

DATA SHEET

TDA8002 IC card interface

Product specification
Supersedes data of 1997 Mar 13
File under Integrated Circuits, IC02

1997 Nov 04

IC card interface

TDA8002

FEATURES

- Single supply voltage interface (3.3 or 5 V environment)
- Low-power sleep mode
- Three specific protected half-duplex bidirectional buffered I/O lines
- V_{CC} regulation (5 V \pm 5%, I_{CC} <65 mA at V_{DD} = 5 V, with controlled rise and fall times)
- Thermal and short-circuit protections with current limitations
- Automatic ISO 7816 activation and deactivation sequences
- Enhanced ESD protections on card side (>6 kV)
- Clock generation for the card up to 12 MHz with synchronous frequency changes
- Clock generation up to 20 MHz (auxiliary clock)
- Synchronous and asynchronous cards (memory and smart cards)
- ISO 7816, GSM11.11 compatibility and EMV (Europay, Mastercard, Visa) compliant
- Step-up converter for V_{CC} generation

- Supply supervisor for spikes elimination and emergency deactivation.

APPLICATIONS

- IC card readers for:
 - GSM applications
 - banking
 - electronic payment
 - identification
 - Pay TV
 - road tolling.

GENERAL DESCRIPTION

The TDA8002 is a complete low-power, analog interface for asynchronous and synchronous cards. It can be placed between the card and the microcontroller. It performs all supply, protection and control functions. It is directly compatible with ISO 7816, GSM11.11 and EMV specifications.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_{DDA}	analog supply voltage		3.0	5	6.5	V
I_{DD}	supply current	sleep mode	–	–	150	μ A
		idle mode; f_{CLK} = 2.5 MHz; f_{CLKOUT} = 10 MHz; V_{DD} = 5 V	–	–	6	mA
		active mode; f_{CLK} = 2.5 MHz; f_{CLKOUT} = 10 MHz; V_{DD} = 5 V	–	–	9	mA
		active mode; f_{CLK} = 2.5 MHz; f_{CLKOUT} = 10 MHz; V_{DD} = 3 V	–	–	12	mA
Card supply						
$V_{CC(O)}$	output voltage	DC load <65 mA	4.75	–	5.25	V
$I_{CC(O)}$	output current	V_{CC} short-circuited to GND	–	–	100	mA
General						
f_{CLK}	card clock frequency		0	–	12	MHz
T_{de}	deactivation cycle time		60	80	100	μ s
P_{tot}	continuous total power dissipation TDA8002AT; TDA8002BT TDA8002G	T_{amb} = –25 to +85 °C	–	–	0.56	W
		T_{amb} = –25 to +85 °C	–	–	0.46	W
T_{amb}	operating ambient temperature		–25	–	+85	°C

IC card interface

TDA8002

ORDERING INFORMATION

TYPE NUMBER ⁽¹⁾	PACKAGE			
	MARKING	NAME	DESCRIPTION	VERSION
TDA8002AT/3/C2 ⁽²⁾	TDA8002AT/3	SO28	plastic small outline package; 28 leads; body width 7.5 mm	SOT136-1
TDA8002AT/5/C2 ⁽³⁾	TDA8002AT/5			
TDA8002BT/3/C2 ⁽²⁾	TDA8002BT/3			
TDA8002BT/5/C2 ⁽³⁾	TDA8002BT/5			
TDA8002G/3/C2 ⁽²⁾	80023	LQFP32	plastic low profile quad flat package; 32 leads; body 5 × 5 × 1.4 mm	SOT401-1
TDA8002G/5/C2 ⁽³⁾	80025			

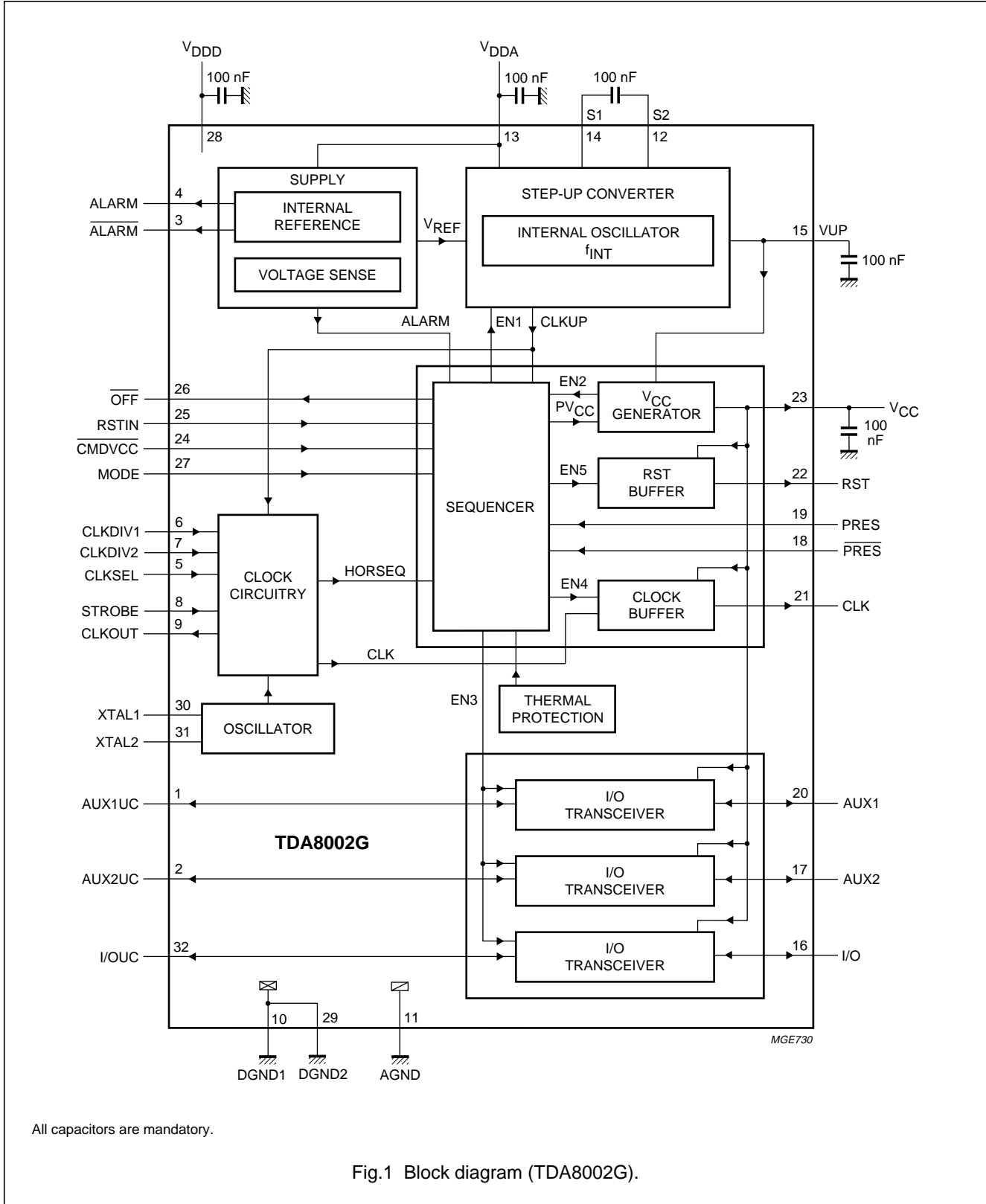
Notes

1. The /3 or /5 suffix indicates the voltage supervisor option.
2. The /3 version can be used with a 3 or 5 V power supply environment (see Chapter "Functional description").
3. The /5 version can be used with a 5 V power supply environment.

IC card interface

TDA8002

BLOCK DIAGRAM



All capacitors are mandatory.

Fig.1 Block diagram (TDA8002G).

