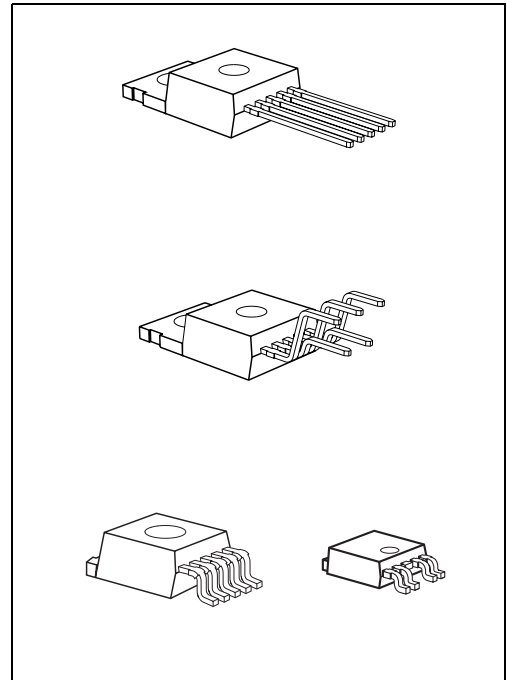




## Features

- 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.

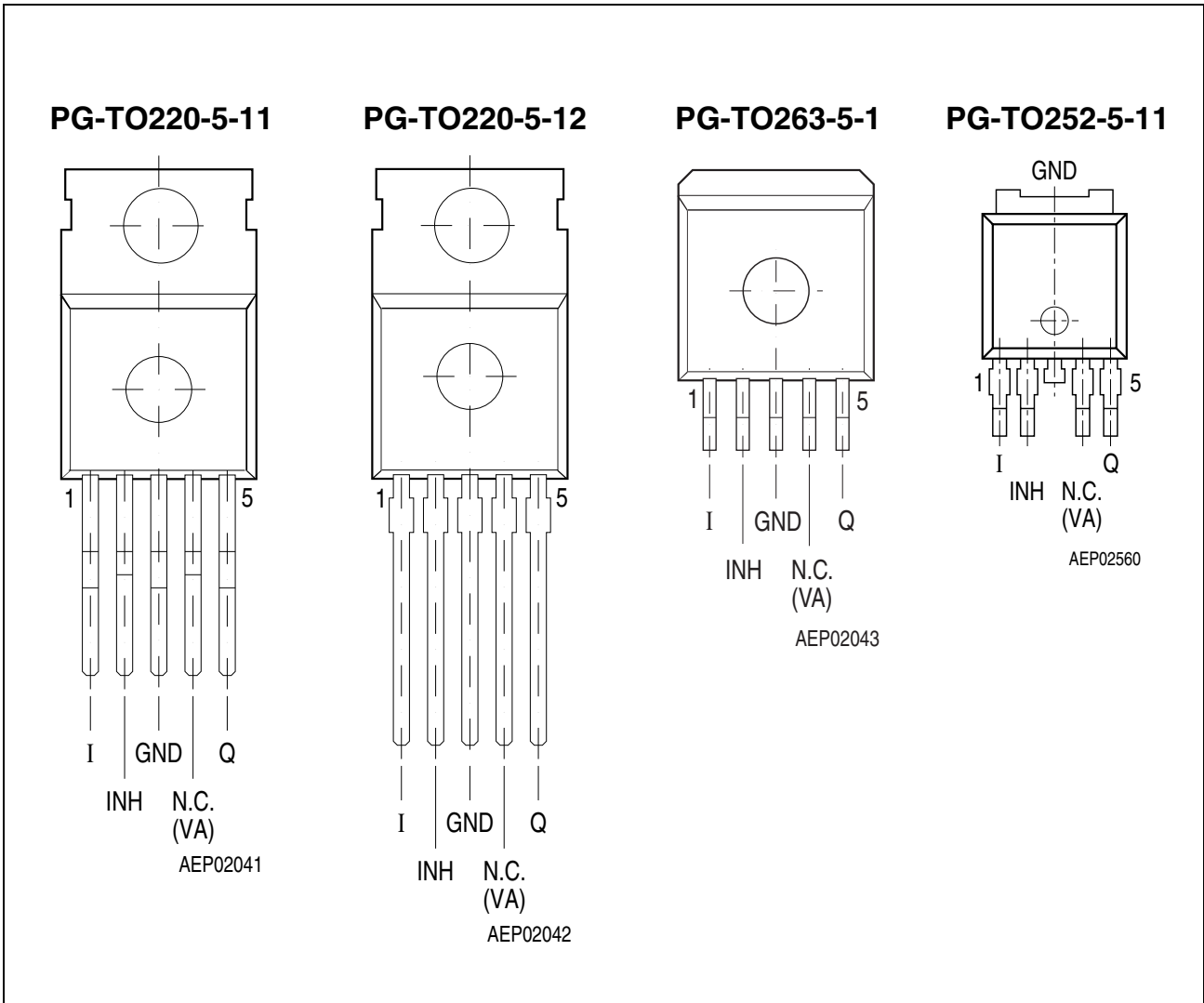
## Dimensioning Information on External Components

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  $C_Q$  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:

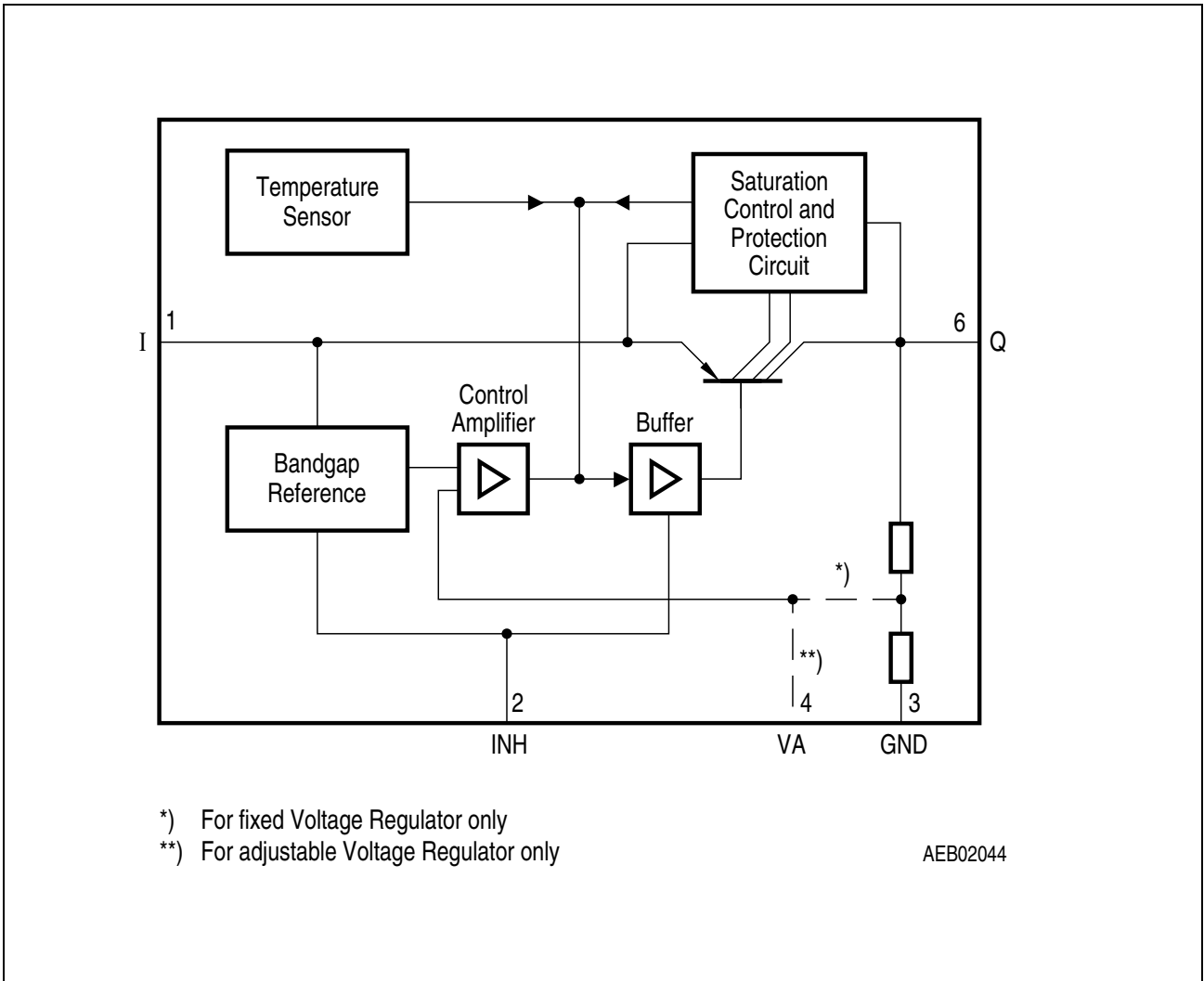
- Overload
- Overtemperature
- Reverse polarity



