OPTIREG™ linear TLE4251

Low drop voltage tracker

AEC Qualified RoHS

Features

- Output tracking tolerance ≤ ±0.2%
- 400 mA output current capability
- Enable function
- Very low current consumption in OFF mode
- Wide operation range: up to 40 V
- Wide temperature range: -40 °C ≤ T_j ≤ 150 °C
- Output protected against short-circuit
- Overtemperature protection
- Reverse polarity proof
- Available in standard PG-TO252-5 and PG-TO263-5 packages
- Green Product (RoHS compliant)
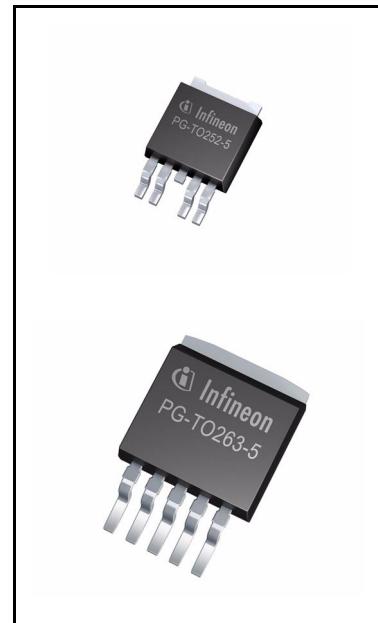
Potential applications

- General automotive applications.

Product validation

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

Description

The OPTIREG™ linear TLE4251 is a monolithic integrated low drop voltage tracker. It is designed to supply e.g. sensors under the severe conditions of automotive applications. Therefore the device is equipped with additional protection functions against overload, short circuit and reverse polarity.

Supply voltages up to 40 V are tracked to a reference voltage given to the adjust input via an external resistor.

The output is able to drive loads up to 400 mA while it follows e.g. the 5 V output of a main voltage regulator within an accuracy of 0.5%. For loads up to 300 mA the tracking accuracy is 0.2%.

The TLE4251 can be switched in stand-by mode via the enable EN input which causes the current consumption to drop to very low values. This feature makes the IC suitable for low power battery applications.

