Pulse and DTMF diallers with redial

PCD3310; PCD3310A

CONTENTS

Pulse and DTMF diallers with redial   PCD3310; PCD3310A

1   FEATURES

- Pulse, DTMF and 'mixed mode' dialling

- Mixed mode dialling: start with pulse dial, end with DTMF dial (e.g. for control of DTMF user equipment via a pulse network)

- 23-digit memory stores last number dialled, or number noted during conversation (notepad)

- Redial of both PABX and external calls

- Supports 16 dial keys: 0 to 9, ∗, # A, B, C, and D

- Supports 4 function keys:

  – Program (P) used to input notepad numbers

  – Flash (FL) allows re-dialling without on-hook

  – Redial (R) recalls and redialls stored number

  – Change from pulse dial to DTMF dial in mixed mode (>)

- DTMF timing:

  – for manual dialling, maximum duration burst/pause intervals are user-determined, but at least minimum duration burst/pause intervals are ensured

  – for redial, minimum duration burst/pause intervals are used

- On-chip voltage reference for supply and temperature independent tone output

- On-chip filtering for low output distortion (CEPT compatible)

- On-chip oscillator uses low-cost 3.58 MHz (TV colour burst) crystal or piezo resonator

- Uses standard single-contact or double-contact (common left open) keyboard

- Keyboard entries fully debounced

- Flash (register recall) output.

2   GENERAL DESCRIPTION

The PCD3310 and PCD3310A are single-chip silicon gate CMOS integrated circuits. They are dual-standard diallers for pulse or dual tone multi-frequency (DTMF) dialling, with on-chip oscillators suitable for use with 3.58 MHz crystals.

Input data is derived from any standard matrix keyboard for dialling in either the pulse or DTMF mode.

Numbers up to 23 digits can be retained in RAM for dialling/redialling.

3   QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{DD}	operating supply voltage		2.5	–	6.0	V
V_{stb}	standby supply voltage		1.8	–	6.0	V
$I_{DD(stb)}$	standby current (on hook)	$V_{stb} = 1.8$ V	–	1.4	4	μA
$I_{DD(conv)}$	operating current in conversation mode	$V_{DD} = 3$ V	–	–	150	μA
$I_{DD(pulse)}$	operating current in pulse dialling mode	$V_{DD} = 3$ V	–	–	200	μA
$I_{DD(DTMF)}$	operating current in DTMF dialling mode	$V_{DD} = 3$ V	–	0.6	0.9	mA
$V_{HG(RMS)}$	DTMF output voltage level for HIGH group (RMS value)		–	192	–	mV
$V_{LG(RMS)}$	DTMF output voltage level for LOW group (RMS value)		–	150	–	mV
G_v	voltage gain (pre-emphasis) of group		–	2.1	–	dB
THD	total harmonic distortion		–	–25	–	dB
T_{amb}	operating ambient temperature		–25	–	+70	°C

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4 ORDERING INFORMATION

Table 1 Package information

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
PCD3310P	DIP20	plastic dual in-line package; 20 leads (300 mil)	SOT146-1
PCD3310AP	DIP20	plastic dual in-line package; 20 leads (300 mil)	SOT146-1
PCD3310T	SO28	plastic small outline package; 28 leads; body width 7.5 mm	SOT136-1
PCD3310AT	SO28	plastic small outline package; 28 leads; body width 7.5 mm	SOT136-1

Table 2 Functional options

TYPE NUMBER	PULSE DIAL; BREAK/MAKE TIME (see notes 1 and 2)	MARK-TO-SPACE RATIO
PCD3310P	67, 33 ms	2 : 1
PCD3310T	67, 33 ms	2 : 1
PCD3310AP	60, 40 ms	3 : 2
PCD3310AT	60, 40 ms	3 : 2

Notes

1. Pulse frequency 10 Hz, inter-digit pause (t_{id}) = 840 ms.

2. Note that the PCD3310P; 10T and the PCD3310AP; 10AT differ only in the break/make ratio in pulse dialling. The break/make times equate to mark-to-space ratios of 2 : 1 and 3 : 2 respectively.

5 BLOCK DIAGRAM
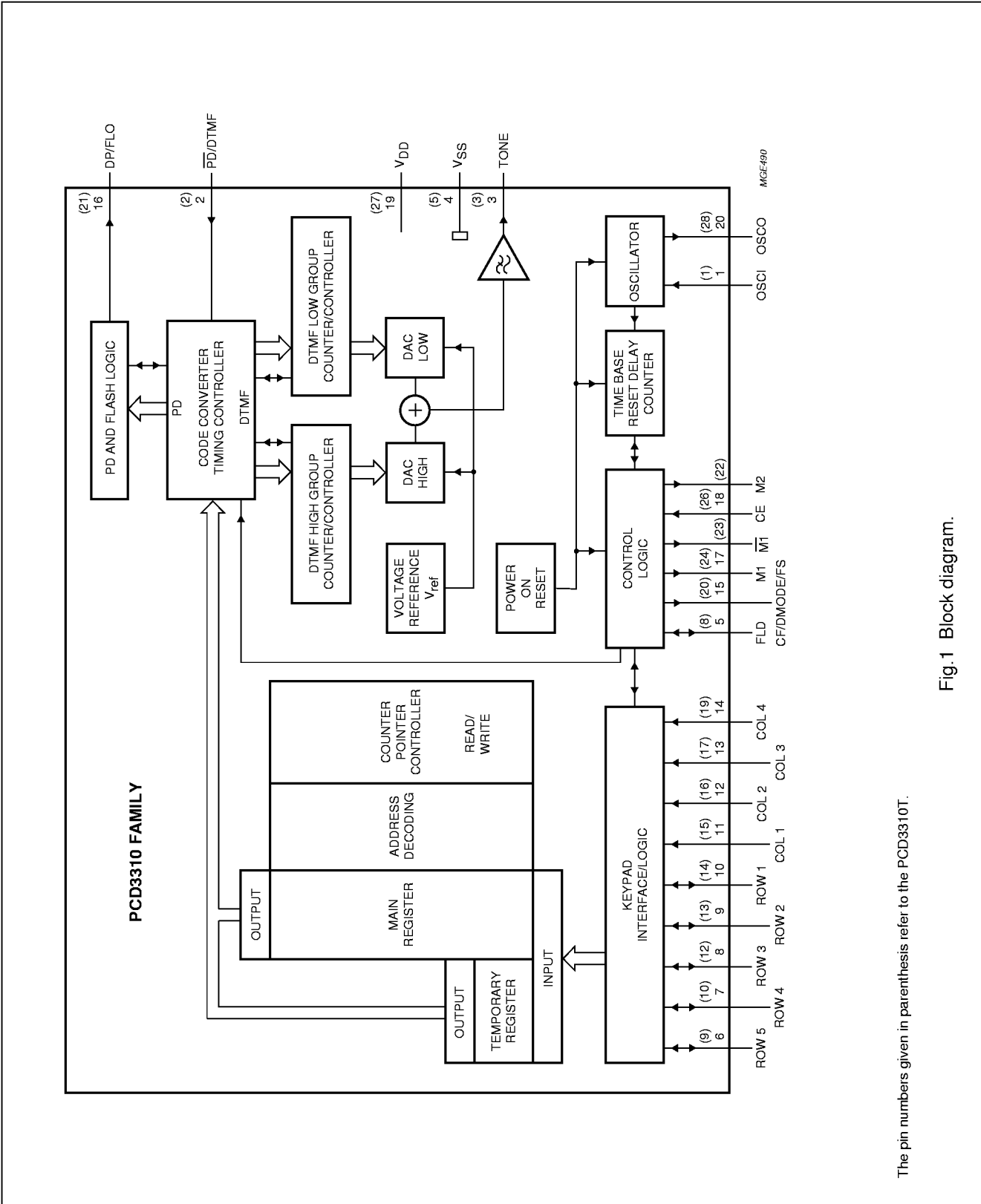

Fig.1 Block diagram.

The pin numbers given in parenthesis refer to the PCD3310T.