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

**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. VA	<b>Not connected</b> for V50, V85, V10 <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.



**Figure 2**      **Block Diagram**

**Table 2 Absolute Maximum Ratings**

Parameter	Symbol	Limit Values		Unit	Test Condition
		Min.	Max.		
<b>Input I</b>					
Voltage	$V_I$	-42	45	V	–
Current	$I_I$	–	–	–	Internally limited
<b>Inhibit INH</b>					
Voltage	$V_{INH}$	-42	45	V	–
<b>Voltage Adjust Input VA</b>					
Voltage	$V_{VA}$	-0.3	10	V	–
<b>Output Q</b>					
Voltage	$V_Q$	-1.0	40	V	–
Current	$I_Q$	–	–	–	Internally limited
<b>Ground GND</b>					
Current	$I_{GND}$	–	100	mA	–
<b>Temperature</b>					
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  $80 \times 80 \times 1.5\text{mm}^3$ ; 35 $\mu$  Cu; 5 $\mu$  Sn; Footprint only; zero airflow.

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

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

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

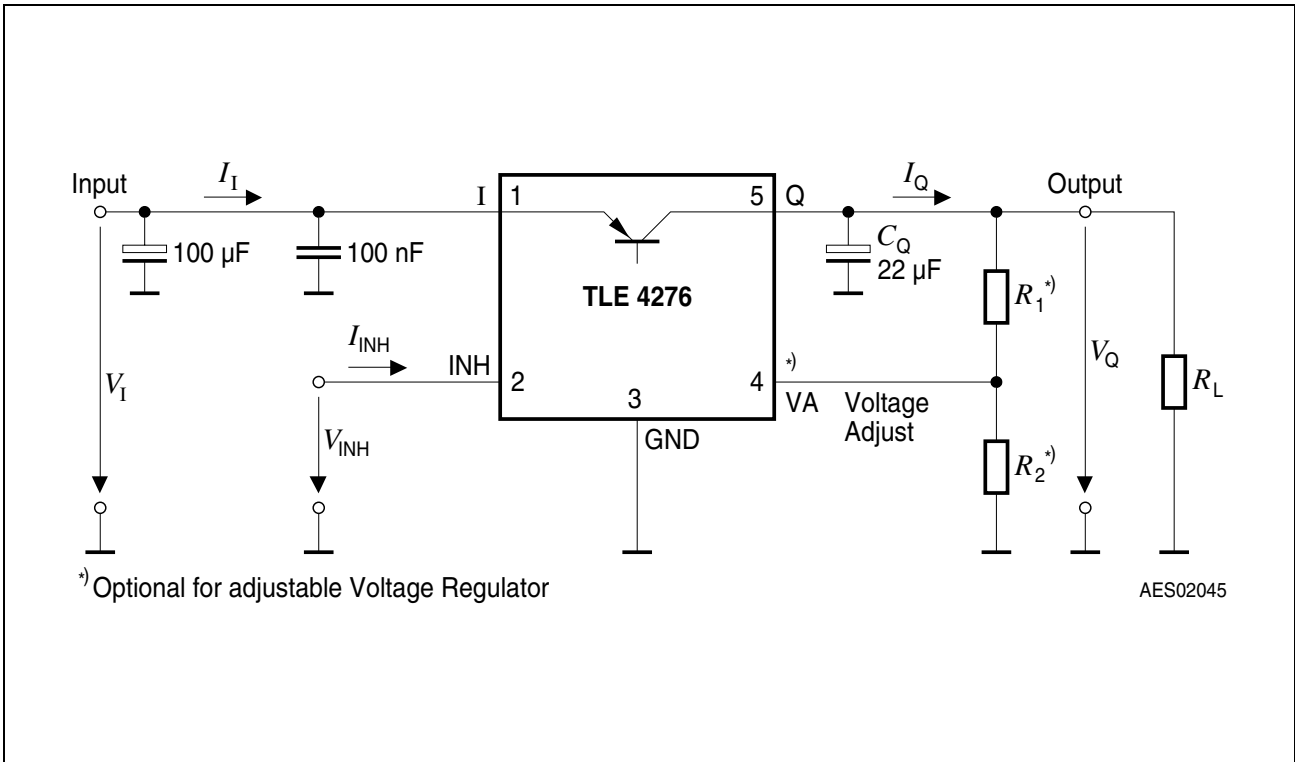
Parameter	Sym- bol	Limit Values			Unit	Measuring Condition	Measuring Circuit
		Min.	Typ.	Max.			
Current consumption; $I_q = I_I - I_Q$	$I_q$	–	15	25	mA	$I_Q = 400 \text{ mA}$	1
Drop voltage <sup>1)</sup>	$V_{DR}$	–	250	500	mV	V50, V85, V10 $I_Q = 250 \text{ mA}$ $V_{DR} = V_I - V_Q$	1
Drop voltage 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

