

# DATA SHEET

## **TDA8000; TDA8000T** Smart card interface

Product specification  
Supersedes data of 1995 Feb 01  
File under Integrated Circuits, IC02

1996 Dec 12

## Smart card interface

## TDA8000; TDA8000T

## FEATURES

- Two protected I/O lines
- $V_{CC}$  regulation (5 V  $\pm$ 4%, 100 mA max. with controlled rise and fall times)
- $V_{PP}$  generation (12.5, 15 or 21 V  $\pm$ 2.5%, 50 mA max. programmable by two bits, with controlled rise and fall times)
- Clock generation (up to 8 MHz)
- Short-circuit, thermal and card extraction protections
- Two voltage supervisors (digital and analog supplies)
- Automatic activation and deactivation sequences via an independent internal clock
- Enhanced ESD protections on card connections (4 kV min.)
- ISO 7816 approval.

## APPLICATIONS

- Pay TV
- Telematics
- Cashless payment
- Multipurpose card-readers, etc.

## GENERAL DESCRIPTION

The TDA8000 is a complete, low-cost analog interface which can be positioned between a smart card or a memory card (ISO 7816) and a microcontroller. It is approved for banking, telecom and pay TV applications.

The complete supply, protection and control functions are realized with only a few external components, which makes the TDA8000 very attractive for consumer applications. Application suggestions and support is available on request (see examples in Chapter "Application information").

## QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{DD}$	supply voltage		6.7	–	18	V
$I_{DD}$	supply current	idle mode; $V_{DD} = 12$ V	–	25	–	mA
		active modes; unloaded	–	32	–	mA
$V_{th2}$	threshold voltage on $V_{SUP}$		4.5	–	4.68	V
$V_{CC}$	card supply voltage		4.8	5.0	5.2	V
$I_{CC}$	card supply current		–	–	–100	mA
$V_H$	high voltage supply for $V_{PP}$		–	–	30	V
$I_{PP}$	programming current	read mode; $V_{PP} = 5$ V	–	–	–50	mA
		write mode; $V_{PP} > 5$ V	–	–	–50	mA
$t_{de}, t_{act}$	deactivation/activation cycle duration		–	–	500	$\mu$ s
$P_{tot}$	continuous total power dissipation	TDA8000; $T_{amb} = +70$ °C; see Fig.10	–	–	2	W
		TDA8000T; $T_{amb} = +70$ °C; see Fig.11	–	–	0.92	W
$T_{amb}$	operating ambient temperature		0	–	+70	°C

## ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA8000	DIP28	plastic dual in-line package; 28 leads (600 mil)	SOT117-1
TDA8000T	SO28	plastic small outline package; 28 leads; body width 7.5 mm	SOT136-1

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BLOCK DIAGRAM

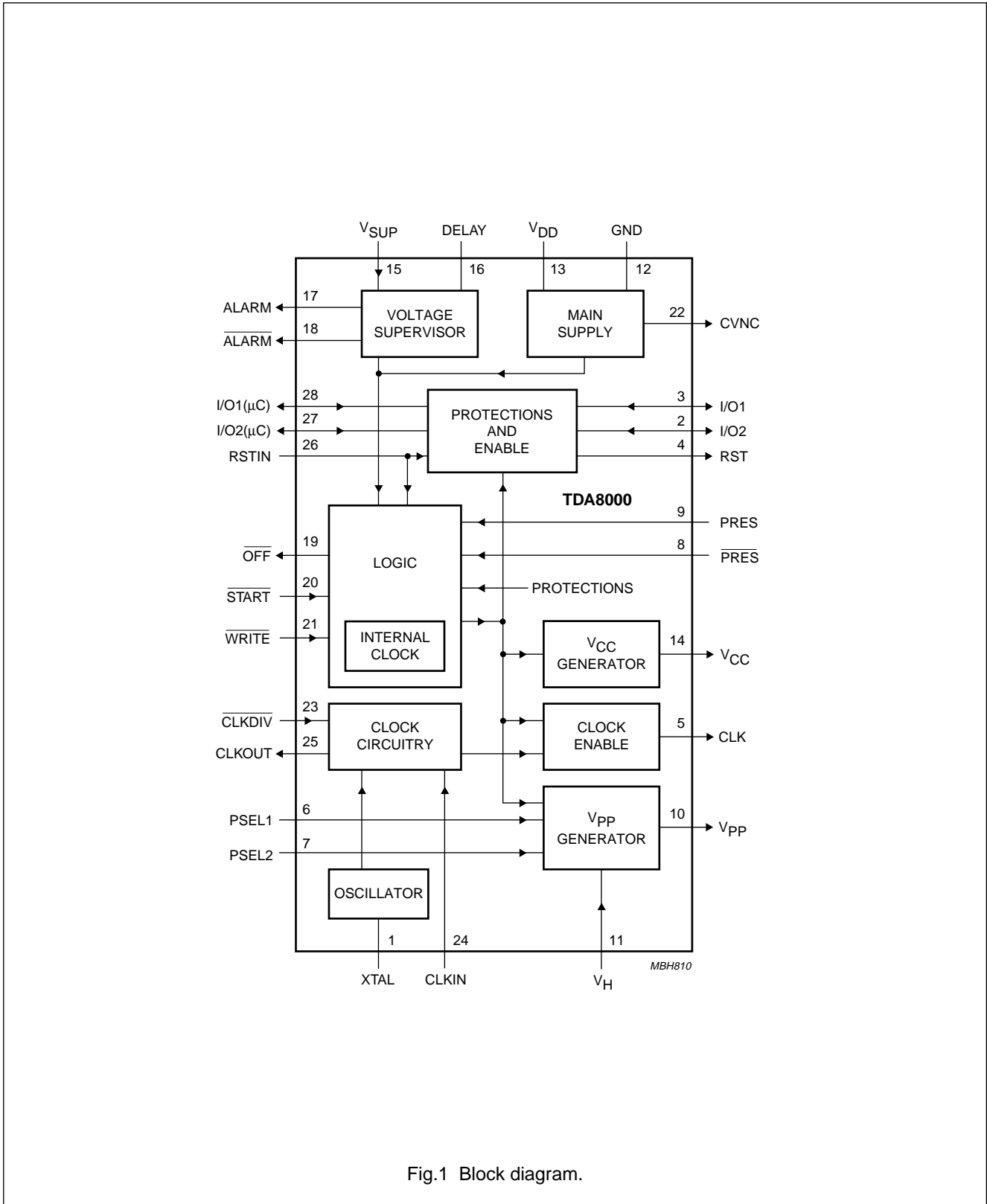


Fig.1 Block diagram.

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PINNING

SYMBOL	PIN	DESCRIPTION
XTAL	1	crystal connection
I/O2	2	data line to/from the card
I/O1	3	data line to/from the card
RST	4	card reset output
CLK	5	clock output to the card
PSEL1	6	programming voltage selection input (see Table 1)
PSEL2	7	programming voltage selection input (see Table 1)
$\overline{\text{PRES}}$	8	card presence contact input (active LOW)
PRES	9	card presence contact input (active HIGH)
V <sub>PP</sub>	10	card programming voltage output
V <sub>H</sub>	11	high voltage supply for V <sub>PP</sub> generation
GND	12	ground
V <sub>DD</sub>	13	positive supply voltage
V <sub>CC</sub>	14	card supply output voltage
V <sub>SUP</sub>	15	voltage supervisor input
DELAY	16	external capacitor connection for delayed reset timing
ALARM	17	open-collector reset output for the microcontroller (active HIGH)
$\overline{\text{ALARM}}$	18	open-collector reset output for the microcontroller (active LOW)
$\overline{\text{OFF}}$	19	interrupt output to the microcontroller (active LOW)
$\overline{\text{START}}$	20	microcontroller input for starting session (active LOW)
$\overline{\text{WRITE}}$	21	control input for applying programming voltage to the card (active LOW)
CVNC	22	internally generated 5 V reference, present when V <sub>DD</sub> is on; to be decoupled externally (47 nF)
$\overline{\text{CLKDIV}}$	23	input for dividing/not dividing the CLKOUT frequency by two (active LOW)
CLKIN	24	external clock signal input
CLKOUT	25	clock output to the microcontroller, or another TDA8000
RSTIN	26	card reset input from the microcontroller (active HIGH)
I/O2( $\mu\text{C}$ )	27	data line to/from the microcontroller; must not be left open-circuit, tie to CVNC if not used
I/O1( $\mu\text{C}$ )	28	data line to/from the microcontroller; must not be left open-circuit, tie to CVNC if not used

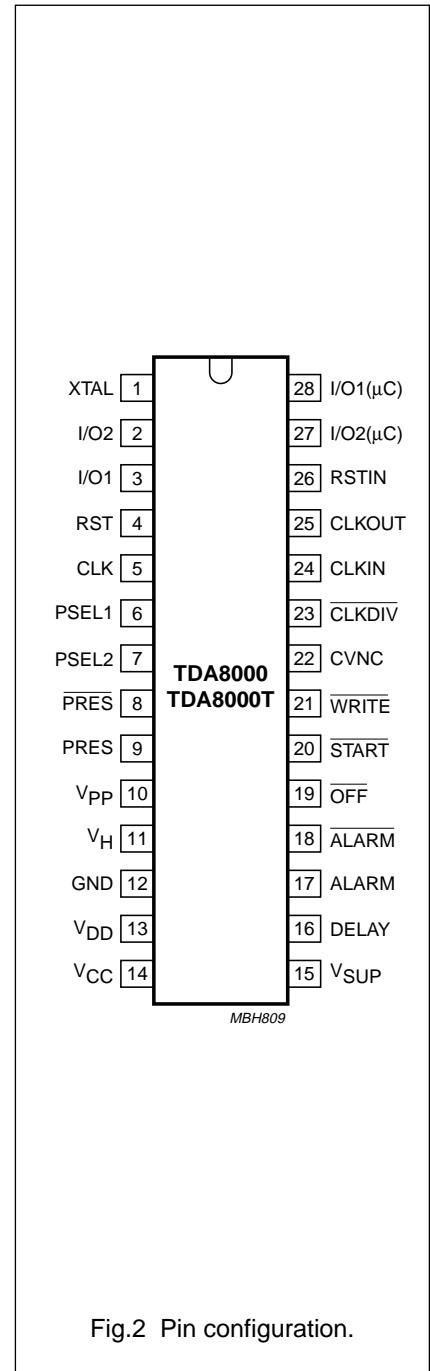


Fig.2 Pin configuration.

