CMOS REPERTORY DIALLER TELEPHONE SET CONTROLLER

GENERAL DESCRIPTION

The PCD3341 is a low threshold voltage IC fabricated in CMOS. It is designed to control display, redial and repertory dialling in a telephone set. The IC has two dialling modes; pulse dialling (PD) and dual tone multi-frequency (DTMF). The architecture of the PCD3341 is identical to that of the PCD3343. It comprises an 8-bit CPU, 224 RAM bytes and 3K ROM bytes (the ROM is already programmed). The operating supply voltage is 2,5 to 6,0 V with a low current consumption in all operating modes: standby, conversation and dialling modes.
Up to 18 digits and 2 manual access pauses can be stored for redial, extended redial and direct dial purposes together with on-chip storage for 10 repertory numbers.
For expansion of the system the PCD3341 provides a two wire serial input/output port, in accordance with the I²C bus specifications, to control the DTMF tone generator, LCD drivers and additional RAMs for additional repertory numbers.

Features

- Pulse dialling
- DTMF dial control of tone generator PCD3312
- Redial
- Extended redial
- Electronic notepad
- Direct dialling (emergency call)
- On-chip storage for 10 repertory dial numbers
- 18-digit capacity for each autodial memory
- Flash or register recall
- Access pause generation and termination
- Manual reset of autodial RAM
- On-chip power-on reset
- Programmed for improved noise immunity
- Extention possible with external RAM for up to 110 repertory dial numbers
- Uses standard 4 x 4 keyboard (single or double contact)
- Additional 10-digits first in first out memory, for infinite long numbers control an LCD via the I²C bus.
- Four extra function keys: program/autodial, flash, redial, access pause
- Keyboard expansion possible for 10 separated repertory dialled numbers
- Automatic recognition of PABX-digits; resulting in an access pause insertion
- Hold input and access pause output (APO) to adjust the duration of the access pause and facilitate use of tone recognizers
- Six diode or strap functions: mark-to-space ratio, tone burst time, inter-digit pause time, access pause time, normal or expanded keyboard, normal or direct dialling

QUICK REFERENCE DATA

Operating supply voltage	V_{DD}	2,5 to 6,0	V
Standby supply voltage	V_{DD}	min. 1,8	V
Operating currents at V_{DD} = 3 V			
conversation mode	I_{DDC}	typ. 270	μA
dialling mode	I_{DDD}	typ. 600	μA
Standby supply current			
at V_{DD} = 1,8 V; T_{amb} = 25 °C	I_{DDO}	typ. 1,2	μA
Crystal frequency	f	3,58	MHz
Operating ambient temperature range	T_{amb}	−25 to + 70	°C

PACKAGE OUTLINES

PCD3341P: 28-lead DIL; plastic (SOT117).
PCD3341T: 28-lead mini-pack; plastic (SO28; SOT136A).

