

## Low-Drop Voltage Regulator

## TLE 4276

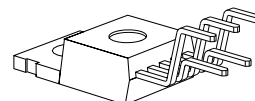
### Features

- 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

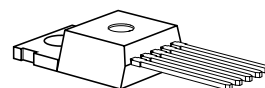
| Type             | Ordering Code | Package       |
|------------------|---------------|---------------|
| TLE 4276 V50     | Q67000-A9262  | P-TO220-5-3   |
| TLE 4276 V85     | Q67000-A9263  | P-TO220-5-3   |
| TLE 4276 V10     | Q67000-A9264  | P-TO220-5-3   |
| TLE 4276 V       | Q67000-A9265  | P-TO220-5-3   |
| TLE 4276 S V50   | Q67000-A9267  | P-TO220-5-43  |
| TLE 4276 S V85   | Q67000-A9269  | P-TO220-5-43  |
| TLE 4276 S V10   | Q67000-A9271  | P-TO220-5-43  |
| TLE 4276 SV      | Q67000-A9273  | P-TO220-5-43  |
| TLE 4276 G V50   | Q67006-A9266  | P-TO220-5-122 |
| TLE 4276 G V85   | Q67006-A9268  | P-TO220-5-122 |
| TLE 4276 G V10   | Q67006-A9270  | P-TO220-5-122 |
| TLE 4276 GV      | Q67006-A9272  | P-TO220-5-122 |
| • TLE 4276 D V50 | Q67006-A9369  | P-TO252-5-1   |
| • TLE 4276 DV    | Q67006-A9361  | P-TO252-5-1   |

■ SMD = Surface Mounted Device

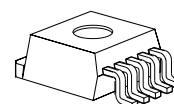
- New type



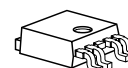
P-TO220-5-3



P-TO-220-5-43



P-TO 220-5-122  
(TO-220 AB/5, Option E3122)



P-TO252-5-1

## 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  $C_Q$  is necessary for the stability of the regulation circuit. Stability is guaranteed at values  $C_Q \geq 22\text{ }\mu\text{F}$  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

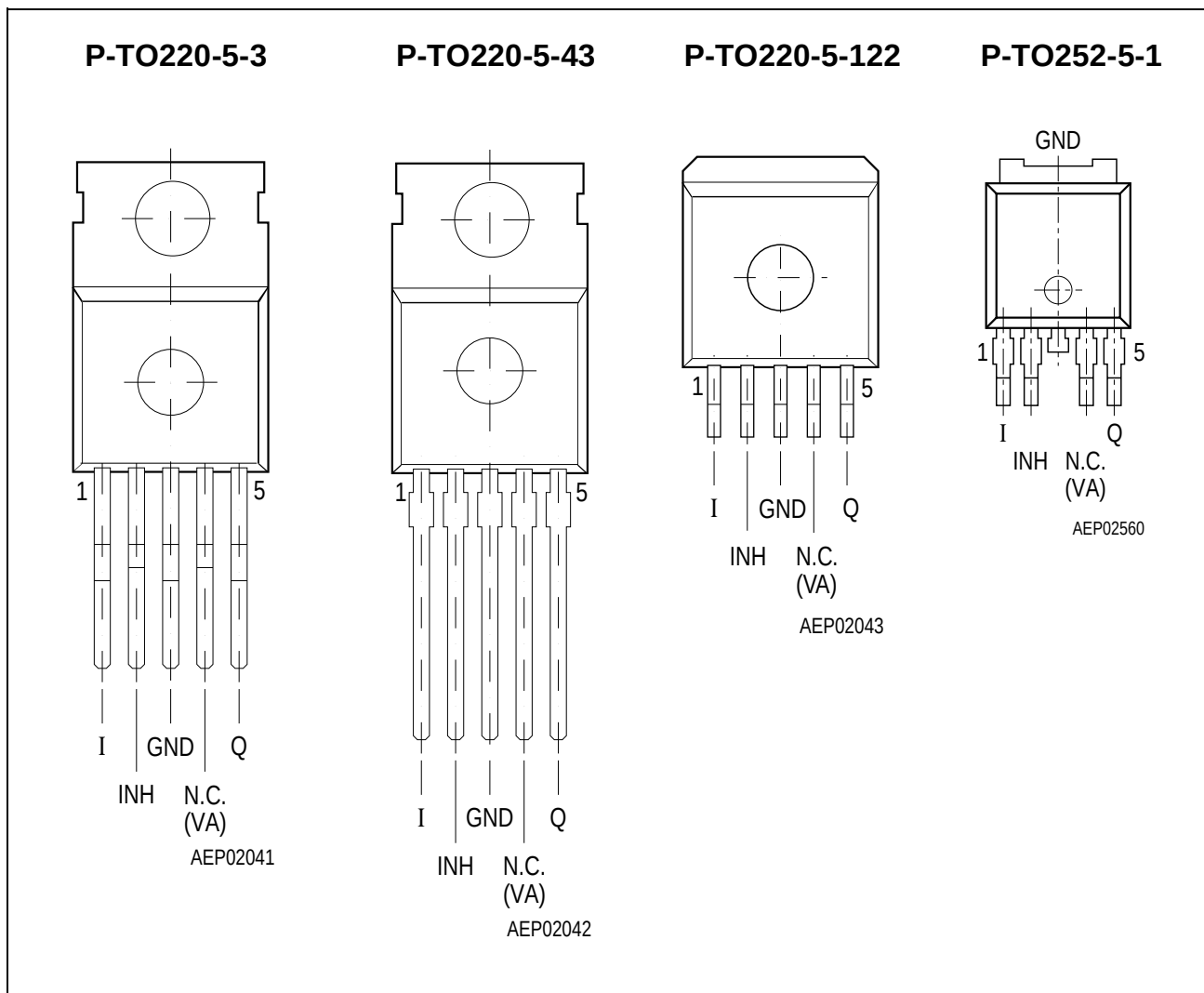
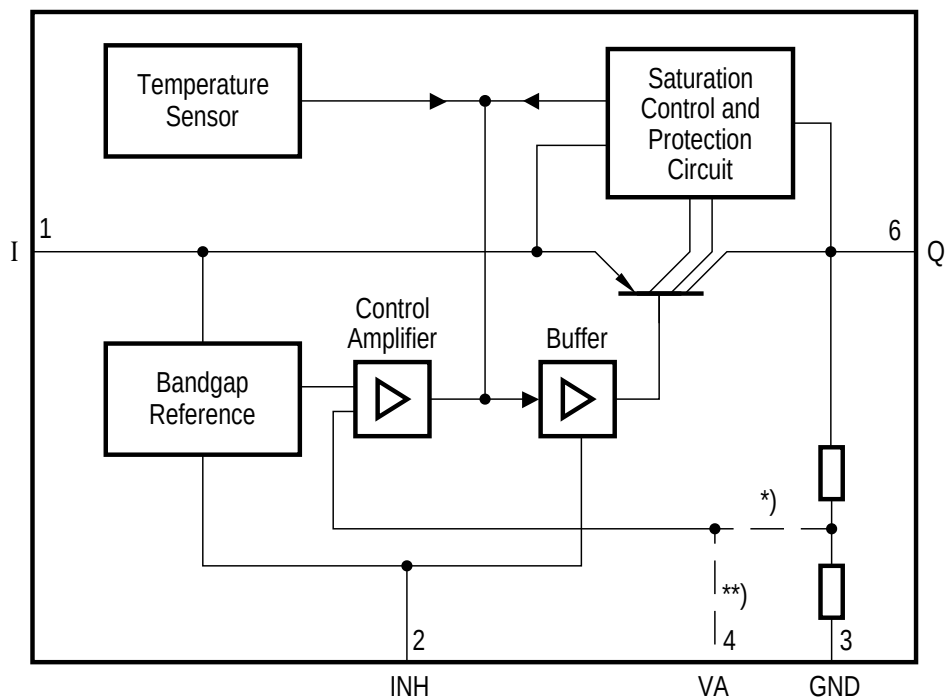


