

# TLE4296-2

Low Drop Voltage Regulator

TLE4296-2GV33  
TLE4296-2GV50

## Data Sheet

Rev. 1.13, 2014-03-18

Automotive Power



## 1 Overview

### Features

- Two versions: 3.3 V, 5.0 V
- Output voltage tolerance  $\leq \pm 4\%$
- Very low drop voltage
- Output current: 30 mA
- Inhibit input
- Low quiescent current consumption
- Wide operation range: up to 45 V
- Wide temperature range:  $T_j = -40\text{ °C}$  to  $+150\text{ °C}$
- Output protected against short circuit
- Overtemperature protection
- Reverse polarity proof
- Very small SMD-Package PG-SCT595
- Green Product (RoHS compliant)
- AEC Qualified



PG-SCT595

### Description

The TLE4296-2 is a monolithic integrated low-drop voltage regulator in the very small SMD package PG-SCT595. It is designed to supply e.g. microprocessor systems under the severe conditions of automotive applications. Therefore the device is equipped with additional protection functions against overload, short circuit and reverse polarity. At overtemperature the regulator is automatically turned off by the integrated thermal protection circuit.

Input voltages up to 40 V are regulated to  $V_{Q,nom} = 3.3\text{ V}$  (V33 version) or 5.0 V (V50 version). The output is able to drive a load of more than 30 mA while it regulates the output voltage within a 4% accuracy. To save energy the device can be switched in stand-by mode via an inhibit input which causes the current consumption to drop below 5  $\mu\text{A}$ .

| Type          | Package   | Marking |
|---------------|-----------|---------|
| TLE4296-2GV33 | PG-SCT595 | C5      |
| TLE4296-2GV50 | PG-SCT595 | C4      |