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**FUNCTIONAL DESCRIPTION****Power supply**

The circuit operates within a supply voltage range of 6.7 to 18 V.  $V_{DD}$  and GND are the supply pins. All card contacts remain inactive during power-up or power-down, provided  $V_{DD}$  does not rise or fall too fast (0.5 V/ms typ.).

**POWER-UP**

The logic part is powered first and is in the reset condition until  $V_{DD}$  reaches  $V_{th1}$ . The sequencer is blocked until  $V_{DD}$  reaches  $V_{th4} + V_{hys4}$ .

**POWER-DOWN**

When  $V_{DD}$  falls below  $V_{th4}$ , an automatic deactivation of the contacts is performed.

**Voltage supervisor**

This block surveys the 5 V supply of the microcontroller ( $V_{SUP}$ ) in order to deliver a defined reset pulse and to avoid any transients on card contacts during power-up or power-down of  $V_{SUP}$ .

The voltage supervisor remains active even if  $V_{DD}$  is powered-down.

**POWER-UP**

As long as  $V_{SUP}$  is below  $V_{th2} + V_{hys2}$  the capacitor  $C_{DEL}$ , connected to the pin DELAY, will be discharged. When  $V_{SUP}$  rises to the threshold level,  $C_{DEL}$  will be recharged. ALARM and  $\overline{ALARM}$  remain active, and the sequencer is blocked until the voltage on the pin DELAY reaches  $V_{th3}$ .

**POWER-DOWN (see Fig.3)**

If  $V_{SUP}$  falls below  $V_{th2}$ ,  $C_{DEL}$  will be discharged, ALARM and  $\overline{ALARM}$  become active, and an automatic deactivation of the contacts is performed.

**Clock circuitry (see Fig.4)**

The clock signal (CLK) can be applied to the card by two different methods:

1. Generation by a crystal oscillator: the crystal (3 to 11 MHz) is connected to pin XTAL. Its frequency is divided by two.
2. Use of a signal frequency already present in the system and connected to the pin CLKIN (up to 8 MHz). Pin XTAL has to be connected to GND via a 1 k $\Omega$  resistor. In this event, the CLKOUT signal remains LOW.

In both events the signal is buffered and enabled.

Pin CLKOUT may be used to clock a microcontroller. The signal ( $\frac{1}{2}f_{xtal}$  or  $f_{xtal}$  if  $\overline{CLKDIV}$  is HIGH) is available when the circuit is powered up.

**State diagram**

Once activated, the circuit has six possible modes of operation:

- Idle
- Activation
- Read
- Write
- Deactivation
- Fault.

Figure 5 shows how these modes are accessible.

**IDLE MODE**

After reset, the circuit enters the IDLE state. A minimum number of circuits are active while waiting for the microcontroller to start a session:

- All card contacts are inactive
- Voltage generators are stopped
- Oscillator is running, providing CLKOUT
- Voltage supervisor is active
- Pins I/O1( $\mu$ C) and I/O2( $\mu$ C) are high impedance.

The  $\overline{OFF}$  line is HIGH if a card is present (PRES and  $\overline{PRES}$  active) and LOW if a card is not present.

**ACTIVATION SEQUENCE**

From the IDLE mode, the circuit enters the ACTIVATION mode when the microcontroller sets the START line (active LOW). The I/O( $\mu$ C) signals must not be LOW. The internal circuitry is activated, the internal clock starts and the following ISO 7816 sequence is performed:

1.  $V_{CC}$  rises from 0 to 5 V
2. I/Os are enabled
3.  $V_{PP}$  rises from 0 to 5 V
4. No change
5. CLK is enabled
6. RST is enabled.

The typical time interval between two steps is 32  $\mu$ s for the first two steps and 64  $\mu$ s for the other three. Timing is derived from the internal clock (see Fig.6).

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Between steps 3 and 5, a HIGH level on pin RSTIN allows the CLK signal to be applied to the card. This feature facilitates a precise count of CLK periods while waiting for the card to respond to a reset.

After step 5, RSTIN has no further action on CLK.

After step 6, RST is set to the complementary value of RSTIN.

## READ MODE

When the activation sequence is completed and, after the card has replied to its Answer-to-Reset, the TDA8000 enters the READ mode. Data is exchanged between the card and the microcontroller via the I/O lines.

When it is required to write to the internal memory of the card, the circuit is set to the WRITE mode by the microcontroller.

Cards with EPROM memory require a programming voltage ( $V_{PP}$ ).

 $V_{PP}$  GENERATION

The circuit supports cards with  $V_{PP}$  of 12.5, 15 or 21 V. The selection of P is achieved by PSEL1 and PSEL2 according to Table 1.

**Table 1** Card programming voltage selection

PSEL1	PSEL2	PROGRAMMING VOLTAGE P
LOW	LOW	5
LOW	HIGH	12.5
HIGH	LOW	15
HIGH	HIGH	21

In order to respect the ISO7816 slopes, the circuit generates  $V_{PP}$  by charging and discharging an internal capacitor. The voltage on this capacitor is then amplified by a power stage gain of 5, powered via an external supply pin  $V_H$  [30 V (max.)].

## WRITE MODE (see Fig.7)

When the microcontroller sets the  $\overline{\text{WRITE}}$  line (active LOW), the circuit enters the WRITE mode.  $V_{PP}$  rises from 5 V to the selected value with a typical slew rate of 1 V/ $\mu\text{s}$ . When the write operation is completed, the microcontroller returns the  $\overline{\text{WRITE}}$  line to its HIGH state, and  $V_{PP}$  falls back to 5 V with the same slew rate.

$\overline{\text{WRITE}}$  has no action outside a session.

## DEACTIVATION SEQUENCE (see Fig.8)

When the session is completed, the microcontroller sets the  $\overline{\text{START}}$  line to its HIGH state.

The circuit then executes an automatic deactivation sequence by counting back the sequencer:

1. Card reset (RST falls to LOW)
2. CLK is stopped
3. No change
4.  $V_{PP}$  falls to 0 V
5. I/O1( $\mu\text{C}$ ) and I/O2( $\mu\text{C}$ ) become high impedance
6.  $V_{CC}$  falls to 0 V.

The circuit returns to the IDLE mode on the next rising edge of the sequencer clock.

## PROTECTIONS

Main fault conditions are monitored by the circuit:

- Short-circuit on  $V_{CC}$
- Short-circuit on  $V_{PP}$
- Over current on I/Os
- Card extraction during transaction
- Overheating problem.

When one of these fault conditions is detected, the circuit pulls the interrupt line  $\overline{\text{OFF}}$  to its active LOW state and returns to the FAULT mode.

## FAULT MODE (see Fig.9)

When a fault condition is written to the microcontroller via the  $\overline{\text{OFF}}$  line, the circuit initiates a deactivation sequence.

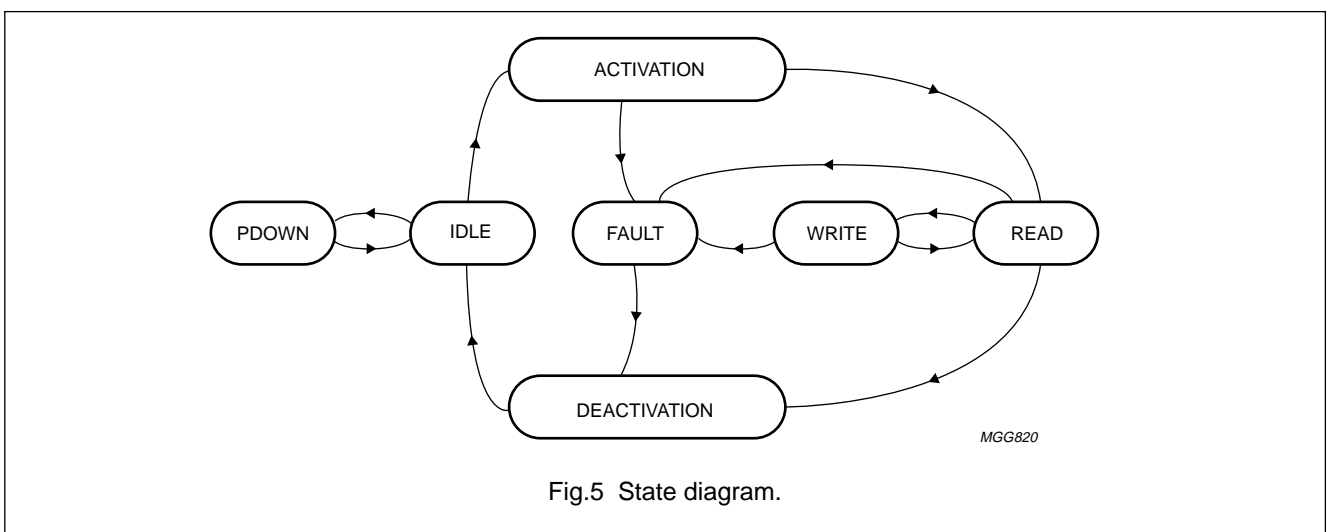
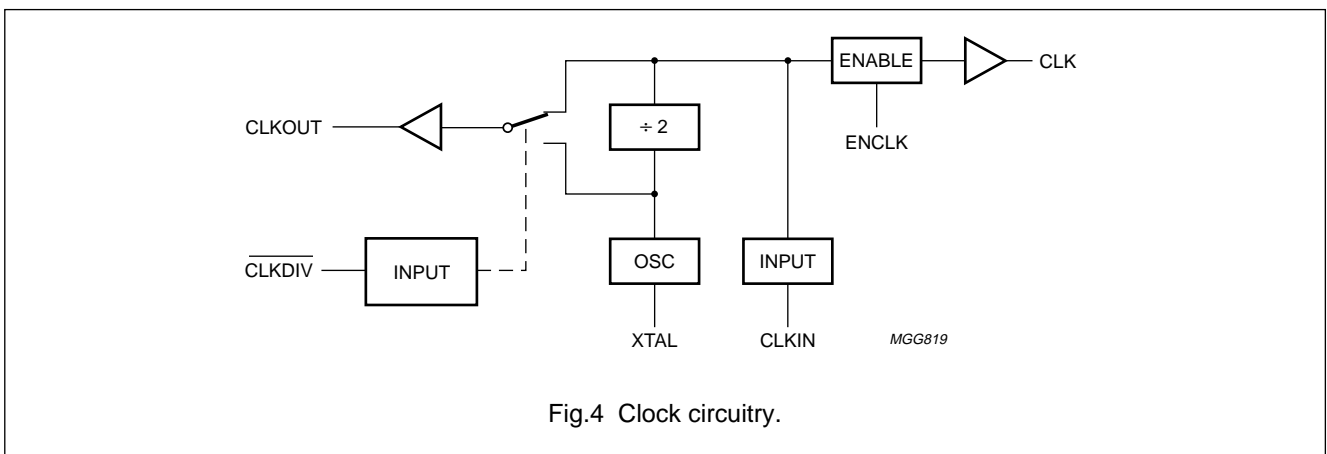
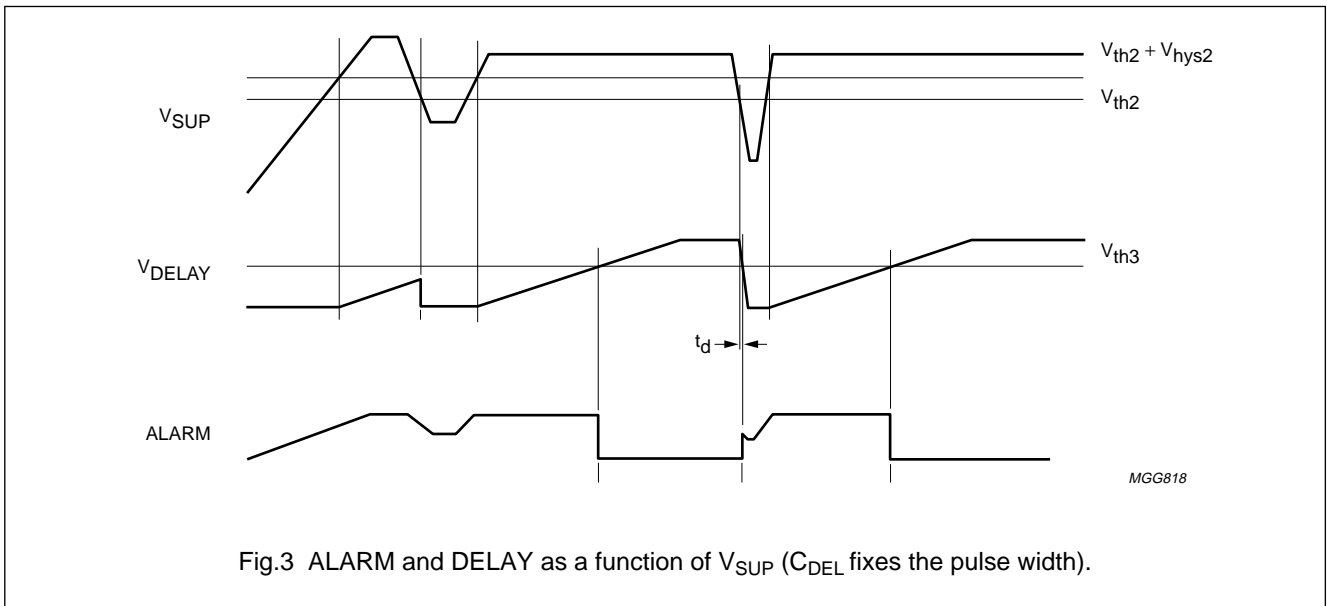
After the deactivation sequence has been completed, the  $\overline{\text{OFF}}$  line is reset to its HIGH state when the microcontroller has reset the  $\overline{\text{START}}$  line HIGH, except if the fault condition was due to a card extraction.

