

# DATA SHEET

## **TZA3023** SDH/SONET STM4/OC12 transimpedance amplifier

Objective specification  
File under Integrated Circuits, IC19

1997 Oct 17

# SDH/SONET STM4/OC12 transimpedance amplifier

TZA3023

**FEATURES**

- Low equivalent input noise, typically 3.5 pA/ $\sqrt{\text{Hz}}$
- Wide dynamic range, typically 1  $\mu\text{A}$  to 1.5 mA
- Differential transimpedance of 21 k $\Omega$
- Wide bandwidth: 600 MHz
- Differential outputs
- On-chip AGC (Automatic Gain Control)
- No external components required
- Single supply voltage from 3.0 to 5.5 V
- Bias voltage for PIN diode.

**APPLICATIONS**

- Digital fibre optic receiver in short, medium and long haul optical telecommunications transmission systems or in high speed data networks
- Wideband RF gain block.

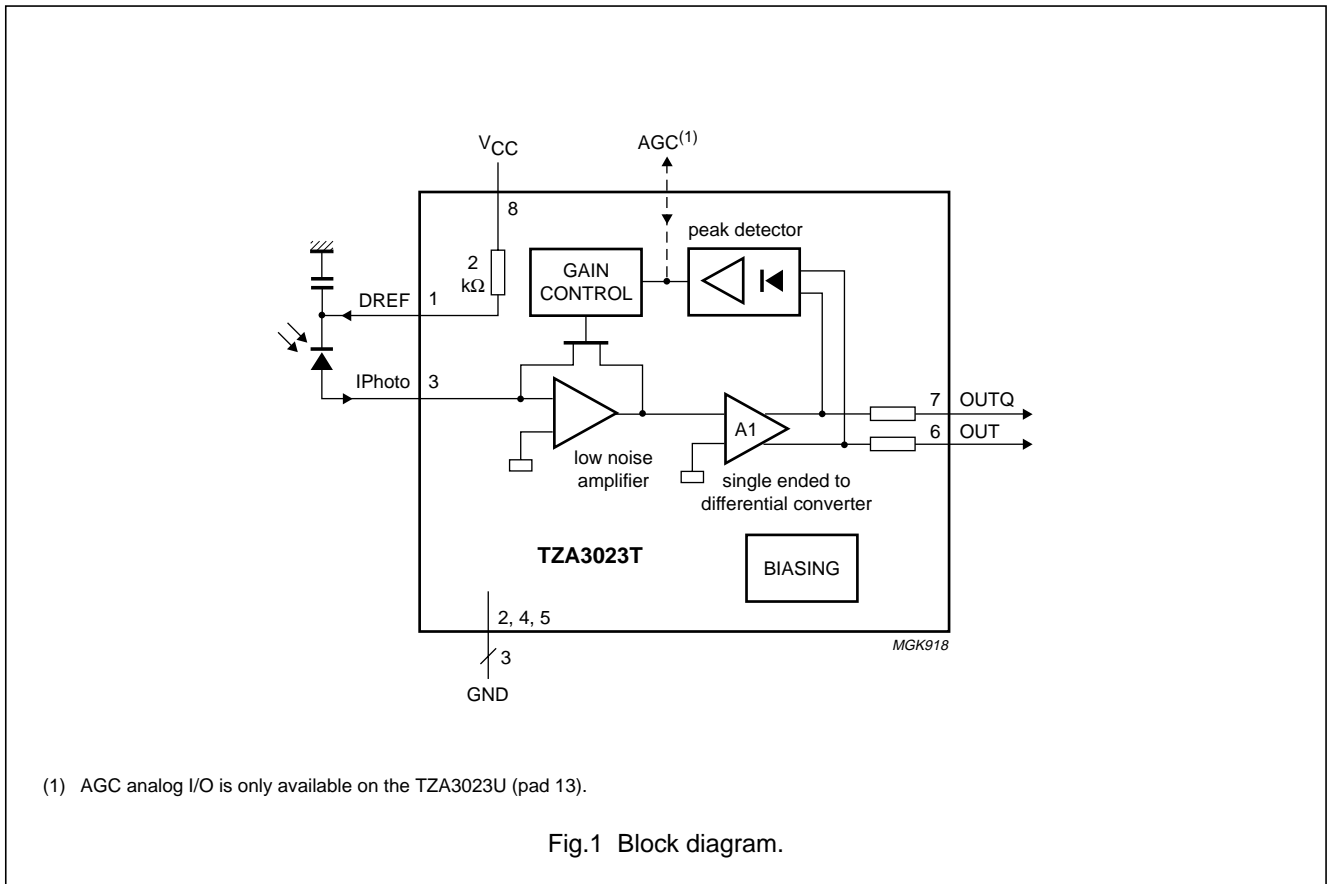
**DESCRIPTION**

The TZA3023 is a low-noise transimpedance amplifier with AGC designed to be used in STM4/OC12 fibre optic links. It amplifies the current generated by a photo detector (PIN diode or avalanche photodiode) and converts it to a differential output voltage.

**ORDERING INFORMATION**

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TZA3023T	SO8	plastic small outline package; 8 leads; body width 3.9 mm	SOT96-1
TZA3023U	naked die	die in waffle pack carriers; die dimensions 0.960 $\times$ 1.210 mm	–

