

Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3; PCD3332-S

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1 FEATURES

- Pulse, DTMF and VT 'mixed mode' dialling
- 13 number repertory dial, up to 32 digits per number
 - 10 one-touch redial or 3 one-touch plus 10 two-touch
 - 250 digits maximum storage
- Last number redial up to 32 digits
- Repertory and redial memory integrity check (memory contents check)
- Notepad memory function
- Flash and Earth register recall
- Access pause generation and termination
- On-chip power-on reset
- Supports function keys as follows:
 - STORE: Program/Store
 - MRC: Memory Recall
 - FLASH: calibrated line-break pulse
 - LNR: Last Number Redial
 - PAUSE: insert access pause between stored digits
 - TONE: change from pulse to DTMF dialling (mixed mode)
 - VOL+/-: speaker/ringer volume control
 - 10 dedicated memory keys
- Strap functions (diode options):
 - MLA: Memory Location Access selection
 - RDS: Enable/Disable ringer validation delay (PCD3332-2)
 - DOO: enable/disable transmission * or # (PCD3332-3/S)
- F/E: register recall Flash or Earth
- M/S: Mark-to-Space ratio selection (3 : 2 or 2 : 1)
- APT: Access Pause Timing selection
- TBT: Tone Burst Time selection
- FTS: Flash Time Selection
- P/T: Pulse or Tone (DTMF) mode selection
- RMS: Ringer Melody Selection (PCD3332-2 and PCD3332-S)
- RFS: Ringer input frequency range selection (19.5 to 57 Hz or 14.4 to 68 Hz) (PCD3332-3)
- Ringer tone generator
- Ringer-input frequency discriminator
- Ringer melody selection via keypad
- Volume control for loudspeaker phones (PCD3332-3)
- On-hook dialling/hands-free mode control (PCD3332-3)
- Pacifier tones.

2 GENERAL DESCRIPTION

The PCD3332-2, PCD3332-3 and PCD3332-S are mixed-mode multistandard repertory dialler/ringer ICs, fabricated in a low threshold voltage CMOS technology. Dial parameters of these ICs can be set by diode options to meet the specific requirements for various countries. The on-chip tone generators are used for DTMF dialling and ringer melody generation. A discriminator input enables the tone output only if a correct ringer frequency is applied. Repertory numbers of up to 32 digits can be stored, with maximum storage of 250 digits.

3 ORDERING INFORMATION

| TYPE NUMBER | PACKAGE | | |
|----------------|---------|--|----------|
| | NAME | DESCRIPTION | VERSION |
| PCD3332-2P | DIP28 | plastic dual in-line package; 28 leads (600 mil) | SOT117-1 |
| PCD3332-2T | SO28 | plastic small outline package; 28 leads; body width 7.5 mm | SOT136-1 |
| PCD3332-3P | DIP28 | plastic dual in-line package; 28 leads (600 mil) | SOT117-1 |
| PCD3332-3T | SO28 | plastic small outline package; 28 leads; body width 7.5 mm | SOT136-1 |
| PCD3332-SP | DIP28 | plastic dual in-line package; 28 leads (600 mil) | SOT117-1 |
| PCD3332-ST | SO28 | plastic small outline package; 28 leads; body width 7.5 mm | SOT136-1 |

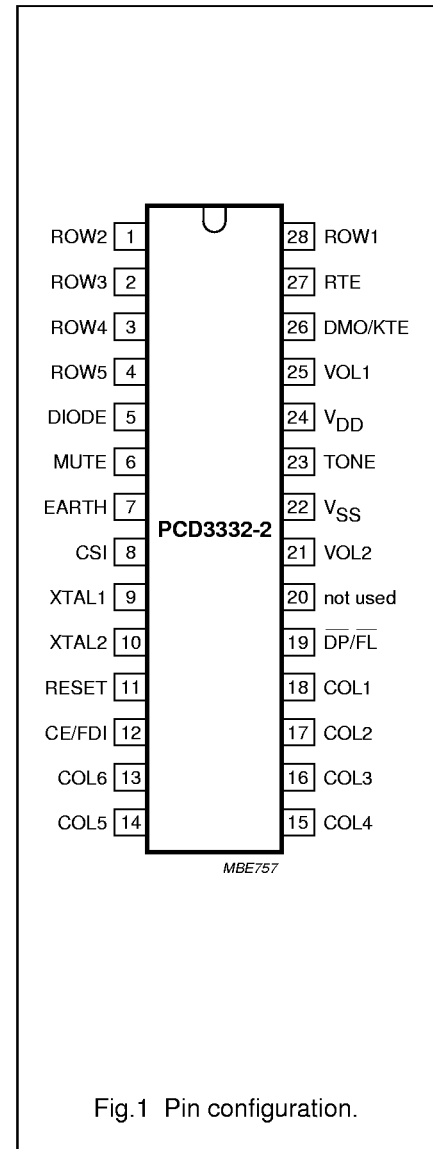
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4 PINNING

4.1 PCD3332-2

| SYMBOL | PIN | TYPE | DESCRIPTION |
|-----------------|-----|--------------------|-------------------------------------|
| ROW2 | 1 | I/O ⁽¹⁾ | row 2 keyboard output |
| ROW3 | 2 | I/O ⁽¹⁾ | row 3 keyboard output |
| ROW4 | 3 | I/O ⁽¹⁾ | row 4 keyboard output |
| ROW5 | 4 | O ⁽²⁾ | row 5 keyboard output |
| DIODE | 5 | I/O ⁽¹⁾ | diode option |
| MUTE | 6 | O ⁽⁴⁾ | mute output |
| EARTH | 7 | O ⁽⁴⁾ | earth recall |
| CSI | 8 | I | cradle switch input |
| XTAL1 | 9 | I | oscillator input |
| XTAL2 | 10 | O | oscillator output |
| RESET | 11 | I | reset input |
| CE/FDI | 12 | I | chip enable/frequency discriminator |
| COL6 | 13 | I/O ⁽¹⁾ | column 6 input |
| COL5 | 14 | I/O ⁽¹⁾ | column 5 input |
| COL4 | 15 | I/O ⁽¹⁾ | column 4 input |
| COL3 | 16 | I/O ⁽¹⁾ | column 3 input |
| COL2 | 17 | I/O ⁽¹⁾ | column 2 input |
| COL1 | 18 | I/O ⁽¹⁾ | column 1 input |
| DP/FL | 19 | O ⁽²⁾ | dial pulse/flash output |
| not used | 20 | O ⁽⁴⁾ | not used, leave pin unconnected |
| VOL2 | 21 | O ⁽³⁾ | volume 2 output |
| V _{SS} | 22 | P | ground |
| TONE | 23 | O | tone generator output |
| V _{DD} | 24 | P | positive supply voltage |
| VOL1 | 25 | O ⁽³⁾ | volume 1 output |
| DMO/KTE | 26 | O ⁽⁴⁾ | dial mode output |
| RTE | 27 | O ⁽⁴⁾ | key/ringer tone enable |
| ROW1 | 28 | I/O ⁽¹⁾ | row 1 keyboard output |



Notes on types and initial states of inputs and outputs

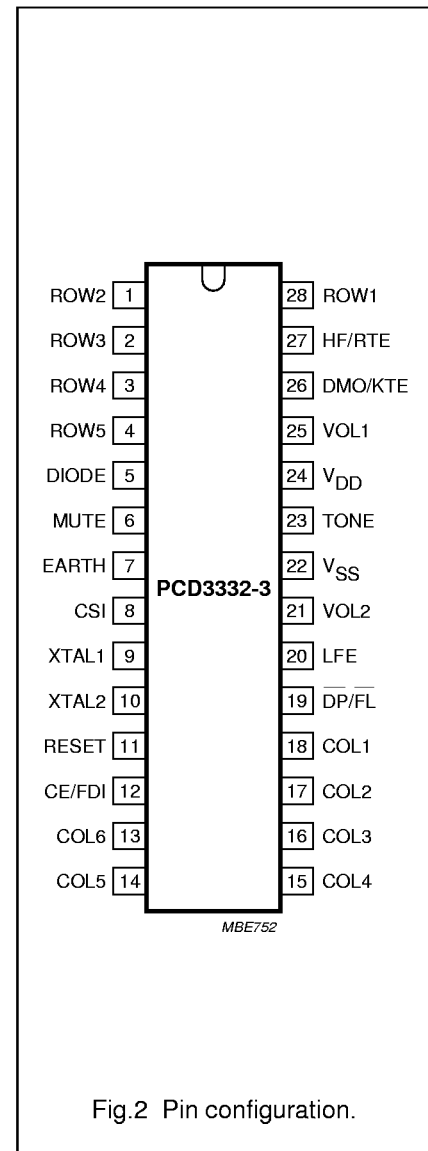
1. Standard input or output, set to HIGH state.
2. Open-drain output, set to HIGH state.
3. Open-drain output, reset to LOW state.
4. Push-pull output, reset to LOW state.