Pulse and DTMF diallers with redial   PCD3310; PCD3310A

6   PINNING

SYMBOL	PINS		TYPE	DESCRIPTION
	PCD3310P PCD3310AP	PCD3310T PCD3310AT		
OSCI	1	1	I	oscillator input
$\overline{PD}$/DTMF	2	2	I	select pin; pulse or DTMF dialling input
TONE	3	3	O	single or dual tone frequency output
n.c.	−	4	−	not connected
V_{SS}	4	5	P	negative supply
n.c.	−	6	−	not connected
n.c.	−	7	−	not connected
FLD	5	8	I/O	flash duration control input/output
ROW 5	6	9	I/O	scanning row 5 keyboard input/output
ROW 4	7	10	I/O	scanning row 4 keyboard input/output
n.c.	−	11	−	not connected
ROW 3	8	12	I/O	scanning row 3 keyboard input/output
ROW 2	9	13	I/O	scanning row 2 keyboard input/output
ROW 1	10	14	I/O	scanning row 1 keyboard input/output
COL 1	11	15	I	sense column 1 keyboard input (with internal pull-up resistor)
COL 2	12	16	I	sense column 2 keyboard input (with internal pull-up resistor)
COL 3	13	17	I	sense column 3 keyboard input (with internal pull-up resistor)
n.c.	−	18	−	not connected
COL 4	14	19	I	sense column 4 keyboard input (with internal pull-up resistor)
CF/DMODE/FS	15	20	O	confidence tone/dialling mode/frequency select outputs
DP/FLO	16	21	O	dialling pulse and flash output
M2	−	22	O	muting output 2
$\overline{M1}$	−	23	O	muting output 1 (active LOW)
M1	17	24	O	muting output 1
n.c.	−	25	−	not connected
CE	18	26	I	chip enable input
V_{DD}	19	27	P	positive supply voltage
OSCO	20	28	O	oscillator output

Pulse and DTMF diallers with redial
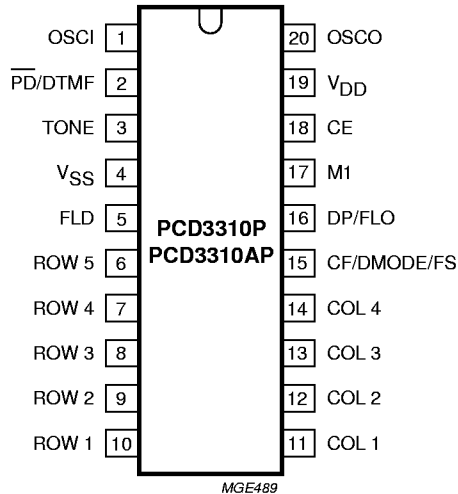
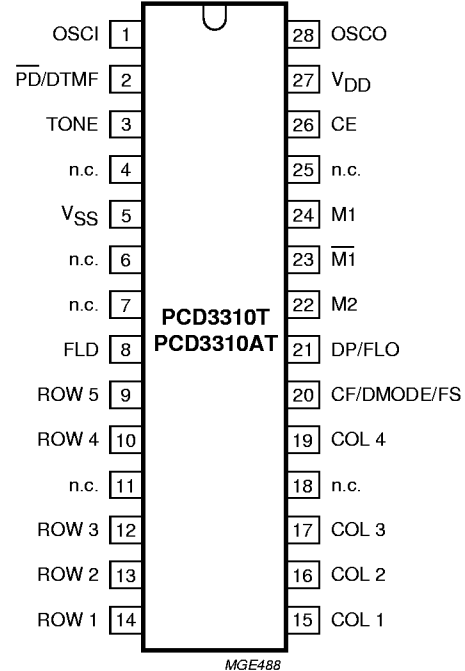## PCD3310; PCD3310A

Fig.2 Pin configuration (DIP20 package).

OSCI 1 — 20 OSCO
$\overline{PD}$/DTMF 2 — 19 V_{DD}
TONE 3 — 18 CE
V_{SS} 4 — 17 M1
FLD 5 — 16 DP/FLO
ROW 5 6 — 15 CF/DMODE/FS
ROW 4 7 — 14 COL 4
ROW 3 8 — 13 COL 3
ROW 2 9 — 12 COL 2
ROW 1 10 — 11 COL 1

PCD3310P
PCD3310AP

MGE489

Fig.3 Pin configuration (SO28 package).

OSCI 1 — 28 OSCO
$\overline{PD}$/DTMF 2 — 27 V_{DD}
TONE 3 — 26 CE
n.c. 4 — 25 n.c.
V_{SS} 5 — 24 M1
n.c. 6 — 23 $\overline{M1}$
n.c. 7 — 22 M2
FLD 8 — 21 DP/FLO
ROW 5 9 — 20 CF/DMODE/FS
ROW 4 10 — 19 COL 4
n.c. 11 — 18 n.c.
ROW 3 12 — 17 COL 3
ROW 2 13 — 16 COL 2
ROW 1 14 — 15 COL 1

PCD3310T
PCD3310AT

MGE488

7 FUNCTIONAL DESCRIPTION

References to 'the device' apply to both the PCD3310 and the PCD3310A.

7.1 Power supply (V_{DD} and V_{SS})

The positive supply of the device (V_{DD}) must meet the voltage requirements as indicated in Chapter 11.
To avoid undefined states of the device at power-on, an internal reset circuit clears the control logic and counters. If V_{DD} drops below the minimum standby supply voltage of 1.8 V the power-on reset circuit inhibits redialling after hook-off. The power-on reset signal has the highest priority; it blocks and resets the device without delay regardless of the state of chip enable input (CE).

7.2 Clock oscillator (OSCI and OSCO)

The timebase for the device for both pulse and DTMF dialling is a crystal controlled on-chip oscillator which is completed by connecting a 3.58 MHz crystal or ceramic resonator between the OSCI and OSCO pins.
Recommended resonator type:

• 3.58 MHz PXE - Murata; CSA 3.58MG310VA.

7.3 Chip enable (CE)

The CE input enables the device and is used to initialize the device. When CE is LOW it provides the static standby condition. In this state the clock oscillator is disabled, all registers and logic are reset with the exception of the redial registers, Read Address Counter (RAC), Write Address Counter (WAC) and Temporary Write Address Counter (TWAC). The RAC points to the first digit of the last number dialled, the WAC and TWAC point to the last entered digits in the main and temporary registers (see Fig.6). The keyboard input is inhibited, but data previously entered is saved in the redial registers provided V_{DD} is higher than V_{stb}. The current drawn is I_{stb} (standby current) and serves to retain data in the redial registers during hook-on.

When CE is HIGH it activates the clock oscillator and the device changes from static standby condition to the conversation mode. The current consumption is $I_{DD(conv)}$ until the first digit is entered from the keyboard. Then a dialling or redialling operation starts. The operating current is $I_{DD(pulse)}$ if in the pulse dialling mode, or $I_{DD(DTMF)}$ if the DTMF dialling mode is selected.

If the CE input is taken to a LOW level for longer than time period t_{rd} (see Figs 11 and 12 and Chapter 12) an internal reset pulse will be generated at the end of the t_{rd} period. The system changes to the static standby state. Short CE pulses of $< t_{rd}$ will not affect the operation of the device and reset pulses are not produced.

7.4 Mode selection ($\overline{PD}$/DTMF)

7.4.1 PULSE MODE

If $\overline{PD}$/DTMF = V_{SS} the pulse mode is selected. Entries of non-numeric keys are neglected, they are neither stored in the redial register nor transmitted.

7.4.2 DTMF MODE

If $\overline{PD}$/DTMF = V_{DD} the dual tone multi-frequency dialling mode is selected. Each non-function key activated corresponds to a combination of two tones, one of four LOW and one of four HIGH frequencies, corresponding to the key's row and column in the keyboard matrix. See Fig.4 and Table 3. The frequencies are transmitted with a constant amplitude, regardless of power supply variations. Harmonic content is filtered out thus meeting the CEPT recommendations.

The transmission time is calibrated for redial. In manual operation the duration of bursts and pauses is the actual key depression time, but not less than the minimum transmission time (t_t) or minimum pause time (t_p).

7.4.3 MIXED MODE

When the $\overline{PD}$/DTMF pin is open-circuit the mixed mode is selected. After activation of CE or FL (Flash) the device starts as a pulse dialler and remains in this state until a non-numeric dial key (A, B, C, D, $*$, #) or the function key > is activated. Pressing a non-numeric dial key causes the corresponding DTMF tones to be output, and any subsequent dialling to be in DTMF mode. Pressing > causes no output tones, but any subsequent dialling is in DTMF mode. The > key should be used if the first DTMF output required is numeric. The device remains in DTMF dial mode until FL is activated or after a static standby condition when CE is re-activated.

A connection between the $\overline{PD}$/DTMF pin and V_{DD} also initiates DTMF dialling. Chip enable, FL or a connection of $\overline{PD}$/DTMF pin to V_{SS} sets the device back to pulse dialling.