**Note**

The two other causes of emergency deactivation (Power failure detected on  $V_{DD}$  or  $V_{SUP}$ ) do not act upon  $\overline{\text{OFF}}$ .

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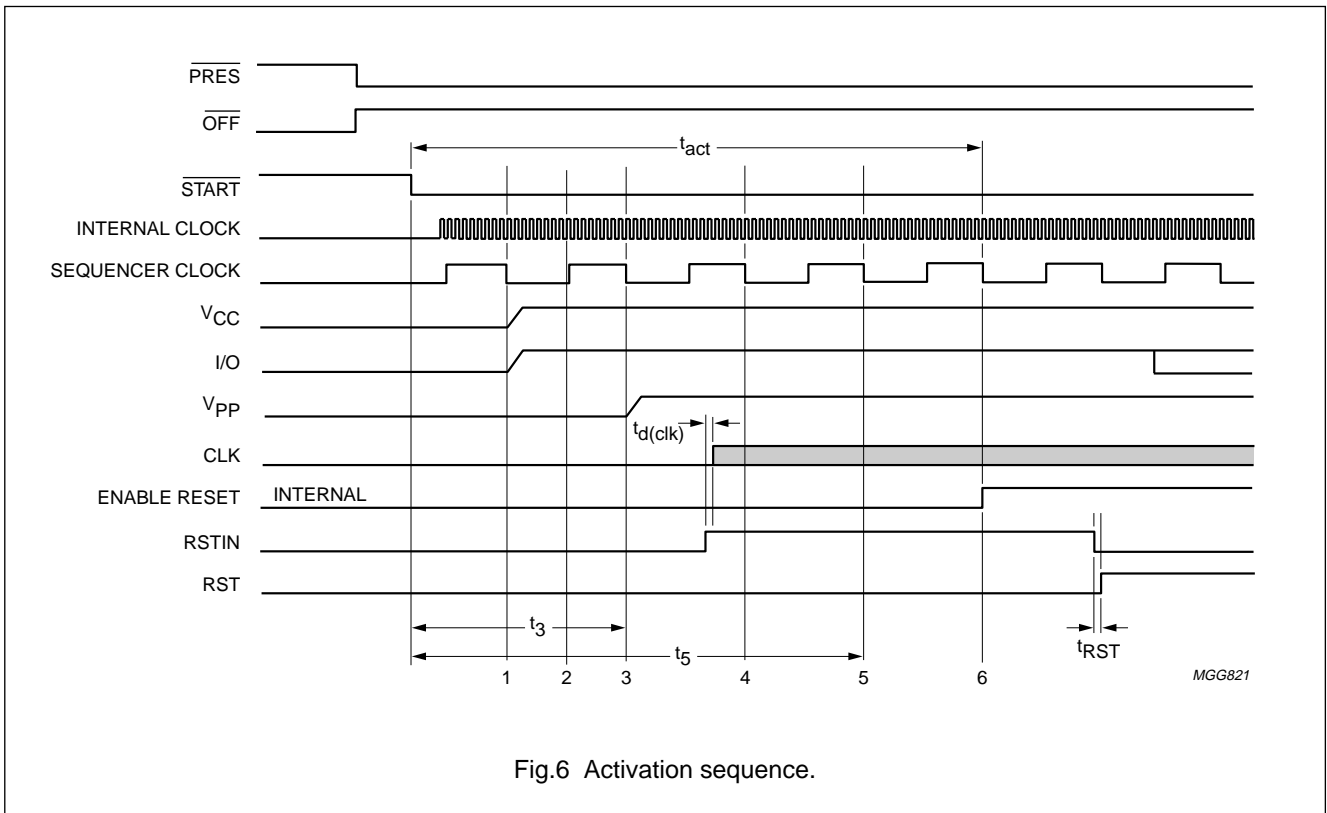


Fig.6 Activation sequence.

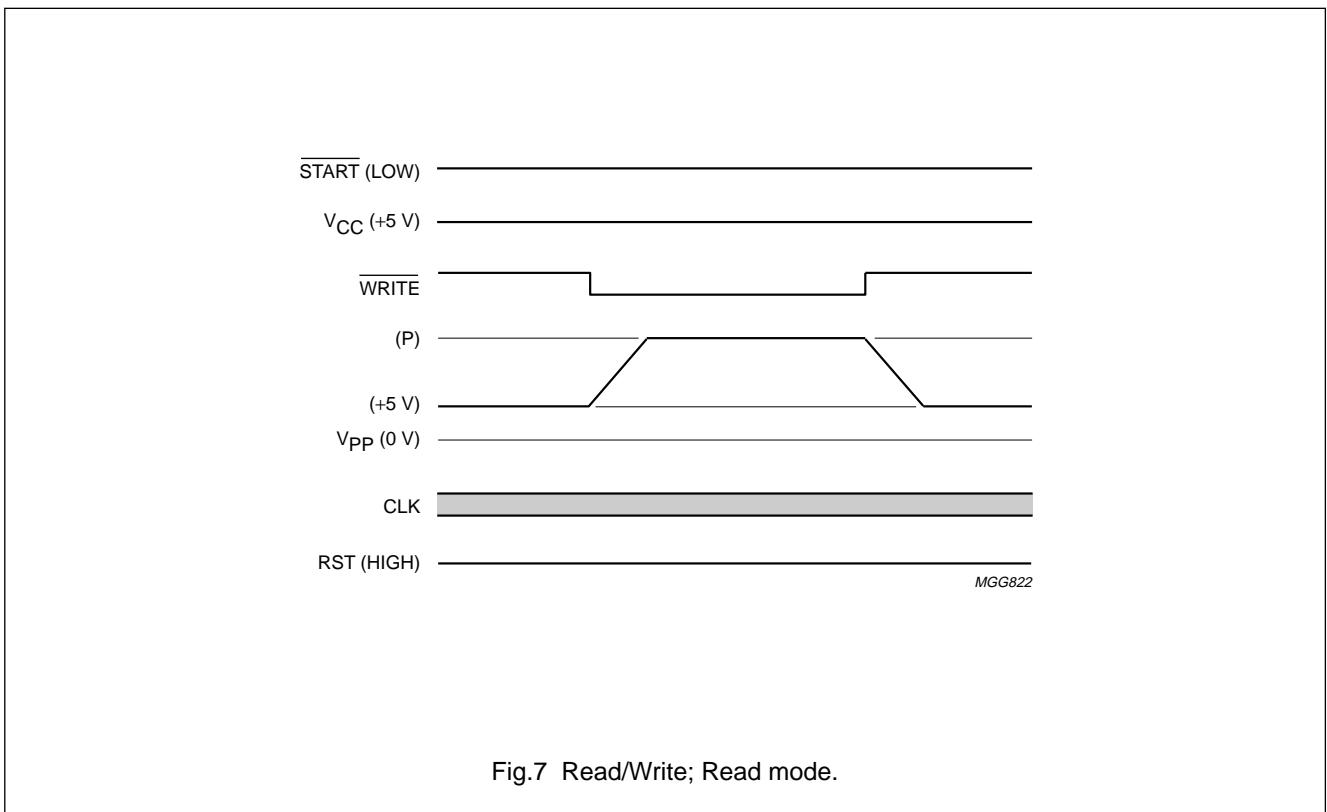


Fig.7 Read/Write; Read mode.