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4.2 PCD3332-3

| SYMBOL | PIN | TYPE | DESCRIPTION |
|-----------------|-----|--------------------|-------------------------------------|
| ROW2 | 1 | I/O ⁽¹⁾ | row 2 keyboard output |
| ROW3 | 2 | I/O ⁽¹⁾ | row 3 keyboard output |
| ROW4 | 3 | I/O ⁽¹⁾ | row 4 keyboard output |
| ROW5 | 4 | O ⁽²⁾ | row 5 keyboard output |
| DIODE | 5 | I/O ⁽¹⁾ | diode option |
| MUTE | 6 | O ⁽⁴⁾ | mute output |
| EARTH | 7 | O ⁽⁴⁾ | earth recall |
| CSI | 8 | I | cradle switch input |
| XTAL1 | 9 | I | oscillator input |
| XTAL2 | 10 | O | oscillator output |
| RESET | 11 | I | reset input |
| CE/FDI | 12 | I | chip enable/frequency discriminator |
| COL6 | 13 | I/O ⁽¹⁾ | column 6 input |
| COL5 | 14 | I/O ⁽¹⁾ | column 5 input |
| COL4 | 15 | I/O ⁽¹⁾ | column 4 input |
| COL3 | 16 | I/O ⁽¹⁾ | column 3 input |
| COL2 | 17 | I/O ⁽¹⁾ | column 2 input |
| COL1 | 18 | I/O ⁽¹⁾ | column 1 input |
| DP/FL | 19 | O ⁽²⁾ | dial pulse/flash output |
| LFE | 20 | O ⁽⁴⁾ | low-frequency amplifier enable |
| VOL2 | 21 | O ⁽³⁾ | volume 2 output |
| V _{SS} | 22 | P | ground |
| TONE | 23 | O | tone generator output |
| V _{DD} | 24 | P | positive supply voltage |
| VOL1 | 25 | O ⁽³⁾ | volume 1 output |
| DMO/KTE | 26 | O ⁽⁴⁾ | dial mode output |
| HF/RTE | 27 | O ⁽⁴⁾ | hands-free/ringer tone enable |
| ROW1 | 28 | I/O ⁽¹⁾ | row 1 keyboard output |



Notes on types and initial states of inputs and outputs

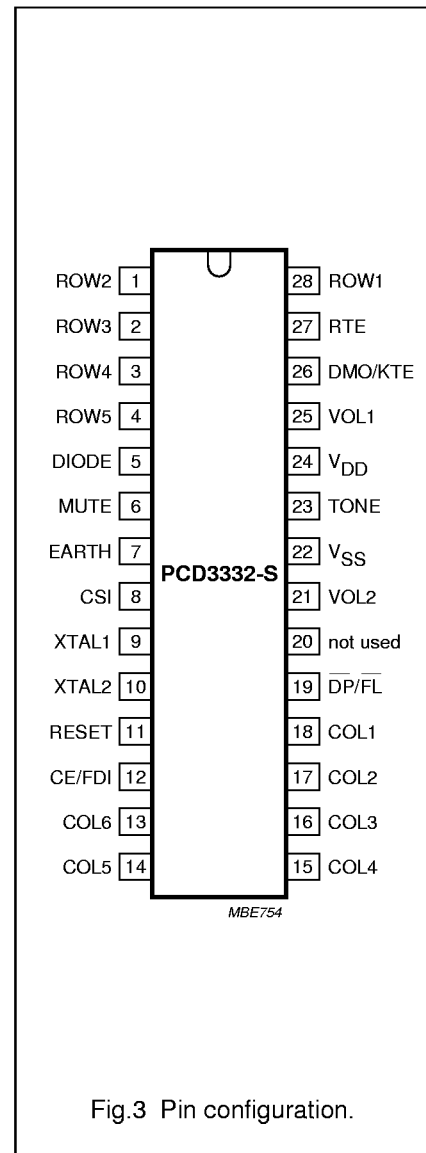
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2. Open-drain output, set to HIGH state.
3. Open-drain output, reset to LOW state.
4. Push-pull output, reset to LOW state.

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4.3 PCD3332-S

| SYMBOL | PIN | TYPE | DESCRIPTION |
|-----------------|-----|--------------------|-------------------------------------|
| ROW2 | 1 | I/O ⁽¹⁾ | row 2 keyboard output |
| ROW3 | 2 | I/O ⁽¹⁾ | row 3 keyboard output |
| ROW4 | 3 | I/O ⁽¹⁾ | row 4 keyboard output |
| ROW5 | 4 | O ⁽²⁾ | row 5 keyboard output |
| DIODE | 5 | I/O ⁽¹⁾ | diode option |
| MUTE | 6 | O ⁽⁴⁾ | mute output |
| EARTH | 7 | O ⁽⁴⁾ | earth recall |
| CSI | 8 | I | cradle switch input |
| XTAL1 | 9 | I | oscillator input |
| XTAL2 | 10 | O | oscillator output |
| RESET | 11 | I | reset input |
| CE/FDI | 12 | I | chip enable/frequency discriminator |
| COL6 | 13 | I/O ⁽¹⁾ | column 6 input |
| COL5 | 14 | I/O ⁽¹⁾ | column 5 input |
| COL4 | 15 | I/O ⁽¹⁾ | column 4 input |
| COL3 | 16 | I/O ⁽¹⁾ | column 3 input |
| COL2 | 17 | I/O ⁽¹⁾ | column 2 input |
| COL1 | 18 | I/O ⁽¹⁾ | column 1 input |
| DP/FL | 19 | O ⁽²⁾ | dial pulse/flash output |
| not used | 20 | O ⁽⁴⁾ | not used, leave pin unconnected |
| VOL2 | 21 | O ⁽³⁾ | volume 2 output |
| V _{SS} | 22 | P | ground |
| TONE | 23 | O | tone generator output |
| V _{DD} | 24 | P | positive supply voltage |
| VOL1 | 25 | O ⁽³⁾ | volume 1 output |
| DMO/KTE | 26 | O ⁽⁴⁾ | dial mode output |
| RTE | 27 | O ⁽⁴⁾ | key/ringer tone enable |
| ROW1 | 28 | I/O ⁽¹⁾ | row 1 keyboard output |



Notes on types and initial states of inputs and outputs

1. Standard input or output, set to HIGH state.
2. Open-drain output, set to HIGH state.
3. Open-drain output, reset to LOW state.
4. Push-pull output, reset to LOW state.

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5 FUNCTIONAL DESCRIPTION

References to the 'PCD3332' or the 'device' apply to the PCD3332-2, the PCD3332-3 and the PCD3332-S.

5.1 Pin description

5.1.1 SUPPLY TERMINALS (V_{DD} AND V_{SS})

To retain data in the RAM, the standby supply voltage of 1 V, must be maintained. To ensure that the contents of the RAM are secure in the event of a power failure, a capacitor may be connected across the supply terminals. The capacitor must have a suitable value to maintain the standby voltage for a certain period of time. The minimum operating voltage of these devices is 2.5 V. The internal power-on reset is enabled for a voltage below this minimum operating voltage.

5.1.2 OSCILLATOR INPUT/OUTPUT (XTAL1 AND XTAL2)

The time base for the PCD3332 is a crystal-controlled on-chip oscillator, which incorporates a 3.58 MHz crystal or ceramic resonator connected between XTAL1 and XTAL2. It should be noted that when using a ceramic resonator, the minimum supply voltage increases. The oscillator starts when V_{DD} reaches its operating voltage level and CE = HIGH (min. 2.5 V).

5.1.3 CHIP ENABLE AND FREQUENCY DISCRIMINATOR INPUT (CE/FDI)

For DC inputs this pin acts as the chip enable (CE) input, and is active HIGH. CE in combination with the Cradle Switch Input (CSI) determines the mode of the device. See Table 1.

For AC inputs the pin acts as the (ringer) Frequency Discriminator Input (FDI).

To generate a correct ringer output tone, the input frequency must be between 19.5 Hz and 57 Hz; frequencies below 18 Hz and higher than 64 Hz are omitted.

The PCD3332-3 has a second (diode selectable) range of valid input frequencies of 14.5 Hz to 68 Hz; frequencies below 14 Hz and higher than 76 Hz are omitted.

Ringer response timing and detection is illustrated in Fig.15.

5.1.4 CRADLE SWITCH INPUT (CSI)

CSI is normally generated from the physical 'off-hooking' of the phone. CSI in combination with CE/FDI determines the operating mode of the PCD3332, as shown in Table 1.

Table 1 Different modes of the PCD3332

| INPUT CSI | INPUT CE/FDI | PCD3332 STATUS |
|-----------|--------------|-------------------------------|
| LOW | LOW | stop or power-down mode |
| HIGH | LOW | idle mode |
| LOW | HIGH | ringer mode |
| HIGH | HIGH | conversation or off-hook mode |

5.1.5 RESET INPUT (RESET)

RESET activates the on-chip reset circuit and is active HIGH. The reset circuit initializes all inputs and outputs. Two other events will cause the chip to initialize:

- CE going HIGH
- V_{DD} falling below 2.5 V, then being restored (power-on reset).

For this reason, RESET may not be required, and can be connected to V_{SS} . This should preferably be via a 100 k Ω resistor, to save leakage current.

Note that a suitable capacitor connected between V_{DD} and V_{SS} will inhibit the decrease of voltage at V_{DD} after a power failure, and thus extend the time until the power-on reset is initiated.

5.1.6 PULSE DIAL AND FLASH OUTPUT ($\overline{DP}/\overline{FL}$)

This pin is the output for:

- The dial pulse sequence (\overline{DP})
- The calibrated LOW pulse (\overline{FL}) after the FLASH key is pressed.

The dialling sequence for pulse dialling is shown in Figs 11 and 12. $\overline{DP}/\overline{FL}$ starts HIGH, pulses are LOW, and the inter-digit pauses are HIGH. Thus, $\overline{DP}/\overline{FL}$ is HIGH during a line-make and LOW during a line-break.

If the Flash/Earth diode option is set to FLASH, then when FLASH is pressed a LOW pulse is output, with a calibrated duration also determined by diode option.

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5.1.7 MUTE OUTPUT (MUTE)

During the dialling sequence this push-pull output is activated. In the pulse dialling mode, MUTE goes HIGH prior to the dialling action and goes LOW after the last t_{idp} (interdigit pause), see Figs 11 and 12. In DTMF dialling, MUTE goes HIGH prior to the dialling action and goes LOW after an additional 'holdover' time, see Figs 13 and 14.

This output is also activated if the device enters the programming mode, to avoid transmitting the keys entered.

5.1.8 DTMF OUTPUT (TONE)

The timing sequence for DTMF dialling is illustrated in Figs 13 and 14. The tones generated by this TONE are filtered by an on-chip switched capacitor filter, and active

RC low-pass filter. Therefore, the total harmonic distortion fulfils the CEPT CS203 recommendations. An on-chip reference voltage provides output tone levels independent of supply voltages and temperatures. Spread among the individual parts is extremely low.

The DC level of the TONE output measures $0.5V_{DD}$ and the impedance is $100\ \Omega$ (typ.). Table 2 shows the frequency tolerances.

The TONE output is also used to generate the ringer melody, key entry acceptance beep, error or warning beeps and confirmation beeps. These beeps are generated/set in programming mode as a response to the users action. The ringer is designed to generate 3-melodies that may be selected using the keyboard. Table 3 shows the implemented ringer melodies.

