

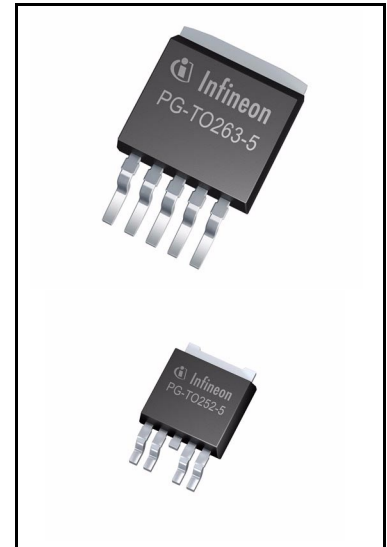
OPTIREG™ Linear TLE4270-2

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 (≤ 400 ms)
- Short-circuit proof
- Wide temperature range
- ESD protection: ± 2 kV HBM¹⁾
- 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, ≤ 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

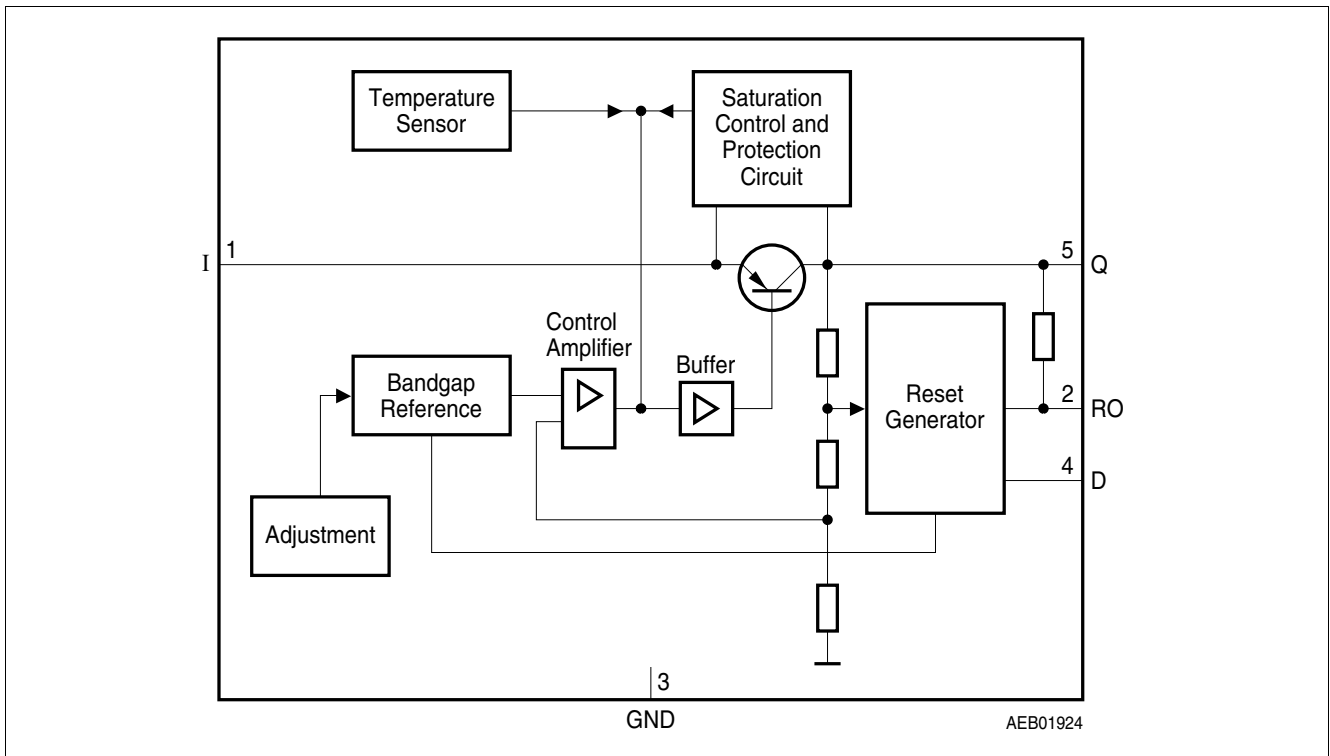


Figure 1 Block diagram

Pin configuration

2 Pin configuration

2.1 Pin assignment

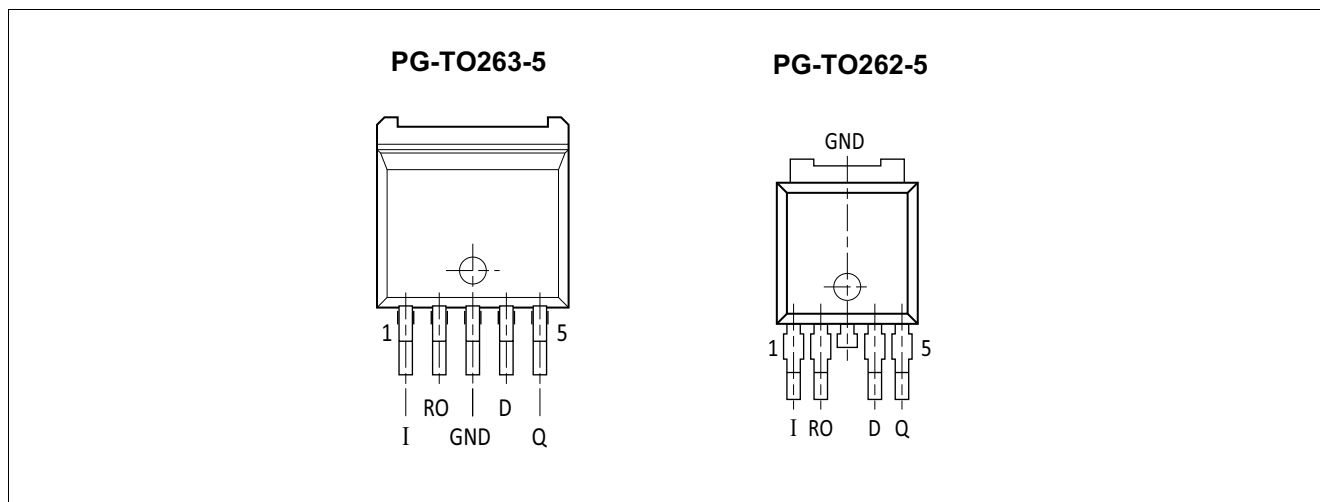


Figure 2 Pin configuration (top view)

2.2 Pin definitions and functions

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

General product characteristics

3 General product characteristics

3.1 Absolute maximum ratings

Table 1 Absolute maximum ratings

$T_j = -40$ to 150°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	$^\circ\text{C}$	-	P_3.1.11
Storage temperature	T_{stg}	-50	-	150	$^\circ\text{C}$	-	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, ¹⁾	P_3.3.1
		–	–	79	K/W	TO252 ¹⁾	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 mm³; 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_{Qmax}	650	850	–	mA	$V_Q = 0\text{ V}$	P_4.0.3
