

# OPTIREG™ Linear TLE4276

## Low Drop Voltage Regulator

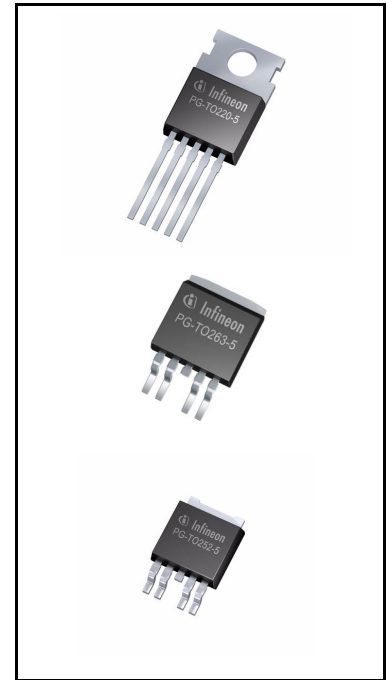


### Features

- 5 V, and 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)

### Potential applications

Automotive applications especially with tight space constraints.



### Product validation

Qualified for Automotive Applications. Product Validation according to AEC-Q100/101.

### Description

The OPTIREG™ Linear TLE4276 is a low-drop voltage regulator in a TO package. The IC regulates an input voltage up to 40 V to  $V_{Q,nom} = 5.0$  V (V50), 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  $\mu$ A. The IC is short-circuit-proof and includes temperature protection which turns off the device at overtemperature.

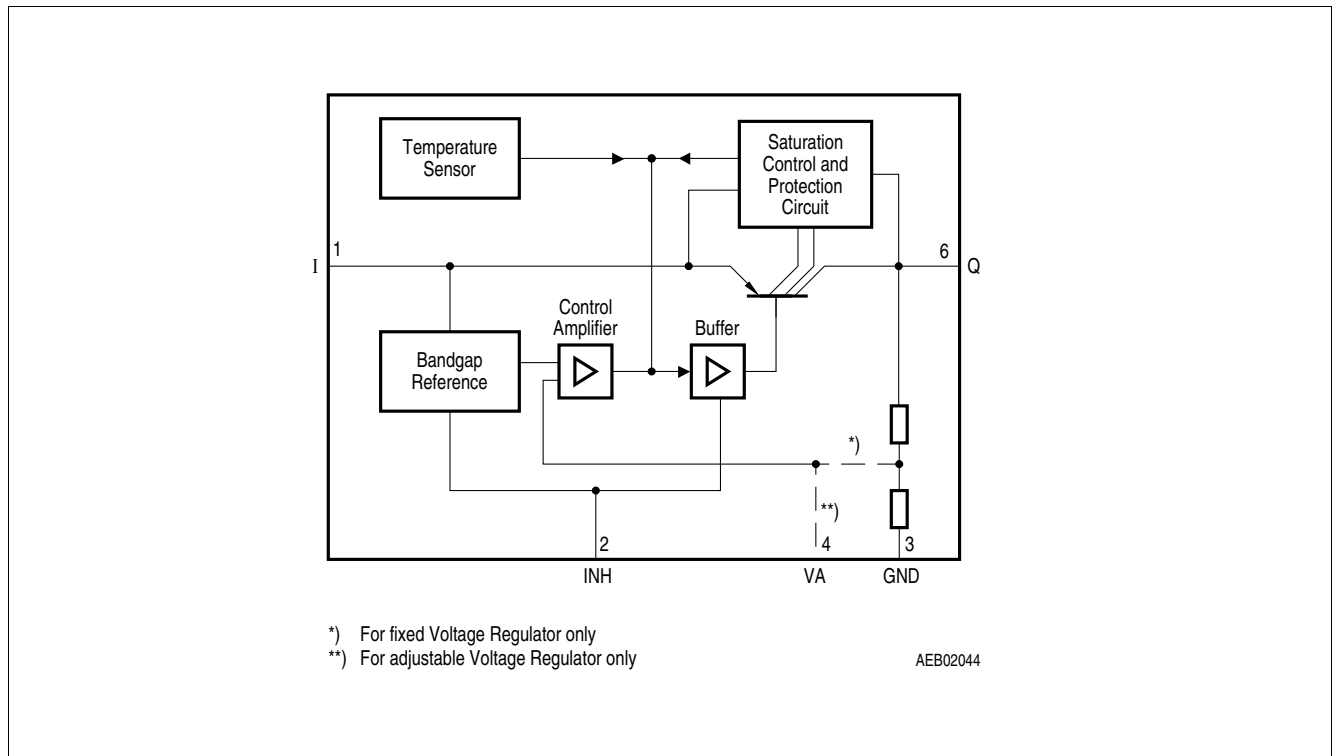
Type	Package	Marking
TLE4276SV	PG-TO220-5	4276V
TLE4276GV50	PG-TO263-5	4276V50
TLE4276GV	PG-TO263-5	4276V
TLE4276DV50	PG-TO252-5	4276V50
TLE4276DV	PG-TO252-5	4276V