Table 2 DTMF frequency tolerances

| ROW/COL | STANDARD FREQUENCY (Hz) | OUTPUT FREQUENCY (Hz) | DEVIATION (%) | DEVIATION (Hz) |
|---------|----------------------------|--------------------------|------------------|-------------------|
| ROW 1 | 697 | 697.90 | +0.13 | +0.90 |
| ROW 2 | 770 | 770.46 | +0.06 | +0.46 |
| ROW 3 | 852 | 852.45 | -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 |

Table 3 Ringer melodies

| KEY DEPRESSED | TONE 1 (Hz) | TONE 2 (Hz) | TONE 3 (Hz) | TONE ON TIME (ms) |
|---------------|-------------|-------------|-------------|-------------------|
| 1 | 826 | 925 | 1037 | 30 |
| 2 | 1037 | 1161 | 1297 | 30 |
| 3 | 1297 | 1455 | 1621 | 30 |

Table 4 Beep frequencies

| BEEP FUNCTION | TONE 1 (Hz) | TONE 2 (Hz) | TONE 3 (Hz) | TONE ON TIME (ms) | TONE OFF TIME (ms) |
|---------------|-------------|-------------|-------------|-------------------|--------------------|
| Key accept | 2358 | — | — | 40 | — |
| Error | 2358 | 2358 | 2358 | 134 | 35 |
| Confirmation | 806 | 899 | 1010 | 134 | 67 |

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5.1.9 REGISTER RECALL (EARTH)

If the Flash/Earth diode option of the PCD3332 is set to the Earth, then dialling the EARTH either out of Repertory/LNR or by pressing the FLASH key will generate a HIGH pulse at the push-pull output EARTH for a calibrated time. Figures 12 and 14 illustrate the EARTH timing relationship with other signals. The calibrated EARTH time is followed by an interdigit time t_{idp} . A second dialling of EARTH can only be performed after the interdigit time has elapsed.

If the Flash key was the first key depressed directly after going off-hook, followed by a second depressing of the Flash key while the EARTH is still in progress, then the second depression will be ignored.

5.1.10 RINGER TONE ENABLE (RTE: PCD3332-2/S)

The PCD3332-2 and PCD3332-S generate tones for the ringer output stage and key tones when depressing a function key at the keypad. Output RTE will go HIGH and stay HIGH for the duration of the tone generated at output TONE.

5.1.11 HANDS-FREE/RINGER TONE ENABLE (HF/RTE: PCD3332-3)

The PCD3332-3 generates tones for the ringer output stage and key tones when depressing a function key at the keypad. Output HF/RTE will go HIGH and stay HIGH for the duration of the tone generated at output TONE.

During the conversation mode, HF/RTE is used for enabling the hands-free mode. Depressing the HOOK key will change the operation mode as follows:

- Change from on-hook (stop mode) to hands-free mode
- Toggles the listening-in mode
- Change from handset to hands-free.

5.1.12 VOLUME CONTROL OUTPUTS (VOL1 AND VOL2)

5.1.12.1 PCD3332-2

The PCD3332-2 has the facility to control the ringer output signal, as well as the loudspeaker volume, by depressing the keys */VOL– or #/ VOL+ during the ringer mode.

If the maximum volume level is reached, depressing #/VOL+ key will not change the volume setting. If the minimum volume level is reached, depressing */VOL– key will not change the volume setting. Selection between ringer volume or conversation mode volume, is performed in the hardware using the RTE output. In the ringer mode the output RTE is HIGH.

Table 5 shows the volume outputs setting, as well as the default setting in case of a power failure or if the power is supplied for the first time.

5.1.12.2 PCD3332-3

The PCD3332-3 has the facility to control the ringer output signal and the loudspeaker signal during listening-in or hands-free operation. Depressing the keys VOL– or VOL+ during the ringer mode will change the ringer volume setting. Depressing the keys VOL– or VOL+ during the conversation mode will change the loudspeaker volume setting.

If the maximum volume level is reached, depressing the VOL+ key will not change the volume setting. If the minimum volume level is reached, depressing the VOL– key will not change the volume setting. Selection between ringer volume or conversation mode volume, is performed in the hardware using the HF/RTE output. In the ringer mode the output HF/RTE is HIGH.

Table 5 shows the volume outputs setting, as well as the default setting in case of a power failure or if the power is supplied for the first time.

5.1.12.3 PCD3332-S

The PCD3332-S has the facility to control the ringer output signal by depressing the keys VOL– or VOL+ during the ringer mode.

If the maximum volume level is reached, depressing the VOL+ key will not change the volume setting. If the minimum volume level is reached, depressing the VOL– key will not change the volume setting. Selection between ringer volume or conversation mode volume, is performed in the hardware using the RTE output. In the ringer mode the output RTE is HIGH.

Table 5 shows the volume outputs setting, as well as the default setting in case of a power failure or if the power is supplied for the first time.

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5.1.13 RINGER VOLUME SETTINGS

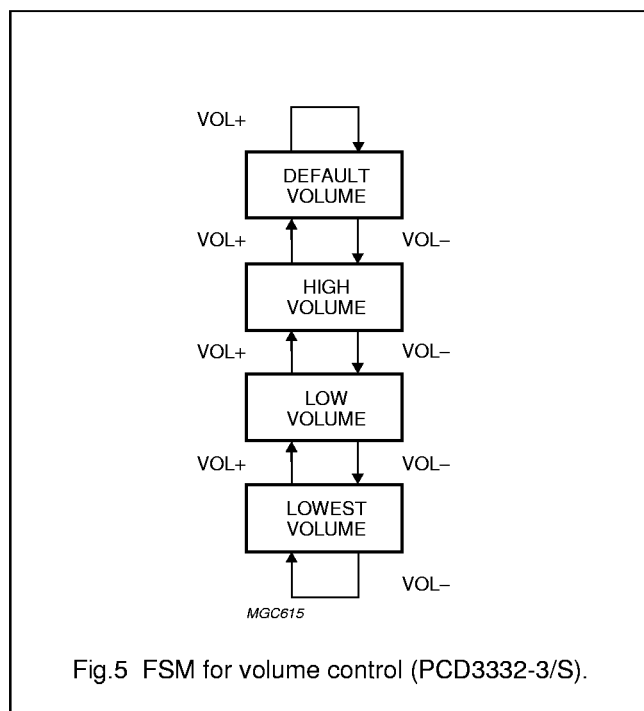
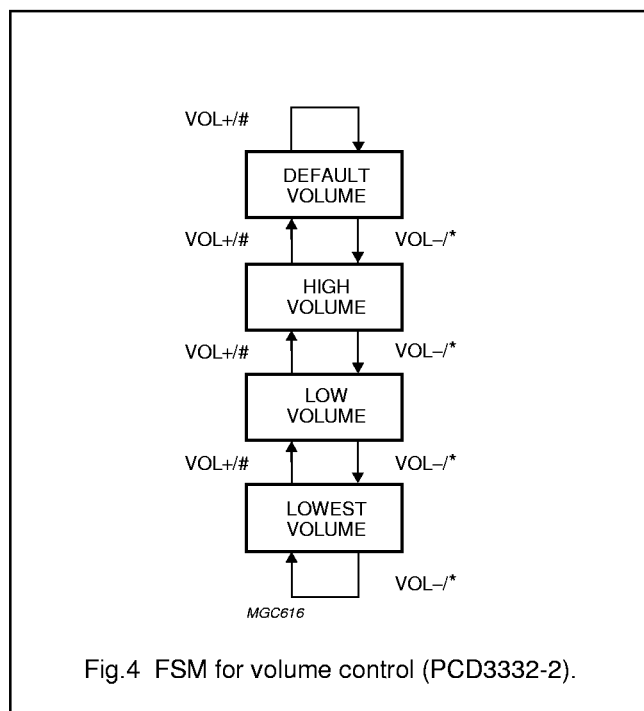


Table 5 State assignment

| STATE | VOL2 | VOL1 |
|------------------------|------|------|
| Default volume setting | HIGH | HIGH |
| High volume setting | HIGH | LOW |
| Low volume setting | LOW | HIGH |
| Lowest volume setting | LOW | LOW |

5.1.14 DIAL MODE OUTPUT /KEY-TONE ENABLE (DMO/KTE)

In the PULSE dialling mode the DMO/KTE output is activated (HIGH), at dialling the Make/Brake pulse dial sequences. Figures 11 and 12 illustrate the signal timing relationship.

In the programming mode, the DMO/KTE output is activated at the same time the key beeps are generated at output TONE and may be used to enable the key tone to the earpiece amplifier.

5.1.15 KEYBOARD INPUTS/OUTPUTS

A single contact keyboard with a maximum of 6 columns and 5 rows can be connected to the PCD3332-2.

The keyboard scanning is started if a key depression is detected. The rows are scanned while the columns are used as sense inputs.

To overcome key bouncing, a debounce on/off time of approximately 14 to 20 ms is implemented.

Only one single key depression is validated and accepted at any one time. Once a key is accepted the keyboard scanning is continued until no further keys are depressed. This means that if a key is accepted but still depressed while a second key is entered, the second key depression is ignored. Also, if two or more keys are depressed within the debounce time while no key is yet accepted, all keys are ignored.

Keyboard detection is also performed in the ringer mode to enable the ringer volume setting and ringer melody selection.

In the on-hook mode or power-down mode of the PCD3332-2 and PCD3332-S, the keyboard I/Os are set to HIGH except ROW 5 which is set to LOW.

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PCD3332-S

In the on-hook mode or power-down mode of the PCD3332-3, the keyboard I/Os are set to HIGH except ROW 5 which is set to LOW. In this instance, depression of the HOOK key can be detected by the external hardware circuitry and converted to an active HIGH signal which is passed to CE in order to 'wake-up' the PCD3332-3.
When the HOOK key has been accepted the PCD3332-3 enters the hands-free mode.

ROW 5 was used to detect the HOOK key, this function is deleted.
ROW 5 is an open-drain input, this configuration is used to avoid current flowing in the on-hook mode or power-down mode. A pull-up resistor should be connected to ROW 5.
The keyboards which the PCD3332-2, PCD3332-3 and PCD3332-S support are shown in Figs 6, 7 and 8 respectively. The figures also show the diode options as 'dotted' keys.