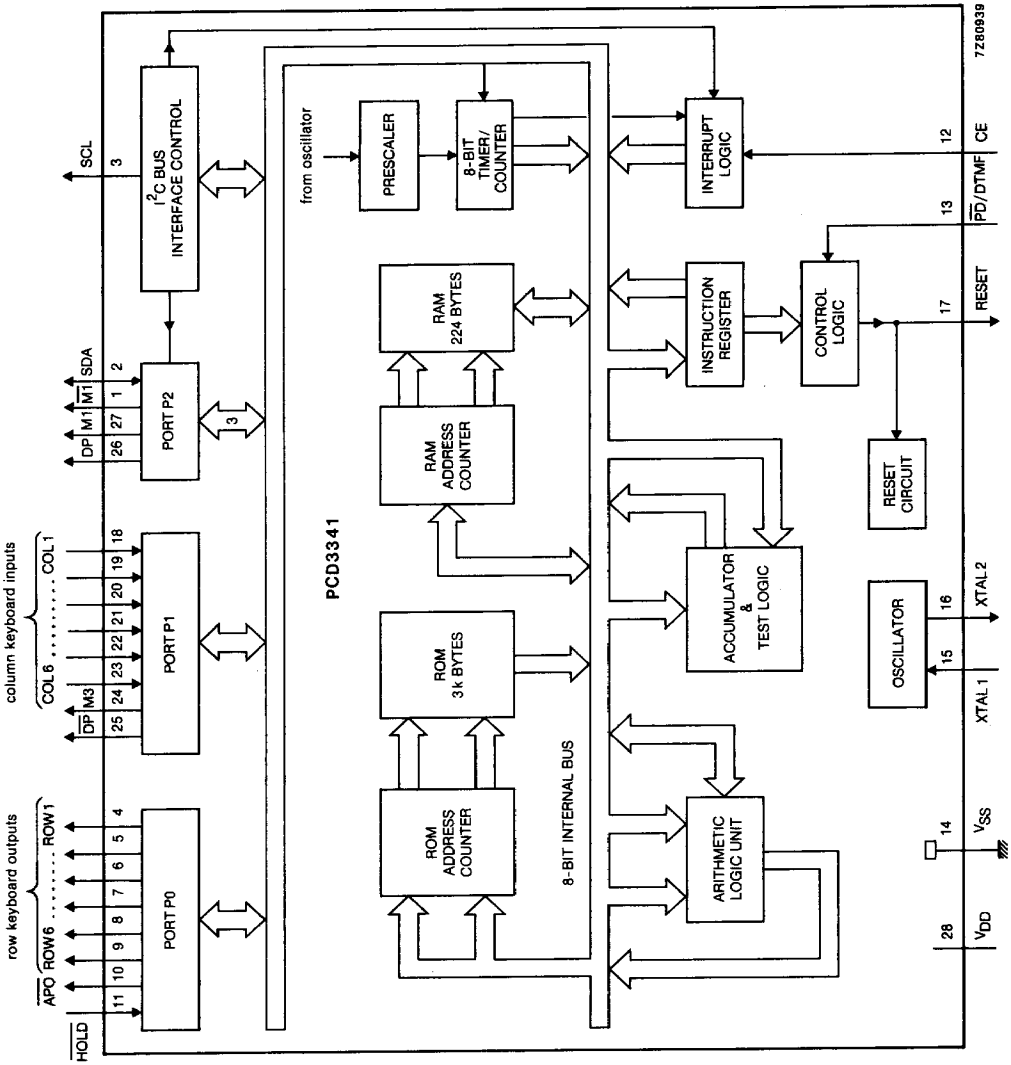


Fig. 1 Block diagram.

DEVELOPMENT DATA

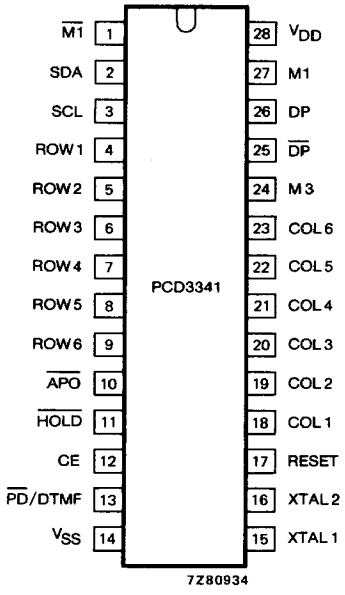


Fig. 2 Pinning diagram.

PINNING

1	$\overline{M1}$	inverted output of M1
2	SDA	serial data
3	SCL	serial clock
4	ROW 1	scanning row keyboard outputs
5	ROW 2	
6	ROW 3	
7	ROW 4	
8	ROW 5	
9	ROW 6	
10	$\overline{APO}$	access pause output
11	$\overline{HOLD}$	hold input
12	CE	chip enable input
13	$\overline{PD}$/DTMF	input to select pulse or DTMF dialling
14	V_{SS}	negative supply
15	XTAL 1	input to on-chip oscillator
16	XTAL 2	output from on-chip oscillator
17	RESET	reset input/output
18	COL 1	sense column keyboard inputs
19	COL 2	
20	COL 3	
21	COL 4	
22	COL 5	
23	COL 6	
24	M3	muting output
25	$\overline{DP}$	inverted pulse dialling output
26	DP	pulse dialling output
27	M1	muting output
28	V_{DD}	positive supply

FUNCTIONAL DESCRIPTION

Power supply (V_{DD}; V_{SS})

Power supply must be retained for data storage.

Clock oscillator (XATL 1; XTAL 2)

The time base for the PCD3341 is a crystal controlled on-chip oscillator which is completed by connecting a 3,58 MHz crystal between XTAL 1 and XTAL 2. The oscillator starts when V_{DD} reaches the operating voltage level and CE = HIGH. The output XTAL 2 can be used to drive the oscillator input of the PCD3312.

Chip Enable (CE)

This active HIGH input is used to initialize part of the system, to select the operational or standby mode and to handle line power breaks.

Pulse dialling outputs (DP; $\overline{DP}$)

DP output drives an external switching transistor or relay in pulse dialling mode. This output is also used to pulse out a calibrated FLASH pulse (recall register) of 90 ms duration as soon as the keyboard input FLASH is activated by depressing the key F. The FLASH function acts like CE with respect to redial.

Muting outputs (M1; $\overline{M1}$; M3)

M1 output is used for muting during the dialling sequence. For pulse dialling M1 goes HIGH with the first inter-digit pause and remains active for 33 or 40 ms (mark-to-space selection) following the last break pulse after the last digit held in store has been transmitted. In DTMF dialling, input $\overline{PD}$/DTMF is HIGH. M1 is HIGH as long as two out of the eight frequency signals are sent, then remains HIGH for an additional 80 ms (hold-over time).
$\overline{M1}$ output is the inverted output of M1.
M3 output is an AND function with $\overline{DP}$ and M1 as input, used for direct drive of a switching transistor for dialling pulses and muting.

Hold input ($\overline{HOLD}$); **access pause output** ($\overline{APO}$)

The hold input suspends dialling after completion of the current digit, or in pulse dialling during an inter-digit pause.
The hold function facilitates an extra time delay during dialling under control of external circuits (dialling tone recognizer). In the hold state ($\overline{HOLD}$ = LOW) the muting output is also LOW, thus the IC is in the conversation mode. The $\overline{HOLD}$ input can be controlled by the access pause output (APO) directly or indirectly via a dialling tone recognizer (see Fig. 3). The tone recognizer automatically terminates access pauses upon receipt of the access tone, regardless of whether this occurs during or after the access pause time (t_{ap}). The $\overline{APO}$ output will go LOW when an access pause is recognized.