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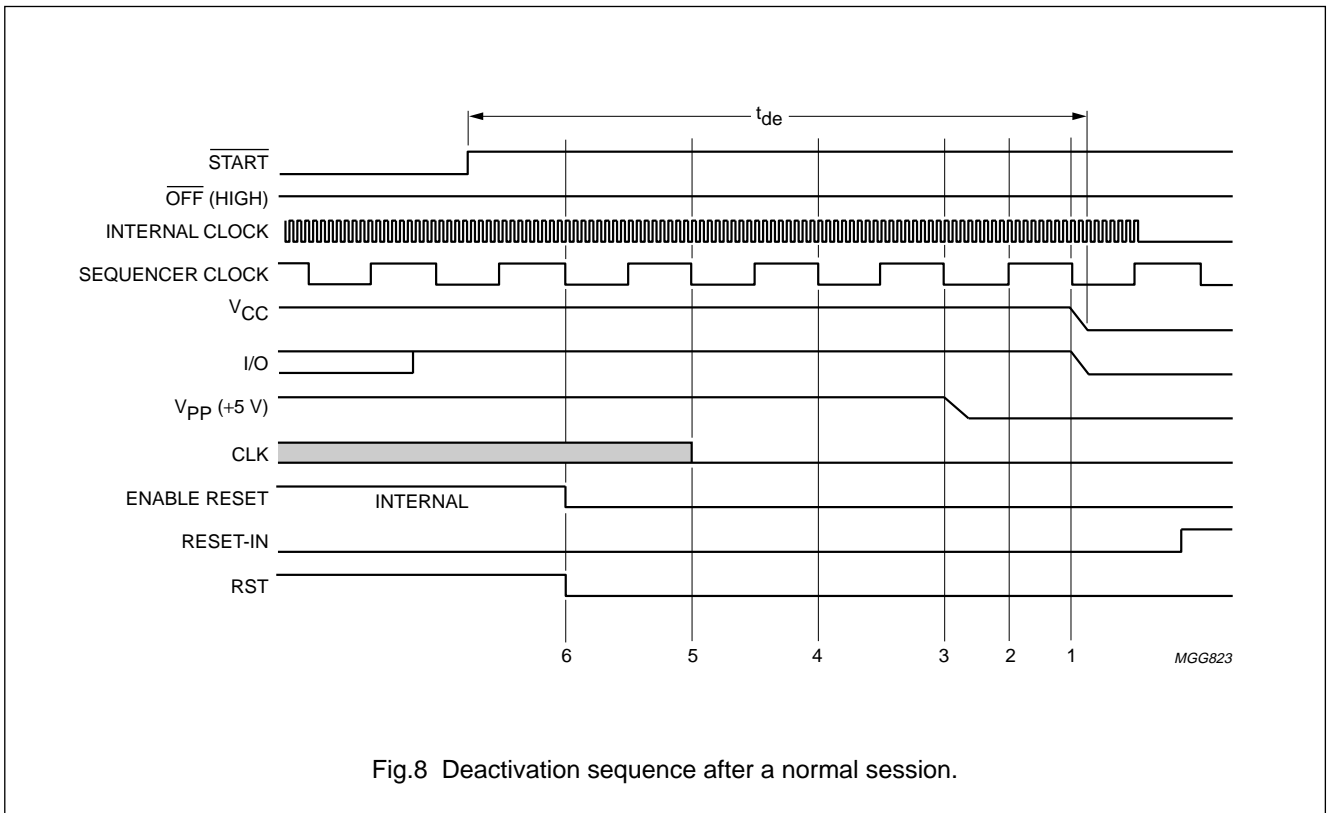


Fig.8 Deactivation sequence after a normal session.

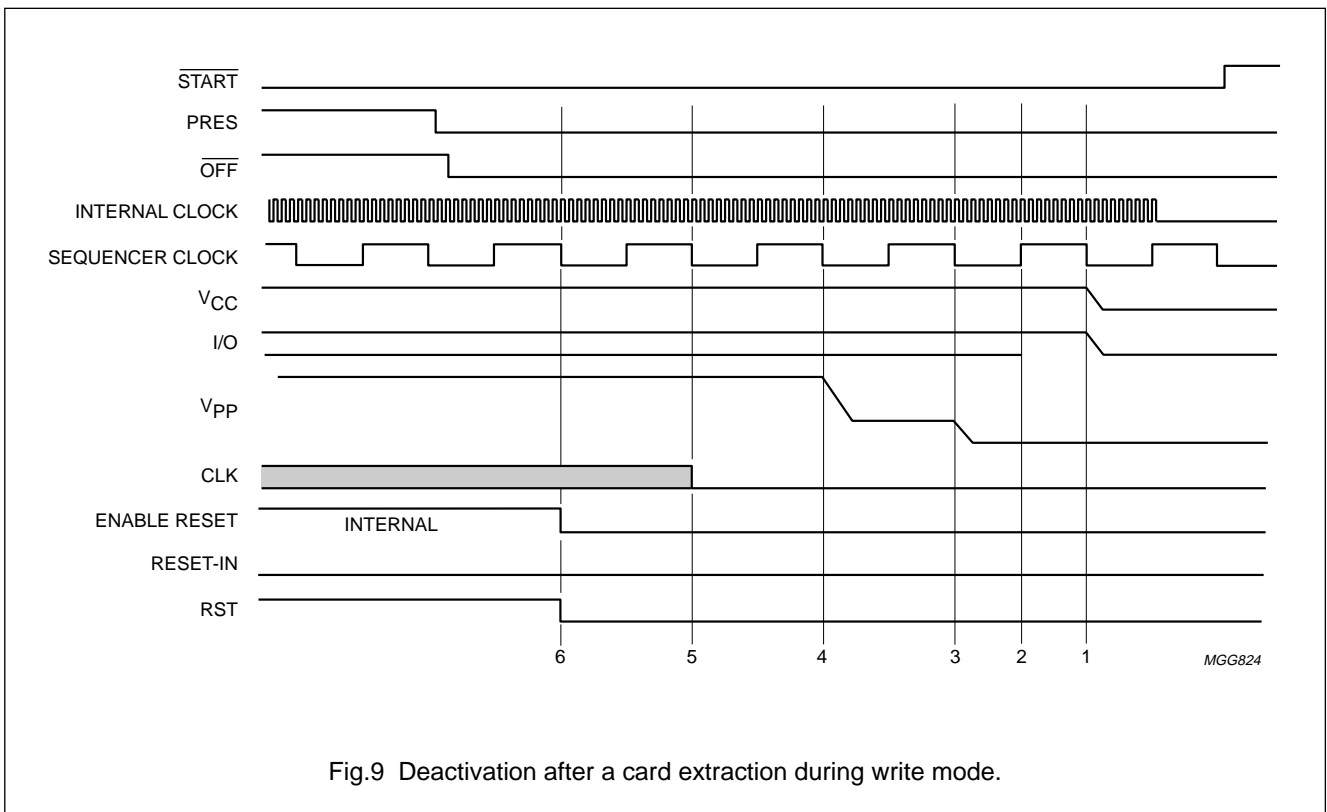


Fig.9 Deactivation after a card extraction during write mode.

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**LIMITING VALUES**

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V <sub>DD</sub>	supply voltage		-0.3	+18	V
V <sub>x1</sub>	voltage on pins PSEL1, PSEL2, PRES, PRES, WRITE, START, OFF, ALARM and RSTIN		-0.3	V <sub>DD</sub>	V
V <sub>H</sub>	voltage on pin V <sub>H</sub>		-0.3	+30	V
V <sub>PP</sub>	voltage on pin V <sub>PP</sub>		-0.3	V <sub>H</sub>	V
V <sub>SUP</sub>	voltage on pin V <sub>SUP</sub>		-0.3	+12	V
V <sub>x2</sub>	voltage on pins ALARM and DELAY		-0.3	V <sub>SUP</sub>	V
V <sub>x3</sub>	voltage on pins XTAL, I/O1(μC), I/O2(μC), CLKIN, CLKOUT, CLKDIV and CVNC		-0.3	+6.0	V
V <sub>x4</sub>	voltage on pins I/O1, I/O2, RST, CLK and V <sub>CC</sub>	duration < 1 ms	-0.3	+7.0	V
P <sub>tot</sub>	continuous total power dissipation	TDA8000; T <sub>amb</sub> = +70 °C; note 1; see Fig.10	-	2	W
		TDA8000T; T <sub>amb</sub> = +70 °C; note 1; see Fig.11	-	0.92	W
T <sub>stg</sub>	storage temperature		-55	+150	°C
V <sub>es</sub>	electrostatic voltage on pins I/O1, I/O2, V <sub>CC</sub> , V <sub>PP</sub> , RST and CLK		-4	+4	kV
	electrostatic voltage on other pins		-2	+2	kV