5.2 Keyboards

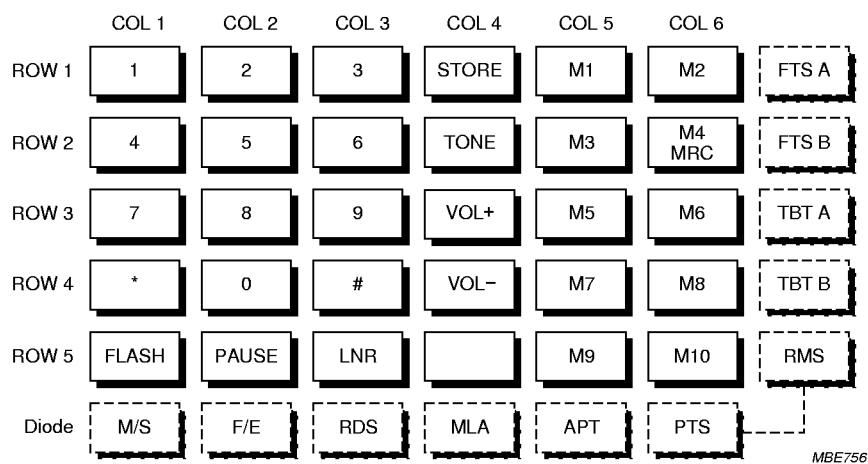


Fig.6 Keyboard layout (PCD3332-2).

Multistandard pulse/tone repertory
diallers/ringers

PCD3332-2; PCD3332-3;
PCD3332-S

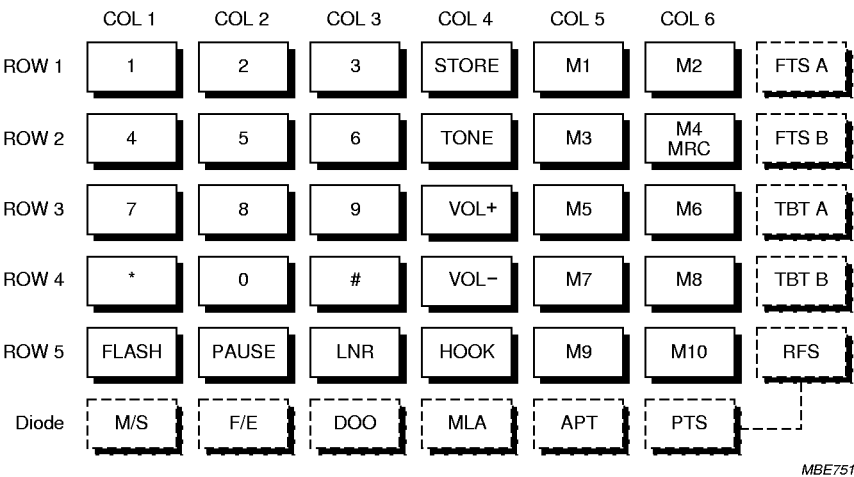


Fig.7 Keyboard layout (PCD3332-3).

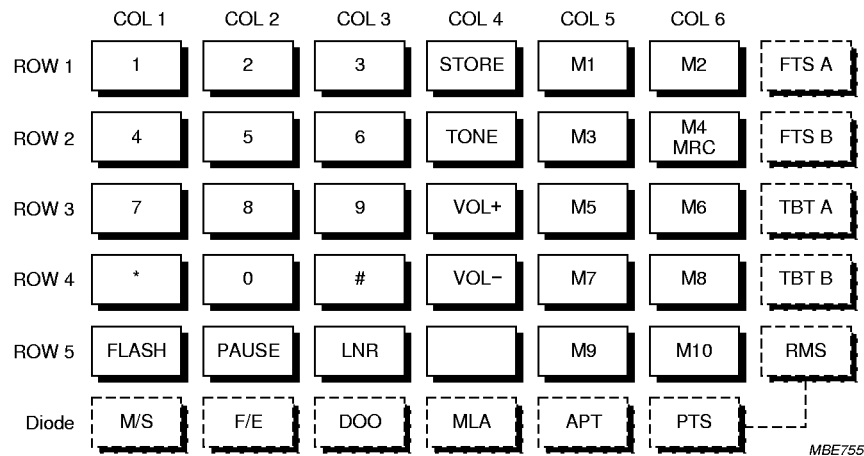


Fig.8 Keyboard layout (PCD3332-S).

Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3; PCD3332-S

5.2.1 KEYBOARD FUNCTION KEYS

5.2.1.1 LNR

If the first key operated after CE = HIGH (off-hook) is key LNR the PCD3332 will transmit the last number dialled before CE was LOW (on-hook).

5.2.1.2 PAUSE

Pressing the PAUSE key will insert an access pause during manual dialling and/or during programming. During manual dialling the pause time is not dialled, but is stored in the redial memory. This means that with manual dialling the user actually waits for the dial tone before dialling is continued. Repertory and LNR dialling however, will dial out the access pause. If the pause key is depressed while an access pause is being dialled, the access pause in progress is terminated and dialling will continue at the next non-access pause digit. The access pause duration is option selectable.

5.2.1.3 TONE (mixed mode dialling)

If the pulse dial mode is selected by the diode option, then pressing the 'TONE', '*' or '#' keys will change the dial mode to DTMF. Pressing the Flash key or going on-hook will restore the pulse dial mode.

5.2.1.4 RECALL (Flash or Earth)

Depressing the FLASH key will activate output $\overline{DP}/\overline{FL}$ or output EARTH for the calibrated time, depending on which function Flash or Earth is selected.

5.2.1.5 STORE

Pressing the STORE key will start/stop the programming mode. To inhibit transmitting the key entries while in programming mode, the output and MUTE is activated.

5.2.1.6 MRC

In order to access one of the memory locations, the MRC key must be depressed followed by one of the numerical keys 0 to 9. To enable the MRC key, diode option MLA must be disconnected.

5.2.1.7 VOL- and VOL+

For the PCD3332-3's 'hands-free' and 'listening-in' modes, where the loudspeaker is on, the VOL keys control the loudspeaker volume. In the ringer mode (all devices), the VOL keys control the ringer volume.

At power-on reset a default volume is preset for both the loudspeaker and the ringer volume.

5.2.2 DIODE OPTIONS

Table 6 Tone Burst Time diode configuration

| TBT A DIODE | TBT B DIODE | SELECTED TIMING (ms) |
|---------------|---------------|----------------------|
| Not connected | not connected | 70/70 |
| Not connected | connected | 100/100 |
| Connected | not connected | 85/85 |
| Connected | connected | 70/140 |

Table 7 Flash time select diode configuration

| FTS A DIODE | FTS B DIODE | SELECTED TIMING (ms) |
|---------------|---------------|----------------------|
| Not connected | not connected | 95 |
| Not connected | connected | 115 |
| Connected | not connected | 270 |
| Connected | connected | 600 |

Table 8 Flash/Earth diode configuration

| F/E DIODE | SELECTED MODE |
|---------------|----------------|
| Not connected | Flash |
| Connected | Earth (400 ms) |

Table 9 Mark/space diode configuration

| M/S DIODE | SELECTED MAKE/BRAKE RATIO (ms) |
|---------------|--------------------------------|
| Not connected | 33/66 (1 : 2) |
| Connected | 40/60 (2 : 3) |

Table 10 Pulse/tone diode configuration

| P/T DIODE | SELECTED DIAL MODE |
|---------------|--------------------|
| Not connected | DTMF |
| Connected | Pulse |

Table 11 Access Pause Time diode configuration

| APT DIODE | SELECTED TIMING (s) |
|---------------|---------------------|
| Not connected | 2 |
| Connected | 4 |

Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3; PCD3332-S

Table 12 Ringer melody selection (PCD3331-2/S)

| RMS DIODE | RINGER FREQUENCY SELECTION (Hz) |
|---------------|--|
| Not connected | ringer melody selection by keys 1, 2 and 3 |
| Connected | default ringer melody |

Table 13 Ringer input frequency selection (PCD3332-3)

| RFS DIODE | RINGER FREQUENCY SELECTION (Hz) |
|---------------|---------------------------------|
| Not connected | 19.5 to 54 |
| Connected | 14.5 to 68 |

Table 14 Memory Location Access diode configuration

| MLA DIODE | KEY FUNCTION |
|---------------|-------------------|
| Not connected | M4/MRC key is MRC |
| Connected | M4/MRC key is M4 |

Table 15 Ringer Delay Selection diode configuration (PCD3332-2)

| RDS DIODE | OUTPUT SELECTION |
|---------------|---------------------------------|
| Not connected | no delay |
| Connected | ringer validation delay, 100 ms |

Table 16 DTMF output option diode configuration (PCD3332-3/S)

| DOO DIODE | OUTPUT SELECTION |
|---------------|------------------------|
| Not connected | no transmission of */# |
| Connected | transmission of */# |

5.2.2.1 Ringer Delay Selection (RDS: PCD3332-2)

If the diode is connected, then the actual ringer frequency validation is started after a delay of 100 ms. This is only performed at the start of each ringer burst signal.

5.2.2.2 DOO DTMF output selection (PCD3332-3/S)

If the diode is connected, then the * and # DTMF signals will be dialled out during pulse-to-tone switching. If the diode is not connected * and # will not be dialled out during pulse-to-tone switching.

5.2.2.3 Ringer Melody Selection (RMS: PCD3332-2/S)

The ringer melody for these devices can be changed by depressing keys 1, 2 and 3. To give default melody only, apply a diode at RMS location.

5.2.2.4 Ringer Input Frequency Range Selection (RFS: PCD3332-3)

For the PCD3332-3, this diode is used to select between two input frequency ranges, 19.5 to 54 Hz or 14.5 to 68 Hz.

5.2.2.5 Memory Location Access (MLA)

To be able to build various telephone models by using the PCD3332, a possibility has been created to define different keypad layouts. e.g. a 13 number repertory dial consist of 10 numbers recalled via MRC + 0 to 9, and 3 direct access numbers M1, M2 and M3. A 10 number direct accessible dialler can be created by applying the keys M1 to M10 while a diode is connected at the MLA location.

5.2.2.6 Mark-to-Space ratio (M/S)

Changes the make-break ratio from 60 : 40 ms (3 : 2) to 66 : 33 ms (2 : 1).

5.2.2.7 Access Pause Time (APT)

To adapt the access pause timing to local requirements, 2 different times for DTMF and the corresponding times for pulse dialling are built-in.

5.2.2.8 Tone Burst Time (TBT)

During automatic transmission of a number in the DTMF mode the tone-on time and the pause time between two digits can be selected by option TBT A and TBT B. During manual dialling this option selects the minimum tone-on and pause time while the maximum time is determined by the time a key is depressed.

5.2.2.9 Pulse/Tone mode Selection (PTS)

The telephone set can be initially set to the PULSE or DTMF mode by switching on and off the diode in the matrix.

The first entry of keys * and # in the pulse dial mode will change the dial mode as well.

5.2.2.10 Flash or Earth register recall (F/E)

Dependent on this option, the output $\overline{DP/FL}$ or output EARTH will be activated after a flash key operation.

Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3; PCD3332-S

5.2.2.11 Flash Time Select

These two diodes set the calibrated flash pulse duration: 100, 115, 270 or 600 ms for the $\overline{DP/FL}$ output, when this output is selected. When the EARTH output is selected the earth pulse is 400 ms.

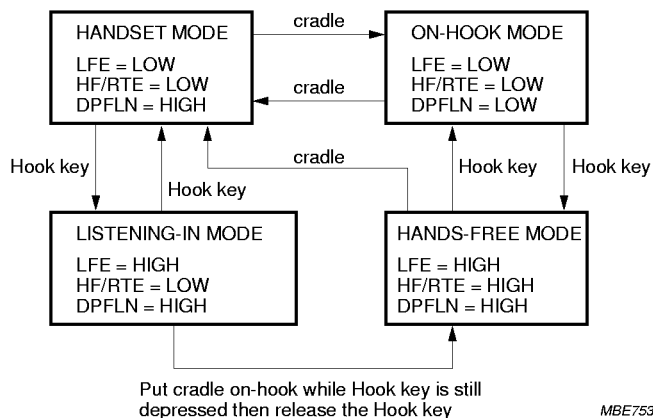
5.2.2.12 Low Frequency amplifier Enable (LFE: PCD3332-3)

Output LFE can be used to enable the TEA108x or TEA109x listening-in or hands-free IC. The HOOK key functions as a toggle to control the hands-free mode (LFE = LOW) or listening-in mode (LFE = HIGH). while in

the off-hook condition the key can be pressed and kept down to replace the handset while saving the LFE and $\overline{DP/FL}$ selection.

5.2.3 HOOK MODES

Figure 9 illustrates the different HOOK modes and how those modes are entered (PCD3332-3). For the PCD3332-2/S only the 'handset' mode and 'on-hook' mode are valid.



For PCD3332-2 and PCD3332-S, only the 'handset mode' and 'on-hook mode' are valid.

Fig.9 Schematic diagram of the HOOK modes.

Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3; PCD3332-S

6 OPERATING PROCEDURES

6.1 Operating modes

The PCD3332-2/S has 4 operating modes:

1. On-hook mode or ringer mode
2. Off-hook mode or conversation mode
3. Programming mode or store mode
4. Dial mode.

The PCD3332-3 has 4 operating modes:

1. On-hook mode or ringer mode
2. Conversation mode which is divided into hands-free mode and listening-in mode
3. Programming mode or store mode
4. Dial mode.

6.1.1 ON-HOOK MODE OR RINGER MODE

When the chip enable input CE/FDI is LOW the PCD3332 is disabled. In the standby mode, the only current drawn is for memory retention of the redial digits. During the

standby mode all keyboard pins are HIGH, except ROW 5 which is set to LOW.

6.1.2 DIAL MODE

Lifting the cradle (handset) or pressing the hook key will put the set in the conversation mode, an accepted key entry is processed and may initiate the following:

- Dialling the digits entered
- Redialling the previously entered digits
- Dialling out a repertory memory
- Enter programming mode.

6.1.3 RESET DELAY TIME

All modes, except for the ringer mode, are terminated by a line break (CE is deactivated), or by going on-hook. If this condition is detected, the reset delay time is initiated.

The set will not enter the on-hook state unless the reset delay has expired. In the event of a line break, the set will remain in the actual operation mode if the line-break is ended while the reset delay is still in progress (see Fig. 10).

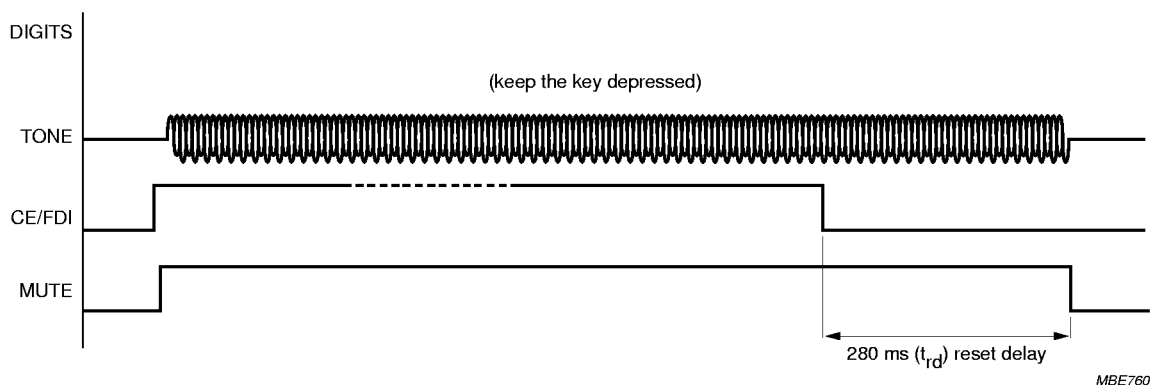
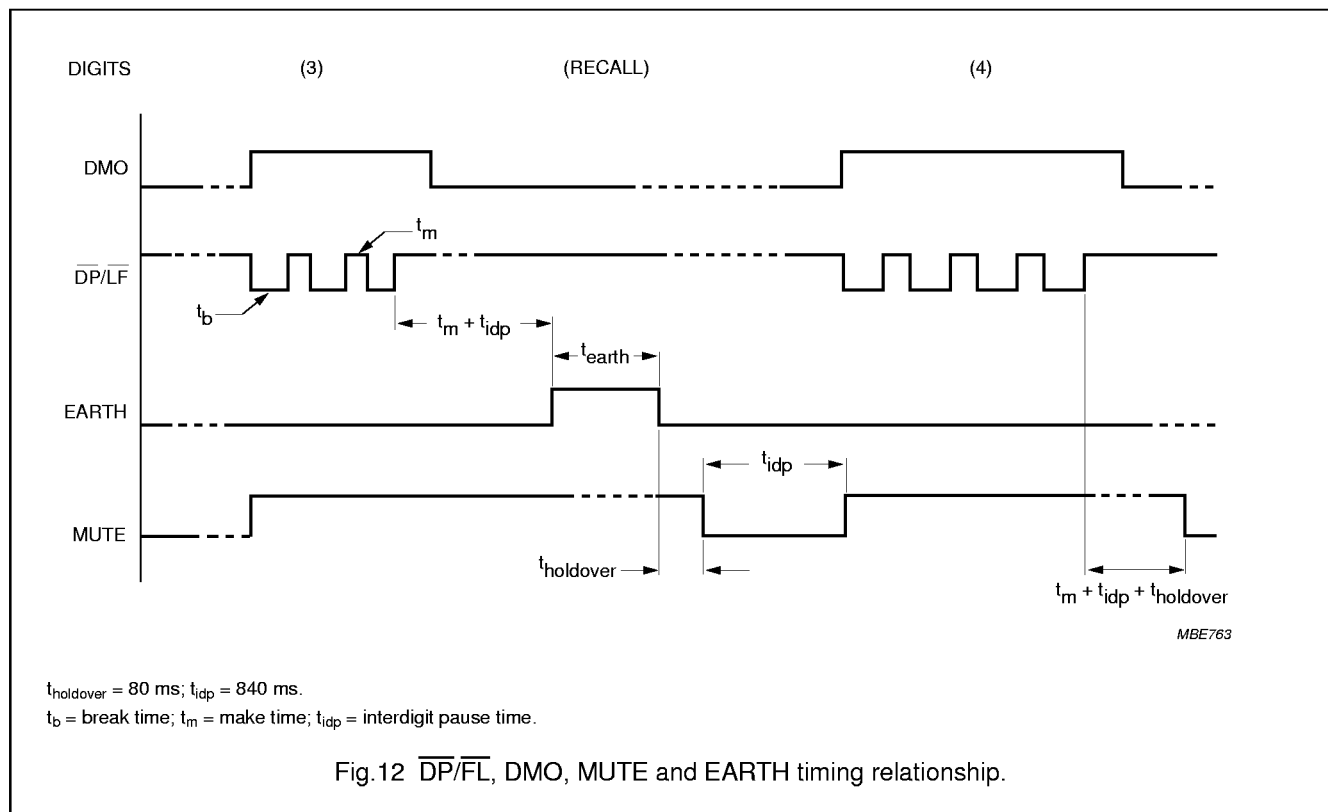
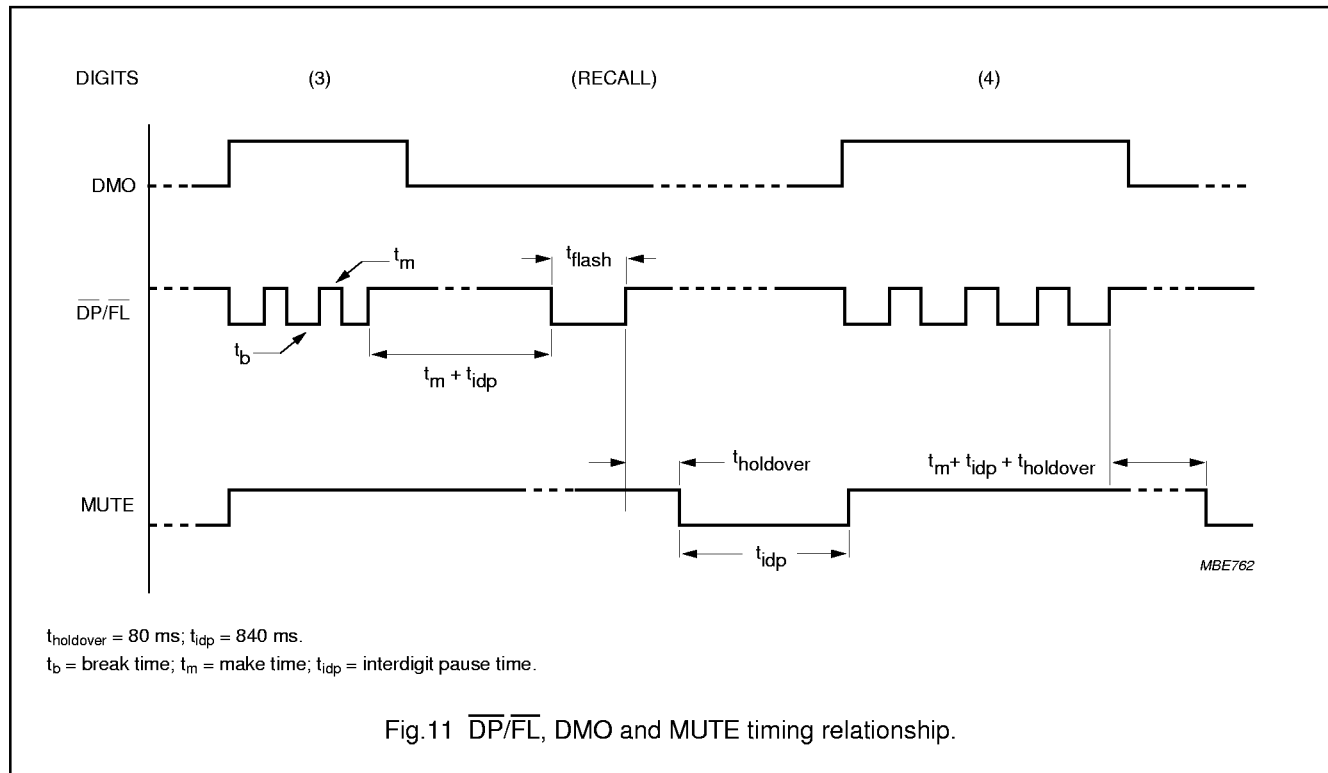


Fig.10 Reset delay timing relationship.

Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3;
PCD3332-S

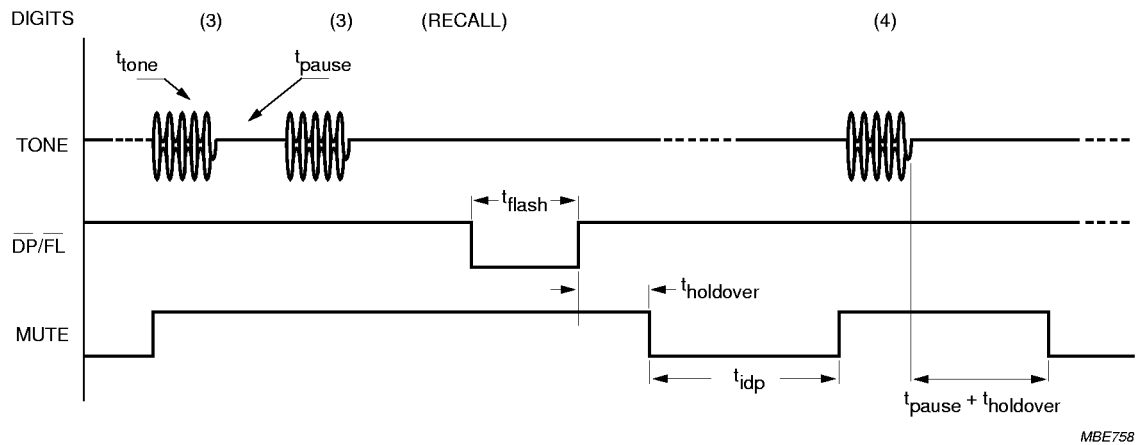
6.1.3.1 Pulse dialling (PTS = ON)



Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3;
PCD3332-S

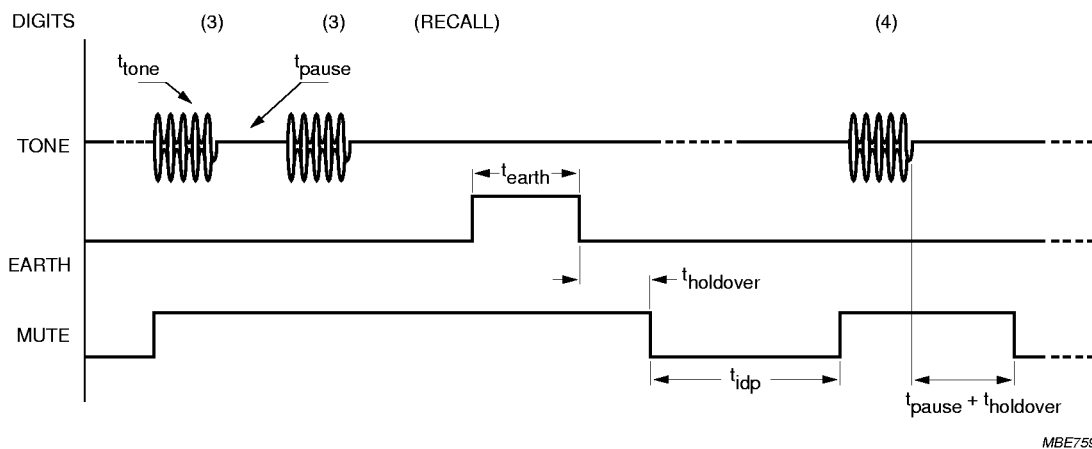
6.1.3.2 DTMF dialling (PTS = OFF)



$t_{\text{holdover}} = 80 \text{ ms}$; $t_{\text{idp}} = 840 \text{ ms}$.

t_{idp} = interdigit pause time.

Fig.13 $\overline{\text{DP/FL}}$, MUTE and TONE timing relationship.



$t_{\text{holdover}} = 80 \text{ ms}$; $t_{\text{idp}} (\text{flash} - \text{idp}) = 840 \text{ ms}$.

t_{idp} = interdigit pause time.

Fig.14 TONE, MUTE and EARTH timing relationship.

Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3; PCD3332-S

6.1.3.3 Manual dialling

During digit entry, the device immediately starts to transmit the digit(s). The minimum transmission time is unaffected by the speed of entry. Transmission continues as long as further data input has to be processed. Up to 32 digits can be stored in the redial register.

After the main register overflows, a 10 digits First-In First-Out register (FIFO) takes over as buffer. After transmitting the first digit of the FIFO register this position is automatically cleared to provide space for storing new data. In this way, the total number of digits which can be transmitted is unlimited, provided the key-in rate is not excessive.

If the key-in rate causes both the redial register and FIFO register to overflow, the PCD3332-2 will return to the conversation mode and no keyboard entries will be accepted.

6.1.3.4 Last number redial

If the first key entered is the LNR key, the stored LNR number is dialled out. LNR can hold a maximum of 32 digits. LNR is inhibited if more than 32 digits are entered, normal dialling however is continued.

LNR functional examples:

↓ = Go on-hook

↑ = Go off-hook

Table 17 LNR capacity

| INPUT | OUTPUT |
|--|---|
| ↑, [1], [2], [3], [4], [5], [6], [7], [8], [9], [0], [1], [2], [3], [4], [5], [6], [7], [8], [9], [0], [1], [2], [3], [4], [5], [6], [7], [8], [9], [0], [1], [2], ↓ | DTMF: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2 |
| ↑, [LNR], ↓ | DTMF: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2 |
| ↑, [LNR], [0], ↓ | DTMF: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2, 0 |
| ↑, [LNR], ↓ | nothing dialled |

Table 18 LNR after programming

| INPUT | OUTPUT |
|---|---|
| ↑, [1], [2], [3], [4], [5], ↓ | DTMF: 1, 2, 3, 4, 5 |
| ↑, [LNR], ↓ | DTMF: 1, 2, 3, 4, 5 |
| ↓, ↑, [STORE] [5], [4], [3], [2], [1], [STORE], [M1], ↓ | beep for each entry (confirmation beep) |
| ↑, [LNR], ↓ | nothing dialled |

Table 19 LNR sliding cursor

| INPUT (M1 = 1, 2, 3, 4 or 5) | OUTPUT |
|--|------------------------------------|
| ↑, [1], [2], [3], [4], [5], [6], [7], [8], [9], [0], ↓ | DTMF: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0 |
| ↑, [1], [2], [3], [LNR], ↓ | DTMF: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0 |
| ↑, [STORE] [5], [4], [3], [2], [1], [STORE], [M1] ↓ | DTMF: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0 |
| ↑, [M1], Wait for end of dial, [M1], ↓ | DTMF: 1, 2, 3, 4, 5, 1, 2, 3, 4, 5 |
| ↑[1], [2], [3], [LNR], ↓ | DTMF: 1, 2, 3, 4, 5, 1, 2, 3, 4, 5 |
| ↑[2], [3], [LNR], ↓ | DTMF: 2, 3 |
| ↑[2], [3], [LNR], ↓ | DTMF: 2, 3 |

Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3;
PCD3332-S

Table 20 LNR if *, #, Tone, and recall is entered in DTMF mode

| INPUT | OUTPUT |
|--|----------------------------------|
| ↑ [1], [2], [*], [3], [4], [Recall], [6], [7], ↓ | DTMF: 1, 2, *, 3, 4, Flash, 6, 7 |
| ↑, [LNR], ↓ | DTMF: Flash, 6, 7 |
| ↑ [Recall], Wait 0.5 sec, [Recall], Wait 0.5 sec, [Recall], [1], [2], [3], ↓ | Flash, Flash, Flash, 1, 2, 3 |
| ↑ [LNR], ↓ | Flash, 1, 2, 3 |
| ↑ [1], [2], [3], [Recall], [3], [2], [1], ↓ | 1, 2, 3, Flash, 3, 2, 1 |
| ↑ [LNR], ↓ | Flash, 3, 2, 1 |
| ↑ [1], [2], [3], [Recall], [*], [3], [2], [1], ↓ | 1, 2, 3, Flash, *, 3, 2, 1 |
| ↑ [LNR], ↓ | *, 3, 2, 1 |
| ↑ [*], [1], [2], [3], [Recall], [3], [2], [1], ↓ | *, 1, 2, 3, Flash, 3, 2, 1 |
| ↑ [LNR], ↓ | Flash, 3, 2, 1 |
| ↑ [*], [1], [2], [3], [Recall], [*], [3], [2], [1], ↓ | *, 1, 2, 3, Flash, 3, 2, 1 |
| ↑ [LNR], ↓ | Flash, 3, 2, 1 |

Table 21 LNR if *, #, Tone, and recall is entered in PULSE mode

| INPUT | OUTPUT |
|--|---|
| ↑ [1], [2], [*], [3], [4], [Recall], [6], [7], ↓ | PULSE: 1, 2, DTMF: 3, 4, Earth, PULSE: 6, 7 |
| ↑ [LNR], ↓ | PULSE: 1, 2 |
| ↑ [Recall], Wait 0.5 sec, [Recall], Wait 0.5 sec, [Recall], [1], [2], [3], ↓ | PULSE: Earth, Earth, Earth, 1, 2, 3 |
| ↑ [LNR], ↓ | PULSE: Earth, 1, 2, 3 |
| ↑ [1], [2], [3], [Recall], [3], [2], [1], ↓ | PULSE: 1, 2, 3, Earth, 3, 2, 1 |
| ↑ [LNR], ↓ | PULSE: Earth, 3, 2, 1 |
| ↑ [1], [2], [3], [Recall], [*], [3], [2], [1], ↓ | PULSE: 1, 2, 3, Earth, DTMF: 3, 2, 1 |
| ↑ [LNR], ↓ | PULSE: 1, 2, 3 |
| ↑ [*], [1], [2], [3], [Recall], [3], [2], [1], ↓ | DTMF: 1, 2, 3, Earth, PULSE: 3, 2, 1 |
| ↑ [LNR], ↓ | PULSE: Earth, 3, 2, 1 |
| ↑ [*], [1], [2], [3], [Recall], [*], [3], [2], [1], ↓ | DTMF: 1, 2, 3, Earth, 3, 2, 1 |
| ↑ [LNR], ↓ | DTMF: 1, 2, 3 |

Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3; PCD3332-S

6.1.3.5 Access pause dialling and termination

Access pauses entered during manual dialling or repertory number storage are not dialled out, but are stored. When LNR or a repertory number is selected for redial, the access pauses are dialled out. If at LNR or repertory dial, an access pause is being dialled out, then depressing the PAUSE key will terminate the access pause in progress and dialling will continue at the first non-access pause digit.