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**Block Diagram**

**1 Block Diagram**

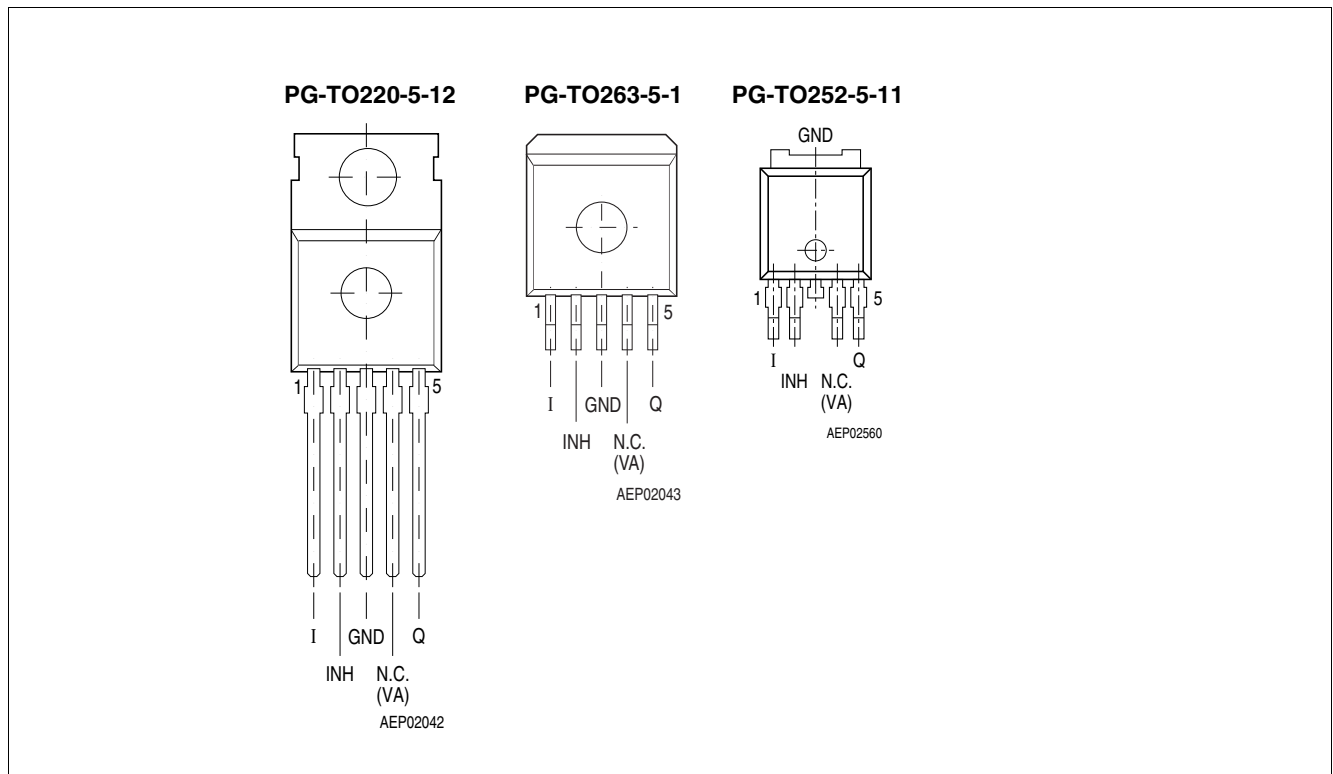


**Figure 1 Block Diagram**

**Pin Configuration**

**2 Pin Configuration**

**2.1 Pin Assignments**



**Figure 2 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 <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.

## **3 Functional Description**

### **Functional Description**

The OPTIREG™ Linear TLE4276 is a low-drop voltage regulator in a TO package. The IC regulates an input voltage up to 40 V to  $V_{Q,nom} = 5.0$  V (V50), 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  $\mu$ 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  $\Omega$  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  $C_O \geq 22$   $\mu$ F and an ESR of  $\leq 3$   $\Omega$  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

