redial store manually before pressing the LNR key. In this case, the remainder of the number will be dialled when the LNR key is pressed.

If the digit(s) dialled manually do not match those in the LNR store, then redialling will be inhibited for the remainder of the call, and the numbers entered will be saved in the LNR store for redialling in a subsequent call.

If the user manually dials the first digit(s) in the LNR store, and then goes on-hook, the whole contents of the store will be retained.

This facility is provided to aid use in PABX applications, where the user must first dial an access digit, or digits, and then wait for a second dial tone before continuing dialling.

Mixed Mode Calls

In the case of a call which starts in LD mode and is switched by the user (via the ★/# key) to DTMF mode, only the digits dialled in LD mode will be retained. This feature is provided to ensure security of PIN (Personal Identification Number) codes. Providing that the number of digits dialled in LD mode does not exceed 24, they will be retained regardless of the number of DTMF digits entered subsequently.

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DTMF Calls

If a call contains the digits ★ or #, only those digits dialled prior to the first press of either ★ or # will be retained in the LNR store. This feature also ensures security for PIN codes whilst allowing exchange facility codes (for example) to be retained.

Memory Dialling

The MA5883 provides 20 memories, each of which has a capacity of 24 digits. There are 10 dedicated memory keys and a REDIAL key which allows the other 10 memories to be dialled. The memories can store pauses and digits to be dialled in LD, DTMF or mixed modes.

Programming Memories

The MA5883 must be “off-hook” and idle:

1. Press the STORE key.
2. Press key S0-S9 or REDIAL + digit 0-9 indicating the memory to be programmed.
3. Enter digits to be stored (no digits will be dialled whilst programming).
4. To finish programming the memory either press the STORE key again or go “on-hook”.
5. Repeat to programme other memories.

If more than 24 digits are entered while programming a memory, then the memory will be cleared until re-programmed. If any “non-valid” keys are pressed during programming (e.g. LNR, TBR) they will be ignored.

Mixed Mode Numbers and Pauses in Memory

Mixed mode (i.e. LD + DTMF numbers are easily programmed into memory. The SELECT pin must be set to one of the ‘LD + DTMF’ modes (as it would be when dialling a mixed mode number), then the store is programmed using the same procedure as above. The first press of */# will be stored as a ‘change to DTMF’ and this will cause all subsequent digits to be sent in DTMF when redialling from memory.

Similarly pauses can be stored in memory by pressing the PAUSE key in the appropriate position when programming.

When redialling from memory, both pauses and LD to DTMF changeovers will cause dialling to halt temporarily until the user presses either the PAUSE/CONT key or the REDIAL key. The exception to this rule is when an LD to DTMF changeover is stored in the first memory location: In this case, DTMF dialling will occur immediately when memory dialling is invoked - this allows DTMF codes to be easily stored and sent, even in a telephone where the normal dialling mode is LD.

It should be noted that a pause or an LD to DTMF changeover each require one memory location.

Dialling from Memories

The MA5883 must be “off-hook” and idle:

1. Press the appropriate memory key S0-S9 or REDIAL + digit 0-9. Dialling will now start.
2. If dialling halts due to a pause or an LD to DTMF changeover in the memory, the PAUSE OUT pin will go high (logic ‘1’). Further dialling can be resumed either by pressing the PAUSE/CONT key, or, alternatively the COLUMN 4 pin can be pulled low (for a minimum of 14ms) to achieve the same

result, thus allowing an external timer circuit to be used. The PAUSE OUT output is reset when dialling resumes.

All Keypad positions are disabled whilst memory dialling is in progress.

Timed Break & Earth Loop Recall (Flash)

The MA5883 supports both TBR and ELR and offers a common operating protocol in both cases.

After a recall (Flash) operation, the dialling mode selected via the SELECT pin will be restored. Also, only the digits dialled after the ELR/TBR operation will be retained in the LNR store.

A TBR (Flash) of 100ms(1) is generated when the TBR key is pressed. The MASK output goes low in order to produce the line break. When in DTMF mode, the MF OUT output also goes low for the duration of the break.