**Inhibit**

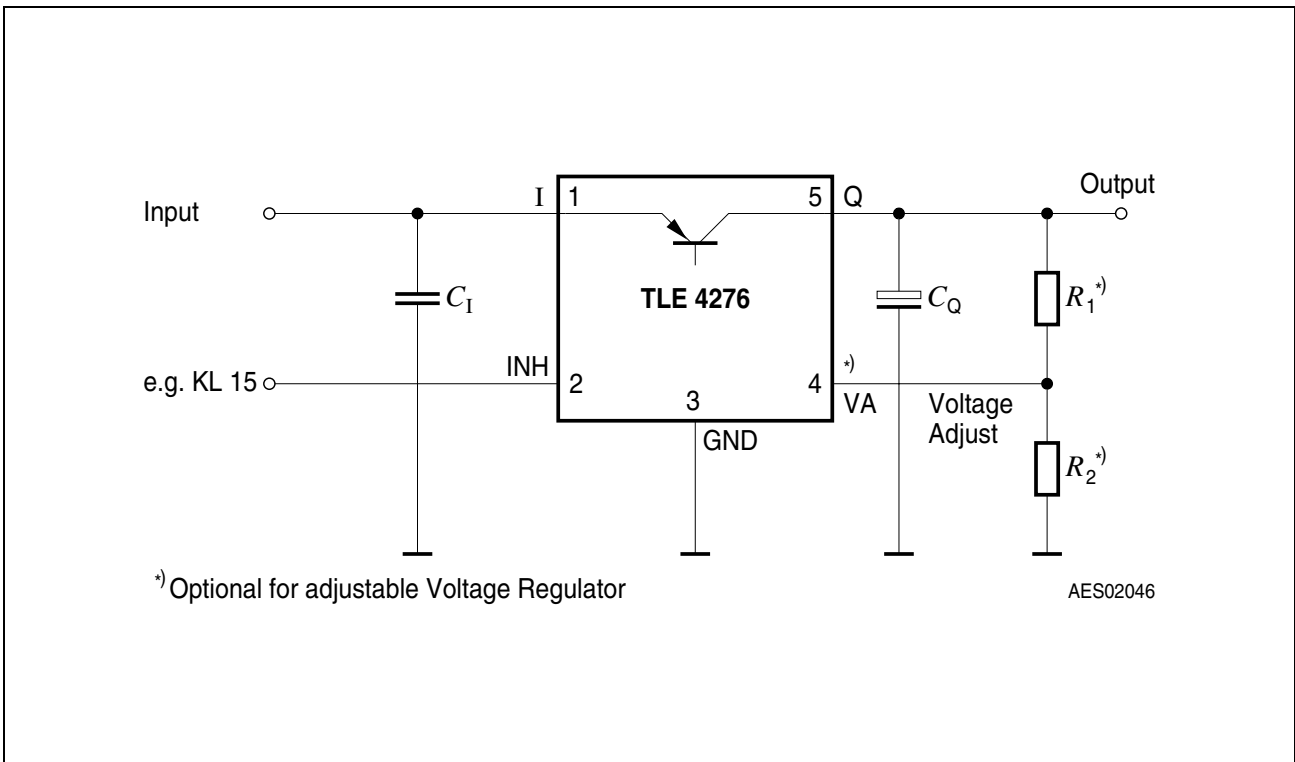
Inhibit on voltage	$V_{INH}$	–	2	3.5	V	$V_Q \geq 4.9 \text{ V}$	1
Inhibit off voltage	$V_{INH}$	0.5	1.7	–	V	$V_Q \leq 0.1 \text{ V}$	1
Input current	$I_{INH}$	5	10	20	$\mu\text{A}$	$V_{INH} = 5 \text{ V}$	1

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**

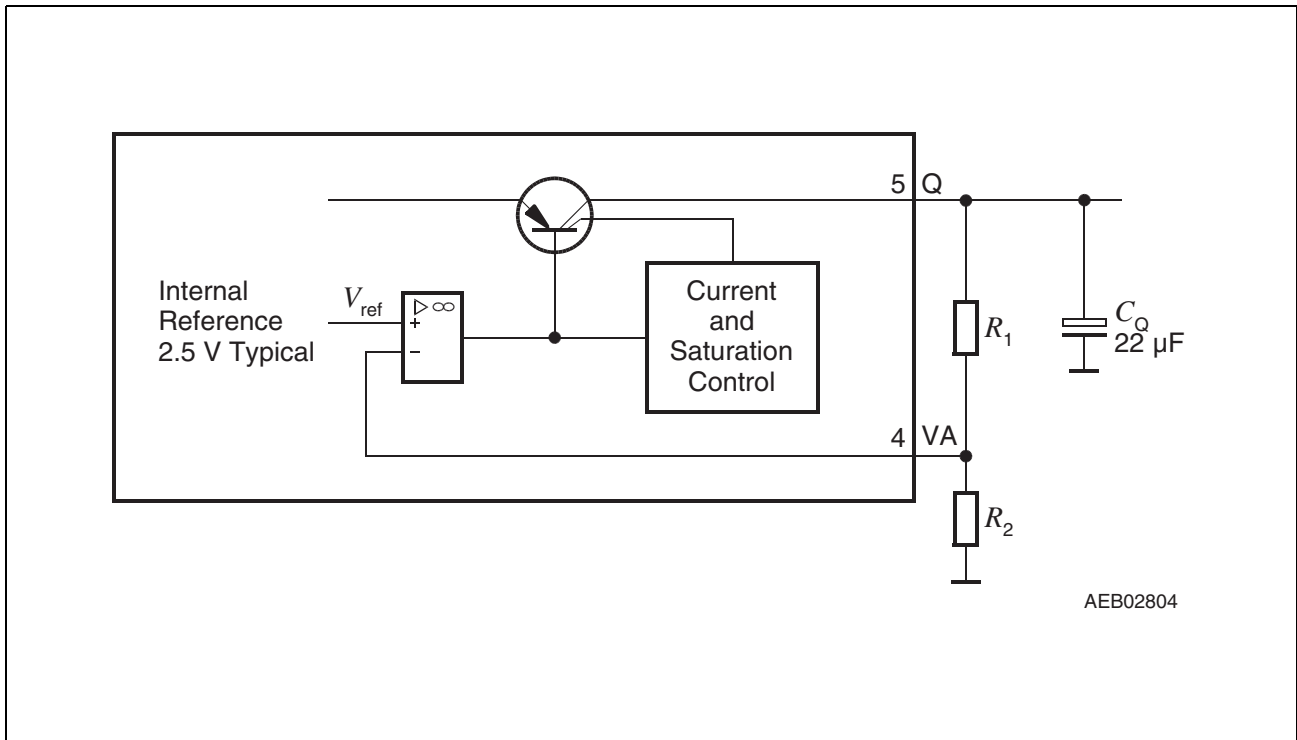


**Figure 4 Application Circuit**

**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 \(1\)](#):

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

$V_{ref}$  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 \(2\)](#):

$$R_2 < 50 \text{ k}\Omega \tag{2}$$

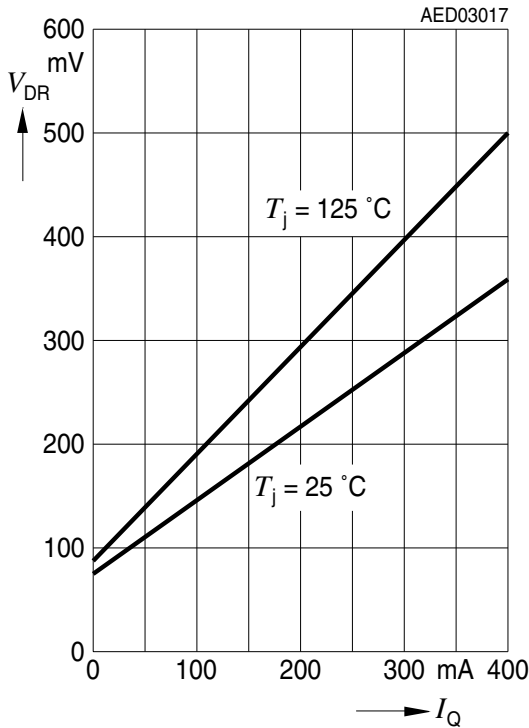
For a 2.5 V output voltage the output pin Q is directly connected to the adjust pin VA.