7.5 Keyboard inputs/outputs

The sense column inputs COL 1 to COL 4 and the scanning row outputs ROW 1 to ROW 5 of the device are connected to the keyboard as shown in Fig.4. All keyboard entries are debounced on both the leading and trailing edges for approximately time period t_e as shown in Figs 11, 12, 13 and 14. Each entry is tested for validity. When a key is depressed, keyboard scanning starts and only returns to the sense mode after release of that key.
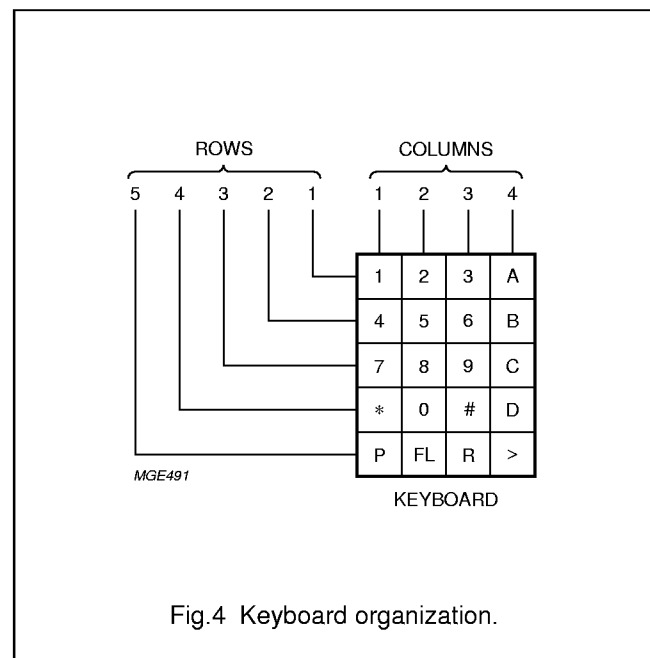

Fig.4 Keyboard organization.

ROW 5 of the keyboard contains the following function keys:

• P = memory clear and programming (notepad)

• FL = flash or register recall

• R = redial

• > = change of dial mode from pulse to DTMF in mixed dialling mode.

In the pulse dialling mode the valid keys are the 10 numeric dial keys (0 to 9). The non-numeric dial keys (A, B, C, D, $*$, #) have no effect on the dialling or the redial storage. Valid function keys are P, R and FL.

In the DTMF mode all dial keys are valid. They are transmitted as a dual tone combination and at the same time stored in the redial register. Valid function keys are P, FL and R.

In the mixed mode all key entries are valid and executed accordingly.

7.6 Flash duration control (FLD)

Flash (or register recall) is activated by the FL key and can be used in DTMF and pulse dialling modes.

The FL key has the same effect as placing the telephone 'on-hook' for a calibrated time. Pressing the FL key will produce a timed line-break of 100 ms (min.) at the DP/FLO output. During the conversation mode pressing FL also acts as a chip enable. The flash pulse duration (t_{FL}) is calibrated and can be prolonged with an external resistor and capacitor connected to the FLD input/output (see Fig.5). The flash pulse resets the Read Address Counter (RAC) to the address of the first entered digit of the last number dialled. Subsequent redial is possible (see Fig.9). The counter of the reset delay time is held for a period of t_{FL}.

7.7 TONE output (DTMF mode)

The single and dual tones which are provided at the TONE output are filtered by an on-chip switched capacitor filter, followed by an on-chip active RC low-pass filter. Hence, the total harmonic distortion of the DTMF tones meets the CEPT recommendations. The tone output has the following states:

- tone OFF; 3-state
- tone ON; the associated frequencies are superimposed on a DC level of $\frac{1}{2}V_{DD}$.

When the DTMF mode is selected output tones are timed in manual dialling with a minimum duration of bursts and pauses, and in redial with a calibrated timing. Single tones may be generated for test purposes (CE = HIGH). Each row and column has one corresponding frequency. High group frequencies are generated by connecting the column to V_{SS} and LOW group frequencies are generated by forcing the row to V_{DD}. The single tone frequency will be transmitted during activation time, but it is neither calibrated nor stored.

An on-chip reference voltage provides output tone levels independent of the supply voltage. Table 3 shows the frequency tolerance of the output tones for DTMF signalling.
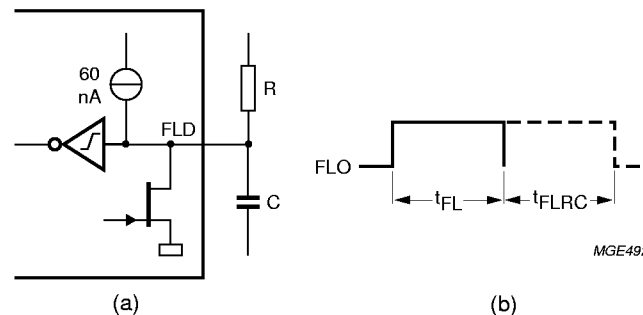
(a) Flash duration control circuit.
(b) Flash pulse timing. $t_{FLRC} \approx R \times C$.

Fig.5 Flash pulse duration setting.

Table 3 Frequency tolerance of the output tones for DTMF signalling; f_{xtal} = 3.579545 MHz

ROW/COLUMN	STANDARD FREQUENCY (Hz)	TONE OUTPUT FREQUENCY (Hz)	FREQUENCY DEVIATION	
			%	Hz
ROW 1	697	697.90	+0.13	+0.90
ROW 2	770	770.46	+0.06	+0.46
ROW 3	852	850.45	−0.18	−1.55
ROW 4	941	943.23	+0.24	+2.23
COL 1	1209	1206.45	−0.21	−2.55
COL 2	1336	1341.66	+0.42	+5.66
COL 3	1477	1482.21	+0.35	+5.21
COL 4	1633	1638.24	+0.32	+5.25

7.8 Dial pulse and Flash output (DP/FLO)

This is a combined output which provides control signals for timing in pulse dialling or for a calibrated line break (flash or register recall) in both dialling modes.

7.9 Mute output (M1)

The MUTE output can be used to disable the microphone during dialling.

During pulse dialling the mute output becomes active HIGH for the period of the inter-digit pause, break time and make time. It remains at this level until the last digit is pulsed out.

During DTMF dialling the mute output becomes active HIGH for the period of tone transmission and remains at this level until the end of hold-over time. It is also active HIGH during flash and flash hold-over time.

7.10 Mute output ($\overline{M1}$)

Inverted output of M1. In the PCD3310P it is only available as a bonding option of M1.

7.11 Muting output (M2)

Active HIGH output during actual dialling; i.e. during break or make time in pulse dialling, or during tone ON/OFF in DTMF dialling. It is an open drain p-channel output.

8 DIALLING PROCEDURES (see Figs 7, 8 and 9)

8.1 Dialling

After CE has risen to V_{DD} the oscillator starts running and the Read Address Counter (RAC) is set to the first address of both the main and temporary redial registers, ready to redial any stored number (see Fig.6). By dialling the first

valid digit, the Temporary Write Address Counter (TWAC) will be set to the first address of the temporary register, and the decoded digit will be stored in the temporary register at that address. The TWAC is then incremented to the next address. The first 5 valid digits will be decoded and stored in the temporary register in this way, and have no effect on the main register and its associated Write Address Counter (WAC). After the sixth valid digit is entered, the TWAC indicates an overflow condition. The data from the temporary register will be copied into the 5 least significant places of the main register and the TWAC into the WAC. The sixth digit, and all subsequent digits will be stored in the main register (a total of not more than 23). If more than 23 digits are entered redial will be inhibited. If not more than 5 digits are entered only the temporary register and the associated TWAC are affected.

All entries are debounced on both the leading and trailing edges for at least time period t_e as shown in Figs 11, 12, 13 and 14.

Each entry is tested for validity before being stored in the redial registers.

• For DTMF dialling all dial keys are valid

• For pulse dialling only numeric dial keys are valid.

Simultaneous to their acceptance and corresponding to the selected mode (pulse, DTMF or mixed), the entries are transmitted as pulse-trains or as DTMF frequencies in accordance with PTT requirements. Non-numeric dial key entries are neglected during pulse dialling; they are neither stored nor transmitted.

8.2 Redialling

After CE has risen to V_{DD} the oscillator starts running. The address of the first digit in the redial register is stored in the RAC, and the device is in the conversation mode. If 'R' is the first keyboard entry the device starts redialling the contents of the temporary register. If the overflow flag of the TWAC was set in the previous dialling, the redialling continues in the main register.

Because access to an external line from a PABX usually involves dialling an access code and waiting for an access tone, a 'one-press' redial may fail due to insufficient delay between the access code and the external number. For this reason, the access code should be redialled. If the access code (up to 4 digits) matches the first part of the stored number, then pressing R after the access tone is obtained will cause the rest of the number to be redialled (see Fig.7, PABX).

Timing in the DTMF mode is calibrated for both tone bursts and pauses.