ELR is supported via the COLUMN 3 pin. If this pin is connected to ground for a minimum of 20ms during an ELR operation, the chip will offer the same operating protocol as for TBR.

This may be achieved by use of the circuit shown below in figure 3, or by use of a double contact switch.

Grounding COLUMN 3 will not directly affect the chip outputs. However, in order to prevent misoperation, the HSW timeout will be disabled during ELR. This is so that the MA5883 cannot go into the on-hook state if the HSW input goes low as a result of ELR signalling (i.e. whilst the telephone is, in reality, still Off-hook). The MASK and IMP outputs will respond as normal to the status of the HSW input.

(1)Other TBR (Flash) periods are available as mask options (see page 7).

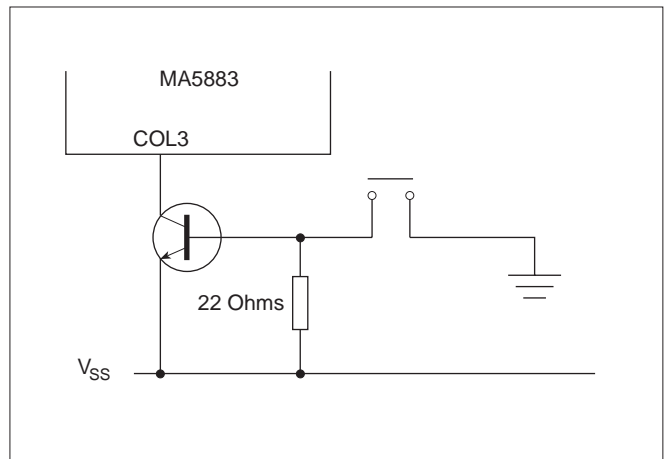


Figure 3. Earth loop recall

Tone Filtering

The spectral purity of the DTMF output is sufficient for most applications. However, where lower distortion DTMF tones are required, an on-chip darlington pair is provided (accessible via pins 7 & 8) for use in a low pass active filter.

Figure 4, below, shows how a 2-pole Sallen and Key filter can be implemented. The typical component values have been chosen to give a second order Butterworth response with a cut-off frequency of about 3.5kHz and a nominal pass-band insertion loss of 0.5dB.

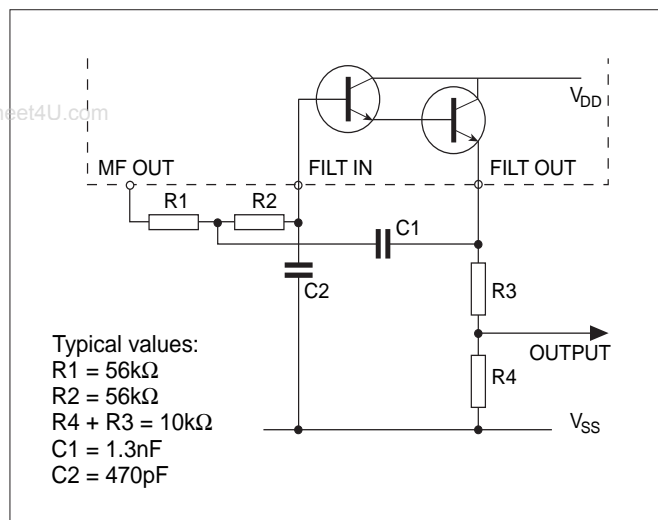


Figure 4. DTMF tone filtering

Oscillator Circuit

This requires an external 560kHz ceramic resonator connected between OSC IN and OSC OUT to provide a timing reference for all chip functions. No other components are required or should be used.

The oscillator circuit is of the 'single pin' type. Internally, the OSC IN pin is connected to VSS and therefore the resonator may alternatively be connected externally between OSC OUT and VSS if desired.

Please consult your resonator supplier who will recommend a suitable resonator type.

DTMF Dialling

During DTMF dialling the MUTE output goes to logic '1' and remains there for the duration of the tone transmission. The IMP output remains low during tone transmission. The MF OUT output rises to its d.c. level of 0.9 VDD at the start of the tone transmission and is kept there between tone bursts. This is to avoid transients at the beginning and end of tone bursts.