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

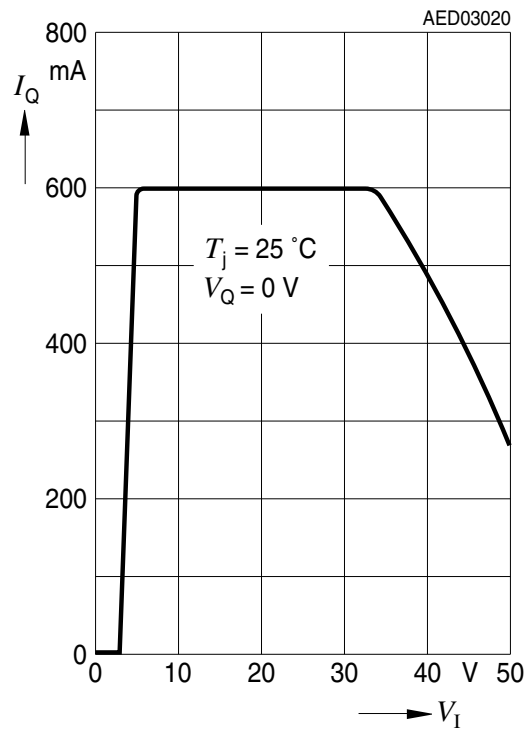
The operation range of the variable TLE 4276 V is  $V_Q + 0.5 \text{ V}$  to 40 V. For internal biasing a minimum input voltage of 4.3 V is required. For output voltages below 4 V the voltage drop is  $4.3 \text{ V} - V_Q$

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

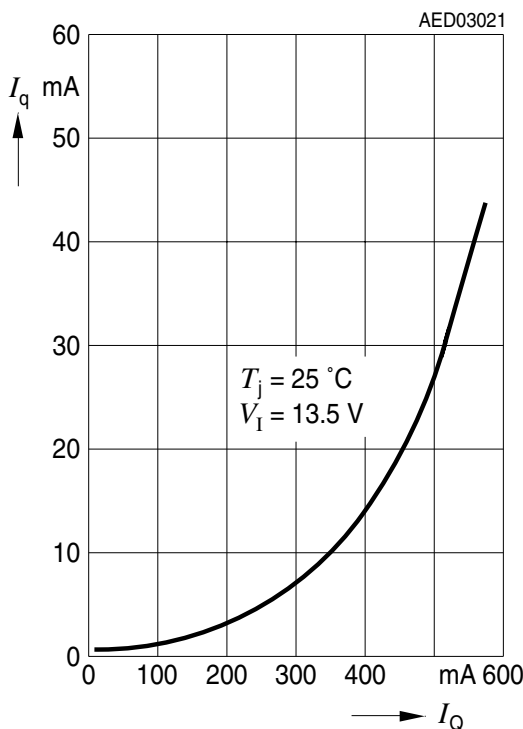
**Voltage  $V_{DR}$  versus Output Current  $I_Q$**



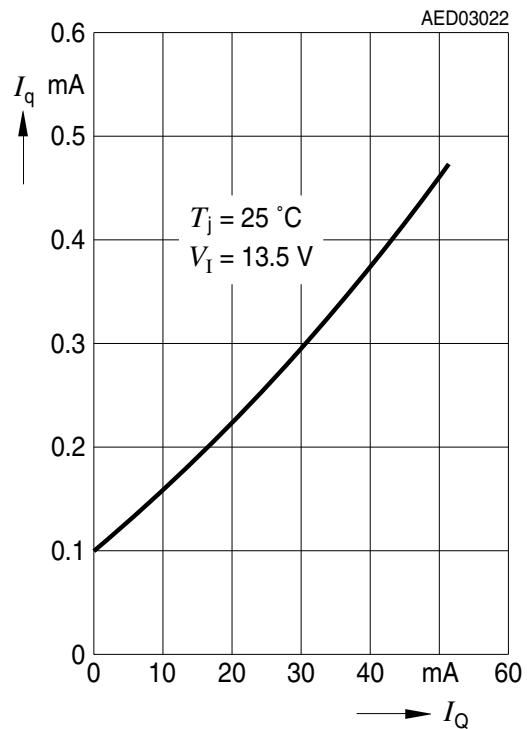
**Max. Output Current  $I_Q$  versus Input Voltage  $V_I$**