**Figure 1** Pin Configuration (top view)

### 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 ground with a capacitor of $C \geq 22 \mu\text{F}$ , $\text{ESR} \geq 3 \Omega$ at 10 kHz.                                                      |



- \*) For fixed Voltage Regulator only  
 \*\*) For adjustable Voltage Regulator only

AEB02044

**Figure 2 Block Diagram**

## Absolute Maximum Ratings

| Parameter | Symbol | Limit Values |      | Unit | Test Condition |
|-----------|--------|--------------|------|------|----------------|
|           |        | min.         | max. |      |                |

## Voltage Regulator

### 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.*

## Operating Range

| Parameter            | Symbol | Limit Values |      | Unit | Remarks                                |
|----------------------|--------|--------------|------|------|----------------------------------------|
|                      |        | min.         | max. |      |                                        |
| Input voltage        | $V_I$  | $V_Q + 0.5$  | 40   | V    | Fixed voltage devices<br>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,<br>$V_Q < 4$ 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 | –                          |

<sup>1)</sup> Package mounted on PCB 80 × 80 × 1.5mm<sup>3</sup>; 35μ Cu; 5μ Sn; Footprint only; zero airflow.

## Characteristics

$V_i = 13.5 \text{ V}$ ;  $-40 \text{ }^\circ\text{C} < T_j < 150 \text{ }^\circ\text{C}$  (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>$T_j \leq 100 \text{ }^\circ\text{C}$                                                                                         | 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                 |

### Characteristics (cont'd)

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

| Parameter                                 | Symbol            | Limit Values |      |      | Unit | Measuring Condition                                                                         | Measuring 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<br>400 mA                                                           | 1                 |
| Line regulation                           | $\Delta V_{Q,Li}$ | –            | 15   | 25   | mV   | $\Delta V_I = 12 \text{ V}$ to 32V<br>$I_Q = 5 \text{ mA}$                                  | 1                 |
| Power supply ripple rejection             | $PSRR$            | –            | 54   | –    | dB   | $f_r = 100 \text{ Hz}$ ;<br>$V_r = 0.5 V_{SS}$                                              | 1                 |
| Temperature output voltage drift          | $dV_Q/dT$         | –            | 0.5  | –    | –    | –                                                                                           | mV/K              |

### Inhibit

|                     |           |     |     |     |               |                          |   |
|---------------------|-----------|-----|-----|-----|---------------|--------------------------|---|
| Inhibit on voltage  | $V_{INH}$ | –   | 2   | 3.5 | V             | $V_Q \geq 4.9 \text{ V}$ | 1 |
| Inhibit off 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 |

