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Programmable Dialing Circuit

PSB 8510-1-P;-1T

PSB 8510-6-P;-6T

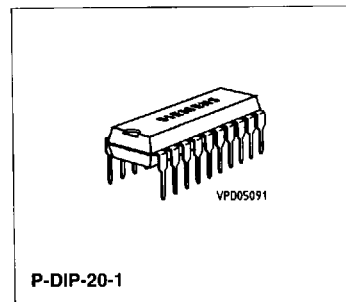
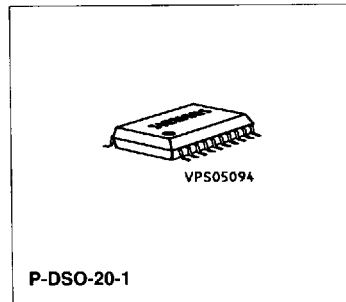
Preliminary Data

CMOS IC

Features

Common Features

- Advanced CMOS technology
- Pulse (PD) and dual tone multi frequency (DTMF) dialing on chip
- Mixed dial and redial (PD/DTMF)
- Selection of default dial mode (PD or DTMF) by selecting pins
- Last number redial up to 22 digits with data retention monitoring
- Generation of 12 different frequency pairs
- DTMF output signals meet CEPT specification without external filtering
- DTMF-level is independent of supply-voltage
- Single tone generation (e.g. for testing)
- No external components except TV standard crystal or ceramic resonator (3.58 MHz)
- Keyboard wake up function allows reduced power consumption
- Automatic and/or manual access pause generation depending on the version
- Signaling key (SK) with flash function
- MUTE signal to mute the speech circuit
- Special device control keys
- Supervision and control of line conditions
- Low data retention voltage (1.2 V)
- Low operation and standby current
- Internal power-on reset



Type	Ordering Code	Package
PSB 8510-1P	Q67100-H6109	P-DIP-20-1
PSB 8510-1T	Q67100-H6148	P-DSO-20-1 (SMD)
PSB 8510-6P	Q67100-H6223	P-DIP-20-1
PSB 8510-6T	Q67100-H6225	P-DSO-20-1 (SMD)

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Special Features (depending on the versions)

- Saved number redial or notice (scratchpad) function up to 22 digits with separate memory
- Signaling key (SK) with flash and line grounding function (PSB 8510-1)
- Mask output

This is a general description of the pulse/tone dialer family PSB 8510-X with an overview on the present versions.

Detailed information on each of these versions is also available.

The digital signaling generator PSB 8510-X is specifically designed to implement Dual Tone Multifrequency (DTMF) and Pulse Dialing (PD) in a telephone set.

The device can be connected directly to a standard push button keyboard (single contact matrix type x-y) with up to 16 buttons.

It works together with an integrated speech circuit (e.g. PSB 4500/01, PSB 4506). Redial allows comfortable dialing. The PSB 8510-X family is a highly flexible device realized by pin selectable and mask programmable functions.

- Mask programmable:
 - All timings in steps of 1 ms up to 6 s (e.g. timing of DTMF and PD, flash and line grounding)
 - Function of the selecting pins
 - Special features (telephone sets for PBX/key systems)
- Pin selectable:
 - Access pause generation and timing
 - Default dialing mode and PD timing (different break/make ratios)
 - Different sets of timings

All possibilities of selecting features and timings are given in the **chapter "Timing Parameters of the Present Versions"**.

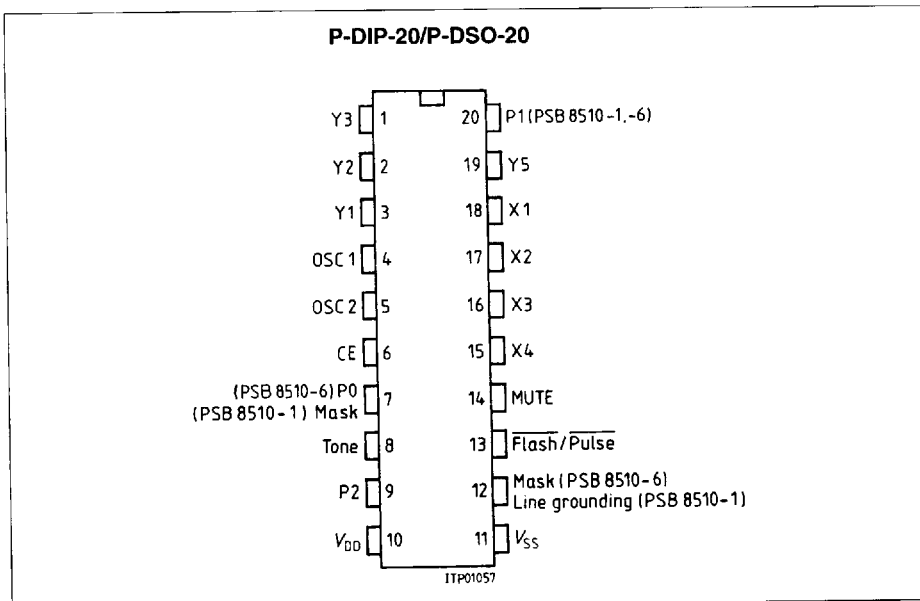
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Pin Configuration
(top view)



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Pin Definitions and Functions