The maximum rate at which tones are sent to line is 100ms on, followed by 100ms off. If keys are activated faster than this they are placed in a temporary store and then sent to line at the maximum rate. Dialling from the LNR store occurs at the maximum rate.

If a key is held down for longer than 100ms, the tone output will continue until the key is released.

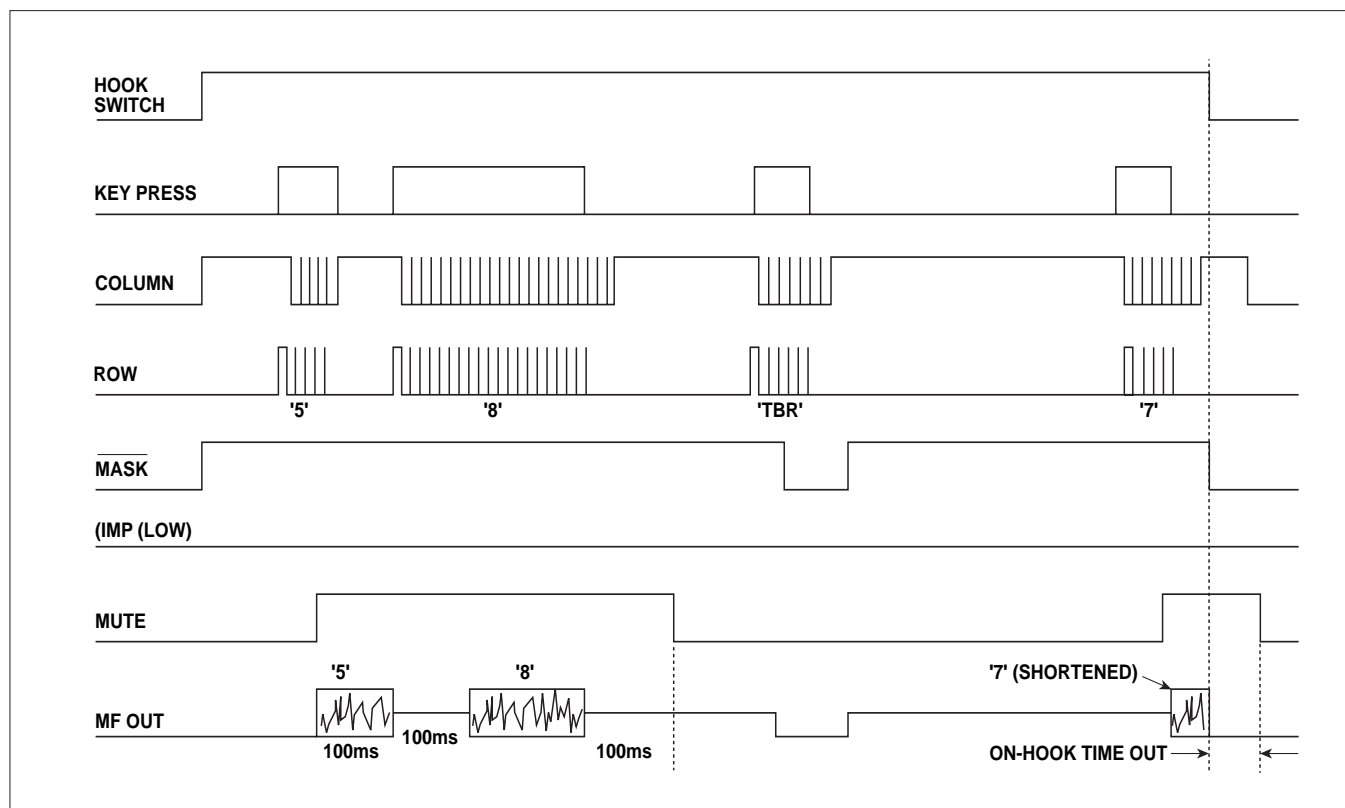


Figure 5. DTMF mode timing diagram

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DTMF Dialling - Tone Frequencies

Keypad	R1	R2	R3	R4	C1	C2	C3
Nominal frequency (Hz)	697	770	852	941	1209	1336	1477
Deviation from nominal (%)	-0.07	-0.10	+0.19	-0.15	-0.17	-0.20	-0.22

NOTE: There will be an additional frequency error caused by any deviation of the resonator frequency from the nominal 560kHz.