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

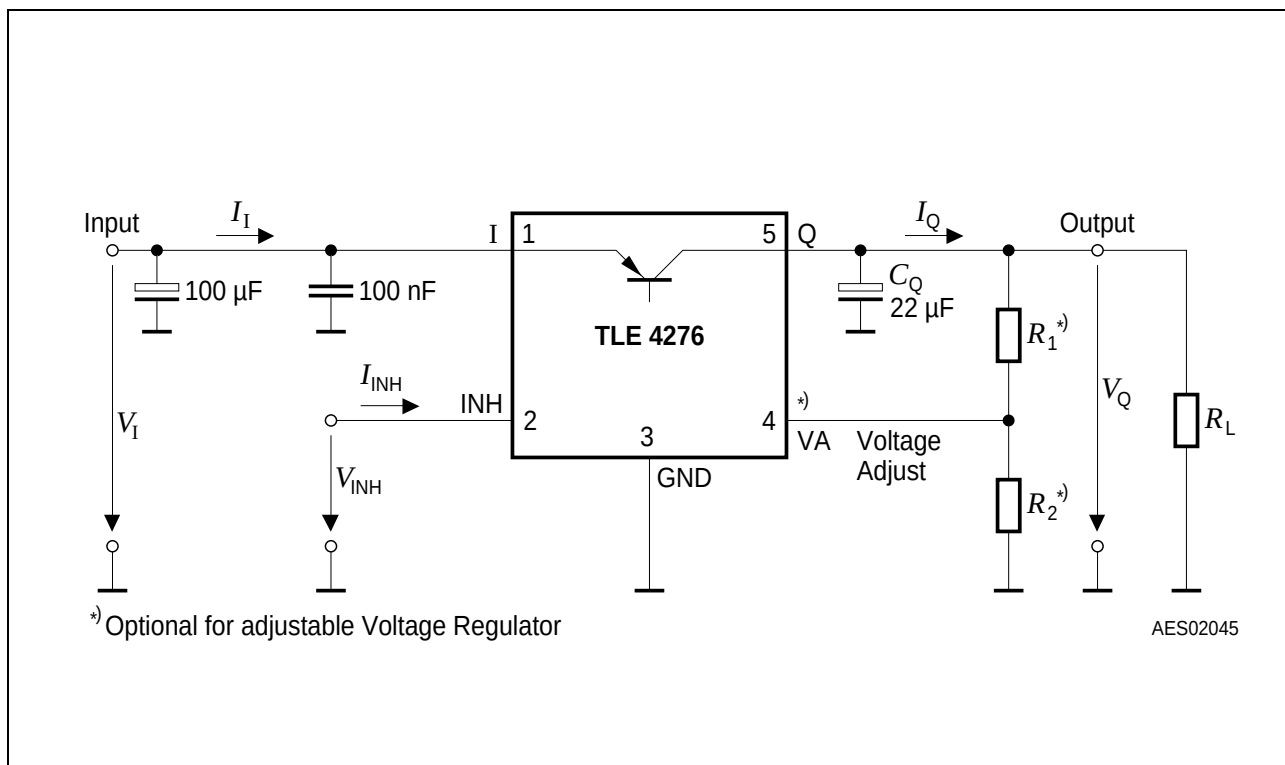


**Figure 3 Measuring Circuit**

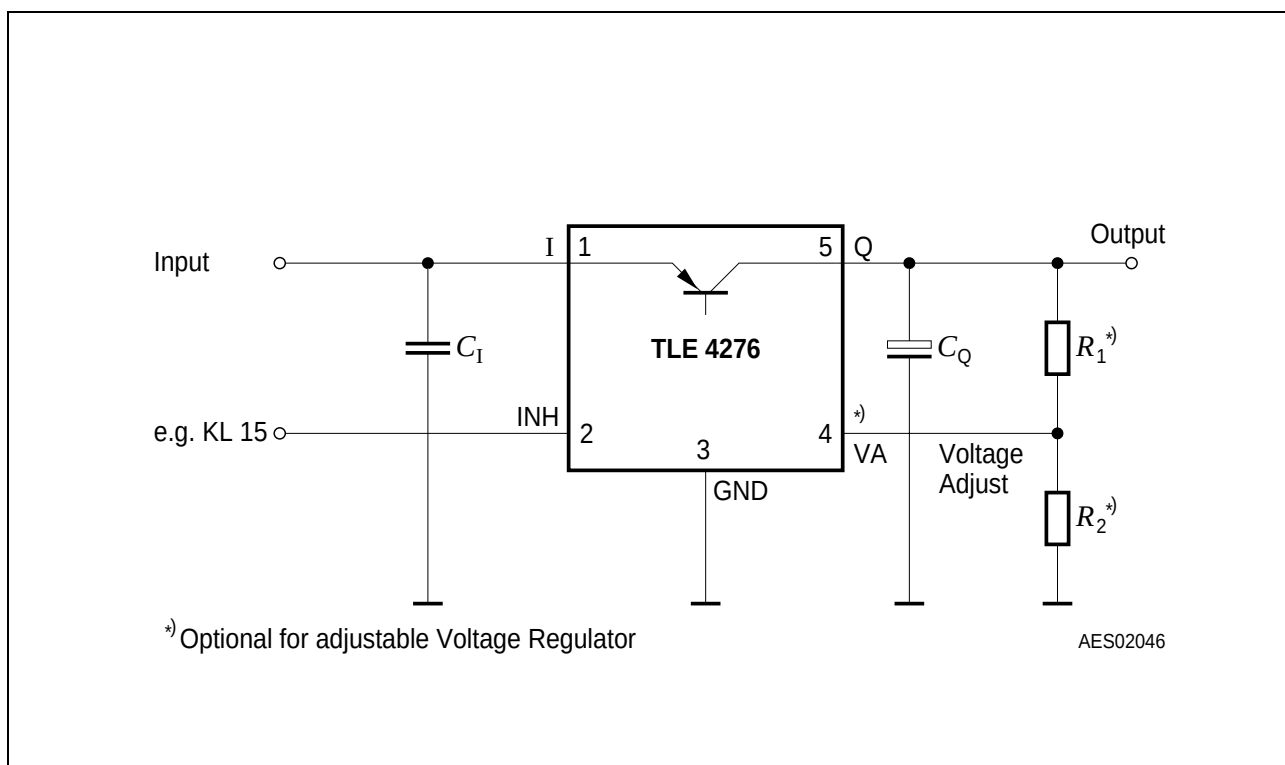


**Figure 4 Application Circuit**

## 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.

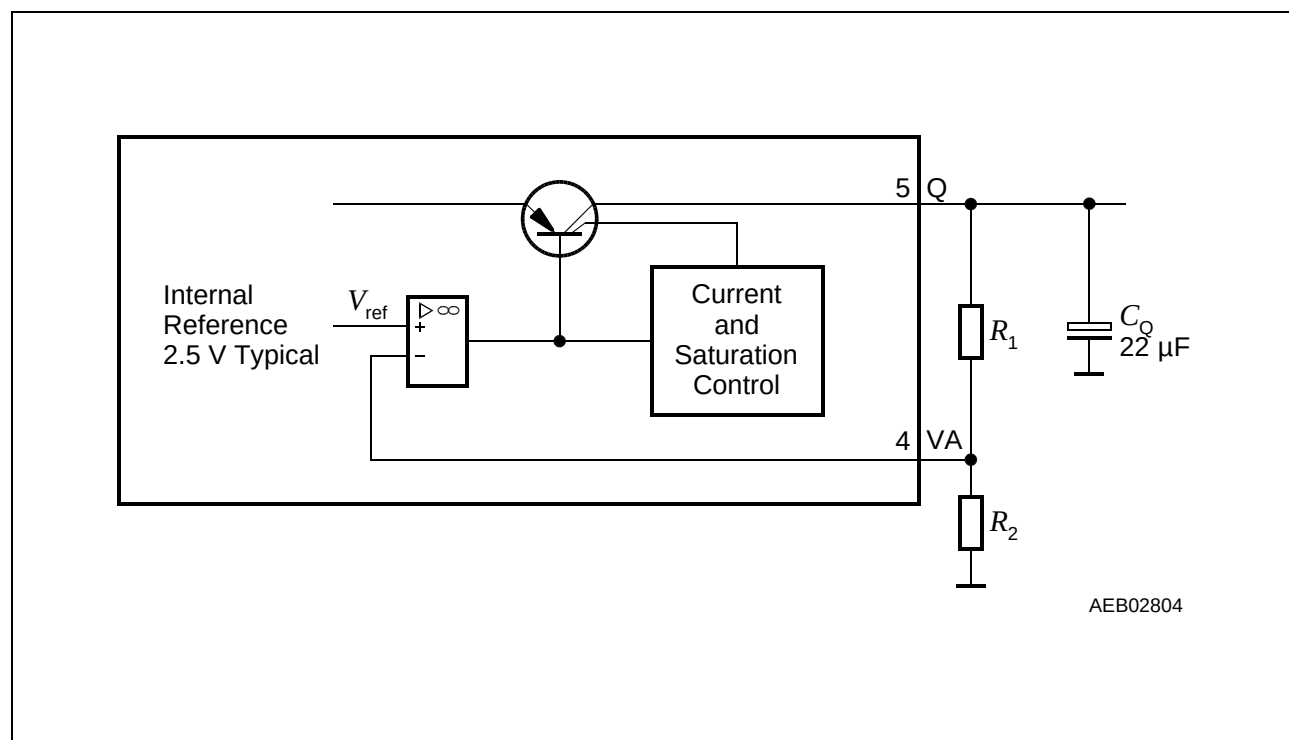


**Figure 5 Application Detail External Components at Output for Variable Voltage Regulator**

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**:

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

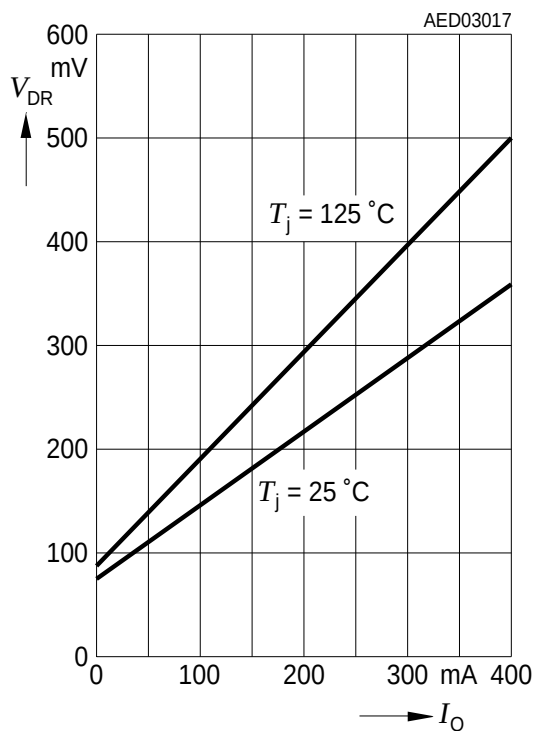