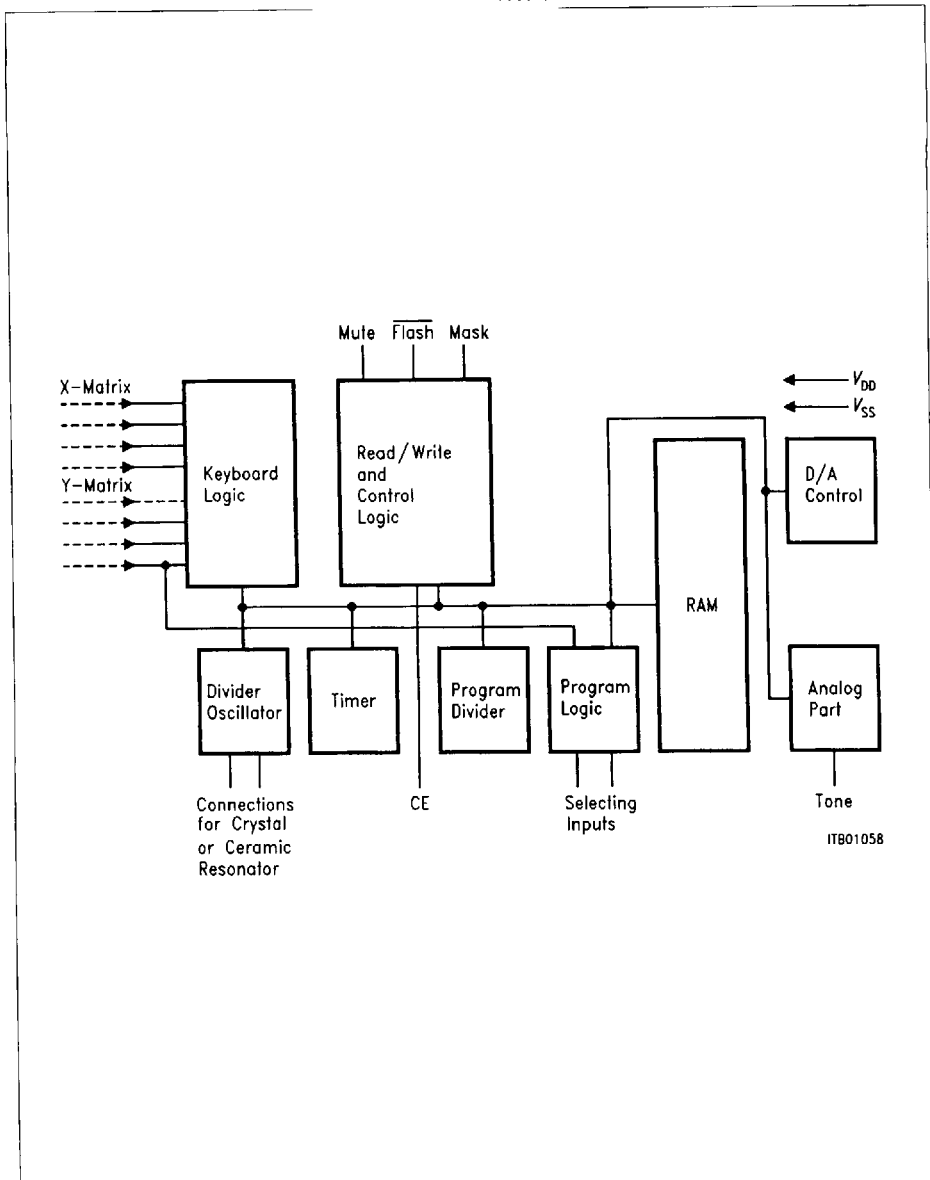
Pin No.	Symbol	Function
1 2 3	Y3 Y2 Y1	Keyboard interface columns
4 5	OSC 1 OSC 2	Connections for crystal or ceramic resonator
6	CE	Hook-Switch/Chip enable
7 7	P0 Mask	Selecting pin (PSB 8510-6) Mask output (PSB 8510-1)
8	Tone	DTMF output
9	P2	Selecting pin
10	V _{DD}	Positive supply voltage
11	V _{SS}	Ground
12 12	Line GND Mask	Line grounding output (PSB 8510-1) Mask output (PSB 8510-6)
13	Flash/Pulse	Flash/Pulse output (active low)
14	MUTE	MUTE output (active high)
15 16 17 18	X4 X3 X2 X1	Keyboard interface rows
19	Y5	Keyboard interface column
20	P1	Selecting pin (PSB 8510-1, -6)

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Block Diagram PSB 8510-X

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Functional Description

After off hook, the device changes from standby to wake-up state. In this state only the pull up/pull down current sources for the keyboard inputs are activated.

After detecting a key input signal, the oscillator starts.

When the amplitude of the clock-generator is high enough to drive the logic, the oscillator current will be reduced.

When there is a valid code at the inputs for longer than 6.4 ms without interruption, it will be accepted.

If the first input is a dialing digit (incl. *,#) or a pause, the LNR-RAM will be reset. The dialing digit or pause will be stored.

The device then starts the dialing procedure. At the same time further digits can be entered from the keyboard. They are also stored in the LNR-RAM.

For the handling of a signal key (SK) pressure **see chapter "Signaling Key Functions"**.

After on hook, the device goes into the standby mode by performing a special procedure.

Clock Generation

The device contains an oscillator circuit with the needed parasitic capacitances on chip. So, to implement the oscillator function, it is only necessary to connect a standard 3.58-MHz TV crystal or an adequate ceramic resonator to the OSC1 and OSC2 pins.

The oscillator starts when a row and a column input is activated. The typical start up time is approximately 1 ms with crystal operation.

If a ceramic resonator is used instead of a crystal, the dimensioning and connecting instructions of the manufacturer should be followed.

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Keyboard Interface

The device can be connected directly to a x-y matrix keyboard without mechanical protection against multi-key pressure (**figure 1**). Internal logic prevents the transmission of illegal information if more than one key is pressed at the same time. The inputs are static after key recognition, i.e. there is no noise generation as occurs with scanned or dynamic inputs. The internal current sources allow contact resistances up to 1 kΩ in the closed condition and down to 100 kΩ in the open condition. The minimum key-closure time is 6.4 ms in the start-up condition and adapts automatically to longer bouncing times. To enable the recognition circuit for the next digit, the key contact has to be opened for more than 12 ms.

