

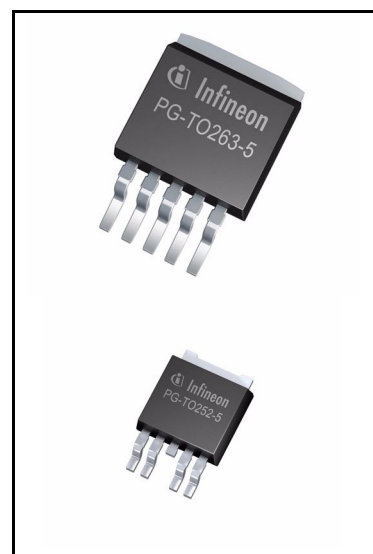
# OPTIREG™ Linear TLE4270-2

## 5-V low drop fixed voltage regulator



### Features

- Output voltage tolerance  $\leq \pm 2\%$
- 650 mA output current capability
- Low-drop voltage
- Reset functionality
- Adjustable reset time
- Suitable for use in automotive electronics
- Integrated overtemperature protection
- Reverse polarity protection
- Input voltage up to 42 V
- Overvoltage protection up to 65 V ( $\leq 400$  ms)
- Short-circuit proof
- Wide temperature range
- ESD protection:  $\pm 2$  kV HBM<sup>1)</sup>
- Green Product (RoHS compliant)



### Potential applications

General automotive applications.

### Product validation

Qualified for automotive applications. Product validation according to AEC-Q100.

### Description

The OPTIREG™ Linear TLE4270-2 is a 5-V low drop fixed-voltage regulator. The maximum input voltage is 42 V (65 V,  $\leq 400$  ms). Up to an input voltage of 26 V and for an output current up to 650 mA it regulates the output voltage within a 2% accuracy. The short circuit protection limits the output current of more than 650 mA. The device incorporates overvoltage protection and a temperature protection which turns off the device at high temperatures.

1) ESD susceptibility, Human Body Model (HBM) according to EIA/JESD 22-A114B.

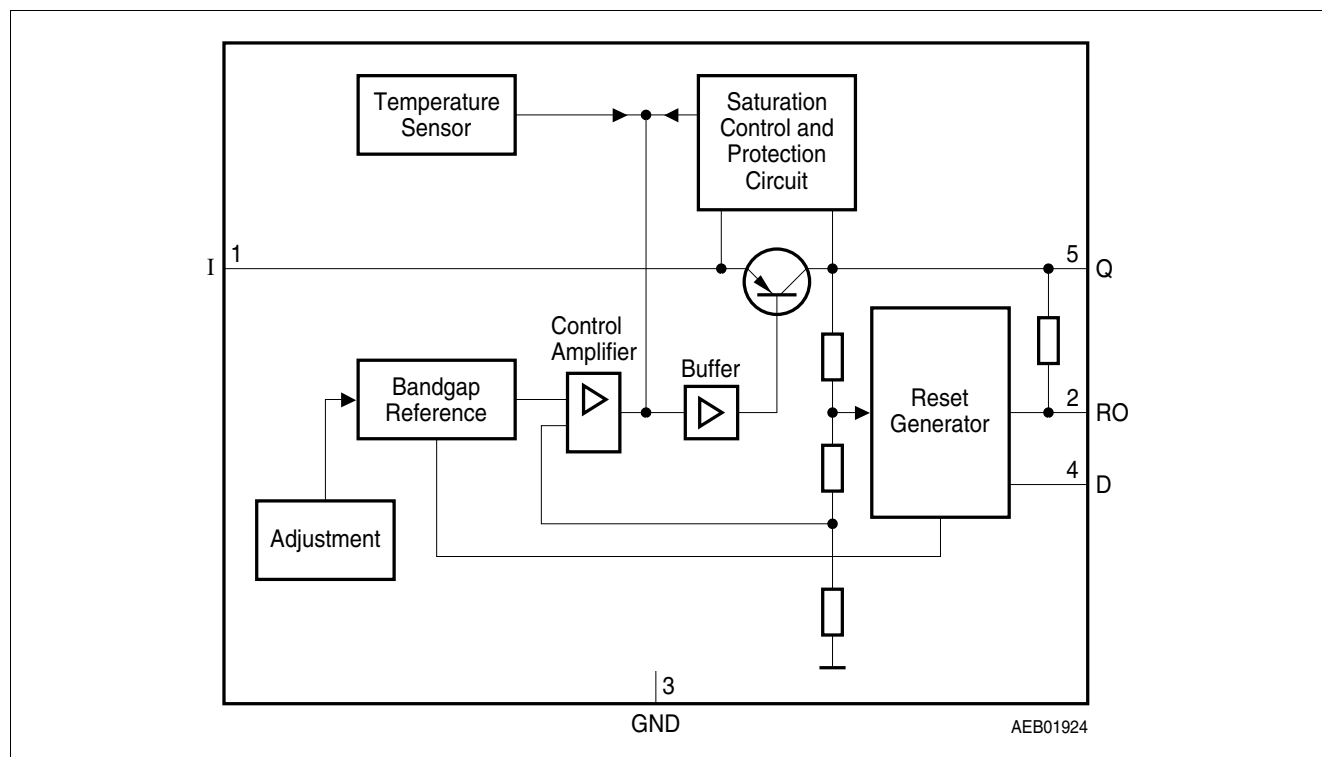
Type	Package	Marking
TLE4270-2G	P-T0263-5	4270-2G
TLE4270-2D	P-T0252-5	4270-2D