In mixed mode only the first part entered (the pulse dialled part of the stored number) can be redialled.

During redial keyboard entries (function or non-function) are not accepted until the device returns to the conversation mode after completion of redialling. No redial activity takes place if one of the following events occur:

- Power-on reset
- Memory clear ('P' without subsequent data entry)
- Memory overflow (more than 23 valid data entries).
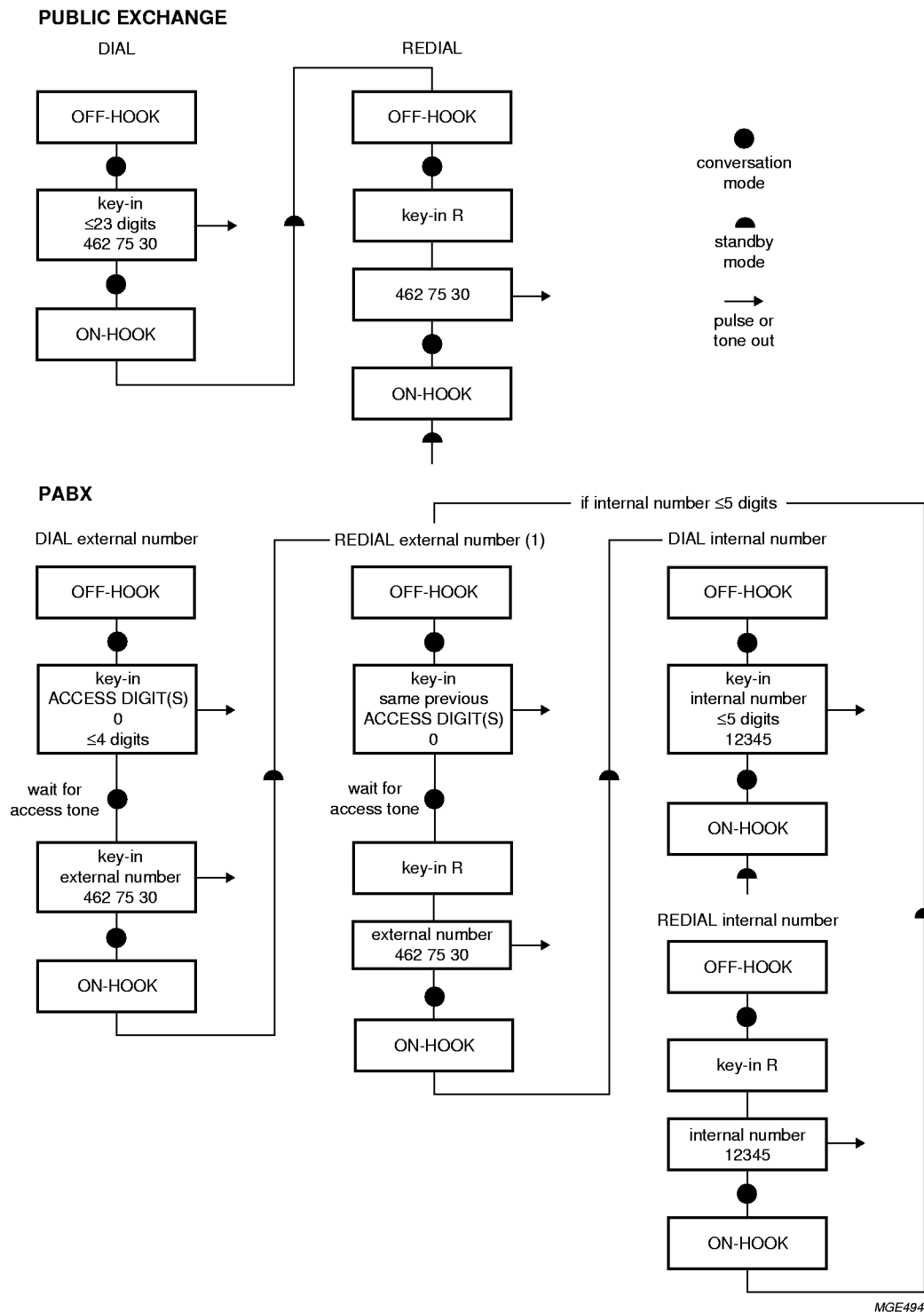
8.3 Notepad

The redial register can also be used as a notepad. In the conversation mode a number with up to 23 digits can be entered and stored for redialling. By activating the program key (P) the WAC and TWAC pointers are reset. This acts like a memory clear (redial is inhibited). Afterwards, by entering and storing any digits, redialling will be possible after flash or hook-on and hook-off (see Fig.9).

During notepad programming the numbers entered will not be transmitted nor is the mute active, only the confidence tone is generated.

Fig.6 Program memory map.

Pulse and DTMF diallers with redial
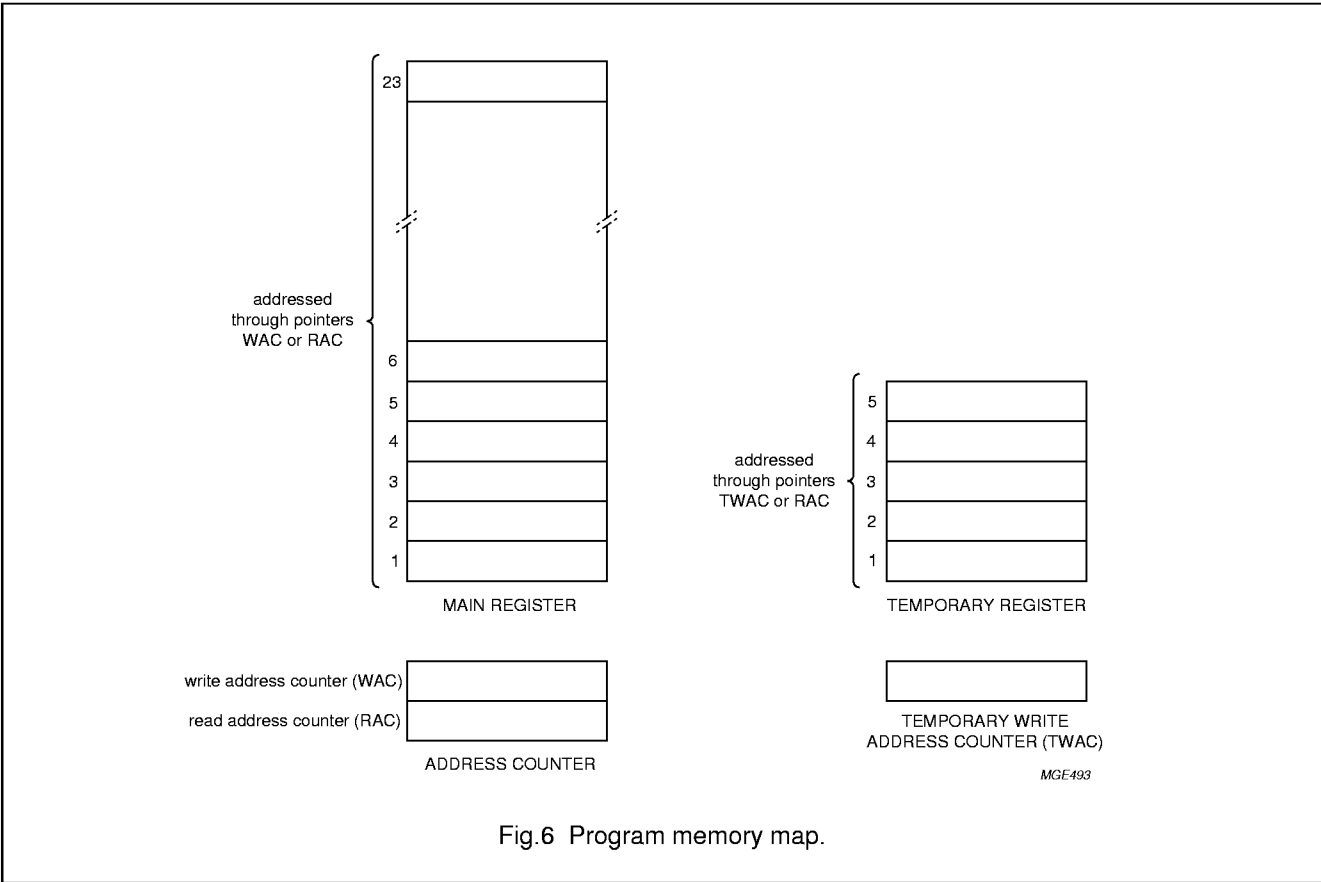
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Fig.7 Pulse or DTMF dialling mode.
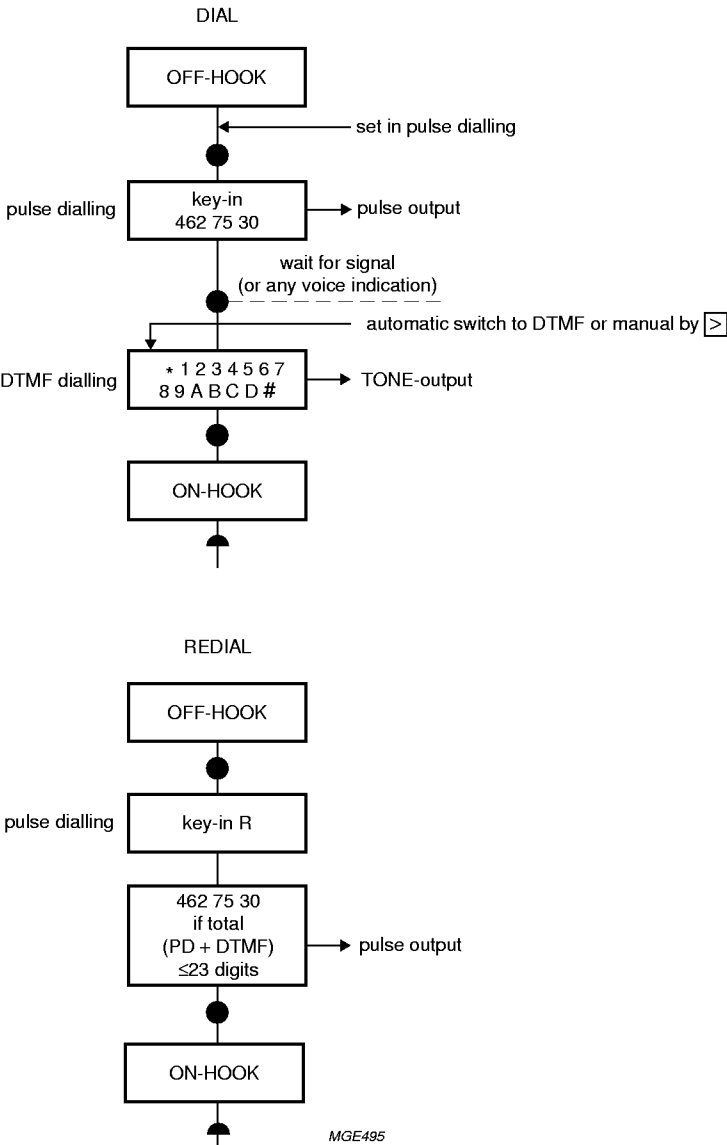
(1) If [access digit(s) + external number] ≤23 digits.