6.1.3.6 Flash/Earth recall

Depending on the option selected (see Table 8), depressing the Flash key will generate a calibrated Flash time at output $\overline{DP}/\overline{FL}$, or a calibrated earth time on the EARTH output. The calibrated earth time is 400 ms, the flash time is set by diodes as shown in Table 7.

The Flash/Earth will also refer the set to dial mode selected by the diode option.

6.1.3.7 Data dialling in the pulse dialling mode

If the PCD3332 is initially set to the pulse dial mode (PTS = ON), depressing the TONE, * or # key will continue dialling in the DTMF mode. Flash/Earth recall will restore the pulse dialling mode.

6.1.4 PROGRAMMING MODE

The PCD3332 has an on-chip CMOS RAM which can store up to 10 numbers of 32 digits with a total of 250 digits (floating memory). If the memory overflows, a warning beep is generated. If the controller is initially set to the pulse dial mode, digits can be stored in the pulse dial and/or in the DTMF mode by depressing key * or # or using the 'change mode' procedure during the store procedure. This function is best illustrated in Table 22.

6.1.4.1 Memory overflow

A total of 250 digits can be stored. If an attempt is made to store a number which will bring the total amount of digits stored to over 250, the TONE output will generate the memory overflow beeps and the store procedure is cancelled.

6.1.4.2 Notepad function

In the speech mode, a number can be entered on the keyboard. This number may be dialled out at the next off-hook situation by LNR or may be entered in memory. This function effectively mimics a notepad for a number passed during a telephone conversation.

6.1.4.3 Repertory and chain dialling

Repertory numbers can be dialled out before or after manual dialling or LNR, and can be entered one after another in a chain. However, during transmission of LNR or a repertory number, a subsequent repertory number is not accepted. This means that a repertory number can only be entered if the previous repertory dial or LNR is ended.

Depending on the MLA diode configuration (see Table 14) the procedure is as follows:

- Direct repertory access: M1 to M10
- Two-key repertory access: MRC_0 to MRC_9.

6.1.5 RINGER MODE (PCD3332-2/S)

The PCD3332-2/S has a built-in frequency discriminator circuit, with CE/FDI being used as the discriminator input. If the ringer frequency supplied is accepted, a ringer melody is generated. When the ringer melody sounds, the ringer volume is adjustable in 4 steps using the */VOL– and #/VOL+ keys.

Depending on the diode RMS, either a default ringer melody is selected, or 1 out of 3 ringer melodies may be selected from the keypad (see Table 12).

6.1.6 RINGER MODE (PCD3332-3)

The PCD3332-3 has a built-in frequency discriminator circuit, with CE/FDI being used as the discriminator input. If the ringer frequency supplied is accepted, a ringer melody is generated. When the ringer melody sounds, the ringer volume is adjustable in 4 steps using the */VOL– and #/VOL+ keys.

Depending on the diode RFS, 1 of 2 different input ringer frequency ranges is selected (see Table 13).

Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3;
PCD3332-S

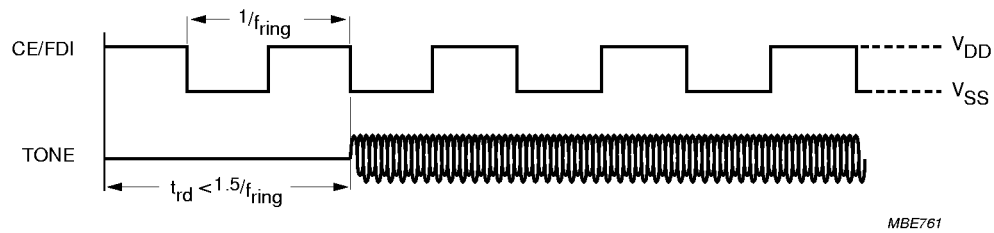


Fig.15 Ringer response timing and detection.

Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3;
PCD3332-S

Table 22 Key sequences in programming mode

| KEY SEQUENCE |
|--|
| Programming a repertory location |
| [STORE] data [STORE] [M1] ⁽¹⁾ |
| [STORE] data [M1] ⁽¹⁾ |
| [STORE] data [STORE] [0] ⁽²⁾ |
| [STORE] data [STORE] [MRC] [0] ⁽²⁾ , and [STORE] data [STORE] [M1] ⁽³⁾ |
| [STORE] data [MRC] [0] ⁽²⁾ , and [STORE] data [M1] ⁽³⁾ |
| Copy LNR to a repertory location |
| [STORE] [LNR] [STORE] [M1] ⁽¹⁾ |
| [STORE] [LNR] [M1] ⁽¹⁾ |
| [STORE] [LNR] [STORE] [0] ⁽²⁾ |
| [STORE] [LNR] [STORE] [MRC] [0] ⁽²⁾ , and [STORE] [LNR] [STORE] [M1] ⁽³⁾ |
| [STORE] [LNR] [MRC] [0] ⁽²⁾ , and [STORE] [LNR] [M1] ⁽³⁾ |
| Clearing a repertory location |
| [STORE] [M1] ⁽¹⁾ |
| [STORE] [STORE] [0] ⁽²⁾ |
| [STORE] [STORE] [MRC] [0] ⁽²⁾ , and [STORE] [STORE] [M1] ⁽³⁾ |
| [STORE] [MRC] [0] ⁽²⁾ , and [STORE] [M1] ⁽³⁾ |
| [STORE] data [MRC] [0] ⁽²⁾ , and [STORE] data [M1] ⁽³⁾ |
| Notepad programming |
| [STORE] data [STORE] [LNR] |
| [STORE] data [LNR] |
| Clear Notepad |
| [STORE] [STORE] [LNR] |
| [STORE] [LNR] |

Notes

1. Select [M1] to [M10].
2. Select [0] to [9].
3. Select [M1] to [M3].

Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3;
PCD3332-S

7 LIMITING VALUES

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

| SYMBOL | PARAMETER | MIN. | MAX. | UNIT |
|-----------|--------------------------------|------|----------------|------|
| V_{DD} | supply voltage | -0.5 | +7.0 | V |
| V_I | all input voltages | -0.5 | $V_{DD} + 0.5$ | V |
| I_I | DC input current | -10 | +10 | mA |
| I_O | DC output current | -10 | +10 | mA |
| P_{tot} | total power dissipation | — | 125 | mW |
| P_O | power dissipation per output | — | 30 | mW |
| I_{SS} | ground supply current | -50 | +50 | mA |
| T_{stg} | storage temperature | -65 | +150 | °C |
| T_j | operating junction temperature | — | 90 | °C |

8 DC CHARACTERISTICS

$V_{DD} = 1.8$ to 6 V; $V_{SS} = 0$ V; $T_{amb} = -25$ to $+70$ °C; all voltages with respect to V_{SS} ; $f_{xtal} = 3.58$ MHz; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|-----------------------|---|--|--------------------|------|--------------------|-----------------|
| Supply | | | | | | |
| V _{DD} | supply voltage operating standby | CE = 0 | 2.5 | — | 6 | V |
| | | | 1.0 | — | 6 | V |
| I _{DD(dial)} | supply current (dialling mode) | note 1, CE = 1 | — | 0.9 | 1.8 | mA |
| | | V _{DD} = 3 V; TONE active V _{DD} = 3 V; TONE not active | — | 0.3 | 0.6 | mA |
| I _{DD(conv)} | supply current (conversation mode) | note 1; CE = 1; V _{DD} = 3 V | — | 0.2 | 0.4 | mA |
| I _{DD(stb)} | supply current (standby mode) | note 2; CE = 0 | — | 1.0 | 2.5 | μA |
| | | V _{DD} = 1.8 V; T _{amb} = 25 °C; V _{DD} = 1.8 V; T _{amb} = 70 °C; | — | — | 10 | 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 _{tz} |
| I _{LI} | input leakage current | V _{SS} ≤ V _I ≤ V _{DD} | −1 | — | +1 | μA |
| Port outputs | | | | | | |
| I _{OL} | LOW level output sink current | V _{DD} = 3 V; V _O = 0.4 V | 0.7 | 3.5 | — | mA |
| I _{OH} | HIGH level pull-up output source current | V _O = 2.7 V; V _{DD} = 3 V | −10 | −20 | — | μA |
| | | V _O = 0 V; V _{DD} = 3 V | — | −100 | −300 | μA |
| I _{OH1} | HIGH level push-pull output source current | V _{DD} = 3 V; V _O = 2.6 V | −0.7 | −4 | — | mA |

Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3;
PCD3332-S

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|------------------------------------|--|---|------|-------------|------|------------|
| TONE output (notes 3 and 4) | | | | | | |
| $V_{HG(RMS)}$ | High Group Frequency voltage. Voltage of higher frequency component for DTMF (RMS value) | | 158 | 181 | 205 | mV |
| $V_{LG(RMS)}$ | Low Group Frequency voltage. Voltage of lower frequency component for DTMF (RMS value) | | 125 | 142 | 160 | mV |
| $\Delta f/f$ | frequency deviation | | -0.6 | – | 0.6 | % |
| V_{DC} | DC voltage level | | – | $0.5V_{DD}$ | – | V |
| $ Z_o $ | output impedance | | – | 100 | 500 | Ω |
| G_v | pre-emphasis of group | | 1.5 | 2.0 | 2.5 | dB |
| THD | total harmonic distortion | $T_{amb} = 25\text{ }^{\circ}\text{C}$; note 5 | – | 25 | – | dB |
| Power-on-reset | | | | | | |
| V_{POR} | Power-on-reset level | | 1.5 | 2.0 | 2.5 | V |
| Oscillator | | | | | | |
| g_m | transconductance | $V_{DD} = 5\text{ V}$ | 0.2 | 0.4 | 1.0 | mS |
| R_F | feedback resistor | | 0.3 | 1.0 | 3.0 | M Ω |

Notes

- $V_{IL} = V_{SS}$; $V_{IH} = V_{DD}$; open-drain outputs connected to V_{SS} ; all other outputs open; TONE not active, unless otherwise specified.
- Crystal connected between XTAL1 and XTAL2; pins T1 and $\overline{CE/T0}$ at V_{SS} ; TONE not active.
- TONE output requires $V_{DD} \geq 2.5\text{ V}$.
- Values are specified for DTMF frequencies only (CEPT).
- Related to the Low Group Frequency component (CEPT).

