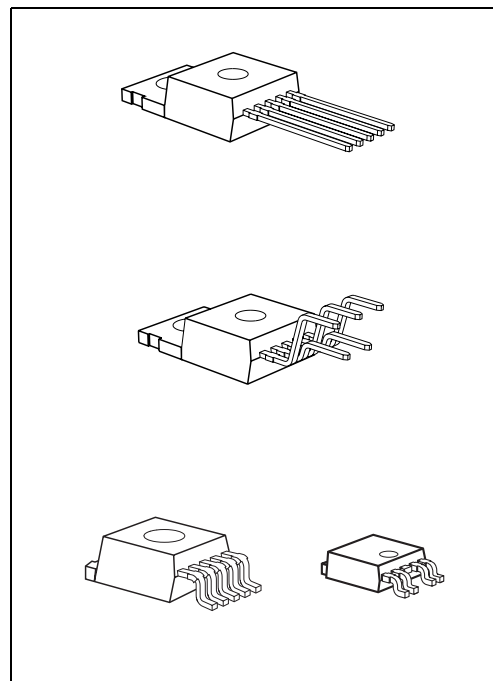




## Features

- 5 V, 8.5 V, 10 V or variable output voltage
- Output voltage tolerance  $\leq \pm 4\%$
- 400 mA current capability
- Low-drop voltage
- Inhibit input
- Very low current consumption
- Short-circuit-proof
- Reverse polarity proof
- Suitable for use in automotive electronics
- Green Product (RoHS compliant)
- AEC Qualified



| Type          | Package       | Type          | Package       |
|---------------|---------------|---------------|---------------|
| TLE 4276 V50  | PG-TO220-5-11 | TLE 4276 GV50 | PG-TO263-5-1  |
| TLE 4276 V85  | PG-TO220-5-11 | TLE 4276 GV85 | PG-TO263-5-1  |
| TLE 4276 V10  | PG-TO220-5-11 | TLE 4276 GV10 | PG-TO263-5-1  |
| TLE 4276 V    | PG-TO220-5-11 | TLE 4276 GV   | PG-TO263-5-1  |
| TLE 4276 SV50 | PG-TO220-5-12 | TLE 4276 DV50 | PG-TO252-5-11 |
| TLE 4276 SV85 | PG-TO220-5-12 | TLE 4276 DV   | PG-TO252-5-11 |
| TLE 4276 SV   | PG-TO220-5-12 |               |               |

## Functional Description

The TLE 4276 is a low-drop voltage regulator in a TO package. The IC regulates an input voltage up to 40 V to  $V_{Q,nom} = 5.0\text{ V (V50)}$ ,  $8.5\text{ V (V85)}$ ,  $10\text{ V (V10)}$  and adjustable voltage (V). The maximum output current is 400 mA. The IC can be switched off via the inhibit input, which causes the current consumption to drop below  $10\text{ }\mu\text{A}$ . The IC is short-circuit-proof and includes temperature protection which turns off the device at overtemperature.

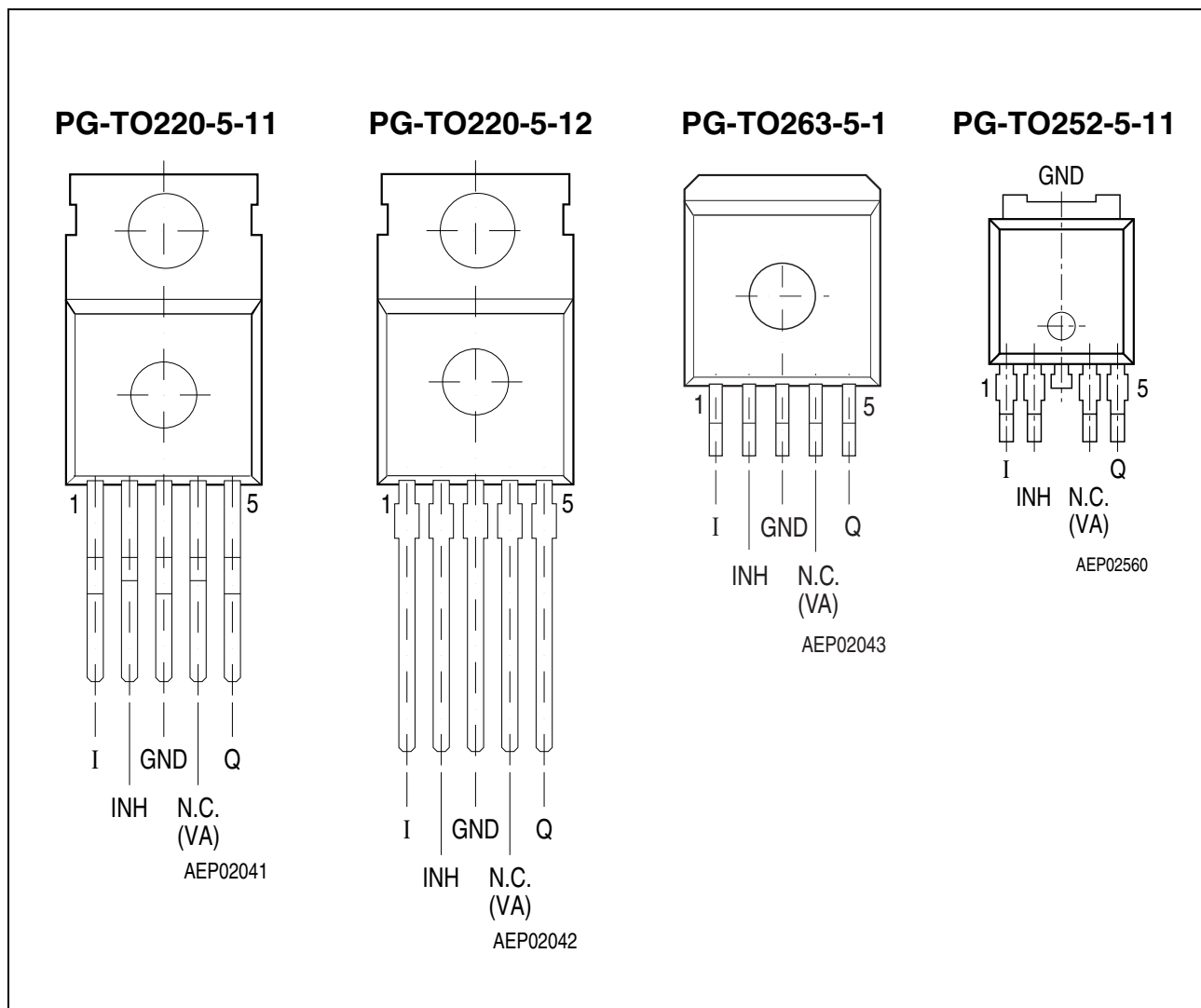
## Dimensioning Information on External Components

The input capacitor  $C_I$  is necessary for compensation of line influences. Using a resistor of approx.  $1\text{ }\Omega$  in series with  $C_I$ , the oscillating of input inductivity and input capacitance can be damped. The output capacitor  $C_O$  is necessary for the stability of the regulation circuit. Stability is guaranteed at values  $C_O \geq 22\text{ }\mu\text{F}$  and an ESR of  $\leq 3\text{ }\Omega$  within the operating temperature range.

