

DATA SHEET

TZA1046

Photodiode and amplifier IC
for CD and DVD applications

Preliminary specification

2004 May 04

**Photodiode and amplifier IC
for CD and DVD applications**

TZA1046

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1 FEATURES

- High frequency RF amplifiers
- Power-down mode for standby condition
- 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 (EG, FH, ETST and HTST) and one high-bandwidth differential RF output (RFP and 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 HTSSON16T with good positional tolerance.

2 APPLICATIONS

- CD and DVD read/write applications.

3 GENERAL DESCRIPTION

The TZA1046 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 TZA1046 and the preamplifier. The gain can be programmed for CD or DVD media with the gain switch CD/DVD.

The H/L switch is a three level switch that can be used to adjust the gain for different dye and phase change media. The third level (high-impedance state) invokes the power-down mode for standby condition.

Gain switch R/W is used to reduce the gain during writing. During CD-R writing with clipping, 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 folded back to reduce power consumption. The output currents can be folded back to almost zero, depending on the light power detected. CD-R writing can also be done without clipping for applications where averaging is used.

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

The HTSSON16T 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 the y direction with respect to the leadframe centre and a tolerance of 50 μm in both x- and y-directions.

In normal operation the satellite outputs F and H are combined as one output FH and the satellite outputs E and G are combined as one output EG. In normal mode the ETST and HTST outputs are not used (high ohmic). When pulling the R/W pin above the supply or is left open the device comes into a testing mode where all four separate satellite channels are directed to the outputs. This mode is used for Optical Pick-up Unit (OPU) alignment of the diodes where all satellite channels must be available.

4 ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TZA1046TM	HTSSON16T	plastic thermal enhanced thin shrink small outline package/transparent; no leads; 16 terminals; body $6.6 \times 5.2 \times 1.1$ mm	SOT814-1

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5 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; 6-channel mode writing DVD+R writing CDR clipping writing DVD+RW or CDR no-clip writing CDRW reading DVD reading CD reading DVD+RW reading CDRW power-down mode	– – – – – – – – – –	13 27 13 12 27 28 27 27 0.4	– – – – – – – – – –	mA mA mA mA mA mA mA mA mA mA
I_{DD2}	supply current back-end	dark conditions; 6-channel mode writing DVD+R writing CDR clipping writing DVD+RW or CDR no-clip writing CDRW reading DVD reading CD reading DVD+RW reading CDRW power-down mode	– – – – – – – – – –	5.3 5.3 5.3 5.3 5.3 5.3 5.3 5.3 6.6 0.1	– – – – – – – – – –	mA mA mA mA mA mA mA mA mA mA
Temperature range						
T_{amb}	ambient temperature		0	–	70	°C
RF bandwidth						
$B_{-3dB(cen)}$	bandwidth of central channels A, B, C and D	$I_o = 1.0$ mA; 6-channel mode reading DVD reading CD reading DVD+RW reading CDRW	130 100 130 80	165 142 162 124	– – – –	MHz MHz MHz MHz
$B_{-3dB(RF)}$	bandwidth of differential channels RFP and RFN	$I_o = 1.0$ mA reading DVD reading CD reading DVD+RW reading CDRW	130 100 130 80	175 130 166 114	– – – –	MHz MHz MHz MHz

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Settling time						
t _{st}	settling time	CD-R write mode (all channels); I _{set} > 300 μA; accuracy set level within ±5 %; write peak level to set level factor < 50	–	–	22	ns
		CD-RW and DVD+RW write modes (all channels); I _{set} > 100 μA; accuracy set level within ±5 %; write peak level to set level factor 2; peak current ≤ I _{o(max)}	–	–	10	ns
		DVD+R write mode (all channels); I _{set} > 100 μA; accuracy set level within ±5 %; write peak level to set level factor 20; peak current ≤ I _{o(max)}	–	–	12	ns
Phase delay and group delay variation						
Δt _{d(p)(RF)}	phase delay variation differential channels RFP and RFN	I _o = 1.0 mA; f _i = 2 to 104 MHz				
		reading DVD	–	0.2	–	ns
		reading CD	–	0.3	–	ns
		reading DVD+RW	–	0.25	–	ns
Δt _{d(g)(RF)}	group delay variation differential channels RFP and RFN	reading CDRW	–	0.5	–	ns
		I _o = 1.0 mA; f _i = 2 to 104 MHz				
		reading DVD	–	0.4	–	ns
		reading CD	–	0.6	–	ns
		reading DVD+RW	–	0.4	–	ns
		reading CDRW	–	1	–	ns
Sensitivity						
s	output current sensitivity	values depend on operating mode; see Table 1	–	–	–	A/W

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Table 1 Output current sensitivity; typical values

MODE	OUTPUT CURRENT SENSITIVITY (A/W) ⁽¹⁾		
	CENTRAL	SATELLITE	DIFFERENTIAL (RFP AND RFN)
Writing DVD+R with averaging	0.72	1.44	0.27
Reading high reflective DVD media: single layer DVD and DVD+R	21.6	43.2	8.10
Writing DVD+RW with averaging	2.88	5.76	1.08
Reading low reflective DVD media: dual layer DVD and DVD+RW	43.2	86.4	16.2
Writing CDR with sampling	43.2	86.4	1.08
Reading high reflective CD media	86.4	173	32.4
Writing CDR with averaging	1.44	2.88	0.54
Writing CDRW with averaging	5.76	11.5	2.16
Reading low reflective CD media: CDRW	173	346	64.8

