DATA SHEET

TZA1045
Photodiode and amplifier IC for CD and DVD applications

Preliminary specification
Supersedes data of 2002 Nov 27

2003 Jun 26

Philips
Semiconductors

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Photodiode and amplifier IC for CD and DVD applications

TZA1045

FEATURES

- High frequency RF amplifiers (typical bandwidth = 240 MHz)
- Suitable for all CD (785 nm) and DVD (655 nm) read/write applications
- Four high bandwidth central outputs (A, B, C, and D), four satellite outputs (E, F, G, and H) and one high bandwidth differential output (RFP, RFN)
- Internal current clamp and current fold back (power reduction)
- Versatile programmable gain switches (CD/DVD, H/L, and R/W)
- Single 5 V supply
- Current outputs for optimum signal transport over flex cable
- Small outline package SSOP16T with good positional tolerance.

APPLICATIONS

- CD and DVD read/write applications.

GENERAL DESCRIPTION

The TZA1045 is a single optical pick-up IC for read/write systems and is suitable for CD and DVD applications.

The device contains eight RF amplifiers for the central and satellite diodes and one differential RF amplifier (RFP and RFN) which handles the sum of the four A, B, C, and D central diode signals.

Programming the gain is a very versatile way to optimize interfacing between the TZA1045 and the pre-amplifier. The gain can be programmed for CD or DVD media with the gain switch CD/DVD.

The H/L switch can be used for CD-R or CD-RW discs.

Gain switch R/W is used to reduce the gain during writing. During writing, the high peak signals for the central and satellite segments are clamped internally and the output currents of the A, B, C, D, E, F, G, and H segments are reduced to almost zero (fold back) to minimize the power consumption.

All outputs are current outputs that can supply a maximum of 8 mA. In CD-R writing mode, the clipping level of the output currents is between 5 and 8 mA.

The SSOP16T package has a low spread on the z tolerance. The z tolerance is measured between the diodes (chip surface) and the bottom of the leads. The diodes have an offset of 54 μm in the ‘y’ direction with respect to the leadframe centre and a tolerance of ±50 μm in both ‘x’ and ‘y’ directions.

The diodes are placed under an angle of 45° ±1° with respect to the leadframe of the module.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TZA1045TS	SSOP16T	plastic shrink small outline package/transparent; 16 leads (straight); body width 4.4 mm	SOT734-1

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supplies						
V_{DD1}	supply voltage front-end		4.5	5.0	5.5	V
V_{DD2}	supply voltage back-end		4.5	5.0	5.5	V
I_{DD1}	supply current front-end	dark conditions				
		writing DVD+R	12.8	17.4	21.3	mA
		writing CD-R	30.9	41.2	51.5	mA
		writing DVD+RW	12.9	17.2	21.5	mA
		writing CD-RW	11.4	15.2	19.0	mA
		reading DVD-ROM	31.9	42.5	53.1	mA
		reading CD-ROM	31.3	41.8	52.2	mA
		reading DVD+RW	31.7	42.2	52.8	mA
		reading CD-RW	30.9	41.2	51.5	mA
I_{DD2}	supply current back-end	dark conditions	–	6.0	–	mA
Temperature range						
T_{amb}	ambient temperature		0	–	70	°C
RF bandwidth						
$B_{-3dB(cen)}$	RF bandwidth central channels A, B, C, and D	I_o = 1 mA				
		writing DVD+R	135	170	205	MHz
		writing CD-R	225	280	340	MHz
		writing DVD+RW	240	300	360	MHz
		writing CD-RW	115	145	175	MHz
		reading DVD-ROM	135	170	205	MHz
		reading CD-ROM	100	125	155	MHz
		reading DVD+RW	135	170	205	MHz
		reading CD-RW	80	105	130	MHz
$B_{-3dB(dif)}$	RF bandwidth differential channels RFP and RFN	I_o = 1 mA				
		writing DVD+R	135	170	205	MHz
		writing CD-R	235	290	350	MHz
		writing DVD+RW	290	360	435	MHz
		writing CD-RW	120	150	180	MHz
		reading DVD-ROM	135	170	210	MHz
		reading CD-ROM	95	120	145	MHz
		reading DVD+RW	140	175	210	MHz
		reading CD-RW	80	105	130	MHz