IC card interface

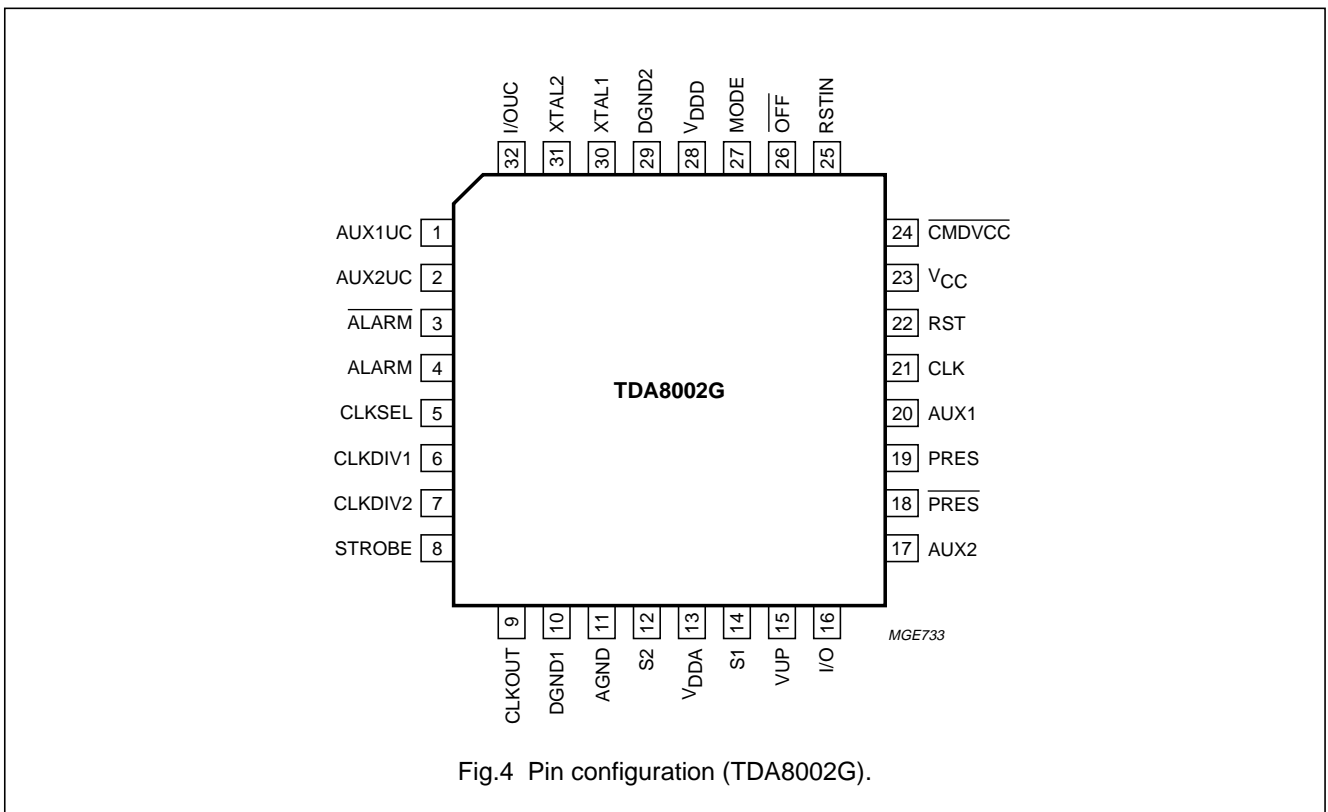
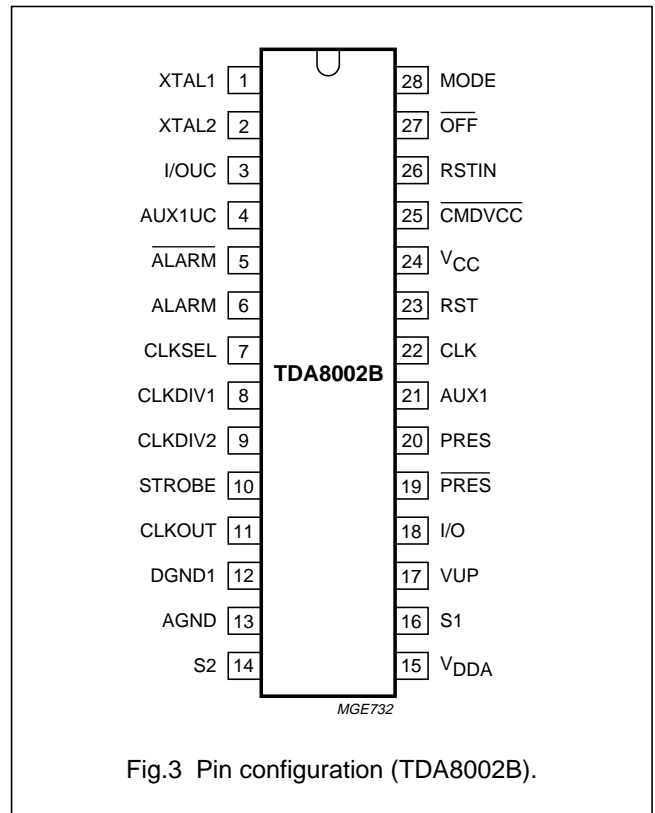
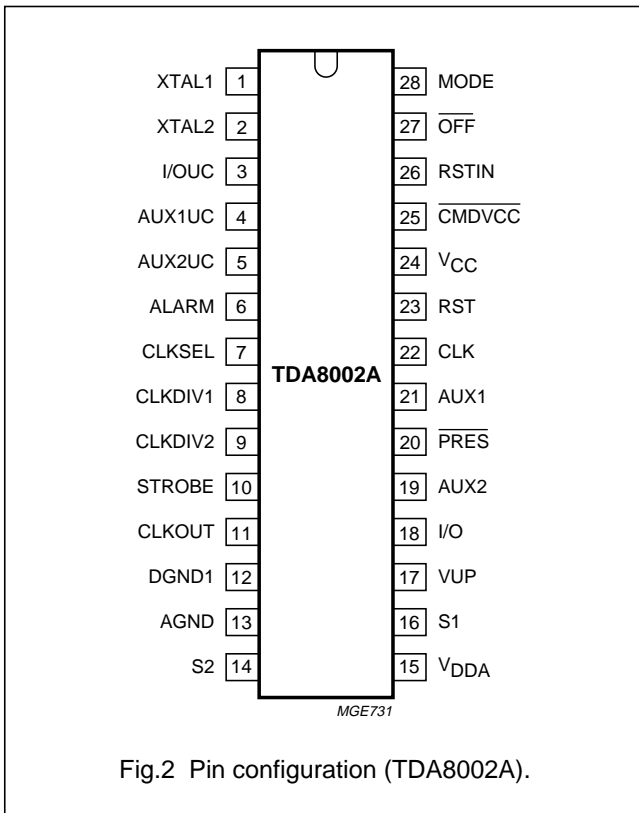
TDA8002

PINNING

SYMBOL	PIN			I/O	DESCRIPTION
	TYPE A	TYPE B	TYPE G		
XTAL1	1	1	30	I/O	crystal connection or input for external clock
XTAL2	2	2	31	I/O	crystal connection
I/OUC	3	3	32	I/O	data I/O line to and from microcontroller
AUX1UC	4	4	1	I/O	auxiliary line to and from microcontroller for synchronous applications
AUX2UC	5	–	2	I/O	auxiliary line to and from microcontroller for synchronous applications
$\overline{\text{ALARM}}$	–	5	3	O	open drain NMOS reset output for microcontroller (active LOW)
ALARM	6	6	4	O	open drain PMOS reset output for microcontroller (active HIGH)
CLKSEL	7	7	5	I	control input signal for CLK (LOW = XTAL oscillator; HIGH = STROBE input)
CLKDIV1	8	8	6	I	control input with CLKDIV2 for choosing CLK frequency
CLKDIV2	9	9	7	I	control input with CLKDIV1 for choosing CLK frequency
STROBE	10	10	8	I	external clock input for synchronous applications
CLKOUT	11	11	9	O	clock output (see Table 1)
DGND1	12	12	10	supply	digital ground 1
AGND	13	13	11	supply	analog ground
S2	14	14	12	I/O	capacitance connection for voltage doubler
V _{DDA}	15	15	13	supply	analog supply voltage
S1	16	16	14	I/O	capacitance connection for voltage doubler
VUP	17	17	15	I/O	output of voltage doubler (connect to 100 nF)
I/O	18	18	16	I/O	data I/O line to and from card
AUX2	19	–	17	I/O	auxiliary I/O line to and from card
$\overline{\text{PRES}}$	20	19	18	I	active LOW card input presence contact
PRES	–	20	19	I	active HIGH card input presence contact
AUX1	21	21	20	I/O	auxiliary I/O line to and from card
CLK	22	22	21	O	clock to card output (C3) (see Table 1)
RST	23	23	22	O	card reset output (C2)
V _{CC}	24	24	23	O	supply for card (C1) (decouple with 100 nF)
$\overline{\text{CMDVCC}}$	25	25	24	I	active LOW start activation sequence input from microcontroller
RSTIN	26	26	25	I	card reset input from microcontroller
$\overline{\text{OFF}}$	27	27	26	O	open drain NMOS interrupt output to microcontroller (active LOW)
MODE	28	28	27	I	operating mode selection input (HIGH = normal; LOW = sleep)
V _{DDD}	–	–	28	supply	digital supply voltage
DGND2	–	–	29	supply	digital ground 2

IC card interface

TDA8002



IC card interface

TDA8002

FUNCTIONAL DESCRIPTION

Power supply

The supply pins for the chip are V_{DDA} , V_{DDD} , AGND, DGND1 and DGND2. V_{DDA} and V_{DDD} (i.e. V_{DD}) should be in the range of 3.0 to 6.5 V. All card contacts remain inactive during power-up or power-down.

On power-up, the logic is reset by an internal signal. The sequencer is not activated until V_{DD} reaches $V_{th2} + V_{hys2}$ (see Fig.5). When V_{DD} falls below V_{th2} , an automatic deactivation sequence of the contacts is performed.

Supply voltage supervisor (V_{DD})

This block surveys the V_{DD} supply. A defined reset pulse of 10 ms minimum (t_W) can be retriggered and is delivered on the ALARM outputs during power-up or power-down of V_{DD} (see Fig.5). This signal is also used for eliminating the spikes on card contacts during power-up or power-down.

When V_{DD} reaches $V_{th2} + V_{hys2}$, an internal delay is started. The ALARM outputs are active until this delay has expired. When V_{DD} falls below V_{th2} , ALARM is activated and a deactivation sequence of the contacts is performed.

For 3 V supply, the supervisor option must be chosen at 3 V. For 5 V supply, both options (3 or 5 V) may be chosen depending on the application.

Clock circuitry

The TDA8002 supports both synchronous and asynchronous cards (I²C-bus memories requiring an acknowledge signal from the master are not supported). There are three methods to clock the circuitry:

- Apply a clock signal to pin STROBE
- Use of an internal RC oscillator
- Use of a quartz oscillator which should be connected between pins XTAL1 and XTAL2.

When CLKSEL is HIGH, the clock should be applied on the STROBE pin, and when CLKSEL is LOW, one of the internal oscillators is used.

When an internal clock is used, the clock output is available on pin CLKOUT. The RC oscillator is selected by making CLKDIV1 HIGH and CLKDIV2 LOW. The clock output to the card is available on pin CLK. The frequency of the card clock can be the input frequency divided by 2 or 4, STOP LOW or 1.25 MHz, depending on the states of CLKDIV1 or CLKDIV2 (see Table 1).

Do not change CLKSEL during activation. When in low-power (sleep) mode, the internal oscillator frequency which is available on pin CLKOUT is lowered to approximately 16 kHz for power-economy purposes.

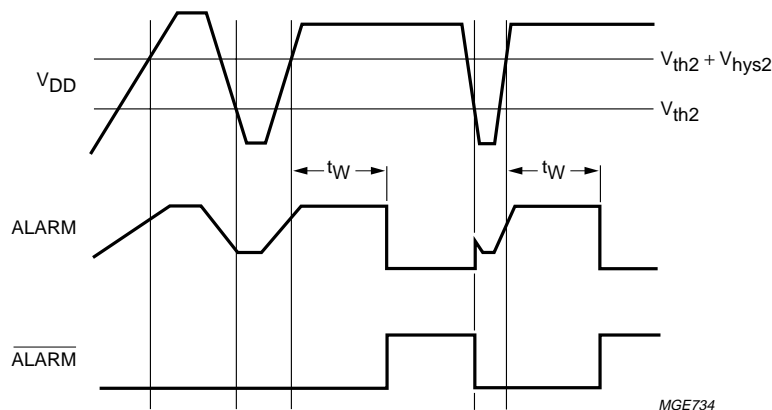


Fig.5 Alarm as a function of V_{DD} (pulse width 10 ms).