## 2 Block Diagram

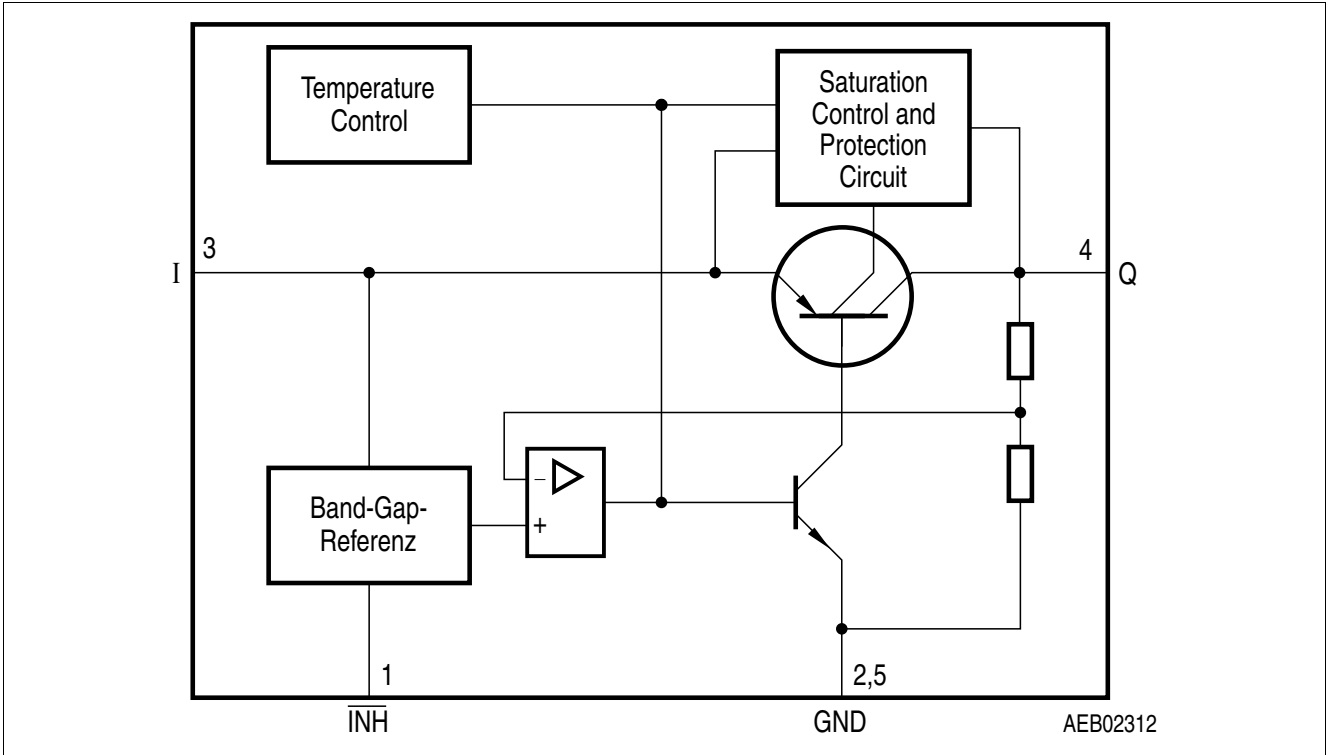


Figure 1 Block Diagram

### 3 Pin Configuration

#### 3.1 Pin Assignment

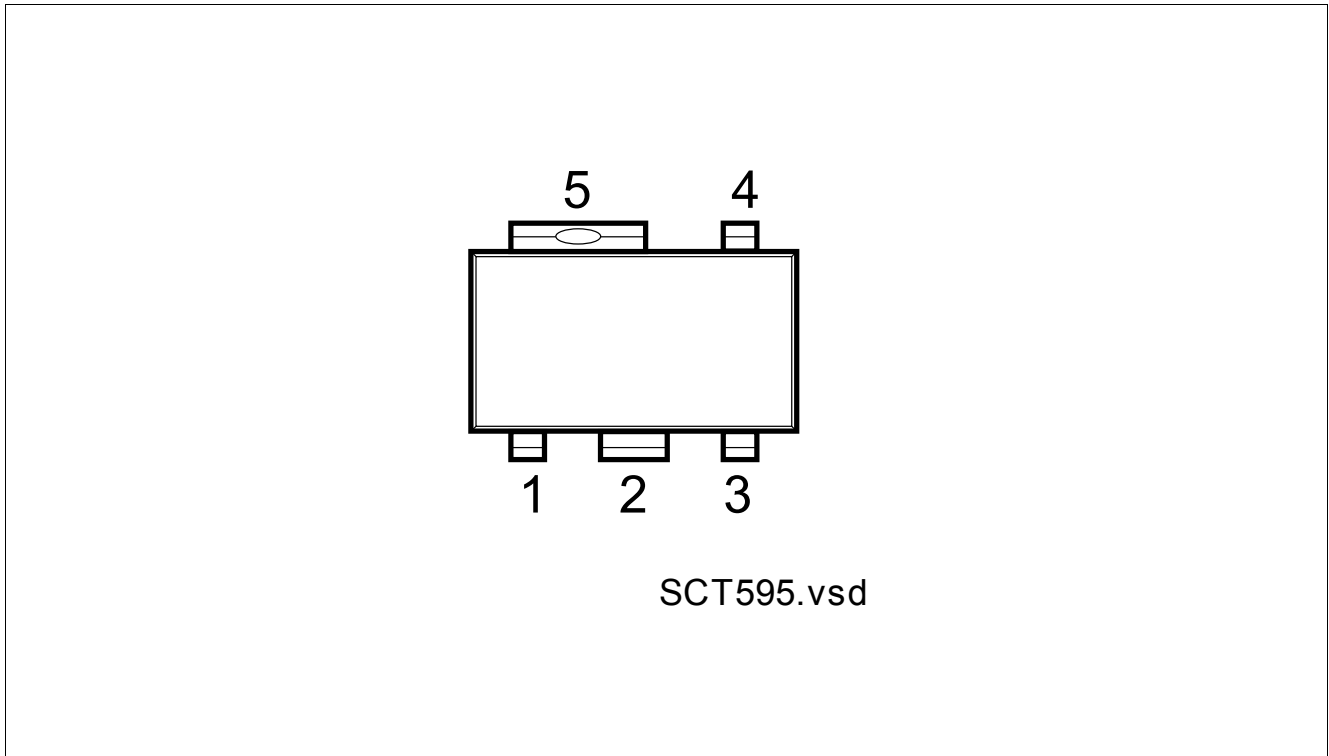


Figure 2 Pin Configuration (top view)

#### 3.2 Pin Definitions and Functions

| Pin | Symbol | Function  |
|-----|--------|---|
| 1   | INH    | <b>Inhibit Input:</b> high level to turn on the IC  |
| 2   | GND    | <b>Ground:</b> connected to pin 5   |
| 3   | I      | <b>Input Voltage</b>  |
| 4   | Q      | <b>Output voltage:</b> must be blocked with a ceramic capacitor $C_Q \geq 3.3 \mu\text{F}$ , $\text{ESR} \leq 2 \Omega$ |
| 5   | GND    | <b>Ground:</b> Connected to pin 2   |

## 4 General Product Characteristics

### 4.1 Absolute Maximum Ratings

#### Absolute Maximum Ratings <sup>1)</sup>

$T_j = -40\text{ °C}$  to  $+150\text{ °C}$ ; all voltages with respect to ground, positive current flowing into pin (unless otherwise specified)

| Pos.                      | Parameter                      | Symbol                      | Limit Values |               | Unit               | Conditions   |
|---------------------------|--------------------------------|-----------------------------|--------------|---------------|--------------------|--|
|                           |                                |                             | Min.         | Max.          |                    |  |
| <b>Input</b>              |                                |                             |              |               |                    |  |
| 4.1.1                     | Voltage                        | $V_I$                       | -42          | 45            | V                  | –  |
| 4.1.2                     | Current                        | $I_I$                       | –            | –             | mA                 | <sup>2)</sup>  |
| <b>Output</b>             |                                |                             |              |               |                    |  |