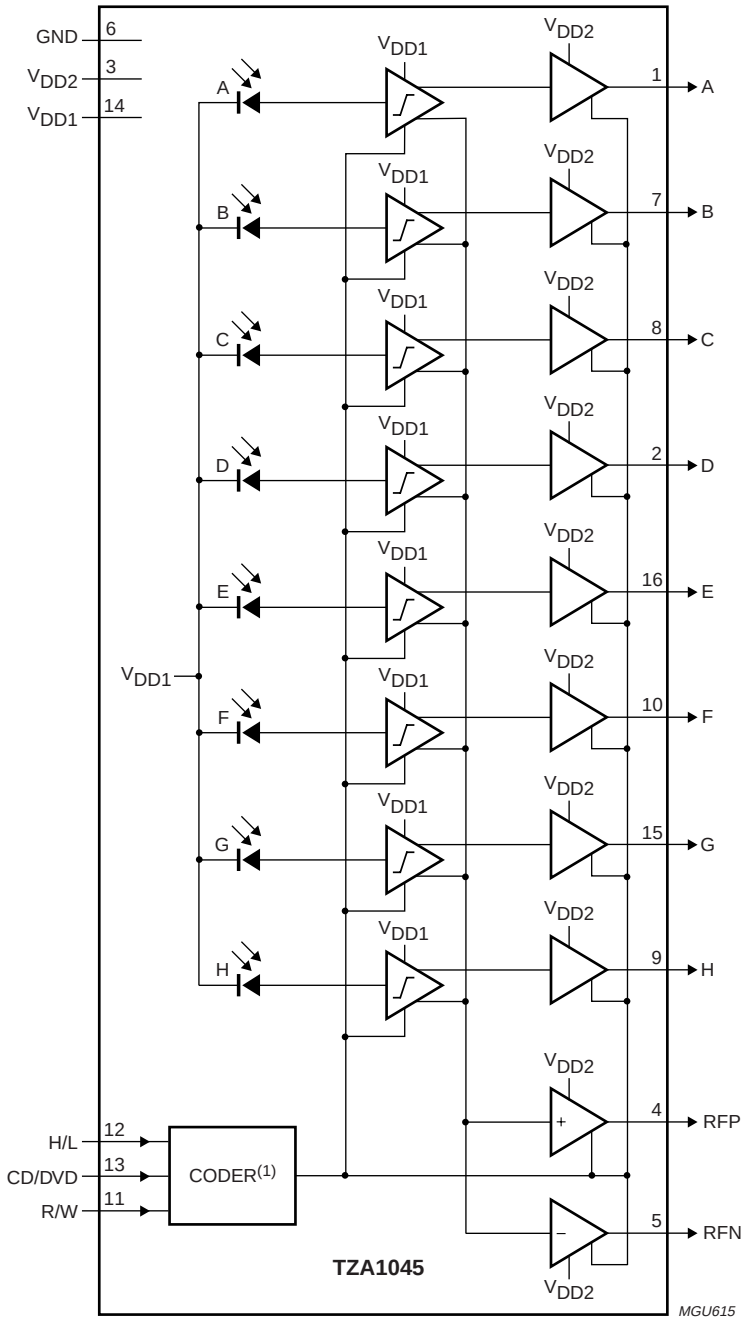
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$B_{-3dB(sat)}$	RF bandwidth satellite channels E, F, G and H	I_o = 1 mA				
		writing DVD+R	65	85	105	MHz
		writing CD-R	70	90	110	MHz
		writing DVD+RW	90	115	140	MHz
		writing CD-RW	60	75	90	MHz
		reading DVD-ROM	85	110	135	MHz
		reading CD-ROM	60	75	90	MHz
		reading DVD+RW	80	100	120	MHz
		reading CD-RW	40	50	60	MHz
Settling time; note 1						
$t_{st(max)}$	settling time	CD-R write mode (central and satellite channels); I_{set} > 300 μA; accuracy set level within ±5%; ratio write to read peak level factor <50	–	< 22	–	ns
		CD-R write mode (differential channels RFP and RFN); I_{set} > 70 μA; accuracy set level within ±5%; ratio write to read peak level factor <50	–	< 22	–	ns
		CD-RW and DVD+RW write modes (all channels); no clip; I_{set} > 70 μA; accuracy set level within ±5%; ratio write to read peak level factor 2; $I_o < I_{o(max)}$	–	< 10	–	ns
		DVD+R write mode (all channels); no clip; I_{set} > 100 μA; accuracy set level within ±5%; ratio write to read peak level factor 20; $I_o < I_{o(max)}$	–	< 15	–	ns
Phase and group delay variation						
$\Delta t_{d(p)(dif)}$	phase delay variation differential channels RFP and RFN	I_o = 1 mA; f_i = 13 to 130 MHz				
		reading DVD-ROM	–	0.15	–	ns
		reading CD-ROM	–	1	–	ns
		reading DVD+RW	–	0.25	–	ns
		reading CD-RW	–	1.3	–	ns
$\Delta t_{d(g)(dif)}$	group delay variation differential channels RFP and RFN	I_o = 1.5 mA; f_i = 2.6 to 130 MHz				
		reading DVD-ROM	–	0.4	–	ns
		reading CD-ROM	–	0.8	–	ns
		reading DVD+RW	–	0.6	–	ns
		reading CD-RW	–	1.2	–	ns