Table 4 Tone frequencies

Loop-Disconnect Dialling

The MASK output is provided in order to disable the speech circuit during LD dialling. Consequently, the MASK output is normally at logic '1' in the off-hook condition, but changes to logic '0' during LD dialling. MASK also changes to logic '0' in order to signal a Timed Break Recall (Flash) to the line.

Both MUTE and MF OUT remain low during LD Dialling. LD Dialling is signalled on the IMP output: a break is signalled by a logic '0', make periods and IDP times are signalled by a logic '1'. When not dialling, the IMP output sits at logic '0'.

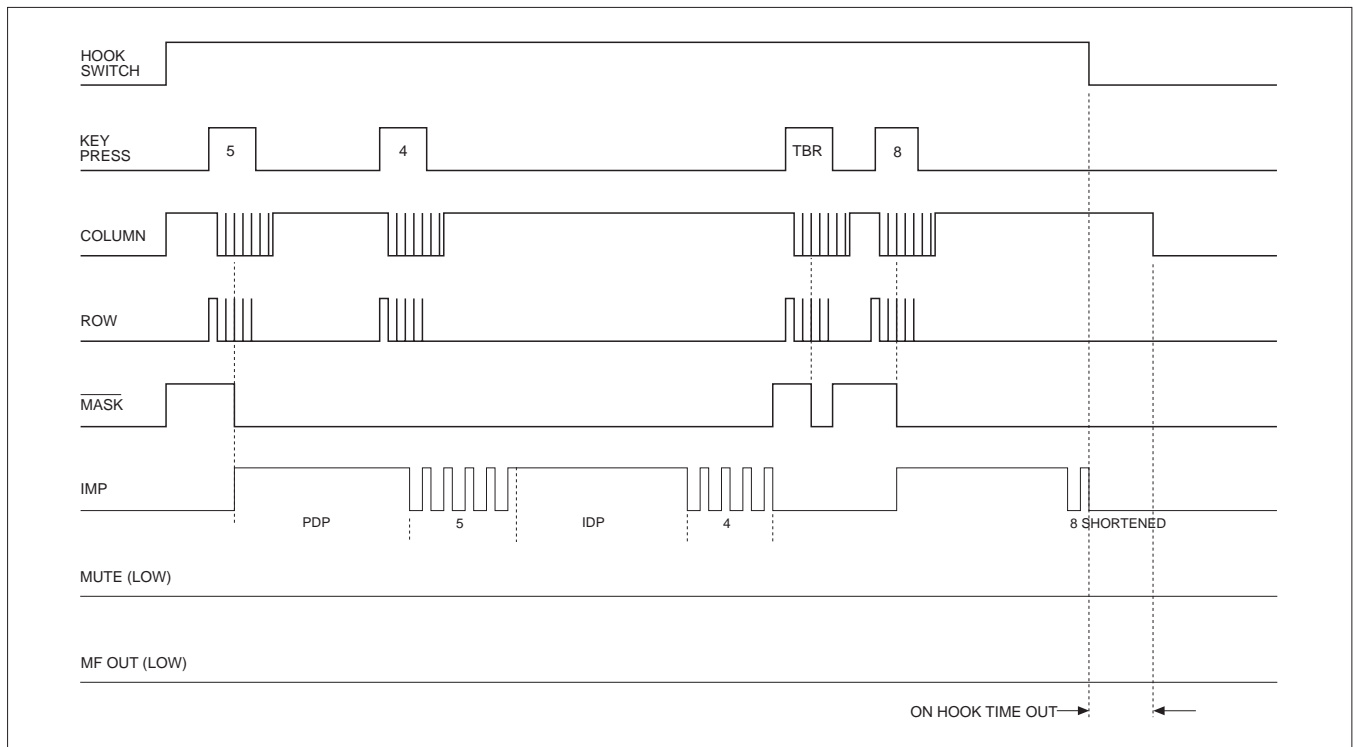


Figure 6. LD dialling

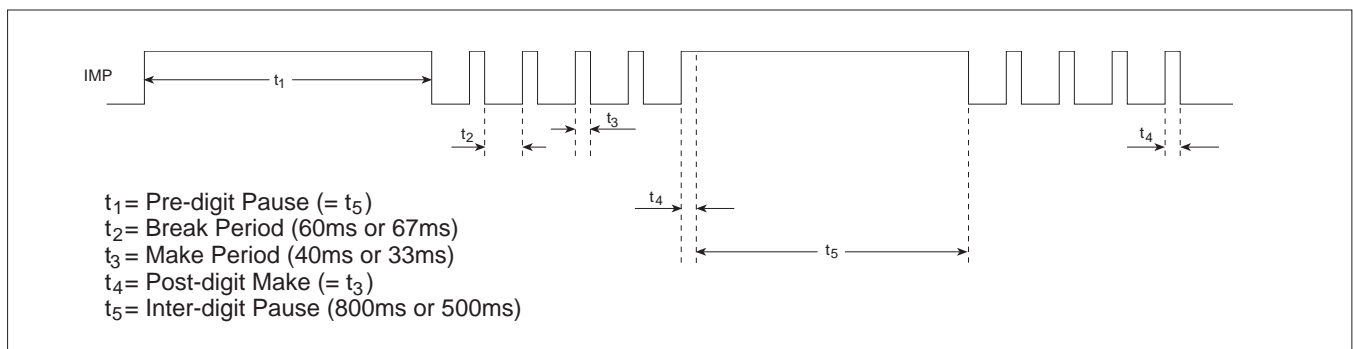


Figure 7. Timing data

Mask Options

The MA5883 has been designed so that many features can be altered quickly and inexpensively at the final stage of manufacture. These options allow the telephone manufacturer to cater for different market requirements throughout the world without changing the telephone circuit.

The options, listed below, are possible in any combination. Standard options are listed first in italics at 'a'. Other options may be produced by arrangement.

1. TBR (Flash) Period:

- a. *100ms*
- b. 200ms
- c. 300ms
- d. 400ms
- e. 500ms
- f. 600ms

2. LD to DTMF Keypad switching:

- a. ** and # keys*