IC card interface

TDA8002

Table 1 Clock circuitry definition

MODE	CLKSEL	CLKDIV1	CLKDIV2	FREQUENCY OF CLK	FREQUENCY OF CLKOUT
HIGH	LOW	HIGH	LOW	$\frac{1}{2}f_{int}$	$\frac{1}{2}f_{int}$
HIGH	LOW	LOW	LOW	$\frac{1}{4}f_{xtal}$	f_{xtal}
HIGH	LOW	LOW	HIGH	$\frac{1}{2}f_{xtal}$	f_{xtal}
HIGH	LOW	HIGH	HIGH	STOP LOW	f_{xtal}
HIGH	HIGH	X ⁽¹⁾	X ⁽¹⁾	STROBE	f_{xtal}
LOW ⁽²⁾	X ⁽¹⁾	X ⁽¹⁾	X ⁽¹⁾	STOP LOW	$\frac{1}{2}f_{int}$ ⁽³⁾

Notes

1. X = don't care.
2. In low-power mode.
3. $f_{int} = 32$ kHz in low-power mode.

I/O circuitry

The three I/O transceivers are identical. The state is HIGH for all I/O pins (i.e. I/O, I/OUC, AUX1, AUX1UC, AUX2 and AUX2UC). Pin I/O is referenced to V_{CC} and pin I/OUC to V_{DD} , thus ensuring proper operation in case $V_{CC} \neq V_{DD}$.

The first side on which a falling edge is detected becomes a master (input). An anti-latch circuitry first disables the detection of the falling edge on the other side, which becomes slave (output).

After a delay time t_d (about 50 ns), the logic 0 present on the master side is transferred on the slave side.

When the input is back to HIGH level, a current booster is turned on during the delay t_d on the output side and then both sides are back to their idle state, ready to detect the next logic 0 on any side.

In case of a conflict, both lines may remain LOW until the software enables the lines to be HIGH. The anti-latch circuitry ensures that the lines do not remain LOW if both sides return HIGH, regardless of the prior conditions. The maximum frequency on the lines is approximately 1 MHz.

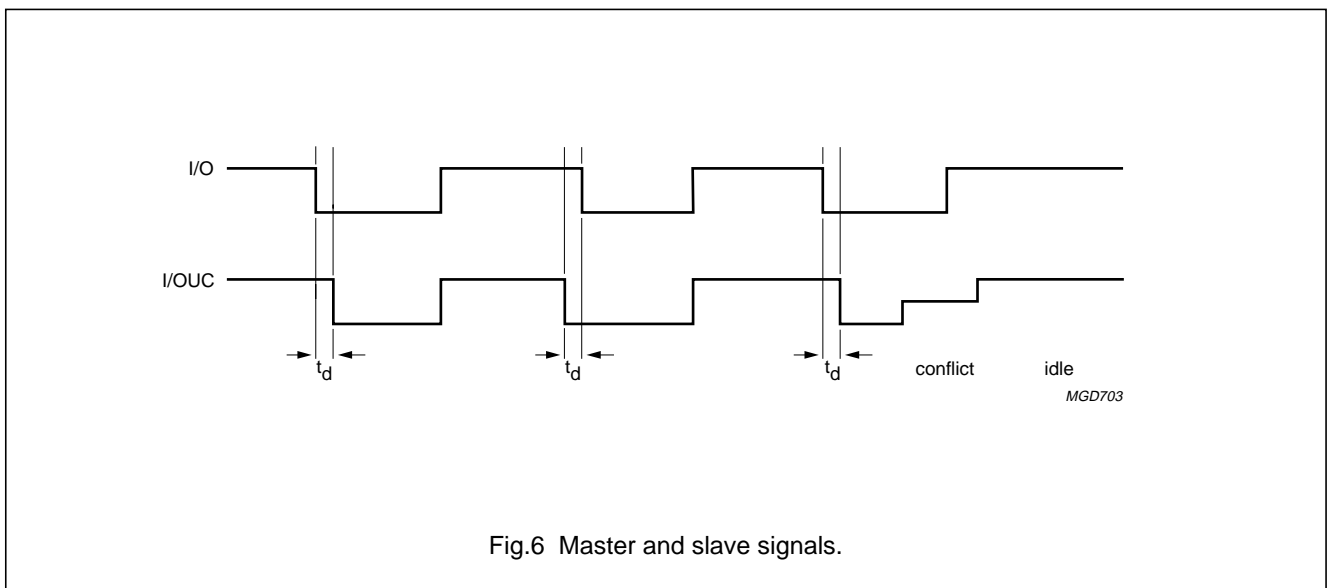


Fig.6 Master and slave signals.

IC card interface

TDA8002

Logic circuitry

After power-up, the circuit has six possible states of operation. Table 1 shows the sequence of these states.

IDLE MODE

After reset, the circuit enters the idle mode. A minimum number of functions in the circuit are active while waiting for the microcontroller to start a session:

- All card contacts are inactive
- I/OUC, AUX1UC and AUX2UC are high-impedance
- Oscillator XTAL runs, delivering CLKOUT
- Voltage supervisor is active.

LOW-POWER (SLEEP) MODE

When pin MODE goes LOW, the circuit enters the low-power (sleep) mode. As long as pin MODE is LOW, no activation is possible.

If pin MODE goes LOW in the active mode, a normal deactivation sequence is performed before entering low-power mode. When pin MODE goes HIGH, the circuit enters normal operation after a delay of at least 6 ms (96 cycles of CLKOUT). During this time the CLKOUT remains at 16 kHz.

- All card contacts are inactive
- Oscillator XTAL does not run
- The V_{DD} supervisor, ALARM output, card presence detection and OFF output remain functional
- Internal oscillator is slowed to 32 kHz, CLKOUT providing 16 kHz.

ACTIVE MODE

When the activation sequence is completed, the TDA8002 will be in the active mode. Data is exchanged between the card and the microcontroller via the I/O lines.

State diagram

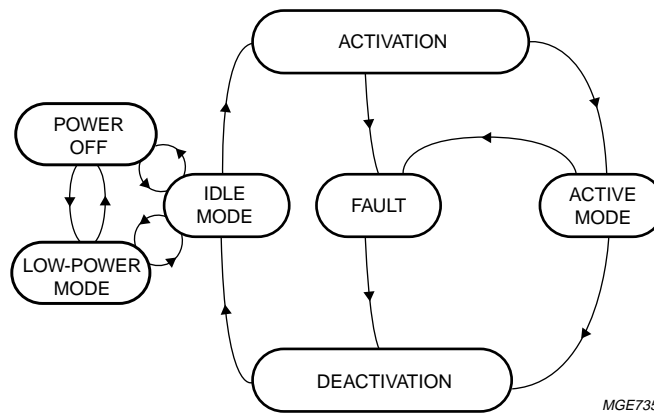


Fig.7 State diagram.

IC card interface

TDA8002

ACTIVATION SEQUENCE

From idle mode, the circuit enters the activation mode when the microcontroller sets the $\overline{\text{CMDVCC}}$ line LOW or sets the MODE line HIGH when the $\overline{\text{CMDVCC}}$ line is already LOW. The internal circuitry is then activated, the internal clock is activated and an activation sequence is executed. When RST is enabled, it becomes the inverse of RSTIN.

Figures 8 to 10 illustrate the activation sequence as described below:

1. Step-up converter is started ($t_1 \approx t_0$)
2. V_{CC} rises from 0 to 5 V ($t_2 = t_1 + 1\frac{1}{2}T$)
3. I/O, AUX1, AUX2 are enabled and CLK is enabled ($t_3 = t_1 + 4T$); a special circuitry ensures that I/O remains below V_{CC} during falling slope of V_{CC}
4. CLK is set by setting RSTIN to HIGH (t_4)
5. RST is enabled ($t_5 = t_1 + 7T$); after t_5 , RSTIN has no further action on CLK, but is only controlling RST.