| 4.1.3                     | Voltage                        | $V_Q$                       | -0.3         | 30            | V                  | –  |
| 4.1.4                     | Current                        | $I_Q$                       | –            | –             | mA                 | <sup>2)</sup>  |
| <b>Inhibit</b>            |                                |                             |              |               |                    |  |
| 4.1.5                     | Voltage                        | $V_{\overline{\text{INH}}}$ | -42          | 45            | V                  | –  |
| 4.1.6                     | Current                        | $I_{\overline{\text{INH}}}$ | -500         | <sup>2)</sup> | $\mu\text{A}$      | –  |
| 4.1.7                     | Current                        | $I_{\overline{\text{INH}}}$ | -5           | 5             | mA                 | $-0.3\text{ V} \leq V_I \leq 45\text{ V}$ ;<br>$t_p < 1\text{ ms}$ |
| <b>Temperatures</b>       |                                |                             |              |               |                    |  |
| 4.1.8                     | Junction Temperature           | $T_j$                       | -40          | 150           | $^{\circ}\text{C}$ | –  |
| 4.1.9                     | Storage Temperature            | $T_{\text{stg}}$            | -50          | 150           | $^{\circ}\text{C}$ | –  |
| <b>Thermal Resistance</b> |                                |                             |              |               |                    |  |
| 4.1.10                    | Junction Pin                   | $R_{\text{thj-pin}}$        | –            | 30            | K/W                | Measured to pin 5  |
| 4.1.11                    | Junction ambient <sup>3)</sup> | $R_{\text{thja}}$           | –            | 179           | K/W                | Zero airflow ;<br>zero heat sink area                              |

1) Not subject to production test, specified by design.