- b. ** key*
- c. No keypad switching

3. Retention of post- */# digits in LNR store (DTMF mode)

- a. *Digits before * or # retained.*
- b. Digits before * or # retained (except when * or # is first digit).
- c. All digits retained.

4. LD dialling options

- a. *Standard (n = n pulses, when 0 = 10)*
- b. Swedish (n = n + 1 pulses)
- c. Norwegian (n = (11-n) pulses)
- d. New Zealand (n = (10-n) pulses)

5. Recall (Flash) / LNR Protocol:

- a. *Digits after recall retained in LNR store*
- b. Digits before recall retained in LNR store
- c. Recall inhibits LNR
- d. For Danish PABX requirements

6. DTMF Minimum Timings:

- a. *100ms on, 100ms off*
- b. 73.3ms on 73.3ms off
- c. 73.3ms on, 146.7ms off

7. Pin 4:

- a. *MASK*
- b. MASK

8. Pin 2:

- a. *IMP*
- b. IMP
- c. $[IMP + \overline{MASK}]$
- d. $[IMP + \overline{MASK}]$

9. Pin 15:

- a. *MUTE*
- b. MUTE

ABSOLUTE MAXIMUM RATINGS

Parameter	Min.	Typ.	Max.	Units	Notes
Supply voltage $V_{DD}-V_{SS}$	-0.3	-	6.5	V	-
Voltage on any pin (except HSW)	$V_{SS}-0.3$	-	$V_{DD}+0.3$	V	-
Voltage on pin HSW	$V_{SS}-0.3$	-	-	V	See note 1 below
Current at any pin (except HSW, FILTOUT and FILTIN)	-1	-	1	mA	-
Current at pin FILTOUT	0	-	0.1	mA	-
Current at pin FILTIN	-5	-	0	mA	-
Operating temperature	-25	-	70	°C	-
Storage temperature	-55	-	125	°C	-

Table 5. Absolute maximum ratings.

