

# DATA SHEET

## **TZA3033** **SDH/SONET STM1/OC3** **transimpedance amplifier**

Objective specification  
File under Integrated Circuits, IC19

1998 Jul 08

# SDH/SONET STM1/OC3 transimpedance amplifier

# TZA3033

### FEATURES

- Low equivalent input noise, typically 1 pA/√Hz
- Wide dynamic range, typically 0.25 μA to 1.6 mA
- Differential transimpedance of 117 kΩ
- Bandwidth minimum 150 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
- Pin compatible with SA5223.

### 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.

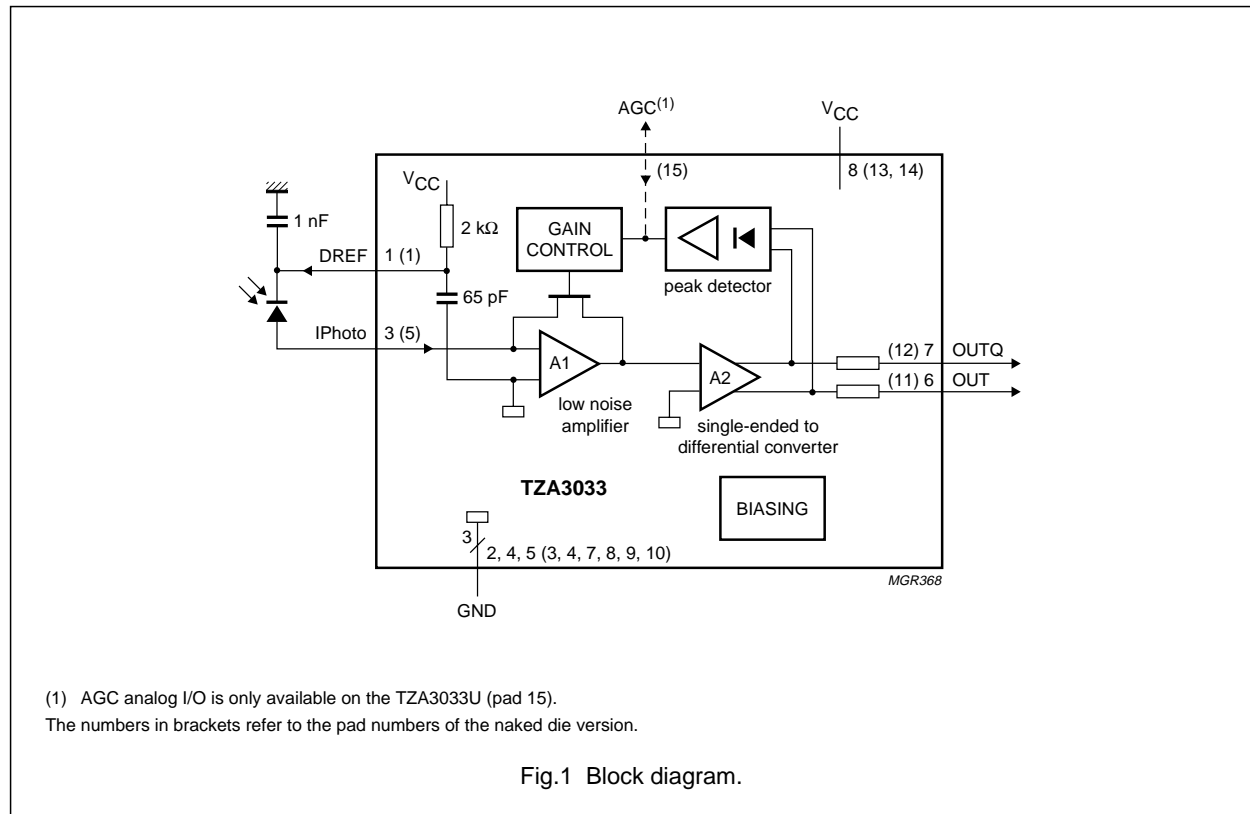
### GENERAL DESCRIPTION

The TZA3033 is a low-noise transimpedance amplifier with AGC designed to be used in STM1/OC3 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 |
| TZA3033T    | SO8       | plastic small outline package; 8 leads; body width 3.9 mm    | SOT96-1 |
| TZA3033U    | naked die | die in waffle pack carriers; die dimensions 0.960 × 1.210 mm | –       |