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Sensitivity						
s_{DVD+R}	output current sensitivity for DVD+R	writing; λ = 655 nm				
		$I_{o(cen)}$	–	1.44	–	A/W
		$I_{o(sat)}$	–	4.76	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	0.54	–	A/W
s_{CD-R}	output current sensitivity for CD-R	writing; λ = 785 nm				
		$I_{o(cen)}$	–	43.2	–	A/W
		$I_{o(sat)}$	–	173	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	1.08	–	A/W
s_{DVD+RW}	output current sensitivity for DVD+RW	writing; λ = 655 nm				
		$I_{o(cen)}$	–	2.88	–	A/W
		$I_{o(sat)}$	–	11.5	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	1.08	–	A/W
		reading; λ = 655 nm				
		$I_{o(cen)}$	–	43.2	–	A/W
		$I_{o(sat)}$	–	173	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	16.2	–	A/W
s_{CD-RW}	output current sensitivity for CD-RW	writing; λ = 785 nm				
		$I_{o(cen)}$	–	5.67	–	A/W
		$I_{o(sat)}$	–	23.0	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	2.16	–	A/W
		reading; λ = 785 nm				
		$I_{o(cen)}$	–	173	–	A/W
		$I_{o(sat)}$	–	691	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	64.8	–	A/W
$s_{DVD-ROM}$	output current sensitivity for DVD-ROM	reading; λ = 655 nm				
		$I_{o(cen)}$	–	21.6	–	A/W
		$I_{o(sat)}$	–	86.4	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	8.1	–	A/W
s_{CD-ROM}	output current sensitivity for CD-ROM	reading; λ = 785 nm				
		$I_{o(cen)}$	–	86.4	–	A/W
		$I_{o(sat)}$	–	346	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	32.4	–	A/W

Note

1. The settling time includes the recovery time.

BLOCK DIAGRAM



(1) The coder translates the three digital inputs into the appropriate gain level of each amplifier. The limiter is switched on only for CD-R writing for the segment outputs.

Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
A	1	central segment output A
D	2	central segment output D
V_{DD2}	3	supply voltage back-end
RFP	4	positive RF output
RFN	5	negative RF output
GND	6	ground
B	7	central segment output B
C	8	central segment output C
H	9	satellite segment output H
F	10	satellite segment output F
R/W	11	gain select switch for reading or writing
H/L	12	gain select switch for high or low reflective media
CD/DVD	13	gain select switch for CD or DVD
V_{DD1}	14	supply voltage front-end
G	15	satellite segment output G
E	16	satellite segment output E

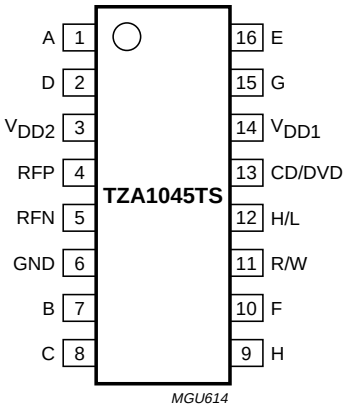


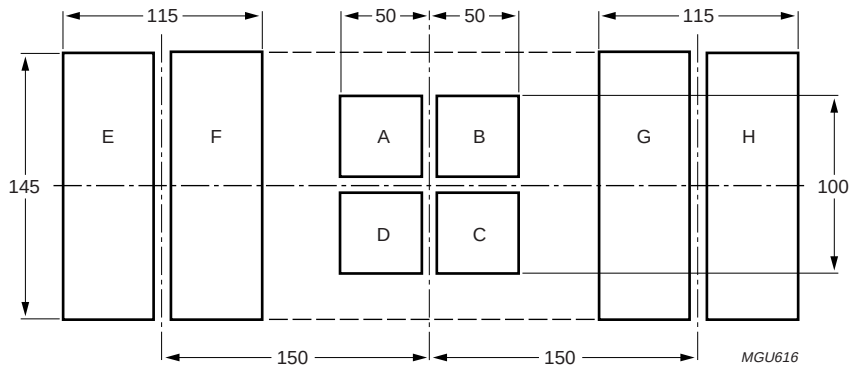
Fig.2 Pin configuration.