Current consumption $I_q = I_1 - I_Q$	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_{DR}	–	350	700	mV	$I_Q = 550\text{ mA}^{(1)}$	P_4.0.7
Load regulation	$\Delta V_{Q,Lo}$	–	25	50	mV	$I_Q = 5\text{ to }550\text{ mA}$; $V_I = 6\text{ V}$	P_4.0.8
Line regulation	$\Delta V_{Q,Li}$	–	12	25	mV	$V_I = 6\text{ to }26\text{ V}$; $I_Q = 5\text{ mA}$	P_4.0.9
Power supply ripple rejection	$PSRR$	–	54	–	dB	$f_r = 100\text{ Hz}$; $V_r = 0.5\text{ Vpp}$	P_4.0.10
Reset generator							
Switching threshold	V_{RT}	4.5	4.65	4.8	V	–	P_4.0.11
Reset high voltage	V_{ROH}	4.5	–	–	V	–	P_4.0.12
Reset low voltage	V_{ROL}	–	60	–	mV	$R_{int} = 30\text{ k}\Omega^{(2)}$; $1.0\text{ V} \leq V_Q \leq 4.5\text{ V}$	P_4.0.13
	V_{ROL}	–	200	400	mV	$I_R = 3\text{ mA}$, $V_Q = 4.4\text{ V}$	P_4.0.14
Reset pull-up	R_{int}	18	30	46	k Ω	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	μA	$V_D = 1.0\text{ V}$	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	μs	$C_D = 100\text{ nF}$	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).