9 AC CHARACTERISTICS

$V_{DD} = 1.8\text{ to }6\text{ V}$; $V_{SS} = 0\text{ V}$; $T_{amb} = -25\text{ to }+70\text{ }^{\circ}\text{C}$; all voltages with respect to V_{SS} ; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--------|-----------------------|---|------|------|------|------|
| t_r | rise time all outputs | $V_{DD} = 5\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$; $C_L = 50\text{ pF}$ | – | 30 | – | ns |
| t_f | fall time all outputs | | – | 30 | – | ns |

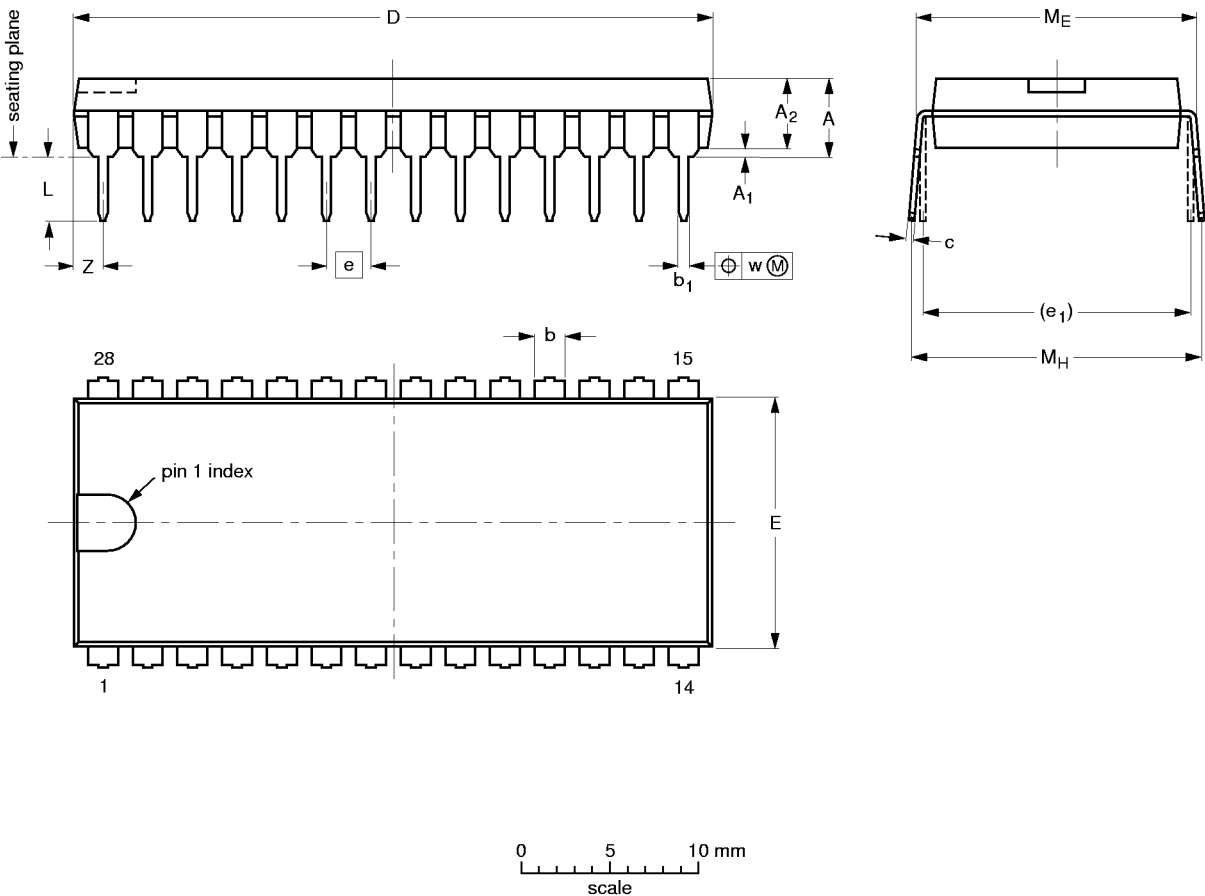
Multistandard pulse/tone repertory
diallers/ringers

PCD3332-2; PCD3332-3;
PCD3332-S

10 PACKAGE OUTLINES

DIP28: plastic dual in-line package; 28 leads (600 mil)

SOT117-1



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 | 5.1 | 0.51 | 4.0 | 1.7 1.3 | 0.53 0.38 | 0.32 0.23 | 36.0 35.0 | 14.1 13.7 | 2.54 | 15.24 | 3.9 3.4 | 15.80 15.24 | 17.15 15.90 | 0.25 | 1.7 |
| inches | 0.20 | 0.020 | 0.16 | 0.066 0.051 | 0.020 0.014 | 0.013 0.009 | 1.41 1.34 | 0.56 0.54 | 0.10 | 0.60 | 0.15 0.13 | 0.62 0.60 | 0.68 0.63 | 0.01 | 0.067 |

Note

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

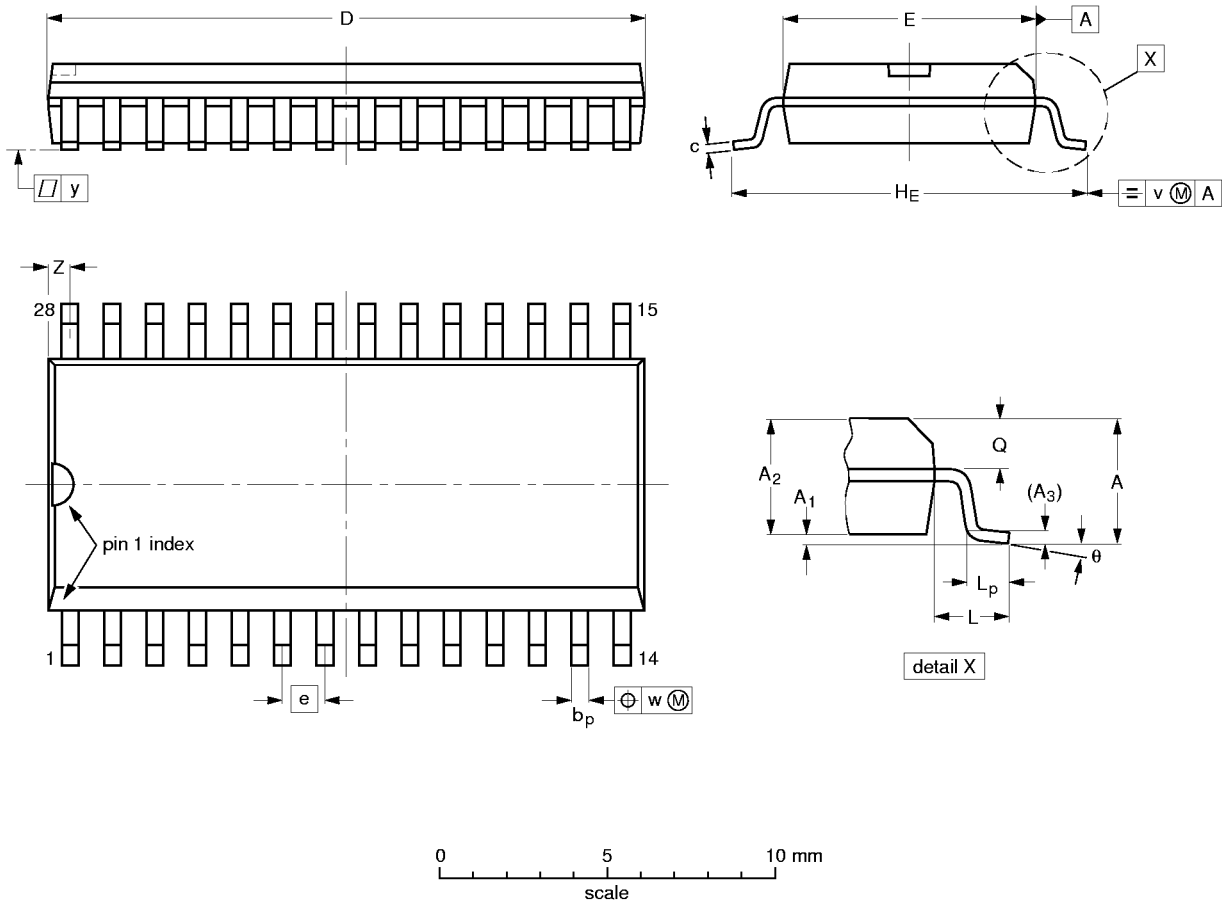
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|--------------------|------------|----------|------|--|------------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT117-1 | 051G05 | MO-015AH | | | | 92-11-17 95-01-14 |

Multistandard pulse/tone repertory
diallers/ringers

PCD3332-2; PCD3332-3;
PCD3332-S

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. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽¹⁾ | e | H _E | L | L _p | 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 |

Multistandard pulse/tone repertory diallers/ringers

PCD3332-2; PCD3332-3; PCD3332-S

11 SOLDERING

11.1 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).

11.2 DIP

11.2.1 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.

11.2.2 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.

11.3 SO

11.3.1 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.

11.3.2 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.

11.3.3 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.