Fig.8 Pulse/DTMF and mixed mode dialling.

NOTEPAD PROGRAM

OFF-HOOK

key-in
462 75 30

key-in P

key-in
355 44 99
≤23 digits

no dialling - no muting

ON-HOOK

NOTEPAD REDIAL

OFF-HOOK

key-in R

355 44 99

ON-HOOK

MEMORY CLEAR

OFF-HOOK

key-in
462 75 30

key-in P

ON-HOOK

OFF-HOOK

key-in R

no
redialling

FLASH

OFF-HOOK

key-in
ACCESS DIGIT(S)
0

wait for
access tone

key-in
external number
462 75 30

key-in FL

wait for
access tone

key-in
internal number
12345

REDIAL
(see PABX
procedure)

MGE496
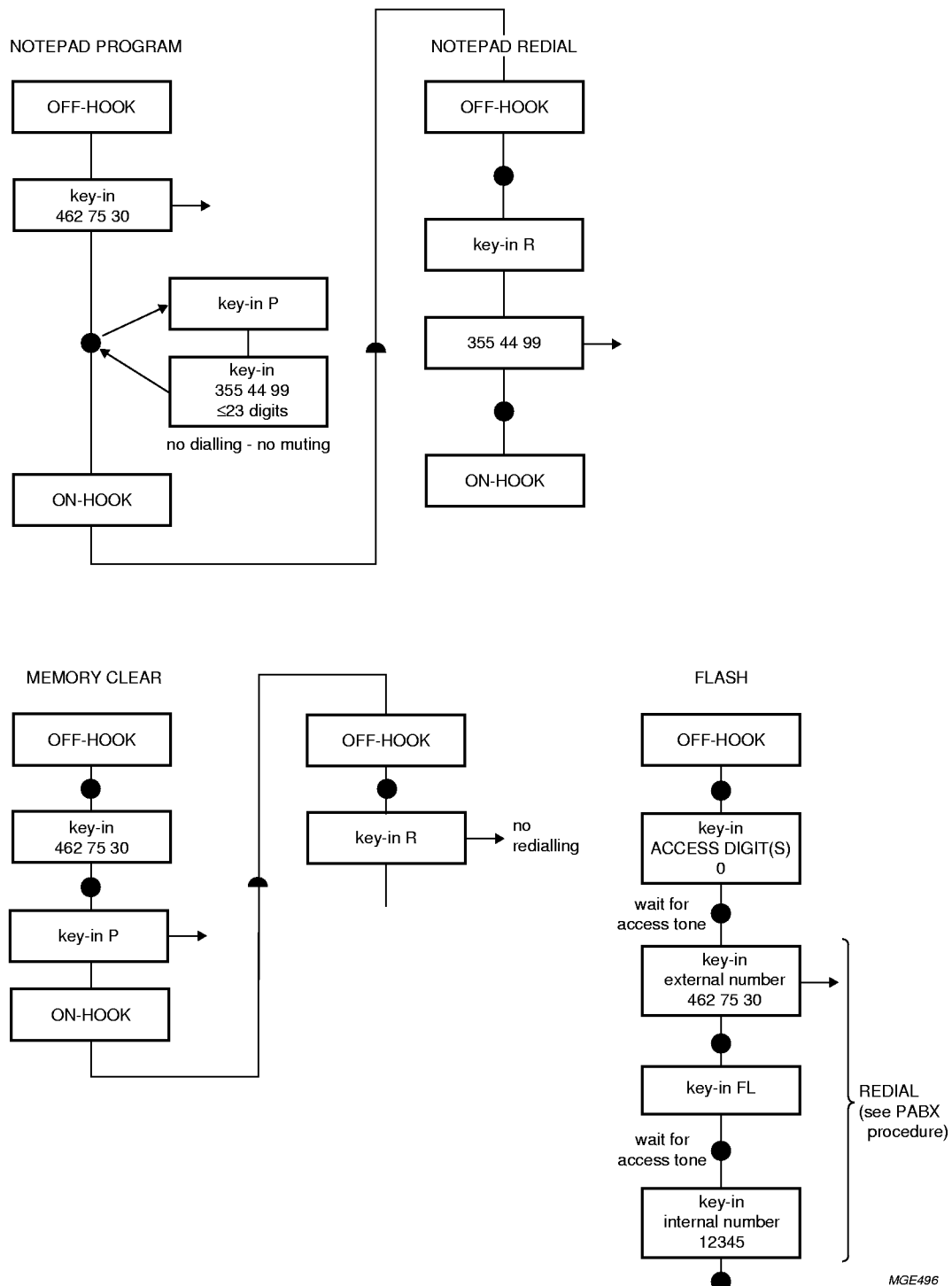
Fig.9 Notepad, memory clear, flash; independent of dialling mode.

9 HANDLING

Inputs and outputs are protected against electrostatic discharge in normal handling. However, it is good practice to take normal precautions appropriate to handling MOS devices (see *"Data Handbook ICO3, Section: General, Handling MOS devices"*).