For a 2.5 V output voltage the output pin Q is directly connected to the adjust pin VA.

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

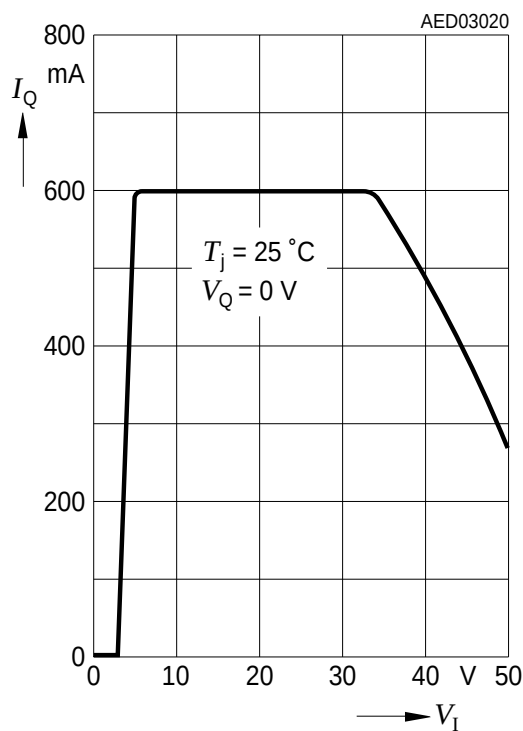
The operation range of the variable TLE 4276 V is  $V_Q + 0.5 \text{ V}$  to 40 V. For internal biasing a minimum input voltage of 4.3 V is required. For output voltages below 4 V the voltage drop is  $4.3 \text{ V} - V_Q$

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

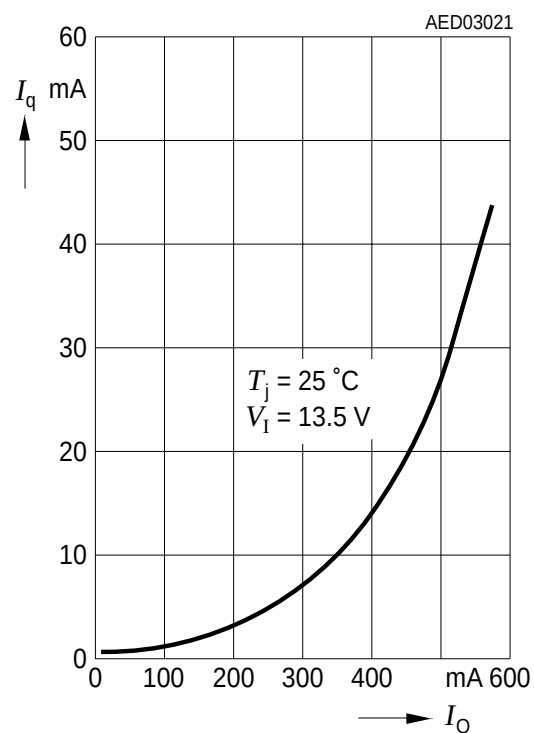
**Voltage  $V_{DR}$  versus Output Current  $I_Q$**