It is also possible to drive the key-recognition circuit with binary input. The corresponding binary codes are given in **table 1**.

The timing is: Valid code input for min. 6.4 ms; then "no input signal" for min. 12 ms.

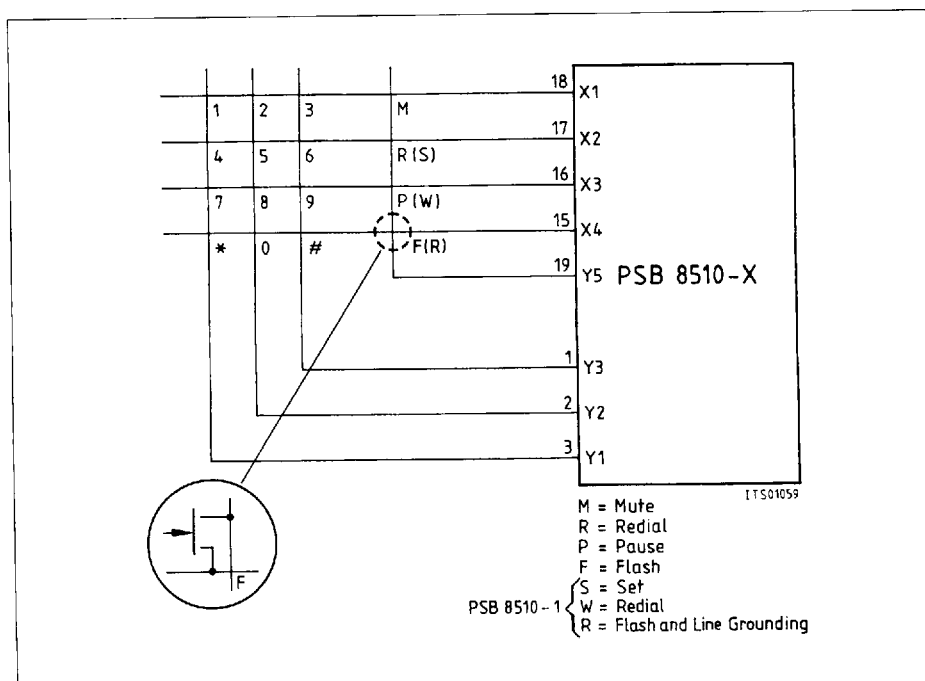


Figure 1
Keyboard Connection

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Table 1
Codes for X-Y-Matrix Input

Y				X				Function
5	3	2	1	4	3	2	1	
0	0	0	0	1	1	1	1	no input signal
0	0	0	1	1	1	1	1	single tone 1209 Hz
0	0	1	0	1	1	1	1	single tone 1336 Hz
0	1	0	0	1	1	1	1	single tone 1477 Hz
0	0	0	0	1	1	1	1	single tone 1633 Hz
0	0	0	0	1	1	1	0	single tone 697 Hz
0	0	0	0	1	1	0	1	single tone 770 Hz
0	0	0	0	1	0	1	1	single tone 852 Hz
0	0	0	0	0	1	1	1	single tone 941 Hz
0	0	0	1	1	1	1	0	key "1"
0	0	0	1	1	1	0	1	key "4"
0	0	0	1	1	0	1	1	key "7"
0	0	0	1	0	1	1	1	key "*"
0	0	1	0	1	1	1	0	key "2"
0	0	1	0	1	1	0	1	key "5"
0	0	1	0	1	0	1	1	key "8"
0	0	1	0	0	1	1	1	key "0"
0	1	0	0	1	1	1	0	key "3"
0	1	0	0	1	1	0	1	key "6"
0	1	0	0	1	0	1	1	key "9"
0	1	0	0	0	1	1	1	key "#"
1	0	0	0	1	1	1	0	key "M"
1	0	0	0	1	1	0	1	key "R" ("S")
1	0	0	0	1	0	1	1	key "P" ("W")
1	0	0	0	0	1	1	1	key "F" ("R")
0	0	1	0	0	0	0	0	clear memories
0	0	0	0	0	1	1	0	TESTM (test-mode)
rest								not accepted

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Dialing Functions

Dual Tone Mode

When a row and a column are connected via key, a dual tone output consisting of the appropriate low group and high group frequency is generated. A DTMF signal can be achieved within t_{KR} after key closure when there is no switch bounce. If two or more keys are pressed at the same time, no tone will appear at the output. The DTMF signal is timed for a minimum sending time of t_{DTMF} or as long as the key is pressed. Subsequently, an Interdigit Pause (IDP) t_{DIDP} is generated. Both times t_{DTMF} and t_{DIDP} are mask-programmable. The MUTE output is active (V_{DD}) during t_{DTMF} and t_{DIDP} .