Type	Package	Marking
TLE4251D	PG-TO252-5	4251
TLE4251G	PG-TO263-5	TLE4251

Table of Contents

1 Block diagram

Figure 1   Block diagram

2 Pin configuration

2.1 Pin assignment
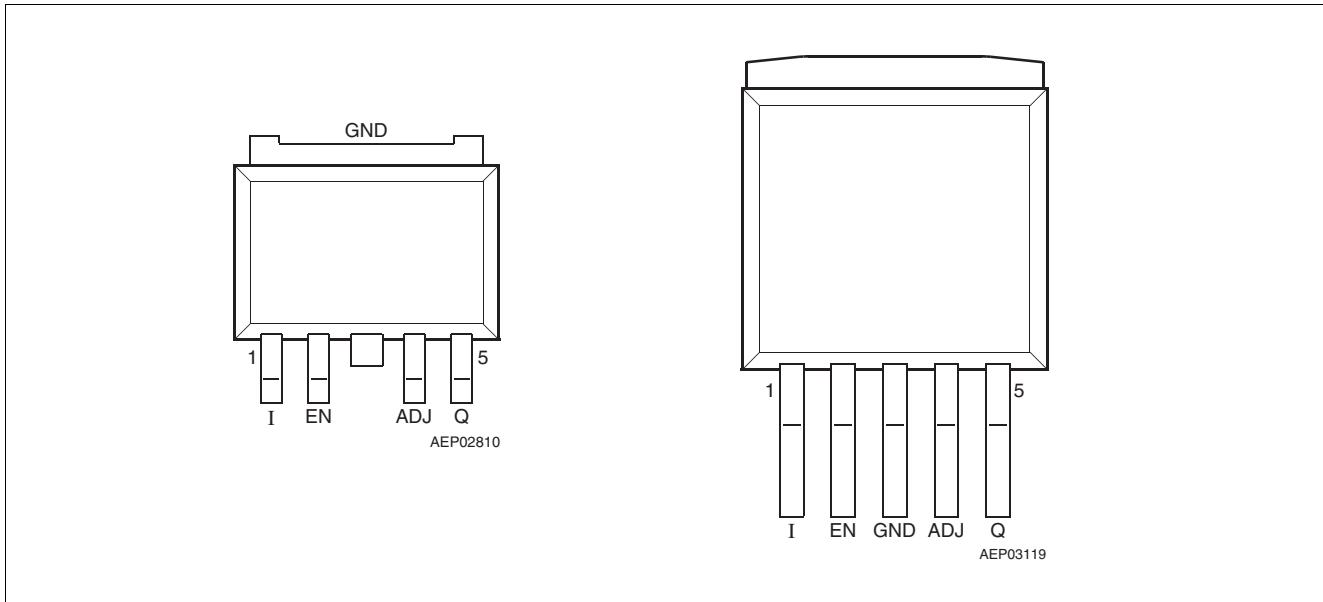
Figure 2 Pin configuration

2.2 Pin definitions and functions

Pin	Symbol	Function
1	I	**Input voltage**
2	EN	**Enable;** high-active input
3	GND	**Ground**
4	ADJ	**Adjust;** connect directly to the reference or with a voltage divider to the reference (for reference-proportional output voltages, $V_Q < V_{ref}$)
5	Q	**Output voltage;** must be blocked by a capacitor $C_Q \geq 22\ \mu F$, ESR $\leq 3\ \Omega$ to GND

3 General product characteristics

3.1 Absolute maximum ratings

Table 1   Absolute maximum ratings[1]

T_j = -40°C to 150°C; all voltages with respect to ground, positive current flowing into pin (unless otherwise specified)

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Input							
Voltage	V_I	-42	–	45	V	–	P_3.1.1
Current	I_I	–	–	–	mA	internally limited	P_3.1.2
Output							
Voltage	V_Q	-2	–	45	V	–	P_3.1.3
Current	I_Q	–	–	–	mA	internally limited	P_3.1.4
Adjust							
Voltage	V_{ADJ}	-42	–	45	V	–	P_3.1.5
Current	I_{ADJ}	–	–	–	µA	internally limited	P_3.1.6
Enable							
Voltage	V_{EN}	-42	–	45	V	–	P_3.1.7
Current	I_{EN}	–	–	–	µA	internally limited	P_3.1.8
Temperatures							
Junction temperature	T_j	-40	–	150	°C	–	P_3.1.9
Storage temperature	T_{stg}	-50	–	150	°C	–	P_3.1.10

1) Not subject to production test, specified by design.

Notes

1. *Stresses above the ones listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*
2. *Integrated protection functions are designed to prevent IC destruction under fault conditions described in the data sheet. Fault conditions are considered as outside normal operating range. Protection functions are not designed for continuous repetitive operation.*

3.2 Functional range

Table 2   Functional range

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Input voltage	V_I	4[1]	–	40	V	–	P_3.2.1
Adjust input voltage	V_{ADJ}	2.5	–	40	V	–	P_3.2.2
Adjust input voltage	V_{ADJ}	0	–	2.5	V	$V_Q \leq V_{ADJ} + \Delta V_Q$	P_3.2.3
Enable input voltage	V_{EN}	0	–	40	V	–	P_3.2.4
Junction temperature	T_j	-40	–	150	°C	–	P_3.2.5

1) $V_I > V_{ADJ} + V_{DR}$

Note: *Within the functional or operating range, the IC operates as described in the circuit description. The electrical characteristics are specified within the conditions given in the electrical characteristics table.*

3.3 Thermal resistance

Note: *This thermal data was generated in accordance with JEDEC JESD51 standards. For further information visit **https://www.jedec.org**.*

Table 3   Thermal resistance

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Junction to case	R_{thJC}	–	4	–	K/W	PG-TO252-5	P_3.3.1
Junction to ambient	R_{thJA}	–	78	–	K/W	[1] PG-TO252-5	P_3.3.2
Junction to case	R_{thJC}	–	3	–	K/W	PG-TO263-5	P_3.3.3
Junction to ambient	R_{thJA}	–	52	–	K/W	[1] PG-TO263-5	P_3.3.4

1)   Worst case, regarding peak temperature; zero airflow; mounted an a PCB 80 × 80 × 1.5 mm^3, heat sink area 300 mm^2.