10 LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{DD}	supply voltage	−0.8	+8.0	V
I_{DD}	supply current	−	50	mA
I_I	DC input current	−10	+10	mA
I_O	DC output current	−10	+10	mA
V_I	all input voltages	−0.8	V_{DD} + 0.8	V
P_{tot}	total power dissipation	−	300	mW
P_o	power dissipation per output	−	50	mW
T_{stg}	storage temperature range	−65	+150	°C
T_{amb}	operating ambient temperature	−25	+70	°C

11 CHARACTERISTICS

V_{DD} = 3 V; V_{SS} = 0 V; f_{osc} = 3.579545 MHz; T_{amb} = −25 to +70 °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_{DD}	operating supply voltage		2.5	−	6.0	V
V_{stb}	standby supply voltage		1.8	−	6.0	V
$I_{DD(conv)}$	operating supply current in conversation mode	oscillator ON	−	−	150	µA
$I_{DD(pulse)}$	operating supply current in pulse dialling or flash mode		−	−	200	µA
$I_{DD(DTMF)}$	operating supply current in DTMF dialling mode	tone ON	−	0.6	0.9	mA
		one OFF	−	−	200	µA
$I_{DD(stb)}$	standby supply current	V_{DD} = 1.8 V oscillator OFF; note 1	−	1.4	4.0	µA
Inputs						
V_{IL}	LOW level input voltage		0	−	$0.3V_{DD}$	V
V_{IH}	HIGH level input voltage		$0.7V_{DD}$	−	V_{DD}	V
I_{LI}	input leakage current pin CE		−1	−	+1	µA
Keyboard inputs						
R_{KON}	keyboard ON resistance		−	−	2	kΩ
R_{KOFF}	keyboard OFF resistance		1	−	−	MΩ

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Outputs						
I_{OL}	LOW level output sink current pins M1, $\overline{M1}$, DP/FLO, CF and FLD	$V_{OL} = V_{SS} + 0.5$ V	0.7	–	–	mA
	LOW level output sink current pin $\overline{PD}$/DTMF	$V_{OL} = V_{SS} + 0.5$ V; note 2	–	–	1	mA
I_{OH}	HIGH level output source current pins M1, $\overline{M1}$, DP/FLO, CF and M2	$V_{OH} = V_{DD} - 0.5$ V	–0.6	–	–	mA
	HIGH level output source current pin $\overline{PD}$/DTMF	$V_{OH} = V_{DD} - 0.5$ V; note 2	–	–	–1	mA
	HIGH level output source current pin FLD	$V_{OH} = V_{DD} - 0.5$ V; note 3	–	–60	–	nA
Tone output (see Fig.10)						
$V_{HG(RMS)}$	DTMF output voltage levels for HIGH group (RMS value)	$V_{DD} = 2.5$ to 6 V	158	192	205	mV
$V_{LG(RMS)}$	DTMF output voltage levels for LOW group (RMS value)	$V_{DD} = 2.5$ to 6 V	125	150	160	mV
Δf	frequency deviation		–0.6	–	+0.6	%
V_{DC}	DC voltage level		–	$0.5V_{DD}$	–	V
$|Z_O|$	output impedance		–	0.1	0.5	kΩ
G_v	voltage gain (pre-emphasis) of group		1.85	2.1	2.35	dB
THD	total harmonic distortion	$T_{amb} = 25$ °C; note 4	–	–25	–	dB

Notes

1. Crystal connected between OSCI and OSCO; CE at V_{SS} and all other pins open-circuit.

2. $< |10$ mA$|$ dynamic current to set/reset $\overline{PD}$/DTMF pin (mixed mode).

3. Flash inactive; output voltage = V_{SS}.

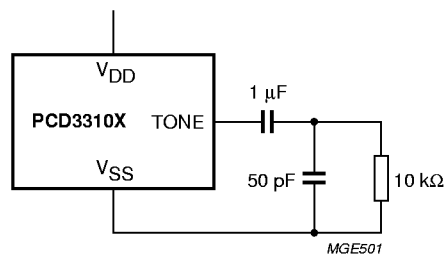4. Related to the level of the LOW group frequency component, according to CEPT recommendations.

**Fig.10** Tone output test circuit.

12 TIMING CHARACTERISTICS

When any key is activated a square wave (330 Hz) is generated and appears at the CF output to serve as an acoustic feed-back for the user.

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
DTMF dialling					
t_t, t_p	transmission and pause times (manual dialling)	68	–	–	ms
t_t, t_p	transmission and pause times (redialling)	68	70	72	ms
Pulse dialling (PCD3310)					
f_{dp}	dialling pulse frequency	9.8	10	10.4	Hz
t_{id}	inter-digit pause	828	840	844	ms
t_b	break time	66	67	68	ms
t_m	make time	32	33	34	ms
Pulse dialling (PCD3310A)					
f_{dp}	dialling pulse frequency	9.8	10	10.4	Hz
t_{id}	inter-digit pause	828	840	844	ms
t_b	break time	59	60	61	ms
t_m	make time	39	40	41	ms
General					
t_{FL}	flash pulse duration	98	100	102	ms
t_{flh}	flash hold-over time	31	33	34	ms
t_h	hold-over time (muting on M1)	78	80	81	ms
t_{on}	clock start-up time	–	4	–	ms
t_e	debounce time	–	12	–	ms
t_{rd}	reset delay time	–	160	–	ms
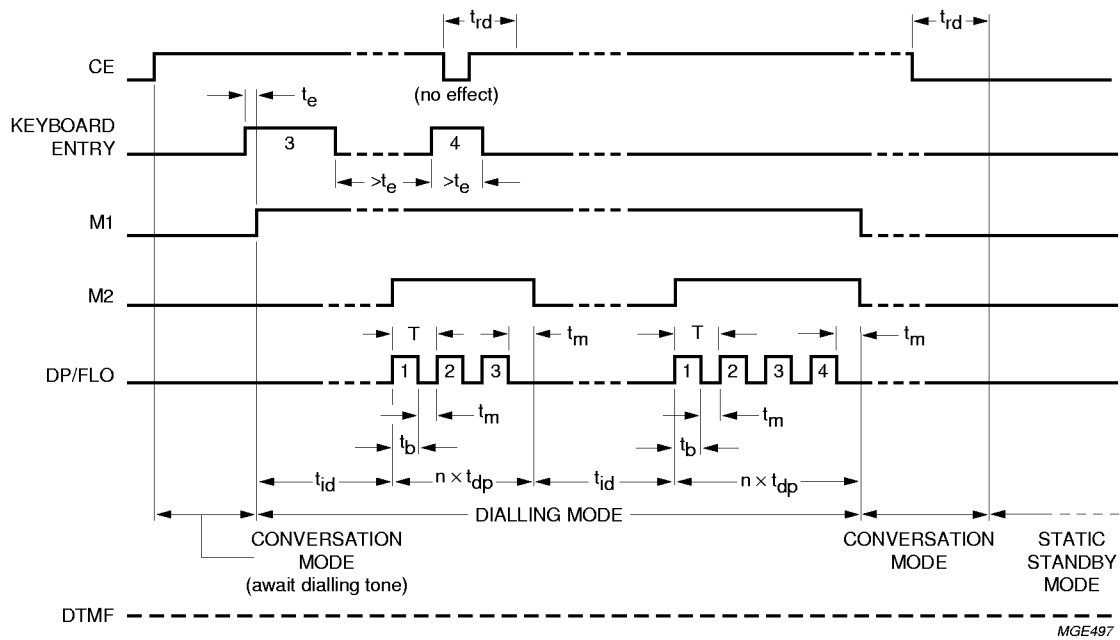
The dashed line signifies floating.

Fig.11 Timing diagram for pulse dialling ($\overline{PD}$/DTMF = V_{SS}).
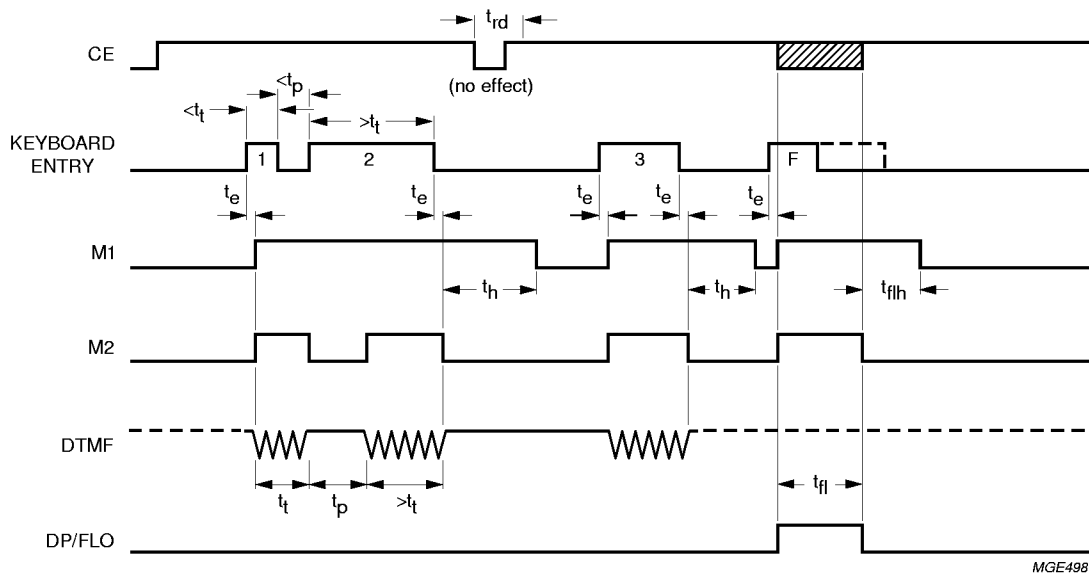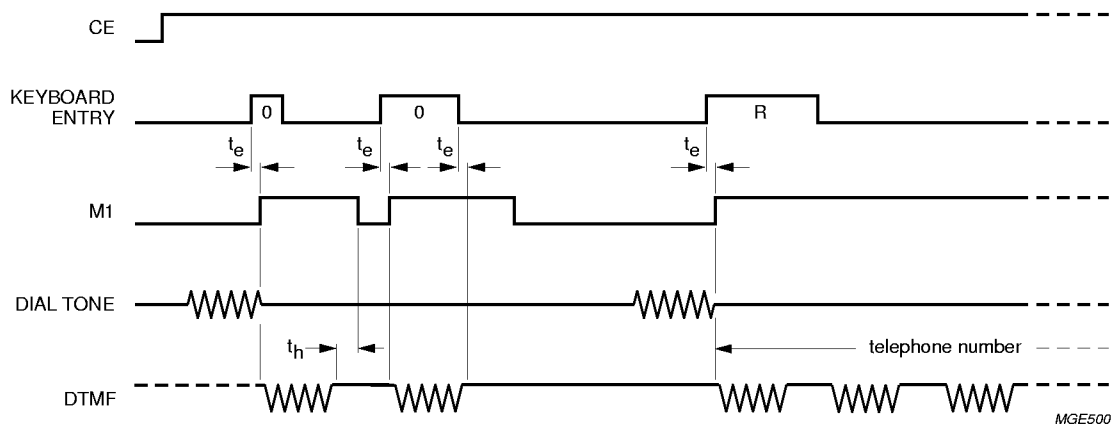