## Circuit Description

The control amplifier compares a reference voltage to a voltage that is proportional to the output voltage and drives the base of the series transistor via a buffer. Saturation control as a function of the load current prevents any oversaturation of the power element. The IC also incorporates a number of internal circuits for protection against:

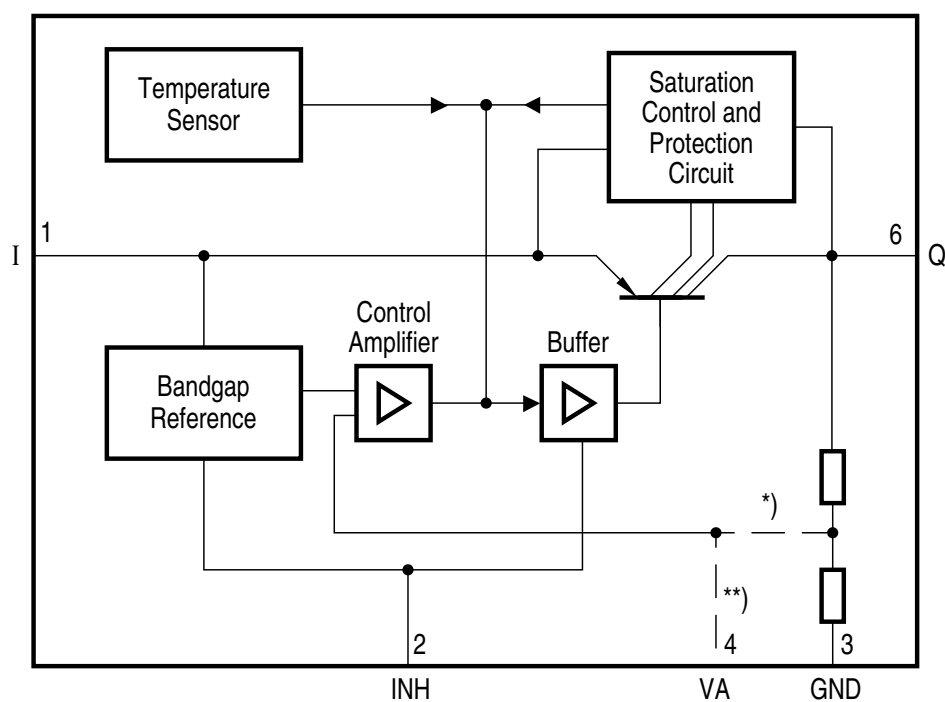
- Overload
- Overtemperature
- Reverse polarity



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

**Table 1** Pin Definitions and Functions

| Pin No.  | Symbol     | Function                                                                                                                                                                  |
|----------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | I          | <b>Input</b> ; block to ground directly at the IC with a ceramic capacitor.                                                                                               |
| 2        | INH        | <b>Inhibit</b> ; low-active input.                                                                                                                                        |
| 3        | GND        | <b>Ground</b>                                                                                                                                                             |
| 4        | N.C.<br>VA | <b>Not connected</b> for V50, V85, V10<br><b>Voltage Adjust Input</b> ; only for adjustable version. Connect an external voltage divider to determine the output voltage. |
| 5        | Q          | <b>Output</b> ; block to GND with a $\geq 22 \mu\text{F}$ capacitor, $\text{ESR} \leq 3 \Omega$ at 10 kHz                                                                 |
| Heatsink |            | Connect to GND.                                                                                                                                                           |



AEB02044

**Figure 2**      **Block Diagram**

**Table 2 Absolute Maximum Ratings**

| Parameter               | Symbol    | Limit Values |      | Unit | Test Condition     |
|-------------------------|-----------|--------------|------|------|--------------------|
|                         |           | Min.         | Max. |      |                    |
| Input I                 |           |              |      |      |                    |
| Voltage                 | $V_I$     | -42          | 45   | V    | —                  |
| Current                 | $I_I$     | —            | —    | —    | Internally limited |
| Inhibit INH             |           |              |      |      |                    |
| Voltage                 | $V_{INH}$ | -42          | 45   | V    | —                  |
| Voltage Adjust Input VA |           |              |      |      |                    |
| Voltage                 | $V_{VA}$  | -0.3         | 10   | V    | —                  |
| Output Q                |           |              |      |      |                    |
| Voltage                 | $V_Q$     | -1.0         | 40   | V    | —                  |
| Current                 | $I_Q$     | —            | —    | —    | Internally limited |
| Ground GND              |           |              |      |      |                    |
| Current                 | $I_{GND}$ | —            | 100  | mA   | —                  |
| Temperature             |           |              |      |      |                    |
| Junction temperature    | $T_j$     | -40          | 150  | °C   | —                  |
| Storage temperature     | $T_{stg}$ | -50          | 150  | °C   | —                  |

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

**Table 3 ESD Rating**

| Parameter      | Symbol        | Limit Values |      | Unit | Notes            |
|----------------|---------------|--------------|------|------|------------------|
|                |               | Min.         | Max. |      |                  |
| ESD Capability | $V_{ESD,HBM}$ | 2000         | –    | V    | Human Body Model |

**Table 4 Operating Range**

| Parameter            | Symbol | Limit Values |      | Unit | Remarks                             |
|----------------------|--------|--------------|------|------|-------------------------------------|
|                      |        | Min.         | Max. |      |                                     |
| Input voltage        | $V_I$  | $V_Q + 0.5$  | 40   | V    | Fixed voltage devices V50, V85, V10 |
| Input voltage        | $V_I$  | $V_Q + 0.5$  | 40   | V    | Variable device V                   |
| Input voltage        | $V_I$  | 4.5 V        | 40   | V    | Variable device V, $V_Q < 4$ V      |
| Junction temperature | $T_j$  | -40          | 150  | °C   | –                                   |

**Thermal Resistance**

|                  |             |   |    |     |                            |
|------------------|-------------|---|----|-----|----------------------------|
| Junction ambient | $R_{thj-a}$ | – | 65 | K/W | TO220                      |
| Junction ambient | $R_{thj-a}$ | – | 80 | K/W | TO252, TO263 <sup>1)</sup> |
| Junction case    | $R_{thj-c}$ | – | 4  | K/W | –                          |

1) Package mounted on PCB  $80 \times 80 \times 1.5\text{mm}^3$ ; 35μ Cu; 5μ Sn; Footprint only; zero airflow.

**Table 5 Characteristics**
 $V_I = 13.5 \text{ V}; -40^\circ\text{C} < T_j < 150^\circ\text{C}$  (unless otherwise specified)

| Parameter                                 | Symbol       | Limit Values |      |      | Unit          | Measuring Condition                                                                                                                                               | Measuring Circuit |
|-------------------------------------------|--------------|--------------|------|------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|                                           |              | Min.         | Typ. | Max. |               |                                                                                                                                                                   |                   |
| Output voltage                            | $V_Q$        | 4.8          | 5.0  | 5.2  | V             | V50-Version<br>$5 \text{ mA} < I_Q < 400 \text{ mA}$<br>$6 \text{ V} < V_I < 28 \text{ V}$                                                                        | 1                 |
| Output voltage                            | $V_Q$        | 4.8          | 5.0  | 5.2  | V             | V50-Version<br>$5 \text{ mA} < I_Q < 200 \text{ mA}$<br>$6 \text{ V} < V_I < 40 \text{ V}$                                                                        | 1                 |
| Output voltage                            | $V_Q$        | 8.16         | 8.50 | 8.84 | V             | V85-Version<br>$5 \text{ mA} < I_Q < 400 \text{ mA}$<br>$9.5 \text{ V} < V_I < 28 \text{ V}$                                                                      | 1                 |
| Output voltage                            | $V_Q$        | 8.16         | 8.50 | 8.84 | V             | V85-Version<br>$5 \text{ mA} < I_Q < 200 \text{ mA}$<br>$9.5 \text{ V} < V_I < 40 \text{ V}$                                                                      | 1                 |
| Output voltage                            | $V_Q$        | 9.6          | 10.0 | 10.4 | V             | V10-Version<br>$5 \text{ mA} < I_Q < 400 \text{ mA}$<br>$11 \text{ V} < V_I < 28 \text{ V}$                                                                       | 1                 |
| Output voltage                            | $V_Q$        | 9.6          | 10.0 | 10.4 | V             | V10-Version<br>$5 \text{ mA} < I_Q < 200 \text{ mA}$<br>$11 \text{ V} < V_I < 40 \text{ V}$                                                                       | 1                 |
| Output voltage tolerance                  | $\Delta V_Q$ | -4           | —    | 4    | %             | V-Version<br>$R_2 < 50 \text{ k}\Omega$<br>$V_Q + 1 \text{ V} \leq V_I \leq 40 \text{ V}$<br>$V_I > 4.5 \text{ V}$<br>$5 \text{ mA} \leq I_Q \leq 400 \text{ mA}$ | 1                 |
| Output current limitation <sup>1)</sup>   | $I_Q$        | 400          | 600  | 1100 | mA            | —                                                                                                                                                                 | 1                 |
| Current consumption;<br>$I_q = I_I - I_Q$ | $I_q$        | —            | —    | 10   | $\mu\text{A}$ | $V_{\text{INH}} = 0 \text{ V};$<br>$T_j \leq 100^\circ\text{C}$                                                                                                   | 1                 |
| Current consumption;<br>$I_q = I_I - I_Q$ | $I_q$        | —            | 100  | 220  | $\mu\text{A}$ | $I_Q = 1 \text{ mA}$                                                                                                                                              | 1                 |
| Current consumption;<br>$I_q = I_I - I_Q$ | $I_q$        | —            | 5    | 10   | mA            | $I_Q = 250 \text{ mA}$                                                                                                                                            | 1                 |