### BLOCK DIAGRAM

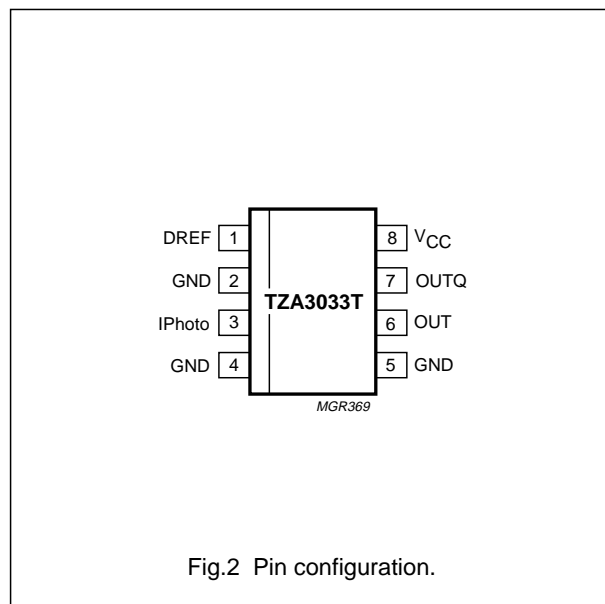


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## PINNING

| SYMBOL   | PIN | TYPE          | DESCRIPTION   |
|----------|-----|---------------|---|
| DREF     | 1   | analog output | bias voltage for PIN diode ( $V_{CC}$ ); 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 voltage is 1048 mV |
| GND      | 4   | ground        | ground  |
| GND      | 5   | ground        | ground  |
| OUT      | 6   | data output   | data output; OUT goes HIGH when current flows into IPhoto (pin 3)                             |
| OUTQ     | 7   | data output   | compliment of OUT (pin 6)   |
| $V_{CC}$ | 8   | supply        | supply voltage  |