**Functional Description**

**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

**Functional Description**

**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
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 × 80 × 1.5 mm ; 35μ Cu; 5μ Sn; Footprint only; zero airflow.

**Functional Description**

**Table 5 Characteristics**

$V_I = 13.5 \text{ V}$ ;  $-40 \text{ °C} < T_j < 150 \text{ °C}$  (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 $5 \text{ mA} < I_Q < 400 \text{ mA}$ $6 \text{ V} < V_I < 28 \text{ V}$	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 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	$\mu\text{A}$	$V_{\text{INH}} = 0 \text{ V}$ ; $T_j \leq 100 \text{ °C}$	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
Current consumption; $I_q = I_I - I_Q$	$I_q$	-	15	25	mA	$I_Q = 400 \text{ mA}$	1
Drop voltage <sup>1)</sup>	$V_{\text{DR}}$	-	250	500	mV	V50 $I_Q = 250 \text{ mA}$ $V_{\text{DR}} = V_I - V_Q$	1
Drop voltage <sup>1)</sup>	$V_{\text{DR}}$	-	250	500	mV	variable devices $I_Q = 250 \text{ mA}$ $V_I > 4.5 \text{ V}$ $V_{\text{DR}} = V_I - V_Q$	1
Load regulation	$\Delta V_{Q,\text{Lo}}$	-	5	35	mV	$I_Q = 5 \text{ mA to } 400 \text{ mA}$	1
Line regulation	$\Delta V_{Q,\text{Li}}$	-	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	$\Delta V_Q/dT$	-	0.5	-	-	-	mV/K