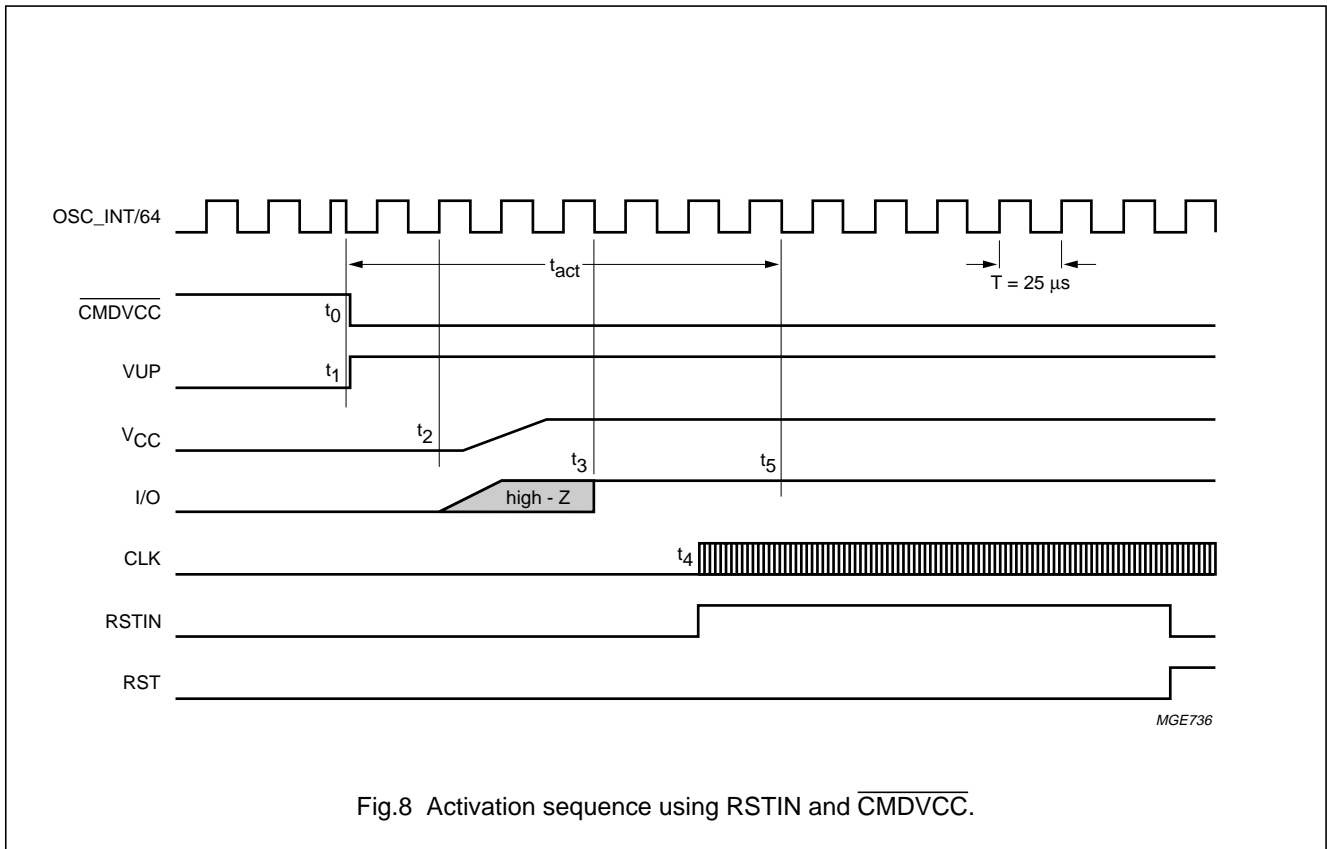


Fig.8 Activation sequence using RSTIN and $\overline{\text{CMDVCC}}$.

IC card interface

TDA8002

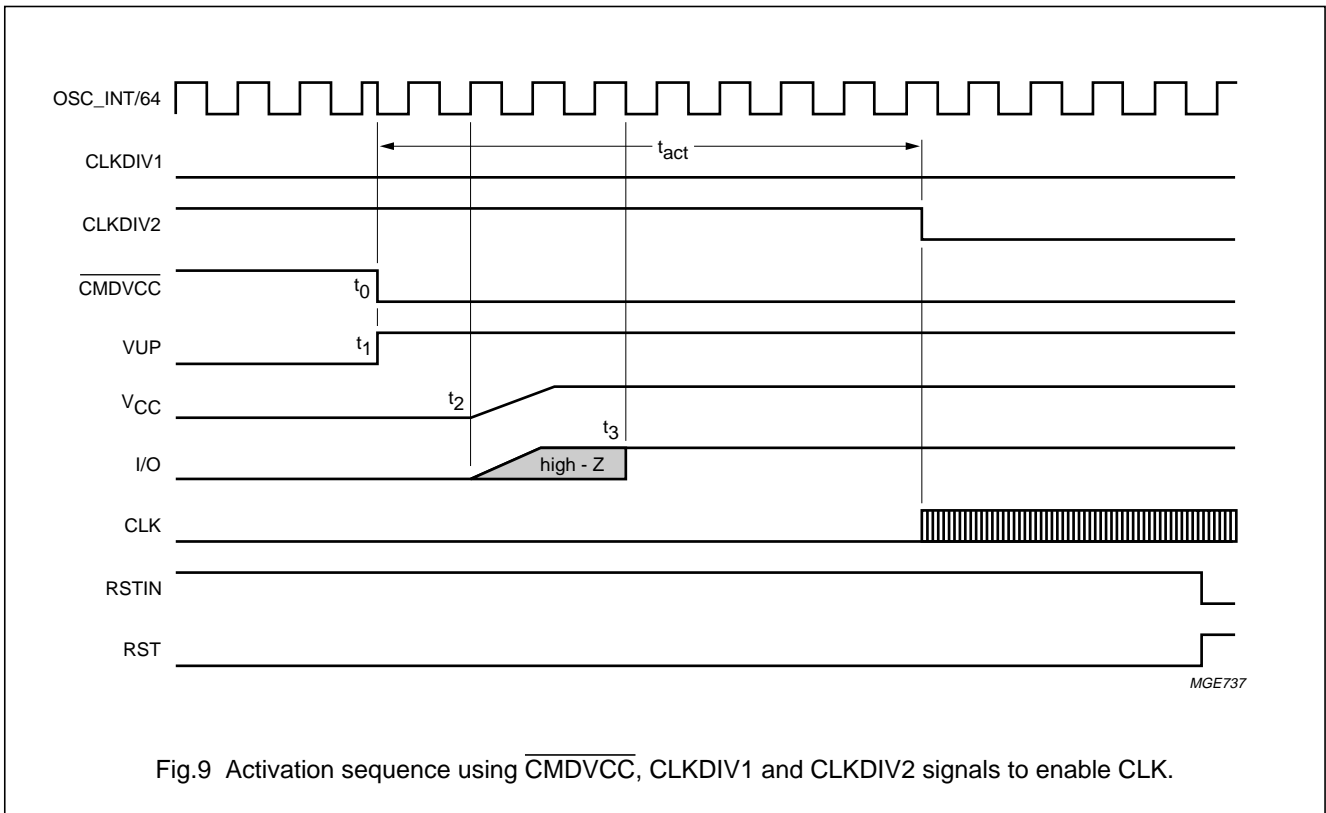


Fig.9 Activation sequence using $\overline{\text{CMDVCC}}$, CLKDIV1 and CLKDIV2 signals to enable CLK.

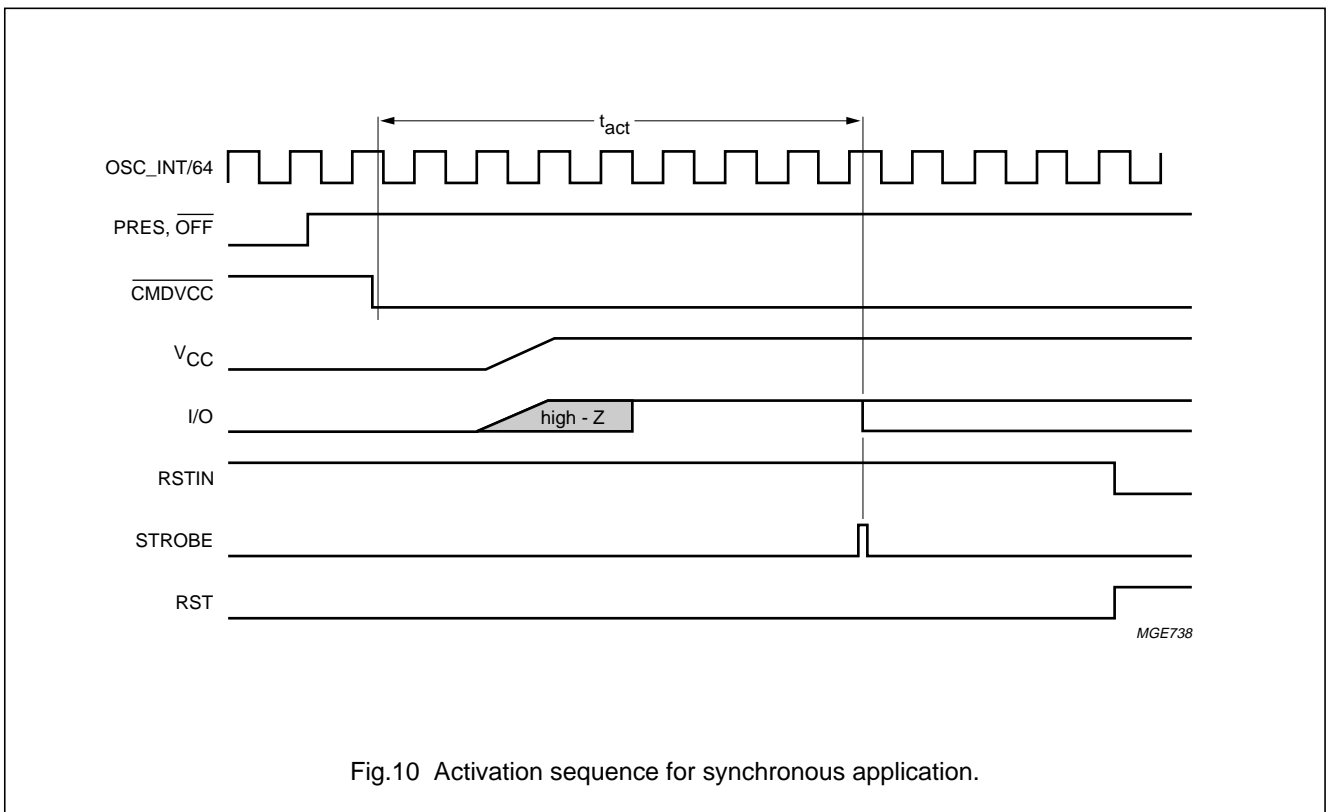


Fig.10 Activation sequence for synchronous application.

IC card interface

TDA8002

DEACTIVATION SEQUENCE

When a session is completed, the microcontroller sets the $\overline{\text{CMDVCC}}$ line to HIGH state or MODE line to LOW state. The circuit then executes an automatic deactivation sequence by counting the sequencer down and ends in idle mode.

Figures 11 and 12 illustrate the deactivation sequence as described below:

1. RST goes LOW ($t_{11} \approx t_{10}$)
2. CLK is stopped ($t_{12} = t_{11} + \frac{1}{2}T$)
3. I/O, AUX1, AUX2 are outputs into high-impedance state ($t_{13} = t_{11} + T$)
4. V_{CC} falls to zero ($t_{14} = t_{11} + 1\frac{1}{2}T$); a special circuitry ensures that I/O remains below V_{CC} during falling slope of V_{CC}
5. VUP falls ($t_{15} = t_{11} + 5T$).