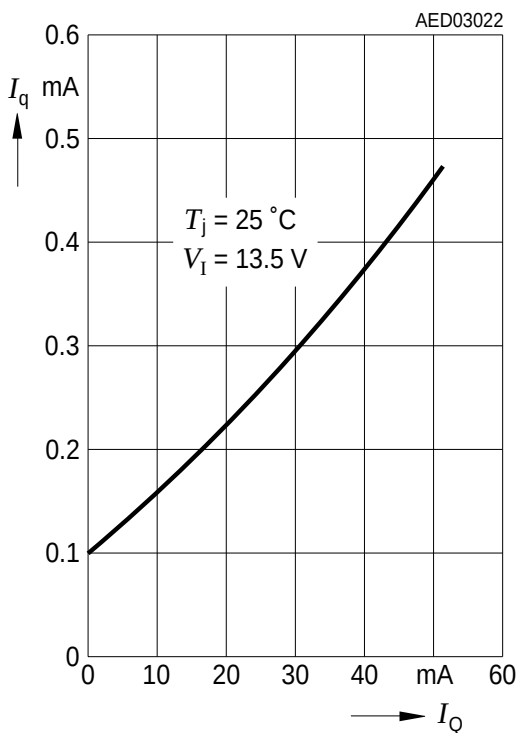
**Max. Output Current  $I_Q$  versus Input Voltage  $V_I$**



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

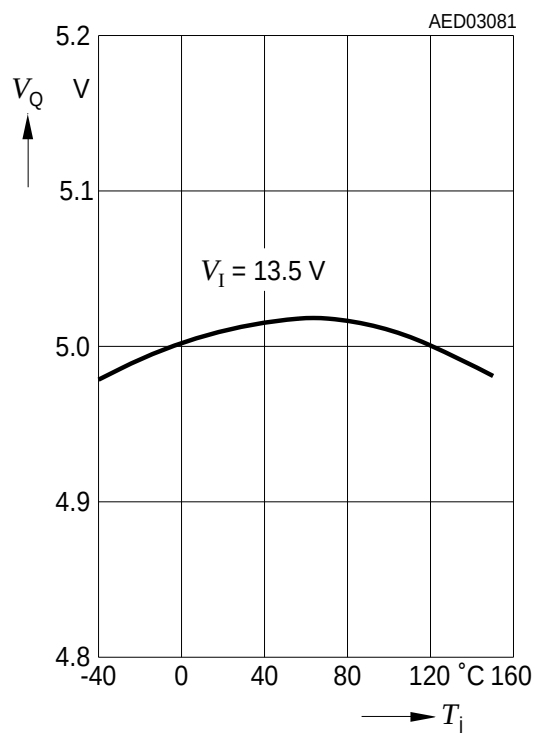


**Current Consumption  $I_q$  versus Output Current  $I_Q$  (low load)**

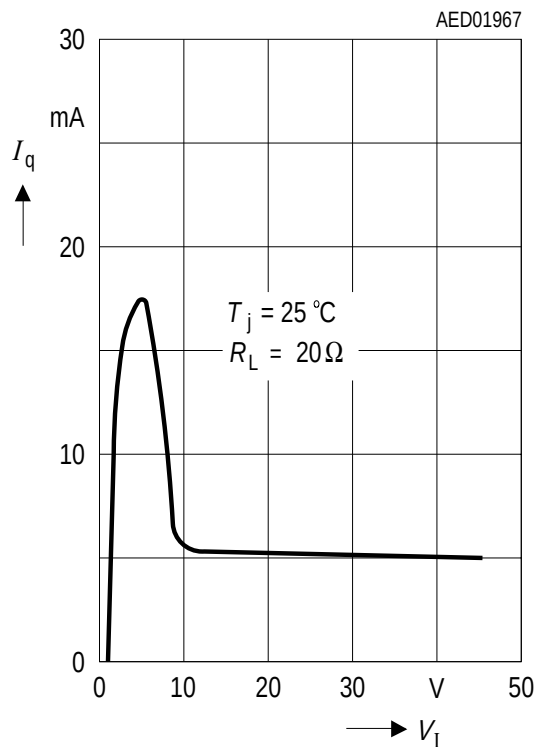


## Typical Performance Characteristics for V50:

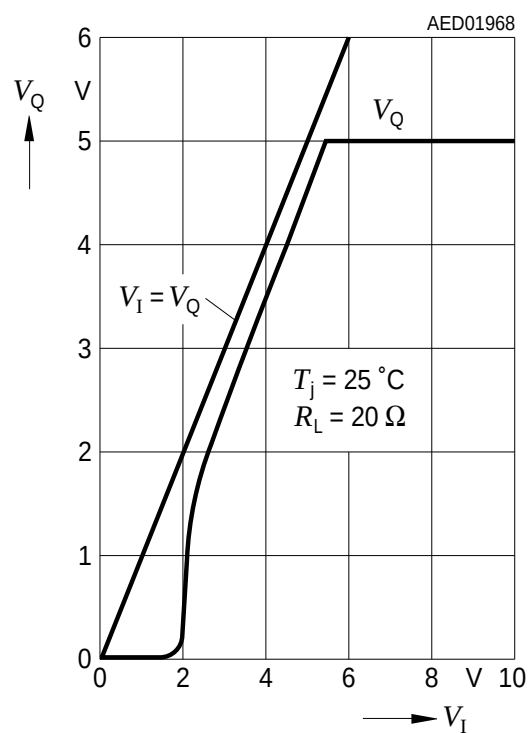
**Output Voltage  $V_Q$  versus Temperature  $T_j$**