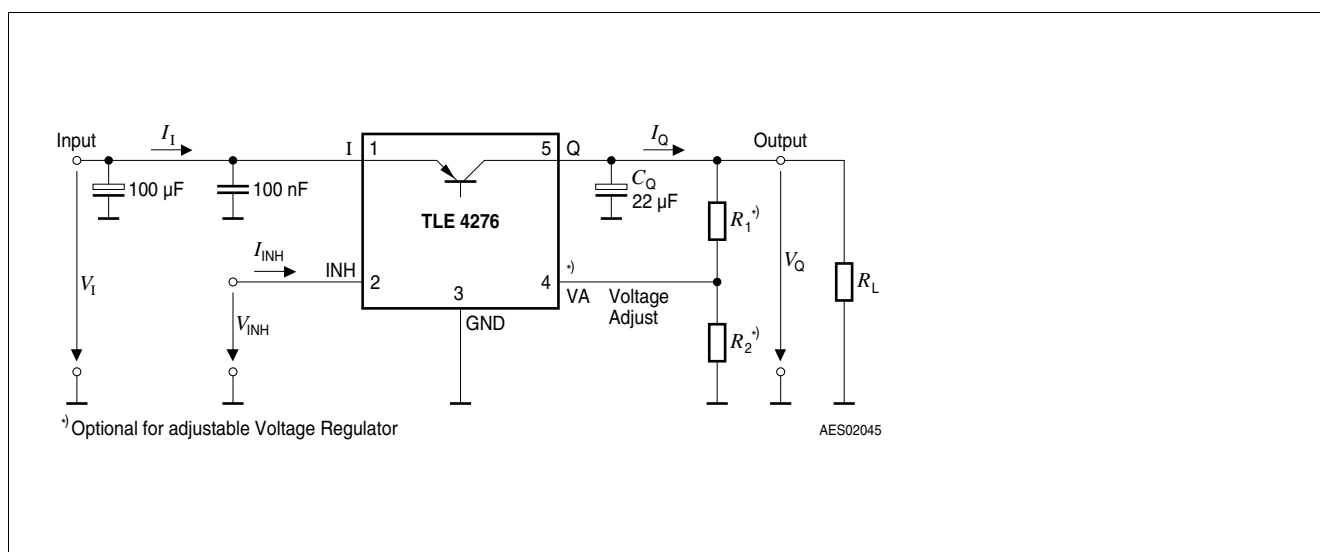
**Functional Description**

**Table 5 Characteristics (cont'd)**

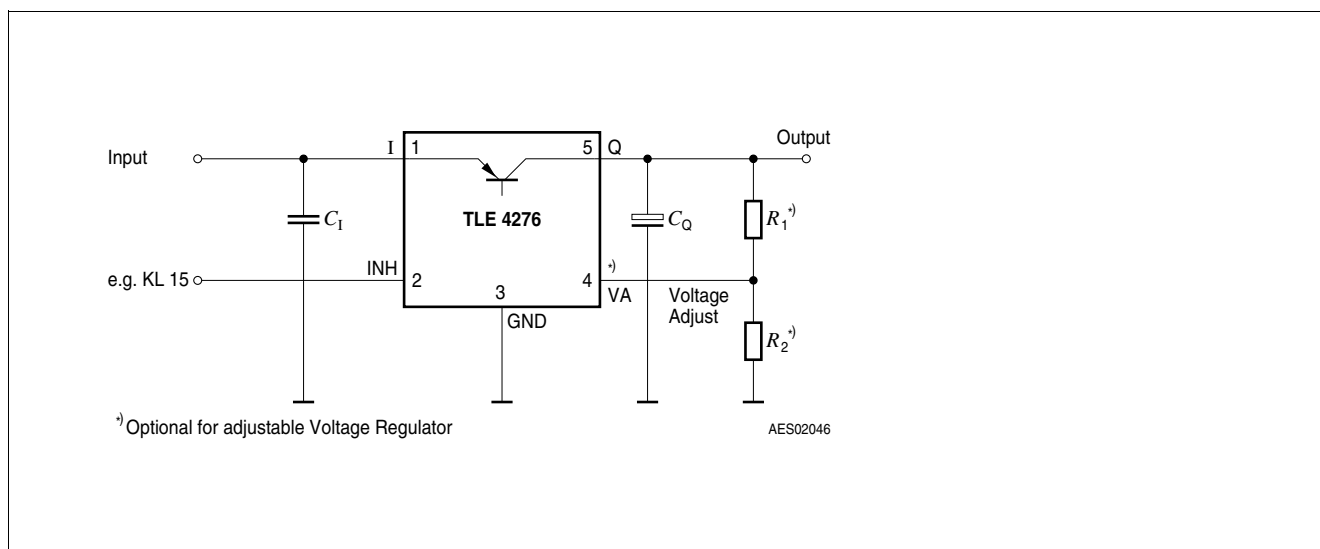
$V_I = 13.5\text{ V}$ ;  $-40\text{ }^\circ\text{C} < T_j < 150\text{ }^\circ\text{C}$  (unless otherwise specified)

Parameter	Symbol	Limit Values			Unit	Measuring Condition	Measuring Circuit
		Min.	Typ.	Max.			
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**



