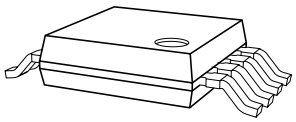
## LED Driver with Adjustable Current — TLE 4241 G

## Target Data

### Features

- Adjustable constant output current
- Wide input voltage range
- Low drop voltage
- Open load detection
- Overtemperature protection
- Short circuit proof
- Reverse polarity proof
- Wide temperature range : – 40 °C < $T_j$ < 150 °C
- Very small SMD-Package



P-TSOP-8-1

| Type | Ordering Code | Package |
|---|---|---|
| ▼ TLE 4241 G | Q67006-A9519 | P-TSOP-8 (SMD) |

▼New type

### Functional Description

The **TLE 4241 G** is an integrated adjustable constant current source. The IC is designed to supply LEDs under the severe conditions of automotive applications resulting in constant brightness and extended LED lifetime. It is provided in the very small P-TSOP-8 (Micro 8) package. Protection circuits prevent damage to the device in case of overload, short circuit, reverse polarity and overtemperature. The connected LEDs are protected against reverse polarity as well as excess voltages up to 45 V. A status output allows handling of open load and short circuit at the main output.
A PWM input offers the possibility to adjust the LED brightness by pulse width modulation.
With an implemented high/low current switch the output current level can be reduced by a fixed factor e.g. for brake/tail light application.
The implemented features such as adjustable output current, the high/low current switch and the provided PWM input make the device well suited for a broad range of LED and other applications.

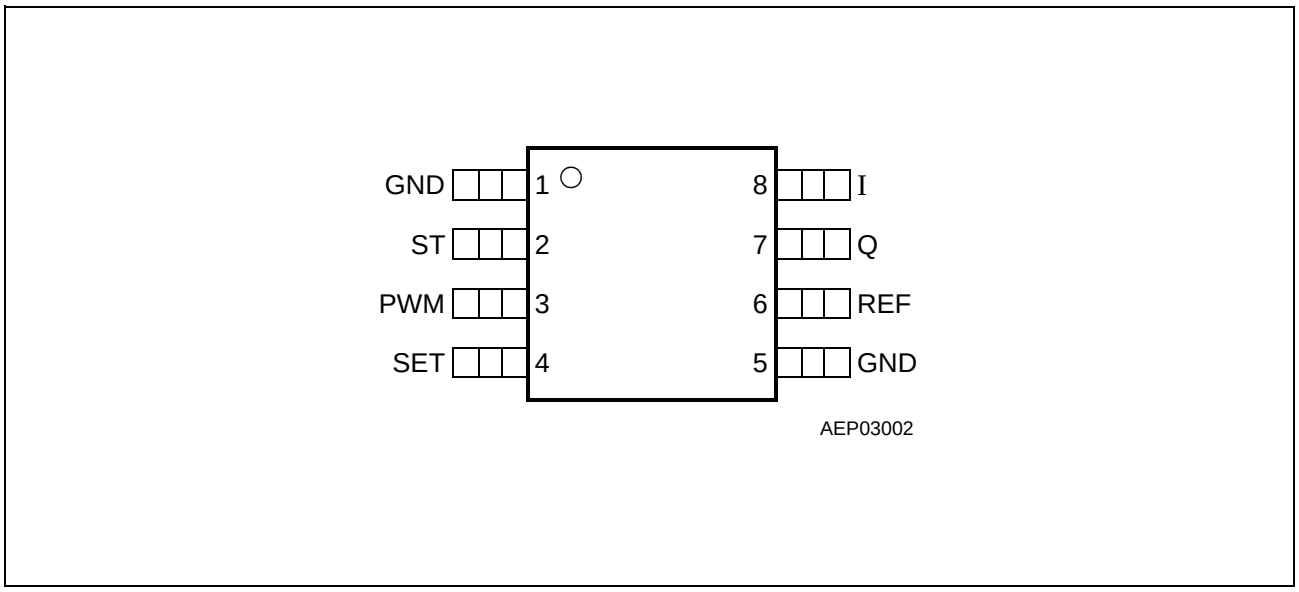



**Figure 1** **Pin Configuration** (top view)

**Pin Definitions and Functions**

| Pin No. | Symbol | Function |
|---|---|---|
| 1 | GND | **Ground**; internally connected to pin 5 |
| 2 | ST | **Status Output**; open collector output, connect to external pull up resistor |
| 3 | PWM | **Pulse Width Modulation Input**; if not needed connect to $V_I$ |
| 4 | SET | **High/Low Current Input**; choice of current level |
| 5 | GND | **Ground**; internally connected to pin 1 |
| 6 | REF | **Reference Input**; connect to GND via an external resistor to adjust the output current |
| 7 | Q | **Output** |
| 8 | I | **Input**; block to GND directly at the IC with a 100 nF ceramic capacitor. |