MODE SELECTION

Table 1 Coder switching

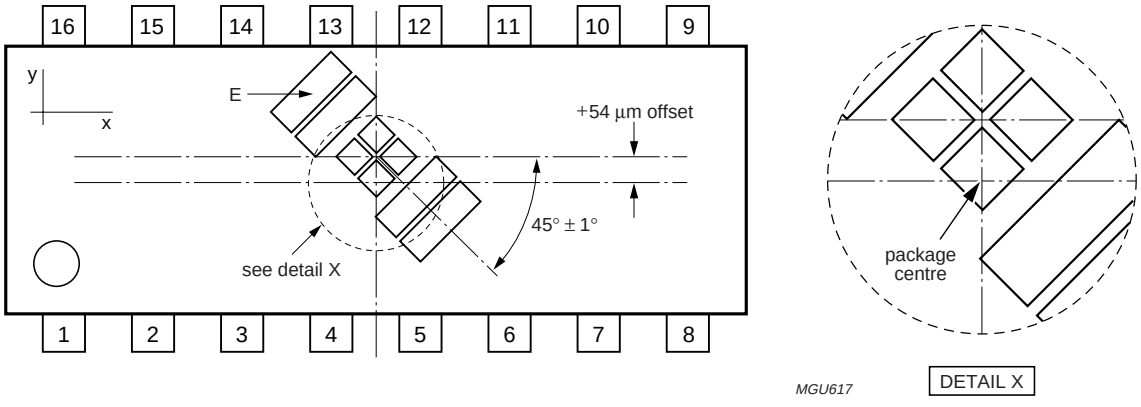
PIN LEVEL			MODE
R/W	H/L	CD/DVD	
LOW	LOW	LOW	writing DVD+R
LOW	LOW	HIGH	writing CD-R
LOW	HIGH	LOW	writing DVD+RW
LOW	HIGH	HIGH	writing CD-RW
HIGH	LOW	LOW	reading DVD-ROM
HIGH	LOW	HIGH	reading CD-ROM
HIGH	HIGH	LOW	reading DVD+RW
HIGH	HIGH	HIGH	reading CD-RW

MECHANICAL DATA



Dimensions in μm.
Space between central segments: <1 μm.
Space between satellite segments: <1 μm.

Fig.3 Photodiode configuration.



45° angle is with respect to the leadframe.
Drawing is not to scale.
Package window is not shown.

Fig.4 Diagram showing position of the photodiode array with respect to the package (top view).

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134).

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{DD1}	supply voltage front-end	–0.3	+5.5	V
V_{DD2}	supply voltage back-end	–0.3	+5.5	V
ΔV_{DD1}	supply voltage difference with respect to V_{DD2}	V_{DD2} – 0.3	V_{DD2} + 0.3	V
ΔV_{DD2}	supply voltage difference with respect to V_{DD1}	V_{DD1} – 0.3	V_{DD1} + 0.3	V
V_n	voltage at pins			
	A, B, C, D, E, F, G, H, RFP and RFN	–0.3	V_{DD2} + 0.3	V
	CD/DVD, H/L and R/W	–0.3	V_{DD1} + 0.3	V