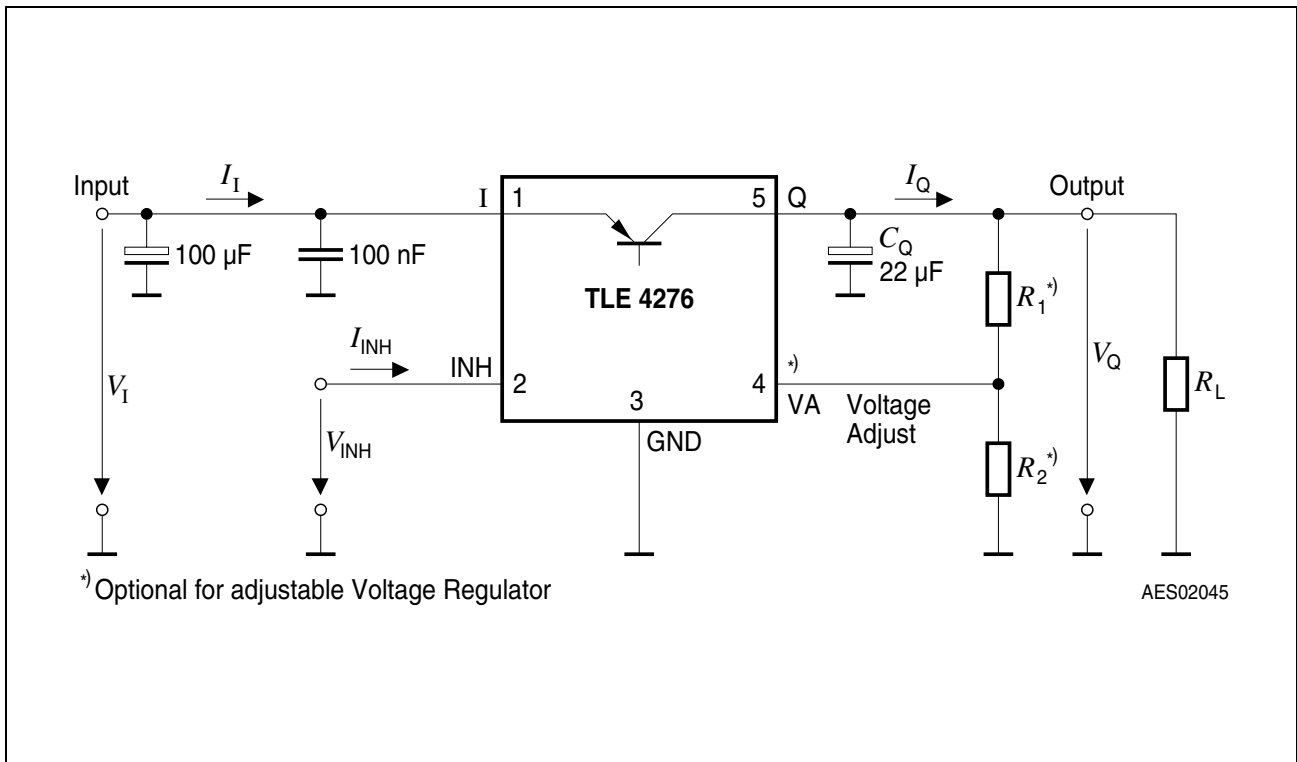
**Table 5 Characteristics (cont'd)**
 $V_I = 13.5 \text{ V}; -40^\circ\text{C} < T_j < 150^\circ\text{C}$  (unless otherwise specified)

| Parameter                                 | Sym-<br>bol       | Limit Values |      |      | Unit | Measuring<br>Condition                                                                      | Measuring<br>Circuit |
|-------------------------------------------|-------------------|--------------|------|------|------|---------------------------------------------------------------------------------------------|----------------------|
|                                           |                   | Min.         | Typ. | Max. |      |                                                                                             |                      |
| Current consumption;<br>$I_q = I_I - I_Q$ | $I_q$             | –            | 15   | 25   | mA   | $I_Q = 400 \text{ mA}$                                                                      | 1                    |
| Drop voltage <sup>1)</sup>                | $V_{DR}$          | –            | 250  | 500  | mV   | V50, V85, V10<br>$I_Q = 250 \text{ mA}$<br>$V_{DR} = V_I - V_Q$                             | 1                    |
| Drop voltage <sup>1)</sup>                | $V_{DR}$          | –            | 250  | 500  | mV   | variable devices<br>$I_Q = 250 \text{ mA}$<br>$V_I > 4.5 \text{ V}$<br>$V_{DR} = V_I - V_Q$ | 1                    |
| Load regulation                           | $\Delta V_{Q,Lo}$ | –            | 5    | 35   | mV   | $I_Q = 5 \text{ mA to } 400 \text{ mA}$                                                     | 1                    |
| Line regulation                           | $\Delta V_{Q,Li}$ | –            | 15   | 25   | mV   | $\Delta V_I = 12 \text{ V to } 32 \text{ V}$<br>$I_Q = 5 \text{ mA}$                        | 1                    |
| Power supply<br>ripple rejection          | $PSRR$            | –            | 54   | –    | dB   | $f_r = 100 \text{ Hz};$<br>$V_r = 0.5 \text{ Vpp}$                                          | 1                    |
| Temperature<br>output voltage<br>drift    | $dV_Q/dT$         | –            | 0.5  | –    | –    | –                                                                                           | mV/K                 |