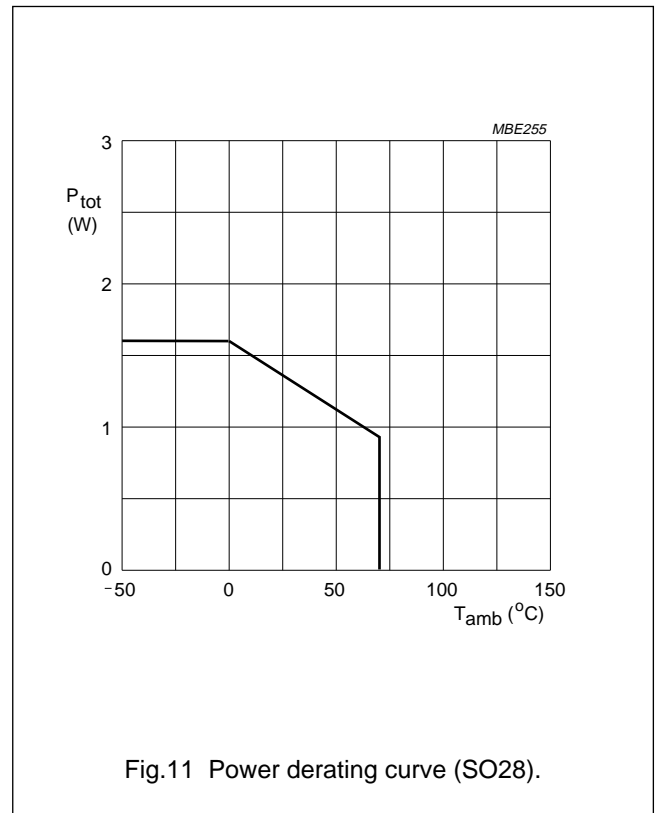
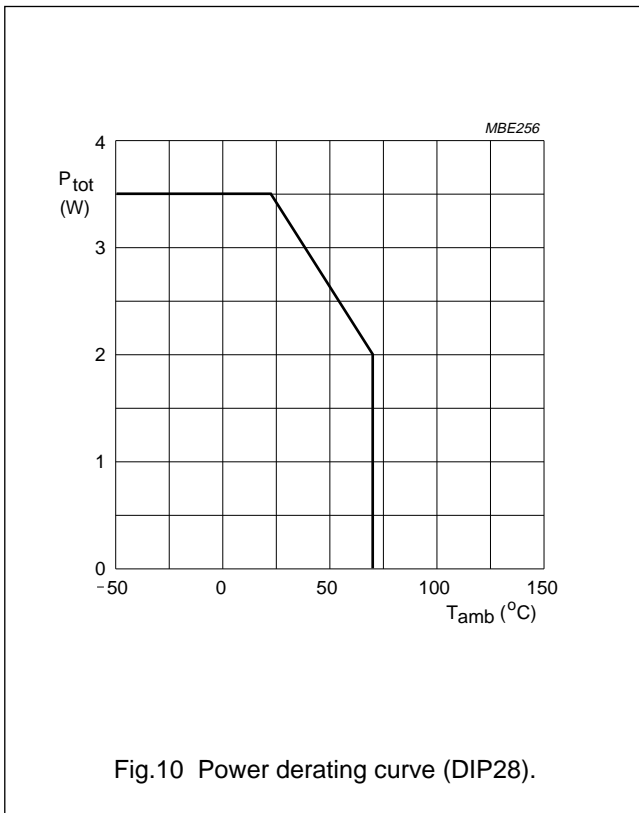
**Note**

- $$P_{tot} = V_{DD} \times (I_{DD(unloaded)} + \sum I_{signals}) + I_{CC} \times (V_{DD} - V_{CC}) + \max.\{(V_H - V_{PP}) \times I_{PP(read)} + (V_H - V_{PP}) \times I_{PP(write)}\} + V_H \times I_{H(unloaded)} + V_{SUP} \times I_{SUP} + (V_{DD} - CVNC) \times I_{CVNC}.$$

Where 'signals' means all signal pins used, excluding the supply pins.

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**HANDLING**

Each pin withstands the ESD test according to MIL-STD-883C class 3 for card contacts, class 2 for the remaining. Method 3015 (HBM 1500 Ω, 100 pF) 3 pulses positive and 3 pulses negative; on each pin referenced to ground.

**THERMAL CHARACTERISTICS**

SYMBOL	PARAMETER	VALUE	UNIT
R <sub>th j-a</sub>	thermal resistance from junction to ambient in free air		
	SOT117-1	30	K/W
	SOT136-1	70	K/W

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**CHARACTERISTICS**

$V_{DD} = 12\text{ V}$ ;  $V_H = 25\text{ V}$ ;  $V_{SUP} = 5\text{ V}$ ;  $f_{xtal} = 7.16\text{ MHz}$  or  $f_{CLKIN} = 3.58\text{ MHz}$ ;  $T_{amb} = 25\text{ °C}$ ; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Supply</b>						
$V_{DD}$	supply voltage		6.7	–	18	V
$I_{DD}$	supply current	idle mode; $V_{DD} = 8\text{ V}$	16	22	30	mA
		idle mode; $V_{DD} = 18\text{ V}$	20	28	36	mA
		active mode; unloaded	26	32	38	mA
$V_{th1}$	threshold voltage for power-on reset		1.5	3.0	4.0	V
$V_{th4}$	threshold voltage on $V_{DD}$ (falling)		6.0	–	6.5	V
$V_{hys4}$	hysteresis on $V_{th4}$		50	–	200	mV
<b>Voltage supervisor</b>						
$V_{SUP}$	supply voltage for the supervisor		–	5	–	V
$I_{SUP}$	input current on $V_{SUP}$		–	1.6	2	mA
$V_{th2}$	threshold voltage on $V_{SUP}$ (falling)		4.5	–	4.68	V
$V_{hys2}$	hysteresis on $V_{th2}$		10	–	80	mV
$V_{th3}$	threshold voltage on DELAY		2.35	–	2.65	V
$I_{DEL}$	output current on DELAY	pin grounded (charge)	–4	–	–2.5	$\mu\text{A}$
		$V_{DEL} = 4\text{ V}$ (discharge)	6	–	–	mA
$V_{DEL}$	voltage on pin DELAY		–	–	3.5	V
<b>ALARM, <math>\overline{\text{ALARM}}</math> (open-collector outputs)</b>						
$I_{OH}$	HIGH level output current on pin ALARM	$V_{OH} = 5\text{ V}$	–	–	25	$\mu\text{A}$
$V_{OL}$	LOW level output voltage on pin ALARM	$I_{OL} = 2\text{ mA}$	–	–	0.4	V
$I_{OL}$	LOW level output current on pin ALARM	$V_{OL} = 0\text{ V}$	–	–	–25	$\mu\text{A}$
$V_{OH}$	HIGH level output voltage on pin ALARM	$I_{OH} = -2\text{ mA}$	$V_{SUP} - 1$	–	–	V
$t_d$	delay between $V_{SUP}$ and ALARM	$C_{DEL} = 47\text{ nF}$ ; see Fig.3	–	–	10	$\mu\text{s}$
$t_{pulse}$	ALARM pulse width	$C_{DEL} = 47\text{ nF}$	30	–	65	ms
<b>Interrupt line <math>\overline{\text{OFF}}</math> (open-collector)</b>						
$I_{OH}$	HIGH level output current	$V_{OH} = 5\text{ V}$	–	–	25	$\mu\text{A}$
$V_{OL}$	LOW level output voltage	$I_{OL} = 1\text{ mA}$	–	–	0.4	V
<b>Logic inputs (<math>\overline{\text{RSTIN}}</math>, <math>\overline{\text{START}}</math>, <math>\overline{\text{WRITE}}</math>, <math>\overline{\text{CLKDIV}}</math>, <math>\overline{\text{PSEL1}}</math>, <math>\overline{\text{PSEL2}}</math>, <math>\overline{\text{PRES}}</math>, <math>\overline{\text{PRES}}</math>); note 1</b>						
$V_{IL}$	LOW level input voltage		–	–	0.8	V
$V_{IH}$	HIGH level input voltage		1.5	–	–	V
$I_{IL}$	LOW level input current	$V_{IL} = 0\text{ V}$	–	–	–20	$\mu\text{A}$
$I_{IH}$	HIGH level input current	$V_{IH} = 5\text{ V}$	–	–	20	$\mu\text{A}$

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Reset output to the card (RST)</b>						
V <sub>IDLE</sub>	output voltage in IDLE mode		–	–	0.4	V
V <sub>OL</sub>	LOW level output voltage	I <sub>OL</sub> = 200 µA	–	–	0.45	V
V <sub>OH</sub>	HIGH level output voltage	I <sub>OH</sub> = –200 µA	4.0	–	V <sub>CC</sub>	V
		I <sub>OH</sub> = –10 µA	V <sub>CC</sub> – 0.7	–	V <sub>CC</sub>	V
t <sub>RST</sub>	delay between RSTIN and RST	RST enabled; see Fig.6	–	–	2	µs
t <sub>r</sub>	rise time	C <sub>L</sub> = 330 pF	–	–	1	µs
t <sub>f</sub>	fall time	C <sub>L</sub> = 330 pF	–	–	1	µs
<b>Clock output to card (CLK)</b>						
V <sub>IDLE</sub>	output voltage in IDLE mode		–	–	0.4	V
V <sub>OL</sub>	LOW level output voltage	I <sub>OL</sub> = 200 µA	–	–	0.4	V
V <sub>OH</sub>	HIGH level output voltage	I <sub>OH</sub> = –200 µA	2.4	–	V <sub>CC</sub> + 0.3	V
		I <sub>OH</sub> = –20 µA	0.7V <sub>CC</sub>	–	V <sub>CC</sub> + 0.3	V
		I <sub>OH</sub> = –10 µA	V <sub>CC</sub> – 0.7	–	V <sub>CC</sub> + 0.3	V
t <sub>r</sub>	rise time	C <sub>L</sub> = 30 pF; note 2	–	–	18	ns
t <sub>f</sub>	fall time	C <sub>L</sub> = 30 pF; note 2	–	–	18	ns
δ	duty factor	C <sub>L</sub> = 30 pF; (XTAL or CLKIN used); note 2	45	–	55	%
Δδ/Δθ	thermal drift on duty factor	DIP and SO packages	–	–0.07	–	%/K
<b>Card programming voltage (V<sub>PP</sub>)</b>						
P	selected voltage	see Table 1				
V <sub>PP</sub>	output voltage	idle mode	–	–	0.4	V
		read mode	V <sub>CC</sub> – 4%	–	V <sub>CC</sub> + 4%	V
		write mode; I <sub>PP</sub> < 50 mA	P – 2.5% <sup>(3)</sup>	–	P + 2.5% <sup>(3)</sup>	V
I <sub>PP</sub>	output current	read mode	–	–	–50	mA
		write mode	–	–	–50	mA
		write mode; V <sub>PP</sub> short-circuited to GND	–	–	–400	mA
SR	slew rate	up or down	0.80	1.0	1.20	V/µs
<b>High-voltage input (V<sub>H</sub>)</b>						
V <sub>H</sub>	input voltage		–	–	30	V
I <sub>H</sub>	input current at V <sub>H</sub>	idle mode	2	–	3	mA
		active mode; unloaded; WRITE = 0				
		P = 5 V	3	–	7	mA
		P = 12.5 V	5	–	10	mA
		P = 15 V	6	–	11	mA
		P = 21 V	8	–	13	mA
V <sub>H</sub> – V <sub>PP</sub>	voltage drop		–	–	2.2	V