CHARACTERISTICS

$V_{DD1} = V_{DD2} = 5$ V; pin R/W = LOW; pin H/L = LOW; pin CD/DVD = HIGH; V_A to $V_H = 2.5$ V; $V_{RFP} = V_{RFN} = 2.5$ V; measured in dark conditions; $T_{amb} = 25$ °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supplies						
V_{DD1}	supply voltage front-end	note 1	4.5	5.0	5.5	V
V_{DD2}	supply voltage back-end	note 1	4.5	5.0	5.5	V
I_{DD1}	supply current front-end	dark conditions; note 2				
		writing DVD+R	12.8	17.4	21.3	mA
		writing CD-R	30.9	41.2	51.5	mA
		writing DVD+RW	12.9	17.2	21.5	mA
		writing CD-RW	11.4	15.2	19.0	mA
		reading DVD-ROM	31.9	42.5	53.1	mA
		reading CD-ROM	31.3	41.8	52.2	mA
		reading DVD+RW	31.7	42.2	52.8	mA
		reading CD-RW	30.9	41.2	51.5	mA
I_{DD2}	supply current back-end	dark conditions; $T_{amb} = 0$ to 70 °C; note 2	4.5	6.0	7.5	mA
Temperature range						
T_{amb}	ambient temperature		0	–	70	°C
Central segment outputs; pins A, B, C, and D						
B_{-3dB}	channel A, B, C, and D RF bandwidth	$I_o = 1$ mA				
		writing DVD+R	135	170	205	MHz
		writing CD-R	225	280	340	MHz
		writing DVD+RW	240	300	360	MHz
		writing CD-RW	115	145	175	MHz
		reading DVD-ROM	135	170	205	MHz
		reading CD-ROM	100	125	155	MHz
		reading DVD+RW	135	170	205	MHz
		reading CD-RW	80	105	130	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
M_{sens}	channel A, B, C and D matching sensitivity	note 3	0	–	+5	%
V_o	output voltage range		1	–	$V_{DD2} - 1$	V
I_o	output current	excluding writing CD-R	0	3	6.5	mA
$I_{o(offset)}$	output offset current	dark conditions; T_{amb} = 0 to 70 °C	–7	–	+15	µA
$I_{o(clip)}$	output current clipping level	CD-R writing; note 4	5	–	8	mA
$I_{n(o)}$	spot noise output current	I_o = 2.0 mA; f_o = 50 MHz				
		reading DVD-ROM	–	480	–	pA/√Hz
		reading CD-ROM	–	1660	–	pA/√Hz
		reading DVD+RW	–	685	–	pA/√Hz
		reading CD-RW	–	1900	–	pA/√Hz
Differential RF outputs; pins RFP and RFN						
B_{-3dB}	channel RFP and RFN RF bandwidth	I_o = 1 mA				
		writing DVD+R	135	170	205	MHz
		writing CD-R	235	290	350	MHz
		writing DVD+RW	290	360	435	MHz
		writing CD-RW	120	150	180	MHz
		reading DVD-ROM	135	170	210	MHz
		reading CD-ROM	95	120	145	MHz
		reading DVD+RW	140	175	210	MHz
		reading CD-RW	80	105	130	MHz
$\Delta t_{d(p)}$	phase delay variation	I_o = 1 mA; f_i = 13 to 130 MHz				
		reading DVD-ROM	–	0.15	–	ns
		reading CD-ROM	–	1	–	ns
		reading DVD+RW	–	0.25	–	ns
		reading CD-RW	–	1.3	–	ns
$\Delta t_{d(g)}$	group delay variation	I_o = 1.5 mA; f_i = 2.6 to 130 MHz				
		reading DVD-ROM	–	0.4	–	ns
		reading CD-ROM	–	0.8	–	ns
		reading DVD+RW	–	0.6	–	ns
		reading CD-RW	–	1.2	–	ns
V_o	output voltage range		1	–	$V_{DD2} - 1$	V
I_o	output current		0	2	8	mA
$I_{o(offset)}$	output offset current	dark conditions; T_{amb} = 0 to 70 °C				
		pin RFP	13	–	0	µA
		pin RFN	–14	–	0	µA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_{n(o)}$	spot noise differential output current	I_o = 2 mA; f_o = 50 MHz				
		reading DVD-ROM	–	360	–	pA/√Hz
		reading CD-ROM	–	1250	–	pA/√Hz
		reading DVD+RW	–	515	–	pA/√Hz
		reading CD-RW	–	1400	–	pA/√Hz
Satellite segment outputs; pins E, F, G and H						
B_{-3dB}	channel E, F, G and H RF bandwidth	I_o = 1 mA				
		writing DVD+R	65	85	105	MHz
		writing CD-R	70	90	110	MHz
		writing DVD+RW	90	115	140	MHz
		writing CD-RW	60	75	90	MHz
		reading DVD-ROM	85	110	135	MHz
		reading CD-ROM	60	75	90	MHz
		reading DVD+RW	80	100	120	MHz
		reading CD-RW	40	50	60	MHz
M_{sens}	channel E, F, G and H matching sensitivity	note 5	0	–	+5	%
V_o	output voltage range		1	–	V_{DD2} – 1	V
I_o	output current	excluding writing CD-R	0	0.75	6.5	mA
$I_{o(offset)}$	output offset current	dark conditions; T_{amb} = 0 to 70 °C	–25	–	+31	µA
$I_{o(clip)}$	current clipping level	CD-R writing; note 4	5	–	8	mA
Settling time; note 6						
$t_{st(max)}$	settling time	CD-R write mode (central and satellite channels); I_{set} > 300 µA; accuracy set level within ±5%; ratio write to read peak level factor <50	–	< 22	–	ns
		CD-R write mode (differential channels RFP and RFN); I_{set} > 70 µA; accuracy set level within ±5%; ratio write to read peak level factor <50	–	< 22	–	ns
		CD-RW and DVD+RW write modes (all channels); no clip; I_{set} > 70 µA; accuracy set level within ±5%; ratio write to read peak level factor 2; $I_o < I_{o(max)}$	–	< 10	–	ns
		DVD+R write mode (all channels); no clip; I_{set} > 100 µA; accuracy set level within ±5%; ratio write to read peak level factor 20; $I_o < I_{o(max)}$	–	< 15	–	ns