**BLOCK DIAGRAM**

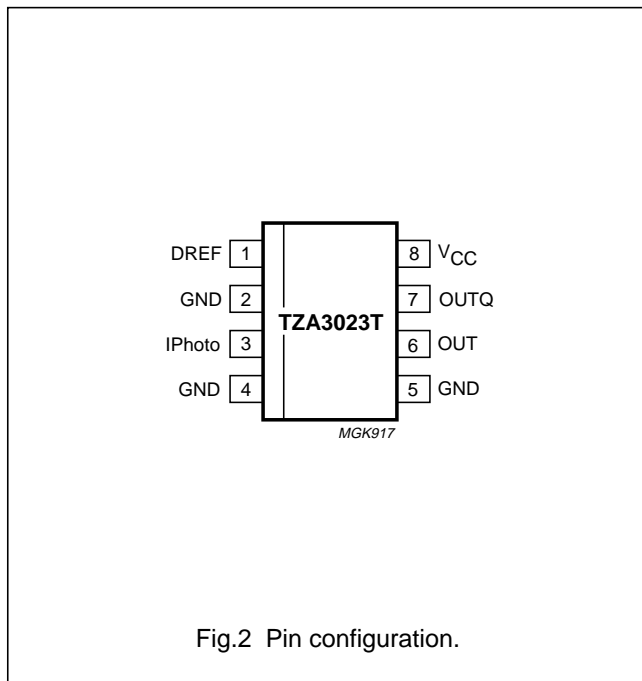


**SDH/SONET STM4/OC12**  
transimpedance amplifier

**TZA3023**

**PINNING**

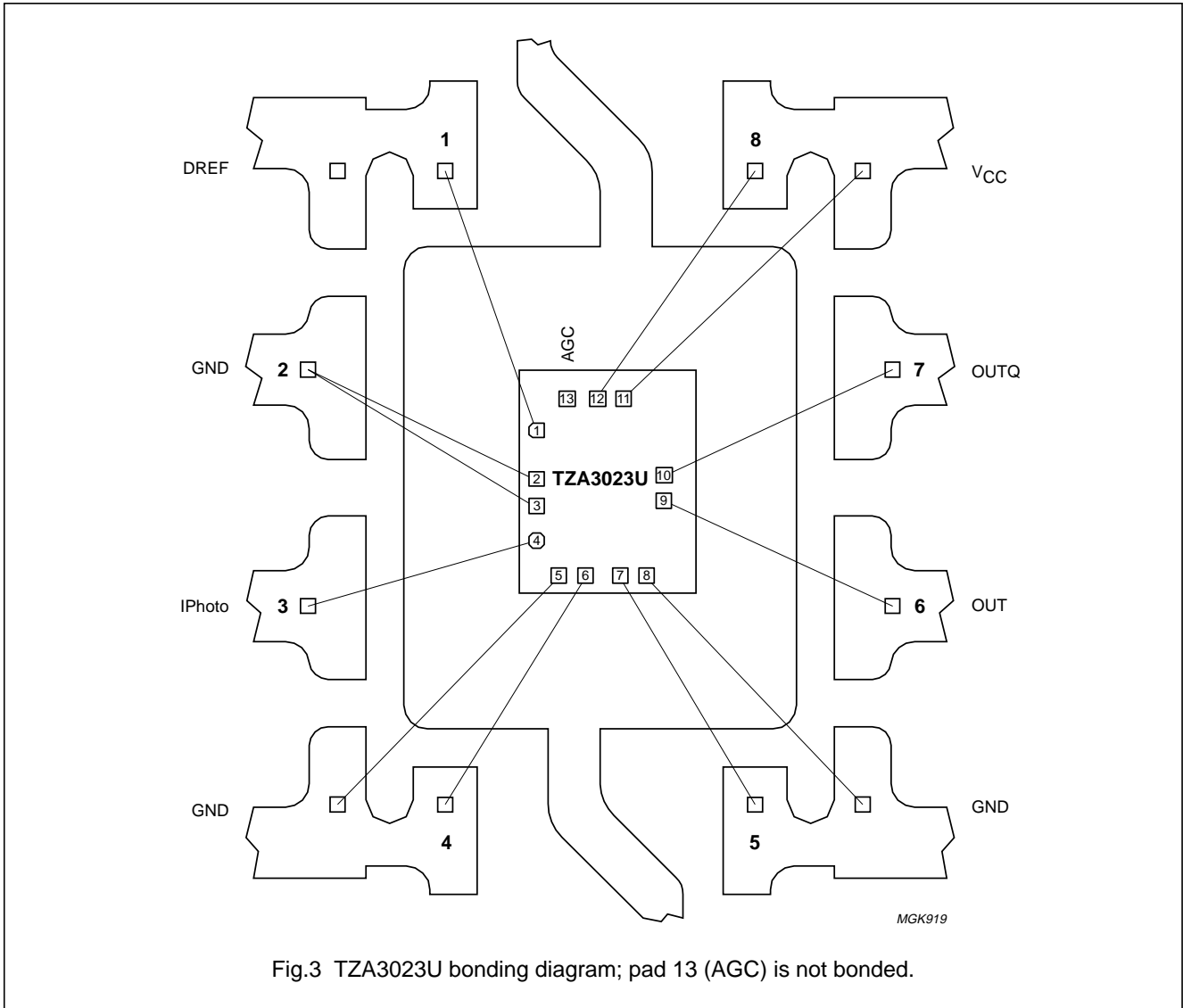
SYMBOL	PIN	TYPE	DESCRIPTION
DREF	1	analog output	bias voltage for PIN diode ( $V_{CCA}$ ); cathode should be connected to this pin
GND	2	ground	ground
IPhoto	3	analog input	current input; anode of PIN diode should be connected to this pin; DC bias level of 800 mV, one diode voltage above ground
GND	4	ground	ground
GND	5	ground	ground
OUT	6	CML output	data output; OUT goes HIGH when current flows into IPhoto (pin 3)
OUTQ	7	CML output	compliment of OUT (pin 6)
$V_{CC}$	8	supply	supply voltage



SDH/SONET STM4/OC12  
transimpedance amplifier

TZA3023

BONDING PAD LOCATIONS



PAD CENTRE LOCATIONS

SYMBOL	PAD	COORDINATES <sup>(1)</sup>	
		x	y
DREF	1	95	881
GND	2	95	618
GND	3	95	473
IPhoto	4	95	285
GND	5	215	95
GND	6	360	95
GND	7	549	95
GND	8	691	95

SYMBOL	PAD	COORDINATES <sup>(1)</sup>	
		x	y
OUT	9	785	501
OUTQ	10	785	641
V <sub>CC</sub>	11	567	1055
V <sub>CC</sub>	12	424	1055
AGC	13	259	1055

Note

1. All coordinates are referenced, in  $\mu\text{m}$ , to the bottom left-hand corner of the die.

## SDH/SONET STM4/OC12 transimpedance amplifier

TZA3023

### FUNCTIONAL DESCRIPTION

The TZA3023 is a transimpedance amplifier intended for use in fibre optic links for signal recovery in STM4/OC12 applications. It amplifies the current generated by a photo detector (PIN diode or avalanche photodiode) and transforms it into a differential output voltage. The most important characteristics of the TZA3023 are high receiver sensitivity and wide dynamic range.