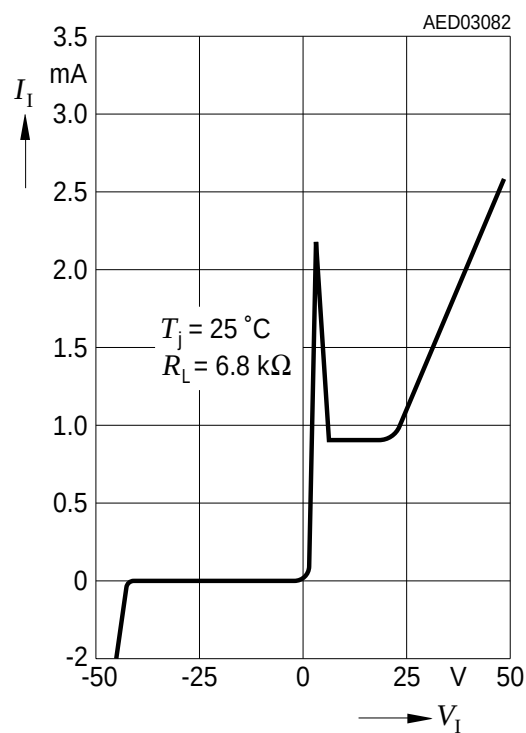
**Current Consumption  $I_q$  versus Input Voltage  $V_I$**



## Low Voltage Behavior

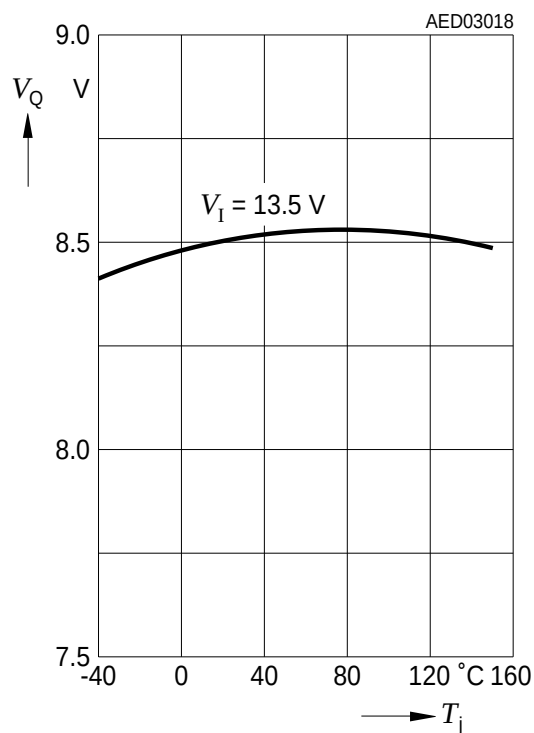


## High Voltage Behavior

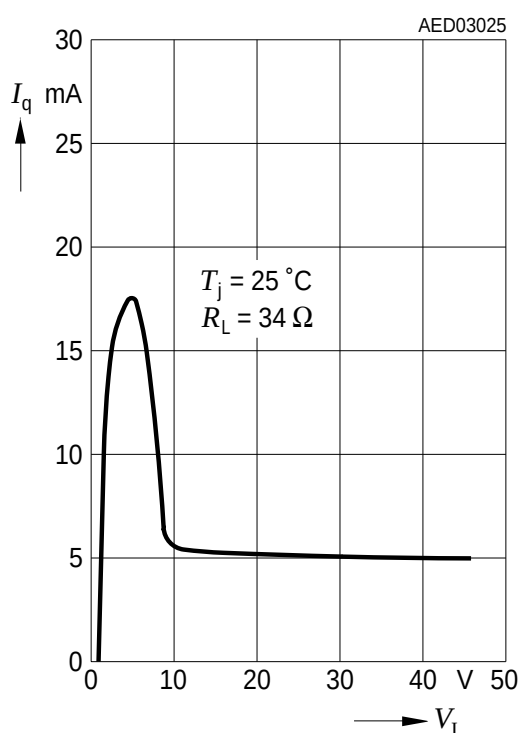


## Typical Performance Characteristics for V85:

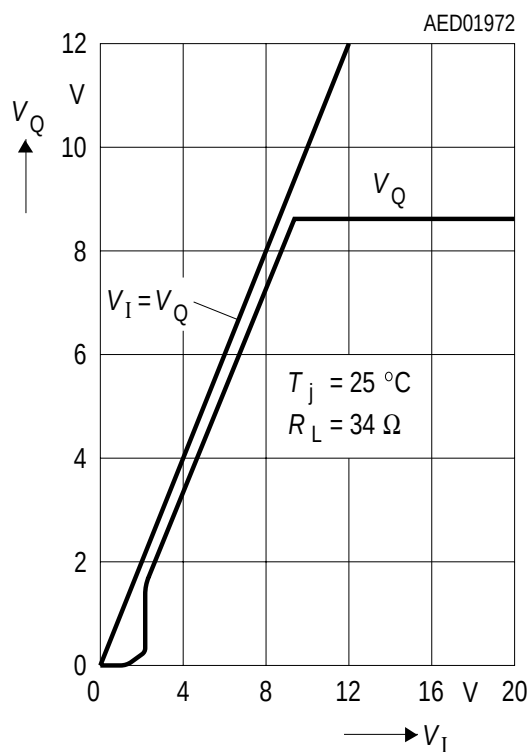
**Output Voltage  $V_Q$  versus Temperature  $T_j$**



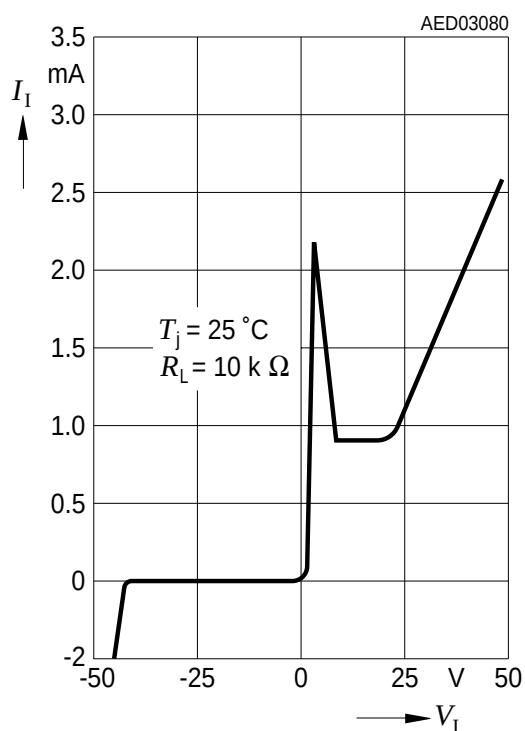
**Current Consumption  $I_q$  versus Input Voltage  $V_I$**