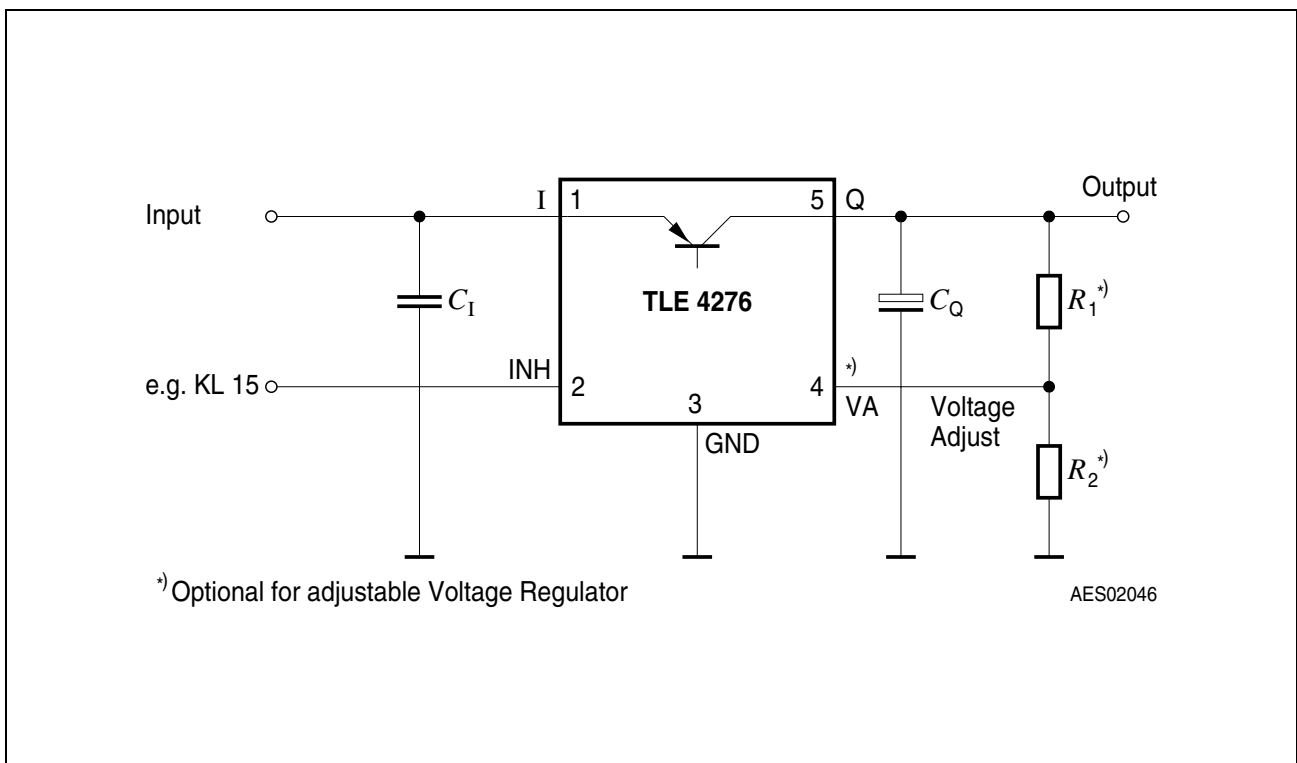
**Inhibit**

|                        |           |     |     |     |               |                          |   |
|------------------------|-----------|-----|-----|-----|---------------|--------------------------|---|
| Inhibit on<br>voltage  | $V_{INH}$ | –   | 2   | 3.5 | V             | $V_Q \geq 4.9 \text{ V}$ | 1 |
| Inhibit off<br>voltage | $V_{INH}$ | 0.5 | 1.7 | –   | V             | $V_Q \leq 0.1 \text{ V}$ | 1 |
| Input current          | $I_{INH}$ | 5   | 10  | 20  | $\mu\text{A}$ | $V_{INH} = 5 \text{ V}$  | 1 |

1) Measured when the output voltage  $V_Q$  has dropped 100 mV from the nominal value obtained at  $V_I = 13.5 \text{ V}$ .



**Figure 3 Measuring Circuit**

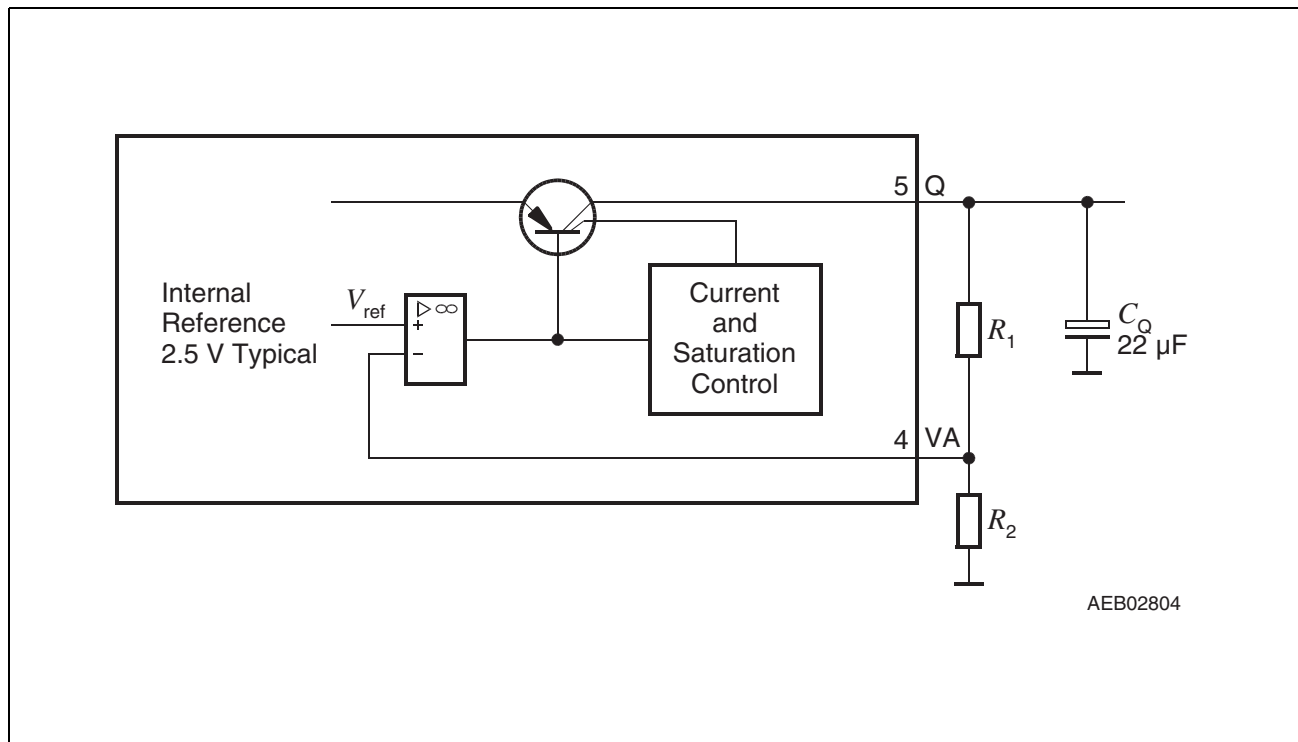


**Figure 4 Application Circuit**

## Application Information for Variable Output Regulator TLE 4276 V, SV, DV, GV

The output voltage of the TLE 4276 V can be adjusted between 2.5 V and 20 V by an external output voltage divider, closing the control loop to the voltage adjust pin VA.

The voltage at pin VA is compared to the internal reference of typical 2.5 V in an error amplifier. It controls the output voltage.



**Figure 5 Application Detail External Components at Output for Variable Voltage Regulator**

The output voltage is calculated according to [Equation \(1\)](#):

$$V_Q = (R_1 + R_2)/R_2 \times V_{ref}, \text{ neglecting } I_{VA} \quad (1)$$

$V_{ref}$  is typically 2.5 V.

To avoid errors caused by leakage current  $I_{VA}$ , we recommend to choose the resistor value  $R_2$  according to [Equation \(2\)](#):

$$R_2 < 50 \text{ k}\Omega \quad (2)$$

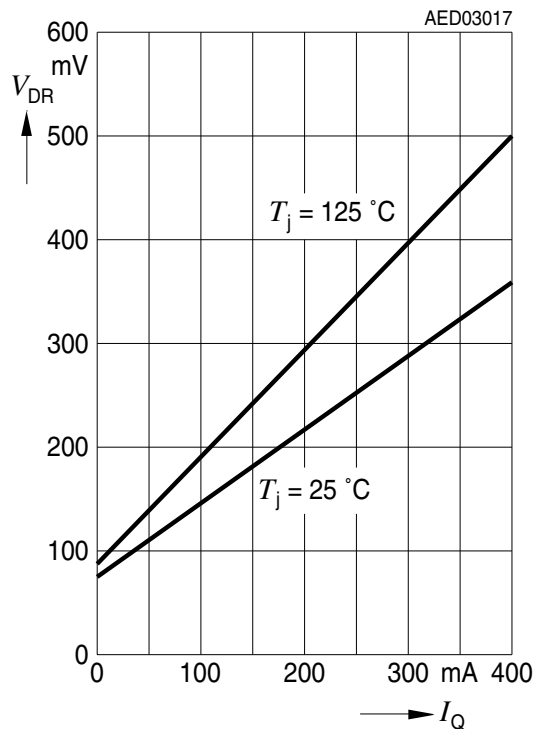
For a 2.5 V output voltage the output pin Q is directly connected to the adjust pin VA.