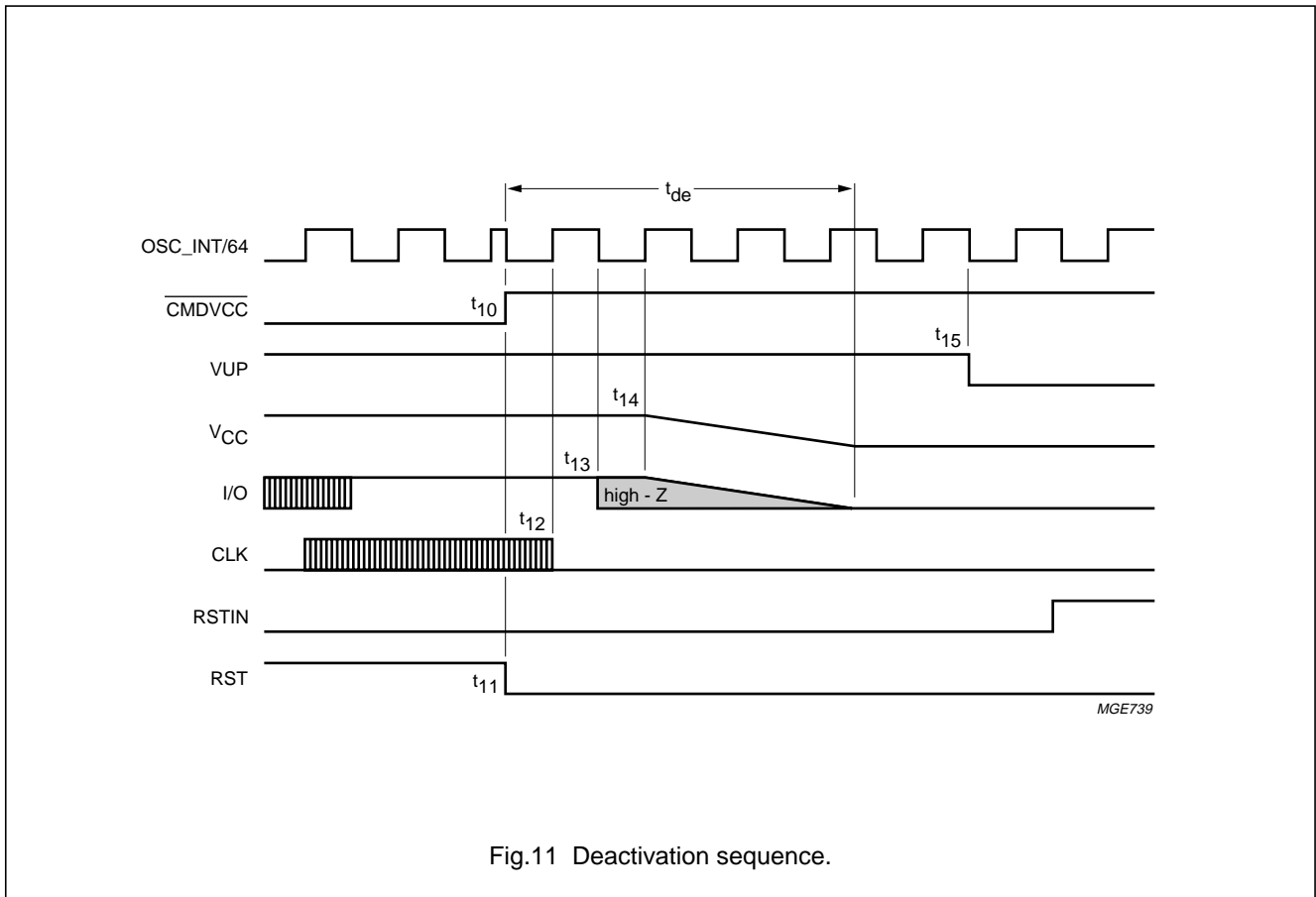


Fig.11 Deactivation sequence.

IC card interface

TDA8002

Fault detection

The following fault conditions are monitored by the circuit:

- Short-circuit or high current on V_{CC}
- Removing card during transaction
- V_{DD} dropping
- Overheating.

When one or more of these faults are detected, the circuit pulls the interrupt line \overline{OFF} to its active LOW state and a deactivation sequence is initiated. In case the card is present the interrupt line \overline{OFF} is set to HIGH when the microcontroller has reset the \overline{CMDVCC} line HIGH (after completion of the deactivation sequence). In case the card is not present \overline{OFF} remains LOW.

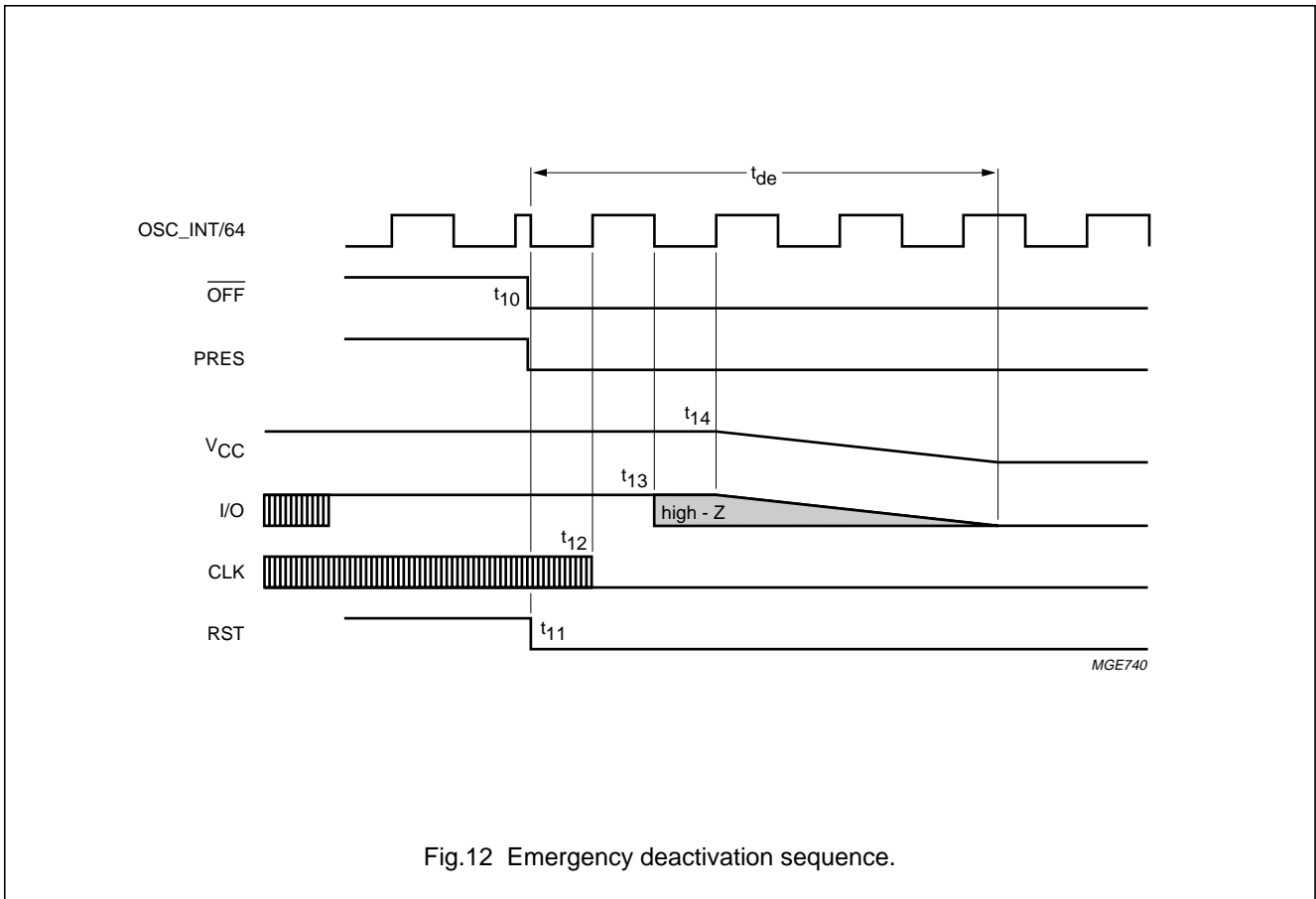


Fig.12 Emergency deactivation sequence.

IC card interface

TDA8002

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134); note 1.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DD}	supply voltage		-0.3	+6.5	V
$V_{i(\text{CMOS})}$	voltage on CMOS pins XTAL1, XTAL2, ALARM, $\overline{\text{ALARM}}$, MODE, RSTIN, CLKSEL, AUX2UC, AUX1UC, CLKDIV1, CLKDIV2, CLKOUT, STROBE, $\overline{\text{CMDVCC}}$ and $\overline{\text{OFF}}$		-0.3	+6.5	V
$V_{i(\text{card})}$	voltage on card contact pins I/O, AUX2, $\overline{\text{PRES}}$, PRES, AUX1, CLK, RST and V_{CC}		-0.3	+6.5	V
V_{es}	electrostatic handling on pins I/O, RST, V_{CC} , CLK, AUX1, AUX2, PRES and $\overline{\text{PRES}}$ on all other pins		-6	+6	kV
			-2	+2	kV
T_{stg}	storage temperature		-55	+125	°C
P_{tot}	continuous total power dissipation TDA8002T TDA8002G	$T_{amb} = -25$ to $+85$ °C	-	0.56	W
		$T_{amb} = -25$ to $+85$ °C	-	0.46	W
T_{amb}	operating ambient temperature		-25	+85	°C
T_j	junction temperature		-	150	°C

Note

1. Stress beyond these levels may cause permanent damage to the device. This is a stress rating only and functional operation of the device under this condition is not implied.