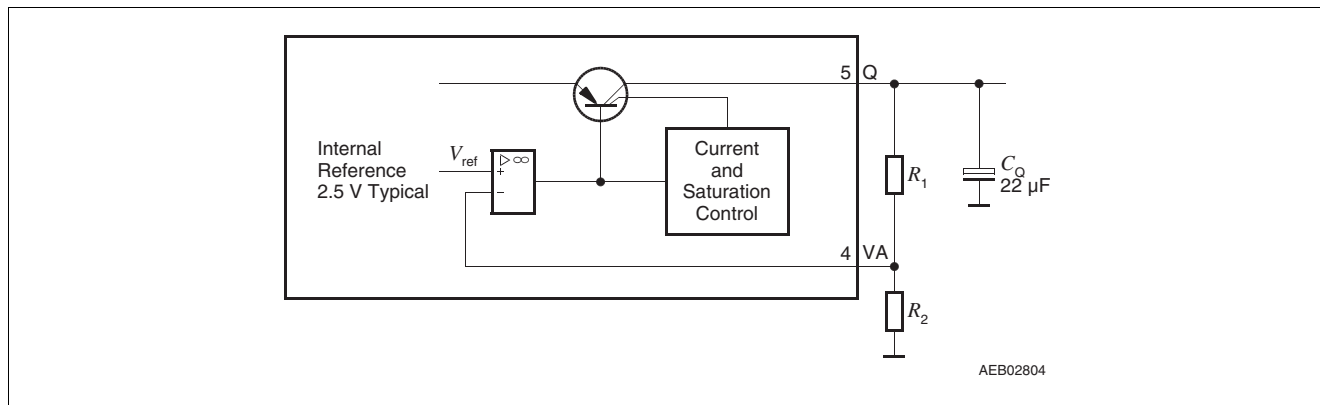
**Figure 4 Application Circuit**

**Functional Description**

**Application Information for Variable Output Regulator TLE 4276 V**

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 (3.1)**:

$$V_Q = (R_1 + R_2)/R_2 \times V_{ref}, \text{ neglecting } I_{VA} \quad (3.1)$$

$V_{ref}$  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 (3.2)**:

$$R_2 < 50 \text{ k}\Omega \quad (3.2)$$

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.

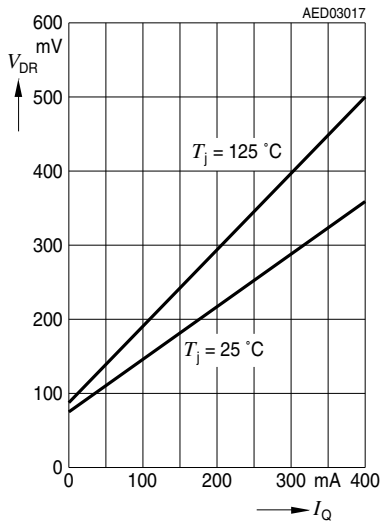
The operation range of the variable TLE 4276 V is  $V_Q + 0.5 \text{ V}$  to 40 V. For internal biasing a minimum input voltage of 4.3 V is required. For output voltages below 4 V the voltage drop is  $4.3 \text{ V} - V_Q$

**Functional Description**

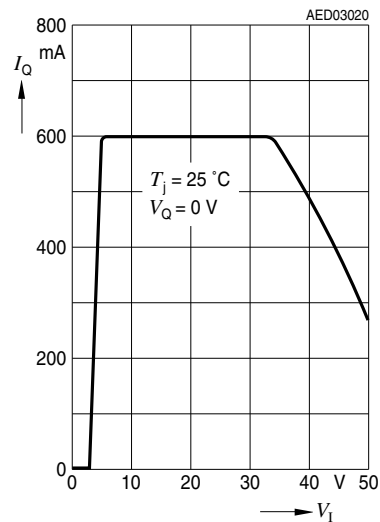
**3.1 Typical Performance Graphs**

**Typical Performance Characteristics V50**

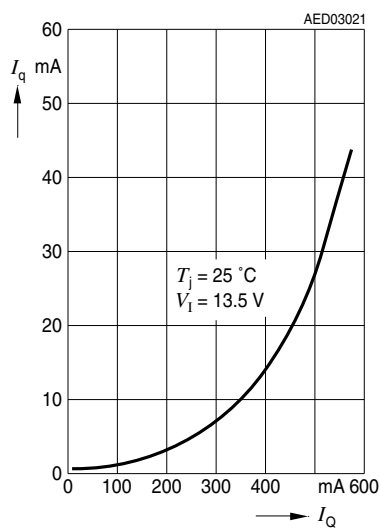
**Voltage  $V_{DR}$  versus Output Current  $I_Q$**



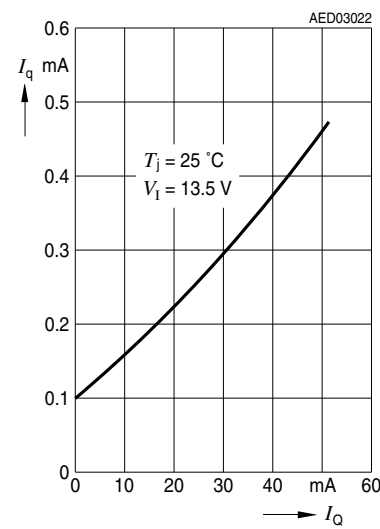
**Current Consumption  $I_q$  versus Output Current  $I_Q$  (high load)**