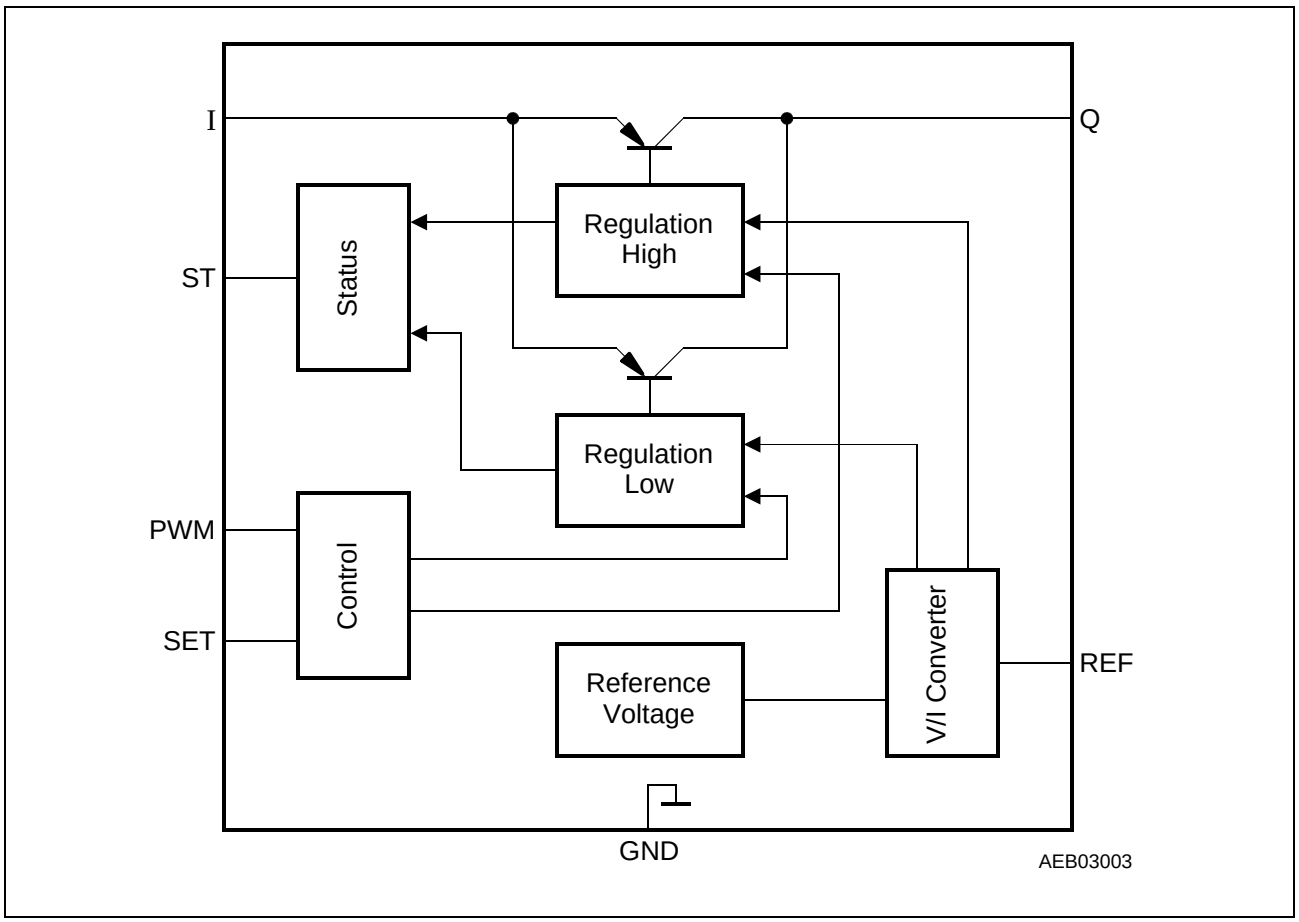



**Figure 2 Block Diagram**

## Absolute Maximum Ratings

– 40 °C < $T_j$ < 150 °C

| Parameter | Symbol | Limit Values | | Unit | Remarks |
|---|---|---|---|---|---|
| | | min. | max. | | |
| **Input** | | | | | |
| Voltage | $V_I$ | – 42 | 45 | V | – |
| Current | $I_I$ | – | – | mA | internally limited |
| **Output** | | | | | |
| Voltage | $V_Q$ | – 1 | 40 | V | – |
| Current | $I_Q$ | – | – | mA | internally limited |
| **Status Output** | | | | | |
| Voltage | $V_{ST}$ | – 0.3 | 40 | V | – |
| Current | $I_{ST}$ | – 5 | 5 | mA | internally limited |
| **Reference Input** | | | | | |
| Voltage | $V_{REF}$ | – 0.3 | 7 | V | – |
| Current | $I_{REF}$ | – 2 | 2 | mA | – |
| **Pulse Width Modulation Input** | | | | | |
| Voltage | $V_{PWM}$ | – 40 | 40 | V | – |
| Current | – | – 1 | 1 | mA | – |
| **High/Low Current Input** | | | | | |
| Voltage | $V_{SET}$ | – 40 | 40 | V | – |
| Current | $I_{SET}$ | – 1 | 1 | mA | – |
| **Temperatures** | | | | | |
| Junction temperature | $T_j$ | – 40 | 150 | °C | – |
| Storage temperature | $T_{stg}$ | – 50 | 150 | °C | – |

**Absolute Maximum Ratings** (cont'd)
– 40 °C < $T_j$ < 150 °C