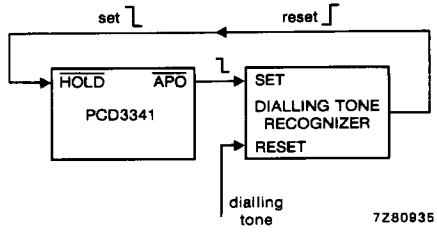


Fig. 3 Automatic variation of length of an access pause under control of a dialling tone recognizer.

Serial data (SDA); **serial clock** (see Fig. 8)

The serial I/O lines SDA and SCL are used to control the PCD3312 in the DTMF dialling mode, additional RAMs (PCD8570) for repertory dialling and LCD drivers (PCF8577). Both outputs require external pull-up resistors.

Keyboard inputs/outputs (COL 1 to 6; ROW 1 to 6)

The sense column inputs COL 1 to COL 6 and the scanning row outputs ROW 1 to ROW 6 are directly connected to a 4 x 4 single contact keyboard matrix. The keyboard organization is shown in Fig. 4.
In pulse dialling mode the valid keys are the 10 numeric keys (0 to 9). The 6 non-numeric keys (A, B, C, D, *, #) have no effect on the dialling.
In DTMF dialling mode the 10 numeric keys and the 6 non-numeric keys are valid. On-chip repertory dialling uses the 10 numeric numbers (no external RAM).
With extended repertory dialling 10 extra keys (M1 to M10) are used (on-chip or external RAM).
Row 5 of the keyboard contains the following special function keys:

- P memory clear and programming (notepad)
- FL flash or register recall
- R redial
- AP manual access pause entry

Diode options (ROW 6)

Row 6 is added to the keyboard matrix to provide the following selections:

Mark-to-space ratio (M/S)
OFF M/S 3:2
ON M/S 2:1

Tone burst time (t_{tb})
OFF t_{tb} = 70 ms
ON t_{tb} = 100 ms

Inter-digit pause (IDP)
OFF IDP = 900 ms
ON IDP = 500 ms

Access pause time (t_{ap})
OFF t_{ap} = 1,5 s (DTMF); 3 s (PD)
ON t_{ap} = 2,5 s (DTMF); 5 s (PD)

Keyboard expansion (EKB)
OFF normal keyboard
ON expanded keyboard

Normal/direct call (N/D)
OFF normal call mode
ON direct call (emergency)

DEVELOPMENT DATA

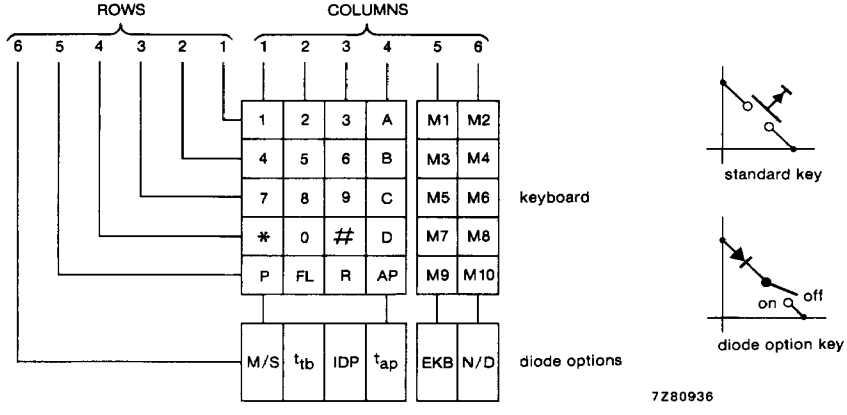


Fig. 4 Keyboard organization.

FUNCTIONAL DESCRIPTION (continued)

Dialling mode selection input ($\overline{PD}$/DTMF)

This input selects the dialling mode:

- $\overline{PD}$/DTMF = LOW selects pulse dialling
- $\overline{PD}$/DTMF = HIGH selects DTMF dialling

Reset input/output (RESET)

When the reset input is active HIGH it can be used to initialize the IC.
In normal application this is achieved by the CE input.
Reset is also an output of the internal power-on-reset circuit, which generates a reset pulse if V_{DD} drops below 1,3 V (typ.).

OPERATION

The PCD3341 has 3 operating modes:

- Standby
- Conversation
- Dialling

Standby mode

When the chip enable input (CE) is LOW the IC is disabled. In the standby mode the only current drawn is from a back up supply (battery or line powered), for memory retention, holding up to 13 call numbers for repertory and redialling.

Conversation mode

After the handset is lifted CE is activated and V_{DD} rises to the working voltage. M1 muting is inactive and speech or dial tone can be heard. With the oscillator operating the chip is ready to accept keyboard entries. Current consumption is $< 300\ \mu A$.

Dialling mode

The dialling mode starts with first valid keyboard entry when it initiates:

- a normal call of a newly dialled number
  or
- a repertory or redialling cycle of previously entered and stored numbers

The current consumption is $< 600\ \mu A$.