HANDLING

Every 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 positive pulses and 3 negative pulses on each pin referenced to ground.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th(j-a)}$	thermal resistance from junction to ambient in free air		
	SOT136-1	70	K/W
	SOT401-1	91	K/W

IC card interface

TDA8002

CHARACTERISTICS

$V_{DD} = 5\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$; $f_{xtal} = 10\text{ MHz}$; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_{DD}	positive supply voltage	option 5 V power supply (TDA8002xx/5)	4.5	5	6.5	V
		option 3.3 V or 5 V power supply (TDA8002xx/3)	3	5	6.5	V
$I_{DD(s)}$	supply current	sleep mode; $V_{DD} = 5\text{ V}$	–	–	200	μA
$I_{DD(idle)}$	supply current	idle mode; $V_{DD} = 5\text{ V}$; $f_{CLK} = 2.5\text{ MHz}$; $f_{CLKOUT} = 10\text{ MHz}$	–	–	6	mA
$I_{DD(active)}$	supply current	active mode $V_{DD} = 5\text{ V}$; $f_{CLK} = 2.5\text{ MHz}$; $f_{CLKOUT} = 10\text{ MHz}$	–	–	9	mA
		$V_{DD} = 3.3\text{ V}$; $f_{CLK} = 2.5\text{ MHz}$; $f_{CLKOUT} = 10\text{ MHz}$	–	–	12	mA
V_{th2}	threshold voltage on V_{DD} for voltage supervisor	falling option 5 V power supply (TDA8002xx/5)	3.9	4.05	4.2	V
		option 3.3 V or 5 V power supply (TDA8002xx/3)	2.6	2.7	2.8	V
		rising option 5 V power supply (TDA8002xx/5)	4	4.2	4.4	V
		option 3.3 or 5 V power supply (TDA8002xx/3)	2.7	2.85	2.99	V
V_{hys2}	hysteresis on V_{th2}		100	150	200	mV
CARD SUPPLY						
$V_{CC(O)(idle)}$	output voltage	idle mode	–	–	0.4	V
$V_{CC(O)(active)}$	output voltage	active mode $I_{CC} < 20\text{ mA}$: DC load with $3\text{ V} < V_{DD} < 3.3\text{ V}$	4.75	–	5.25	V
		$I_{CC} < 65\text{ mA}$: DC load with $3.3\text{ V} < V_{DD} < 6.5\text{ V}$	4.75	–	5.25	V
		$I_{CC} = 40\text{ mA}$: AC load	4.6	–	5.4	V
$I_{CC(O)}$	output current	$V_{CC(O)} = \text{from } 0 \text{ to } 5\text{ V}$	–	–	65	mA
		V_{CC} short-circuited to ground	–	–	100	mA
SR	slew rate	rising or falling slope	0.12	0.17	0.22	V/ μs

IC card interface

TDA8002

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Crystal connections (XTAL1 and XTAL2)						
C_{ext}	external capacitors	note 1	–	15	–	pF
f_{xtal}	resonance frequency	note 2	2	–	24	MHz
Data lines						
GENERAL						
t_{edge}	delay between falling edge of I/O, AUX1, AUX2 and I/OUC, AUX1UC, AUX2UC		–	200	–	ns
	delay between falling edge of I/OUC, AUX1UC, AUX2UC and I/O, AUX1, AUX2		–	200	–	ns
t_r, t_f	rise and fall times	$C_i = C_o = 30$ pF	–	–	0.5	μ s
DATA LINES I/O, AUX1 AND AUX2						
$V_{OH(I/O)}$	HIGH-level output voltage on data lines	$I_{OH} = -20$ μ A	$V_{CC} - 0.5$	–	$V_{CC} + 0.1$	V
		$I_{OH} = -100$ μ A	3.5	–	–	V
$V_{OL(I/O)}$	LOW-level output voltage on data lines	$I_{I/O} = 1$ mA	–	–	300	mV
$V_{IH(I/O)}$	HIGH-level input voltage on data lines		1.8	–	V_{CC}	V
$V_{IL(I/O)}$	LOW-level input voltage on data lines		0	–	0.8	V
$V_{I/O(idle)}$	voltage on data lines outside a session		–	–	0.4	V
R_{pu}	internal pull-up resistance between data lines and V_{CC}		8	10	12	k Ω
I_{edge}	current from data lines when active pull-up is active		–	1	–	mA
$I_{IL(I/O)}$	LOW-level input current on data lines	$V_{IL} = 0.4$ V	–	–	–600	μ A
$I_{IH(I/O)}$	HIGH-level input current on data lines	$V_{IH} = V_{CC}$	–	–	10	μ A
DATA LINES I/OUC, AUX1UC AND AUX2UC						
$V_{OH(I/OUC)}$	HIGH-level output voltage on data lines	$I_{OH} = -20$ μ A	$V_{DD} - 1$	–	$V_{DD} + 0.2$	V
$V_{OL(I/OUC)}$	LOW-level output voltage on data lines	$I_{I/OUC} = 1$ mA	–	–	300	mV
$V_{IH(I/OUC)}$	HIGH-level input voltage on data lines		$0.7V_{DD}$	–	V_{DD}	V
$V_{IL(I/OUC)}$	LOW-level input voltage on data lines		0	–	$0.3V_{DD}$	V
$Z_{I/OUC(idle)}$	impedance on data lines outside a session		10	–	–	M Ω

IC card interface

TDA8002

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
ALARM, $\overline{\text{ALARM}}$ and $\overline{\text{OFF}}$ when connected (open-drain outputs)						
$I_{\text{OH}(\overline{\text{ALARM}})}$	HIGH-level output current on pin $\overline{\text{ALARM}}$	$V_{\text{OH}(\overline{\text{ALARM}})} = 5 \text{ V}$	–	–	5	μA
$V_{\text{OL}(\overline{\text{ALARM}})}$	LOW-level output voltage on pin $\overline{\text{ALARM}}$	$I_{\text{OL}(\overline{\text{ALARM}})} = 2 \text{ mA}$	–	–	0.4	V
$I_{\text{OH}(\overline{\text{OFF}})}$	HIGH-level output current on pin $\overline{\text{OFF}}$	$V_{\text{OH}(\overline{\text{OFF}})} = 5 \text{ V}$	–	–	5	μA
$V_{\text{OL}(\overline{\text{OFF}})}$	LOW-level output voltage on pin $\overline{\text{OFF}}$	$I_{\text{OL}(\overline{\text{OFF}})} = 2 \text{ mA}$	–	–	0.4	V
$I_{\text{OL}(\text{ALARM})}$	LOW-level output current on pin ALARM	$V_{\text{OL}(\text{ALARM})} = 0 \text{ V}$	–	–	–5	μA
$V_{\text{OH}(\text{ALARM})}$	HIGH-level output voltage on pin ALARM	$I_{\text{OH}(\text{ALARM})} = -2 \text{ mA}$	$V_{\text{DD}} - 1$	–	–	V
t_{W}	ALARM pulse width		6	–	20	ms
Clock output (CLKOUT; powered from V_{DD})						
f_{CLKOUT}	frequency on CLKOUT		0	–	20	MHz
		low power	–	16	–	kHz
V_{OL}	LOW-level output voltage	$I_{\text{OL}} = 1 \text{ mA}$	0	–	0.5	V
V_{OH}	HIGH-level output voltage	$I_{\text{OH}} = -1 \text{ mA}$	$V_{\text{DD}} - 0.5$	–	–	V
$t_{\text{r}}, t_{\text{f}}$	rise and fall times	$C_{\text{L}} = 15 \text{ pF}$; notes 3 and 5	–	–	8	ns
δ	duty factor	$C_{\text{L}} = 15 \text{ pF}$; notes 3 and 5	40	–	60	%
Internal oscillator						
f_{int}	frequency of internal oscillator	active mode	2.2	2.7	3.2	MHz
		sleep mode	–	32	–	kHz
Card reset output (RST)						
$V_{\text{O}(\text{inact})}$	output voltage	inactive modes	0	–	0.3	V
$t_{\text{d}(\text{RST})}$	delay between RSTIN and RST	RST enabled	–	–	100	ns
V_{OL}	LOW-level output voltage	$I_{\text{OL}} = 200 \mu\text{A}$	0	–	0.3	V
V_{OH}	HIGH-level output voltage	$I_{\text{OH}} = -200 \mu\text{A}$	4.3	–	V_{CC}	V
		$I_{\text{OH}} = -50 \mu\text{A}$	$V_{\text{CC}} - 0.5$	–	V_{CC}	V
Card clock output (CLK)						
$V_{\text{O}(\text{inact})}$	output voltage	inactive modes	0	–	0.3	V
V_{OL}	LOW-level output voltage	$I_{\text{OL}} = 200 \mu\text{A}$	0	–	0.3	V
V_{OH}	HIGH-level output voltage	$I_{\text{OH}} = -50 \mu\text{A}$	$V_{\text{CC}} - 0.5$	–	V_{CC}	V
t_{r}	rise time	$C_{\text{L}} = 30 \text{ pF}$; note 3	–	–	8	ns
t_{f}	fall time	$C_{\text{L}} = 30 \text{ pF}$; note 3	–	–	8	ns
δ	duty factor	$C_{\text{L}} = 30 \text{ pF}$; note 3	45	–	55	%
SR	slew rate (rise and fall)		0.2	–	–	V/ns

IC card interface

TDA8002

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Strobe input (STROBE)						
f _{STROBE}	frequency on STROBE		0	–	20	MHz
V _{IL}	LOW-level input voltage		0	–	0.3V _{DD}	V
V _{IH}	HIGH-level input voltage		0.7V _{DD}	–	V _{DD}	V
Logic inputs (CLKSEL, CLKDIV1, CLKDIV2, MODE, $\overline{\text{CMDVCC}}$ and RSTIN); note 4						
V _{IL}	LOW-level input voltage		0	–	0.8	V
V _{IH}	HIGH-level input voltage		1.8	–	V _{DD}	V
Logic inputs (PRES, $\overline{\text{PRES}}$); note 4						
V _{IL}	LOW-level input voltage		0	–	0.3V _{DD}	V
V _{IH}	HIGH-level input voltage		0.7V _{DD}	–	V _{DD}	V
I _{IL(PRES)}	LOW-level input current on pin PRES	V _{OL} = 0 V	–	–	–10	μA
I _{IH(PRES)}	HIGH-level input current on pin PRES		–	–	10	μA
Protections						
T _{sd}	shut-down local temperature		–	135	–	°C
I _{CC(sd)}	shut-down current at V _{CC}		–	–	90	mA
Timing						
t _{act}	activation sequence duration	see Fig.9; guaranteed by design	–	180	220	μs
t _{de}	deactivation sequence duration	see Fig.11; guaranteed by design	50	70	90	μs
t ₃	start of the window for sending CLK to the card	see Figs 8 and 9	–	–	130	μs
t ₅	end of the window for sending CLK to the card	see Fig.8	150	–	–	μs

Notes

1. It may be necessary to put capacitors from XTAL1 and XTAL2 to ground depending on the choice of crystal or resonator.
2. When the oscillator is stopped in mode 1, XTAL1 is set to HIGH.
3. The transition time and duty cycle definitions are shown in Fig.13; $\delta = \frac{t_1}{t_1 + t_2}$
4. $\overline{\text{PRES}}$ and $\overline{\text{CMDVCC}}$ are active LOW; RSTIN and PRES are active HIGH.
5. CLKOUT transition time and duty cycle do not need to be tested.