## Low Voltage Behavior

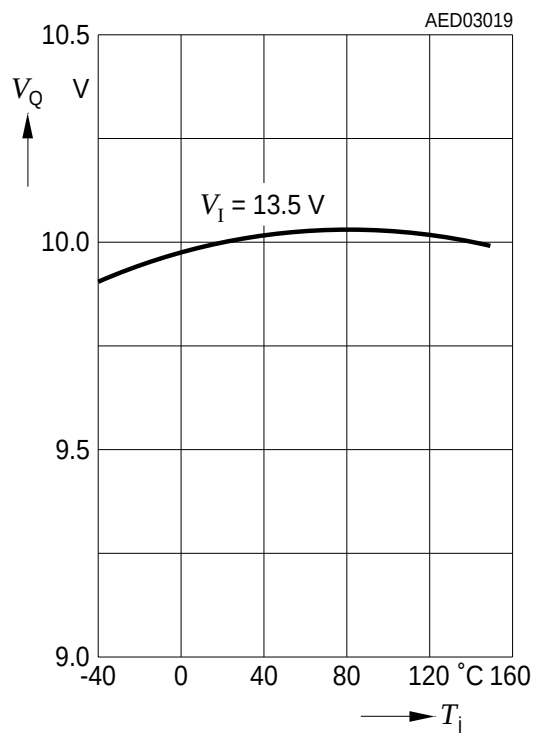


## High Voltage Behavior

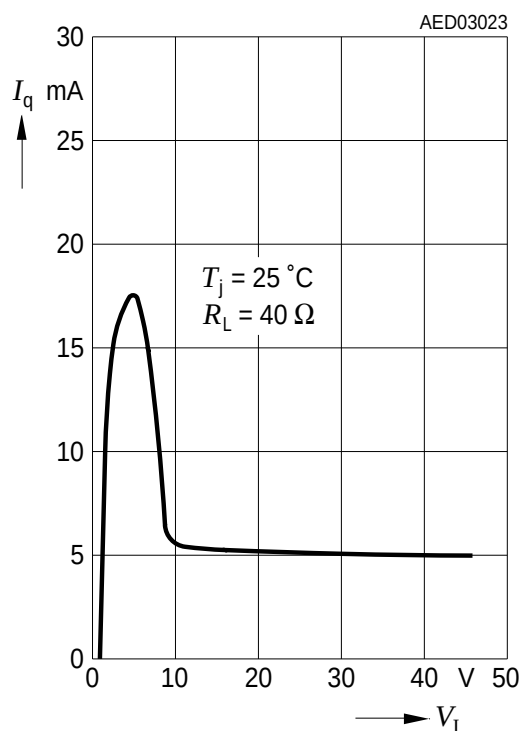


## Typical Performance Characteristics for V10:

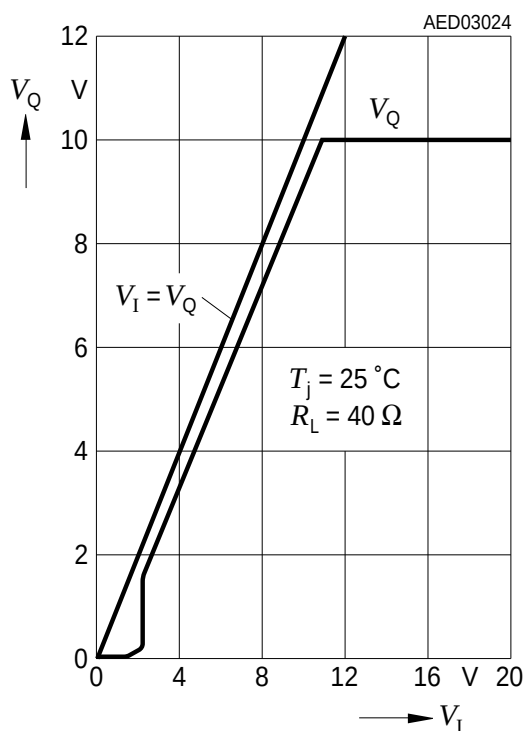
**Output Voltage  $V_Q$  versus Temperature  $T_j$**



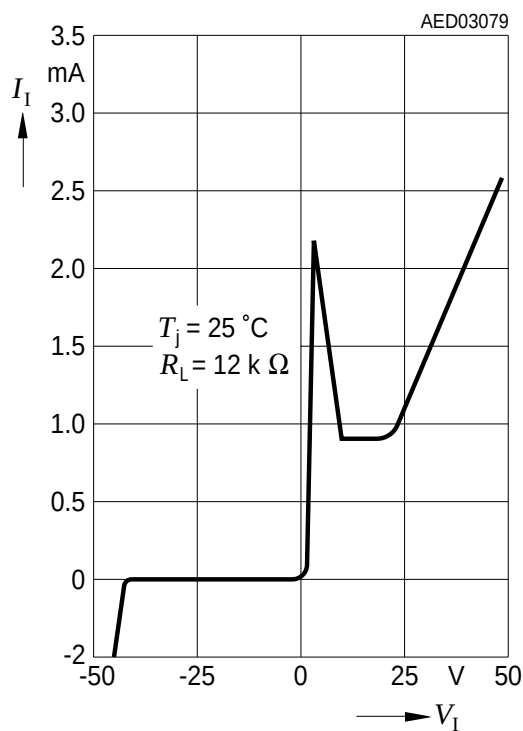
**Current Consumption  $I_q$  versus Input Voltage  $V_I$**