Pulse dialling ($\overline{PD}$/DTMF = LOW)

The keyboard entry initiates a recall from a previously stored number or is a simultaneous keying-in and pulsing-out activity, with storing for possible later recall. If in the recalled number or at keying-in the keys *, #, A, B, C, D keys are used these digits will not be transmitted. Normally, keying-in is faster than pulsing-out (fed from the redial register). Pulsing sequences start with M1 going HIGH followed by an inter-digit pause of 900 or 500 ms duration (diode option IDP), followed by a sequence of pulses corresponding to the present digit in store. Each pulse starts with a mark (line break) followed by space (line make).
The pulse period is 100 ms with a mark-to-space ratio of 3:2 or 2:1 (diode option). After transmission os a digit, the next digit will be processed again starting with an inter-digit pause. The pulsing is suspensed if $\overline{HOLD}$ goes LOW. It will be terminated if the current memory content has been transmitted or the handset is replaced (CE = LOW $< t_{rd}$). The pulses are available on the DP line. After completion of the number string M1 goes LOW and the circuit changes from dialling mode to conversation mode.

Dual Tone Multi Frequency dialling ($\overline{PD}$/DTMF = HIGH)

The PCD3341 converts keyboard inputs into serial data, via the I^2 bus lines SDA and SCL, suitable for control of the PCD3312 DTMF tone generator. These tones are transmitted with minimum tone burst durations of 70, 70 ms. The maximum tone burst duration is equal to the key depression time. With redial and repertory dialling tones are automatically fed at a rate of 70, 70 ms. After dialling the muting output goes LOW after a hold-over time of 80 ms and the circuit is switched to the conversation mode.

DEVELOPMENT DATA

SYSTEM EXTENSION

The PCD3341 can control the extensions of a telephone set via its I²C bus. Both in DTMF dialling and pulse dialling, an extended repertory dialler provides more than 10 stored on-chip numbers and the indication on a L.C. display of all keys pressed (programming or dialling procedure).
The following ICs can be used in combination with the PCD3341:

- PCD3312 DTMF generator
- PCD8570 256 x 8 static CMOS RAM
- PCF8577 2 LCD drivers in LCD module

DTMF dialling

By using a PCD3312 DTMF generator with I²C bus interface, the PCD3341 may be extended to Dual Tone Multi Frequency dialling applications. This is selected when the input pin $\overline{PD}$/DTMF = HIGH.
DTMF dialling is much faster than pulse dialling. Each keypad digit corresponds to a unique combination of two frequencies; one from a group of 4 high frequencies, and one from a group of 4 low frequencies. Both frequencies are applied simultaneously to the line.
The PCD3341 is capable of directly driving the PCD3312 oscillator.

Repertory dialling

If more than 10 stored numbers are required repertory dialling can be extended by the I²C bus lines and external CMOS RAMs (PCD8570) with serial interface. With a RAM capacity of 256 x 8 bits another 20 stored numbers can be added. A maximum of 5 external RAMs can be served by the PCD3341 directly. This provides a telephone with a total capacity of 110 (100) stored numbers.
The number of external RAMs connected on the I²C bus lines is automatically checked by the PCD3341 at initial turn-on.
To identify each RAM, the PCD8570 has 3 hardware address pins (A2, A1, A0) which allows a maximum of 8 RAMs to be connected.

Table 1 Repertory number organisation

PCD8570 address			Keyboard digit(s)	
A2	A1	A0	Without EKB	With EKB
0	0	0	10 to 29	00 to 19
0	0	1	30 to 49	20 to 39
0	1	0	50 to 69	40 to 59
0	1	1	70 to 89	60 to 79
1	0	0	90 to 99	80 to 99
PCD3341			00 to 09	M1 to M10

Display

To display the dialled phone number or programmed number the PCD3341 provides the signals to control a LC Display module using two PCD8577 duplex drivers. These signals are fed via the I²C bus lines.
In the dialling and programming modes the digits are displayed from right to left in the sequence entered by the keyboard. The access pause is indicated by the bar. If the number of digits exceeds 16, they drop out on the left side of the display.

OPERATING PROCEDURE

Initialization

At the first application of the standby power supply, the PCD3341 will clear the RAM in order to avoid a wrong content.
By lifting the handset the buffer capacitor for V_{DD} is charged to the operating voltage. CE will than be activated. Within start-up time the oscillator starts and the initialization program begins.

Automatic access pause setting

Before the start procedure, the system can also be initialized by setting the access pause system (e.g. for PABX applications). The circuit will automatically insert an access pause after recognition of access of a number within a digit group. This (or these) digit(s) must be programmed. Up to a maximum of 3 digits per group can be programmed.
The procedure is as follows:

- Depress and hold pushbutton P
- Press and release pushbutton R
- Enter 1, 2 or 3 digits as access digit for first group
- Release pushbutton P (only if no second group is required)
- Press and release pushbutton R
- Enter 1, 2 or 3 digits for second group
- Release pushbutton P

Apart from the procedure that automatically detectes and insertes access pause(s), a telephone number with up to 2 additional manually inserted access pauses can be dialled or programmed, by pressing button AP. In DTMF dialling mode each access pause has a duration of 1,5 or 2,5 seconds. In PD mode each access pause has a duration of 3 or 5 seconds.

DEVELOPMENT DATA

Data entry

The debounce keyboard entries are written into the on-chip CMOS RAM in consecutive order.