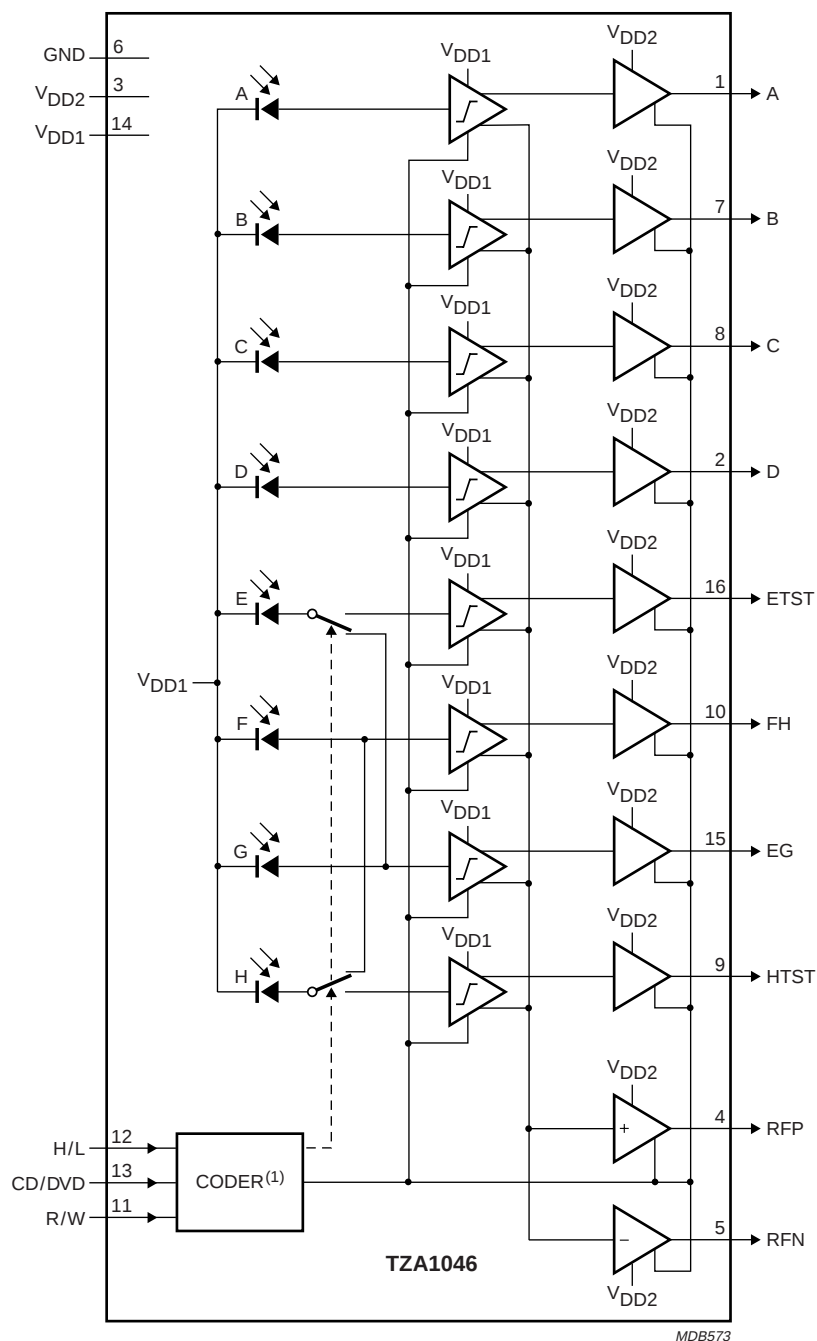
Note

1. The sensitivity of the TZA1046 is specified in A/W because it has current outputs. In the application diagram (see Fig.6) the resistors of 150 Ω convert the currents into voltages. The maximum absolute spread is ± 20 %.

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6 BLOCK DIAGRAM



(1) The coder translates the three digital inputs into the appropriate gain level of each amplifier. The limiter is switched to a high level for other modes than the CD-R writing mode for all segment outputs.

Fig.1 Block diagram.

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7 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
HTST	9	satellite segment output H in test mode; note 1
FH	10	sum of satellite segment F and segment H output, segment F output in test mode; note 1
R/W	11	gain select switch for reading or writing and to select the test mode
H/L	12	gain select switch for low reflective (H/L = 1) and high reflective (H/L = 0) media
CD/DVD	13	gain select switch for CD or DVD
V _{DD1}	14	supply voltage front-end
EG	15	Sum of satellite segment E and segment G output, satellite output G in test mode; note 1
ETST	16	segment E output in test mode; note 1

Note

1. In test mode all separate satellite signals are available. In normal mode HTST and ETST are high ohmic, FH is the sum of F and H and EG is the sum of E and G.