High receiver sensitivity is achieved by minimizing noise in the transimpedance amplifier. The signal current generated by a PIN diode can vary between 1  $\mu$ A to 1 mA peak-to-peak. An AGC loop is implemented to make it possible to handle such a wide dynamic range. The AGC loop increases the dynamic range of the receiver by

reducing the feedback resistance of the preamplifier. The AGC loop hold capacitor is integrated on-chip, so an external capacitor is not needed for AGC. The AGC voltage can be monitored at pad 13 on the naked die (TZA3023U). Pad 13 is not bonded in the packaged device (TZA3023T). This pad can be left unconnected during normal operation. It can also be used to force an external AGC voltage. If pad 13 (AGC) is connected to GND, the internal AGC loop is disabled and the receiver gain is at a maximum. The maximum input current is then about 50  $\mu$ A. A differential amplifier converts the output of the preamplifier to a differential voltage.

### LIMITING VALUES

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

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
$V_{CC}$	supply voltage	-0.5	+5.5	V
$V_n$	DC voltage			
	pin 3/pad 4: IPhoto	-0.5	+1	V
	pins 6 and 7/pads 9 and 10: OUT and OUTQ	-0.5	$V_{CC} + 0.5$	V
	pad 13: AGC (TZA3023U only)	-0.5	$V_{CC} + 0.5$	V
	pin 1/pad 1: DREF	-0.5	$V_{CC} + 0.5$	V
$I_n$	DC current			
	pin 3/pad 4: IPhoto	-1	+2.5	mA
	pins 6 and 7/pads 9 and 10: OUT and OUTQ	-15	+15	mA
	pad 13: AGC (TZA3023U only)	-0.2	+0.2	mA
	pin 1/pad 1: DREF	-2.5	+2.5	mA
$P_{tot}$	total power dissipation	-	300	mW
$T_{stg}$	storage temperature	-65	+150	$^{\circ}$ C
$T_j$	junction temperature	-	150	$^{\circ}$ C
$T_{amb}$	ambient temperature	-40	+85	$^{\circ}$ C

### THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th(j-s)}$	thermal resistance from junction to solder point	tbf	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	tbf	K/W

# SDH/SONET STM4/OC12 transimpedance amplifier

TZA3023

## CHARACTERISTICS

For typical values  $T_{amb} = 25\text{ °C}$  and  $V_{CC} = 5\text{ V}$ ; minimum and maximum values are valid over the entire ambient temperature range and process spread.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CC}$	supply voltage		3	5	5.5	V
$I_{CC}$	supply current	ac coupled; $R_L = 50\ \Omega$	–	28	50	mA
$P_{tot}$	total power dissipation	$V_{CC} = 5\text{ V}$	–	140	275	mW
		$V_{CC} = 3.3\text{ V}$	–	95	180	mW
$T_j$	junction temperature		–40	–	+110	°C
$T_{amb}$	ambient temperature		–40	+25	+85	°C
$R_{tr}$	small-signal transresistance of the receiver	measured differentially; $R_L = \infty$	–	42	–	k $\Omega$
		measured differentially; ac coupled; $R_L = 50\ \Omega$	–	21	–	k $\Omega$
$f_{-3dB(h)}$	high frequency –3 dB point	$C_i = 0.7\text{ pF}$	–	600	–	MHz
$I_{i(IPhoto)(p-p)}$	input current on pin IPhoto (peak-to-peak value)	$V_{CC} = 5\text{ V}$	–300	+4	+1500	$\mu\text{A}$
		$V_{CC} = 3.3\text{ V}$	–300	+4	+500	$\mu\text{A}$
$V_{bias(IPhoto)}$	input bias voltage on pin IPhoto		720	800	970	mV
$I_{n(tot)}$	total integrated RMS noise current over bandwidth (referenced to input)	note 1				
		$\Delta f = 311\text{ MHz}$	–	55	–	nA
		$\Delta f = 450\text{ MHz}$	–	80	–	nA
		$\Delta f = 622\text{ MHz}$	–	120	–	nA
$\Delta R_{tr}/\Delta t$	AGC loop constant		–	1	–	dB/ms
PSRR	power supply rejection ratio at $V_{CC}$	measured differentially; note 2				
		$f = 100\text{ kHz to }10\text{ MHz}$	–	1	2	$\mu\text{A/V}$
		$f = 10\text{ MHz to }100\text{ MHz}$	–	2	5	$\mu\text{A/V}$
		$f = 100\text{ MHz to }1\text{ GHz}$	–	5	100	$\mu\text{A/V}$