Dialling

If the first pushbutton pressed is 0 to 9 in pulse dialling or 0-9, A to D, *, # in DTMF dialling, digits are entered into the redial register after initial clearing. During the data entry the circuit starts with the transmission of the call and is unaffected by the speed of entry. Transmission continues as long as further data input has to be processed. Up to 18 digits can be stored in the redial register. After the main store overflows, a 10 digit 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 the storage of new data. In this way, the total number that can be transmitted is unlimited, provided the key-in rate is not excessive. However, if the FIFO register overflows (more than 10 digits in store) further input will be ignored.

Redial

If the first digit entered is "REDIAL" R, the stored number in the redial register will be recalled and transmitted.
If the current content is less than 18 digits, new digits entered are appended automatically to the redial number. After the 18th digit has been entered the FIFO register will take over as previously described in the dialling section.

OPERATING PROCEDURE (continued)

Extended Redial

The dialled number is saved in the extended redial buffer if pushbutton P is the last key pressed before the handset is replaced.
By pressing and releasing pushbutton P followed by pressing and releasing pushbutton R, will cause the extended redial register to be recalled and transmitted in the same manner as by redial. If less than 18 digits are contained in the extended redial register, digits can be added until the total content is 18. After the 18th digit the FIFO register will take over as before. The original number is not affected by the new digits

Direct call/Emergency call

This is a diode option usually operated by a turn key switch. If set the programmed number will be dialled by pressing ANY key. In normal mode the turn key switch is positioned OFF with the diode option OFF.
Programmed is achieved by lifting the handset, depressing the P pushbutton with key in the OFF position, then turning the key switch to ON position (diode option ON). The required telephone number is now entered. Pushbutton P can now be released and the handset replaced.
After programming, the key switch can remain in the ON position (activating emergency call) or be switched off (normal mode). If the key switch is the ON position, emergency calling is possible by removing the handset and pressing ANY pushbutton.

Repertory dialling

The PCD3341 has an on-chip CMOS RAM to store up to ten 18 digit numbers, and can be extended up to 100 (110) numbers using external CMOS RAMs with 2-line serial interface. The circuit automatically checks the number of external RAMs. If no external RAM is connected the on-chip repertory is limited to 10 numbers. In this application the standard keypad (0 to 9) and one digit address can be used. With the diode option EKB (expanded keyboard) ON the extended keypad matrix (M1 to M10) can be used to access the on-chip repertory. If external RAMs are connected the capacity of the repertory can be increased up to 100 (110) numbers. In this application the standard keypad (0 to 9) and/or the extended keypad (M1 to M10) can be used to access the repertory (see Table 1).
Programming is possible only after the handset is lifted and no pushbutton is operated before P.
Programming is achieved by pushbutton P being continually depressed, entering the repertory address of one or two digits, followed by the number (including access digits) then releasing pushbutton P.
The designated telephone number, including access digits, is dialled after pressing pushbutton P followed by the address. With extended keypad a single address pushbutton is required. After transmission of the repertory sequence, it is possible to manually enter additional digits (see redial).

Successive repertory dialling during a call (chain dialling)

It is possible to dial more than one repertory number during one single telephone call.
The following procedures are possible:

- Redial, extended redial or a repertory number followed by new digits
- Repertory number followed by one or more repertory numbers
- Normal dial, redial or extended redial followed by one or more repertory numbers

Note pad

Note pad provides the facility to store a number during conversation mode without dialling and muting. This number will be stored in the extended redial register and recalled with the extended redial procedure.
The programming procedure is as follows:

- Depress and release pushbutton P
- Depress and release pushbutton P
- Enter the telephone number
- Depress and release pushbutton P

If a wrond number is entered, correction is achieved by re-starting the programming procedure.

Memory clear

A built-in manually total clear facilitates resetting of the autodial RAM after servicing, maintenance or telephone set delivery.
The procedure is as follows:

- Hook-on, depress and keep depressed keys 2, 5, 8, 0
- Hook-off, release keys 2, 5, 8, 0

Table 2 Display indications

procedure	key procedure	display indication
Programming automatic access pauses after access digits	$\bar{P}$R00R9	Pr–00–9
dialling	004627530	00–4627530
redial	R	r=00–4627530
Extended redial		
programming	004627530P	00–4627530P
dialling	PR	Pr=00–4627530
emergency redial		
programming	N/D OFF, $\bar{P}$, N/D ON(+ TN)	PH–00–4627530
dialling	N/D ON any key	H=00–4627530
repertory programming	$\bar{P}$12004627530	P12–00–4627530
programming	$\bar{P}$12004627530	P12–00–4627530
dialling	P12	P12=00–4627530
repertory with extended keyboard		
programming	$\bar{P}$ M1 004627530	PM1–00–4627530
dialling	M1	M1=00–4627530
note pad programming	PP0080808P	7530PP00–808080P
note pad dialling	PR	00–808080
error	incorrect key procedure	≡

Where: TN = telephone number
P = depress and release pushbutton P
$\bar{P}$ = depress pushbutton P continually during programming
R = depress and release pushbutton R

DEVELOPMENT DATA

RATINGS

Limiting values in accordance with the Absolute maximum System (IEC 134)