| Parameter | Symbol | Limit Values | | Unit | Remarks |
|---|---|---|---|---|---|
| | | min. | max. | | |

**Thermal Resistances**

| | | | | | |
|---|---|---|---|---|---|
| Junction ambient | $R_{thja}$ | – | 135 | K/W | –[1)] |

1) Worst case regarding peak temperature; mounted on PCB 80 × 80 × 1.5 mm$^3$, 35 µm Cu, 300 mm$^2$ heat sink area.

*Note: Maximum ratings are absolute ratings; exceeding any one of these values may cause irreversible damage to the integrated circuit*

**Operating Range**

| Parameter | Symbol | Limit Values | | Unit | Remarks |
|---|---|---|---|---|---|
| | | min. | max. | | |
| Input voltage | $V_I$ | 3 | 45 | V | – |
| Status output voltage | $V_{ST}$ | – | 16 | V | – |
| SET voltage | $V_{SET}$ | 0 | 40 | V | – |
| PWM voltage | $V_{PWM}$ | 0 | 40 | V | – |
| Junction temperature | $T_j$ | – 40 | 150 | °C | – |
| Reference Resistor | $R_{REF}$ | 7 | 100 | kΩ | – |

## Electrical Characteristics

9 V ≤ $V_I$ ≤ 16 V; $R_{REF}$ = 12 kΩ; $V_{PWM} \geq V_{PWM,H}$; – 40 °C < $T_j$ < 150 °C; all voltages with respect to ground; positive current defined flowing into pin; unless otherwise specified