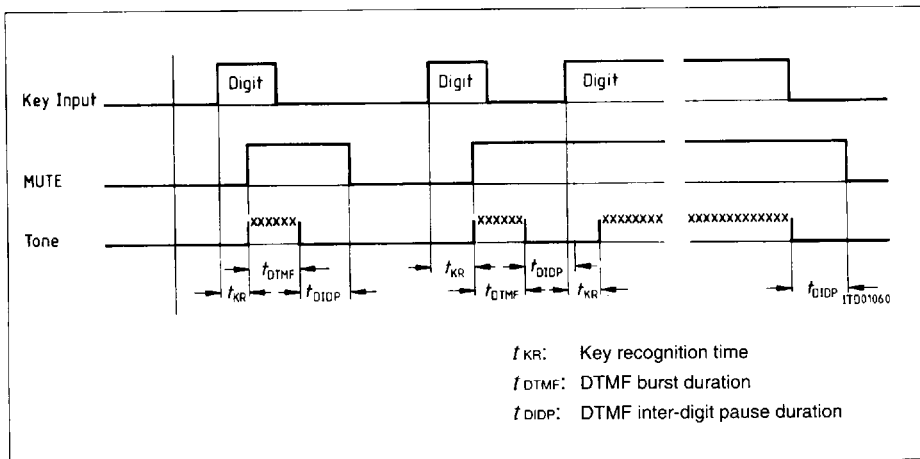


Figure 2
DTMF-Dialing

Single Tone Mode

A low group tone can be generated by connecting an appropriate row input (X1 ... X4) to ground (V_{SS}). A high group tone can be generated by connecting an appropriate column input (Y1...Y3) to V_{DD} . Both modes can also be obtained with binary inputs (see table 1). In this mode no digits will be stored in the RAM. The generation time is as long as the inputs are connected to V_{DD} or V_{SS} (respectively). A stored dialed-number remains in the RAM.

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Table 2
Output Frequencies

Active Input	Output Frequency (Hz)		% Error (without Crystal Drift)
	Specified	Actually	
X1	697	695.32731	- 0.240
X2	770	773.45398	+ 0.448
X3	852	849.84449	- 0.253
X4	941	942.97813	+ 0.210
Y1	1209	1207.67375	- 0.110
Y2	1336	1336.64862	+ 0.049
Y3	1477	1480.37428	+ 0.228

Oscillator frequency $f_{XTAL} = 3.579545$ MHz

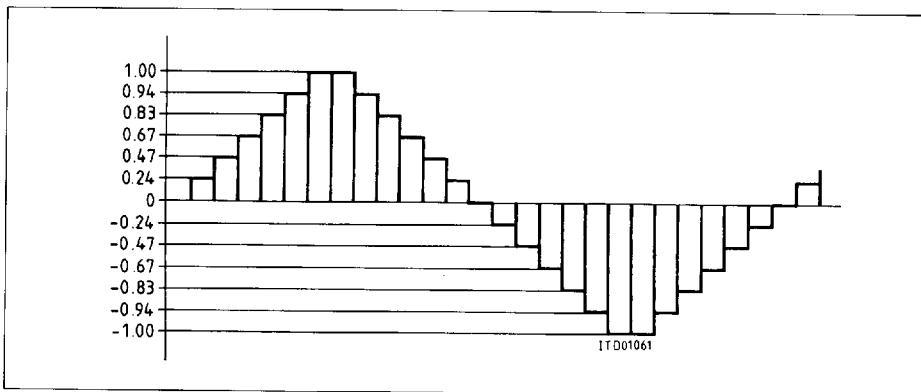


Figure 3
Synthesized Output Waveforms

Tone Generation

For the tone generation the device contains only one D/A-converter, which is designed as a special capacitor network for generating sine-waves as shown in **figure 3**. The converter is multiplexed to generate the two frequency groups.

The two sine-waves so generated are equal in amplitude and have very low distortion. They are filtered separately by second order lowpass filters and added in the output buffer which is connected as a first order lowpass filter. The ratio of the amplitudes of the frequencies from the low and high group depends only on the ratio of two resistors. So the DTMF output signals meet CEPT specification without external components.

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Pulse Mode

When the device is in Pulse-Dialing-mode (PD), the tone output is switched to high impedance and the $\overline{\text{Flash/Pulse}}$ output works as pulse output. After a digit is read from RAM, the device first generates an Interdigit Pause (IDP), which is t_{IDP} long.

The $\overline{\text{Flash/Pulse}}$ output is then switched from high impedance to V_{SS} during the Break-time (t_B). Subsequently the $\overline{\text{Flash/Pulse}}$ output is switched back to high impedance or to V_{DD} (depends on the version) for the Make-time (t_M). Depending on the digit read from RAM, the device repeats this Break-Make cycle. During Interdigit Pause (t_{IDP}), Make-time (t_M) and Break-time (t_B), the MUTE output is active (V_{DD}).

The values of t_B , t_M , t_{IDP} as well as the PD frequency are mask-programmable and pin-selectable. Two mask signals are possible (Mask 1 or Mask 2).

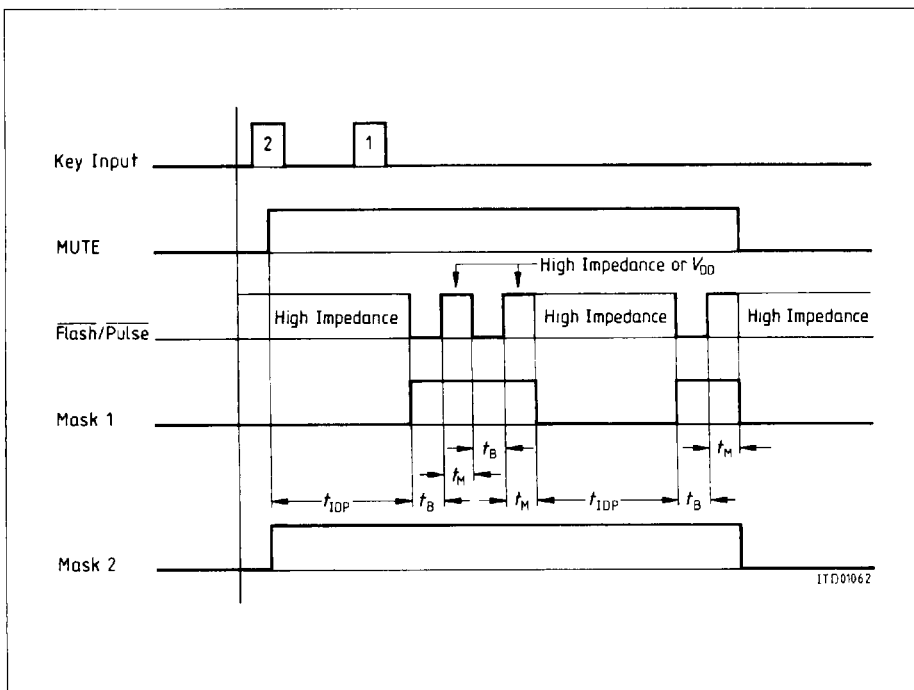


Figure 4
Pulse Dialing

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Special Functions

Keyboard Configuration

Figure 5 shows the keyboard configuration with a maximum number of keys.