The dashed line signifies floating.

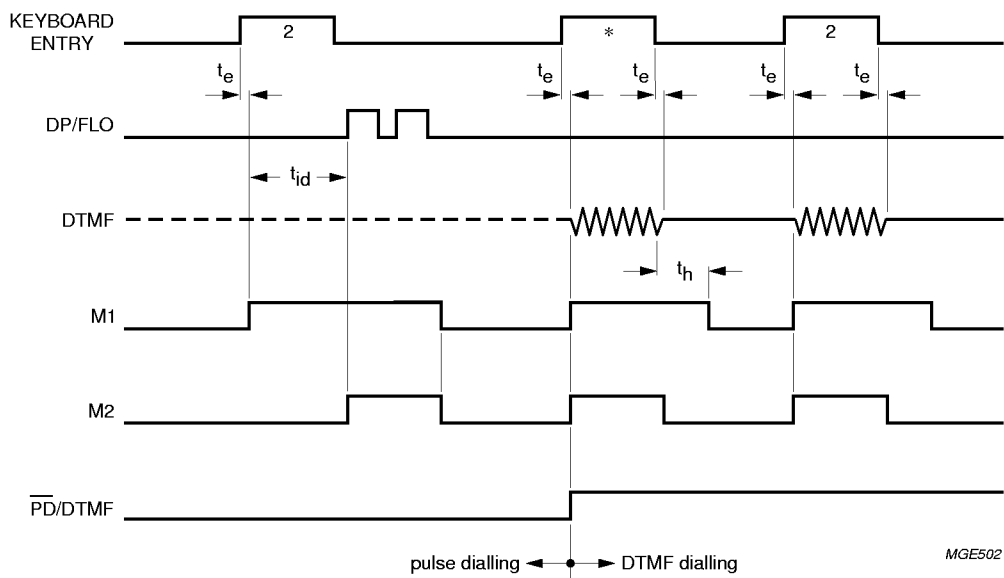Fig.12 Timing diagram for DTMF dialling ($\overline{PD}$/DTMF = V_{DD}).

The dashed line signifies floating.

Fig.13 Timing diagram showing REDIAL where PABX access digits are the first keyboard entries in DTMF dialling mode.

The dashed line signifies floating.

Fig.14 .Timing diagram for mixed mode ($\overline{PD}$/DTMF open-circuit).

Pulse and DTMF diallers with redial

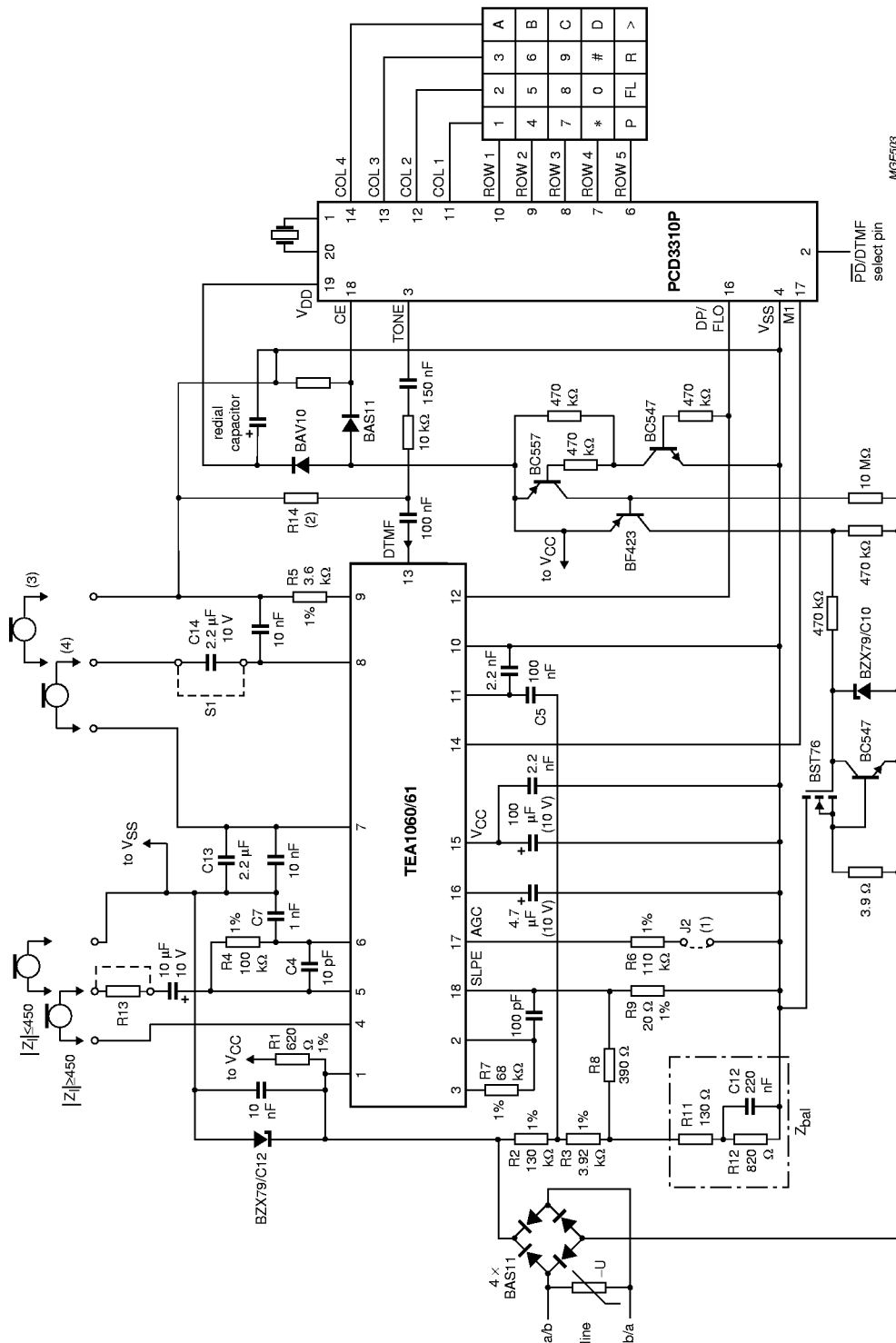PCD3310; PCD3310A

13 APPLICATION INFORMATION

Fig.15 Application diagram of the full electronic basic telephone set.