IC card interface

TDA8002

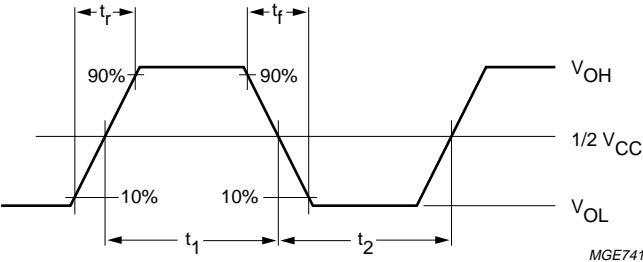


Fig.13 Definition of transition times.

IC card interface

TDA8002

APPLICATION INFORMATION

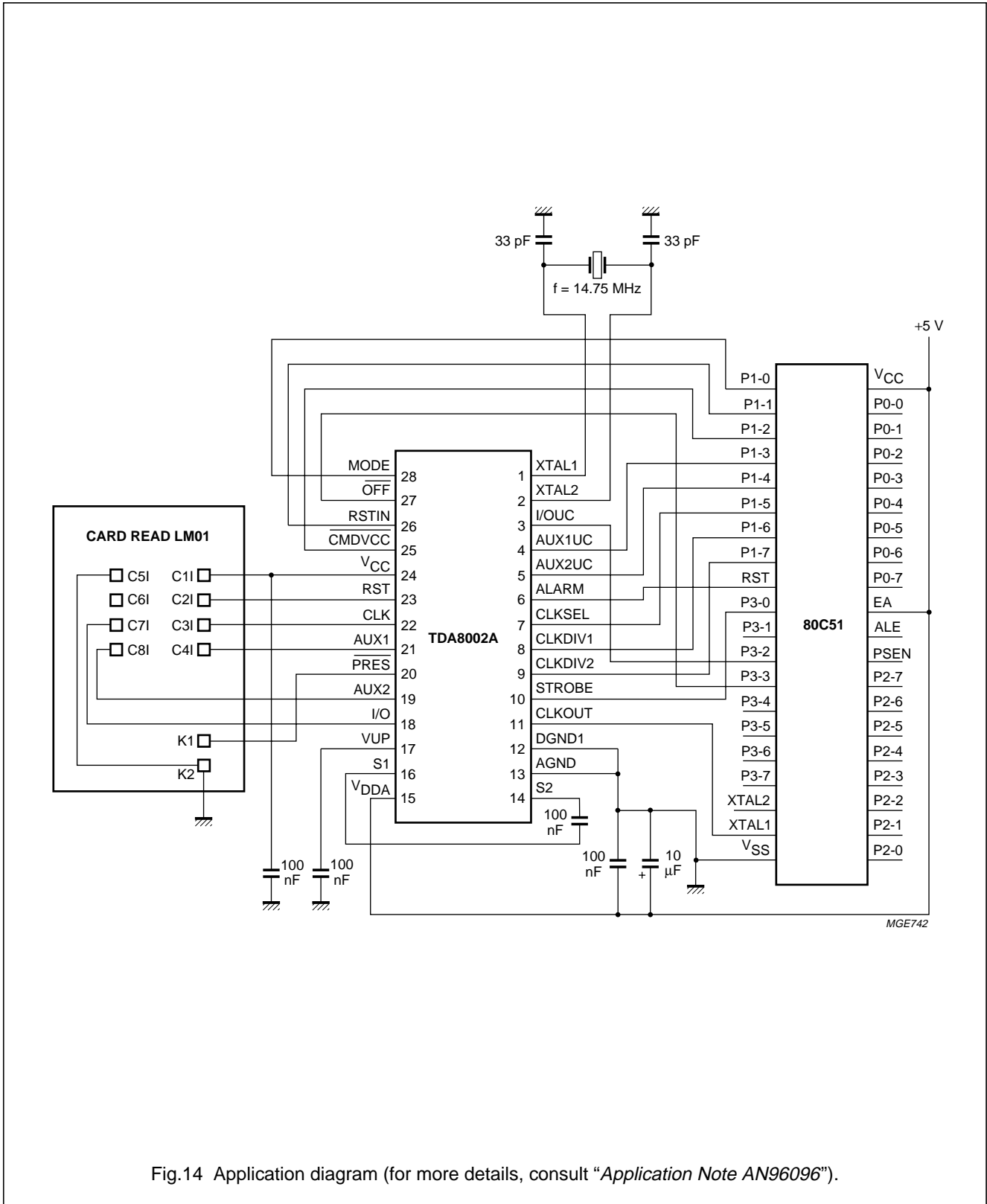


Fig.14 Application diagram (for more details, consult "Application Note AN96096").

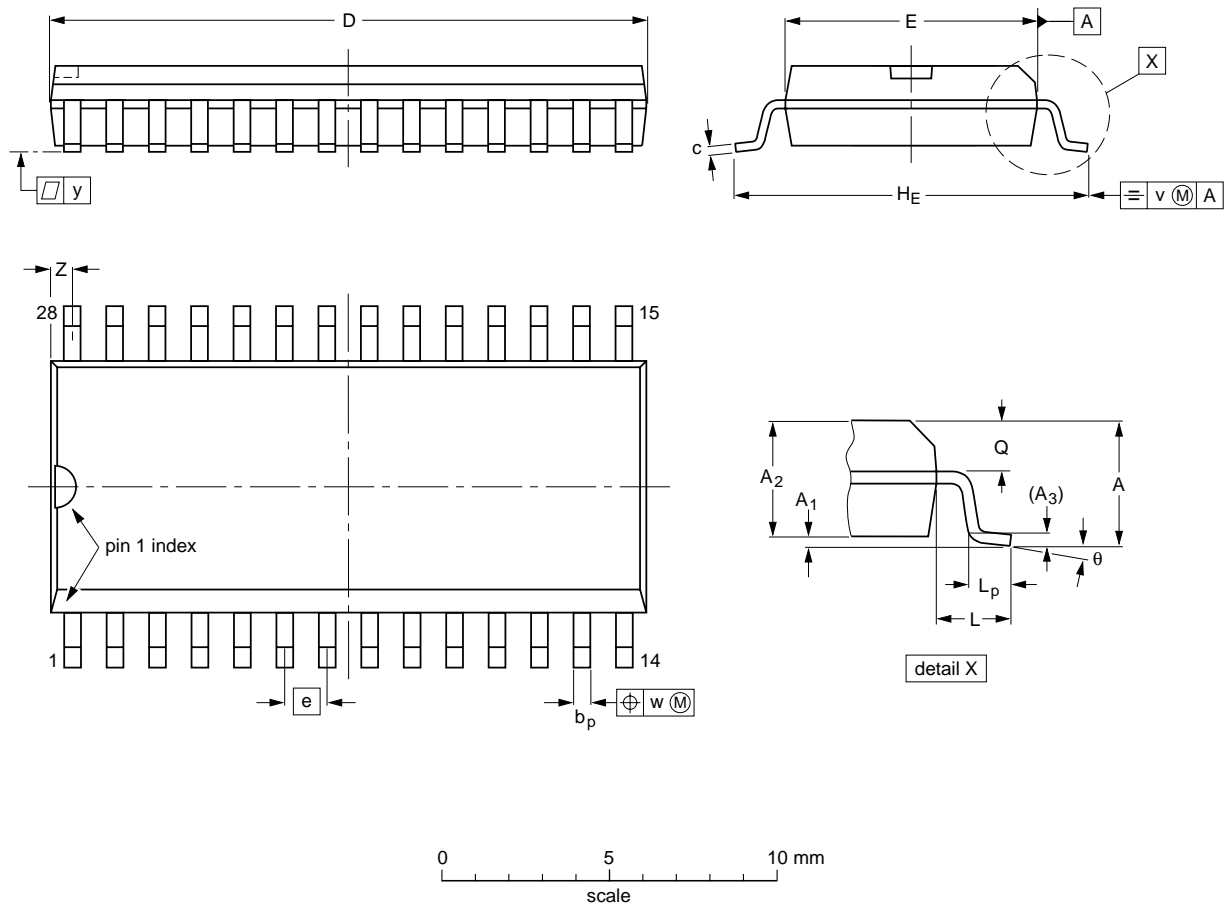
IC card interface

TDA8002

PACKAGE OUTLINES

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	0.419 0.394	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.