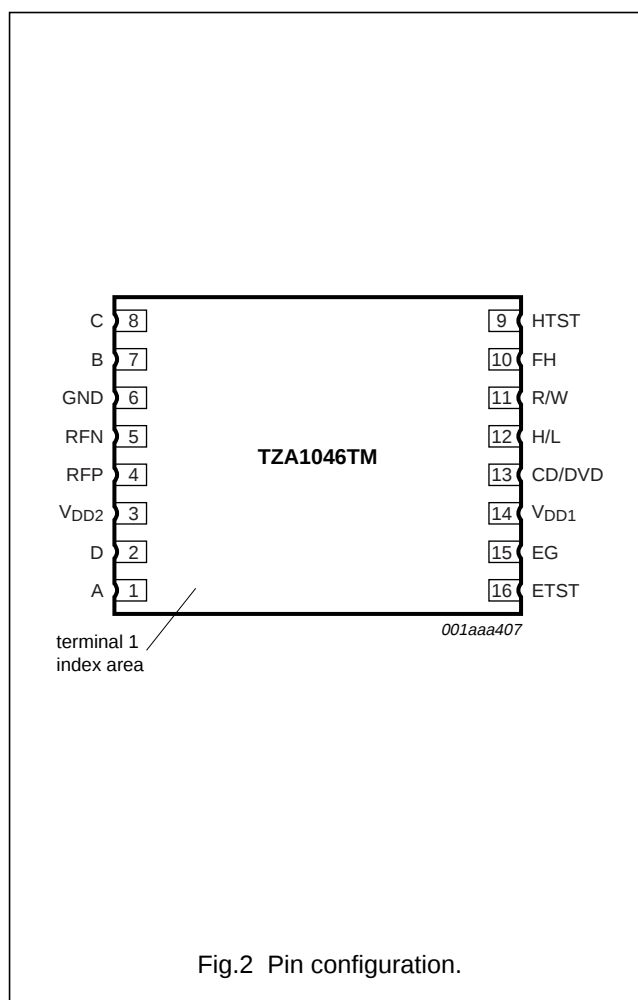


Fig.2 Pin configuration.

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8 MODE SELECTION

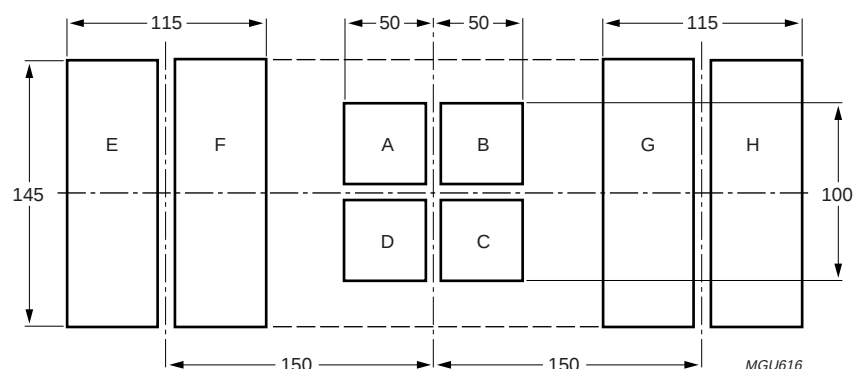
Table 2 Coder switching

PIN LEVEL			MODE
R/W	H/L	CD/DVD	
6-channel mode			
don't care	open	LOW	Power-down
LOW	LOW	LOW	writing DVD+R no-clip or averaging mode
LOW	LOW	HIGH	writing CDR write-clip or sample mode
LOW	open	HIGH	writing CDR no-clip or averaging mode
LOW	HIGH	LOW	writing DVD+RW no-clip mode; either sampling or averaging mode
LOW	HIGH	HIGH	writing CDRW no-clip mode, either sampling or averaging mode
HIGH	LOW	LOW	reading DVD+R; DVD-SL
HIGH	LOW; open	HIGH	reading CD and CDR
HIGH	HIGH	LOW	reading DVD+RW; DVD-DL
HIGH	HIGH	HIGH	reading CDRW
8-channel test mode; note 1			
test mode	LOW	LOW	reading DVD+R and DVD-SL
	LOW; open	HIGH	reading CD and CDR
	HIGH	LOW	reading DVD+RW and DVD-DL
	HIGH	HIGH	reading CDRW

Note

1. The 8-channel test mode is activated when $V_{I(\text{test-on})}$ or $I_{I(\text{test-on})}$ is applied to pin R/W or if pin R/W is left open. The values of $V_{I(\text{test-on})}$ or $I_{I(\text{test-on})}$ can be found in Chapter 11.

9 MECHANICAL DATA


 Dimensions in μm .