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**Block diagram**

**1 Block diagram**

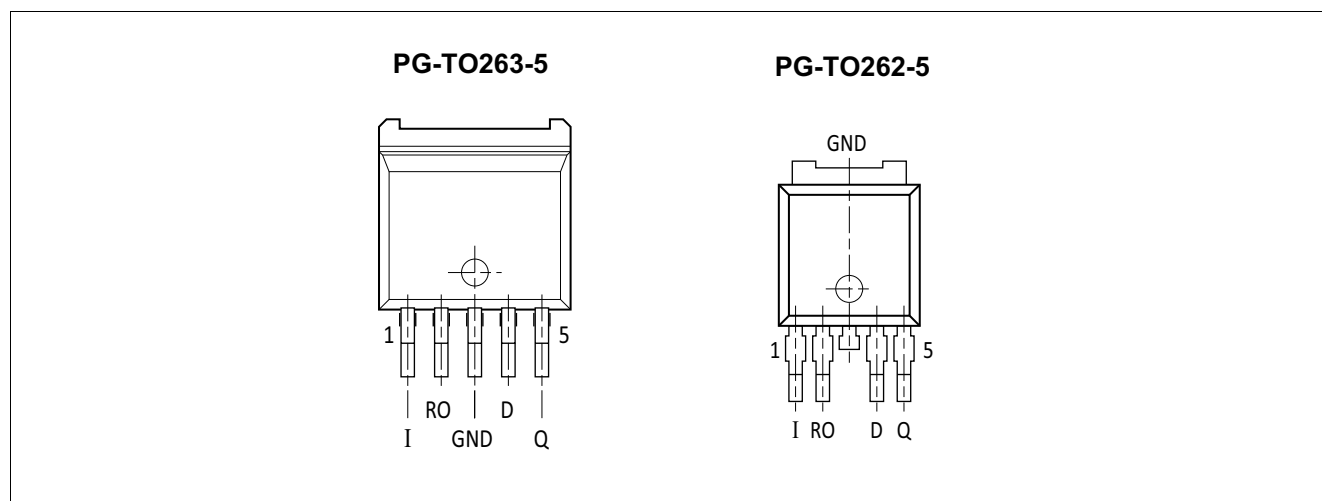


**Figure 1 Block diagram**

## Pin configuration

## 2 Pin configuration

### 2.1 Pin assignment



**Figure 2** Pin configuration (top view)

### 2.2 Pin definitions and functions

Pin	Symbol	Function
1	I	<b>Input;</b> block to ground directly at the IC with a ceramic capacitor.
2	RO	<b>Reset output;</b> the open collector output is connected to the 5-V output via an integrated resistor of 30 kΩ.
3	GND	<b>Ground;</b> internally connected to heatsink.
4	D	<b>Reset delay;</b> connect a capacitor to ground for delay time adjustment.
5	Q	<b>5-V output;</b> block to ground with 22 μF capacitor, ESR < 3 Ω.

### 3 General product characteristics

#### 3.1 Absolute maximum ratings

**Table 1** Absolute maximum ratings

$T_j = -40$  to  $150^\circ\text{C}$

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Input I							
Voltage	$V_I$	-42	–	42	V	–	P_3.1.1
Voltage	$V_I$	–	–	65	V	$t \leq 400$ ms	P_3.1.2
Current	$I_I$	–	–	–	–	Internally limited	P_3.1.3
Reset output RO							
Voltage	$V_{RO}$	-0.3	–	7	V	–	P_3.1.4
Current	$I_{RO}$	–	–	–	–	Internally limited	P_3.1.5
Reset delay D							
Voltage	$V_D$	-0.3	–	7	V	–	P_3.1.6
Current	$I_D$	–	–	–	–	Internally limited	P_3.1.7
Output Q							
Voltage	$V_Q$	-1.0	–	16	V	–	P_3.1.8
Current	$I_Q$	–	–	–	–	Internally limited	P_3.1.9
Ground GND							
Current	$I_{GND}$	-0.5	–	–	A	–	P_3.1.10
Temperatures							
Junction temperature	$T_j$	–	–	150	°C	–	P_3.1.11
Storage temperature	$T_{stg}$	-50	–	150	°C	–	P_3.1.12

#### 3.2 Functional range

**Table 2** Functional range

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Input voltage	$V_I$	6	–	42	V	–	P_3.2.1
Junction temperature	$T_j$	-40	–	150	$^\circ\text{C}$	–	P_3.2.2

**General product characteristics**

### 3.3 Thermal resistance

**Table 3 Thermal resistance**

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Thermal resistance							
Junction ambient	$R_{thJA}$	–	–	65	K/W	TO263, <sup>1)</sup>	P_3.3.1
		–	–	79	K/W	TO252 <sup>1)</sup>	P_3.3.2
Junction case	$R_{thJC}$	–	–	3	K/W	TO-263 Packages	P_3.3.3

1) Mounted on PCB, 80 × 80 × 1.5 mm<sup>3</sup>; 35 μ Cu; 5 μ Sn; footprint only; zero airflow.

## Functional description

## 4 Functional description

### 4.1 Circuit description

The control amplifier compares a reference voltage, which is kept highly accurate by resistance adjustment, to a voltage that is proportional to the output voltage and drives the base of a series transistor via a buffer. Saturation control as a function of the load current prevents any over-saturation of the power element.