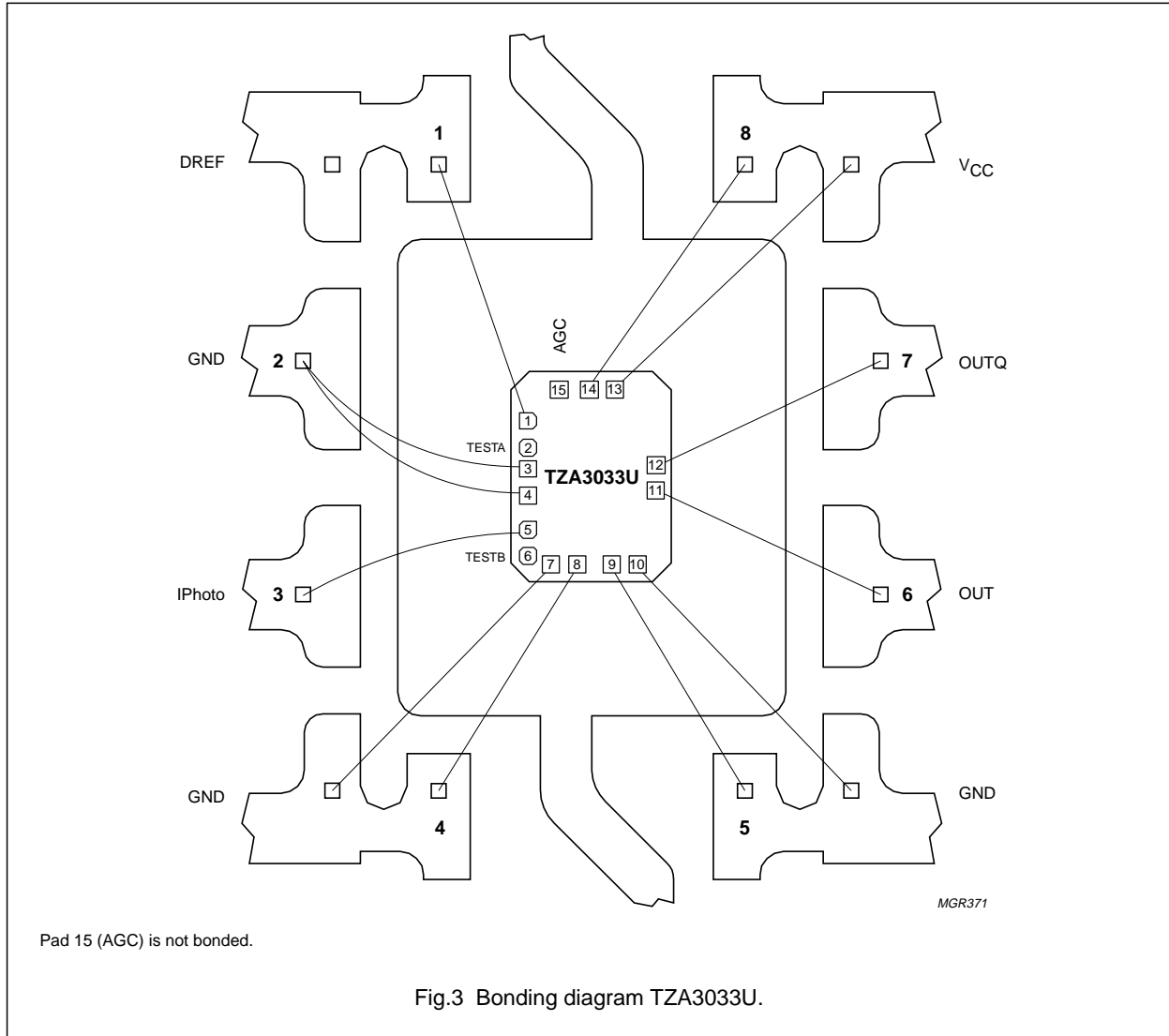


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**PAD CONFIGURATION**

**Bonding pad locations**



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## Pad centre locations

| SYMBOL          | PAD | COORDINATES <sup>(1)</sup> |      |
|-----------------|-----|----------------------------|------|
|                 |     | x                          | y    |
| DREF            | 1   | 95                         | 881  |
| TESTA           | 2   | 95                         | 735  |
| GND             | 3   | 95                         | 618  |
| GND             | 4   | 95                         | 473  |
| IPhoto          | 5   | 95                         | 285  |
| TESTB           | 6   | 95                         | 147  |
| GND             | 7   | 215                        | 95   |
| GND             | 8   | 360                        | 95   |
| GND             | 9   | 549                        | 95   |
| GND             | 10  | 691                        | 95   |
| OUT             | 11  | 785                        | 501  |
| OUTQ            | 12  | 785                        | 641  |
| V <sub>CC</sub> | 13  | 567                        | 1055 |
| V <sub>CC</sub> | 14  | 424                        | 1055 |
| AGC             | 15  | 259                        | 1055 |

## Note

- All coordinates ( $\mu\text{m}$ ) are measured with respect to the bottom left-hand corner of the die.

## FUNCTIONAL DESCRIPTION

The TZA3033 is a transimpedance amplifier intended for use in fibre optic links for signal recovery in STM1/OC3 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 TZA3033 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 0.25  $\mu\text{A}$  to 1.6 mA (peak-to-peak value). An AGC loop (see Fig.1) 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.