		High Frequencies Group			Control Keys	
		1209	1336	1477		
Low Frequencies Group	697	①	②	③	F1	X1
	770	④	⑤	⑥	F2	X2
	852	⑦	⑧	⑨	F3	X3
	941	*	0	#	F4	X4
		Y1	Y2	Y3	Y5	

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Figure 5
Keyboard Configuration

The column Y5 is optional.

The functions of the column Y5 are mask-programmable (for the actual existing control keys see chapter "Present Versions of the PSB 8510-X").

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RAM Configuration

- | | |
|---------------------|--------------------------|
| 1. RAM | 1st digit ... 22nd digit |
| 2. RAM | 1st digit ... 22nd digit |
| 3. RAM (cyclic RAM) | 1st digit ... 8th digit |

Last/Saved Number Redial

Last Number Redial (LNR) is possible by depressing the "Redial"-key as first key input after off hook. Then all stored digits of the LNR-RAM will be sent out.

Saved Number Redial (SNR) is possible by depressing the "MUTE"- and the "Redial"-key one after the other. Then all stored digits of the SNR-RAM will be sent out (valid for devices with a SNR function).

After finishing the redial functions (LNR, SNR), it is possible to dial additionally an unlimited number of digits, which will be transmitted. These digits are stored in the cyclic RAM and the contents of the LNR- and SNR-RAM will not be affected.

In conversation mode after finishing dialing it is possible to save the last number of the LNR-RAM into the SNR-RAM with the "Redial"-key (valid for devices with a SNR function).

Access Pause Function

If the telephone needs access pauses, e.g. for trunk searching or dial-tone connection, they should be stored in the RAM for redial access.

The PSB 8510-X offers two possible methods of generating and storing access pauses.

1. Pause Key Function (Manual Pause)

Pressing the pause-key in the dial sequence causes a pause code to be stored in the RAM. When this code is read, dialing is interrupted for the access pause time chosen at the selecting pins.

2. Automatic Pause Function

If an automatic pause function is enabled (via selecting pins, **see chapter "Timing Parameters"**) a defined number of pauses can be generated automatically.

They are generated if the time between two key pressures is greater than e.g. 800 ms in DTMF-mode or if the time between the end of the last pulse chain and the next key pressure is greater than 10 ms in pulse-mode (mask-programmable, depending on requirements).

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Access Pause Duration

The maximum duration of an Access Pause is t_{AP} .

Each access pause can be shortened via the redial-key (go-function), then the next digit will be read from RAM.

During the pause-time t_{AP} , the MUTE output is inactive.

Signaling Key Functions

The signaling key (SK) means either the flashing key or the flashing plus line grounding key.

If the signaling key is pressed, an SK code is written in the RAM. Reading this code, independent of dialing mode, the device generates either just a flash signal or a flash signal plus a line grounding signal simultaneously (depending on the version).

During a Flash signal (t_{FL}) the Flash/Pulse output is switched from high impedance to V_{SS} . A loop-disconnection will be ignored by the dialer in this state. After the Flash signal (t_{FL}) a Flash Pause (t_{FLP}) follows.

Both times t_{FL} and t_{FLP} are mask programmable and/or pin-selectable. In case of line grounding (t_{LG}), the line grounding output is switched from high impedance to V_{DD} . After the line grounding signal (t_{LG}), a line grounding pause (t_{LGP}) follows.

During line grounding signal (t_{LG}) the mask output is active (V_{DD}). The total time of flash signal and flash pause is identical with the total time of line grounding signal and line grounding pause ($t_{FL} + t_{FLP} = t_{LG} + t_{LGP} = t_{SK}$). During this time (t_{SK}) the MUTE output is active (V_{DD}).

After the signaling key function (t_{SK}) in last number redial an access pause with t_{AP} can be generated before the next digit is read from RAM.

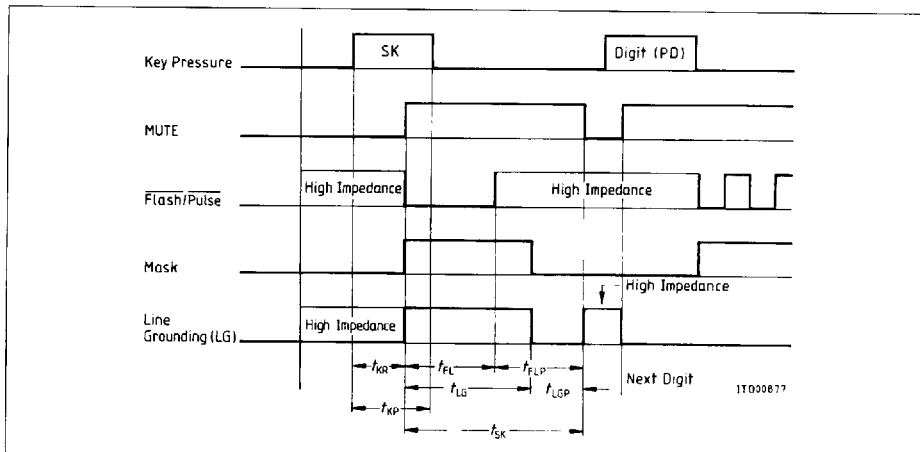


Figure 6
Timing Diagram for a Signaling Key Function with Pulse Dialing (PSB 8510-1)

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MUTE/Mask Signal

The MUTE output is active (V_{DD}) while sending dial information including Interdigit Pauses (IDP) ($t_{DTMF} + t_{DIDP}$ in DTMF and $t_B + t_M + t_{IDP}$ in PD mode) and while sending a signaling key (SK) function (t_{SK}).