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Common mode ripple, all channels						
CMR	common mode ripple	I_o = 2 mA (peak); f_o up to 65 MHz; note 7	–20	–	–	dB
Control inputs; pins R/W, H/L and CD/DVD						
$Z_{i(pd)}$	pull-down input impedance		–	230	–	kΩ
V_{IL}	LOW-level input voltage		–0.2	–	+1	V
V_{IH}	HIGH-level input voltage		2.1	–	V_{DD1} + 0.2	V
$t_{t(G)}$	gain transition time		–	2	–	µs
Sensitivity; note 8						
s_{DVD+R}	output current sensitivity for DVD+R	writing; λ = 655 nm; note 9				
		$I_{o(cen)}$	–	1.44	–	A/W
		$I_{o(sat)}$	–	4.76	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	0.54	–	A/W
s_{CD-R}	output current sensitivity for CD-R	writing; λ = 785 nm; note 10				
		$I_{o(cen)}$	–	43.2	–	A/W
		$I_{o(sat)}$	–	173	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	1.08	–	A/W
s_{DVD+RW}	output current sensitivity for DVD+RW	writing; λ = 655 nm; note 9				
		$I_{o(cen)}$	–	2.88	–	A/W
		$I_{o(sat)}$	–	11.5	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	1.08	–	A/W
		reading; λ = 655 nm; note 11				
		$I_{o(cen)}$	–	43.2	–	A/W
		$I_{o(sat)}$	–	173	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	16.2	–	A/W
s_{CD-RW}	output current sensitivity for CD-RW	writing; λ = 785 nm; note 9				
		$I_{o(cen)}$	–	5.67	–	A/W
		$I_{o(sat)}$	–	23.0	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	2.16	–	A/W
		reading; λ = 785 nm; note 11				
		$I_{o(cen)}$	–	173	–	A/W
		$I_{o(sat)}$	–	691	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	64.8	–	A/W
$s_{DVD-ROM}$	output current sensitivity for DVD-ROM	reading; λ = 655 nm; note 11				
		$I_{o(cen)}$	–	21.6	–	A/W
		$I_{o(sat)}$	–	86.4	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	8.1	–	A/W

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$S_{CD\text{-}ROM}$	output current sensitivity for CD-ROM	reading; λ = 785 nm; note 11				
		$I_{o(cen)}$	–	86.4	–	A/W
		$I_{o(sat)}$	–	346	–	A/W
		$I_{o(RFP)}$, $I_{o(RFN)}$	–	32.4	–	A/W

Notes

1. The supplies are connected internally by diodes. Differences between the supply voltages should not exceed 0.3 V.
2. Estimated average power consumption (typical value):
   $P = V_{DD} \times (1.4 \times I_{o(av)} \times 9 + I_{DD1} + I_{DD2})$ where $I_{o(av)}$ is the average output current.
   Conditions: $V_{DD} = V_{DD1} = V_{DD2}$ and $I_o < 8$ mA.
3. Outputs A, B, C, and D: I_o = 1 mA output current. Definition of matching: $\frac{I_{o(max)} - I_{o(min)}}{(I_A + I_B + I_C + I_D) \times \frac{1}{4}} - V_{ref} \times I_{(o)av}$ where

   $V_{ref} = V_{ref1} = V_{ref2}$ (see Fig.5) and $I_{(o)av}$ is the average output current.
4. The clipping function is active in the CD-R write mode for the segment outputs (not for outputs RFP and RFN) and in the read mode for all outputs. In the read mode, the clipping level is increased to 8 mA.
5. Outputs E, F, G, and H: I_o = 1.5 mA output current. Definition of matching: $\frac{I_{o(max)} - I_{o(min)}}{(I_E + I_F + I_G + I_H) \times \frac{1}{4}} - V_{ref} \times I_{(o)av}$ where

   $V_{ref} = V_{ref1} = V_{ref2}$ (see Fig.5) and $I_{(o)av}$ is the average output current.