The IC also incorporates a number of internal circuits for protection against:

- Overload
- Overvoltage
- Overtemperature
- Reverse polarity

### 4.2 Electrical characteristics

**Table 4 Electrical characteristics**

$V_I = 13.5 \text{ V}$ ;  $T_J = -40 \text{ to } 125^\circ\text{C}$  (unless otherwise specified)

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Output voltage	$V_Q$	4.90	5.00	5.10	V	$5 \text{ mA} \leq I_Q \leq 550 \text{ mA}$ ; $6 \text{ V} \leq V_I \leq 26 \text{ V}$	P_4.0.1
	$V_Q$	4.90	5.00	5.10	V	$26 \text{ V} \leq V_I \leq 36 \text{ V}$ ; $I_Q \leq 300 \text{ mA}$	P_4.0.2
Output current limiting	$I_{Q\text{max}}$	650	850	–	mA	$V_Q = 0 \text{ V}$	P_4.0.3
Current consumption $I_q = I_I - I_Q$	$I_q$	–	1	1.5	mA	$I_Q = 5 \text{ mA}$	P_4.0.4
	$I_q$	–	55	75	mA	$I_Q = 550 \text{ mA}$	P_4.0.5
	$I_q$	–	70	90	mA	$I_Q = 550 \text{ mA}$ ; $V_I = 5 \text{ V}$	P_4.0.6
Drop voltage	$V_{\text{DR}}$	–	350	700	mV	$I_Q = 550 \text{ mA}^{(1)}$	P_4.0.7
Load regulation	$\Delta V_{Q,\text{Lo}}$	–	25	50	mV	$I_Q = 5 \text{ to } 550 \text{ mA}$ ; $V_I = 6 \text{ V}$	P_4.0.8
Line regulation	$\Delta V_{Q,\text{Li}}$	–	12	25	mV	$V_I = 6 \text{ to } 26 \text{ V}$ ; $I_Q = 5 \text{ mA}$	P_4.0.9
Power supply ripple rejection	$\text{PSRR}$	–	54	–	dB	$f_r = 100 \text{ Hz}$ ; $V_r = 0.5 \text{ Vpp}$	P_4.0.10

#### Reset generator

Switching threshold	$V_{\text{RT}}$	4.5	4.65	4.8	V	–	P_4.0.11
Reset high voltage	$V_{\text{ROH}}$	4.5	–	–	V	–	P_4.0.12
Reset low voltage	$V_{\text{ROL}}$	–	60	–	mV	$R_{\text{int}} = 30 \text{ k}\Omega^{(2)}$ ; $1.0 \text{ V} \leq V_Q \leq 4.5 \text{ V}$	P_4.0.13
	$V_{\text{ROL}}$	–	200	400	mV	$I_R = 3 \text{ mA}$ , $V_Q = 4.4 \text{ V}$	P_4.0.14
Reset pull-up	$R_{\text{int}}$	18	30	46	k $\Omega$	Internally connected to Q	P_4.0.15



**Functional description**

**Table 4 Electrical characteristics (cont'd)**

$V_I = 13.5 \text{ V}$ ;  $T_j = -40 \text{ to } 125^\circ\text{C}$  (unless otherwise specified)

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Charge current	$I_{D,c}$	8	14	25	$\mu\text{A}$	$V_D = 1.0 \text{ V}$	P_4.0.16
Upper reset timing threshold	$V_{DU}$	1.4	1.8	2.3	V	–	P_4.0.17
Lower reset timing threshold	$V_{DL}$	0.2	0.45	0.8	V	$V_Q < V_{RT}$	P_4.0.18
Delay time	$t_{rd}$	–	13	–	ms	$C_D = 100 \text{ nF}$	P_4.0.19
Reset reaction time	$t_{rr}$	–	–	3	$\mu\text{s}$	$C_D = 100 \text{ nF}$	P_4.0.20

**Overvoltage protection**

Turn-off voltage	$V_{I,ov}$	42	44	46	V	–	P_4.0.21
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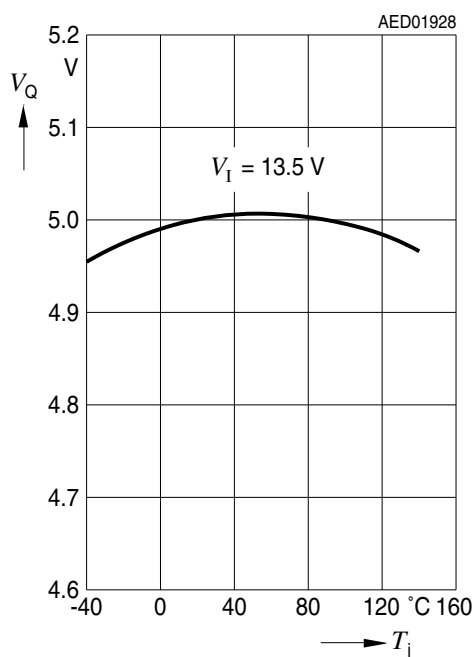
- 1) Drop voltage =  $V_I - V_Q$  (measured when the output voltage has dropped 100 mV from the nominal value obtained at 13.5 V input).
- 2) Reset peak is always lower than 1.0 V.