2) Internally limited

3) Worst case regarding peak temperature

*Note: Stresses above the ones listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

*Note: Integrated protection functions are designed to prevent IC destruction under fault conditions described in the data sheet. Fault conditions are considered as “outside” normal operating range. Protection functions are not designed for continuous repetitive operation.*

## 4.2 Functional Range

**Table 1 Example 1 for Functional Range - use only for MOSFET and Voltage Linear Regulator**

| Pos.  | Parameter            | Symbol                      | Limit Values |      | Unit | Conditions    |
|-------|----------------------|-----------------------------|--------------|------|------|---------------|
|       |                      |                             | Min.         | Max. |      |               |
| 4.2.1 | Input Voltage        | $V_1$                       | 4.0          | 45   | V    | TLE4296-2GV33 |
| 4.2.2 |                      |                             | 5.5          | 45   | V    | TLE4296-2GV50 |
| 4.2.3 | Inhibit Voltage      | $V_{\overline{\text{INH}}}$ | -0.3         | 40   | V    | –             |
| 4.2.4 | Junction Temperature | $T_j$                       | -40          | 150  | °C   | –             |

*Note: Within the functional or operating range, the IC operates as described in the circuit description. The electrical characteristics are specified within the conditions given in the Electrical Characteristics table.*

## 5 Electrical Characteristics

### 5.1 Electrical Characteristics Voltage Regulator

#### Electrical Characteristics

$V_I = 13.5 \text{ V}$ ;  $V_{\text{INH}} > 2.5 \text{ V}$ ;  $T_j = -40 \text{ }^\circ\text{C}$  to  $+150 \text{ }^\circ\text{C}$ ; all voltages with respect to ground (unless otherwise specified)

| Pos.   | Parameter                     | Symbol          | Limit Values |      |      | Unit          | Measuring Condition   |
|--------|-------------------------------|-----------------|--------------|------|------|---------------|---|
|        |                               |                 | Min.         | Typ. | Max. |               |   |
| 5.1.1  | Output Voltage                | $V_Q$           | 3.17         | 3.3  | 3.43 | V             | $1 \text{ mA} \leq I_Q \leq 30 \text{ mA}$  |
| 5.1.2  | TLE4296-2GV33                 |                 | 3.17         | 3.3  | 3.43 | V             | $I_Q = 10 \text{ mA}$ ;<br>$4.3 \text{ V} \leq V_I \leq 40 \text{ V}$   |
| 5.1.1  | Output Voltage                | $V_Q$           | 4.80         | 5.00 | 5.20 | V             | $1 \text{ mA} \leq I_Q \leq 30 \text{ mA}$  |
| 5.1.2  | TLE4296-2GV50                 |                 | 4.80         | 5.00 | 5.20 | V             | $I_Q = 10 \text{ mA}$ ;<br>$6 \text{ V} \leq V_I \leq 40 \text{ V}$   |
| 5.1.3  | Output Current Limitation     | $I_Q$           | 30           | –    | –    | mA            | <sup>1)</sup>   |
| 5.1.4  | Dropout Voltage <sup>1)</sup> | $V_{\text{dr}}$ | –            | 250  | 300  | mV            | $I_Q = 20 \text{ mA}$   |
| 5.1.5  | Output capacitor              | $C_Q$           | 3.3          | –    | –    | $\mu\text{F}$ | $\text{ESR} \leq 2 \Omega$ at 10 kHz  |
| 5.1.6  | Current Consumption           | $I_q$           | –            | 2    | 5.2  | mA            | $I_Q < 30 \text{ mA}$   |
| 5.1.7  | $I_q = I_I - I_Q$             |                 | –            | 130  | 170  | $\mu\text{A}$ | $I_Q < 0.1 \text{ mA}$ ; $T_j < 85 \text{ }^\circ\text{C}$  |
| 5.1.8  | Quiescent Current (stand-by)  | $I_q$           | –            | –    | 1    | $\mu\text{A}$ | $V_{\text{INH}} = 0.4 \text{ V}$ ; $T_j < 85 \text{ }^\circ\text{C}$  |
| 5.1.9  | $I_q = I_I - I_Q$             |                 | –            | –    | 5    | $\mu\text{A}$ | $V_{\text{INH}} = 0.4 \text{ V}$  |
| 5.1.10 | Load Regulation               | $\Delta V_Q$    | –            | 17   | 50   | mV            | $1 \text{ mA} < I_Q < 25 \text{ mA}$ ;<br>$T_j = 25 \text{ }^\circ\text{C}$ ;<br>TLE4296-2GV50                      |
| 5.1.11 |                               |                 | –            | 14   | 40   | mV            | $1 \text{ mA} < I_Q < 25 \text{ mA}$ ;<br>$T_j = 25 \text{ }^\circ\text{C}$ ;<br>TLE4296-2GV33                      |
| 5.1.12 | Line Regulation               | $\Delta V_Q$    | –            | 10   | 25   | mV            | $V_I = (V_{Q,\text{nom}} + 0.5 \text{ V})$<br>to 36 V ;<br>$I_Q = 1 \text{ mA}$ ; $T_j = 25 \text{ }^\circ\text{C}$ |
| 5.1.13 | Power Supply Ripple Rejection | PSRR            | –            | 60   | –    | dB            | $f_r = 100 \text{ kHz}$ ; $V_r = 0.5 \text{ Vpp}$   |