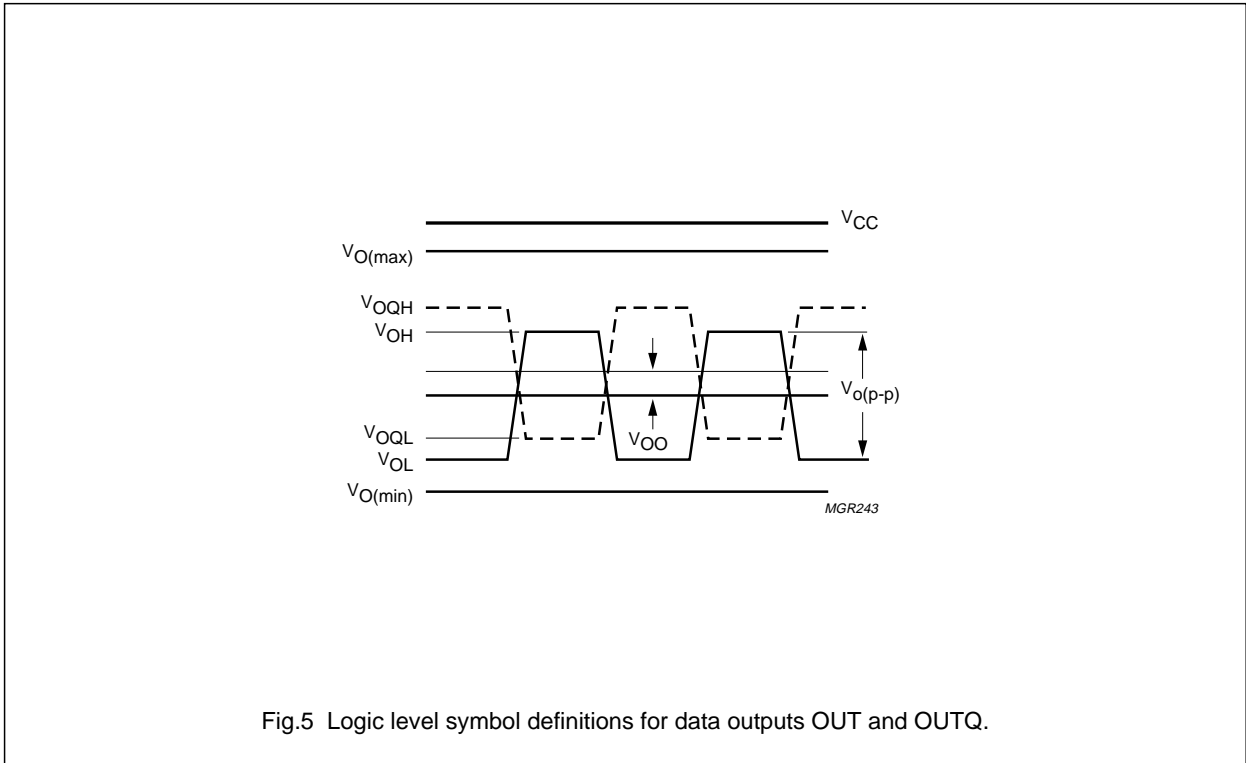
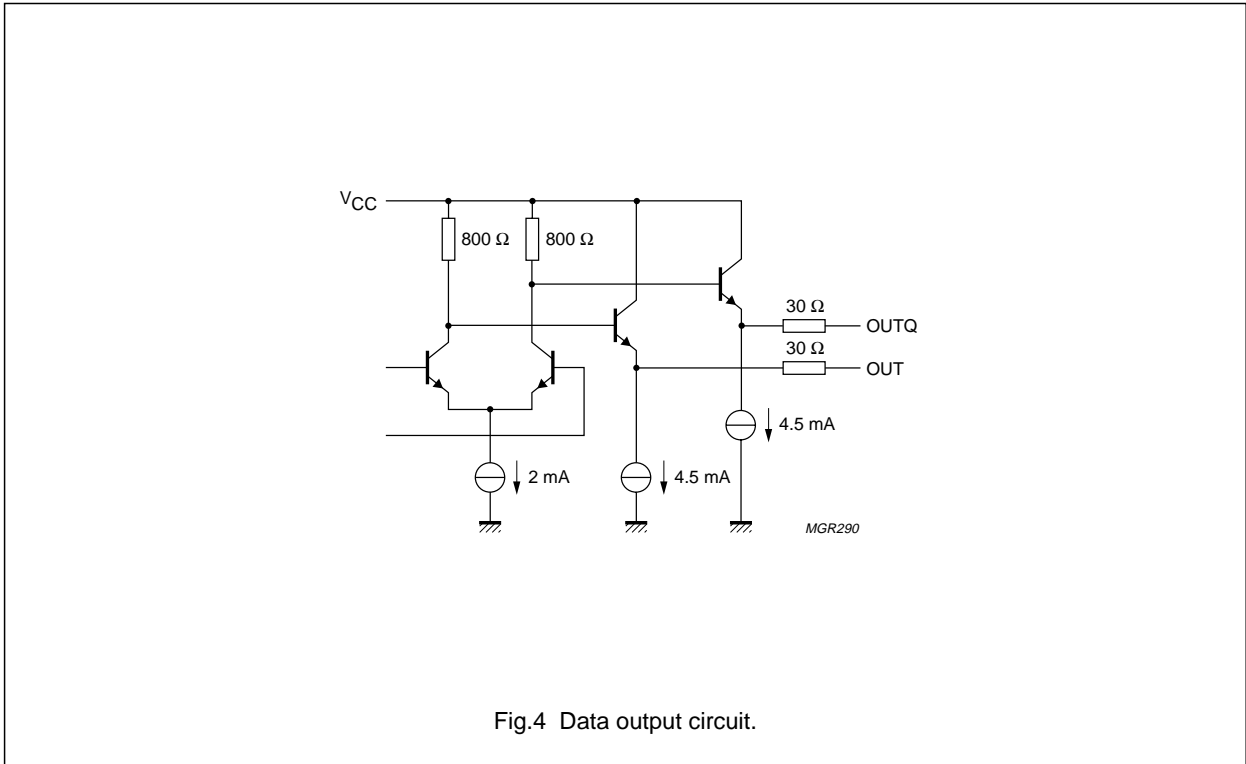
The AGC voltage can be monitored at pad 15 on the naked die (TZA3033U). Pad 15 is not bonded in the packaged device (TZA3033T). This pad can be left unconnected during normal operation. It can also be used to force an external AGC voltage. If pad 15 (AGC) is connected to V<sub>CC</sub>, the internal AGC loop is disabled and the receiver gain is at a maximum. The maximum input current is then about 10  $\mu\text{A}$ .