## Functional description

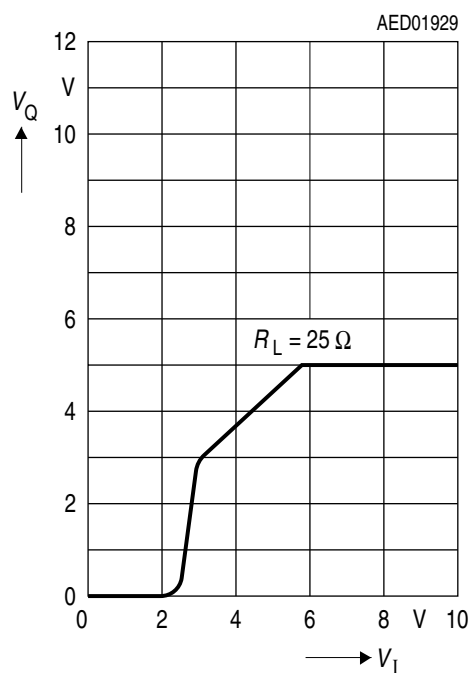
### 4.3 Typical performance graphs

#### Typical performance characteristics

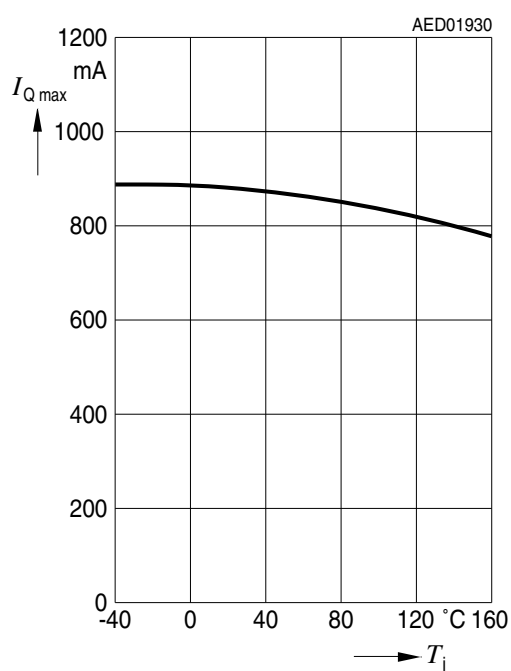
**Output voltage  $V_Q$  vs.  
junction temperature  $T_j$**



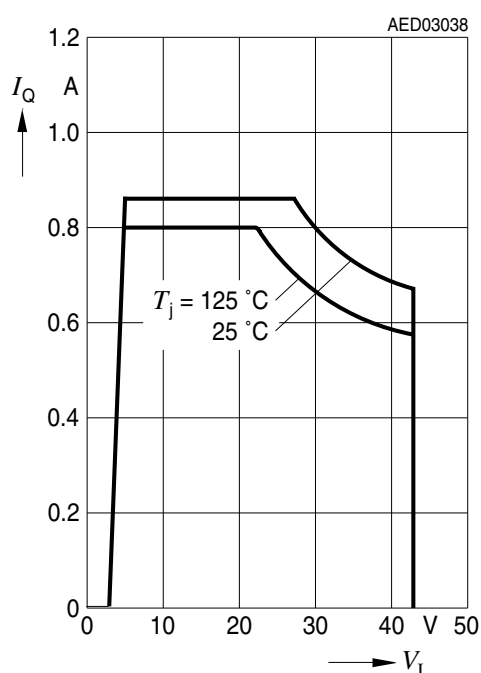
**Output voltage  $V_Q$  vs.  
input voltage  $V_I$**