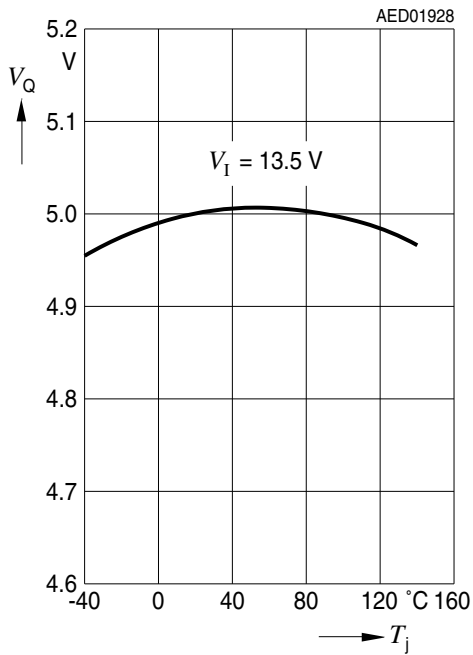
2) Reset peak is always lower than 1.0 V.

Functional description

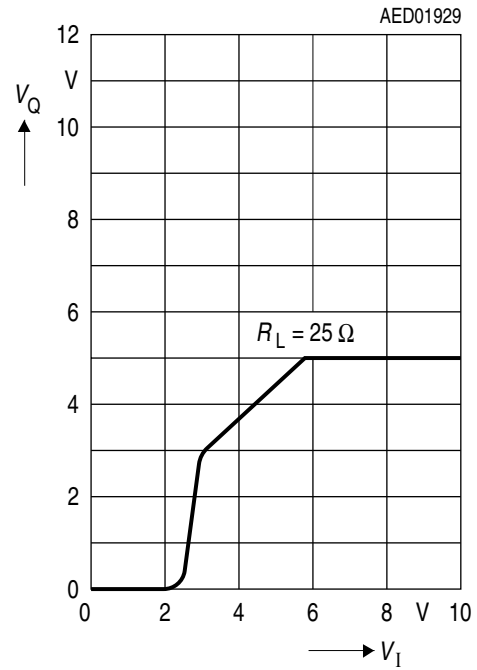
4.3 Typical performance graphs

Typical performance characteristics

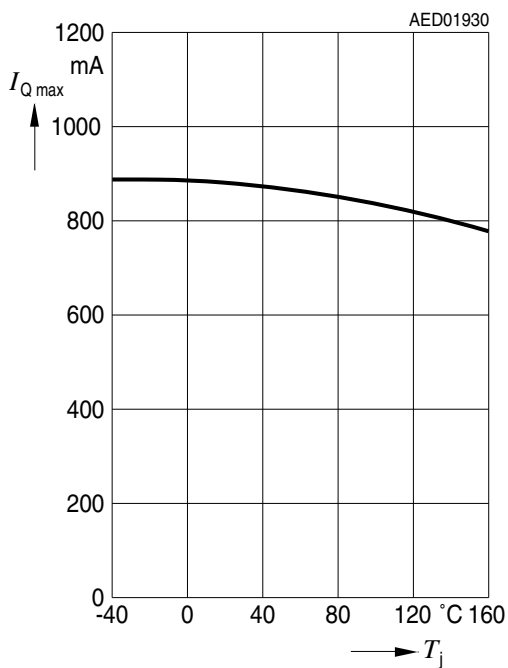
Output voltage V_Q vs. junction temperature T_j



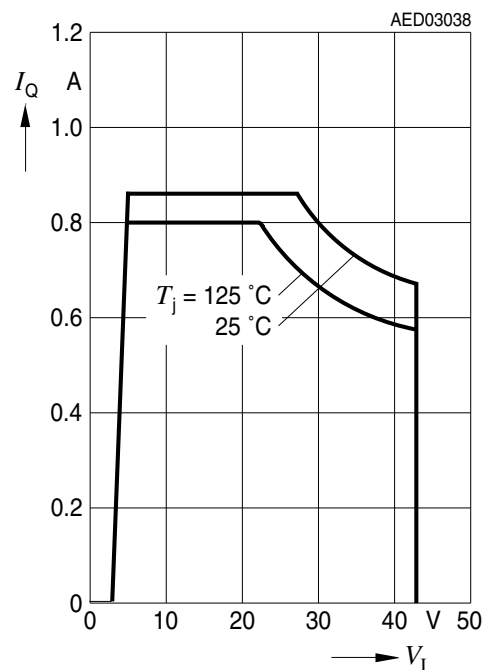
Output voltage V_Q vs. input voltage V_I