   M_{sens} = ±7% for reading CD-RW, CD-ROM, DVD+RW and writing CD-R mode.
6. The settling time includes the recovery time.
7. Definition: $20 \log \times \frac{I_{RFP} + I_{RFN}}{I_{RFP} - I_{RFN}}$
8. The sensitivity of the TZA1045 is specified in A/W because it has current outputs. In the application diagram (see Fig.5) the resistors of 150 Ω convert the currents into voltages (V/W). The maximum absolute spread is ±10%.
9. Writing without clipping.
10. Writing with clipping in CD-R mode for all segment outputs (not outputs RFP and RFN).
11. Reading with clipping active and switched to a level of typical 8 mA.

APPLICATION INFORMATION

An application example for the TZA1045 is shown in Fig.5. The satellite segment pins are cross-coupled to be suitable for rewritable applications.

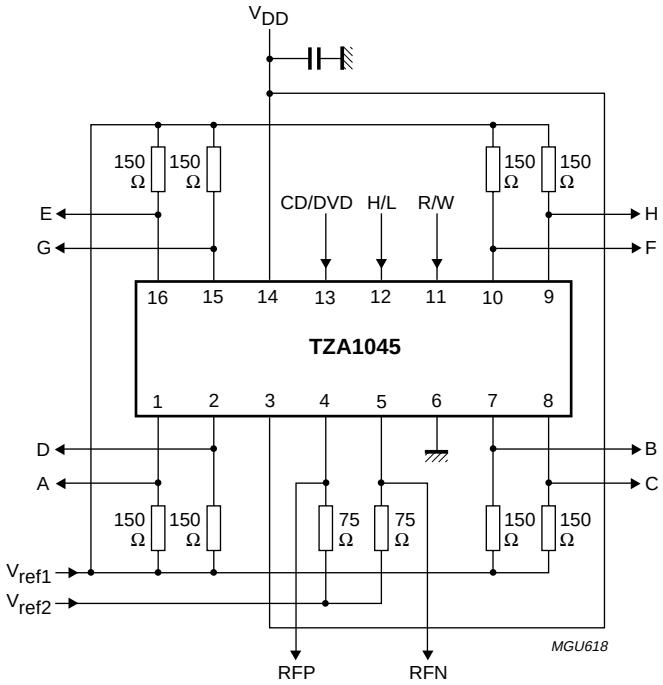
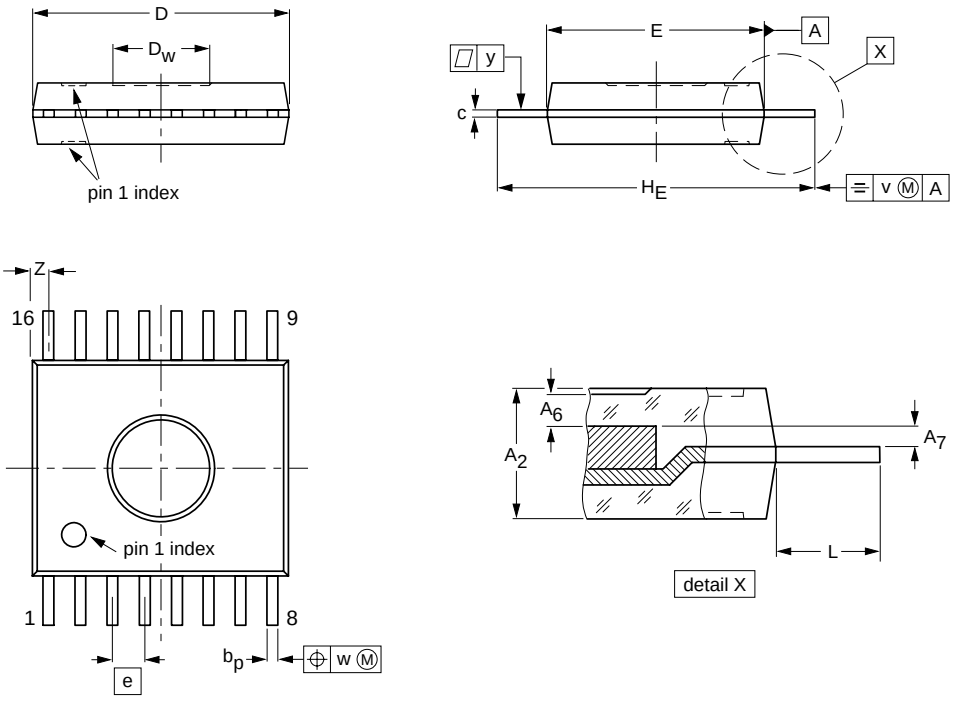


Fig.5 Application example.