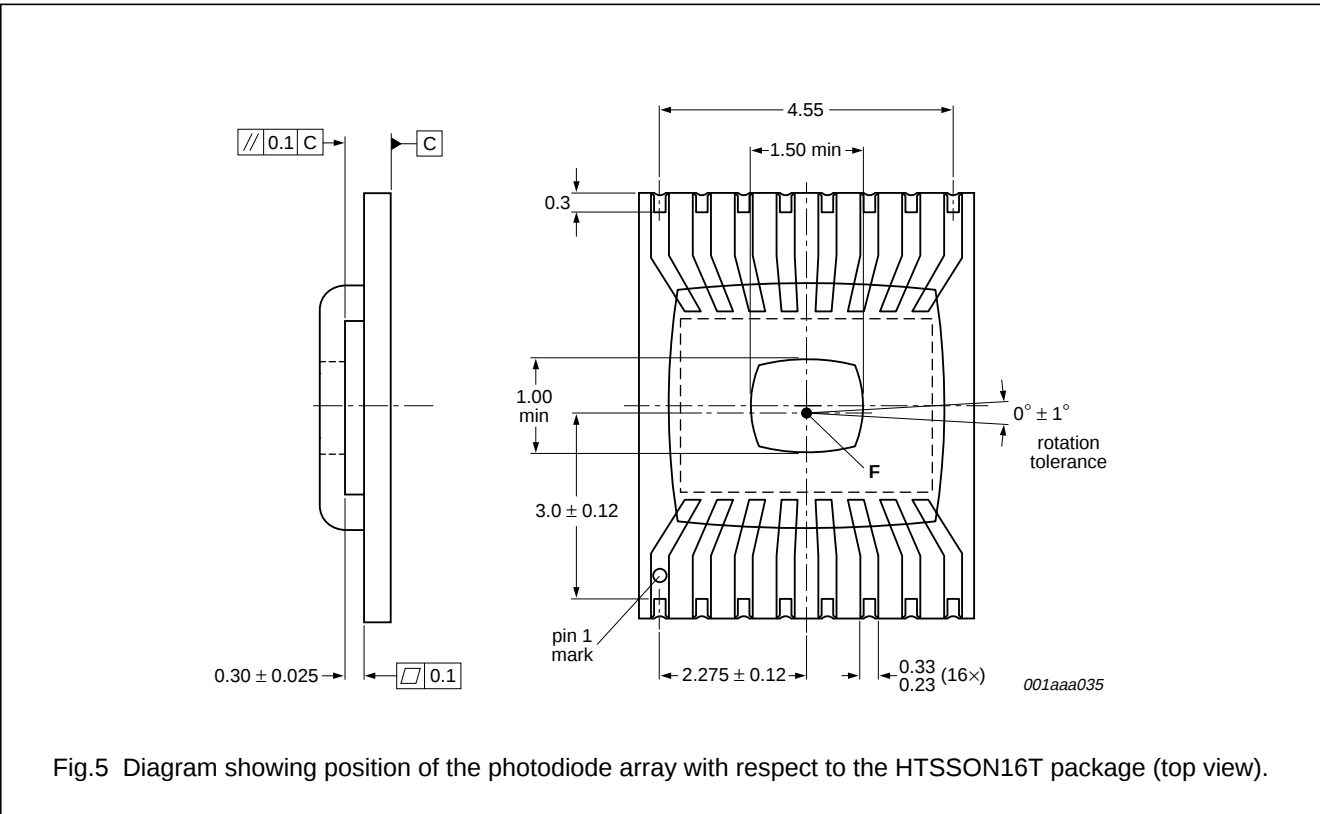
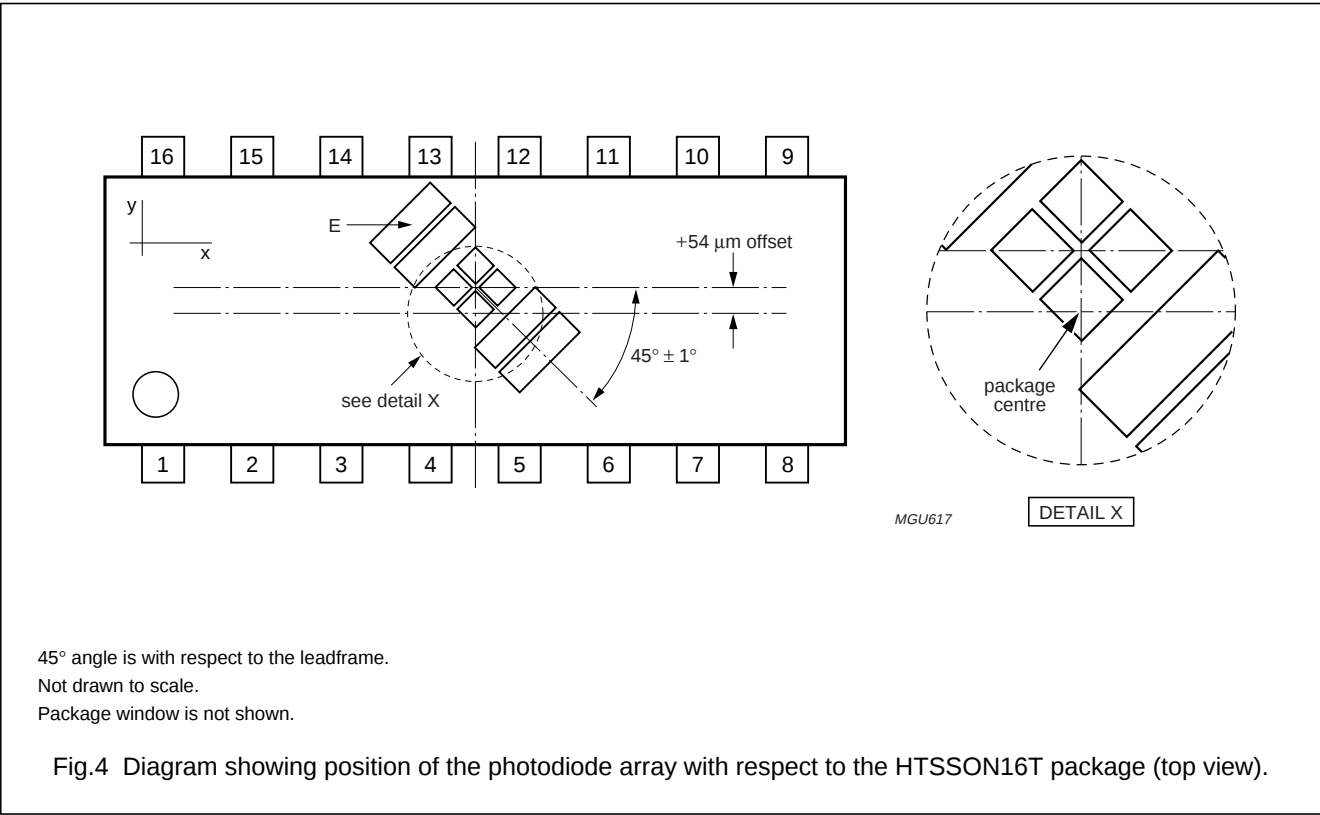
 Space between central segments: $< 1 \mu\text{m}$.

 Space between satellite segments: $< 1 \mu\text{m}$.

Fig.3 Photodiode configuration.