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

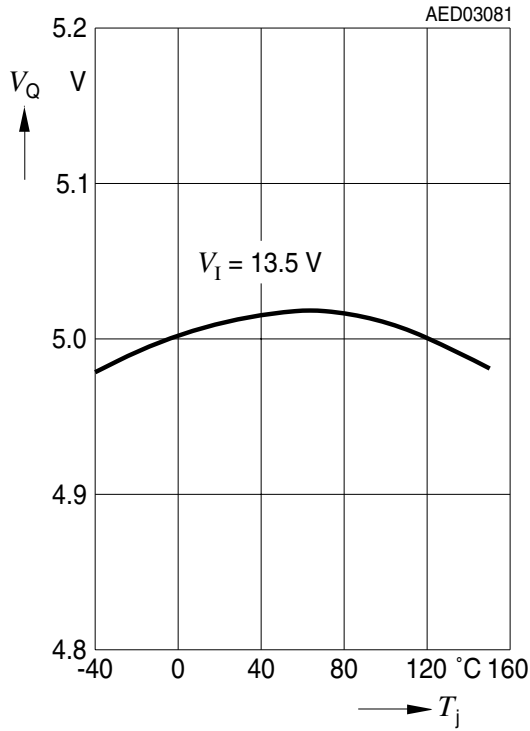


**Current Consumption  $I_q$  versus Output Current  $I_Q$  (low load)**

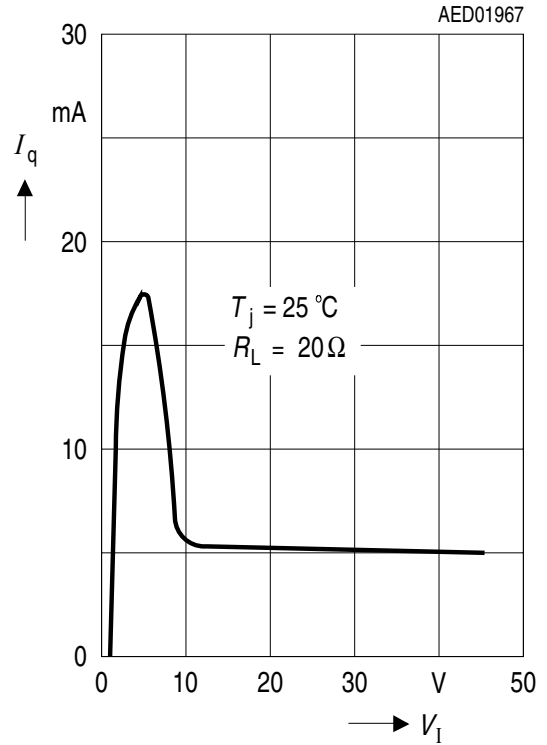


**Typical Performance Characteristics for V50:**

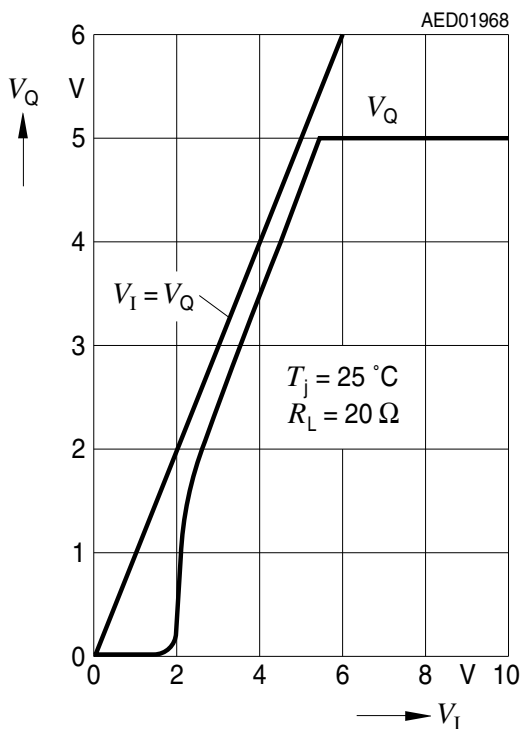
**Output Voltage  $V_Q$  versus Temperature  $T_j$**



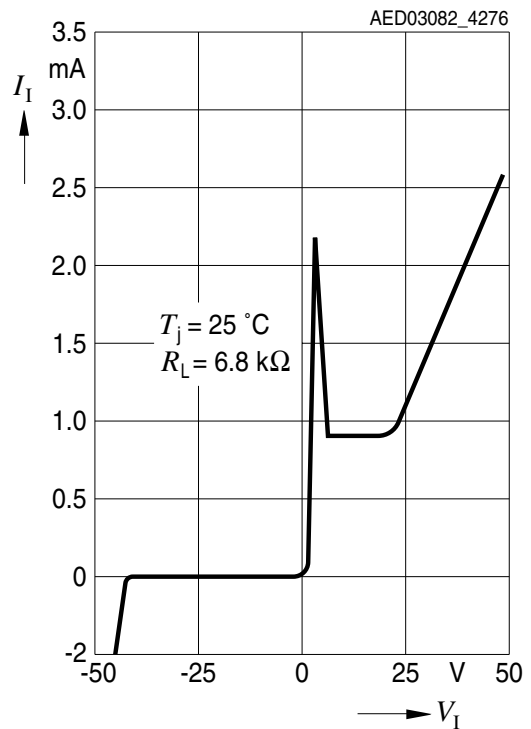
**Current Consumption  $I_q$  versus Input Voltage  $V_I$**



**Low Voltage Behavior**

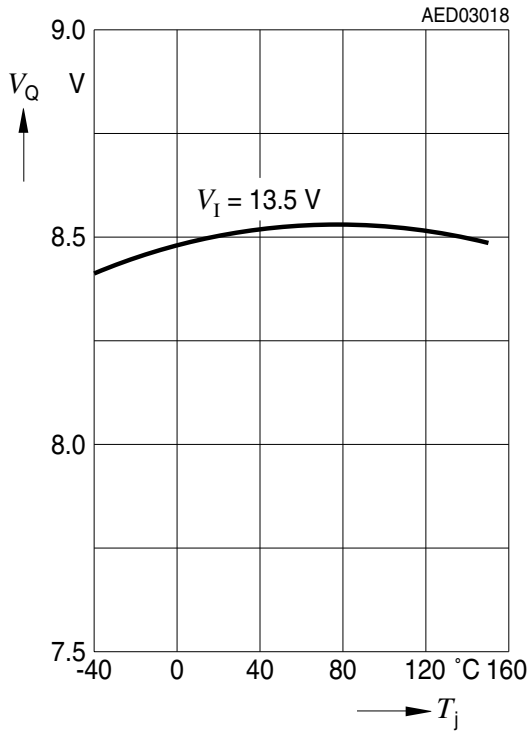


**High Voltage Behavior**

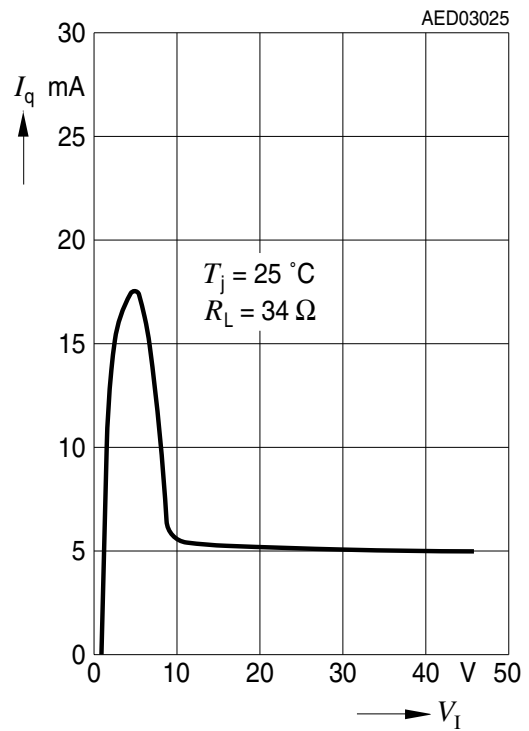


**Typical Performance Characteristics for V85:**

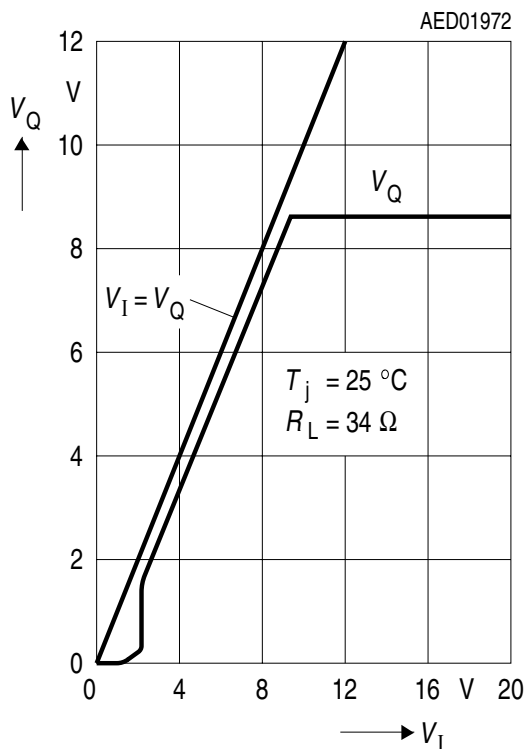
**Output Voltage  $V_Q$  versus Temperature  $T_j$**



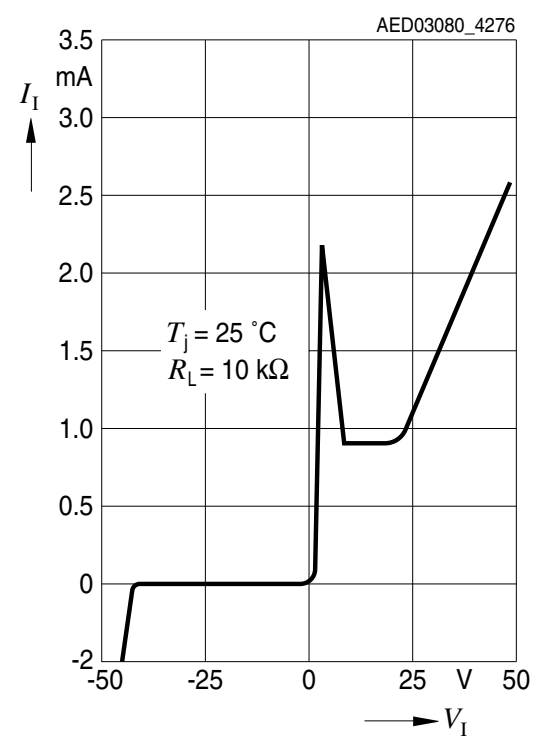
**Current Consumption  $I_q$  versus Input Voltage  $V_I$**