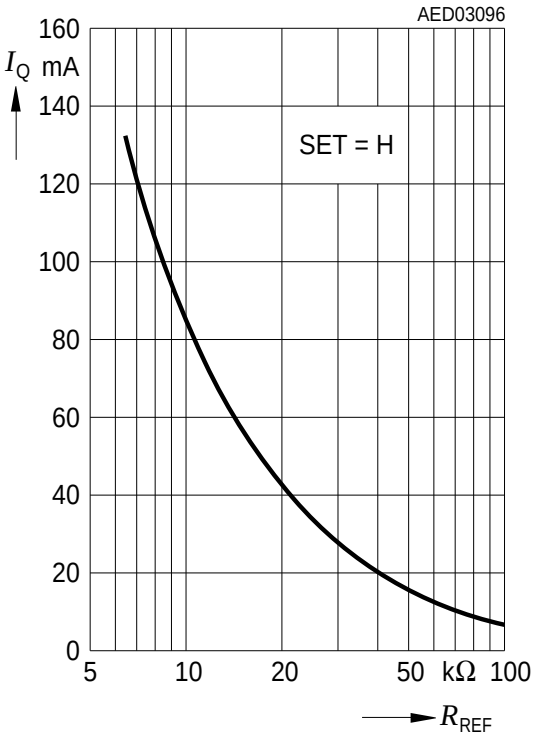
| Parameter | Symbol | Limit Values | | | Unit | Test Condition |
|---|---|---|---|---|---|---|
| | | min. | typ. | max. | | |
| Current consumption off mode | $I_{qOFF}$ | – | – | 10 | µA | PWM = L |
| Current consumption | $I_{qL}$ | – | 0.5 | 1.0 | mA | SET = L; $V_Q$ = 6 V |
| Current consumption | $I_{qH}$ | – | 3.0 | 10.0 | mA | SET = H; $V_Q$ = 6 V |
| Current consumption open load | $I_{qL,O}$ | – | – | 3.0 | mA | SET = L; $V_Q$ open |
| Current consumption open load | $I_{qH,O}$ | – | – | 3.0 | mA | SET = H; $V_Q$ open |
| **Output** | | | | | | |
| Output current | $I_Q$ | 6.4 | 8.0 | 9.6 | mA | SET = L |
| Output current | $I_Q$ | 52 | 65 | 78 | mA | SET = H |
| Output current limit | $I_{Qmax}$ | – | 50 | – | mA | SET = L; $R_{REF}$ = 0 Ω |
| Output current limit | $I_{Qmax}$ | – | 150 | – | mA | SET = H; $R_{REF}$ = 0 Ω |
| Drop voltage | $V_{dr}$ | – | 0.2 | 0.5 | V | SET = L; $I_Q$ = 8 mA |
| Drop voltage | $V_{dr}$ | – | 0.3 | 0.5 | V | SET = H; $I_Q$ = 65 mA |
| **PWM Input** | | | | | | |
| PWM high level | $V_{PWM,H}$ | 2.0 | – | – | V | – |
| PWM low level | $V_{PWM,L}$ | – | – | 0.6 | V | – |
| PWM input current high level | $I_{PWM,H}$ | – | 220 | 500 | µA | $V_{PWM}$ = 5.0 V |
| PWM input current low level | $I_{PWM,L}$ | – 10 | – | 10 | µA | $V_{PWM}$ = 0.0 V |
| Turn on delay time | $t_{PWM,ON}$ | 10 | 25 | 50 | µs | see **Fig. 3** |
| Turn off delay time | $t_{PWM,OFF}$ | 5 | 10 | 20 | µs | see **Fig. 3** |

**Electrical Characteristics** (cont'd)

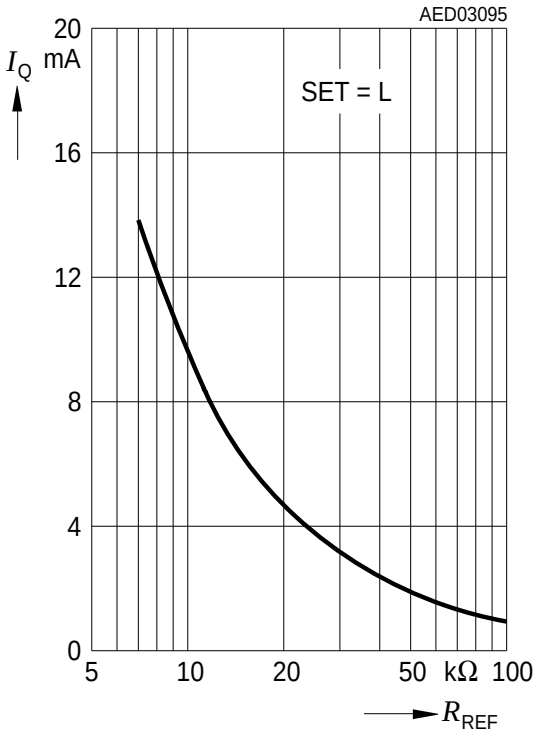
9 V ≤ $V_I$ ≤ 16 V; $R_{REF}$ = 12 kΩ; $V_{PWM} \geq V_{PWM,H}$; – 40 °C < $T_j$ < 150 °C; all voltages with respect to ground; positive current defined flowing into pin; unless otherwise specified