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10 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, ETST, FH, EG, HTST, RFP and RFN	-0.3	$V_{DD2} + 0.3$	V
	CD/DVD and H/L	-0.3	$V_{DD1} + 0.3$	V
	R/W	-0.3	$V_{DD1} + 2.5$	V

11 CHARACTERISTICS

$V_{DD1} = V_{DD2} = 2.0$ V; pin R/W = LOW; pin H/L = LOW; pin CD/DVD = HIGH; $V_A = V_B = V_C = V_D = 2.0$ V;
 $V_{EG} = V_{FH} = V_{ETST} = V_{HTST} = 2.0$ V; $V_{RFP} = V_{RFN} = 2.0$ V; measured in dark conditions; $T_{amb} = 25$ °C; 6-channel mode;
 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; 6-channel mode; note 2				
		writing DVD+R	–	13	–	mA
		writing CDR clipping	–	27	–	mA
		writing DVD+RW or CDR no-clip	–	13	–	mA
		writing CDRW	–	12	–	mA
		reading DVD	–	27	–	mA
		reading CD	–	28	–	mA
		reading DVD+RW	–	27	–	mA
		reading CDRW	–	27	–	mA
		power-down mode	–	0.4	–	mA

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I _{DD2}	supply current back-end	dark conditions; 6-channel mode; note 2				
		writing DVD+R	–	5.3	–	mA
		writing CDR clipping	–	5.3	–	mA
		writing DVD+RW or CDR no-clip	–	5.3	–	mA
		writing CDRW	–	5.3	–	mA
		reading DVD	–	5.3	–	mA
		reading CD	–	5.3	–	mA
		reading DVD+RW	–	5.3	–	mA
		reading CDRW	–	6.6	–	mA
		power-down mode	–	0.1	–	mA
Temperature range						
T _{amb}	ambient temperature		0	–	70	°C
Central segment output channels: pins A, B, C and D						
B _{–3dB}	bandwidth	I _o = 1.0 mA				
		writing DVD+R	–	172	–	MHz
		writing CDR clipping	–	206	–	MHz
		writing DVD+RW or CDR no-clip	–	211	–	MHz
		writing CDRW	–	125	–	MHz
		reading DVD	130	165	–	MHz
		reading CD	100	142	–	MHz
		reading DVD+RW	130	162	–	MHz
		reading CDRW	80	124	–	MHz
Δt _{d(p)}	phase delay variation	I _o = 1mA; f _i = 2 to 104 MHz				
		reading DVD	–	0.25	–	ns
		reading CD	–	0.15	–	ns
		reading DVD+RW	–	0.2	–	ns
		reading CDRW	–	0.3	–	ns
M _{sens}	channel matching sensitivity	note 3	0	–	5	%
V _o	output voltage range		1	–	V _{DD2} – 1	V
I _o	output current		0	–	8	mA
I _{o(offset)}	output offset current	dark conditions; T _{amb} = 0 to 70 °C				
		reading CDRW	–14	–1.5	+11	μA
		other modes	–14	–0.9	+12	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 = 1.0 mA; f _o = 50 MHz; note 5				
		reading CD	–	1.2	–	nA/√Hz
		reading DVD+RW	–	0.4	–	nA/√Hz
		reading CDRW	–	2.0	–	nA/√Hz

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Differential RF outputs channel: pins RFP and RFN						
B _{-3dB}	bandwidth	I _o = 1.0 mA				
		writing DVD+R	–	120	–	MHz
		writing CDR clipping	–	205	–	MHz
		writing DVD+RW or CDR no-clip	–	375	–	MHz
		writing CDRW	–	118	–	MHz
		reading DVD	130	175	–	MHz
		reading CD	100	130	–	MHz
		reading DVD+RW	130	166	–	MHz
		reading CDRW	80	114	–	MHz
$\Delta t_{d(p)}$	phase delay variation	I _o = 1.0 mA; f _i = 2 to 104 MHz				
		reading DVD	–	0.2	–	ns
		reading CD	–	0.3	–	ns
		reading DVD+RW	–	0.25	–	ns
$\Delta t_{d(g)}$	group delay variation	I _o = 1.0 mA; f _i = 2 to 104 MHz				
		reading DVD	–	0.4	–	ns
		reading CD	–	0.6	–	ns
		reading DVD+RW	–	0.4	–	ns
		reading CDRW	–	1	–	ns
CMR	common mode ripple	I _o = 2 mA (peak); f _o up to 104 MHz; note 6	–20	–	–	dB
V _o	output voltage range		1	–	V _{DD2} – 1	V
I _o	output current		0	–	8	mA
I _{o(offset)}	output offset current	dark conditions; T _{amb} = 0 to 70 °C				
		pin RFP	7	22	40	μA
		pin RFN	–7	–20	–35	μA
		pin RFP; reading CDRW	14	43	79	μA
I _{n(o)}	spot noise output current	pin RFN; reading CDRW	–13	–39	–70	μA
		I _o = 1.0 mA; f _o = 50 MHz; note 5				
		reading CD	–	0.9	–	nA/√Hz
		reading DVD+RW	–	0.3	–	nA/√Hz
		reading CDRW	–	1.5	–	nA/√Hz