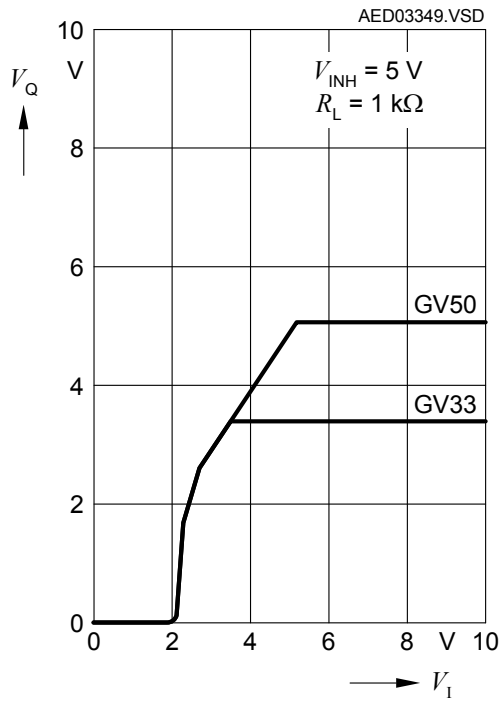
#### Logic Inhibit Input

|        |                           |                              |     |   |     |               |                                     |
|--------|---------------------------|------------------------------|-----|---|-----|---------------|-------------------------------------|
| 5.1.14 | Inhibit, Turn-on voltage  | $V_{\text{INH},\text{high}}$ | –   | – | 2.2 | V             | $V_Q > 0.95 \cdot V_{Q,\text{nom}}$ |
| 5.1.15 | Inhibit, Turn-off voltage | $V_{\text{INH},\text{low}}$  | 0.4 | – | –   | V             | $V_Q < 0.1 \text{ V}$               |
| 5.1.16 | H-input current           | $I_{\text{INH},\text{high}}$ | –   | 8 | 12  | $\mu\text{A}$ | $V_{\text{INH}} = 5 \text{ V}$      |
| 5.1.17 | L-input current           | $I_{\text{INH},\text{low}}$  | -2  | – | 2   | $\mu\text{A}$ | $V_{\text{INH}} = 0 \text{ V}$      |