During access pauses the MUTE output is not active (V_{SS}).

The mask output is active (V_{DD}) while sending digits in PD mode ($t_B + t_M$), excluding IDP (Mask1) or including IDP (Mask2) and while sending a line grounding signal (t_{LG}), excluding line grounding pause (t_{LGP}).

In conversation mode and during access pause the MUTE output can be activated by pressing the MUTE key (M).

A subsequent key input (any key) deactivates the MUTE output (V_{SS}). It is possible to toggle the MUTE output with the MUTE key without invoking any other function.

Selection and Changing of Dialing Mode

The default dialing mode is chosen by the selecting pin (see chapter "Timing Parameters").

After hooking off and depressing the first key (oscillator starts), the device checks the selecting pins and sets the default dialing mode (PD or DTMF).

Changing dialing mode in off hook condition after the first key pressure by switching the selecting pins is not possible. Changing dialing mode via keyboard is possible, depending on the version.

Test Mode

The device has different test modes. By connecting the inputs X2, X3 to V_{DD} and X1, X4 as well as all Y-inputs to V_{SS} (TESTM) and releasing them, one test mode after the other will be activated. In each of these test modes the X/Y key-inputs work normally. In the different modes all timings will speed up with defined factors.

Hook-Switch/Chip Enable (CE)

The device achieves reduced power consumption for data retention in power down mode, when the CE-input is low (V_{SS}).

In this mode the pull up/pull down-current sources are disconnected from the key inputs. All other inputs are inactive (standby mode).

When the CE-input is high (V_{DD}), the row and column-inputs are enabled and the device can be started via key pressure (wake-up-mode).

When the device is started, it ignores line current breaks, which pull the CE-input down to V_{SS} , for up to e.g. 240 ms. The device interrupts dialing but accepts key-inputs during that time and continues dialing when the line current is restored.

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Absolute Maximum Ratings

$T_A = -25$ to 70 °C

Parameter	Symbol	Limit Values		Unit
		min.	max.	
DC supply voltage	$(V_{DD}-V_{SS})$	- 0.5	28	V
Input voltage at any pin	V_I	$V_{SS} - 0.5$	$V_{DD} + 0.5$	V
Power dissipation	P_{tot}		500	mW
Operating ambient temperature	T_A	- 25	70	°C
Storage temperature	T_{stg}	- 55	125	°C

DC Characteristics

$V_{DD} = 3.5$ and $T_A = -25$ to 70 °C, unless otherwise noted

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
Supply voltage					
a) for specified DTMF-level and distortion	V_{DD}	3.0	3.5	6.0	V
b) for digital operation	V_{DD}	2.5		6.0	V
Operating current					
a) DTMF, one key pressed tone and MUTE					
output unloaded $V_{DD} = 3.5$ V	I_{DD}		1	1.5	mA
$V_{DD} = 3.0$ V	I_{DD}			1.2	mA
b) Pulse-dialing, pause or flash, no key pressed, MUTE and line GND unloaded	I_{DD}		0.25	0.30	mA
Current in wake-up-mode before first key pressure	I_{DD}		10	1	μA
Standby current CE = V_{SS}	I_{DD}		0.5	1	μA
Standby voltage for data retention	V_{DD}	1.2		6	V

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DC Characteristics (cont'd)

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	

Outputs
MUTE, Mask

H-voltage	V_{OH}	3.1			V
L-voltage	V_{OL}			0.4	V
H-current	I_{OH}	0.5		2	mA
L-current	I_{OL}	1		3	mA

Flash

H-voltage	V_{OH}	3.1			V
L-voltage	V_{OL}			0.4	V
H-current	I_{OH}	0.5		2	mA
L-current	I_{OL}	1		3	mA

Tone

DC-level	V_{DC}	1.9	2	2.1	V
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Inputs
Chip enable (CE)

Input voltage	V_{IH}	$(V_{DD} - 0.5)$		$(V_{DD} + 0.3)$	V
	V_{IL}	$(V_{SS} - 0.3)$		$(V_{SS} + 0.5)$	V
Input current	I_{IH}			50	nA
	$-I_{IL}$			50	nA

Selecting Pins
(P0, P1, P2)

Input voltage	V_{IH}	$(V_{DD} - 0.5)$		$(V_{DD} + 0.3)$	V
	V_{IL}	$(V_{SS} - 0.3)$		$(V_{SS} + 0.5)$	V
Input current	(during scanning)	I_{IH}		400	μ A
		$-I_{IL}$		400	μ A
(scanning completed)	I_{IH}			100	nA
	$-I_{IL}$			100	nA

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Matrix Keyboard Operation

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
Keyboard current X connected to Y	I_{Key}		70	100	μA

X1...X4

Input current $V_{IN} = 0-1 V$	$-I_{IL}$			400	μA
Input voltage	V_{IH}	$(V_{DD} - 0.5)$		$(V_{DD} + 0.3)$	V
	V_{IL}	$(V_{SS} - 0.3)$		$(V_{SS} + 0.5)$	V