NOTE 1: A diode is internally connected between this pin and V_{DD} . Provided current is externally limited to 300 μ A max. no damage will occur.

NOTE 2: Stresses above those listed under 'Absolute Maximum Ratings' may cause permanent damage to this device. This is a stress rating only and functional operation of the device at these or any other condition above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability.

NOTE 3: These temperature ranges do not apply to all package types. Many package types are available and these may have limited temperature ranges. Further information is available on request.

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DC OPERATING CONDITIONS AND CHARACTERISTICS

Condition		Min.	Typ.	Max.	Units	Notes
Supply voltage:	On-hook	1.8	-	5.7	V	For memory retention
	Off-hook	2.4	-	5.7	V	
Hookswitch input:	On-hook	-	-	0.2 V _{DD}	-	-
	Off-hook	0.8 V _{DD}	-	-	-	

Table 6. Recommended DC operating conditions.

Parameter		Min.	Typ.	Max.	Units	Notes
Supply current:	On-hook	-	<0.1	5	μA	at V _{DD} = 2.0 True only if MF OUT is low
	Off-hook	-	1.5		μA	
	MF tone sending	-		1.0	mA	
	LD impulsing	-		200	μA	
Output high voltage (MASK, MUTE, IMP, PAUSE Outputs)		2.2	-		V	I = -1mA
Output low voltage (MASK, MUTE, IMP, PAUSE Outputs)		-	-	0.3	V	I = +1mA
MF OUT d.c. level during tone sending			0.9V _{DD}	-	V	-
MF OUT output resistance		-	3	5	kΩ	-
'Key Pressed' resistance		-	-	2	kΩ	2.5V < V _{DD} < 5.7V
'Key Not Pressed' resistance		500	-	-	kΩ	2.5V < V _{DD} < 5.7V
Darlington pair current gain		600	50,000	-	-	I _e = 100μA, V _{ce} = 2V

Table 7. DC characteristics

NOTE: 1. V_{DD} = 2.5V at 25°C unless specified.

AC OPERATING CONDITIONS AND CHARACTERISTICS

Condition		Min.	Typ.	Max.	Units	Notes
Oscillating frequency		-	560	-	kHz	-

Table 8. Recommended AC operating conditions.

Condition		Min.	Typ.	Max.	Units	Notes
Tone output:	Low group	57	64	-	mV r.m.s.	No load
	High group		81	91	mV r.m.s.	No load
High-to-low group amplitude ratio (pre-emphasis)		1.5	2	2.5	dB	See note 2
Total harmonic distortion:	0 - 4 kHz	-	1.5	-	%	-
	0 - 10 kHz	-	2.5	-	%	-
	0 - 50 kHz	-	5.0	-	%	-
	0 - 200 kHz	-	6.5	10	%	-
Oscillator start up time		-	<0.1	1	ms	-

Table 9. AC characteristics.