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Satellite segment output channels: pins ETST, FH, EG and HTST; note 7						
B _{-3dB}	bandwidth	I _o = 1.0 mA; 6-channel mode				
		writing DVD+R	–	93	–	MHz
		writing CDR clipping	–	81	–	MHz
		writing DVD+RW or CDR no-clip	–	107	–	MHz
		writing CDRW	–	66	–	MHz
		reading DVD	10	75	–	MHz
		reading CD	10	61	–	MHz
		reading DVD+RW	10	66	–	MHz
reading CDRW	10	56	–	MHz		
M _{sens}	channel matching sensitivity	note 8	0	–	5	%
V _o	output voltage range		1	–	V _{DD2} – 1	V
I _o	output current		0	–	8	mA
I _{o(offset)}	output offset current	dark conditions; T _{amb} = 0 to 70 °C				
		reading CDRW	–25	–4	17	µA
		other modes	–23	–5.4	12	µA
I _{o(clip)}	current clipping level	CD-R writing; note 4	5	–	8	mA
I _{n(o)}	spot noise output current	I _o = 1.0 mA; f _o = 25 MHz; note 5				
		reading CD	–	2.2	–	nA/√Hz
		reading DVD+RW	–	0.8	–	nA/√Hz
		reading CDRW	–	4.3	–	nA/√Hz
Settling time, all channels; note 9						
t _{st}	settling time	CD-R write mode; I _{set} > 300 µA; accuracy set level within ±5 %; write peak level to set level factor < 50	–	–	22	ns
		CD-RW and DVD+RW write modes; I _{set} > 100 µA; accuracy set level within ±5 %; write peak level to set level factor 2; peak current ≤ I _{o(max)}	–	–	10	ns
		DVD+R write mode; I _{set} > 100 µA; accuracy set level within ±5 %; write peak level to set level factor 20; peak current ≤ I _{o(max)}	–	–	12	ns
Control inputs: pins R/W, H/L and CD/DVD						
V _{IL}	LOW-level input voltage	note 10	0	–	0.6	V
V _{IH}	HIGH-level input voltage	note 10	2.5	–	V _{DD1}	V
Z _{I(pd)}	pull-down input impedance	only pin CD/DVD	–	200	–	kΩ

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Test mode: pin R/W						
$V_{I(\text{test-on})}$	input voltage to activate the test mode	note 11	$V_{DD1} + 2$	—	8	V
$I_{I(\text{test-on})}$	force current into pin to activate the test mode		800	—	1200	μA
Sensitivity						
s	output current sensitivity	values depend on operating mode; see Table 3	—	—	—	A/W

Notes

- The supplies are connected internally by diodes. Differences between the supply voltages should not exceed 0.3 V.
- Estimated average power consumption (6 channel mode):

$$P = I_{DD1} \times V_{DD1} + I_{DD2} \times V_{DD2} + \frac{11}{3} \times I_{O(RF)} \times V_{DD2} \times K_2 - \frac{8}{3} \times I_{O(RF)} \times V_{ref} + (I_{O(EG)} + I_{O(FH)}) \times (V_{DD2} \times K_1 - V_{ref}) - 2 \times I_{O(RF)}^2 \times R_{L2} - \frac{16}{9} \times I_{O(RF)}^2 \times R_{L1} - I_{O(EG)}^2 \times R_{L1} - I_{O(FH)}^2 \times R_{L1}, \text{ where:}$$

R_{L2} is the load resistance on each of the differential RF outputs RFP and RFN and R_{L1} is the load resistance on all other outputs.

$K_1 = 1.35$ and $K_2 = 1.6$ for CD-RW reading; $K_1 = 1.50$ and $K_2 = 1.40$ for other modes.

$V_{ref} = V_{ref1} = V_{ref2}$; see Fig.6.

- Outputs A, B, C, and D: $I_o = 3$ mA output current. Definition of matching:
$$\frac{I_{o(\max)} - I_{o(\min)}}{(I_A + I_B + I_C + I_D) \times \frac{1}{4}}$$
- 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 above $I_{o(\max)}$.
- The S/N ratio improves significantly when the sensitivity is lowered.
- Definition:
$$20 \log \frac{I_{RFP} + I_{RFN}}{I_{RFP} - I_{RFN}}$$
- In test mode all channels are active, in normal mode channels EG and FH are active and channels ETST and HTST are off.
- Outputs ETST, FH, EG, and HTST: $I_o = 1.5$ mA output current; $M_{sens} = \pm 7\%$ for reading CD-RW, CD-ROM, DVD+RW and writing CD-R.
Definition of matching in normal mode:
$$\frac{I_{o(\max)} - I_{o(\min)}}{(I_{FH} + I_{EG}) \times \frac{1}{2}}$$

Definition of matching in test mode:
$$\frac{I_{o(\max)} - I_{o(\min)}}{(I_{ETST} + I_{FH} + I_{EG} + I_{HTST}) \times \frac{1}{4}}$$
- The settling time includes the recovery time.
- Pins R/W and H/L are three-level switches. When these pins are left open-circuit two internal resistors (150 k Ω to GND and 350 k Ω to V_{DD}) will keep them between 1.3 and 1.7 V.
- The test mode is also activated when the R/W pin is left open-circuit.

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Table 3 Output current sensitivity; typical values

MODE	OUTPUT CURRENT SENSITIVITY (A/W) ⁽¹⁾		
	CENTRAL	SATELLITE	DIFFERENTIAL (RFP AND RFN)
Writing DVD+R with averaging	0.72	1.44	0.27
Reading high reflective DVD media: single layer DVD and DVD+R	21.6	43.2	8.10
Writing DVD+RW with averaging	2.88	5.76	1.08
Reading low reflective DVD media; dual layer DVD and DVD+RW	43.2	86.4	16.2
Writing CDR with sampling	43.2	86.4	1.08
Reading high reflective CD media	86.4	173	32.4
Writing CDR with averaging	1.44	2.88	0.54
Writing CDRW with averaging	5.76	11.5	2.16
Reading low reflective CD media: CDRW	173	346	64.8

Note

1. The sensitivity of the TZA1046 is specified in A/W because it has current outputs. In the application diagram (see Fig.6) the resistors of 150 Ω convert the currents into voltages. The maximum absolute spread is $\pm 20\%$.