| Parameter | Symbol | Limit Values | | | Unit | Test Condition |
|---|---|---|---|---|---|---|
| | | min. | typ. | max. | | |
| **SET Input** | | | | | | |
| SET high level | $V_{SET,H}$ | 2.0 | – | – | V | – |
| SET low level | $V_{SET,L}$ | – | – | 0.6 | V | – |
| SET input current high level | $I_{SET,H}$ | – | 220 | 500 | µA | $V_{SET}$ = 5.0 V |
| SET input current low level | $I_{SET,L}$ | – 10 | – | 10 | µA | $V_{SET}$ = 0.0 V |
| Delay time L -> H | $I_{SET,H}$ | – | – | 45 | µs | see **Fig. 3** |
| Delay time H -> L | $I_{SET,L}$ | – | – | 15 | µs | see **Fig. 3** |
| **Status Output** | | | | | | |
| Lower status switching threshold | $I_{QLL}$ | 0.2 | – | – | mA | SET = L; ST = L |
| Upper status switching threshold | $I_{QLH}$ | – | – | 1 | mA | SET = L; ST = H |
| Lower status switching threshold | $I_{QHL}$ | 5 | – | – | mA | SET = H; ST = L |
| Upper status switching threshold | $I_{QHH}$ | – | – | 10 | mA | SET = H; ST = H |
| Status low voltage | $V_{STL}$ | – | – | 0.4 | V | $I_{ST}$ = 2.0 mA |
| Leakage current | $I_{STLK}$ | – | – | 10 | µA | $V_{ST}$ = 5.0 V |

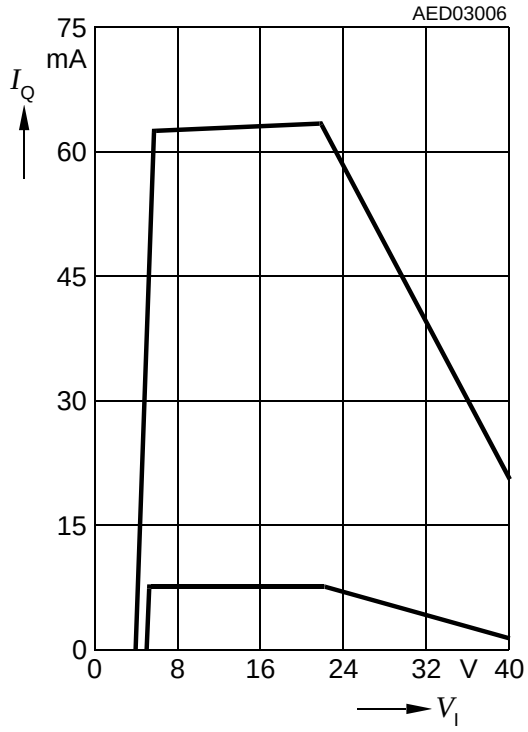
### Output Current versus External Resistor $R_{REF}$, SET = H