The accuracy of the resistors  $R_1$  and  $R_2$  add an additional error to the output voltage tolerance.

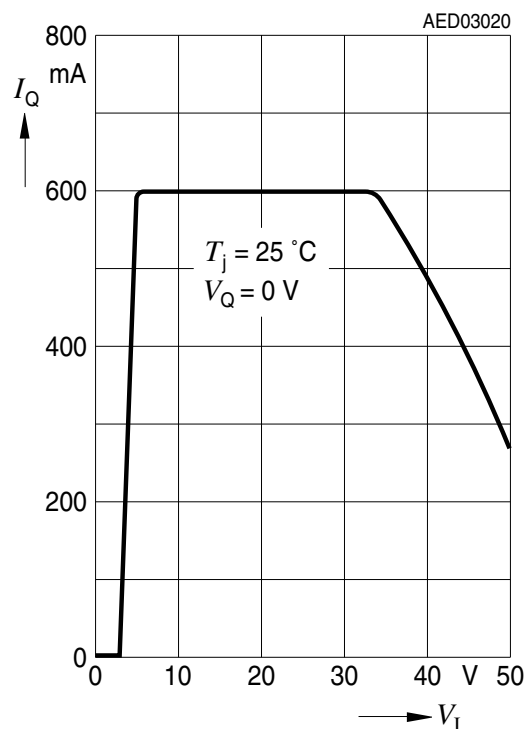
The operation range of the variable TLE 4276 V is  $V_Q + 0.5 \text{ V}$  to 40 V. For internal biasing a minimum input voltage of 4.3 V is required. For output voltages below 4 V the voltage drop is  $4.3 \text{ V} - V_Q$

# Typical Performance Characteristics (V50, V85 and V10):

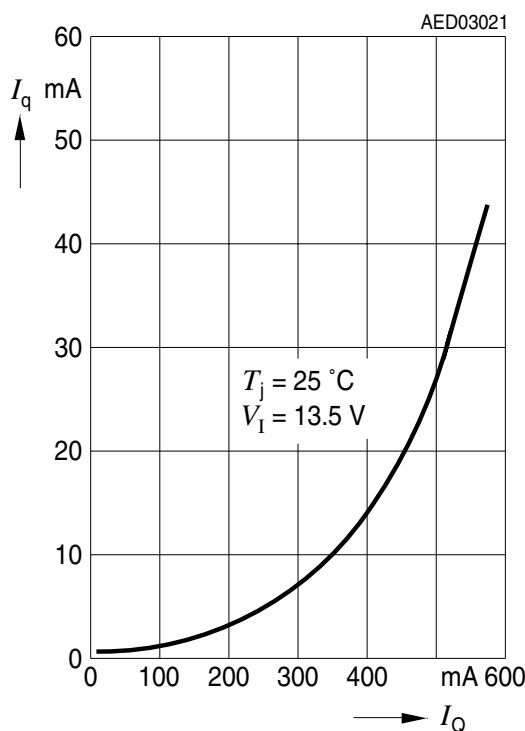
**Voltage  $V_{DR}$  versus Output Current  $I_Q$**



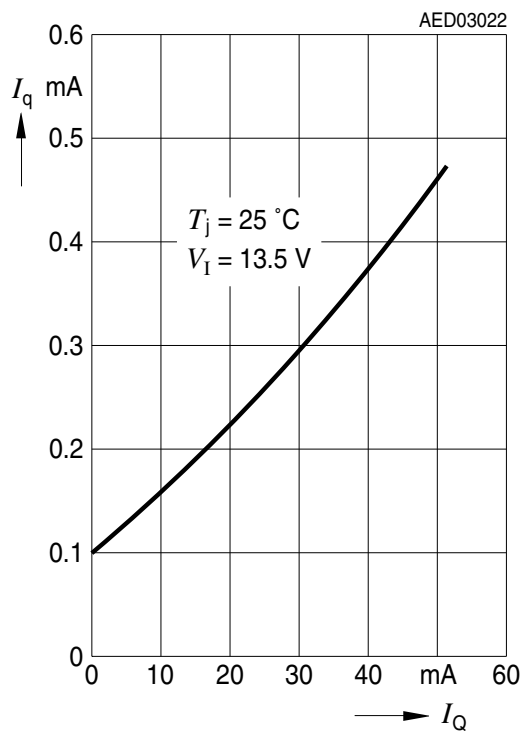
**Max. Output Current  $I_Q$  versus Input Voltage  $V_I$**



**Current Consumption  $I_q$  versus Output Current  $I_Q$  (high load)**

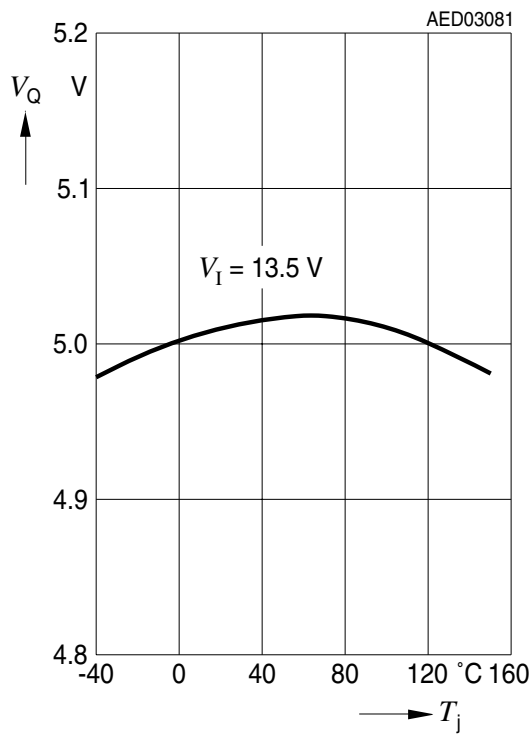


**Current Consumption  $I_q$  versus Output Current  $I_Q$  (low load)**

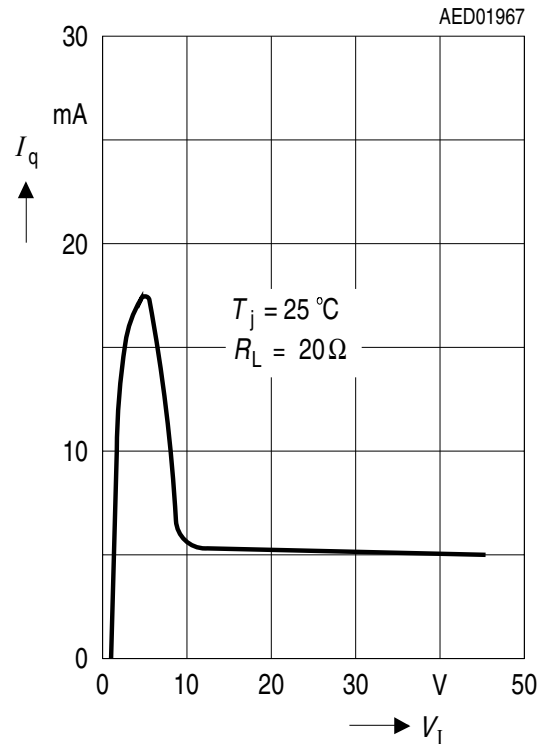


## Typical Performance Characteristics for V50:

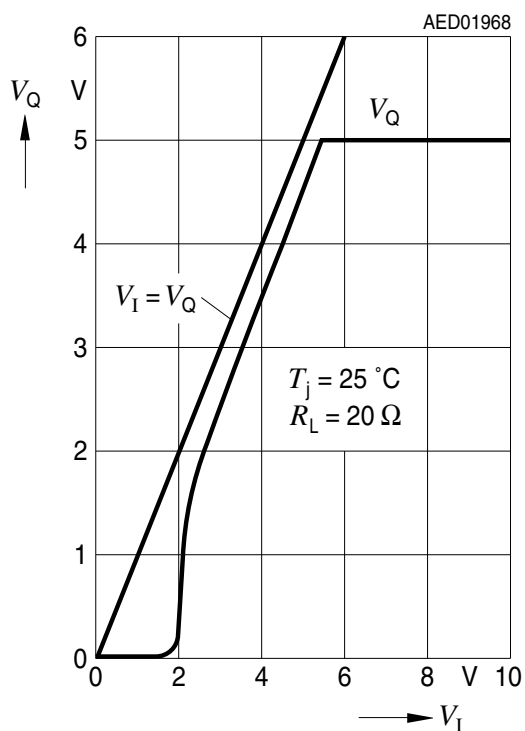
Output Voltage  $V_Q$  versus Temperature  $T_j$