Y1...Y5

Input current $V_{IN} = 2.5-3.5 V$	I_{IH}			400	μA
Input voltage	V_{IH}	$(V_{DD} - 0.5)$		$(V_{DD} + 0.3)$	V
	V_{IL}	$(V_{SS} - 0.3)$		$(V_{SS} + 0.5)$	V
ON resistance (Contact ON)	$R_{Key ON}$			1	$k\Omega$
OFF resistance (Contact OFF)	$R_{Key OFF}$	100			$k\Omega$

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AC Characteristics

$T_A = -25$ to 70 °C

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	

Tone Output

Small signal output impedance	Z_o	0.6	0.8	1.3	$k\Omega$
Output resistance (load AC-coupled) for specified distortion (CEPT)	R_L	15	30	∞	$k\Omega$

Output Voltage

(rms-values, no load)

Sum level	V_s		426		mV
L-group	V_L	236	265	297	mV
H-group	V_H	297	333	373	mV
Pre-emphasis	P_D	1	2	3	dB
Frequency deviation (without crystal tolerance)	F	-0.254		0.448	%

Oscillator

Recommended crystal	R_s L_L C_M C_N		100 96 0.02 5		Ω mHy pF pF
Start-up time	t_{SO}	0.5	0.6	1	ms
Keyboard debounce time	t_b	6.4	adaptive	adaptive	ms
Set-up time (first key depressing to full level for DTMF) ($t_{SO} + t_b + t_{br}$: read-write-logic)	t_s	8			ms

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PSB 8510-1-P;-1T
PSB 8510-6-P;-6T

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Present Versions of the PSB 8510-X

	PSB 8510-1 Germany	PSB 8510-6 "Rest of the World"
Ordering Code	Q67100-H8327	Q67100-H6066
Keyboard		
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ * 0 #	(M) (MUTE) (S) (Set) (W) (Redial) (R) (Flash & LG)	(M) (MUTE) (R) (Redial) (P) (Pause) (F) (Flash)
Pin-Assignment		
Pin 7 Pin 12 Pin 20	MASK Line Grounding Sel. Pin P1 (AP)	Select. Pin P0 MASK Select. Pin P1
Memory/ Number of Digits	LNR / 22 Cyclic / 8	LNR / 22 SNR/22 Cyclic / 8
Redial	(W) → LNR	(R) → LNR (M) + (R) → SNR
Access Pause		
manual	—	(P)
automatic:		
<i>Pulse-Mode</i>	P20: V _{DD} /open max. 2	P7, P9, P20 max. 2
Location	any	between first 3 digits
Generat. Time	10 ms	10 ms
<i>DTMF-Mode</i>		
Location	max. 1 any	max. 2 between first 3 digits
Generat. Time	1000 ms	800 ms
Duration (sel. Pin)	3 s/1.8 s (P20)	4 s/—
Flash Timing		
active/pause	80 ms/420 ms 80 ms/970 ms	depends on sel. pins/550 ms
DTMF Timing		
active/pause	90 ms/90 ms	90 ms/90 ms
Change Dial Mode via Keyboard		
Default PD → DTMF	(S) + (*) + (S)	(*) or (M) + (F)
back to PD	(R)	(F) or (M) + (F)
Default DTMF → PD	not possible	(M) + (F)
back to DTMF	not possible	(M) + (F)

"+" means: subsequent key pressures

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Timing Parameters of the Present Versions

Timing of the PSB 8510-1

Signaling key

Flash (t_{FL1}): 80 ms
Flash pause (t_{FLP1}): 420 ms
Flash (t_{FL2}): 80 ms
Flash pause (t_{FLP2}): 970 ms

Line grounding (t_{LG1}): 450 ms
Line grounding pause (t_{LGP1}): 50 ms
Line grounding (t_{LG2}): 1000 ms
Line grounding pause (t_{LGP2}): 50 ms

Pulse dialing (PD)

Dialing frequency: 10 Hz
Interdigit pause (t_{IDP}): 820 ms

Tone dialing (DTMF)

Minimum sending time (t_{DTMF}): 90 ms
Interdigit pause (t_{DIDP}): 90 ms

Selecting Pins		Default Dialing Mode	Break/Make Ratio t_s / t_M	Access Pause t_{AP} (s)	Automatic Pause
P1 (20)	P2 (9)				
0	0	PD	60/40	—	no
x	0	PD	60/40	3	yes
1	0	PD	60/40	1.8	yes
0	1	PD	66.7/33.3	—	no
x	1	PD	66.7/33.3	3	yes
1	1	PD	66.7/33.3	1.8	yes
0	x	DTMF	—	—	no
x	x	DTMF	—	3	yes
1	x	DTMF	—	1.8	yes

0 = Pin connected to V_{SS}
1 = Pin connected to V_{DD}
x = Pin not connected

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Timings of the PSB 8510-6

Signaling Key		Tone dialing (DTMF)	
Flash (t_{FL}):	see table	Minimum sending time (t_{DTMF}):	90 ms
Flash pause ($t_{R,P}$):	50 ms	Interdigit pause (t_{DIDP}):	90 ms
Pulse dialing		Access pause (t_{AP}):	
Dialing frequency:	see table	Access pause after flash:	500 ms
Interdigit pause (t_{IDP}):	see table	Access pause after changing dial mode:	4 s