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

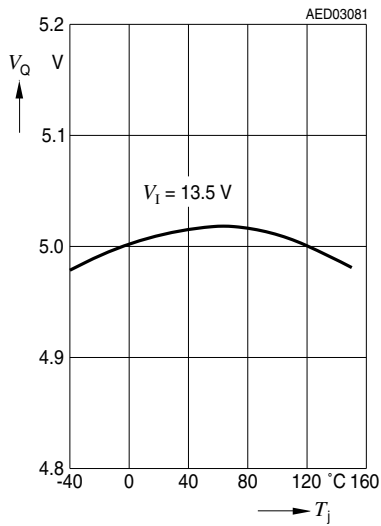


**Current Consumption  $I_q$  versus Output Current  $I_Q$  (low load)**

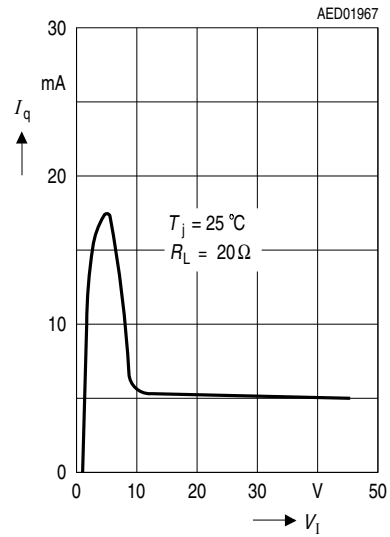


**Functional Description**

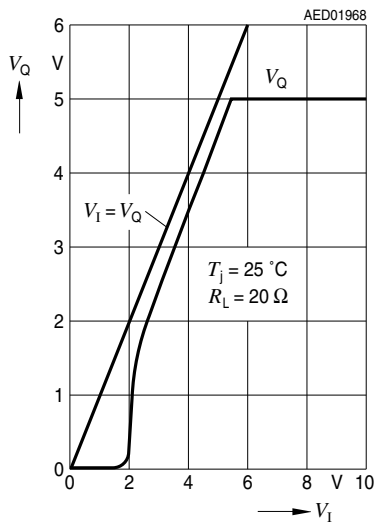
**Output Voltage  $V_Q$  versus Temperature  $T_j$**



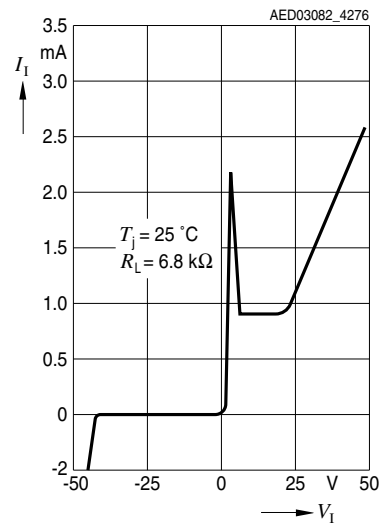
**Current Consumption  $I_q$  versus Input Voltage  $V_I$**