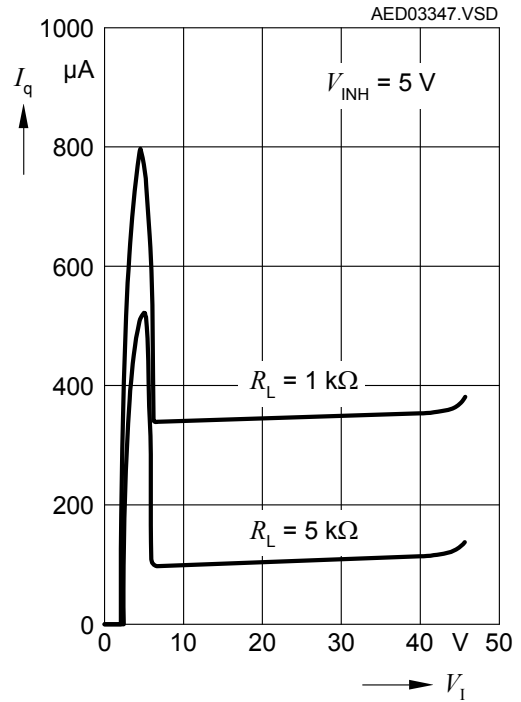
1) Measured when the output voltage  $V_Q$  has dropped 100 mV from the nominal value.

## 5.2 Typical Performance Characteristics Voltage Regulator

Output Voltage  $V_Q$  vs. Input Voltage  $V_I$



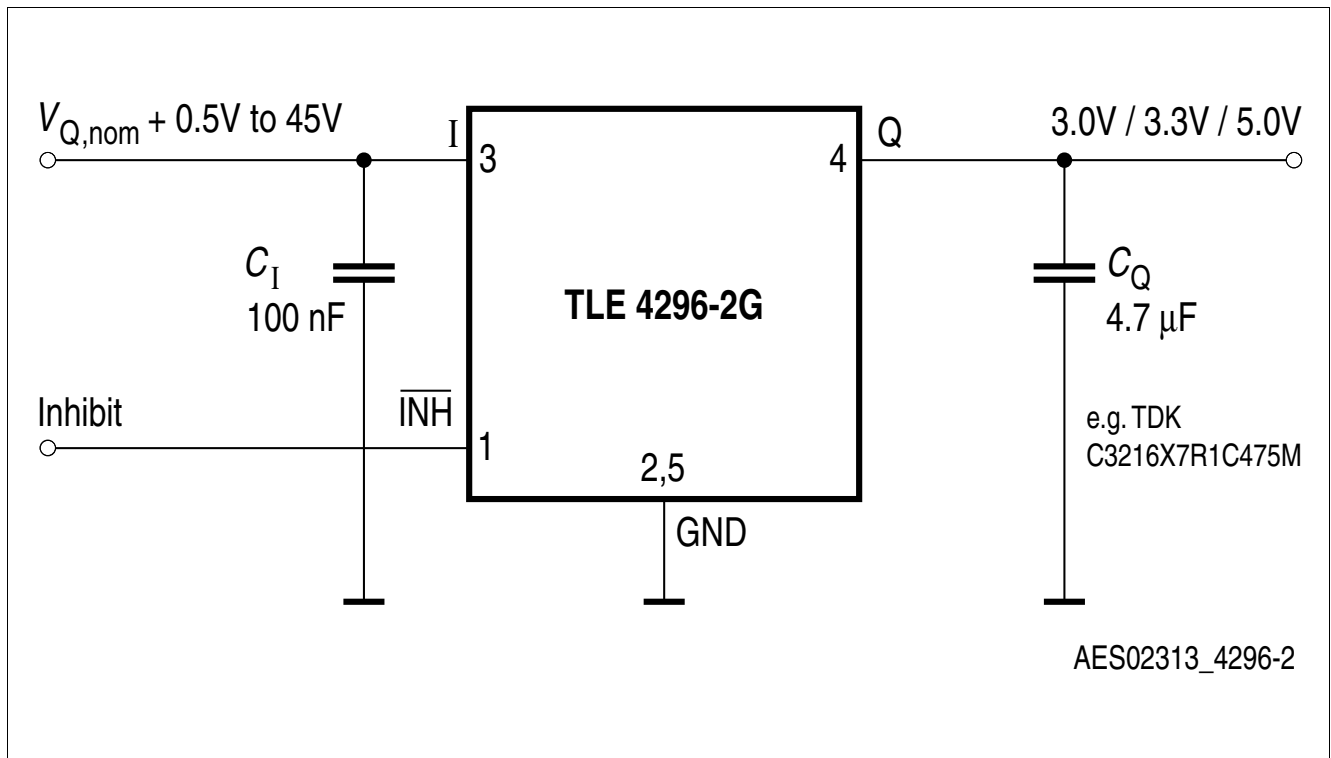
Current Consumption  $I_q$  vs. Input Voltage  $V_I$