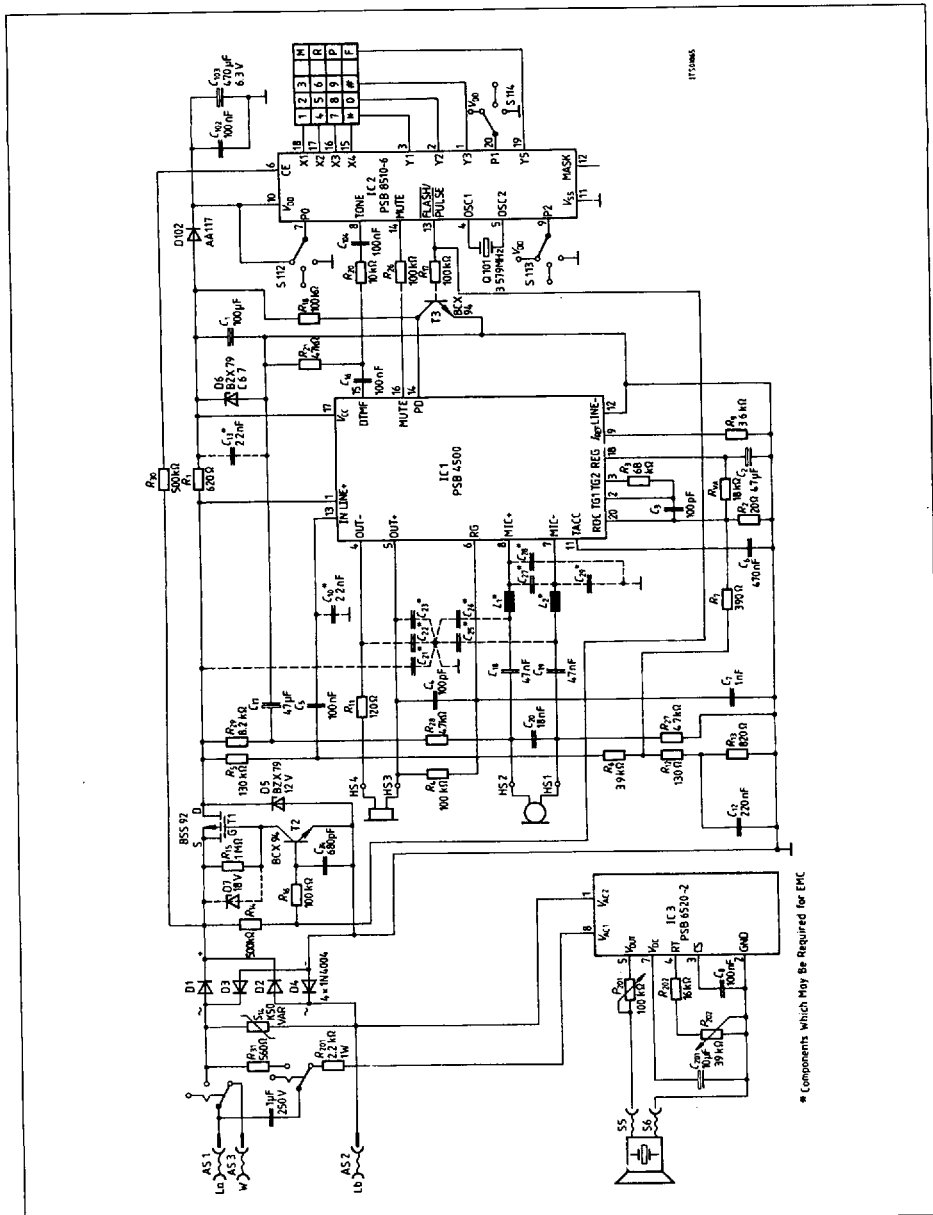
Selecting Pins			Default Dialing Mode	Pulse Dialing (PD)			Flash t_{FL} (ms)		Automatic Pause	
P0 (7)	P2 (9)	P1 (20)		Frequency (Hz)	Break/Make Ratio t_B/t_M (ms/ms)	Inter-digit Pause t_{IDP} (ms)	PD	DTMF	PD	DTMF
x	x	x	DTMF	10	66.7:33.3	800	300	80	no	yes
x	1	x	DTMF	10	66.7:33.3	800	300	80	no	no
1	x	x	PD	10	66.7:33.3	800	-	-	no	no
1	1	x	PD	10	66.7:33.3	800	-	-	yes	no
x	0	x	PD	10	60:40	800	-	-	no	no
0	x	x	PD	10	60:40	800	-	-	yes	no
0	0	x	PD	16	60:40	500	-	-	yes	no
0	1	x	PD	18	60:40	440	-	-	yes	no
1	0	x	PD	16	66.7:33.3	500	-	-	yes	no
x	x	1	DTMF	10	66.7:33.3	800	300	120	no	no
x	1	1	DTMF	10	66.7:33.3	800	300	120	no	yes
1	x	1	DTMF	10	66.7:33.3	800	300	180	no	no
1	1	1	DTMF	10	66.7:33.3	800	300	180	no	yes
x	0	1	PD	10	66.7:33.3	800	-	-	no	no
0	x	1	PD	10	66.7:33.3	800	-	-	yes	no
0	0	1	PD	20	66.7:33.3	400	-	-	no	no
0	1	1	PD	20	66.7:33.3	400	-	-	yes	no
1	0	1	PD	10	60:40	800	-	-	yes	no
x	x	0	DTMF	10	66.7:33.3	800	300	300	no	no
x	1	0	DTMF	10	66.7:33.3	800	300	300	no	yes
1	x	0	PD	10	66.7:33.3	800	-	-	no	no
1	1	0	PD	10	66.7:33.3	800	-	-	yes	no
x	0	0	PD	16	66.7:33.3	500	-	-	yes	no
0	x	0	PD	10	60:40	800	-	-	no	no
0	0	0	PD	10	60:40	800	-	-	yes	no
0	1	0	PD	16	60:40	500	-	-	yes	no
1	0	0	PD	18	60:40	440	-	-	yes	no

0 = Pin connected to V_{SS}
 1 = Pin connected to V_{DD}
 x = Pin not connected

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* Components which may be required for EMC

Application Circuit (Example)