## Low Voltage Behavior



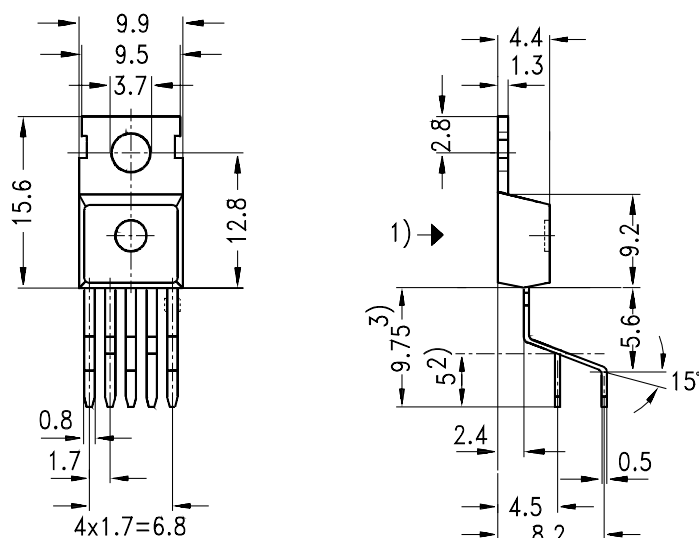
## High Voltage Behavior



## Package Outlines

### P-TO220-5-3

(Plastic Transistor Single Outline)



GPT05165

- 1) shear and punch direction no burrs this surface
- 2) min. length by tinning
- 3) max. 11 mm allowable by tinning

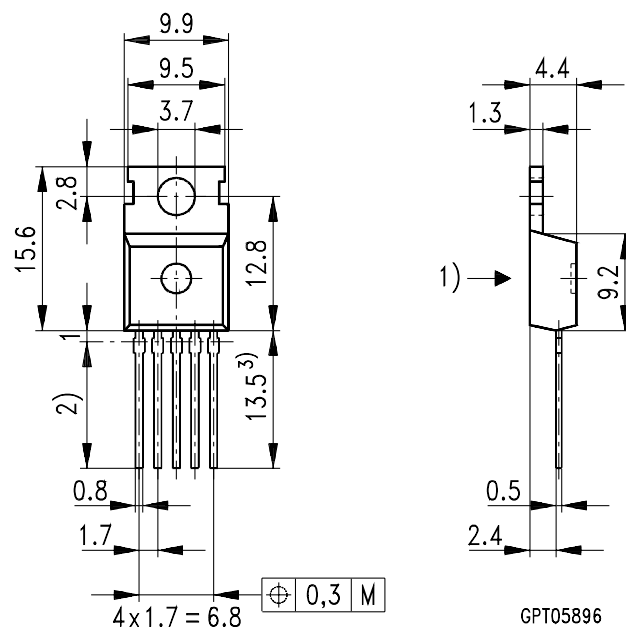
### Sorts of Packing

Package outlines for tubes, trays etc. are contained in our Data Book "Package Information"

Dimensions in mm

# P-TO220-5-43

(Plastic Transistor Single Outline)



- 1) Punch direction, burr max. 0.04
- 2) Dip tinning
- 3) Max. 14.5 by dip tinning press burr  
max. 0.05 radii not dimensioned max. 0.2

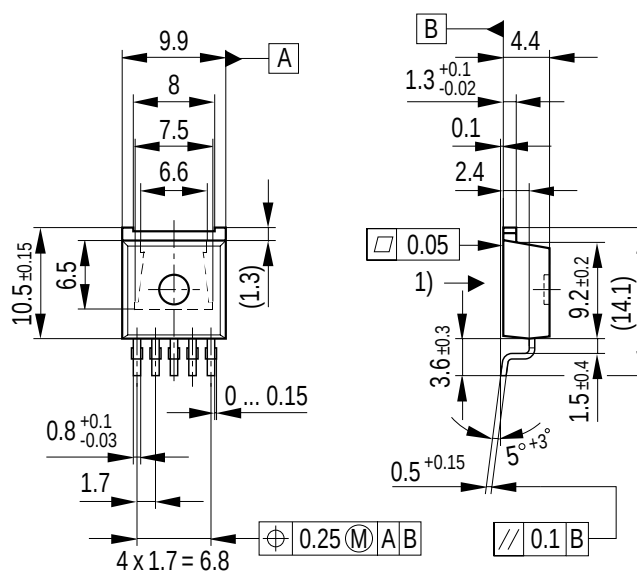
## Sorts of Packing

Package outlines for tubes, trays etc. are contained in our Data Book "Package Information"

Dimensions in mm

**P-TO220-5-122**

(Plastic Transistor Single Outline)



- 1) Shear and punch direction no burrs this surface  
 --- Back side, heatsink contour  
 All metal surfaces tin plated, except area of cut

GPT05259

## Sorts of Packing

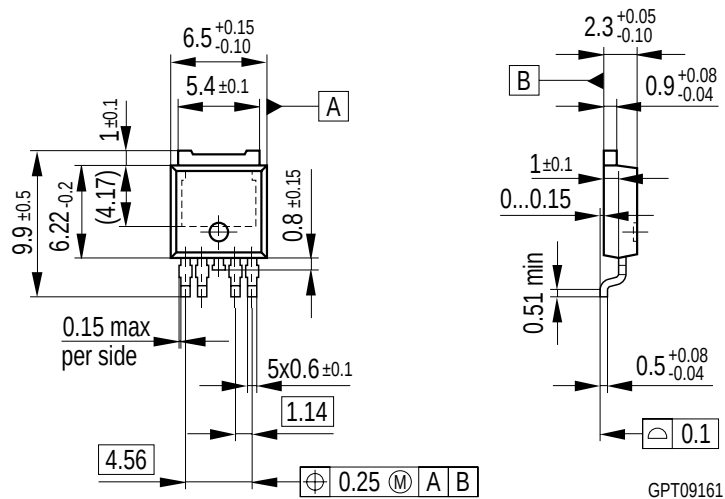
Package outlines for tubes, trays etc. are contained in our Data Book "Package Information".

SMD = Surface Mounted Device

Dimensions in mm

# P-TO252-5-1

(Plastic Transistor Single Outline)



All metal surfaces tin plated, except area of cut.

## 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 2000-10-11**

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

**© Infineon Technologies AG 2000.  
All Rights Reserved.**

**Attention please!**

The information herein is given to describe certain components and shall not be considered as warranted characteristics.

Terms of delivery and rights to technical change reserved.

We hereby disclaim any and all warranties, including but not limited to warranties of non-infringement, regarding circuits, descriptions and charts stated herein.

Infineon Technologies is an approved CECC manufacturer.

**Information**

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office in Germany or our Infineon Technologies Representatives worldwide (see address list).

**Warnings**

Due to technical requirements components may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies Office.

Infineon Technologies Components may only be used in life-support devices or systems with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.