Supply voltage range (pin 28)	V_{DD}		−0,8 to 8	V
D.C. current into any input or output	$\pm I_I, \pm I_O$	max.	10	mA
All input voltages	V_I	V_{SS} −0,8 V to V_{DD}	+ 0,8	V
Total power dissipation	P_{tot}	max.	500	mW
Power dissipation per output	P_O	max.	50	mW
Storage temperature range	T_{stg}		−65 to + 150	°C
Operating ambient temperature range	T_{amb}		−25 to + 70	°C

DEVELOPMENT DATA

CHARACTERISTICS

V_{DD} = 3 V; V_{SS} = 0 V; crystal parameters: f_{osc} = 3,57954 MHz; R_S = 50 Ω max.; T_{amb} = 25 °C; unless otherwise specified.

parameter	symbol	min.	typ.	max.	unit
Supply					
Operating supply voltage	V_{DD}	2,5	3	6,0	V
Operating supply current					
conversation mode (CE = 1)	I_{DDC}	–	270	–	μA
dialling mode (CE = 1)	I_{DDD}	–	600	–	μA
Standby supply voltage (CE = 0)	V_{DDO}	1,8	3	6,0	V
Standby supply current (CE = 0)	I_{DDO}	–	–	2,5	μA
RESET I/O					
Switching level at $V_{DD} < V_{RESET}$	V_{RESET}	–	1,3	1,5	V
Sink current at $V_{DD} < V_{RESET}$	I_{OL}	–	7	–	μA
Inputs					
Input voltage LOW (any pin)	V_{IL}	0	–	$0{,}3V_{DD}$	V
Input voltage HIGH (any pin)	V_{IH}	$0{,}7V_{DD}$	–	–	V
Input leakage current; CE					
at $V_I = V_{SS}$ to V_{DD}	$-I_{IL}$	–	–	100	nA
at CE = 1	I_{IL}	–	–	1	μA
Keyboard contact resistance					
Keyboard ON	R_{KON}	–	–	1	kΩ
Keyboard OFF	R_{KOFF}	100	–	–	kΩ
Outputs					
M1, $\overline{M1}$, M3, DP, $\overline{DP}$					
Output sink current at V_{OL} = 0,4 V	I_{OL}	–	1,5	–	mA
Output source current at V_{OH} = 2,6 V (push-pull)	$-I_{OH}$	–	1,5	–	mA
SDA, SCL					
Output sink current at V_{OL} = 0,4 V	I_{OL}	1,5	–	–	mA
Output source leakage current at V_{OH} = 0 to V_{DD} (open drain)	$-I_{OH}$	–	–	1	μA

CHARACTERISTICS (continued)

parameter	symbol	min.	typ.	max.	unit
Inputs/Outputs					
COL 1 to 6, ROW 1 to 6, $\overline{HOLD}$, $\overline{APO}$					
Output sink current at V_{OL} = 0,4 V	I_{OL}	0,6	1,5	–	mA
Output source current at V_{OH} = 2,6 V	$-I_{OH}$	25	–	–	μA
Output source current at $V_{OH} = V_{SS}$	$-I_{OH}$	–	–	200	μA
TIMING (see Figs. 5, 6 and 7)					
Clock start-up time	t_{ON}	–	–	10	ms
Oscillator period	C_P	–	–	0,279	μs
Pulse dialling ($\overline{PD}$/DTMF input LOW; M/S diode OFF)					
Mark-to-space ratio 3:2					
Dialling pulse frequency	f_{DP}	–	9,94	–	Hz
Dialling pulse period	t_{DP}	–	100,6	–	ms
Break time	t_b	–	60,3	–	ms
Make time	t_m	–	40,3	–	ms
Mark-to-space ratio 2:1 (M/S diode ON)					
Dialling pulse frequency	f_{DP}	–	9,94	–	Hz
Dialling pulse period	t_{DP}	–	100,6	–	ms
Break time	t_b	–	67	–	ms
Make time	t_m	–	33,5	–	ms
Access pause					
t_{ap} diode OFF	t_{ap}	–	3	–	s
t_{ap} diode ON	t_{ap}	–	5	–	s
Mute hold-over time during access pause	t_h	–	1	–	s
Inter-digit pause					
IDP diode OFF	t_{id}	–	892	–	ms
IDP diode ON	t_{id}	–	496	–	ms
Reset delay time	t_{rd}	–	160,9	180	ms
Reset delay time during access pause	t_{rd}	–	302	320	ms
Debounce time	t_e	13,5	–	–	ms
Flash pulse duration	t_{FL}	–	94	–	ms

parameter	symbol	min.	typ.	max.	unit
DTMF dialling ($\overline{PD}$/DTMF input HIGH; SDA timing via PCD3312)					
Tone transmission time (t_{tb} diode OFF)	t_t	–	74	–	ms
Tone break time	t_b	–	74	–	ms
Mute hold-over time during dialling	t_h	–	154	–	ms
Tone transmission time (t_{tb} diode ON)	t_t	–	101	–	ms
Tone break time	t_b	–	101	–	ms
Mute hold-over time during dialling	t_h	–	101	–	ms
Access pause					
t_{ap} diode OFF	t_{ap}	–	1,5	–	s
t_{ap} diode ON	t_{ap}	–	2,5	–	s
Mute hold-over time during access pause	t_h	–	1	–	s