Output current I_Q vs. junction temperature T_j

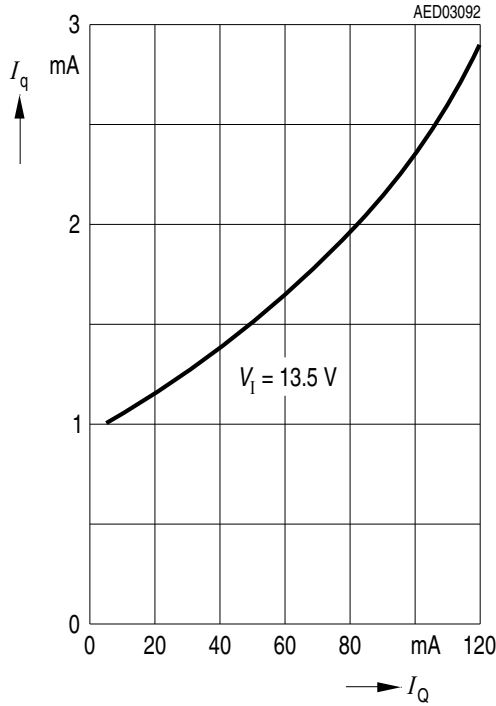


Output current I_Q vs. input voltage V_I

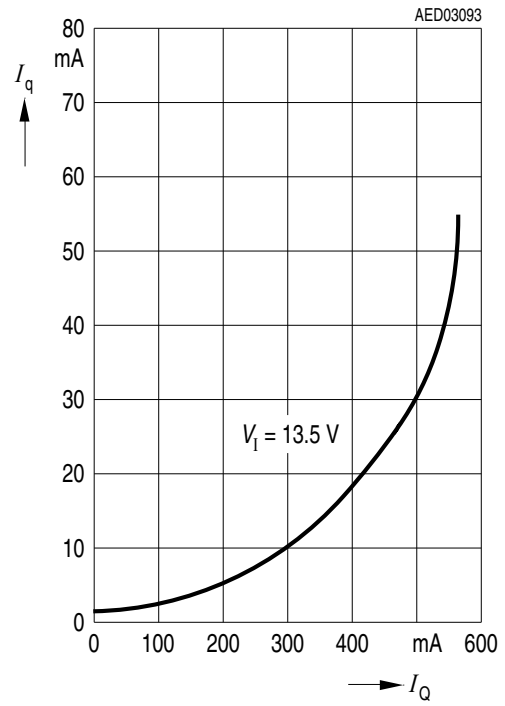


Functional description

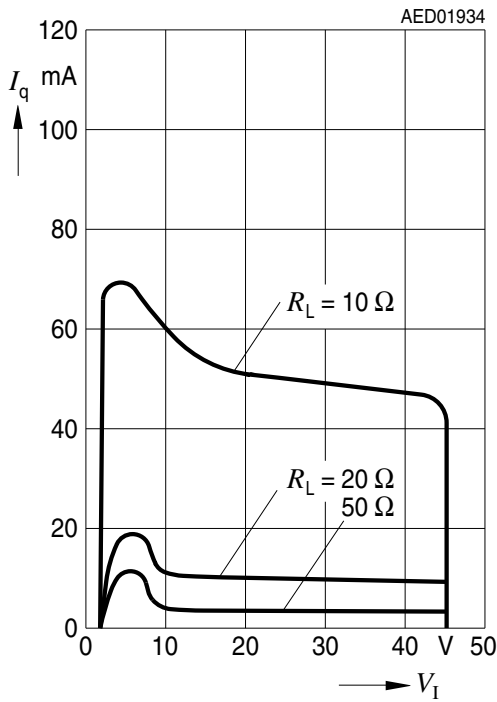
Current consumption I_q vs. output current I_Q