SDH/SONET STM4/OC12  
transimpedance amplifier

TZA3023

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Data outputs: OUT and OUTQ</b>						
$V_{O(CM)}$	common mode output voltage	ac coupled; $R_L = 50 \Omega$	$V_{CC} - 1.65$	$V_{CC} - 1.57$	$V_{CC} - 1.4$	V
$V_{O(se)(p-p)}$	single-ended output voltage (peak-to-peak value)	ac coupled; $R_L = 50 \Omega$	150	200	260	mV
$V_{OO}$	differential output offset voltage		-30	-	+30	mV
$R_o$	single ended output resistance	DC tested	42	50	58	$\Omega$
$t_r$	rise time	20% to 80%	-	200	300	ps
$t_f$	fall time	80% to 20%	-	140	250	ps

Notes

1. All  $I_{n(tot)}$  measurements were made with an input capacitance of  $C_i = 1.2$  pF. This was comprised of 0.7 pF for the photodiode itself, with 0.3 pF allowed for the PCB layout and 0.2 pF intrinsic to the package.
2. PSRR is defined as the ratio of the equivalent current change at the input ( $\Delta I_{Photo}$ ) to a change in supply voltage:

$$PSRR = \frac{\Delta I_{Photo}}{\Delta V_{CC}}$$

For example, a +1 mV disturbance on  $V_{CC}$  at 10 MHz will typically add an extra 2 nA to the photodiode current.