### Output Current versus Temperature, External Resistor $R_{REF}$, SET = L




### Output Current and Output Voltage versus Input Voltage



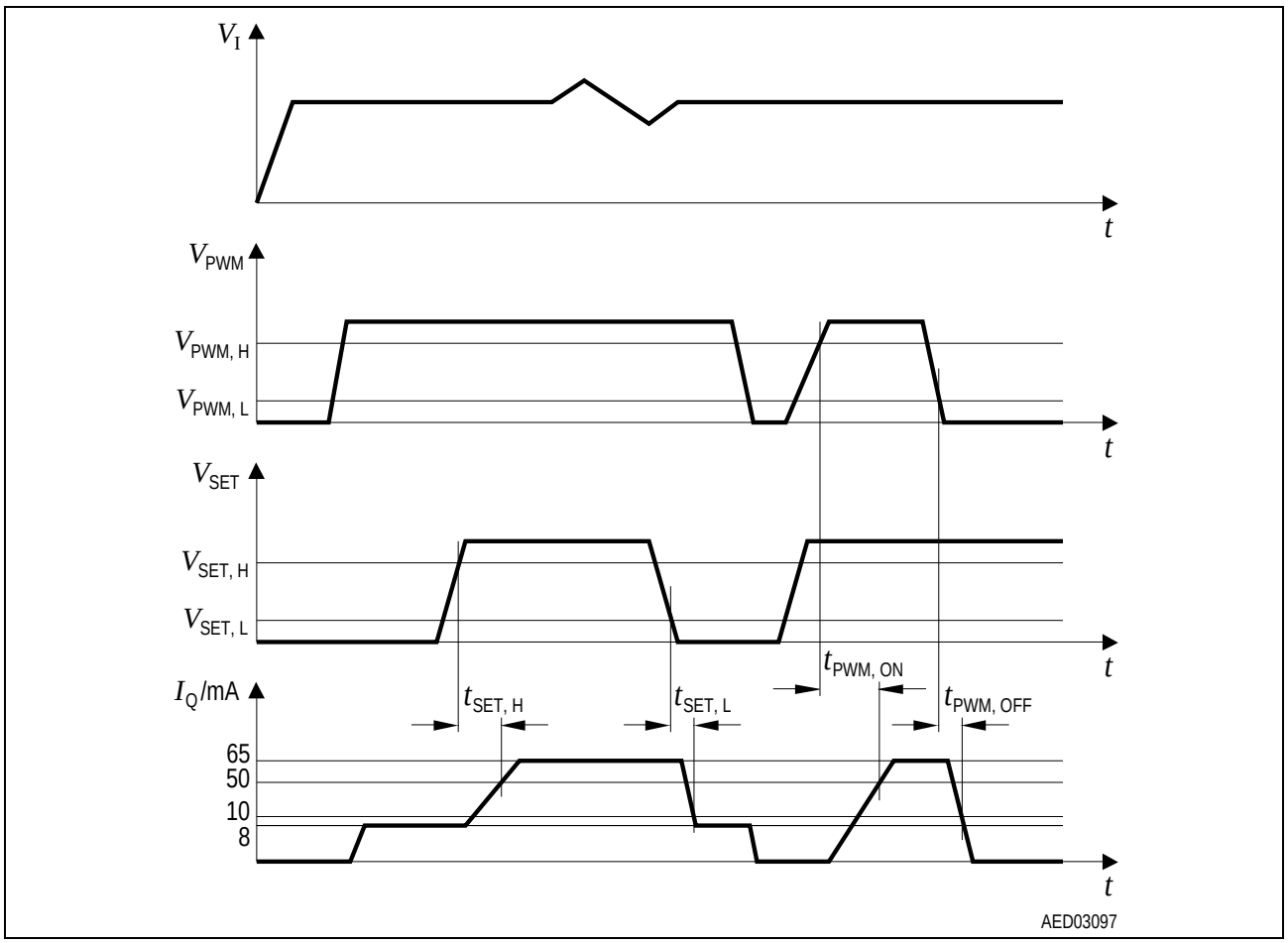



**Figure 3 Timing and Function Diagram, $R_{REF}$ = 12 KΩ**

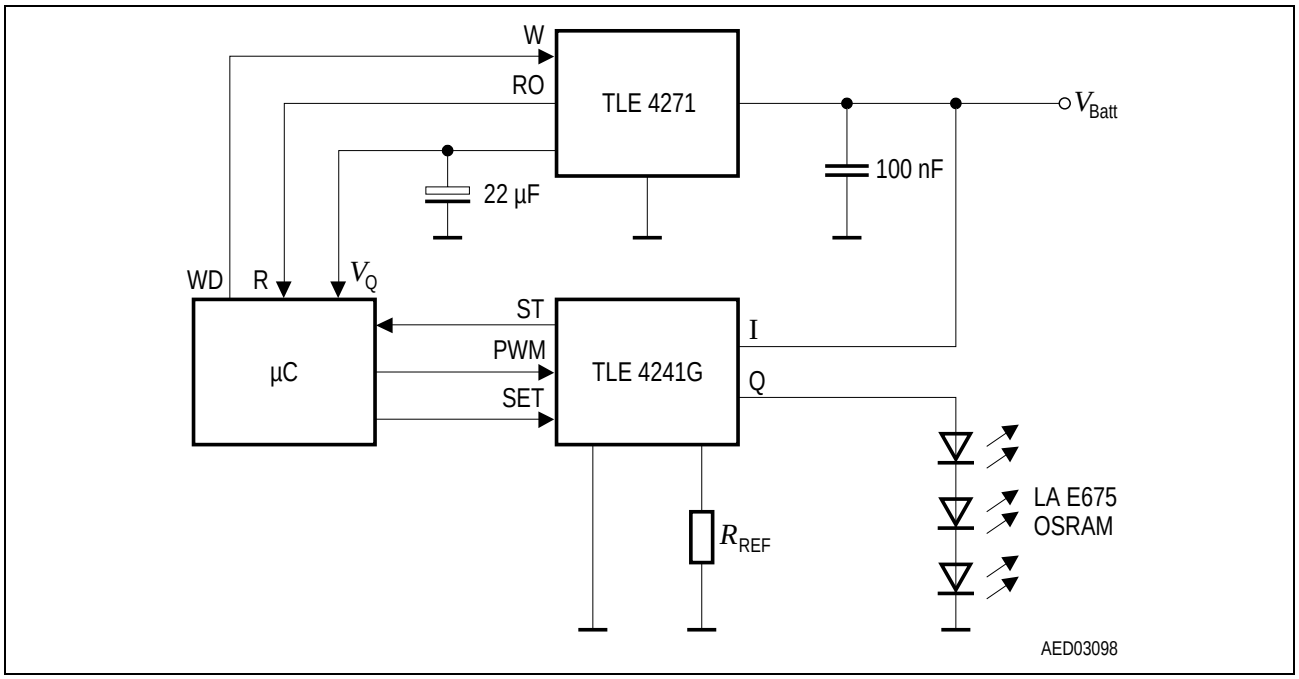
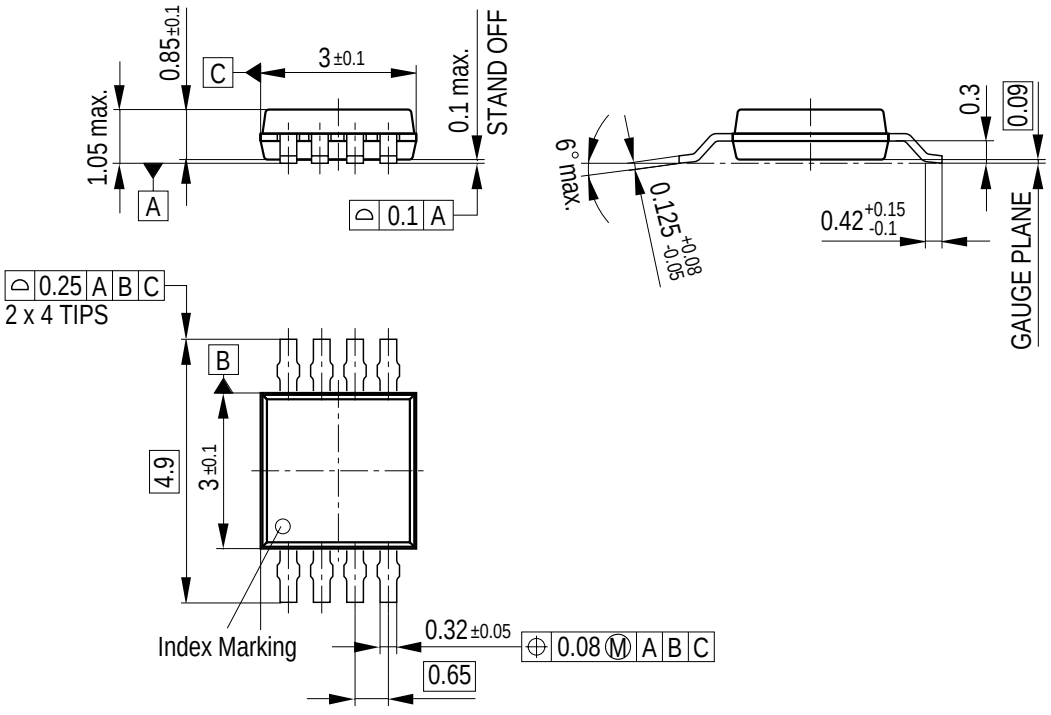



**Figure 4 Application Circuit**

## Package Outlines

**P-TSOP-8**
(Special Package)




**Sorts of Packing**
Package outlines for tubes, trays etc. are contained in our Data Book “Package Information”.

SMD = Surface Mounted Device

Dimensions in mm

**Edition 2000-10-20**

**Published by Infineon Technologies AG,
St.-Martin-Strasse 53,
D-81541 München, Germany**



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