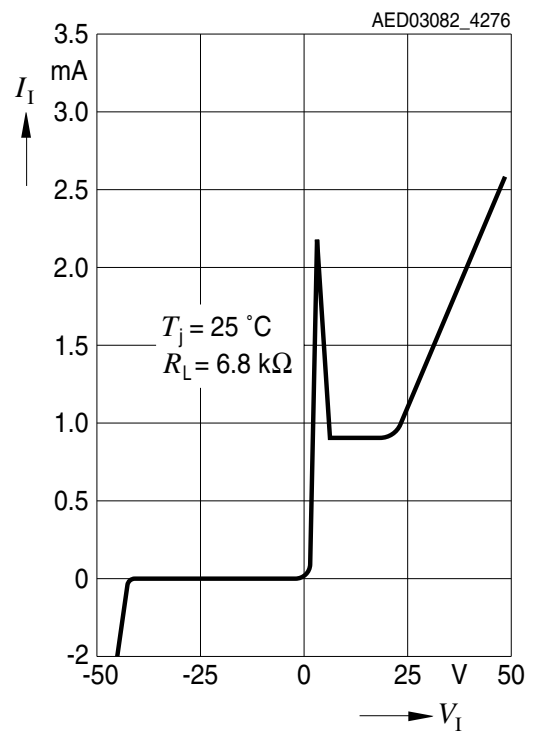
Current Consumption  $I_q$  versus Input Voltage  $V_I$



## Low Voltage Behavior

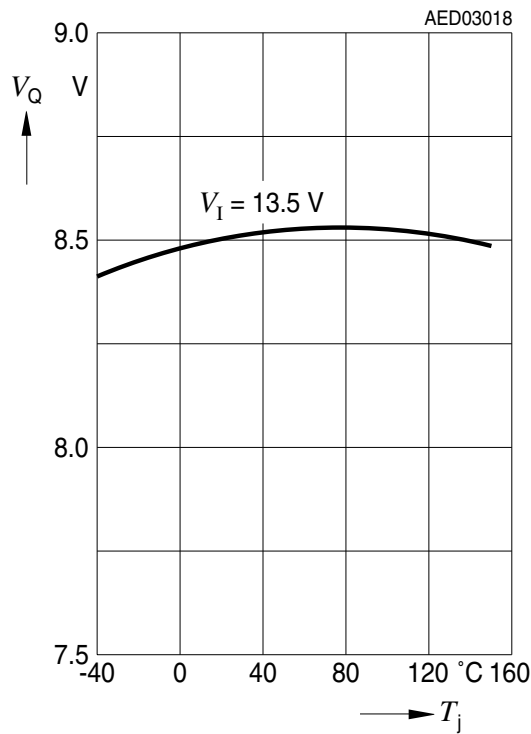


## High Voltage Behavior

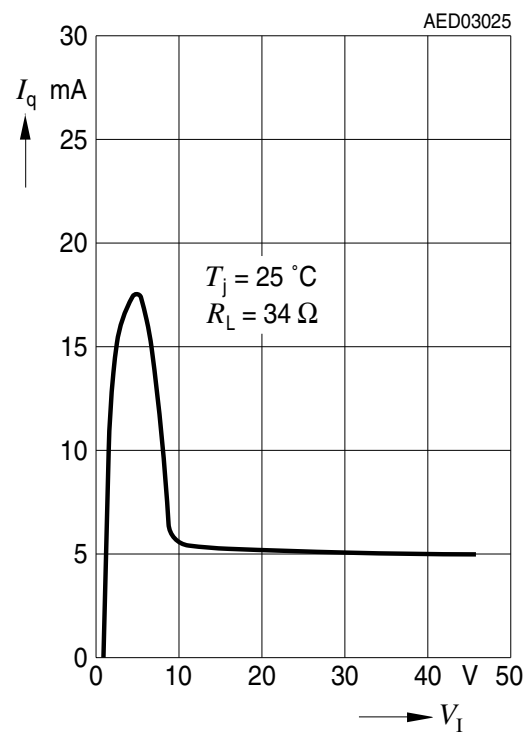


## Typical Performance Characteristics for V85:

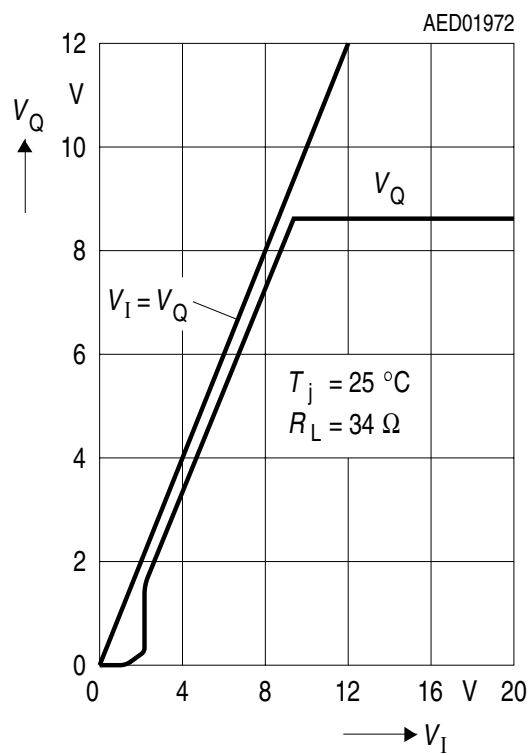
Output Voltage  $V_Q$  versus Temperature  $T_j$



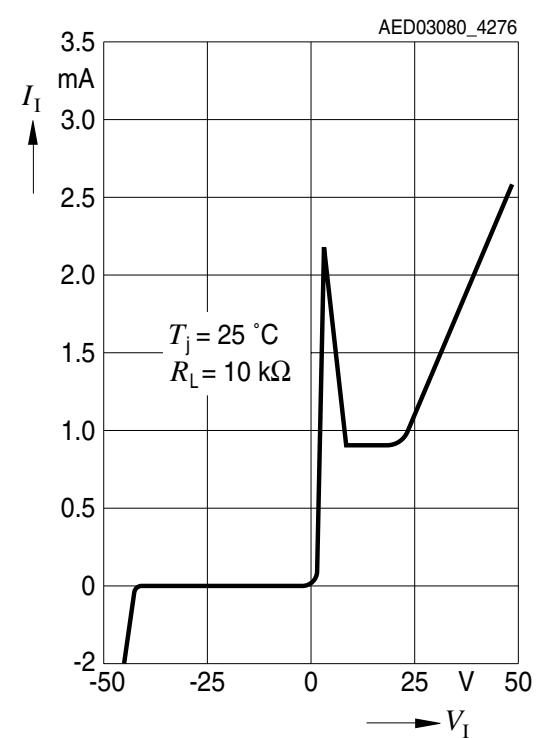
Current Consumption  $I_q$  versus Input Voltage  $V_I$