A differential amplifier converts the output of the preamplifier to a differential voltage. The data output circuit is given in Fig.4.

The logic level symbol definitions are shown in Fig.5.

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**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 5: IPhoto                       | -0.5 | +2             | V    |
|           | pins 6 and 7/pads 11 and 12: OUT and OUTQ | -0.5 | $V_{CC} + 0.5$ | V    |
|           | pad 15: AGC (TZA3033U 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 5: IPhoto                       | -1   | +2.5           | mA   |
|           | pins 6 and 7/pads 11 and 12: OUT and OUTQ | -15  | +15            | mA   |
|           | pad 15: AGC (TZA3033U 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           | °C   |
| $T_j$     | junction temperature                      | -    | 150            | °C   |
| $T_{amb}$ | ambient temperature                       | -40  | +85            | °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  |

**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; $R_L = 50\ \Omega$         | -    | 37   | -    | mA         |
| $P_{tot}$     | total power dissipation                      | $V_{CC} = 5\text{ V}$                  | -    | 185  | -    | mW         |
|               |  | $V_{CC} = 3.3\text{ V}$                | -    | 116  | -    | mW         |
| $T_j$         | junction temperature                         |  | -40  | -    | +120 | °C         |
| $T_{amb}$     | ambient temperature                          |  | -40  | +25  | +85  | °C         |
| $R_{tr}$      | small-signal transresistance of the receiver | measured differentially;<br>AC coupled |      |      |      |            |
|               |  | $R_L = \infty$                         | -    | 234  | -    | k $\Omega$ |
|               |  | $R_L = 50\ \Omega$                     | -    | 117  | -    | k $\Omega$ |
| $f_{-3dB(h)}$ | high frequency -3 dB point                   | $C_i = 0.7\text{ pF}$                  | 120  | 150  | -    | MHz        |