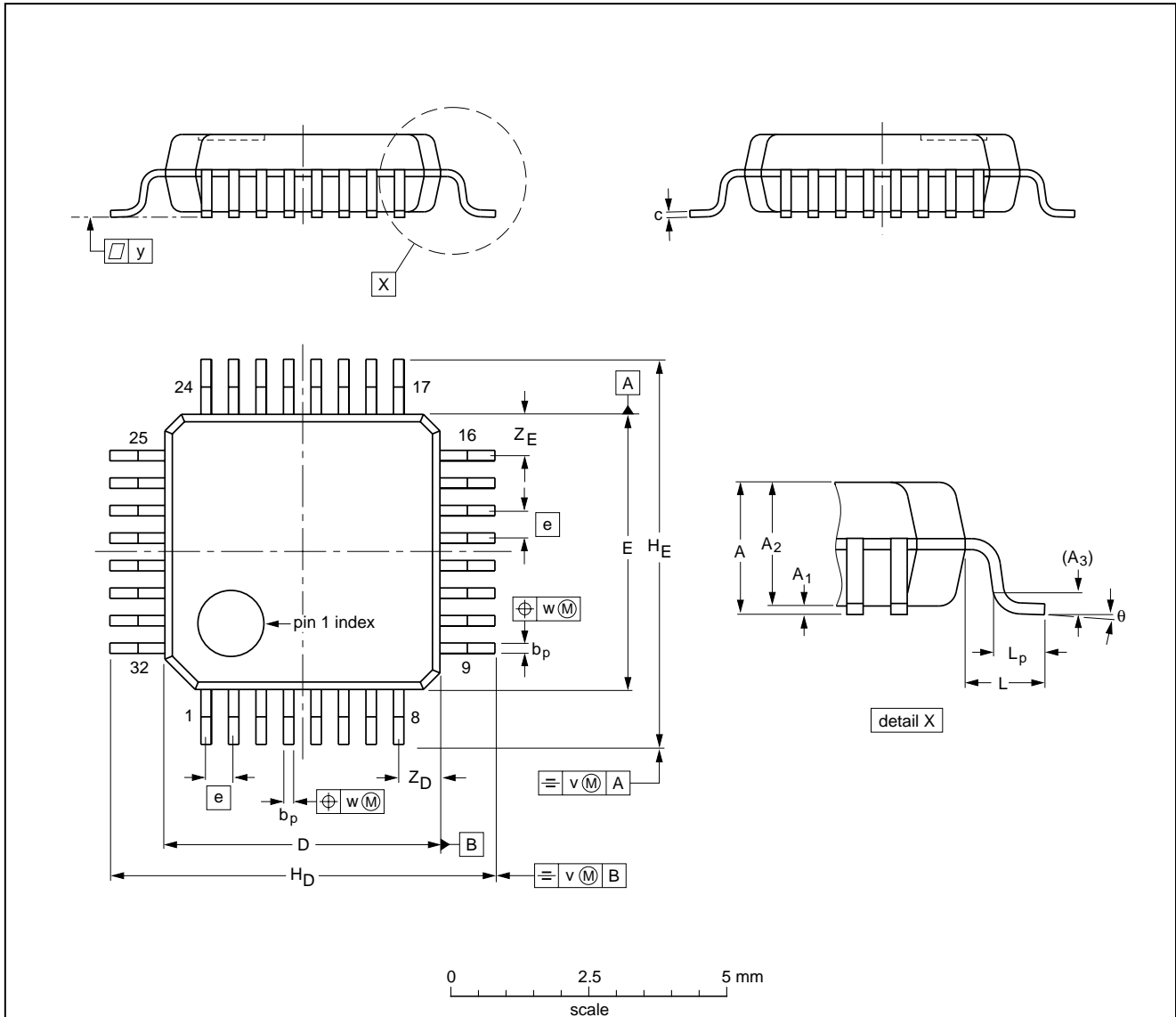
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT136-1	075E06	MS-013AE				95-01-24 97-05-22

IC card interface

TDA8002

LQFP32: plastic low profile quad flat package; 32 leads; body 5 x 5 x 1.4 mm

SOT401-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.60	0.15 0.05	1.5 1.3	0.25	0.27 0.17	0.18 0.12	5.1 4.9	5.1 4.9	0.5	7.15 6.85	7.15 6.85	1.0	0.75 0.45	0.2	0.12	0.1	0.95 0.55	0.95 0.55	7° 0°

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			
SOT401-1						95-12-19 97-08-04

IC card interface

TDA8002

SOLDERING**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).

Reflow soldering

Reflow soldering techniques are suitable for all LQFP and 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 methods exist for reflowing; for example, infrared/convection heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 50 and 300 seconds depending on heating method. Typical reflow peak temperatures range from 215 to 250 °C.

Wave soldering**LQFP**

Wave soldering is **not** recommended for LQFP packages. This is because of the likelihood of solder bridging due to closely-spaced leads and the possibility of incomplete solder penetration in multi-lead devices.

CAUTION

Wave soldering is NOT applicable for all LQFP packages with a pitch (e) equal or less than 0.5 mm.

If wave soldering cannot be avoided, for LQFP packages with a pitch (e) larger than 0.5 mm, the following conditions must be observed:

- **A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.**
- **The footprint must be at an angle of 45° to the board direction and must incorporate solder thieves downstream and at the side corners.**

SO

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.

METHOD (LQFP AND SO)

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.

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.

IC card interface

TDA8002

DEFINITIONS

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

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

IC card interface

TDA8002

NOTES

IC card interface

TDA8002

NOTES

IC card interface

TDA8002

NOTES

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. +43 160 1010,
Fax. +43 160 101 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 0044

Finland: Sinikalliontie 3, FIN-02630 ESPOO,
Tel. +358 9 615800, Fax. +358 9 61580920

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, Band Box Building, 2nd floor,
254-D, Dr. Annie Besant Road, Worli, MUMBAI 400 025,
Tel. +91 22 493 8541, Fax. +91 22 493 0966

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, PO Box 18053,
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,
Tel. +60 3 750 5214, Fax. +60 3 757 4880

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. +7 095 755 6918, Fax. +7 095 755 6919

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

Slovakia: see Austria

Slovenia: see Italy

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,
Tel. +46 8 632 2000, Fax. +46 8 632 2745

Switzerland: Allmendstrasse 140, CH-8027 ZÜRICH,
Tel. +41 1 488 2686, Fax. +41 1 481 7730

Taiwan: Philips Semiconductors, 6F, No. 96, Chien Kuo N. Rd., Sec. 1,
TAIPEI, Taiwan Tel. +886 2 2134 2865, Fax. +886 2 2134 2874

Thailand: PHILIPS ELECTRONICS (THAILAND) Ltd.,
209/2 Sanpavuth-Bangna Road Prakanong, BANGKOK 10260,
Tel. +66 2 745 4090, Fax. +66 2 398 0793

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,
Tel. +1 800 234 7381

Uruguay: see South America

Vietnam: see Singapore

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

For all other countries apply to: Philips Semiconductors, Marketing & Sales Communications,
Building BE-p, P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands, Fax. +31 40 27 24825

Internet: <http://www.semiconductors.philips.com>

© Philips Electronics N.V. 1997

SCA55

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner.

The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent- or other industrial or intellectual property rights.

Printed in The Netherlands

547047/1200/03/pp28

Date of release: 1997 Nov 04

Document order number: 9397 750 02454

Let's make things better.

Philips
Semiconductors



PHILIPS

SUNSTAR 商斯达实业集团是集研发、生产、工程、销售、代理经销、技术咨询、信息服务等为一体的高科技企业，是专业高科技电子产品生产厂家，是具有 10 多年历史的专业电子元器件供应商，是中国最早和最大的仓储式连锁规模经营大型综合电子零部件代理分销商之一，是一家专业代理和分销世界各大品牌 IC 芯片和电子元器件的连锁经营综合性国际公司，专业经营进口、国产名厂名牌电子元件，型号、种类齐全。在香港、北京、深圳、上海、西安、成都等全国主要电子市场设有直属分公司和产品展示展销窗口门市部专卖店及代理分销商，已在全国范围内建成强大统一的供货和代理分销网络。我们专业代理经销、开发生产电子元器件、集成电路、传感器、微波光电元器件、工控机/DOC/DOM 电子盘、专用电路、单片机开发、MCU/DSP/ARM/FPGA 软件硬件、二极管、三极管、模块等，是您可靠的一站式现货配套供应商、方案提供商、部件功能模块开发配套商。商斯达实业公司拥有庞大的资料库，有数位毕业于著名高校——有中国电子工业摇篮之称的西安电子科技大学（西军电）并长期从事国防尖端科技研究的高级工程师为您精挑细选、量身订做各种高科技电子元器件，并解决各种技术问题。

微波光电部专业代理经销高频、微波、光纤、光电元器件、组件、部件、模块、整机；电磁兼容元器件、材料、设备；微波 CAD、EDA 软件、开发测试仿真工具；微波、光纤仪器仪表。欢迎国外高科技微波、光纤厂商将优秀产品介绍到中国、共同开拓市场。长期大量现货专业批发高频、微波、卫星、光纤、电视、CATV 器件：晶振、VCO、连接器、PIN 开关、变容二极管、开关二极管、低噪晶体管、功率电阻及电容、放大器、功率管、MMIC、混频器、耦合器、功分器、振荡器、合成器、衰减器、滤波器、隔离器、环行器、移相器、调制解调器；光电子元件和组件：红外发射管、红外接收管、光电开关、光敏管、发光二极管和发光二极管组件、半导体激光二极管和激光器组件、光电探测器和光接收组件、光发射接收模块、光纤激光器和光放大器、光调制器、光开关、DWDM 用光发射和接收器件、用户接入系统光收发器件与模块、光纤连接器、光纤跳线/尾纤、光衰减器、光纤适配器、光隔离器、光耦合器、光环行器、光复用器/转换器；无线收发芯片和模组、蓝牙芯片和模组。

更多产品请看本公司产品专用销售网站：

商斯达中国传感器科技信息网：<http://www.sensor-ic.com/>

商斯达工控安防网：<http://www.pc-ps.net/>

商斯达电子元器件网：<http://www.sunstare.com/>

商斯达微波光电产品网：[HTTP://www.rfoe.net/](http://www.rfoe.net/)

商斯达消费电子产品网：<http://www.icasic.com/>

商斯达实业科技产品网：<http://www.sunstars.cn/> 微波元器件销售热线：

地址：深圳市福田区福华路福庆街鸿图大厦 1602 室

电话：0755-82884100 83397033 83396822 83398585

传真：0755-83376182 (0) 13823648918 MSN: SUNS8888@hotmail.com

邮编：518033 E-mail:szss20@163.com QQ: 195847376

深圳赛格展销部：深圳华强北路赛格电子市场 2583 号 电话：0755-83665529 25059422

技术支持：0755-83394033 13501568376

欢迎索取免费详细资料、设计指南和光盘；产品凡多，未能尽录，欢迎来电查询。

北京分公司：北京海淀区知春路 132 号中发电子大厦 3097 号

TEL: 010-81159046 82615020 13501189838 FAX: 010-62543996

上海分公司：上海市北京东路 668 号上海赛格电子市场 D125 号

TEL: 021-28311762 56703037 13701955389 FAX: 021-56703037

西安分公司：西安高新开发区 20 所(中国电子科技集团导航技术研究所)

西安劳动南路 88 号电子商城二楼 D23 号

TEL: 029-81022619 13072977981 FAX:029-88789382