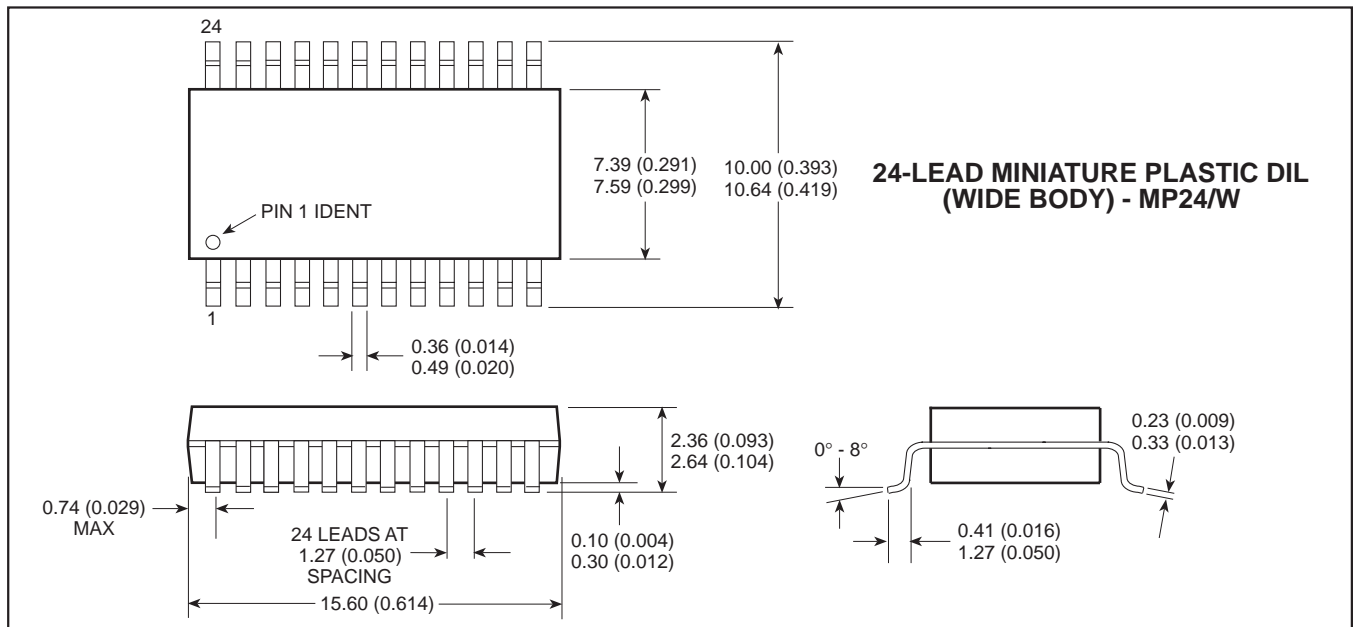
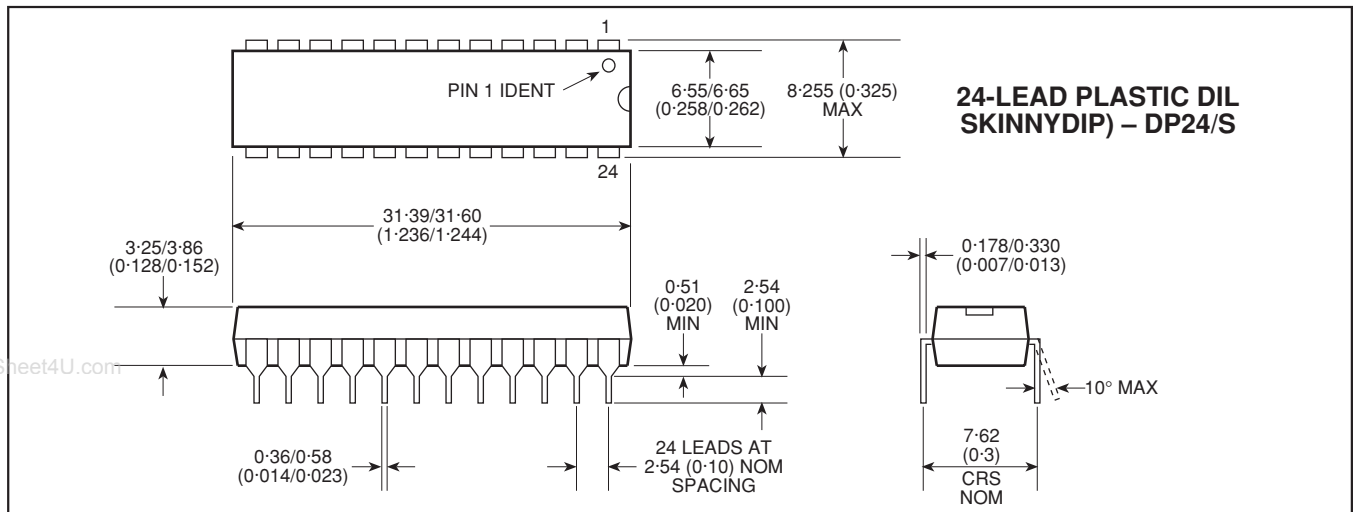
NOTE 1: V_{DD} = 2.5V.

NOTE 2: Typical value varies slightly dependant upon particular tone pair.

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PACKAGE DETAILS

Dimensions are shown thus: mm (in). For further package information, please contact you local Customer Service Centre



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