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| SYMBOL                                | PARAMETER   | CONDITIONS                               | MIN.                    | TYP.                    | MAX.                    | UNIT            |
|---------------------------------------|---|--|-------------------------|-------------------------|-------------------------|-----------------|
| $I_{n(\text{tot})}$                   | total integrated RMS noise current over bandwidth | referred to input; note 1                |                         |                         |                         |                 |
|                                       |   | $\Delta f = 90 \text{ MHz}$              | –                       | 16                      | –                       | nA              |
|                                       |   | $\Delta f = 120 \text{ MHz}$             | –                       | tbf                     | –                       | nA              |
|                                       |   | $\Delta f = 150 \text{ MHz}$             | –                       | tbf                     | –                       | nA              |
| $\Delta R_{\text{tr}}/\Delta t$       | AGC loop constant                                 |  | –                       | 1                       | –                       | dB/ms           |
| PSRR                                  | power supply rejection ratio                      | measured differentially; note 2          |                         |                         |                         |                 |
|                                       |   | $f = 100 \text{ kHz to } 10 \text{ MHz}$ | –                       | 0.5                     | –                       | $\mu\text{A/V}$ |
|                                       |   | $f = 100 \text{ MHz}$                    | –                       | 10                      | –                       | $\mu\text{A/V}$ |
| <b>Input: IPhoto</b>                  |   |  |                         |                         |                         |                 |
| $I_{i(\text{IPhoto})(\text{p-p})}$    | input current on pin IPhoto (peak-to-peak value)  | $V_{\text{CC}} = 5 \text{ V}$            | –500                    | +1                      | +1800                   | $\mu\text{A}$   |
|                                       |   | $V_{\text{CC}} = 3.3 \text{ V}$          | –500                    | +1                      | +1600                   | $\mu\text{A}$   |
| $V_{\text{bias}(\text{IPhoto})}$      | input bias voltage on pin IPhoto                  |  | –                       | 1048                    | –                       | mV              |
| <b>Data outputs: OUT and OUTQ</b>     |   |  |                         |                         |                         |                 |
| $V_{\text{O}(\text{CM})}$             | common mode output voltage                        | AC coupled; $R_{\text{L}} = 50 \Omega$   | $V_{\text{CC}} - 1.800$ | $V_{\text{CC}} - 1.700$ | $V_{\text{CC}} - 1.600$ | V               |
| $V_{\text{o}(\text{se})(\text{p-p})}$ | single-ended output voltage (peak-to-peak value)  | AC coupled; $R_{\text{L}} = 50 \Omega$   | –                       | 150                     | 260                     | mV              |
| $V_{\text{OO}}$                       | differential output offset voltage                |  | –100                    | –                       | +100                    | mV              |
| $R_{\text{o}}$                        | output resistance                                 | single-ended; DC tested                  | 42                      | 50                      | 58                      | $\Omega$        |
| $t_{\text{r}}$                        | rise time   | 20% to 80%                               | –                       | tbf                     | –                       | ps              |
| $t_{\text{f}}$                        | fall time   | 80% to 20%                               | –                       | tbf                     | –                       | ps              |