APPLICATION INFORMATION

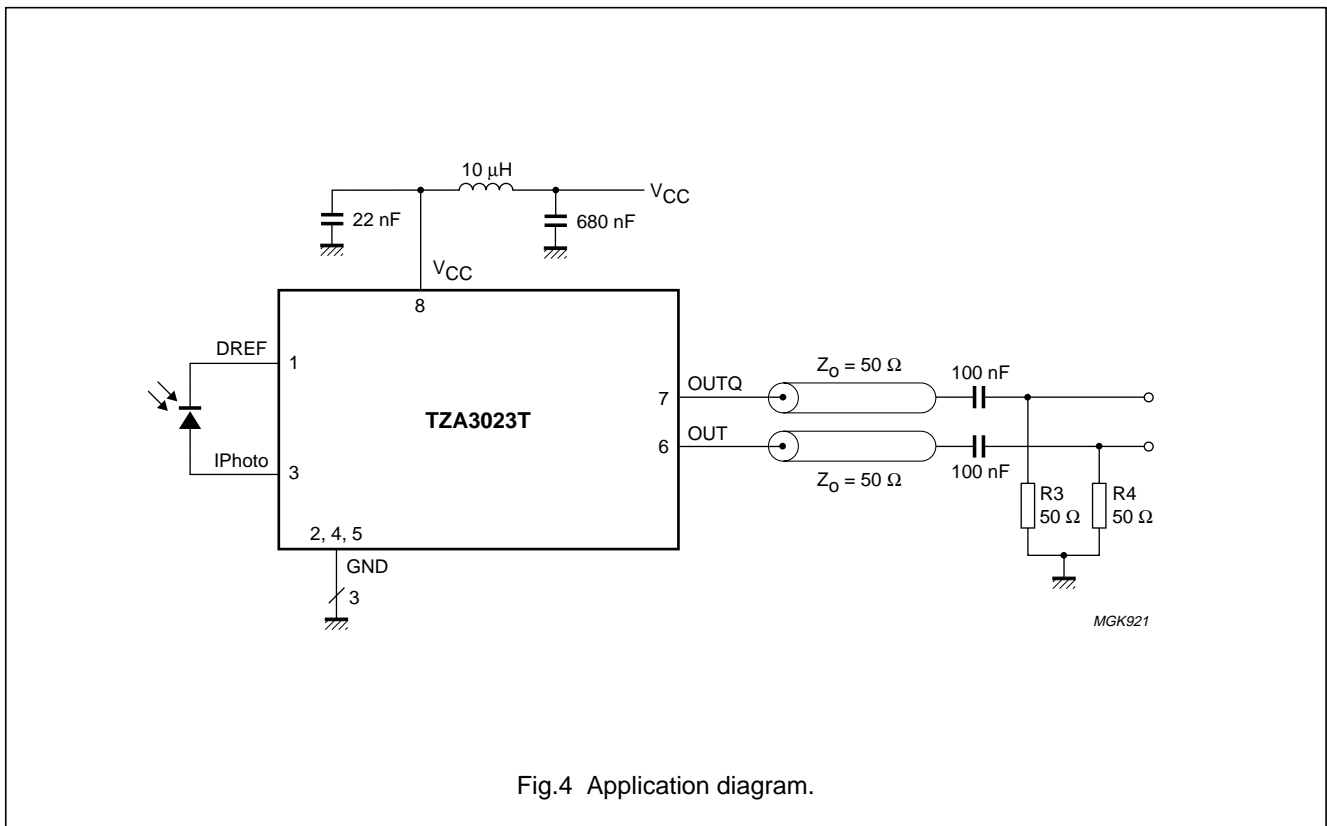