## Low Voltage Behavior

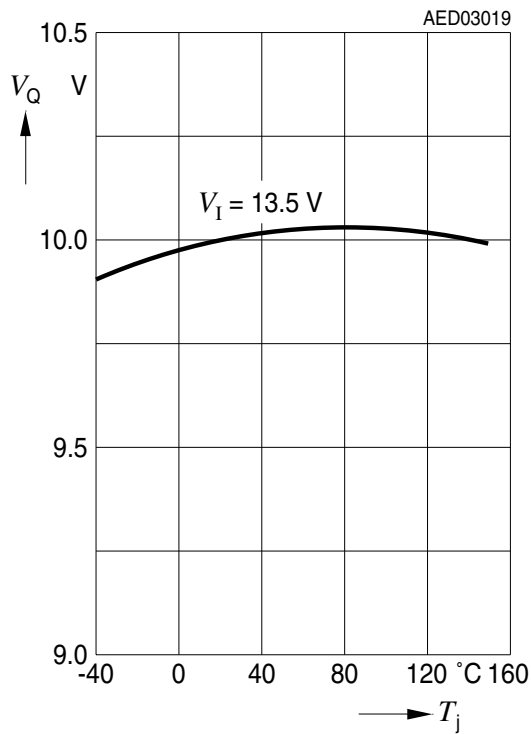


## High Voltage Behavior

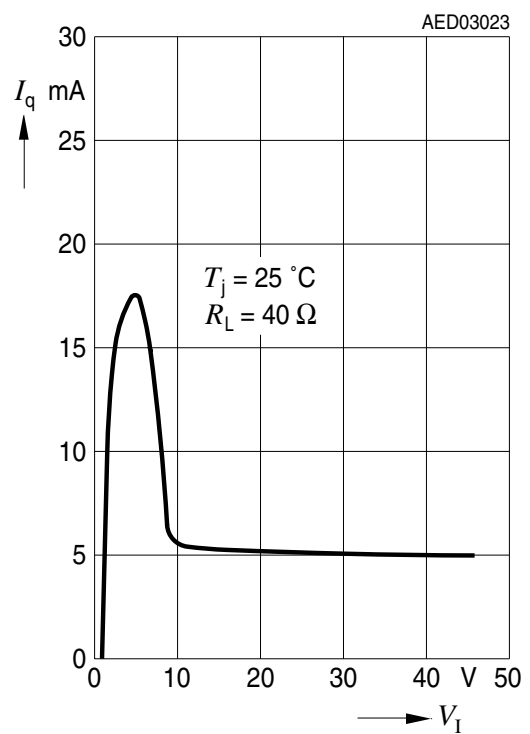


## Typical Performance Characteristics for V10:

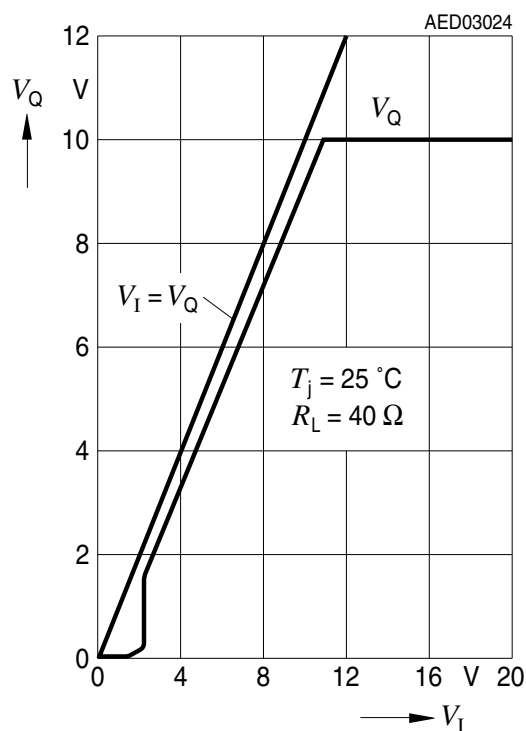
Output Voltage  $V_Q$  versus Temperature  $T_j$



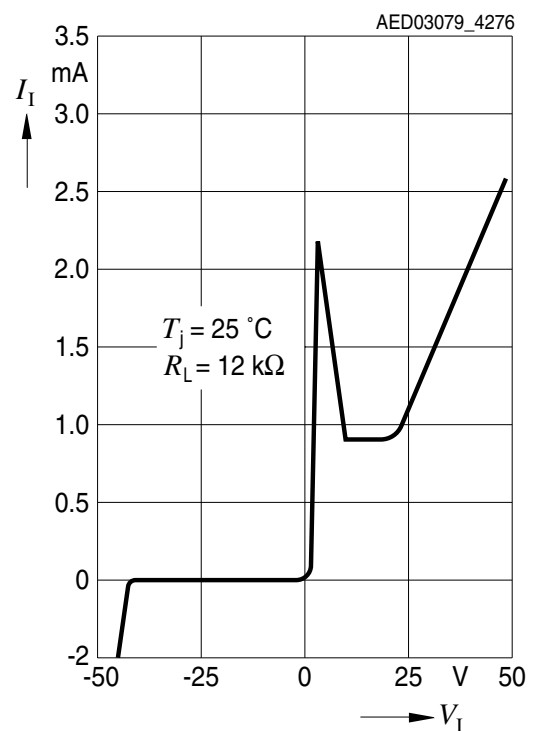
Current Consumption  $I_q$  versus Input Voltage  $V_I$