## 6 Application Information

Note: The following information is given as a hint for the implementation of the device only and shall not be regarded as a description or warranty of a certain functionality, condition or quality of the device.



**Figure 3 Application Diagram**

In the TLE4296-2 the output voltage is divided and compared to an internal reference of 2.5 V typical. The regulation loop controls the output to achieve a stabilized output voltage.

**Figure 3** shows a typical application circuit. In order to maintain the stability of the control loop the TLE4296-2 output requires an output capacitor  $C_Q$  of at least 3.3  $\mu\text{F}$  with a maximum permissible ESR of 2  $\Omega$ . It is recommended to use a multi layer ceramic capacitor for  $C_Q$ , e.g. the TDK C3216X7R1C475M with a nominal capacitance of 4.7  $\mu\text{F}$ . Aluminum electrolytic as well as tantalum capacitors do not cover the required ESR range over the full operating temperature range of  $T_j = -40\text{ }^\circ\text{C}$  to  $+150\text{ }^\circ\text{C}$ .

At the input of the regulator an input capacitor is necessary for compensating line influences (100 nF ceramic capacitor recommended). A resistor of approx. 1  $\Omega$  in series with  $C_I$ , can damp any oscillation occurring due the input inductivity and the input capacitor. If the regulator is sourced via long input lines of several meters it is recommended to place an additional electrolytic capacitor  $\geq 47\text{ }\mu\text{F}$  at the input.