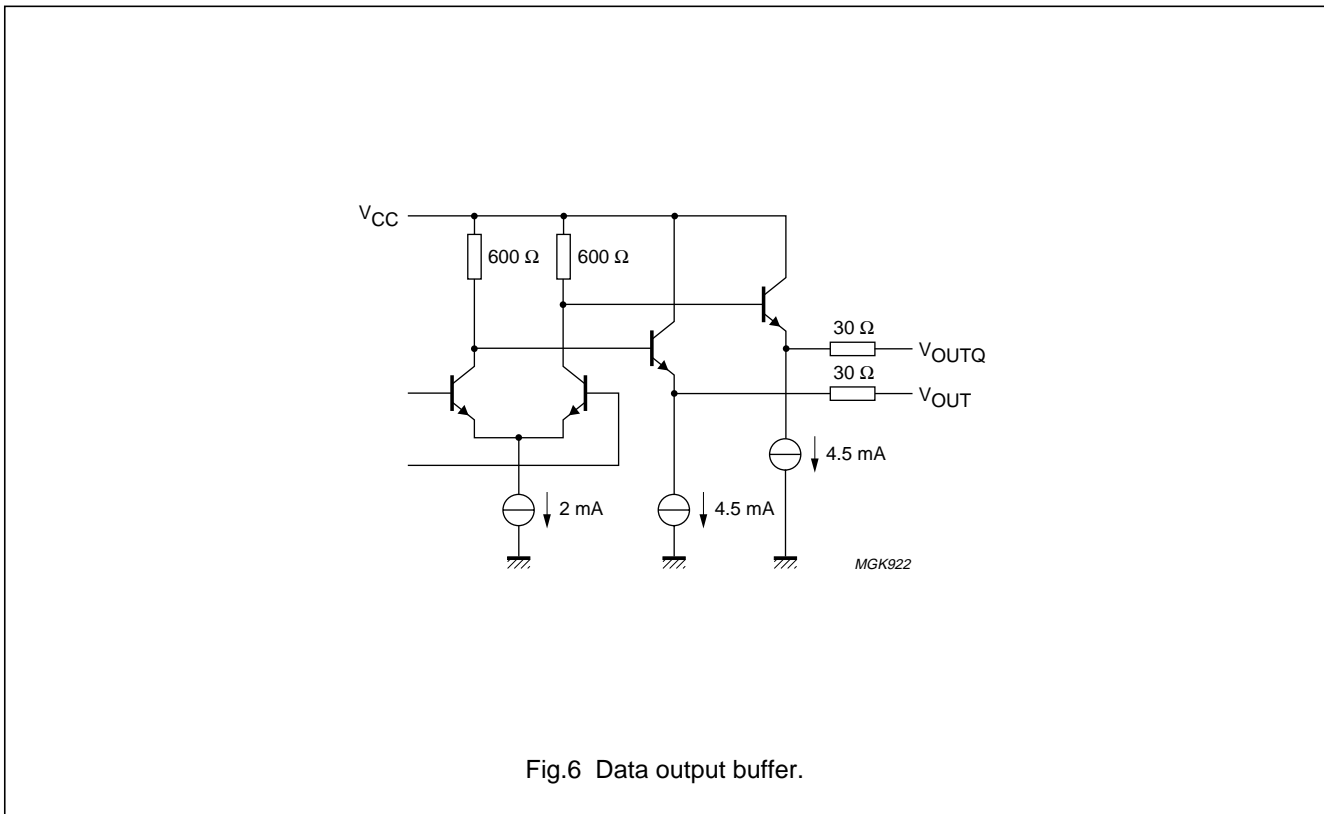
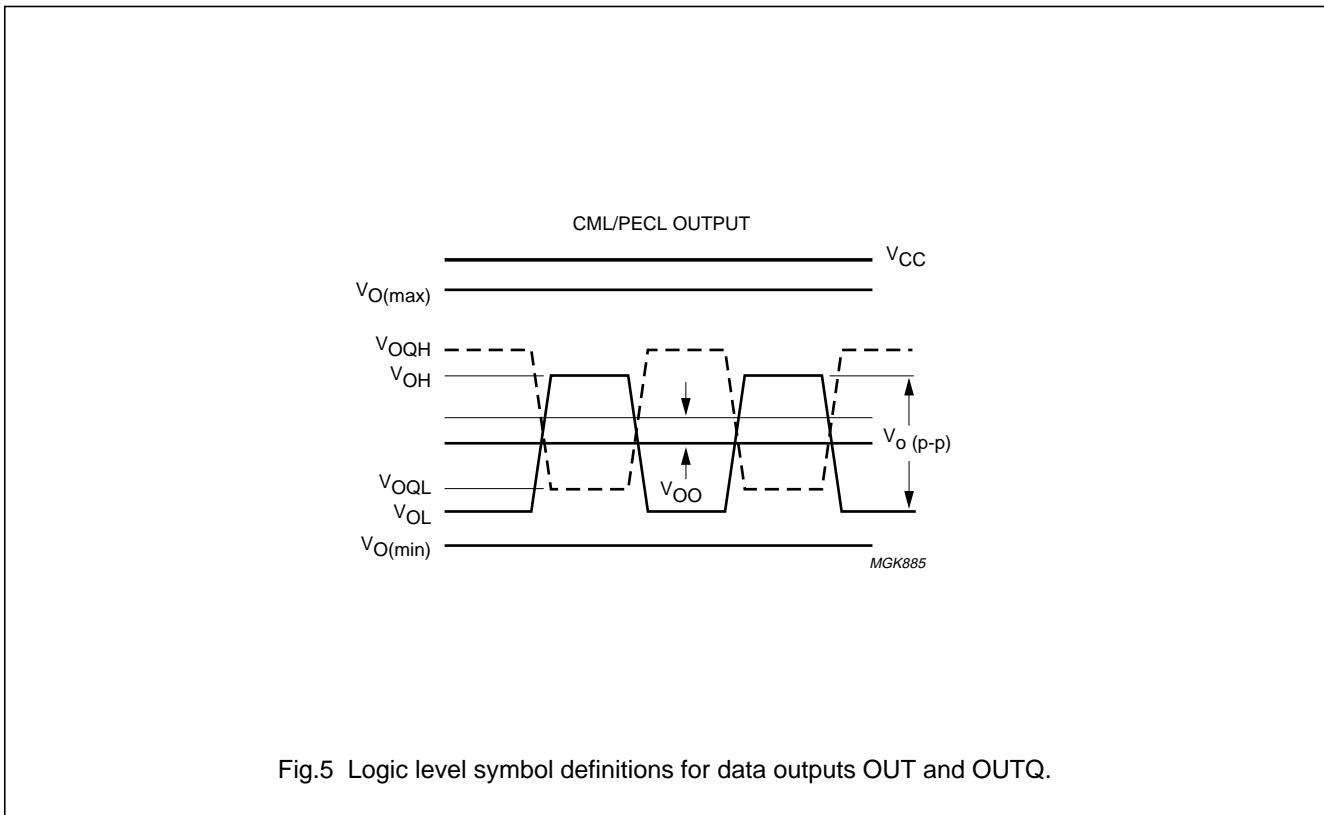