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12 APPLICATION AND TEST INFORMATION

12.1 Application example

An application example for the TZA1046 is shown in Fig.6. The satellite segment pins are cross-coupled to be suitable for rewritable applications.

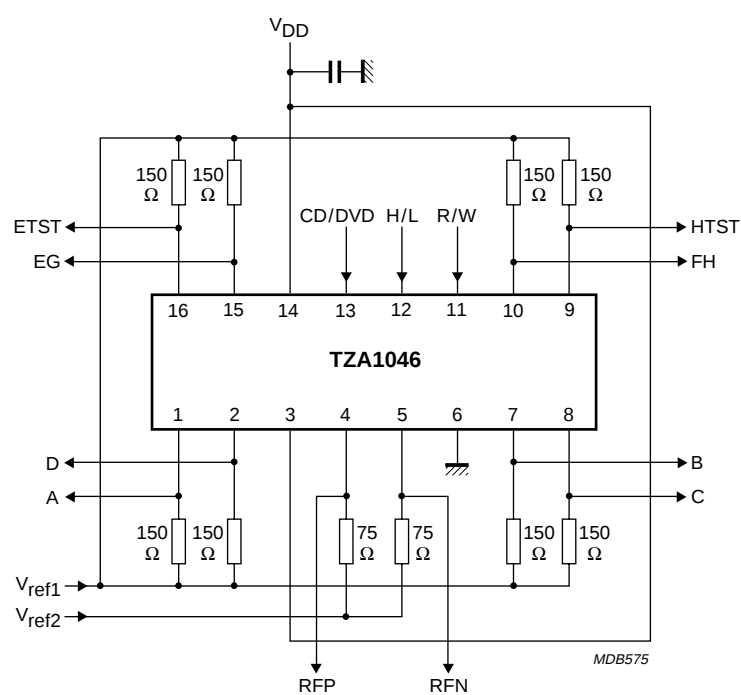


Fig.6 Application example.

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12.2 Test mode description

Alignment of the diodes during OPU manufacturing requires the availability of all satellite outputs. In normal mode the F and H channels are combined to a single output FH and the E and G channels are combined to a single output EG. This is done to switch off two channels in the normal mode (application usage) which saves power consumption. For alignment of the diodes each individual satellite output must be available and therefore the TZA1046 can be put in a test mode where all satellite channels are available. The test mode is activated by pulling the R/W digital input pin above the supply (2 to 2.5 V higher than V_{DD1}), by forcing an input current into this pin (800 to 1200 μA) or by leaving the pin open-circuit. Fig.7 shows the R/W input configuration.

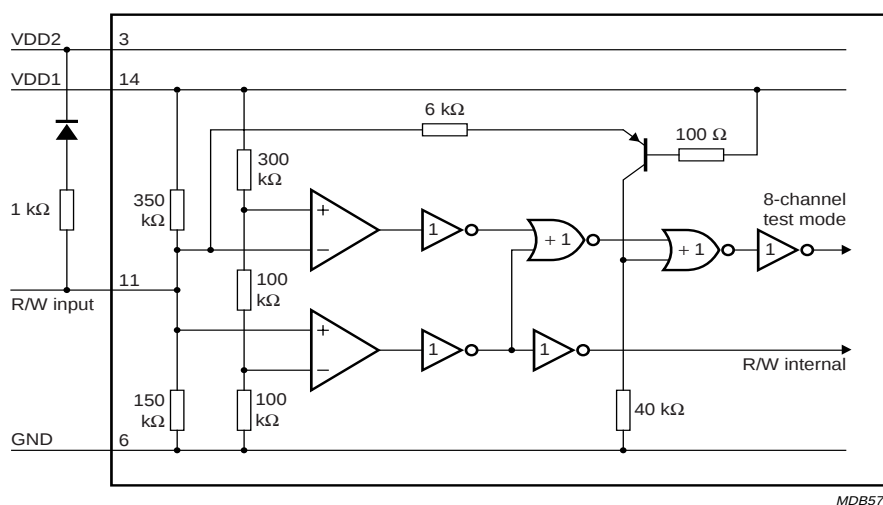


Fig.7 R/W input configuration.