DEVELOPMENT DATA

Timing diagrams

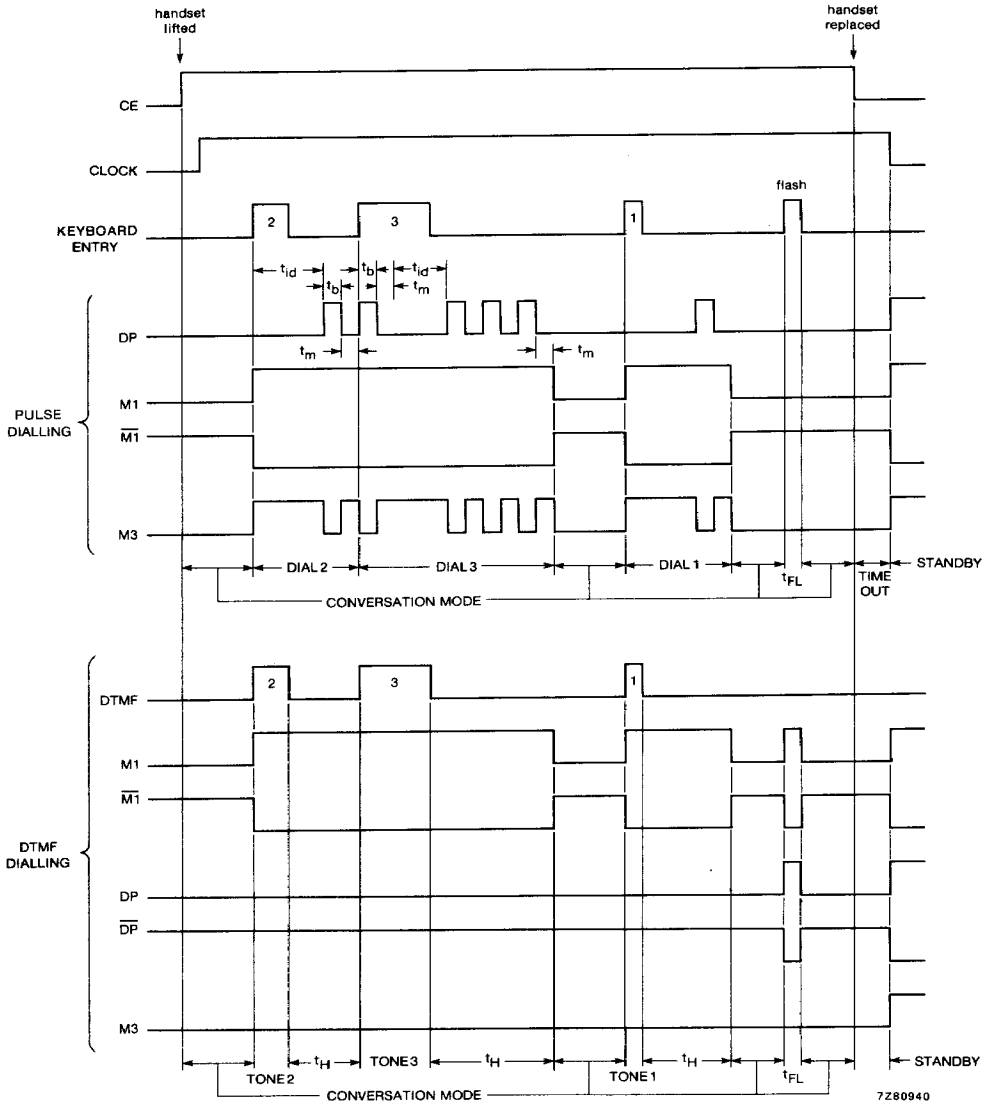


Fig. 5 Pulse dialling; DTMF dialling.

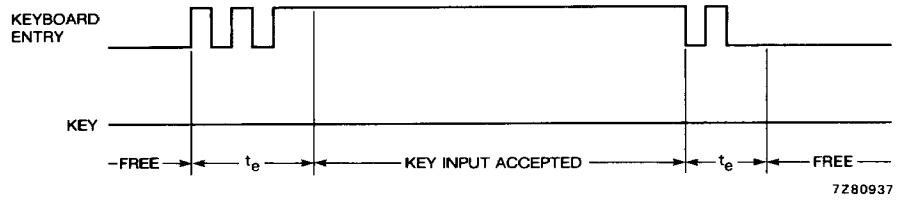


Fig. 6 Keyboard entry with noise debounced.