**Output current  $I_Q$  vs.  
junction temperature  $T_j$**

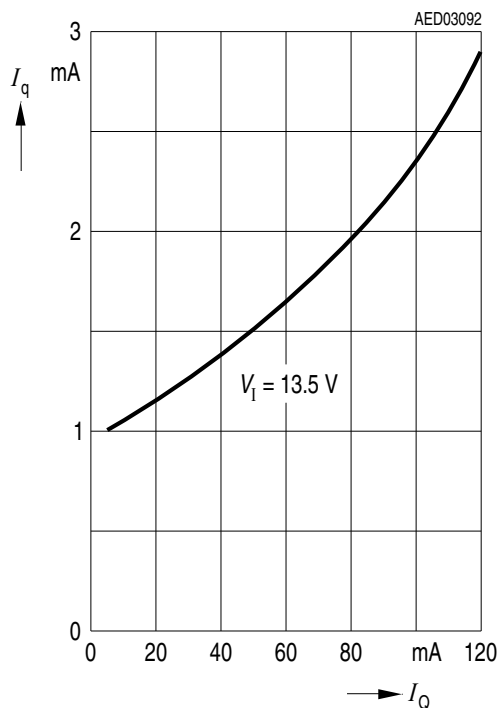


**Output current  $I_Q$  vs.  
input voltage  $V_I$**

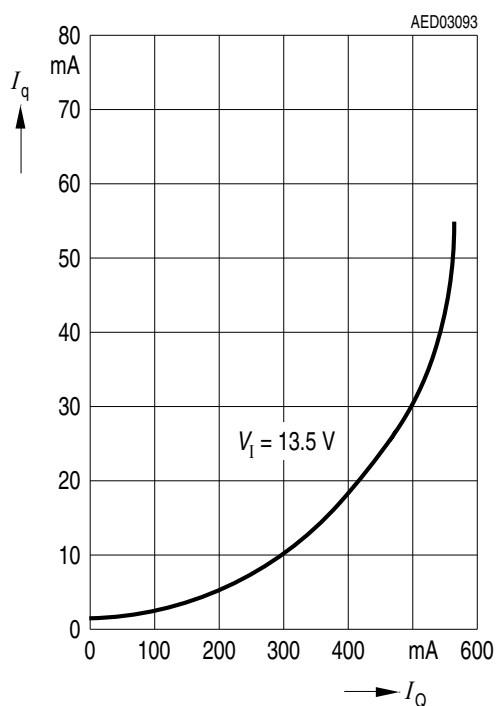


## Functional description

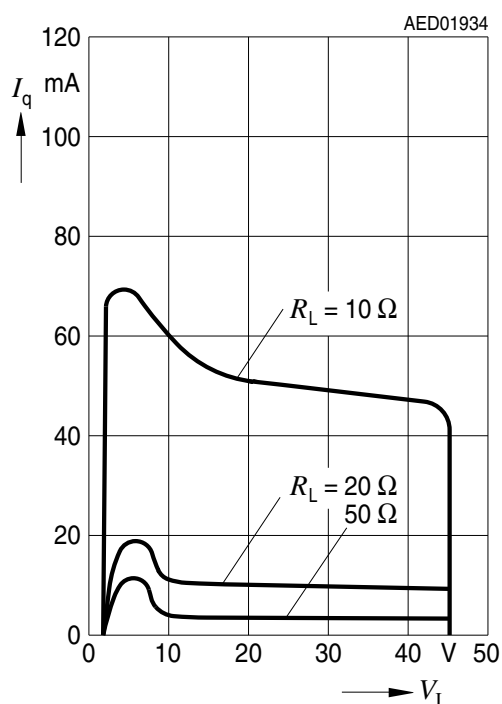
**Current consumption  $I_q$  vs.  
output current  $I_Q$**



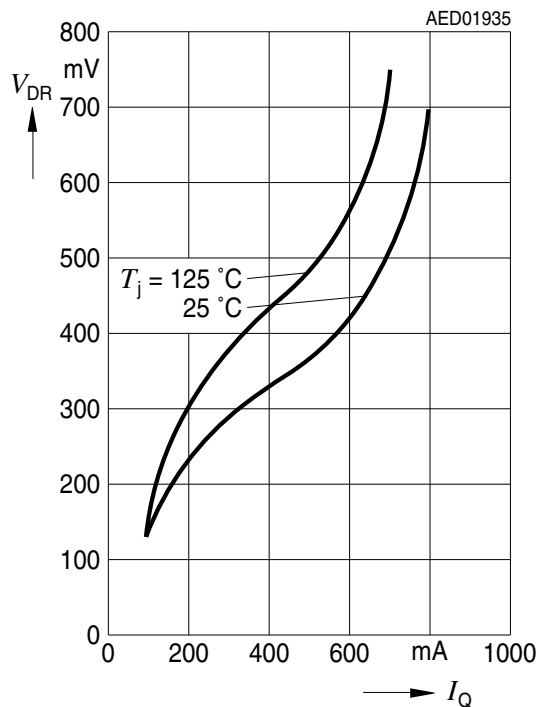
**Current consumption  $I_q$  vs.  
output current  $I_Q$**



**Current consumption  $I_q$  vs.  
input voltage  $V_I$**



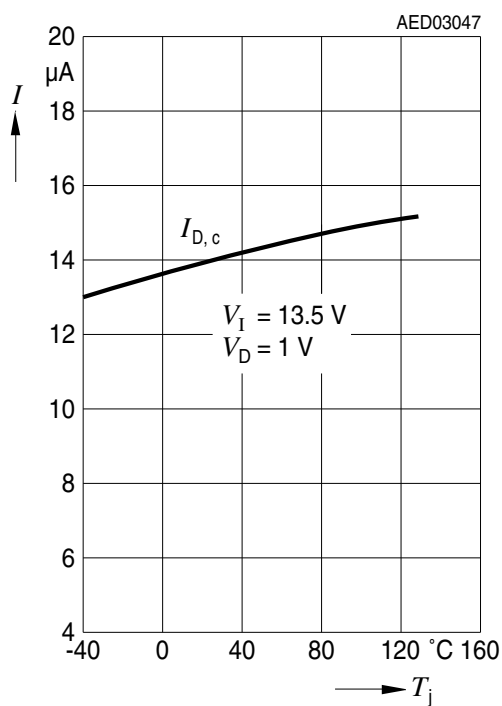
**Drop voltage  $V_{DR}$  vs.  
output current  $I_Q$**