**Low Voltage Behavior**

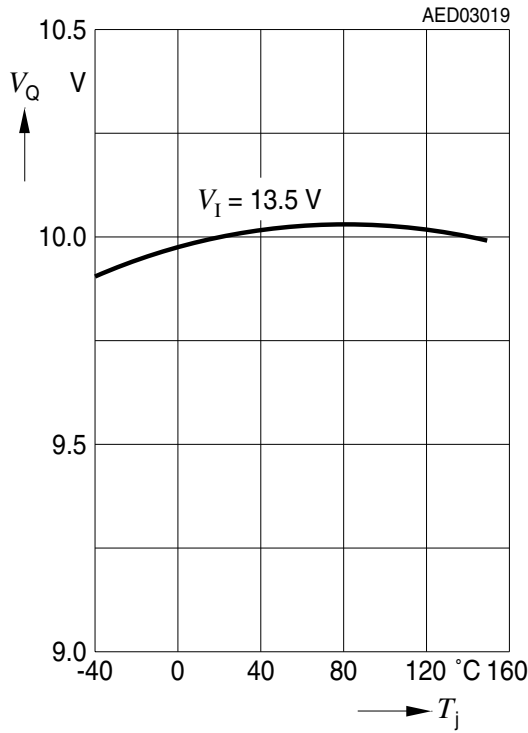


**High Voltage Behavior**

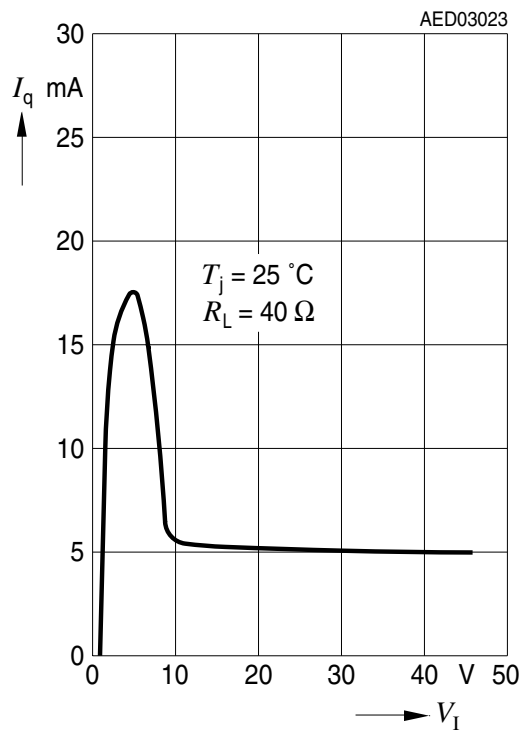


**Typical Performance Characteristics for V10:**

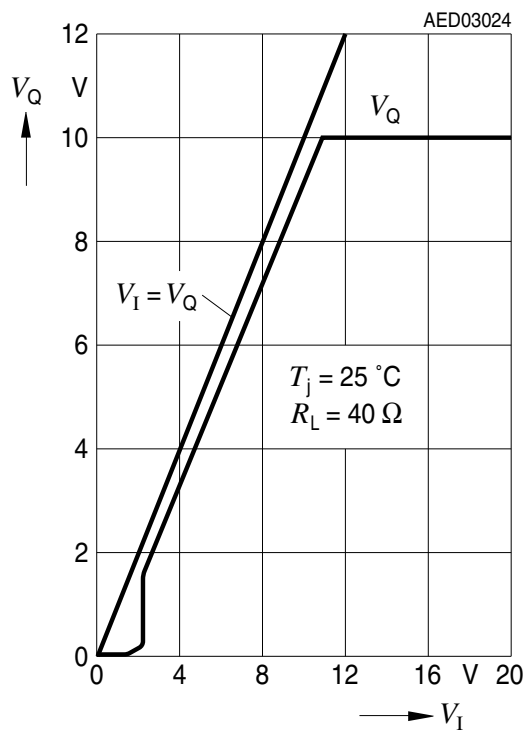
**Output Voltage  $V_Q$  versus Temperature  $T_j$**



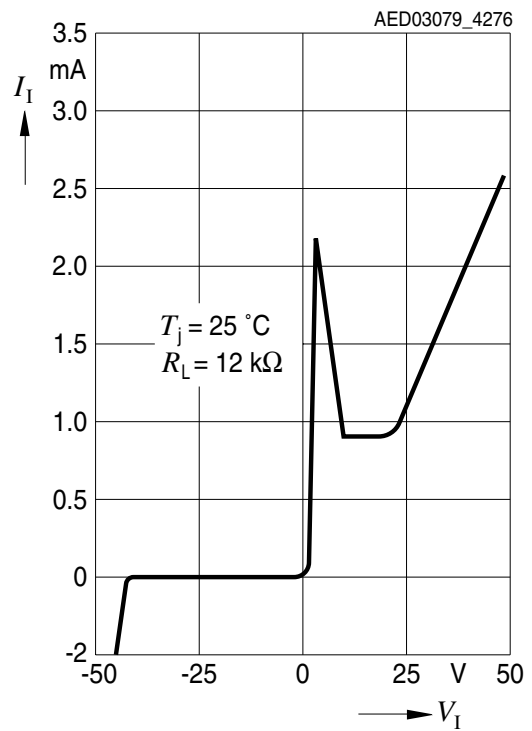
**Current Consumption  $I_q$  versus Input Voltage  $V_I$**