**Notes**

- All  $I_{n(\text{tot})}$  measurements were made with an input capacitance of  $C_{\text{i}} = 1 \text{ pF}$ . This was comprised of 0.5 pF for the photodiode itself, with 0.3 pF allowed for the printed-circuit board layout and 0.2 pF intrinsic to the package.
- PSRR is defined as the ratio of the equivalent current change at the input ( $\Delta I_{\text{IPhoto}}$ ) to a change in supply voltage:

$$\text{PSRR} = \frac{\Delta I_{\text{IPhoto}}}{\Delta V_{\text{CC}}}$$

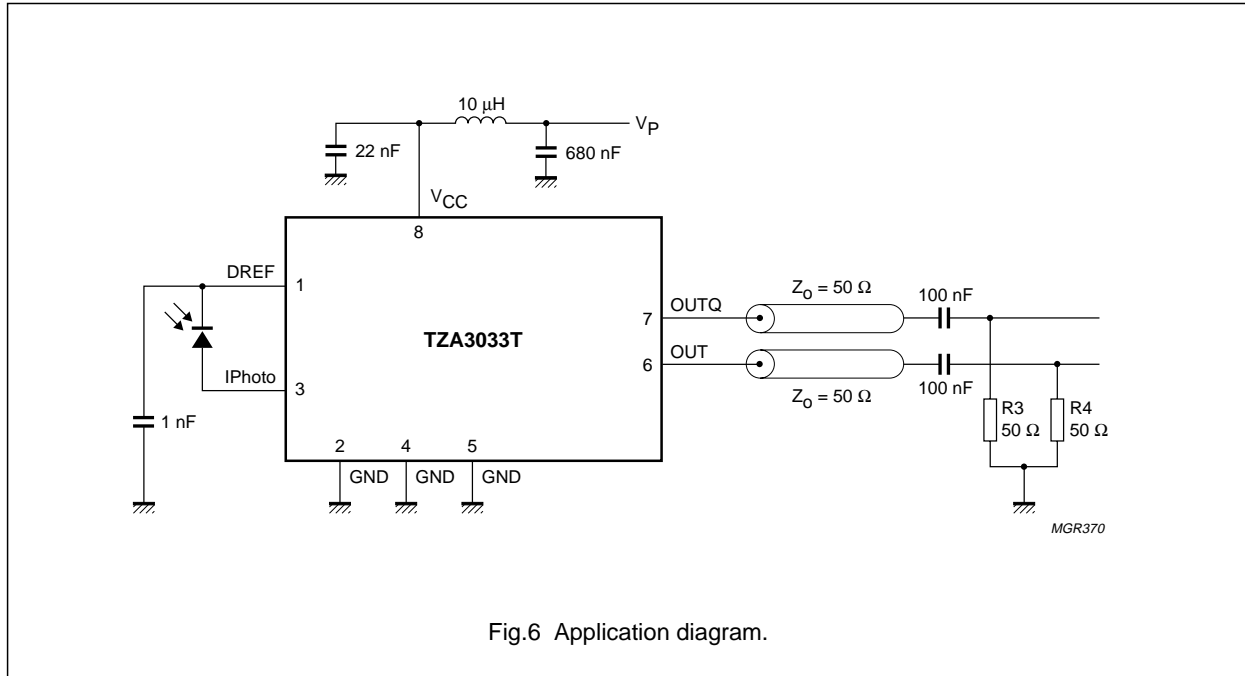
For example, a disturbance of +4 mV disturbance on  $V_{\text{CC}}$  at 10 MHz will typically add an extra 2 nA to the photodiode current. The external capacitor between DREF and GND has a large impact on PSRR. The specification is valid with an external capacitor of 1 nF.