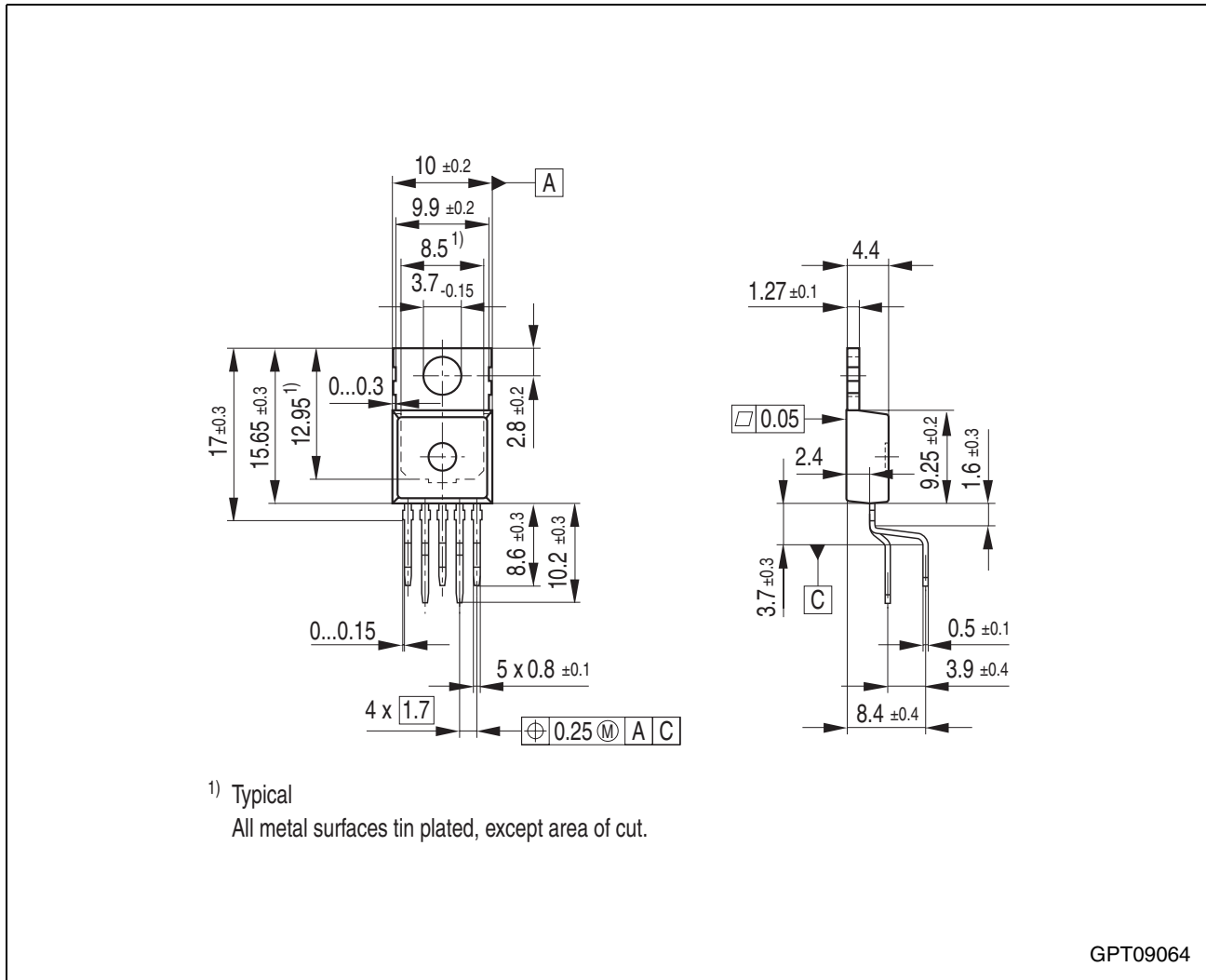
## Low Voltage Behavior



## High Voltage Behavior



## Package Outlines



**Figure 6** PG-TO220-5-11 (Plastic Transistor Single Outline)

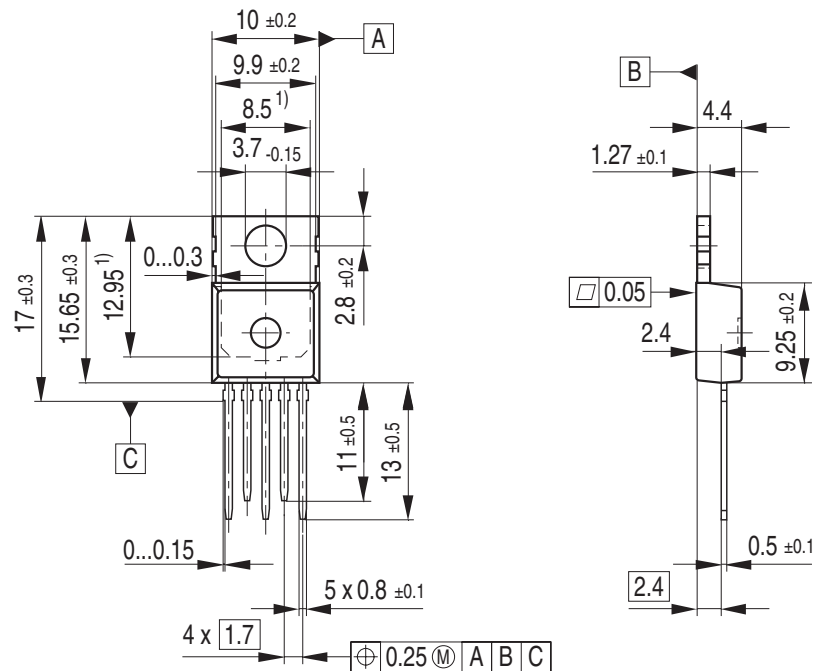
### Green Product (RoHS compliant)

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).

You can find all of our packages, sorts of packing and others in our Infineon Internet Page "Products": <http://www.infineon.com/products>.

SMD = Surface Mounted Device

Dimensions in mm



1) Typical  
Metal surface min. X = 7.25, Y = 12.3  
All metal surfaces tin plated, except area of cut.

GPT09065

**Figure 7** PG-TO220-5-12 (Plastic Transistor Single Outline)

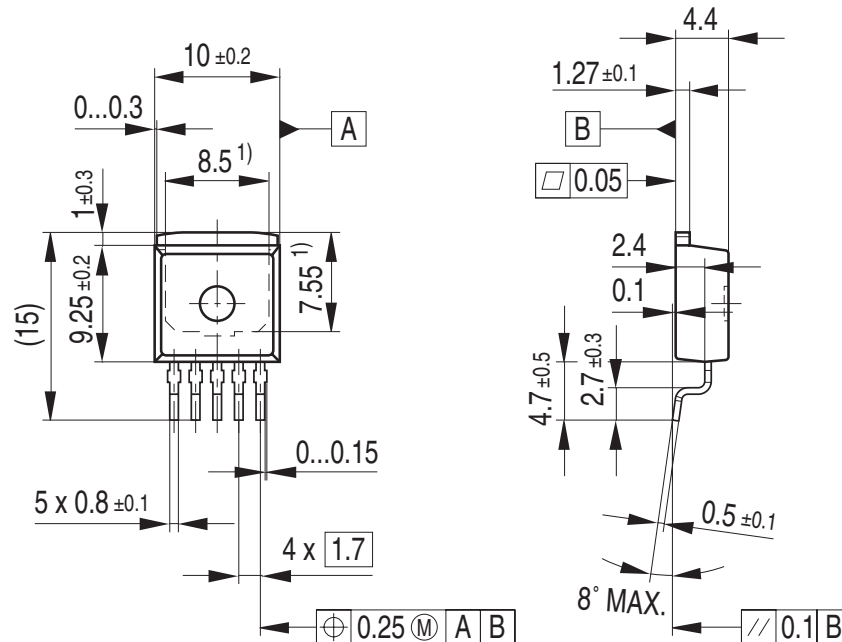
### Green Product (RoHS compliant)

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SMD = Surface Mounted Device

Dimensions in mm



1) Typical

Metal surface min. X = 7.25, Y = 6.9

All metal surfaces tin plated, except area of cut.

GPT09113

**Figure 8** PG-TO263-5-1 (Plastic Transistor Single Outline)

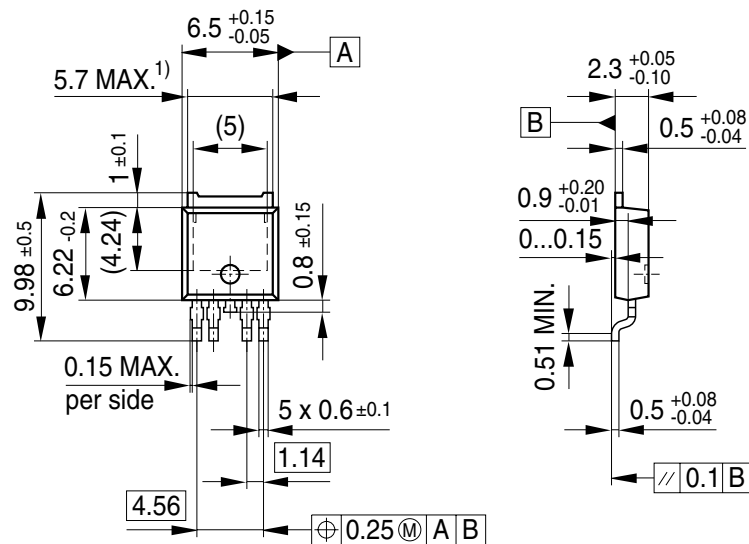
### Green Product (RoHS compliant)

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SMD = Surface Mounted Device

Dimensions in mm



GPT09527

**Figure 9** PG-TO252-5-11 (Plastic Transistor Single Outline)

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SMD = Surface Mounted Device

Dimensions in mm

## Revision History

| Version  | Date       | Changes                                                                                                                                                                                                                                                                                                             |
|----------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rev. 2.7 | 2007-10-23 | <b>Page 17</b> : Corrected package outline drawing of PG-TO263-5-1                                                                                                                                                                                                                                                  |
| Rev. 2.6 | 2007-03-20 | Initial version of RoHS-compliant derivate of TLE 4276<br><b>Page 1</b> : AEC certified statement added<br><b>Page 1</b> and <b>Page 15</b> : RoHS compliance statement and Green product feature added<br><b>Page 1</b> and <b>Page 15</b> : Package changed to RoHS compliant version<br>Legal Disclaimer updated |
| Rev. 2.5 | 2004-12-23 | Added ESD capability information in table "Maximum Ratings".                                                                                                                                                                                                                                                        |

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