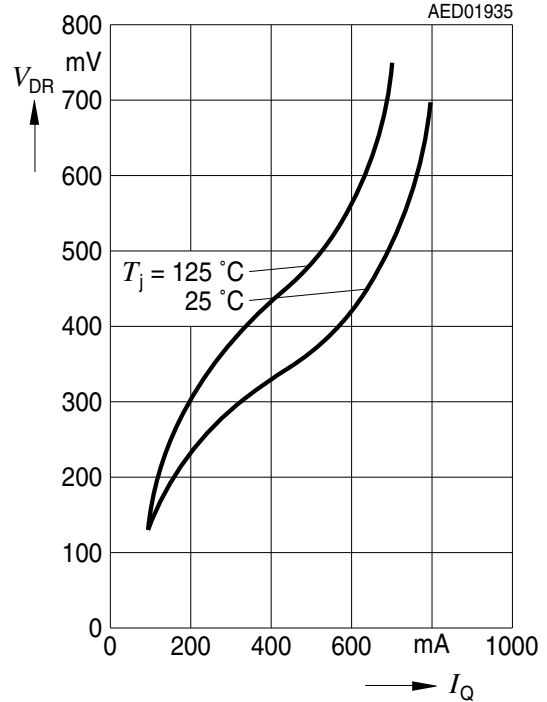
Current consumption I_q vs. output current I_Q



Current consumption I_q vs. input voltage V_1



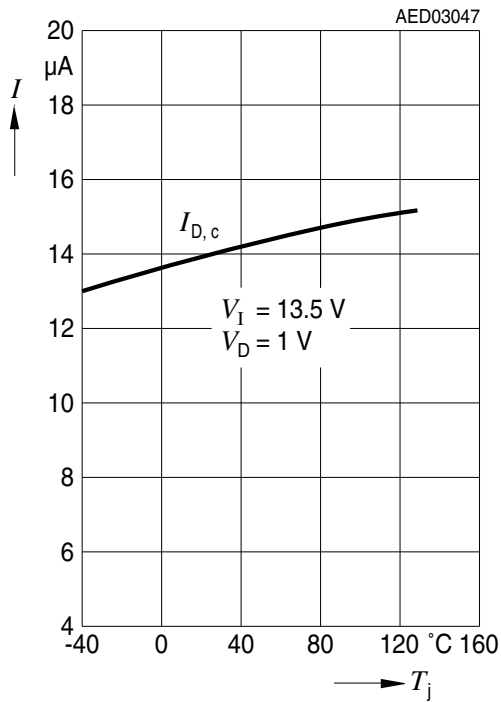
Drop voltage V_{DR} vs. output current I_Q



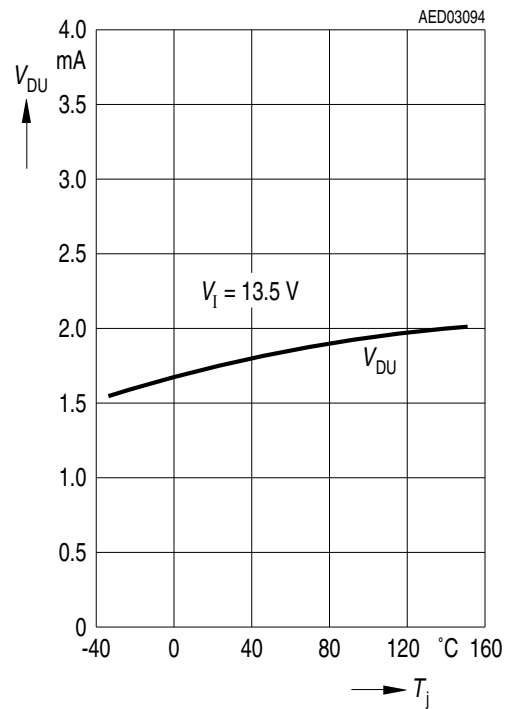
Functional description

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 V to $V_{Q,\text{nom}} = 5.0\text{ V}$. Up to 26 V it produces a regulated output current of more than 650 mA . Above 26 V the save-operating-area protection allows operation up to 36 V with a regulated output current of more than 300 mA . Overvoltage protection limits operation at 42 V . The overvoltage protection hysteresis restores operation if the input voltage has dropped below 36 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.