Fig.4 Application diagram.

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transimpedance amplifier

TZA3023





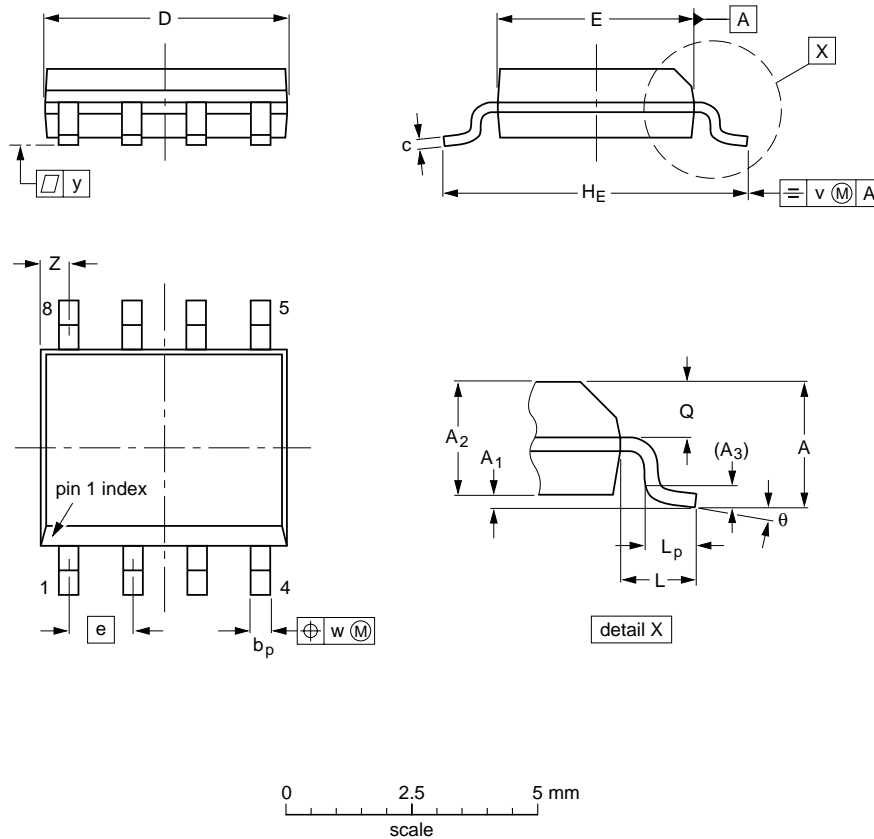
SDH/SONET STM4/OC12  
transimpedance amplifier

TZA3023

PACKAGE OUTLINE

S08: plastic small outline package; 8 leads; body width 3.9 mm

SOT96-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(2)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	z <sup>(1)</sup>	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	5.0 4.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.20 0.19	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT96-1	076E03S	MS-012AA				95-02-04 97-05-22

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**SDH/SONET STM4/OC12**  
**transimpedance amplifier**

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**TZA3023****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 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 techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

**Wave soldering**

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.

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.

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**SDH/SONET STM4/OC12**  
**transimpedance amplifier**


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TZA3023

**DEFINITIONS**

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

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