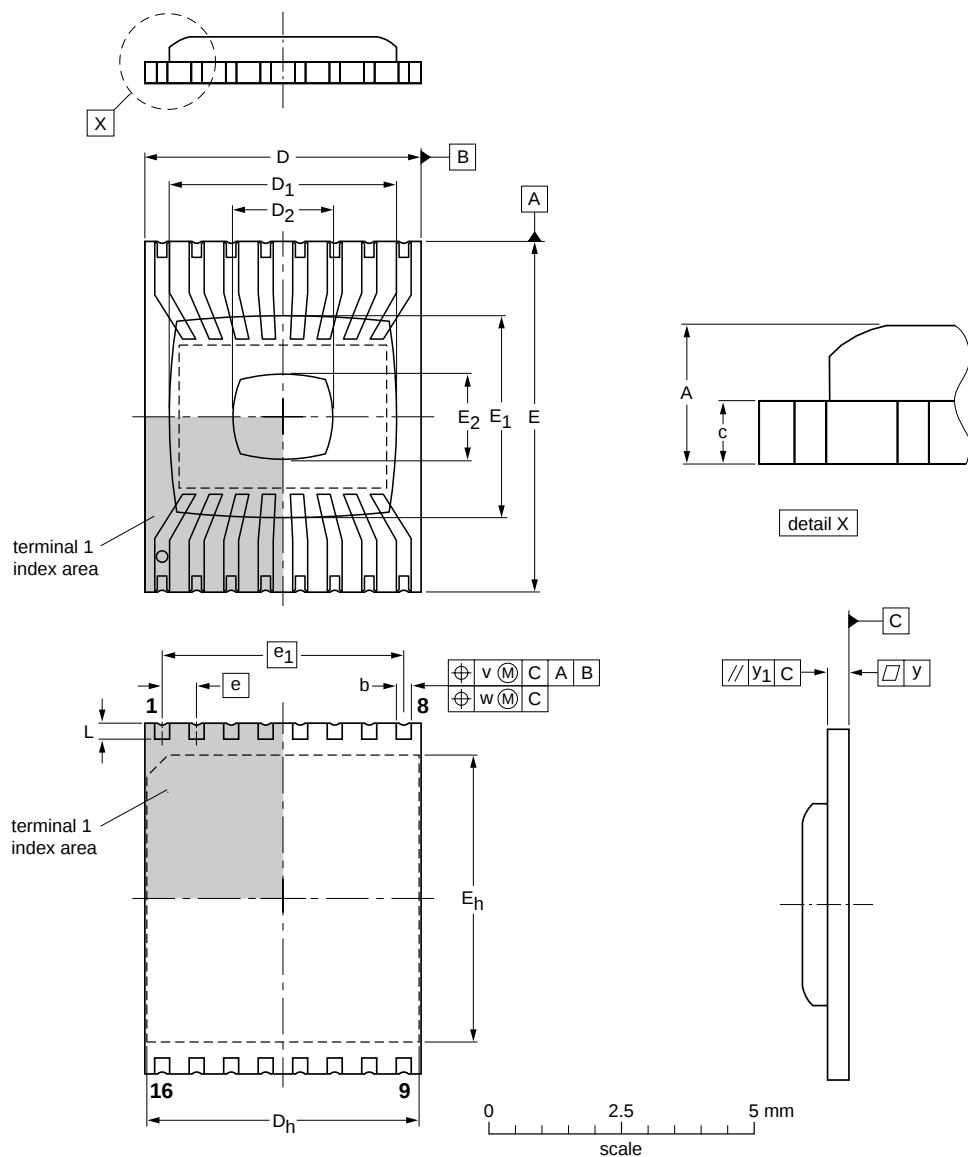
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13 PACKAGE OUTLINE

HTSSON16T: plastic thermal enhanced thin shrink small outline package/transparent; no leads;
16 terminals; body 6.6 x 5.2 x 1.1 mm

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DIMENSIONS (mm are the original dimensions)

UNIT	A max.	b	c	D	D ₁	D ₂ min.	D _h	E	E ₁	E ₂ min.	E _h	e	e ₁	L	v	w	y	y ₁
mm	1.1	0.33 0.23	0.5 0.3	5.3 5.1	4.5 4.0	1.50	5.15 4.95	6.7 6.5	4.2 3.7	1.00	5.4 5.2	0.65	4.55	0.3	0.1	0.05	0.05	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT814-1	---	---	---			03-10-10 03-11-19

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14 SOLDERING

14.1 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.

14.2 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 225 °C (SnPb process) or below 245 °C (Pb-free process)
 - for all BGA, HTSSON-T and SSOP-T packages
 - for packages with a thickness ≥ 2.5 mm
 - for packages with a thickness < 2.5 mm and a volume ≥ 350 mm³ so called thick/large packages.
- below 240 °C (SnPb process) or below 260 °C (Pb-free process) for packages with a thickness < 2.5 mm and a volume < 350 mm³ so called small/thin packages.

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

14.3 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.

14.4 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.

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

PACKAGE ⁽¹⁾	SOLDERING METHOD	
	WAVE	REFLOW ⁽²⁾
BGA, HTSSON..T ⁽³⁾ , LBGA, LFBGA, SQFP, SSOP..T ⁽³⁾ , TFBGA, USON, VFBGA	not suitable	suitable
DHVQFN, HBCC, HBGA, HLQFP, HSO, HSOP, HSQFP, HSSON, 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
CWQCCN..L ⁽⁸⁾ , PMFP ⁽⁹⁾ , WQCCN..L ⁽⁸⁾	not suitable	not suitable

Notes

- 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.
- 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”.
- 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 $217\text{ °C} \pm 10\text{ °C}$ measured in the atmosphere of the reflow oven. The package body peak temperature must be kept as low as possible.
- 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.
- 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.
- 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.
- 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.
- Image sensor packages in principle should not be soldered. They are mounted in sockets or delivered pre-mounted on flex foil. However, the image sensor package can be mounted by the client on a flex foil by using a hot bar soldering process. The appropriate soldering profile can be provided on request.
- Hot bar or manual soldering is suitable for PMFP packages.

15 ADDITIONAL SOLDERING INFORMATION

- Reflow peak temperature for TZA1046TM should be no higher than $215\text{ °C} \pm 5\text{ °C}$.
- Manual soldering for TZA1046TM is not encouraged. In case of touch-up desolder the defective device manually and use reflow soldering for the assembly of the replacing device.

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16 DATA SHEET STATUS

LEVEL	DATA SHEET STATUS ⁽¹⁾	PRODUCT STATUS ⁽²⁾⁽³⁾	DEFINITION
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
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Notes

1. Please consult the most recently issued data sheet before initiating or completing a design.
2. The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.
3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

17 DEFINITIONS

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). 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.

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