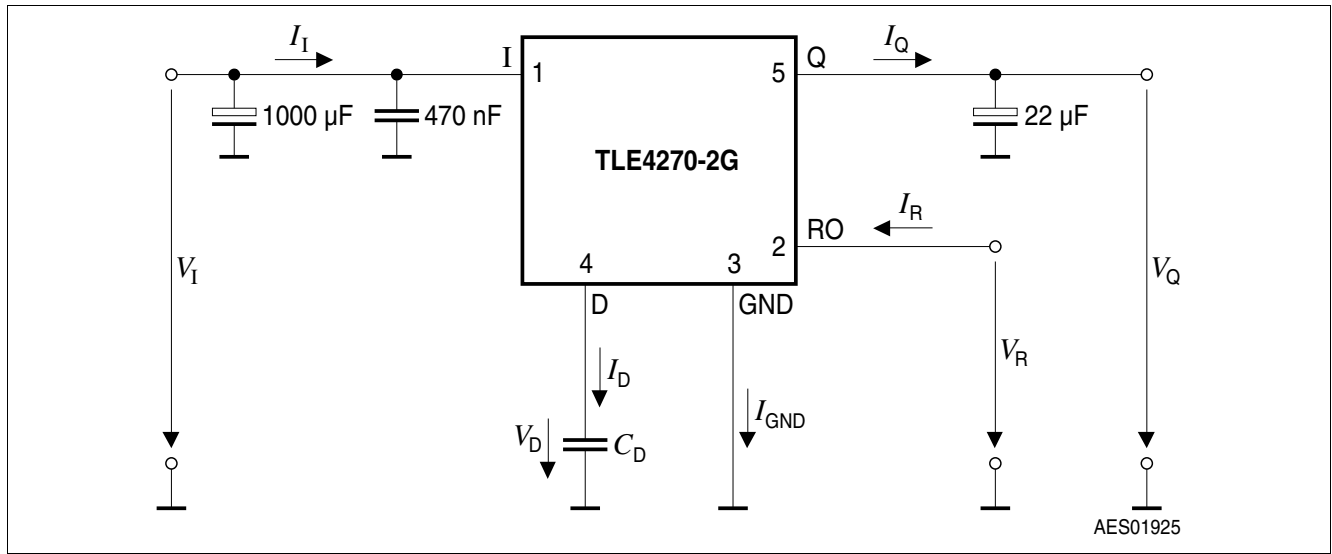


Figure 3 Test circuit

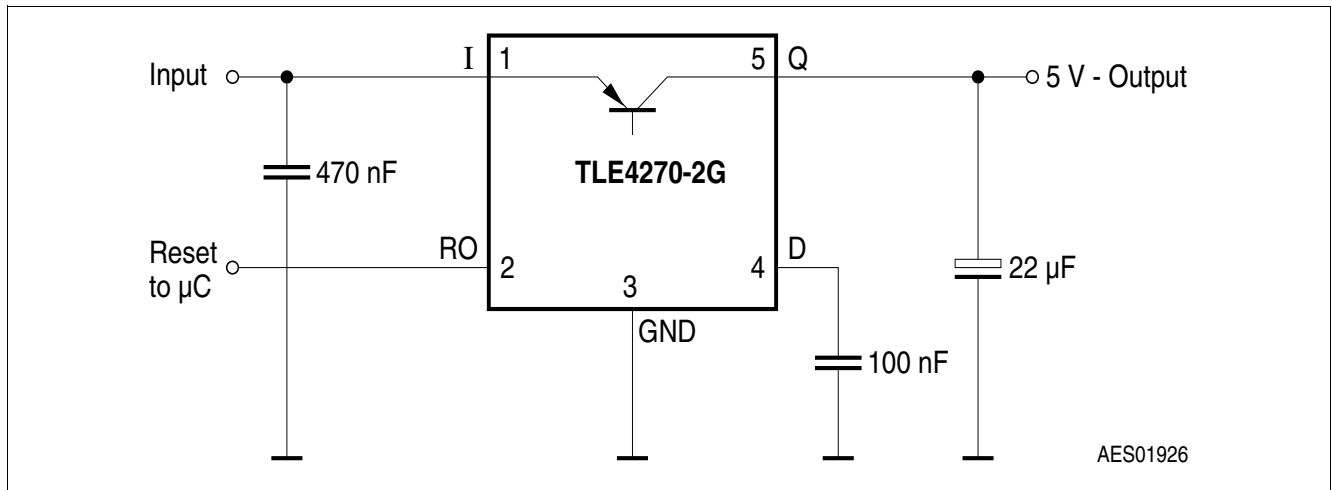


Figure 4 Application circuit

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_O is necessary for the stability of the regulating circuit. Stability is guaranteed at values of $C_O \geq 22\ \mu\text{F}$ 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:

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

Definitions:

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

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

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

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 μ s for delay capacitor of 47 nF. For other values for C_D the reaction time can be estimated using the following equation:

$$t_{rr} \approx 20 \text{ s/F} \times C_D \tag{5.3}$$

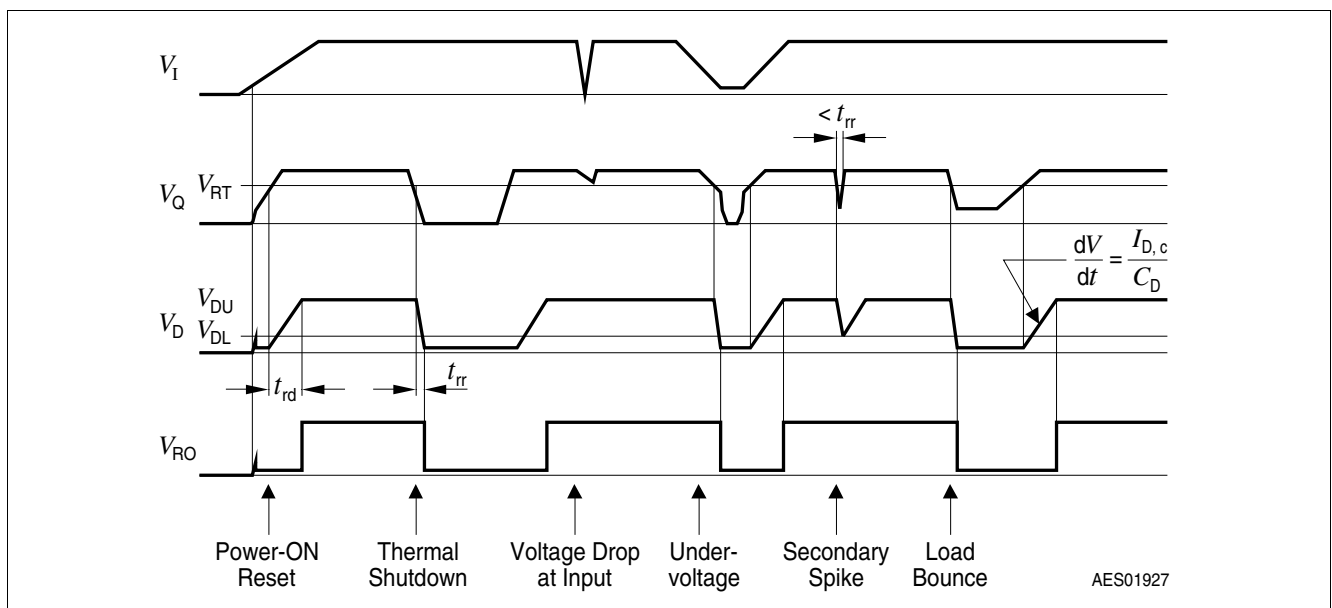


Figure 5 Reset time response

Package information

6 Package information

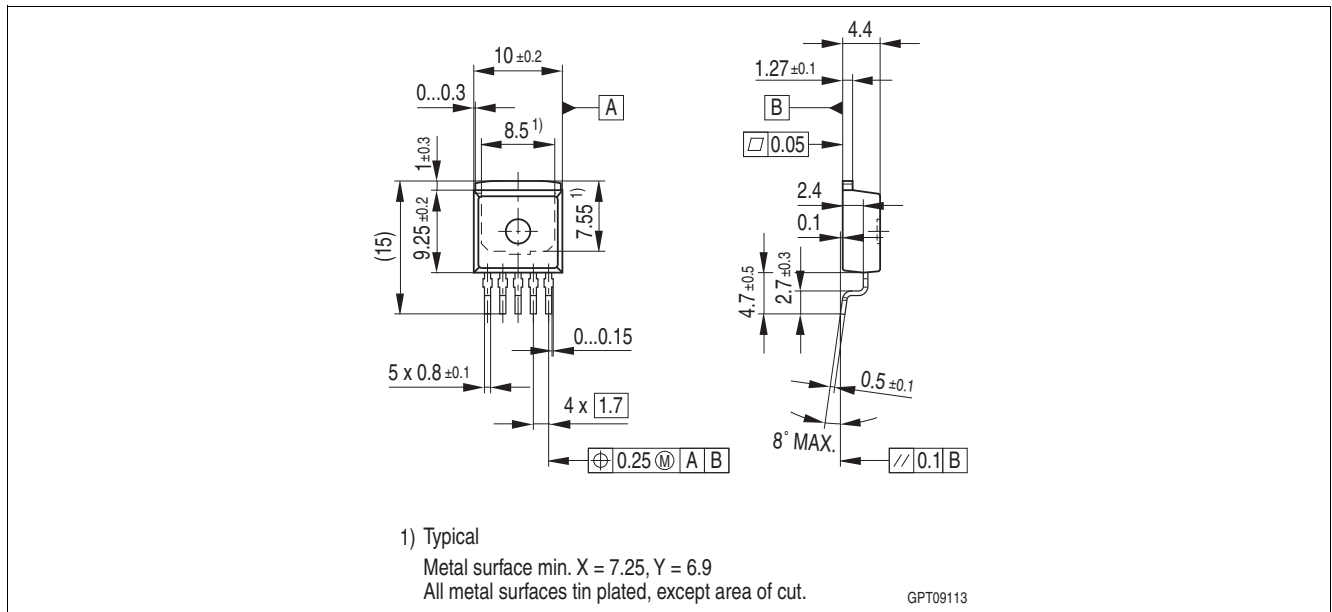


Figure 6 P-TO263-5 (plastic transistor single outline)¹⁾