## 7 Package Outlines

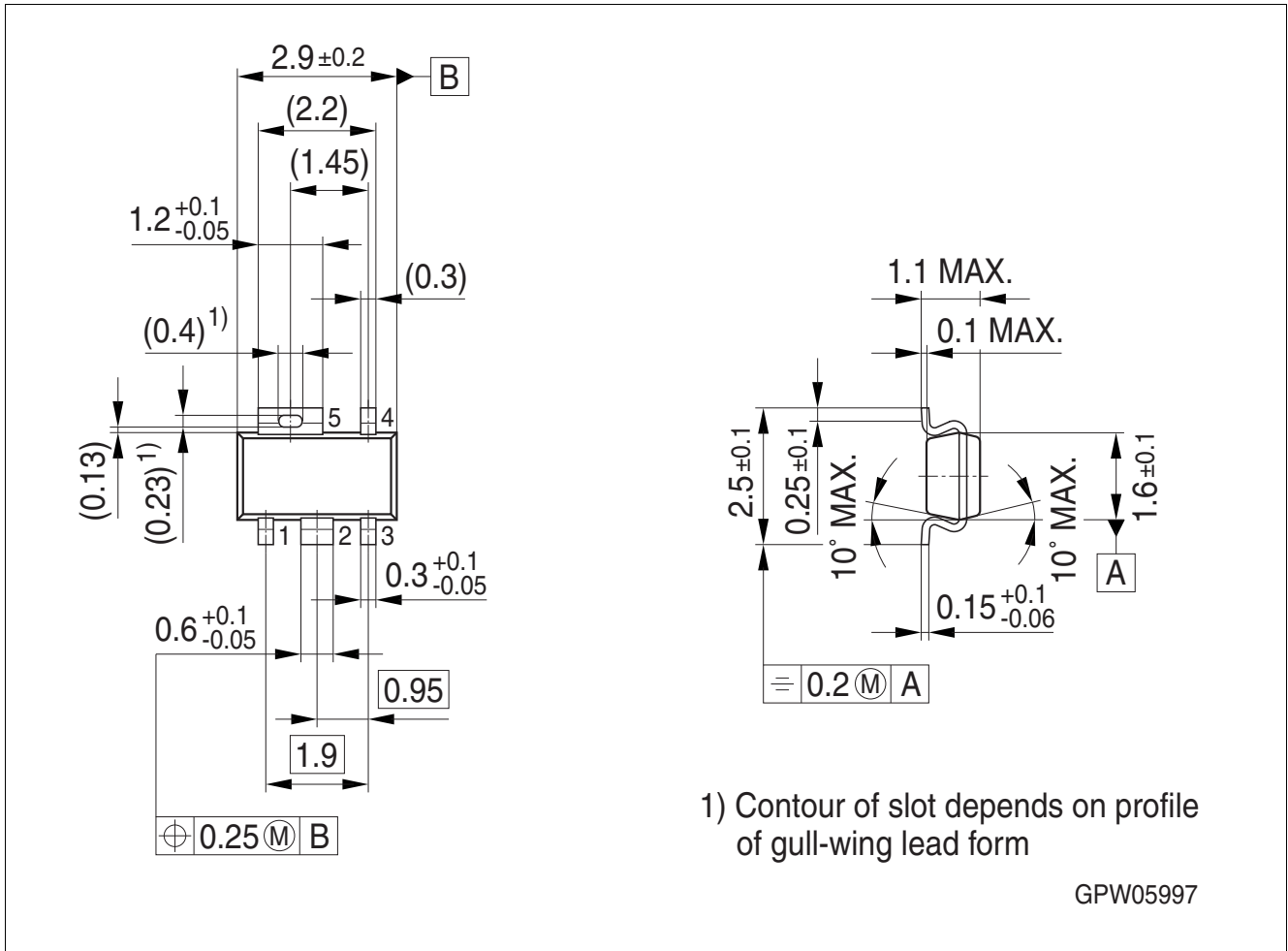


Figure 4 PG-SCT595 (Plastic Small Outline)

### Green Product (RoHS compliant)

To meet the world-wide customer requirements for environmentally friendly products and to be compliant with government regulations the device is available as a green product. Green products are RoHS-Compliant (i.e. Pb-free finish on leads and suitable for Pb-free soldering according to IPC/JEDEC J-STD-020).

For further information on alternative packages, please visit our website:

<http://www.infineon.com/packages>.

Dimensions in mm

## 8 Revision History

| Revision  | Date       | Changes   |
|-----------|------------|---|
| Rev. 1.13 | 2014-03-18 | <b>Page 5:</b> Typo (introduced in Rev. 1.11) in Unit of parameter <b>4.1.6</b> corrected from A to $\mu\text{A}$ . No change of the device or test limits.   |
| Rev. 1.12 | 2011-05-11 | <b>Page 2:</b> Current Consumption in Standby corrected from 5mA to 5 $\mu\text{A}$ in the Functional Description. Value in Electrical Characteristics is still correct.  |
| Rev. 1.11 | 2011-02-10 | <b>Page 2:</b> Marking added.<br><b>Page 1:</b> Coverpage added.<br>All Pages: New Infineon Data Sheet Layout applied.  |
| Rev. 1.1  | 2008-01-28 | Initial version of RoHS-compliant derivate of TLE 4296-2<br><b>Page 2:</b> AEC certified statement added.<br><b>Page 2</b> and <b>Page 10:</b> RoHS compliance statement and Green product feature added.<br><b>Page 2</b> and <b>Page 10:</b> Package changed to RoHS compliant version.<br>Legal Disclaimer updated |
| Rev. 1.0  | 2004-01-01 | Final Data Sheet  |

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