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Card supply voltage (V<sub>CC</sub>)</b>						
V <sub>CC</sub>	output voltage	idle mode	–	–	0.4	V
		active mode; I <sub>CC</sub> < 100 mA	4.80	–	5.20	V
I <sub>CC</sub>	output current		–	–	–100	mA
		V <sub>CC</sub> connected to GND	–	–	–400	mA
SR	slew rate	up or down	0.80	1.0	1.20	V/μs
<b>5 V reference output (CVNC)</b>						
V <sub>CVNC</sub>	output voltage at CVNC	I <sub>CVNC</sub> < –15 mA	4.5	5.0	5.5	V
<b>Crystal connection (XTAL)</b>						
R <sub>xtal(neg)</sub>	negative resistance at crystal	3 MHz < f <sub>i</sub> < 11 MHz; note 4	–	–	–300	Ω
V <sub>xtal</sub>	DC voltage at crystal		3	–	4	V
f <sub>xtal</sub>	crystal resonant frequency		3	–	11	MHz
<b>External clock input (CLKIN)</b>						
f <sub>ext</sub>	frequency at CLKIN	note 2	0	–	8	MHz
V <sub>IL</sub>	LOW level input voltage		0	–	0.8	V
V <sub>IH</sub>	HIGH level input voltage		1.5	–	5	V
I <sub>IL</sub>	LOW level input current	V <sub>IL</sub> = 0 V	–	–	–20	μA
I <sub>IH</sub>	HIGH level input current	V <sub>IH</sub> = 2 V	–	–	20	μA
C <sub>I</sub>	input capacitance		–	–	5	pF
<b>Clock output (CLKOUT)</b>						
f <sub>CLKOUT</sub>	frequency on CLKOUT		1	–	8	MHz
V <sub>OL</sub>	LOW level output voltage	I <sub>OL</sub> = 1 mA	–	–	0.4	V
V <sub>OH</sub>	HIGH level output voltage	V <sub>OH</sub> = –200 μA	3	–	–	V
		V <sub>OH</sub> = –10 μA	4	–	–	V
t <sub>r</sub> , t <sub>f</sub>	rise and fall times	C <sub>L</sub> = 30 pF; note 2	–	–	25	ns
δ	duty factor	CLKDIV = 0; C <sub>L</sub> = 30 pF; note 2	45	–	55	%
		CLKDIV = 1; C <sub>L</sub> = 30 pF; note 2	40	–	60	%
Δδ/Δθ	thermal drift on duty factor	DIP and SO packages	–	–0.1	–	%/C

## Smart card interface

## TDA8000; TDA8000T

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Data lines [I/O1, I/O2, I/O1(<math>\mu</math>C), I/O2(<math>\mu</math>C)]; note 5</b>						
V <sub>OH</sub>	HIGH level output voltage on I/O	4.5 < V <sub>SUP</sub> < 5.5; 4.5 < V <sub>I/O(<math>\mu</math>C)</sub> < 5.5; I <sub>OH</sub> = -20 $\mu$ A	4	-	V <sub>CC</sub> + 0.2	V
		4.5 < V <sub>SUP</sub> < 5.5; 4.5 < V <sub>I/O(<math>\mu</math>C)</sub> < 5.5; I <sub>OH</sub> = -200 $\mu$ A	2.4	-	-	V
V <sub>OL</sub>	LOW level output voltage on I/O	I <sub>I/O</sub> = 1 mA; I/O( $\mu$ C) grounded	-	-	65	mV
I <sub>IL</sub>	LOW level input current on I/O( $\mu$ C)	I/O( $\mu$ C) grounded; I <sub>I/O</sub> = 0	-	-	-500	$\mu$ A
		I/O( $\mu$ C) grounded; I/O connected to V <sub>CC</sub>	-	-	-5	mA
V <sub>OH</sub>	HIGH level output voltage on I/O( $\mu$ C)	4.5 < V <sub>I/O</sub> < 5.5	4	-	V <sub>SUP</sub> + 0.2	V
V <sub>OL</sub>	LOW level output voltage on I/O( $\mu$ C)	I <sub>I/O(<math>\mu</math>C)</sub> = 1 mA; I/O grounded	-	-	70	mV
I <sub>IL</sub>	LOW level input current on I/O	I/O grounded; I <sub>I/O(<math>\mu</math>C)</sub> = 0	-	-	-500	$\mu$ A
		I/O grounded; I/O( $\mu$ C) connected to V <sub>SUP</sub>	-	-	-5	mA
V <sub>IDLE</sub>	voltage on I/O outside a session		-	-	0.4	V
Z <sub>IDLE</sub>	impedance on I/O( $\mu$ C) outside a session		10	-	-	M $\Omega$
R <sub>pu</sub>	internal pull-up resistance between I/O and V <sub>CC</sub>		17	20	23	k $\Omega$
t <sub>r</sub> , t <sub>f</sub>	rise and fall times	C <sub>i</sub> = C <sub>o</sub> = 30 pF	-	-	1	$\mu$ s
<b>Protections</b>						
T <sub>sd</sub>	shut-down local temperature		-	135	-	$^{\circ}$ C
I <sub>CC(sd)</sub>	shut-down current at V <sub>CC</sub>		-175	-	-230	mA
I <sub>PP(sd)</sub>	shut-down current at V <sub>PP</sub>		-90	-	-140	mA
I <sub>I/O(sd)</sub>	shut-down current at I/O	from I/O to I/O( $\mu$ C)	3	-	5	mA
<b>Timing</b>						
t <sub>act</sub>	activation sequence duration	see Fig.6	250	-	500	$\mu$ s
t <sub>de</sub>	deactivation sequence duration	see Fig.8	250	-	500	$\mu$ s
t <sub>3</sub>	start of the window for sending CLK to the card	see Fig.6	-	-	140	$\mu$ s

Smart card interface

TDA8000; TDA8000T

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
t <sub>5</sub>	end of the window for sending CLK to the card	see Fig.6	160	–	–	μs
t <sub>st</sub>	maximum pulse width on START before V <sub>CC</sub> starts rising		–	–	30	μs
t <sub>d(clk)</sub>	delay between RSTIN and CLK	see Fig.6	–	–	2	μs

Notes

1.  $\overline{\text{START}}$ ,  $\overline{\text{WRITE}}$ ,  $\overline{\text{CLKDIV}}$  and  $\overline{\text{PRES}}$  are active LOW; RSTIN and PRES are active HIGH.
2. The transition time and duty factor definitions are shown in Fig.12;  $\delta = \frac{t_1}{t_1 + t_2}$ .
3. P is the card programming voltage set by pins PSEL1 and PSEL2.
4. This condition ensures correct start-up of the oscillator with crystals having series resistance up to 100 Ω.
5. The path between I/O and I/O(μC) is as follows (see Fig.13):
  - a) Clamp to V<sub>CC</sub>.
  - b) 20 kΩ pull-up resistor to V<sub>CC</sub>; thus V<sub>OH</sub> on I/O.
  - c) Two opposite npn transistors with sensing pnp transistor.
  - d) Clamp to V<sub>SUP</sub>; thus V<sub>OH</sub> on I/O(μC).
  - e) The base current of the npn transistor is decreasing when their collector current increases. This means the voltage drop is very low for small currents and becomes maximum for some mA. Thus V<sub>OL</sub> on I/O and I/O(μC), current limits, and high impedance feature. The output current from I/O and I/O(μC) when the line is open-circuit is the sum of the pull-up current and the base currents.

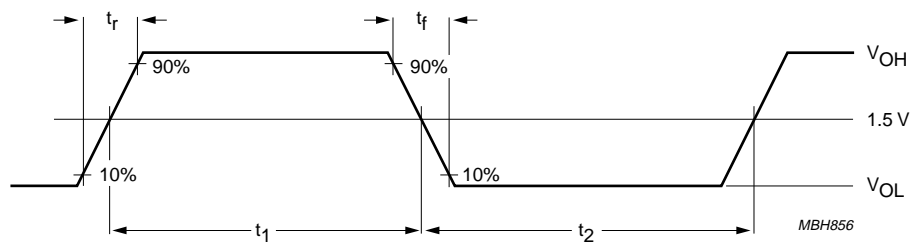


Fig.12 Definition of transition times.



Smart card interface

TDA8000; TDA8000T

INTERNAL PIN CONFIGURATION

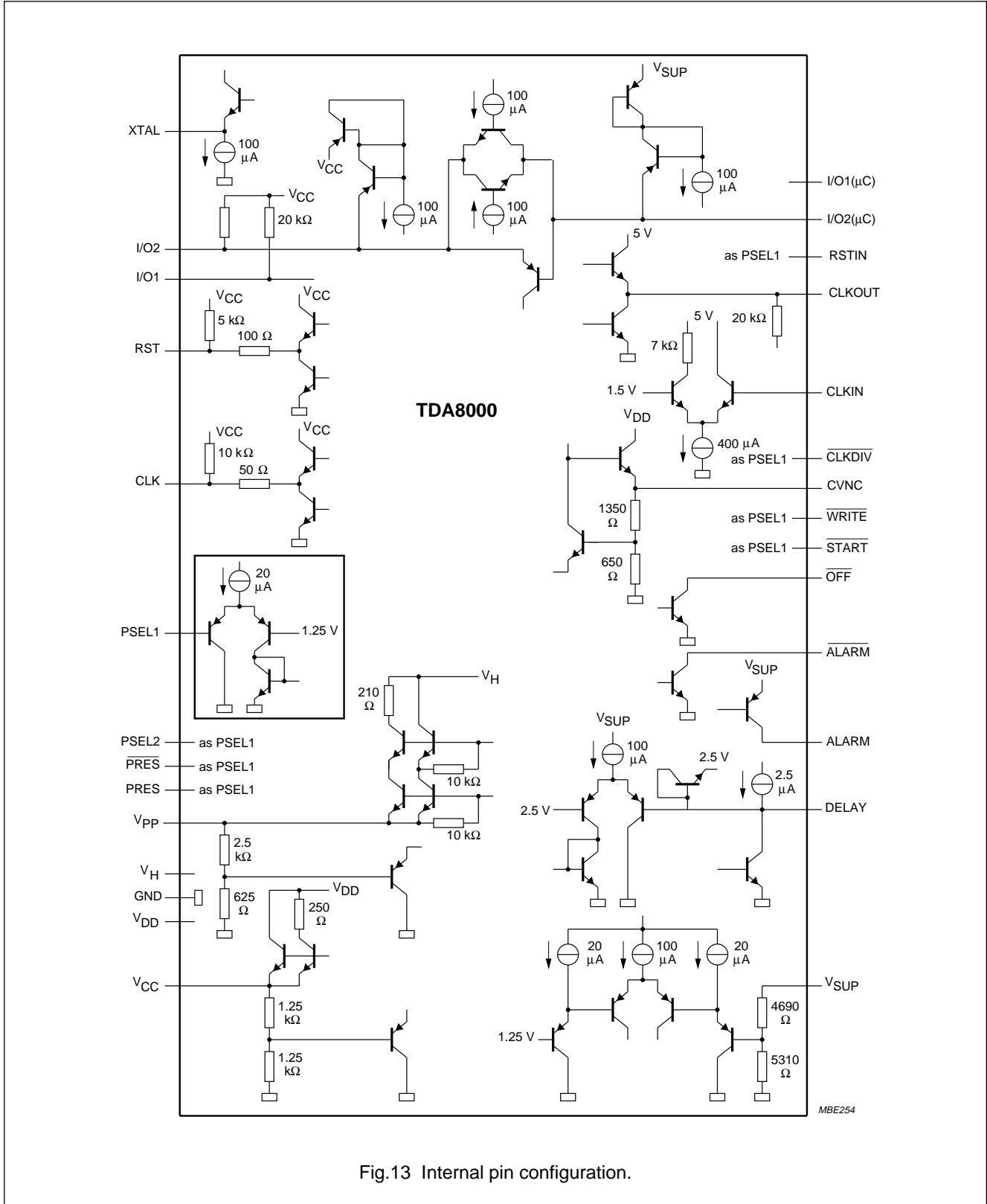


Fig.13 Internal pin configuration.