**Low Voltage Behavior**

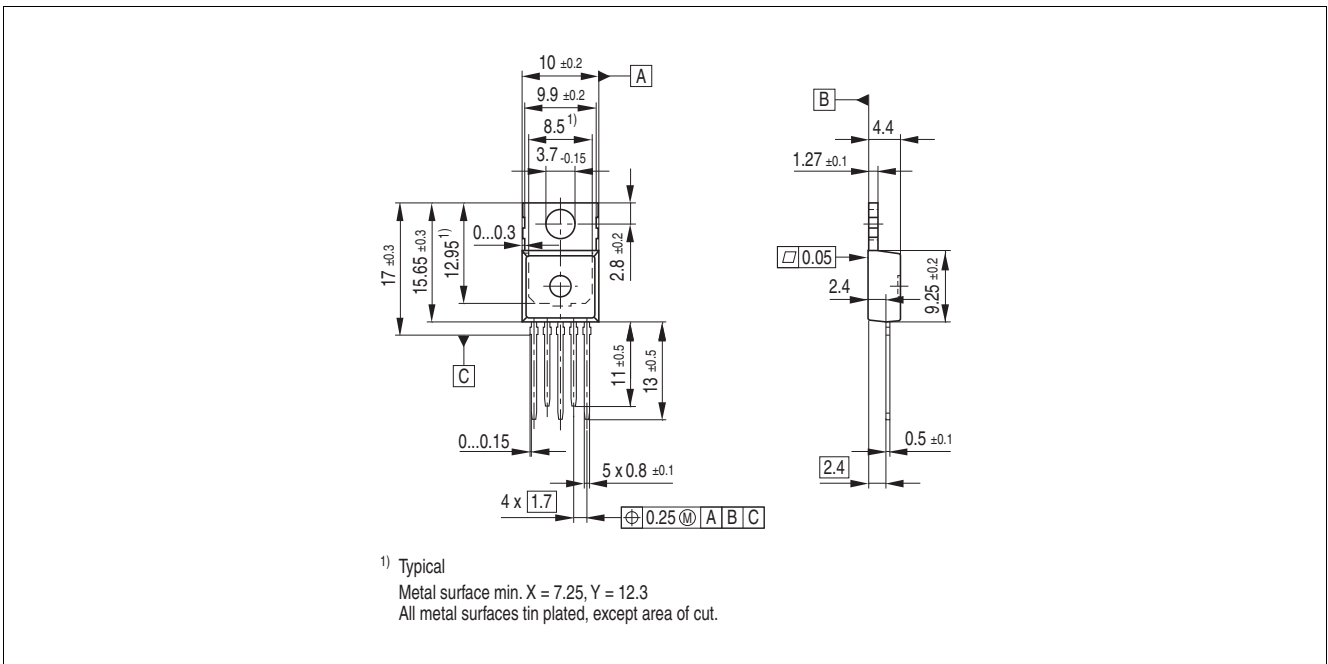


**High Voltage Behavior**

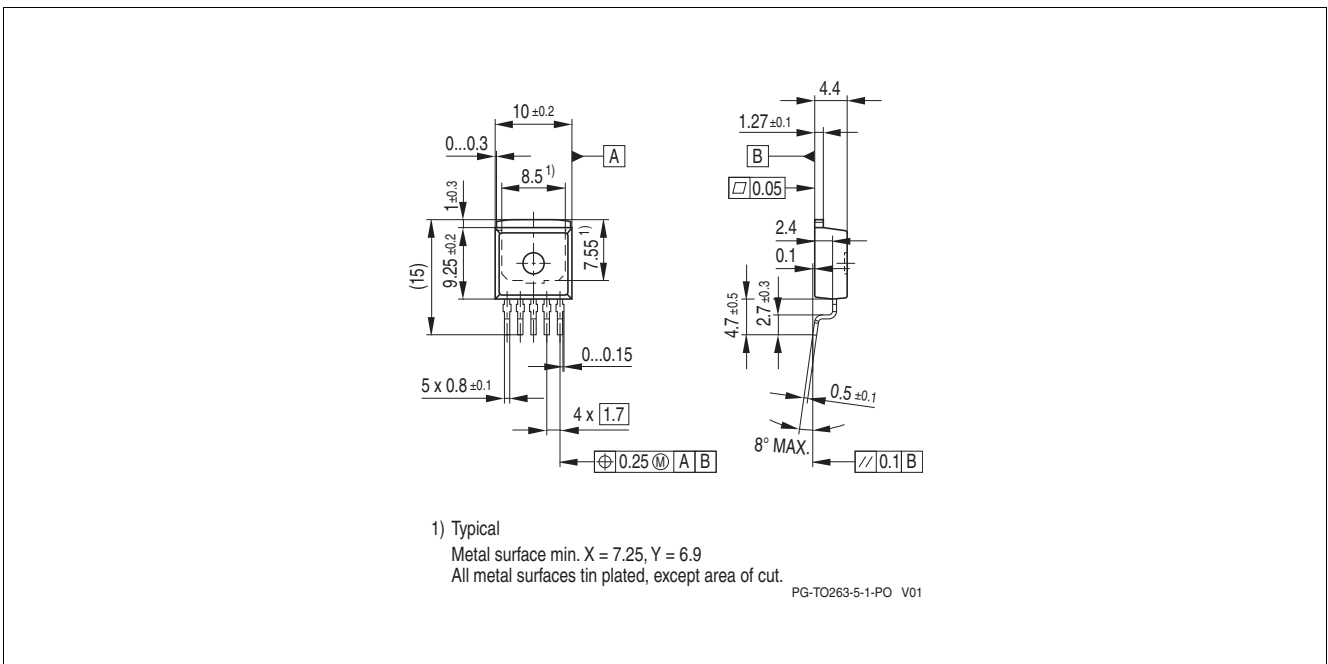


**Package information**

**4 Package information**



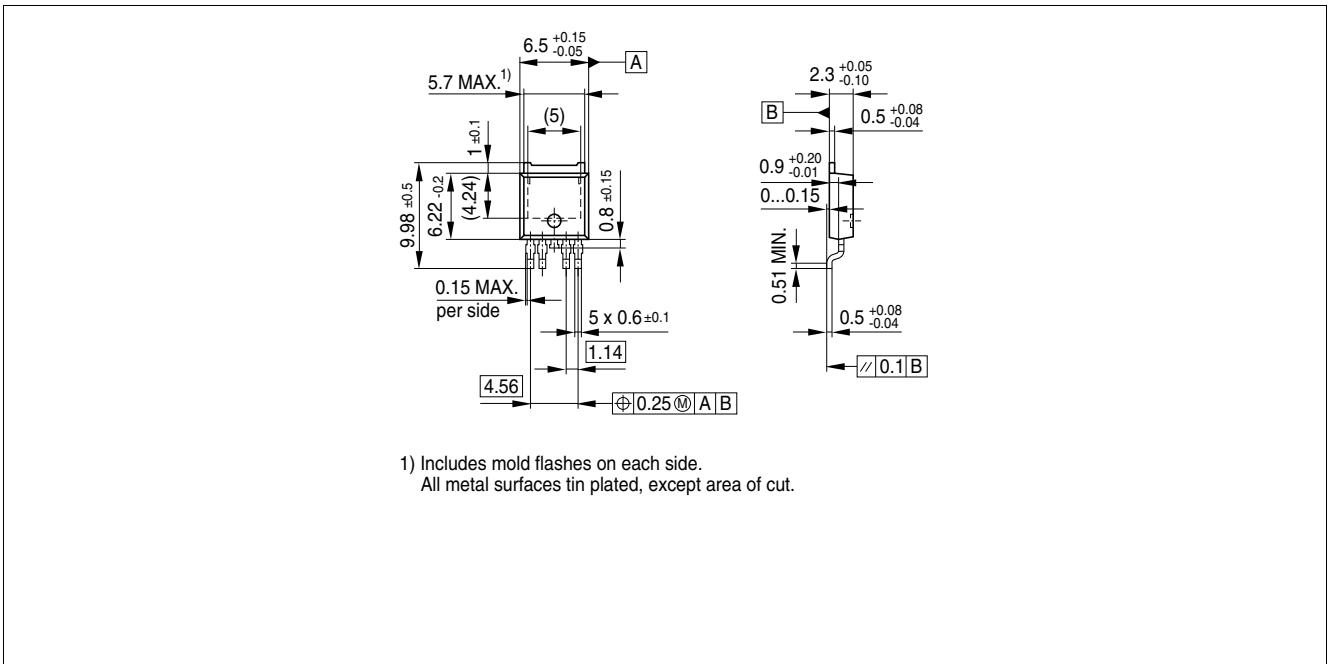
**Figure 6 PG-TO220-5 1)**



**Figure 7 PG-TO263-5 1)**

1) Dimensions in mm

**Package information**



**Figure 8 PG-T0252-5<sup>1)</sup>**

**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).

**Further information on packages**

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

1) Dimensions in mm

**Revision History**

**5 Revision History**

<b>Revision</b>	<b>Date</b>	<b>Changes</b>
2.81	2019-05-22	Updated layout (OPTIREG)
2.80	2018-01-10	Deleted obsolete products: TLE4276V50, TLE4276V85, TLE4276V10, TLE4276SV50, TLE4276SV85, TLE4276GV85 and TLE4276GV10 Updated Template

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**Document reference**

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