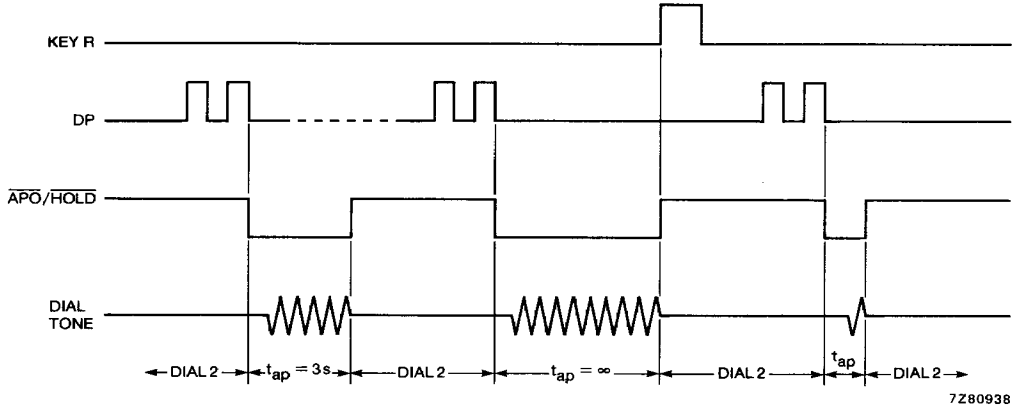
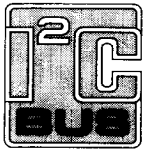


Fig. 7 Access pause with reset by; internal 3 s timer, key R, tone recognizer.

DEVELOPMENT DATA



Purchase of Philips' I²C components conveys a license under the Philips' I²C patent to use the components in the I²C-system provided the system conforms to the I²C specifications defined by Philips.

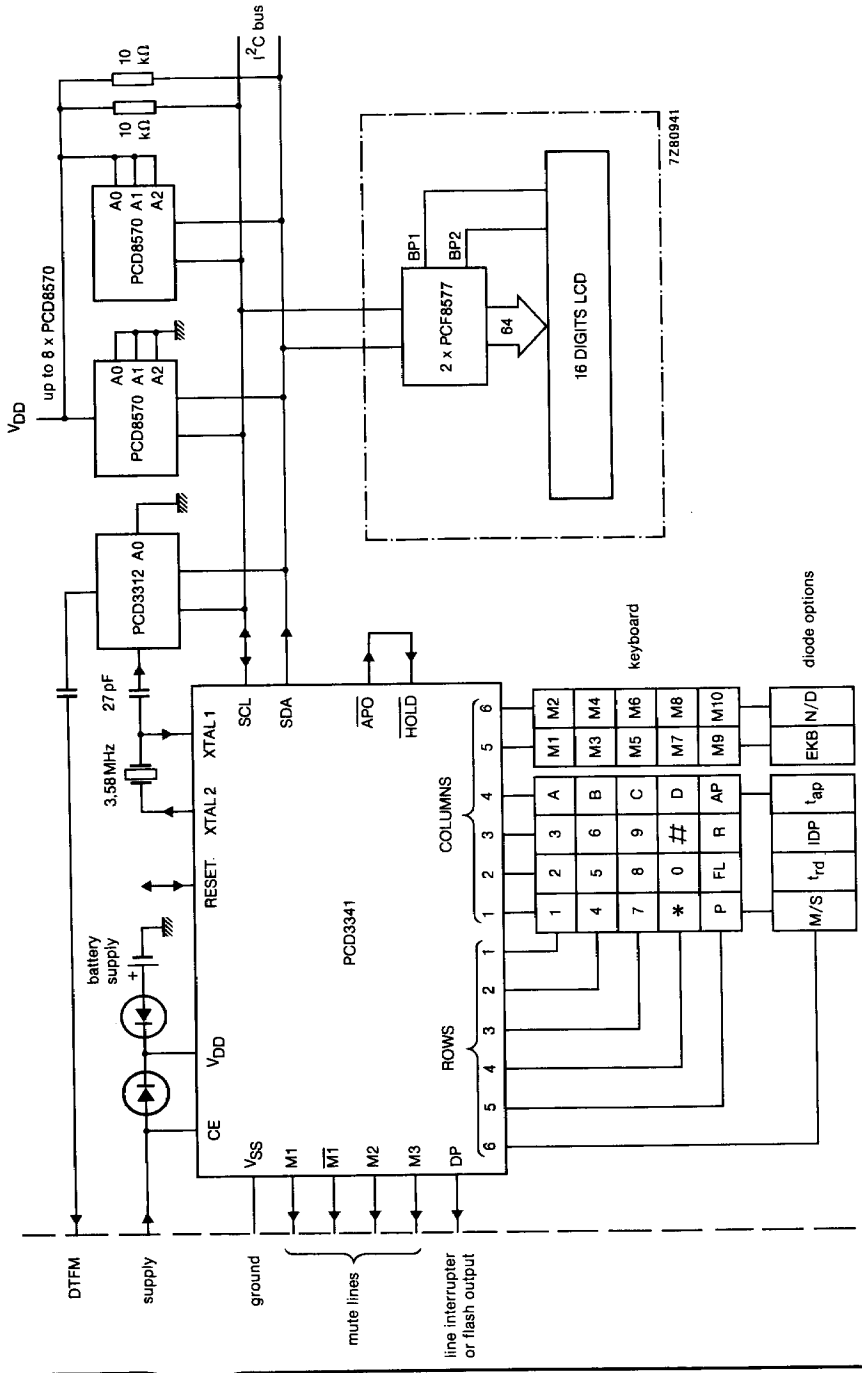


Fig. 8 PCD3341 in combination with PCD3312 (DTMF dialler), PCD8570 (2 K RAM) and PCF8577 (display drivers).

APPLICATION INFORMATION