**Low Voltage Behavior**



**High Voltage Behavior**



Package Outlines

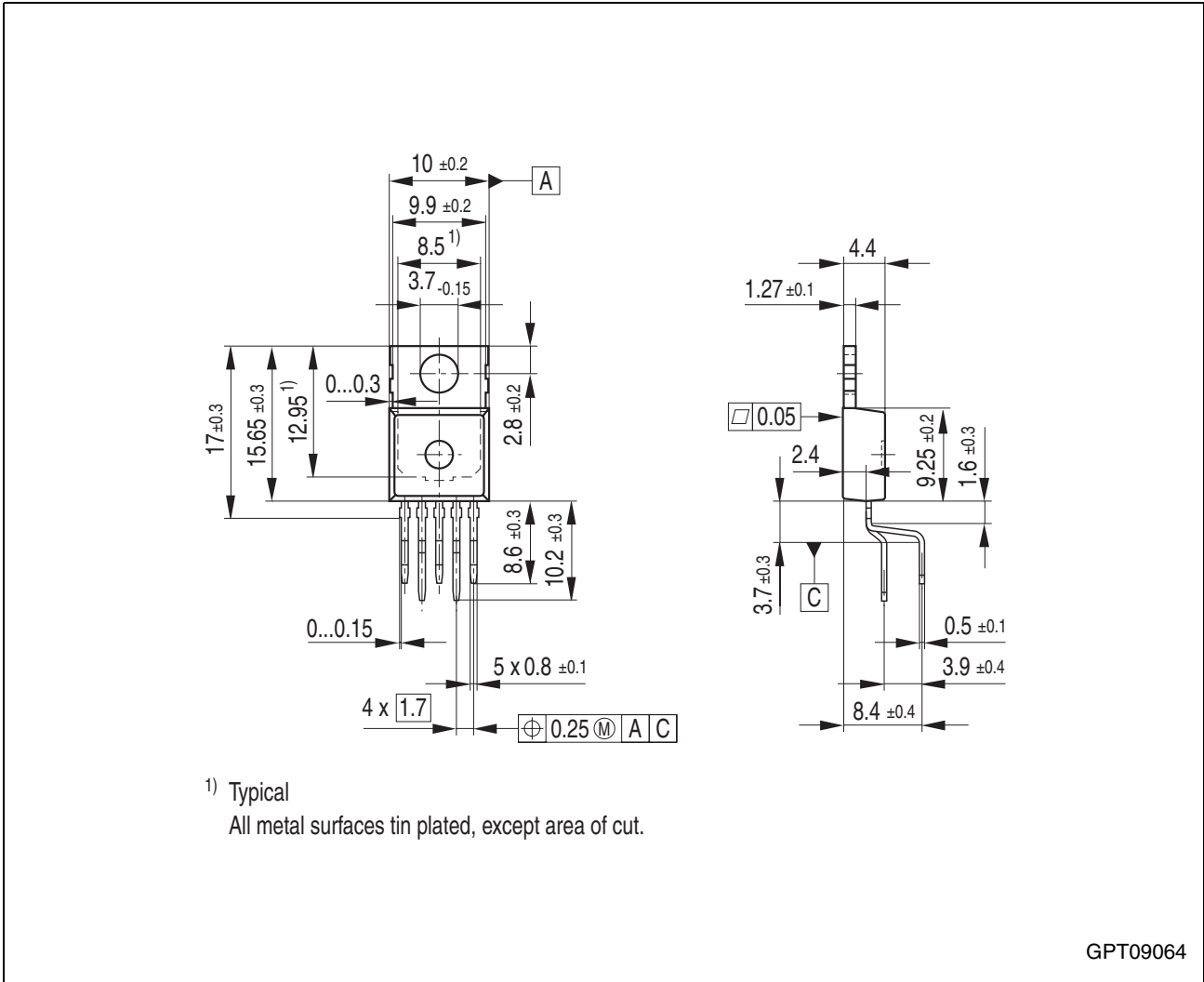


Figure 6 PG-TO220-5-11 (Plastic Transistor Single Outline)

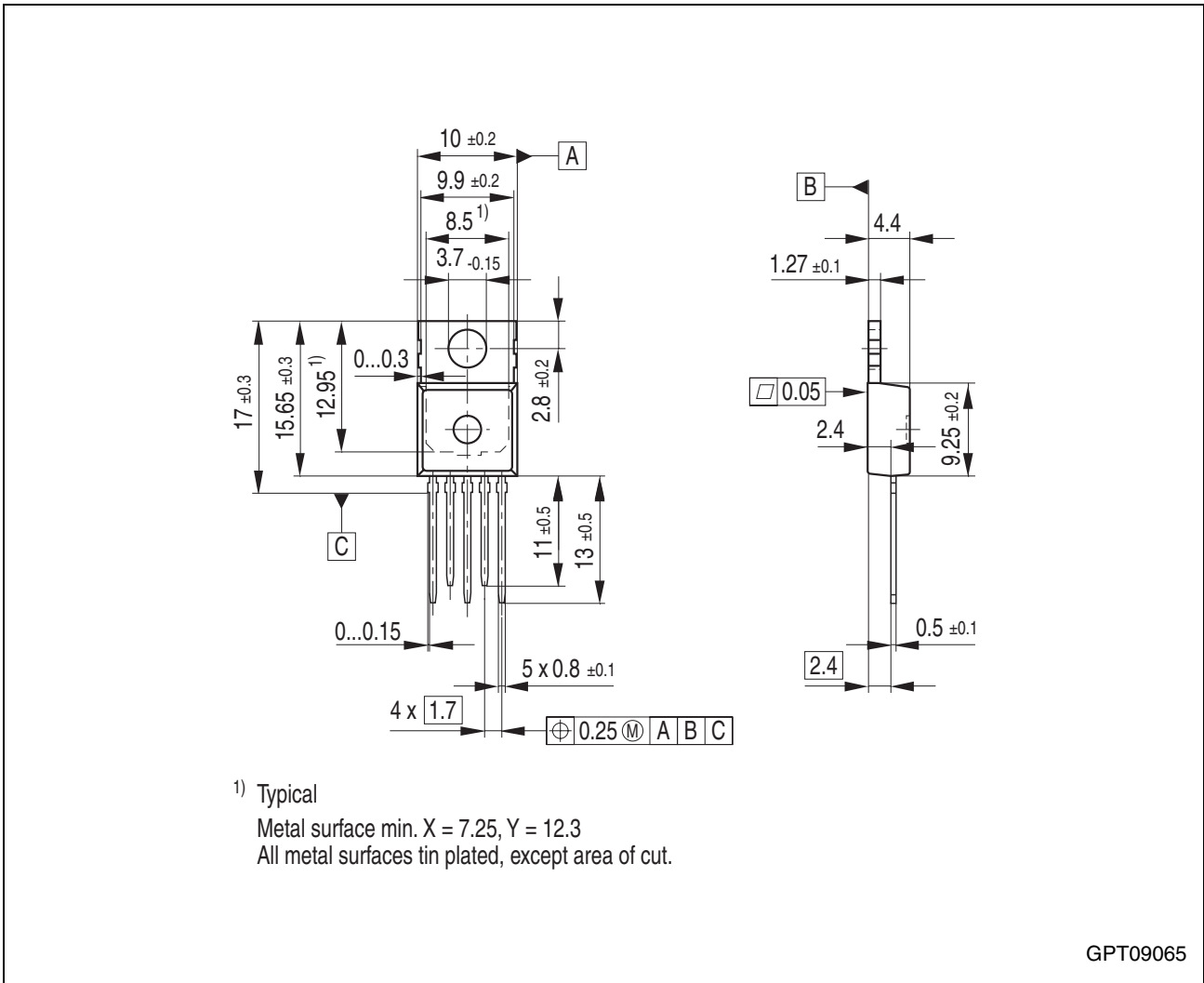
Green Product (RoHS compliant)

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).