Smart card interface

TDA8000; TDA8000T

APPLICATION INFORMATION

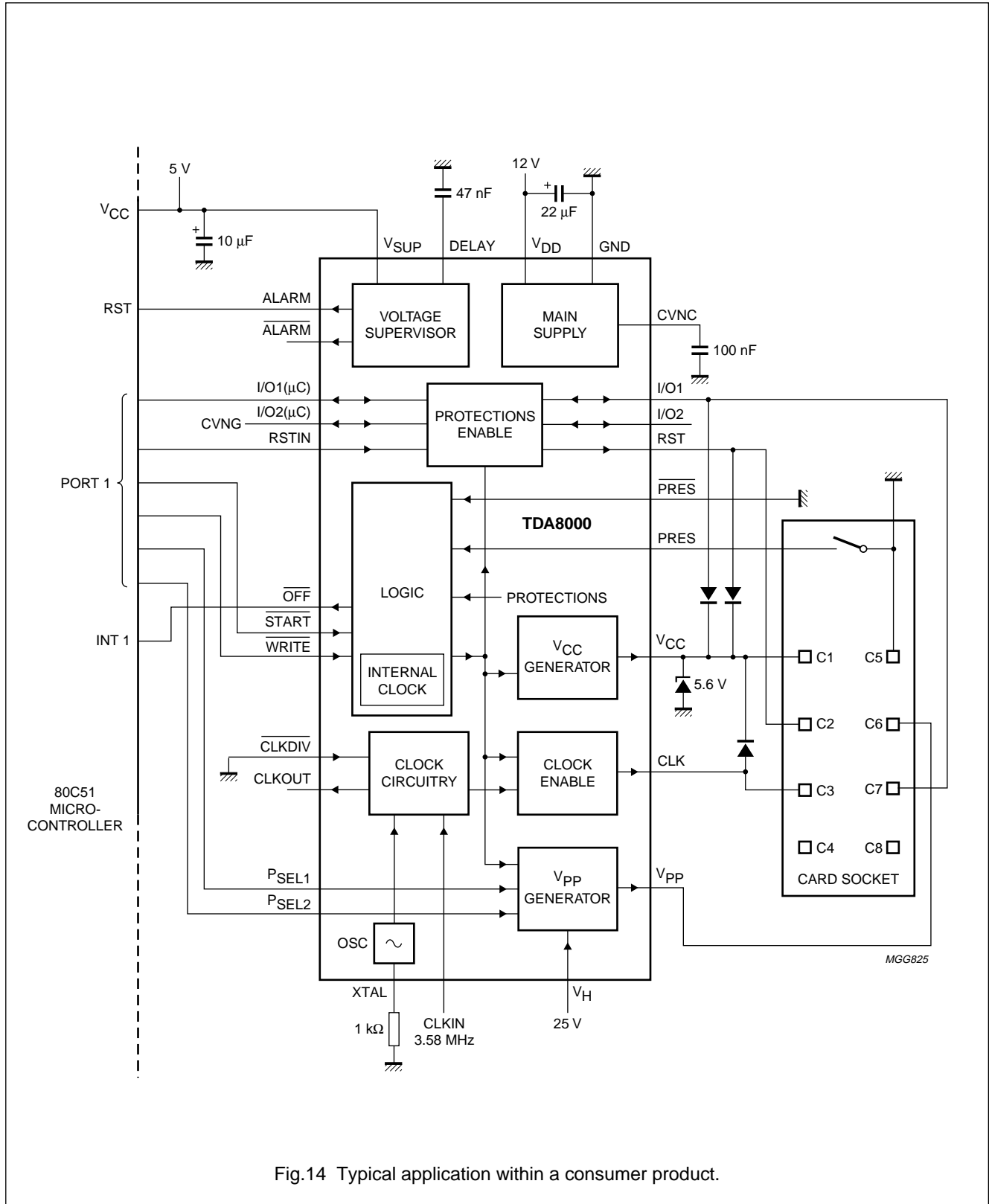


Fig.14 Typical application within a consumer product.



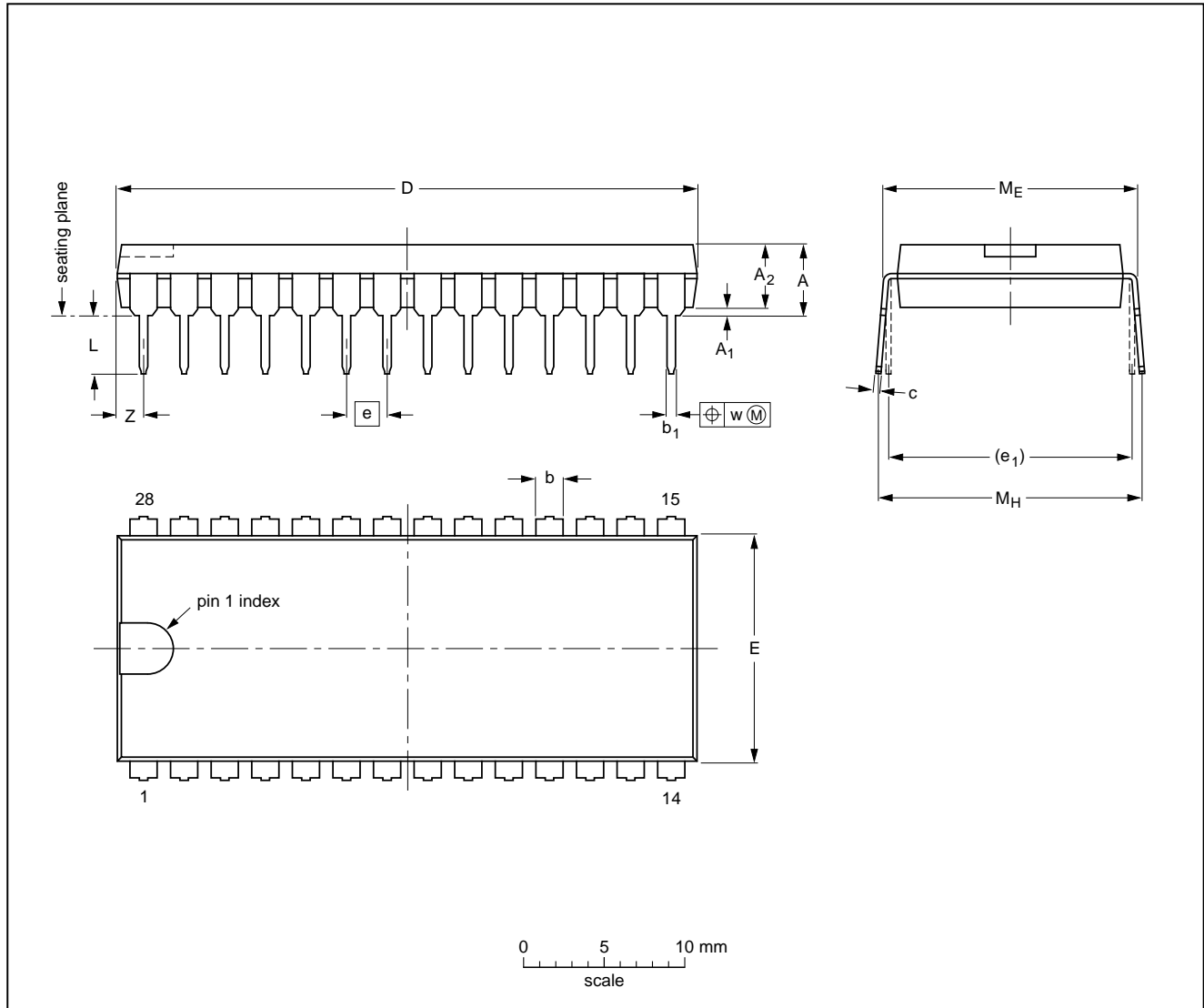
Smart card interface

TDA8000; TDA8000T

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 <sub>1</sub> min.	A <sub>2</sub> max.	b	b <sub>1</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	e <sub>1</sub>	L	M <sub>E</sub>	M <sub>H</sub>	w	Z <sup>(1)</sup> 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.