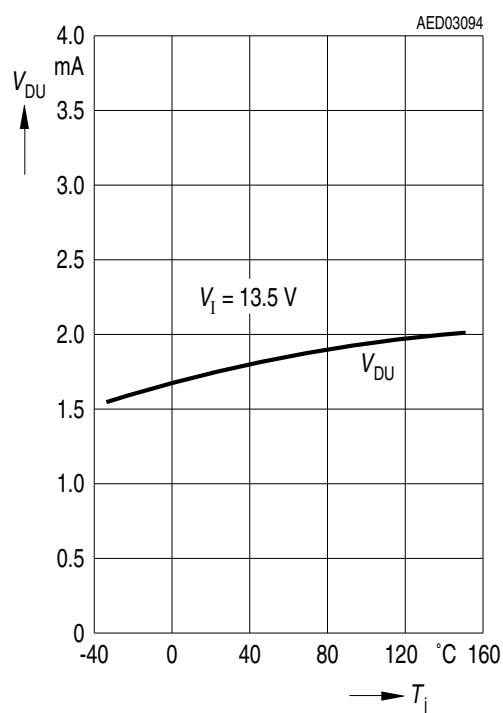
## Functional description

## Typical performance characteristics

**Charge current  $I_{D,c}$  vs.  
junction temperature  $T_j$**



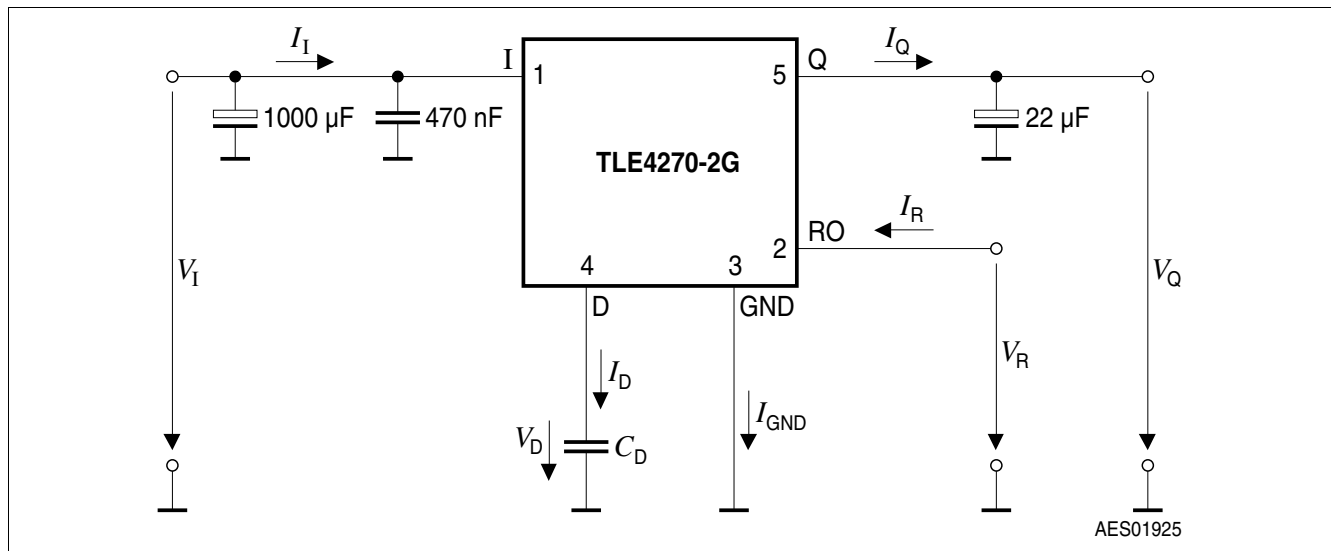
**Upper reset timing threshold  $V_{DU}$  vs.  
junction temperature  $T_j$**



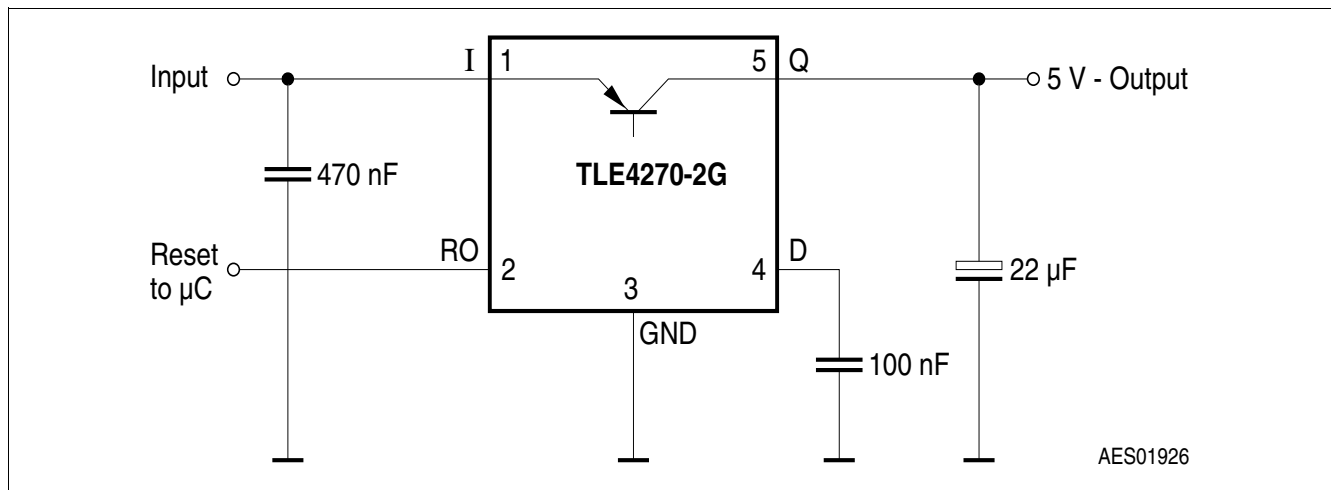
## Application information

### 5 Application information

The IC regulates an input voltage in the range of  $V_I = 5.5 \text{ V}$  to  $36 \text{ V}$  to  $V_{Q, \text{nom}} = 5.0 \text{ V}$ . Up to  $26 \text{ V}$  it produces a regulated output current of more than  $650 \text{ mA}$ . Above  $26 \text{ V}$  the save-operating-area protection allows operation up to  $36 \text{ V}$  with a regulated output current of more than  $300 \text{ mA}$ . Overvoltage protection limits operation at  $42 \text{ V}$ . The overvoltage protection hysteresis restores operation if the input voltage has dropped below  $36 \text{ V}$ . A reset signal is generated for an output voltage of  $V_Q < 4.5 \text{ V}$ . The delay for power-on reset can be set externally with a capacitor.