4 Electrical characteristics

4.1 Electrical characteristics

Table 4 Electrical characteristics

V_I = 13.5 V; 2.5 V ≤ V_{ADJ} ≤ V_I - 0.5 V; T_j = -40°C to 150°C; unless otherwise specified

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Output							
Output voltage tracking accuracy $\Delta V_Q = V_{ADJ} - V_Q$	ΔV_Q	-10	–	10	mV	V_I < 13.5 V; -40 °C < T_j < 125 °C; 1 mA < I_Q < 300 mA	P_4.1.1
Output voltage tracking accuracy	ΔV_Q	-10	–	10	mV	6 V < V_I < 40 V; 5 mA < I_Q < 200 mA	P_4.1.2
Output voltage tracking accuracy	ΔV_Q	-25	–	25	mV	6 V < V_I < 28 V; 1 mA < I_Q < 300 mA	P_4.1.3
Drop voltage	V_{dr}	–	280	520	mV	[1]I_Q = 300 mA; V_{ADJ} > 4 V; Enable ON	P_4.1.4
Output current	I_Q	400	450	800	mA	[1]T_j ≤ 125 °C	P_4.1.5
Output capacitor	C_Q	22	–	–	µF	ESR ≤ 3 Ω at 10 kHz	P_4.1.6
Current consumption $I_q = I_I - I_Q$	I_q	–	10	20	mA	I_Q = 300 mA	P_4.1.7
Current consumption $I_q = I_I - I_Q$	I_q	–	230	300	µA	I_Q < 1 mA; T_j < 85 °C; V_{EN} in ON state	P_4.1.8
Quiescent current (standby) $I_q = I_I - I_Q$	I_q	–	0	2	µA	V_{EN} = 0 V; T_j < 85 °C	P_4.1.9
Regulator Performance							
Load regulation	ΔV_Q	-35	±5	35	mV	5 mA < I_Q < 300 mA; V_I = 6 V; V_{ADJ} = 5 V	P_4.1.10
Line regulation	ΔV_Q	-25	±10	25	mV	12 V < V_I < 32 V; I_Q = 5 mA	P_4.1.11
Power Supply Ripple Rejection	$PSRR$	60	–	–	dB	[2]f_r = 100 Hz; V_r = 0.5 V_{pp}; V_{ADJ} = 5 V; C_Q = 22 µF Tantalum	P_4.1.12
Adjust Input							
Input biasing current	I_{ADJ}	–	0.1	0.5	µA	V_{ADJ} = 5 V	P_4.1.13
Enable							
Enable on voltage range	$V_{EN\,ON}$	2	–	–	V	V_Q ON	P_4.1.14
Enable off voltage range	$V_{EN\,OFF}$	–	–	0.5	V	V_Q ≤ 0.1 V	P_4.1.15
Input current	I_{EN}	5	40	70	µA	V_{EN} = 5 V	P_4.1.16

1) Measured when the output voltage V_Q has dropped 100 mV from the nominal value.

2) Not subject to production test, specified by design.