PACKAGE OUTLINE

SSOP16T: plastic shrink small outline package/transparent; 16 leads (straight); body width 4.4 mm SOT734-1



DIMENSIONS (mm are the original dimensions)

UNIT	A_2	A_6	A_7	b_p	c	$D^{(1)}$	$D_w^{(2)}$	$E^{(1)}$	e	H_E	L	v	w	y	$Z^{(1)}$
mm	1.3 1.1	0.37 0.17	0.25 0.15	0.32 0.20	0.25 0.13	5.3 5.1	2.1 1.9	4.5 4.3	0.65	6.7 6.5	1.1	0.2	0.13	0.1	0.48 0.18

Notes

1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.
2. Sensor area

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT734-1						01-11-09

SOLDERING

Introduction to soldering surface mount packages

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (document order number 9398 652 90011).

There is no soldering method that is ideal for all surface mount IC packages. Wave soldering can still be used for certain surface mount ICs, but it is not suitable for fine pitch SMDs. In these situations reflow soldering is recommended.

Reflow soldering

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. Driven by legislation and environmental forces the worldwide use of lead-free solder pastes is increasing.

Several methods exist for reflowing; for example, convection or convection/infrared heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 270 °C depending on solder paste material. The top-surface temperature of the packages should preferably be kept:

- below 220 °C (SnPb process) or below 245 °C (Pb-free process)
  - for all BGA and SSOP-T packages
  - for packages with a thickness ≥ 2.5 mm
  - for packages with a thickness < 2.5 mm and a volume ≥ 350 mm^3 so called thick/large packages.
- below 235 °C (SnPb process) or below 260 °C (Pb-free process) for packages with a thickness < 2.5 mm and a volume < 350 mm^3 so called small/thin packages.

Moisture sensitivity precautions, as indicated on packing, must be respected at all times.

Wave soldering

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used the following conditions must be observed for optimal results:

- Use a double-wave soldering method comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
- For packages with leads on two sides and a pitch (e):
  - larger than or equal to 1.27 mm, the footprint longitudinal axis is **preferred** to be parallel to the transport direction of the printed-circuit board;
  - smaller than 1.27 mm, the footprint longitudinal axis **must** be parallel to the transport direction of the printed-circuit board.

  The footprint must incorporate solder thieves at the downstream end.
- For packages with leads on four sides, the footprint must be placed at a 45° angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

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.

Typical dwell time of the leads in the wave ranges from 3 to 4 seconds at 250 °C or 265 °C, depending on solder material applied, SnPb or Pb-free respectively.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

Manual soldering

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron 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.

Suitability of surface mount IC packages for wave and reflow soldering methods

PACKAGE[1]	SOLDERING METHOD	
	WAVE	REFLOW[2]
BGA, LBGA, LFBGA, SQFP, SSOP-T[3], TFBGA, VFBGA	not suitable	suitable
DHVQFN, HBCC, HBGA, HLQFP, HSQFP, HSOP, HTQFP, HTSSOP, HVQFN, HVSON, SMS	not suitable[4]	suitable
PLCC[5], SO, SOJ	suitable	suitable
LQFP, QFP, TQFP	not recommended[5][6]	suitable
SSOP, TSSOP, VSO, VSSOP	not recommended[7]	suitable

Notes

1. For more detailed information on the BGA packages refer to the *"(LF)BGA Application Note*" (AN01026); order a copy from your Philips Semiconductors sales office.
2. All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the *"Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods"*.
3. These transparent plastic packages are extremely sensitive to reflow soldering conditions and must on no account be processed through more than one soldering cycle or subjected to infrared reflow soldering with peak temperature exceeding 217 °C ± 10 °C measured in the atmosphere of the reflow oven. The package body peak temperature must be kept as low as possible.
4. These packages are not suitable for wave soldering. On versions with the heatsink on the bottom side, the solder cannot penetrate between the printed-circuit board and the heatsink. On versions with the heatsink on the top side, the solder might be deposited on the heatsink surface.
5. If wave soldering is considered, then the package must be placed at a 45° angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
6. Wave soldering is suitable for LQFP, TQFP and QFP packages with a pitch (e) larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
7. Wave soldering is suitable for SSOP, TSSOP, VSO and VSSOP packages with a pitch (e) equal to or larger than 0.65 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5 mm.

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