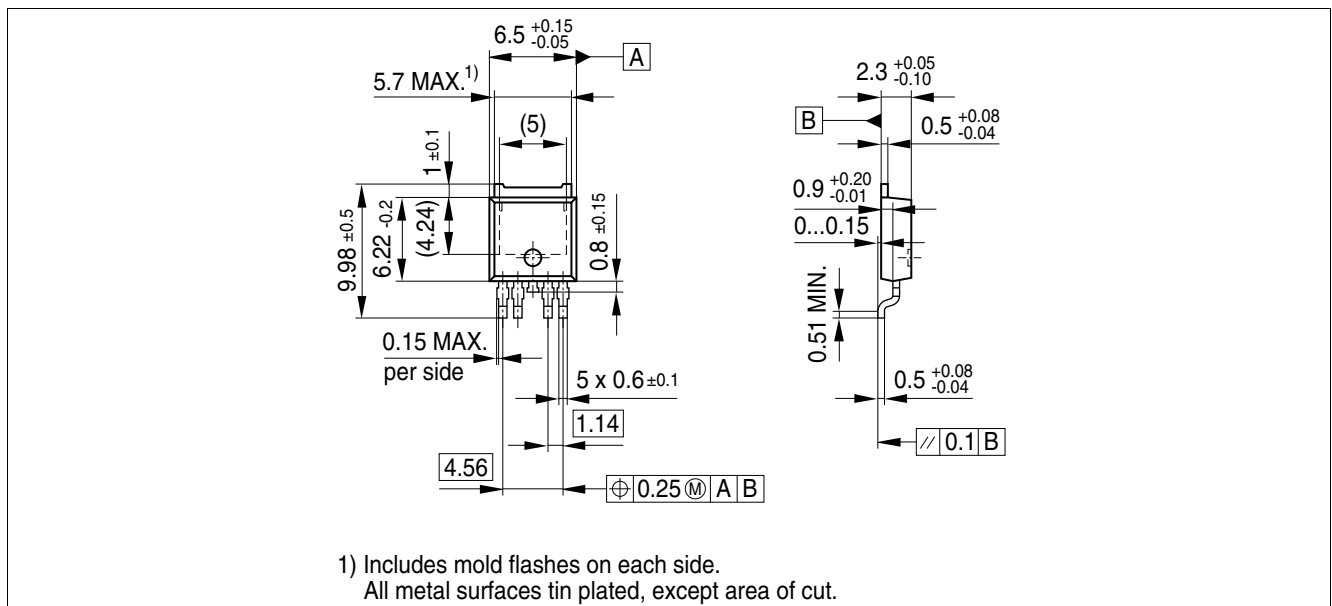


Figure 7 P-TO252-5 (plastic transistor single outline)¹⁾

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

Version	Date	Changes
1.9	2020-02-25	Editorial changes, including rearranged content.
1.8	2007-11-09	Page 1: 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. Page 1: AEC certified statement added Page 1 and Page 15: RoHS compliance statement and Green product feature added Page 1 and Page 15: Package changed to RoHS compliant version Legal Disclaimer updated

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