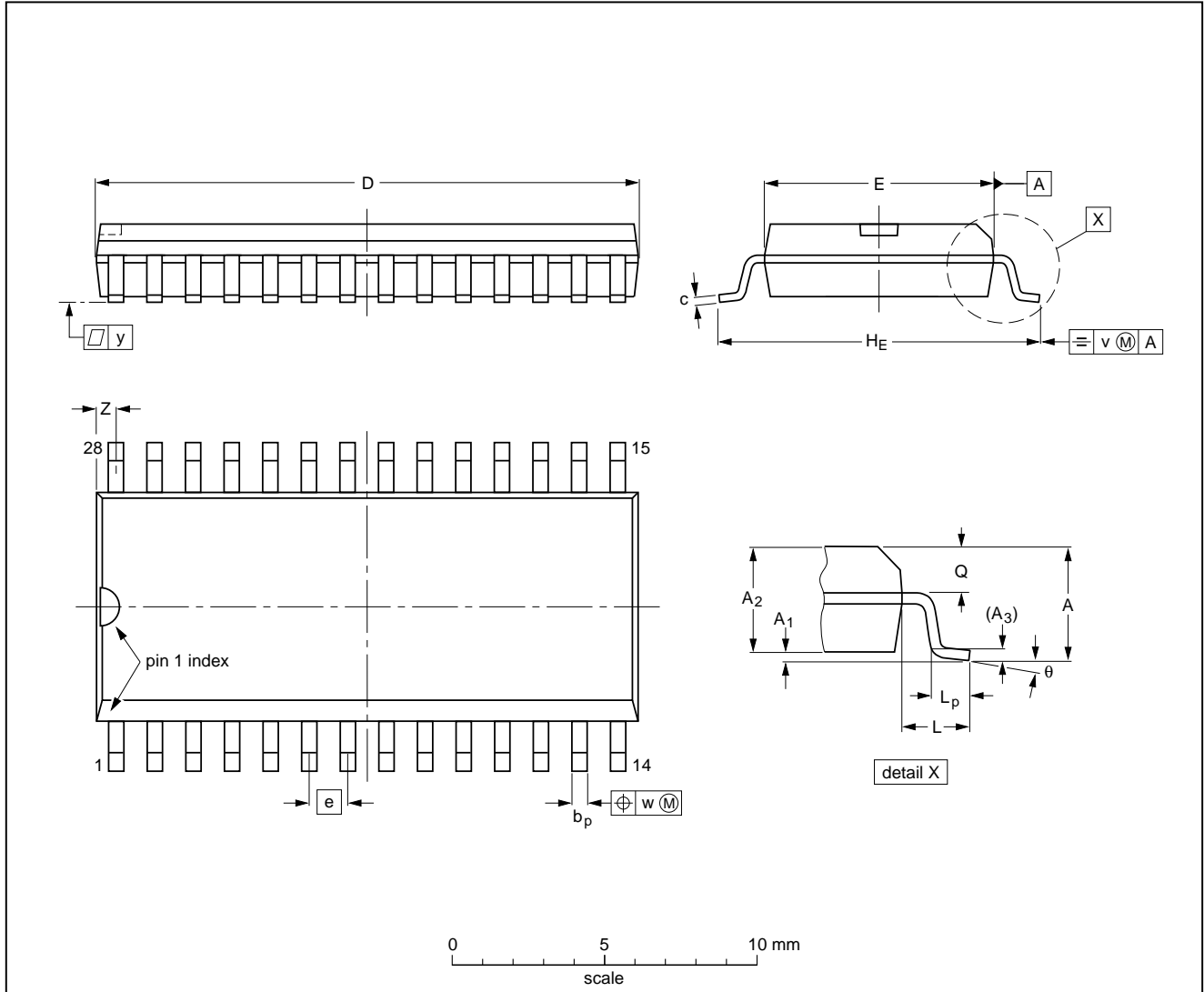
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT117-1	051G05	MO-015AH				92-11-17 95-01-14

Smart card interface

TDA8000; TDA8000T

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 <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	z <sup>(1)</sup>	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

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## Smart card interface

## TDA8000; TDA8000T

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### SOLDERING

#### Plastic dual in-line packages

##### BY DIP OR WAVE

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

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified storage maximum. 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.

##### REPAIRING SOLDERED JOINTS

Apply a low voltage soldering iron below the seating plane (or not more than 2 mm above it). If its temperature is below 300 °C, it must not be in contact for more than 10 s; if between 300 and 400 °C, for not more than 5 s.

#### Plastic small outline packages

##### BY WAVE

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

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

A modified wave soldering technique is recommended using two solder waves (dual-wave), in which a turbulent wave with high upward pressure is followed by a smooth laminar wave. Using a mildly-activated flux eliminates the need for removal of corrosive residues in most applications.

##### BY SOLDER PASTE REFLOW

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

Several techniques exist for reflowing; for example, thermal conduction by heated belt, infrared, and vapour-phase reflow. Dwell times vary between 50 and 300 s according to 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 min at 45 °C.

##### REPAIRING SOLDERED JOINTS (BY HAND-HELD SOLDERING IRON OR PULSE-HEATED SOLDER TOOL)

Fix the component by first soldering two, diagonally opposite, end pins. Apply the heating tool to the flat part of the pin only. Contact time must be limited to 10 s at up to 300 °C. When using proper tools, all other pins can be soldered in one operation within 2 to 5 s at between 270 and 320 °C. (Pulse-heated soldering is not recommended for SO packages.)

For pulse-heated solder tool (resistance) soldering of VSO packages, solder is applied to the substrate by dipping or by an extra thick tin/lead plating before package placement.

## Smart card interface

## TDA8000; TDA8000T

**DEFINITIONS**

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

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# Philips Semiconductors – a worldwide company

**Argentina:** see South America

**Australia:** 34 Waterloo Road, NORTH RYDE, NSW 2113,  
Tel. +61 2 9805 4455, Fax. +61 2 9805 4466

**Austria:** Computerstr. 6, A-1101 WIEN, P.O. Box 213,  
Tel. +43 1 60 101, Fax. +43 1 60 101 1210

**Belarus:** Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,  
220050 MINSK, Tel. +375 172 200 733, Fax. +375 172 200 773

**Belgium:** see The Netherlands

**Brazil:** see South America

**Bulgaria:** Philips Bulgaria Ltd., Energoproject, 15th floor,  
51 James Bourchier Blvd., 1407 SOFIA,  
Tel. +359 2 689 211, Fax. +359 2 689 102

**Canada:** PHILIPS SEMICONDUCTORS/COMPONENTS,  
Tel. +1 800 234 7381

**China/Hong Kong:** 501 Hong Kong Industrial Technology Centre,  
72 Tat Chee Avenue, Kowloon Tong, HONG KONG,  
Tel. +852 2319 7888, Fax. +852 2319 7700

**Colombia:** see South America

**Czech Republic:** see Austria

**Denmark:** Prags Boulevard 80, PB 1919, DK-2300 COPENHAGEN S,  
Tel. +45 32 88 2636, Fax. +45 31 57 1949

**Finland:** Sinikalliontie 3, FIN-02630 ESPOO,  
Tel. +358 9 615800, Fax. +358 9 61580/xxx

**France:** 4 Rue du Port-aux-Vins, BP317, 92156 SURESNES Cedex,  
Tel. +33 1 40 99 6161, Fax. +33 1 40 99 6427

**Germany:** Hammerbrookstraße 69, D-20097 HAMBURG,  
Tel. +49 40 23 53 60, Fax. +49 40 23 536 300

**Greece:** No. 15, 25th March Street, GR 17778 TAVROS/ATHENS,  
Tel. +30 1 4894 339/239, Fax. +30 1 4814 240

**Hungary:** see Austria

**India:** Philips INDIA Ltd, Shivsagar Estate, A Block, Dr. Annie Besant Rd.  
Worli, MUMBAI 400 018, Tel. +91 22 4938 541, Fax. +91 22 4938 722

**Indonesia:** see Singapore

**Ireland:** Newstead, Clonskeagh, DUBLIN 14,  
Tel. +353 1 7640 000, Fax. +353 1 7640 200

**Israel:** RAPAC Electronics, 7 Kehilat Saloniki St, TEL AVIV 61180,  
Tel. +972 3 645 0444, Fax. +972 3 649 1007

**Italy:** PHILIPS SEMICONDUCTORS, Piazza IV Novembre 3,  
20124 MILANO, Tel. +39 2 6752 2531, Fax. +39 2 6752 2557

**Japan:** Philips Bldg 13-37, Kohnan 2-chome, Minato-ku, TOKYO 108,  
Tel. +81 3 3740 5130, Fax. +81 3 3740 5077

**Korea:** Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL,  
Tel. +82 2 709 1412, Fax. +82 2 709 1415

**Malaysia:** No. 76 Jalan Universiti, 46200 PETALING JAYA, SELANGOR,  
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**Mexico:** 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905,  
Tel. +9-5 800 234 7381

**Middle East:** see Italy

**Netherlands:** Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,  
Tel. +31 40 27 82785, Fax. +31 40 27 88399

**New Zealand:** 2 Wagener Place, C.P.O. Box 1041, AUCKLAND,  
Tel. +64 9 849 4160, Fax. +64 9 849 7811

**Norway:** Box 1, Manglerud 0612, OSLO,  
Tel. +47 22 74 8000, Fax. +47 22 74 8341

**Philippines:** Philips Semiconductors Philippines Inc.,  
106 Valero St. Salcedo Village, P.O. Box 2108 MCC, MAKATI,  
Metro MANILA, Tel. +63 2 816 6380, Fax. +63 2 817 3474

**Poland:** Ul. Lukiska 10, PL 04-123 WARSZAWA,  
Tel. +48 22 612 2831, Fax. +48 22 612 2327

**Portugal:** see Spain

**Romania:** see Italy

**Russia:** Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW,  
Tel. +7 095 247 9145, Fax. +7 095 247 9144

**Singapore:** Lorong 1, Toa Payoh, SINGAPORE 1231,  
Tel. +65 350 2538, Fax. +65 251 6500

**Slovakia:** see Austria

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**South Africa:** S.A. PHILIPS Pty Ltd., 195-215 Main Road Martindale,  
2092 JOHANNESBURG, P.O. Box 7430 Johannesburg 2000,  
Tel. +27 11 470 5911, Fax. +27 11 470 5494

**South America:** Rua do Rocio 220, 5th floor, Suite 51,  
04552-903 São Paulo, SÃO PAULO - SP, Brazil,  
Tel. +55 11 821 2333, Fax. +55 11 829 1849

**Spain:** Balmes 22, 08007 BARCELONA,  
Tel. +34 3 301 6312, Fax. +34 3 301 4107

**Sweden:** Kottbygatan 7, Akalla, S-16485 STOCKHOLM,  
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**Taiwan:** PHILIPS TAIWAN Ltd., 23-30F, 66,  
Chung Hsiao West Road, Sec. 1, P.O. Box 22978,  
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**Thailand:** PHILIPS ELECTRONICS (THAILAND) Ltd.,  
209/2 Sanpavuth-Bangna Road Prakanong, BANGKOK 10260,  
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**Turkey:** Talatpasa Cad. No. 5, 80640 GÜLTEPE/ISTANBUL,  
Tel. +90 212 279 2770, Fax. +90 212 282 6707

**Ukraine:** PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7,  
252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

**United Kingdom:** Philips Semiconductors Ltd., 276 Bath Road, Hayes,  
MIDDLESEX UB3 5BX, Tel. +44 181 730 5000, Fax. +44 181 754 8421

**United States:** 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,  
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**Uruguay:** see South America

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**Yugoslavia:** PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD,  
Tel. +381 11 625 344, Fax. +381 11 635 777

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Printed in The Netherlands

537021/1200/04/pp24

Date of release: 1996 Dec 12

Document order number: 9397 750 01383

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