**Figure 3** Test circuit



**Figure 4** Application circuit

#### 5.1 Design notes for external components

An input capacitor  $C_I$  is necessary for compensation of line influences. The resonant circuit consisting of lead inductance and input capacitance can be damped by a resistor of approx.  $1 \Omega$  in series with  $C_I$ . An output capacitor  $C_Q$  is necessary for the stability of the regulating circuit. Stability is guaranteed at values of  $C_Q \geq 22 \mu\text{F}$  and an ESR of  $< 3 \Omega$ .

## Application information

### 5.2 Reset circuitry

If the output voltage decreases below 4.5 V, an external capacitor  $C_D$  on pin 4 (D) will be discharged by the reset generator. If the voltage on this capacitor drops below  $V_{DL}$ , a reset signal is generated on pin 2 (RO), i.e. reset output is set low. If the output voltage rises above the reset threshold,  $C_D$  will be charged with constant current. After the power-on-reset time the voltage on the capacitor reaches  $V_{DU}$  and the reset output will be set high again. The value of the power-on-reset time can be set within a wide range depending of the capacitance of  $C_D$ .

### 5.3 Reset timing

The power-on reset delay time is defined by the charging time of an external capacitor  $C_D$  which can be calculated as follows:

$$C_D = (\Delta t \times I_{D,c}) / \Delta V \quad (5.1)$$

Definitions:

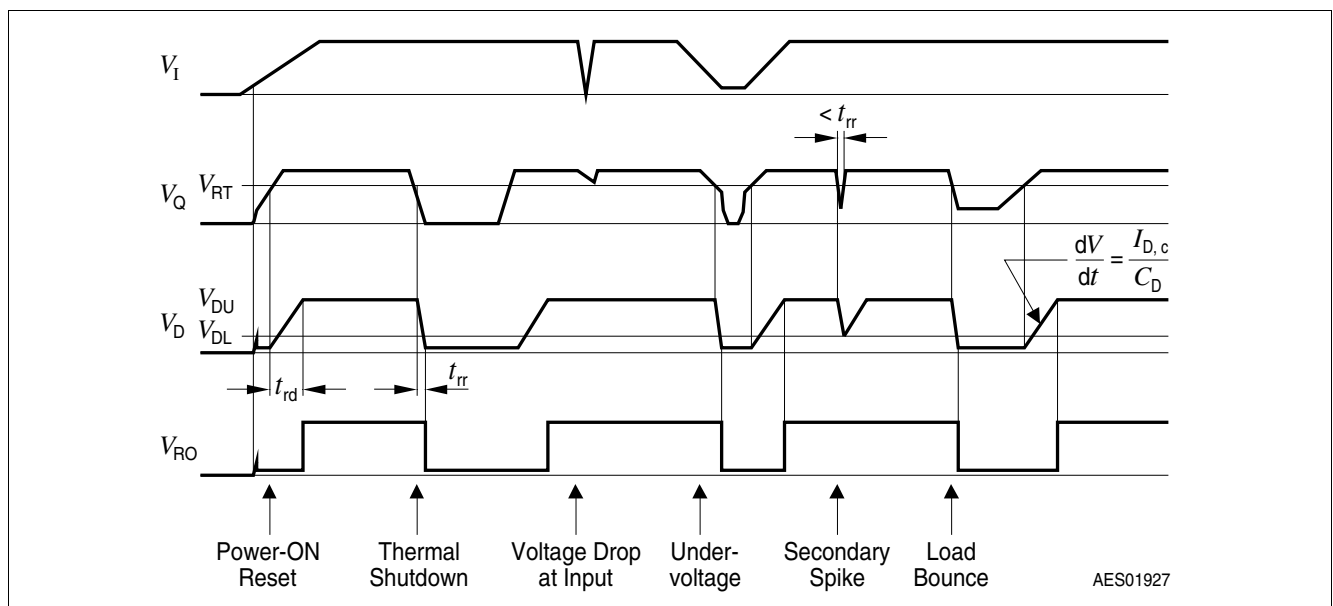
- $C_D$  = delay capacitors
- $\Delta t$  = reset delay time  $t_{rd}$
- $I_{D,c}$  = charge current, typical 14  $\mu A$
- $\Delta V = V_{DU}$ , typical 1.8 V

$V_{DU}$  = upper reset timing threshold at  $C_D$  for reset delay time

$$t_{rd} = \Delta V \times C_D / I_{D,c} \quad (5.2)$$

The reset reaction time  $t_{rr}$  is the time it takes the voltage regulator to set the reset out LOW after the output voltage has dropped below the reset threshold. It is typically 1  $\mu s$  for delay capacitor of 47 nF. For other values for  $C_D$  the reaction time can be estimated using the following equation:

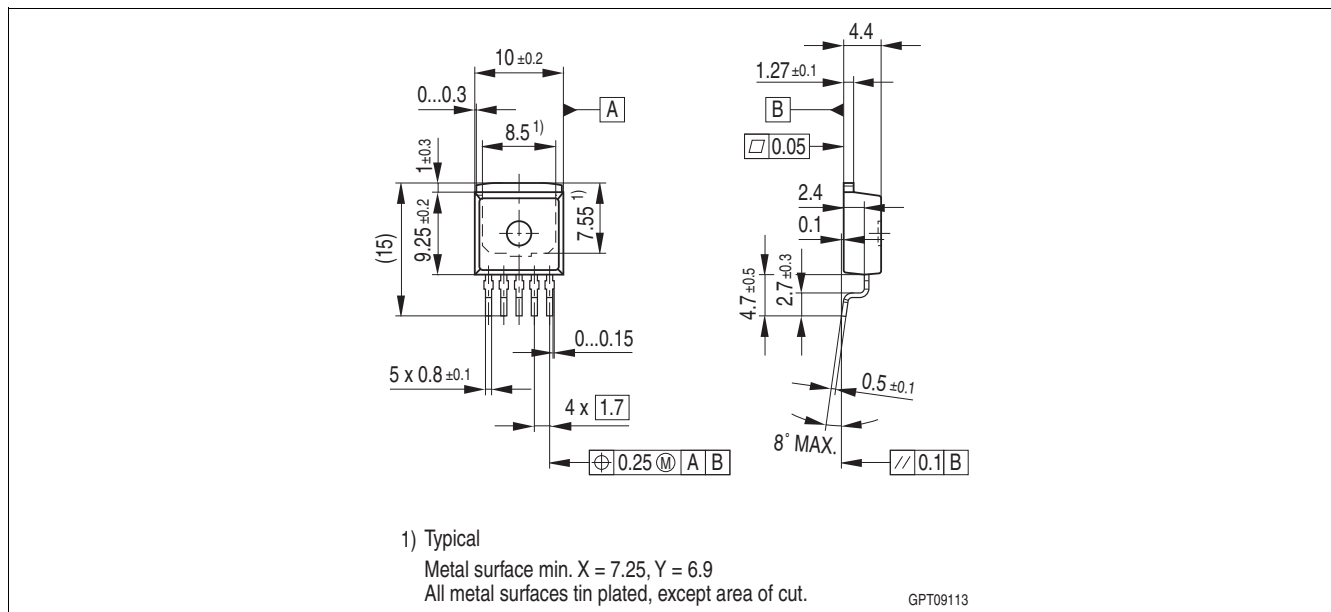
$$t_{rr} \approx 20 \text{ s/F} \times C_D \quad (5.3)$$



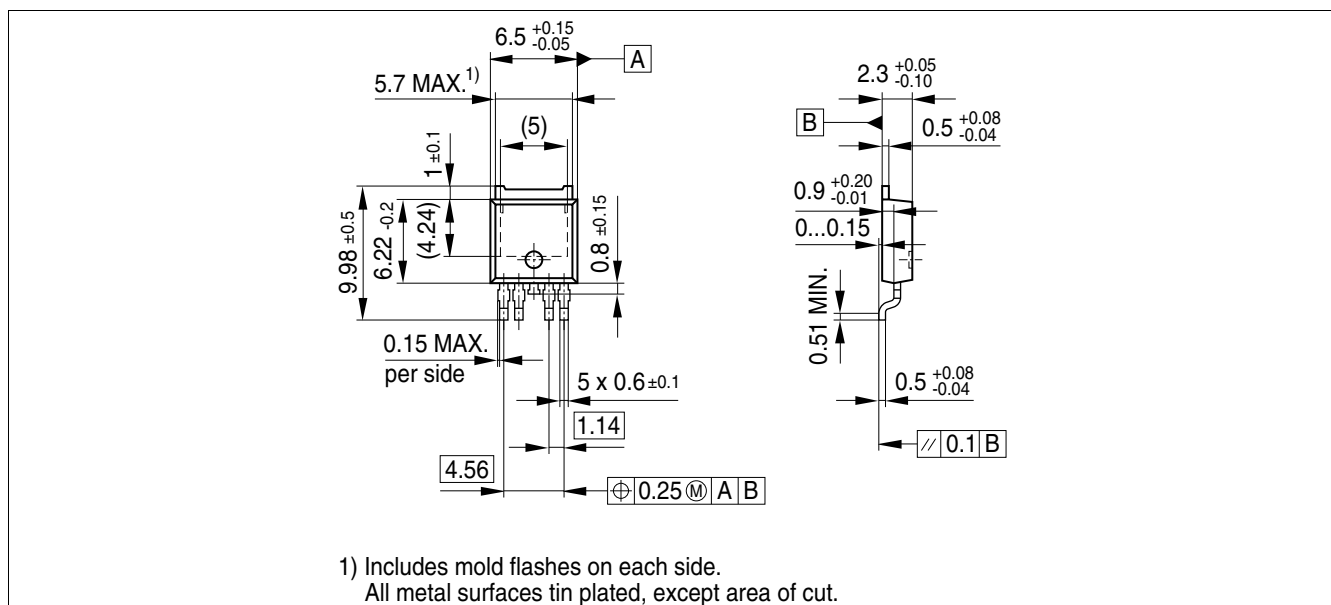
**Figure 5 Reset time response**

**Package information**

## 6 Package information



**Figure 6 P-TO263-5 (plastic transistor single outline)<sup>1)</sup>**



**Figure 7 P-TO252-5 (plastic transistor single outline)<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**

## **7 Revision history**

<b>Version</b>	<b>Date</b>	<b>Changes</b>
1.9	2020-02-25	Editorial changes, including rearranged content.
1.8	2007-11-09	<b>Page 1:</b> Changed ESD specification from “>4000V” to “±2 kV HBM” according to PCN No. 2007-08
1.7	2007-03-20	Initial version of RoHS-compliant derivate of TLE 4270. Change of product name to TLE4270-2 due to modified chip layout and size. <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



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