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SMD = Surface Mounted Device

Dimensions in mm



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

**Green Product** (RoHS compliant)

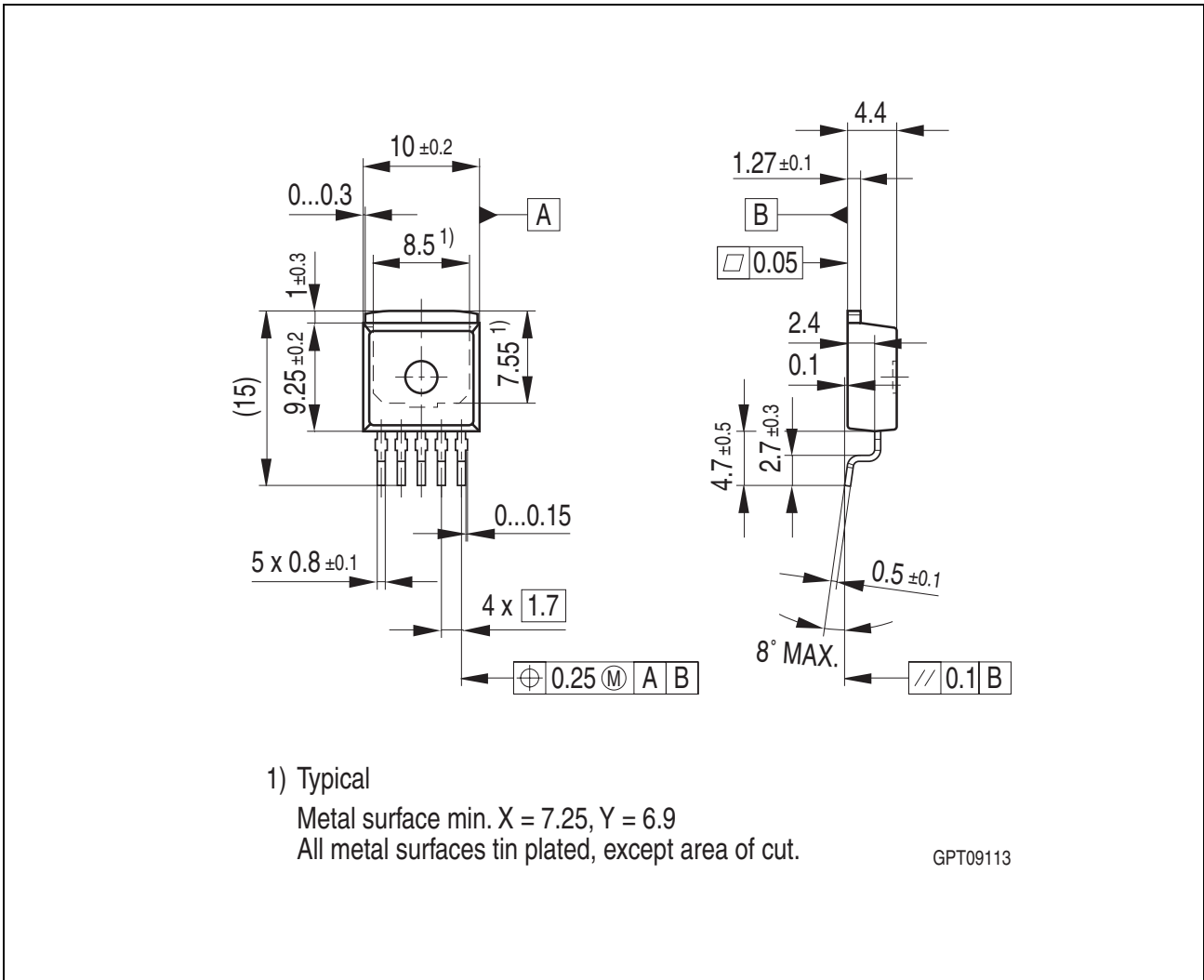
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SMD = Surface Mounted Device

Dimensions in mm





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

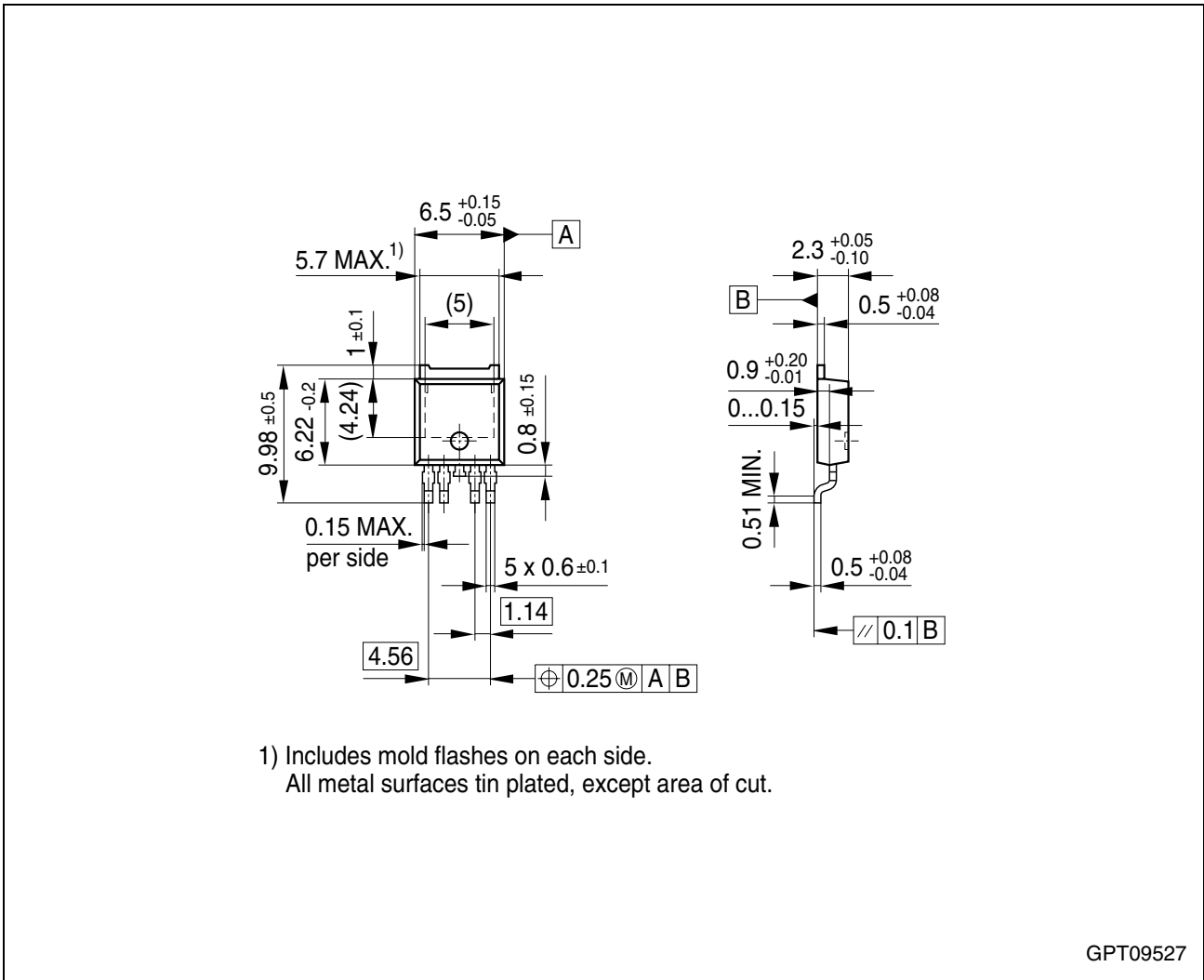
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SMD = Surface Mounted Device

Dimensions in mm



**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 <b>Page 1</b> : AEC certified statement added <b>Page 1</b> and <b>Page 15</b> : RoHS compliance statement and Green product feature added <b>Page 1</b> and <b>Page 15</b> : Package changed to RoHS compliant version Legal Disclaimer updated
Rev. 2.5	2004-12-23	Added ESD capability information in table "Maximum Ratings".

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