(1) Automatic line compensation obtained by connecting R6 to V_{SS}.
(2) The value of resistor R14 is determined by the required level at LN and the DTMF gain of the TEA1060 and TEA1061.
(3) Symmetrical low-impedance inputs for dynamic and magnetic microphones (TEA1060).
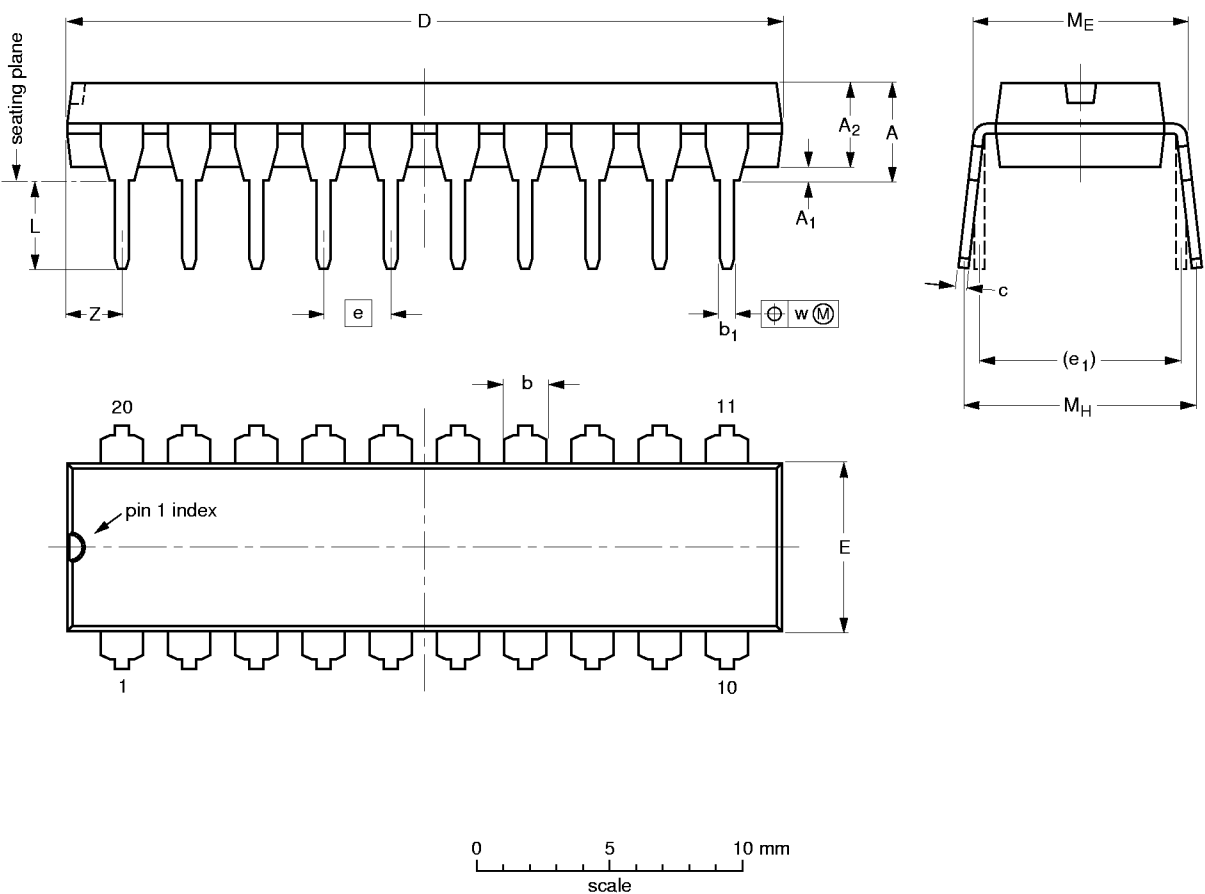(4) Asymmetrical high-impedance inputs for electret microphones (TEA1061).

Pulse and DTMF diallers with redial

PCD3310; PCD3310A

14 PACKAGE OUTLINES

DIP20: plastic dual in-line package; 20 leads (300 mil)

SOT146-1

DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	$D^{(1)}$	$E^{(1)}$	e	e_1	L	M_E	M_H	w	$Z^{(1)}$ max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	0.36 0.23	26.92 26.54	6.40 6.22	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.0
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.014 0.009	1.060 1.045	0.25 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.078

Note

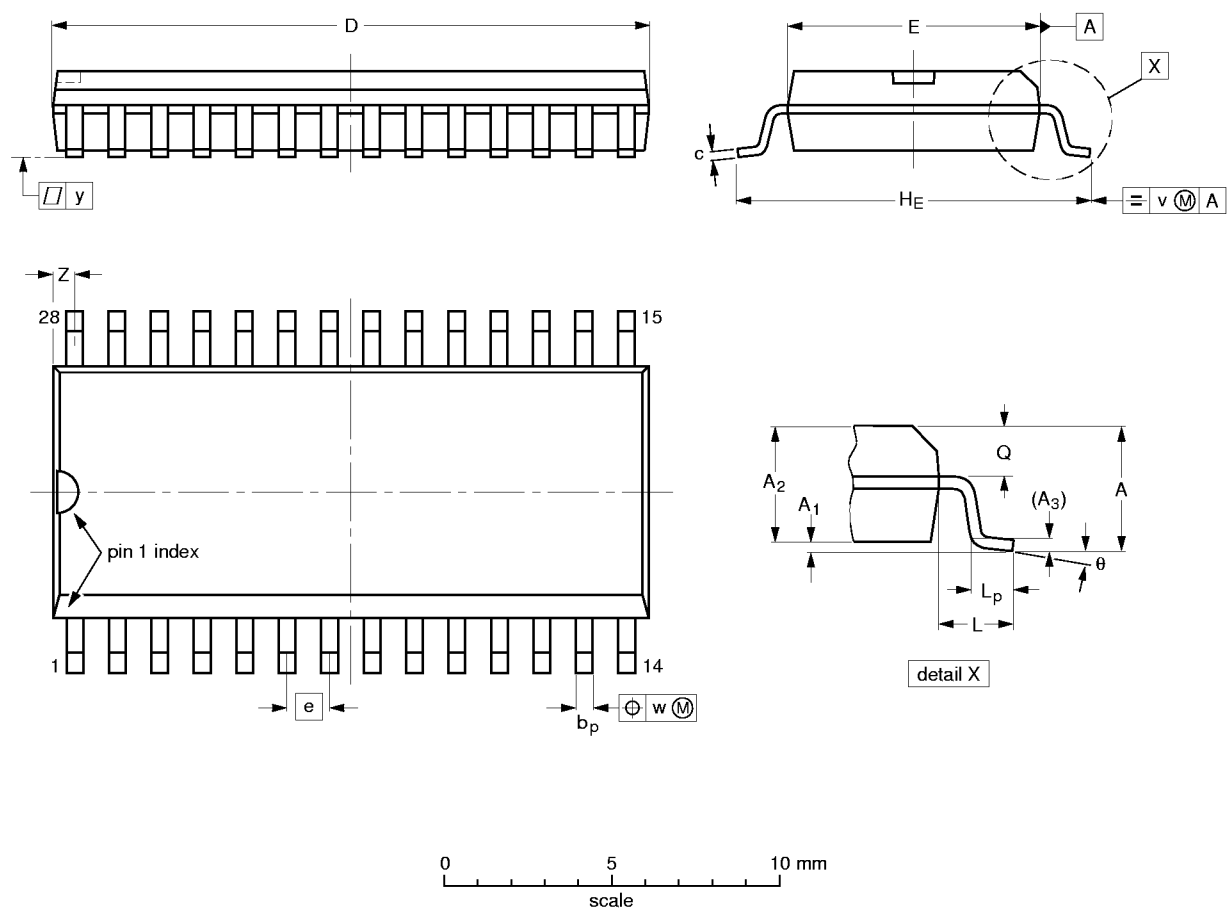1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT146-1			SC603			92-11-17 95-05-24

SO28: plastic small outline package; 28 leads; body width 7.5 mm

SOT136-1

DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A₁	A₂	A₃	bₚ	c	D(1)	E(1)	e	HE	L	Lₚ	Q	v	w	y	Z(1)	θ
mm	2.65	0.30 / 0.10	2.45 / 2.25	0.25	0.49 / 0.36	0.32 / 0.23	18.1 / 17.7	7.6 / 7.4	1.27	10.65 / 10.00	1.4	1.1 / 0.4	1.1 / 1.0	0.25	0.25	0.1	0.9 / 0.4	8° 0°
inches	0.10	0.012 / 0.004	0.096 / 0.089	0.01	0.019 / 0.014	0.013 / 0.009	0.71 / 0.69	0.30 / 0.29	0.050	0.42 / 0.39	0.055	0.043 / 0.016	0.043 / 0.039	0.01	0.01	0.004	0.035 / 0.016	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT136-1	075E06	MS-013AE				~~91-08-13~~ 95-01-24

15 SOLDERING

15.1 Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"IC Package Databook"* (order code 9398 652 90011).

15.2 DIP

15.2.1 SOLDERING BY DIPPING OR BY WAVE

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\ max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

15.2.2 REPAIRING SOLDERED JOINTS

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

15.3 SO

15.3.1 REFLOW SOLDERING

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

15.3.2 WAVE SOLDERING

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

15.3.3 REPAIRING SOLDERED JOINTS

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

16 DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	