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## APPLICATION INFORMATION



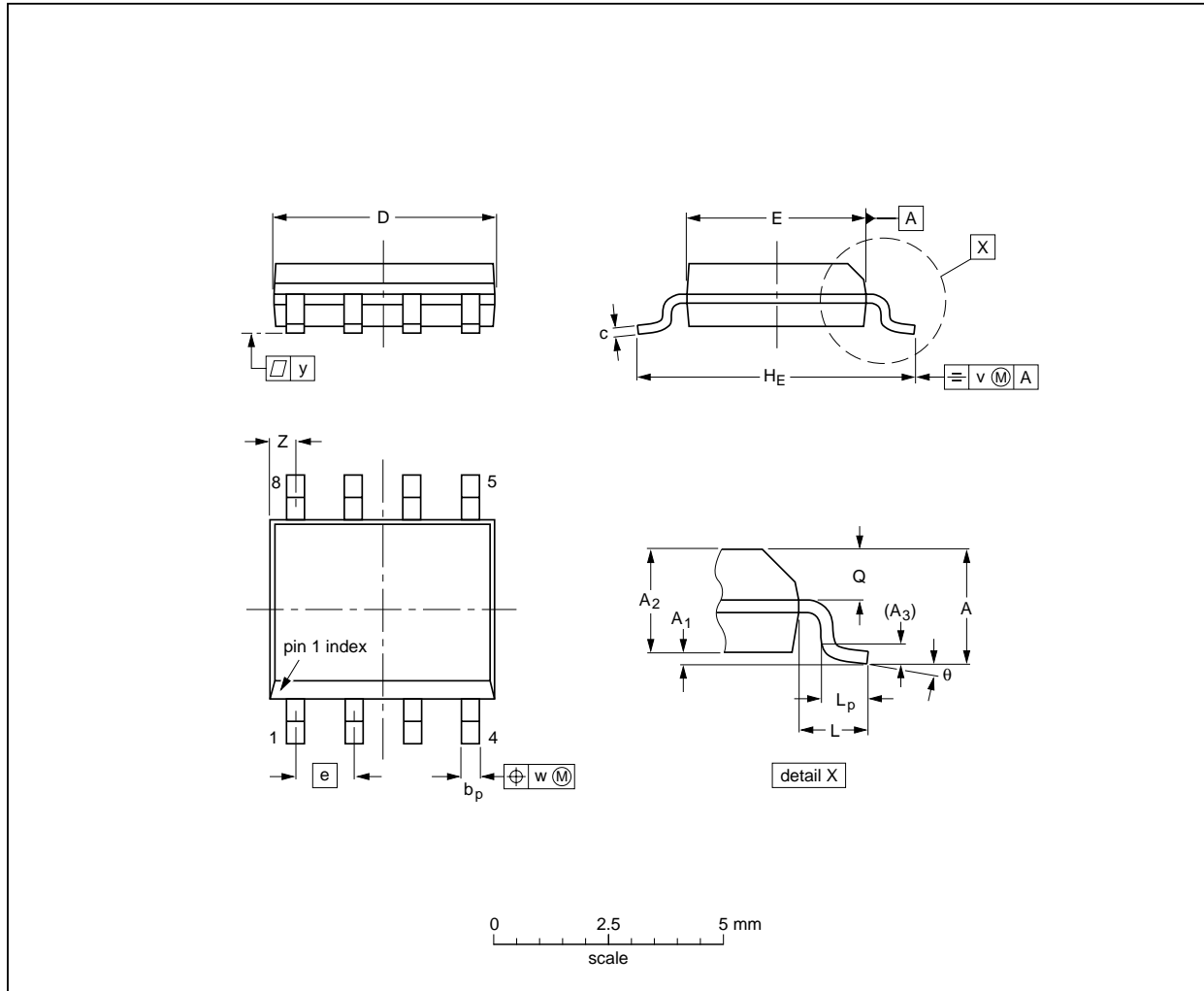
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PACKAGE OUTLINE

SO8: 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<br>0.10   | 1.45<br>1.25   | 0.25           | 0.49<br>0.36   | 0.25<br>0.19     | 5.0<br>4.8       | 4.0<br>3.8       | 1.27  | 6.2<br>5.8     | 1.05  | 1.0<br>0.4     | 0.7<br>0.6     | 0.25 | 0.25 | 0.1   | 0.7<br>0.3       | 8°<br>0° |
| inches | 0.069  | 0.010<br>0.004 | 0.057<br>0.049 | 0.01           | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.20<br>0.19     | 0.16<br>0.15     | 0.050 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.024 | 0.01 | 0.01 | 0.004 | 0.028<br>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<br>97-05-22 |

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**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 *"Data Handbook IC26; Integrated Circuit Packages"* (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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**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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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.

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**NOTES**

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**NOTES**

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