4.1.1   Typical performance graphs

Typical performance characteristics

**Quiescent current I_q versus output current I_Q**
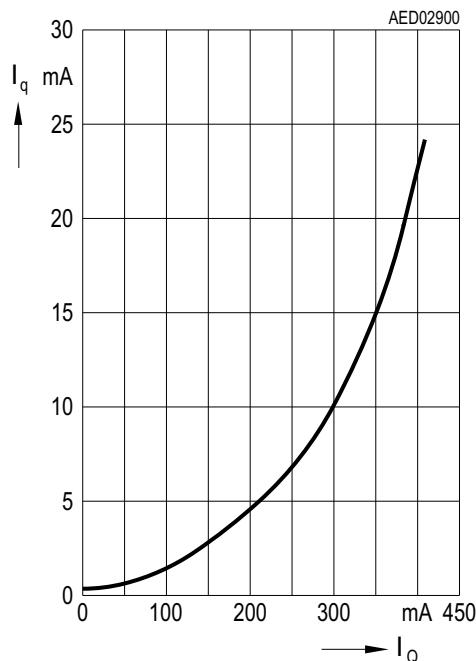
**Enable current I_{EN} versus enable voltage V_{EN}**
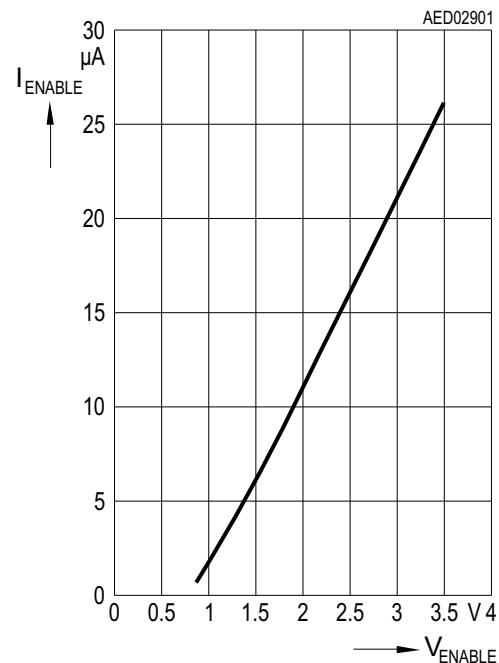
**Tracking accuracy ΔV_Q versus junction temperature T_J , V_{ADJ} = 5V**
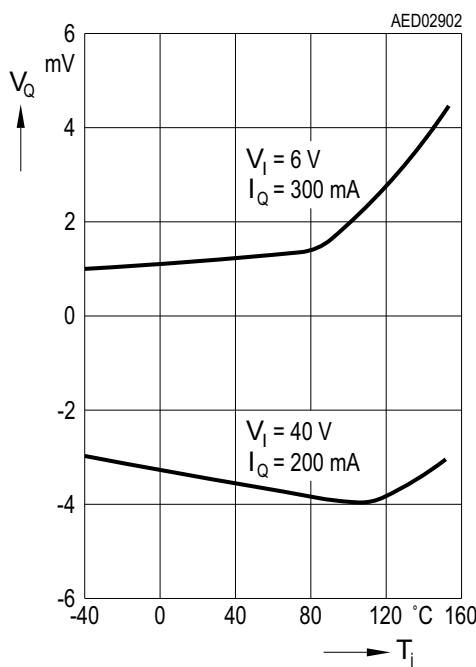
Current consumption I_q versus input voltage V_I , V_{ADJ} = 5V
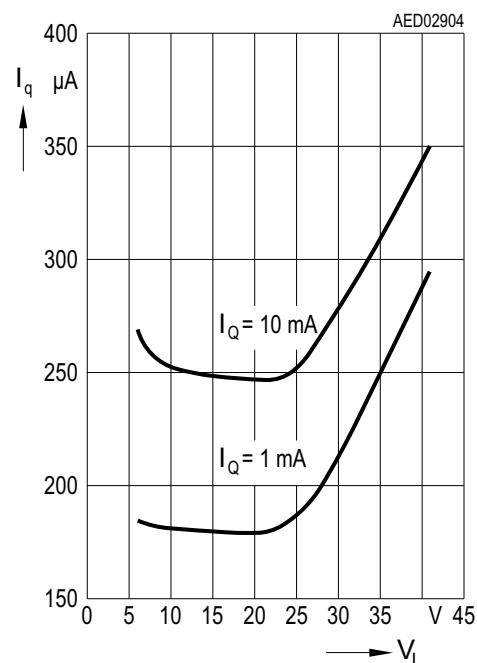
Tracking accuracy ΔV$_Q$ versus output current I$_Q$
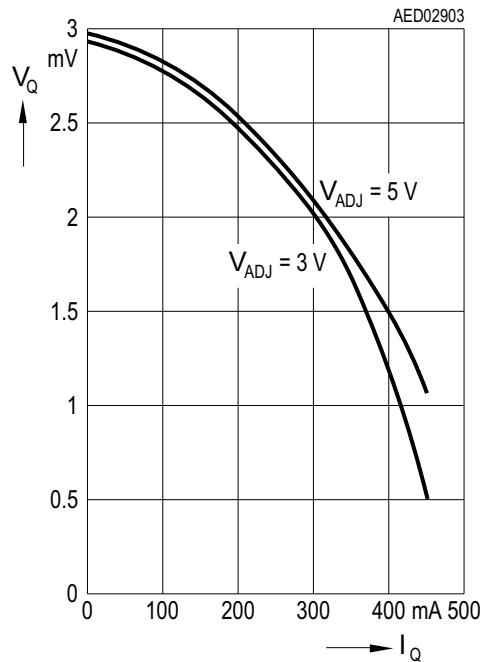
5 Application information

Note: *The following information is given as a hint for the implementation of the device only and shall not be regarded as a description or warranty of a certain functionality, condition or quality of the device.*
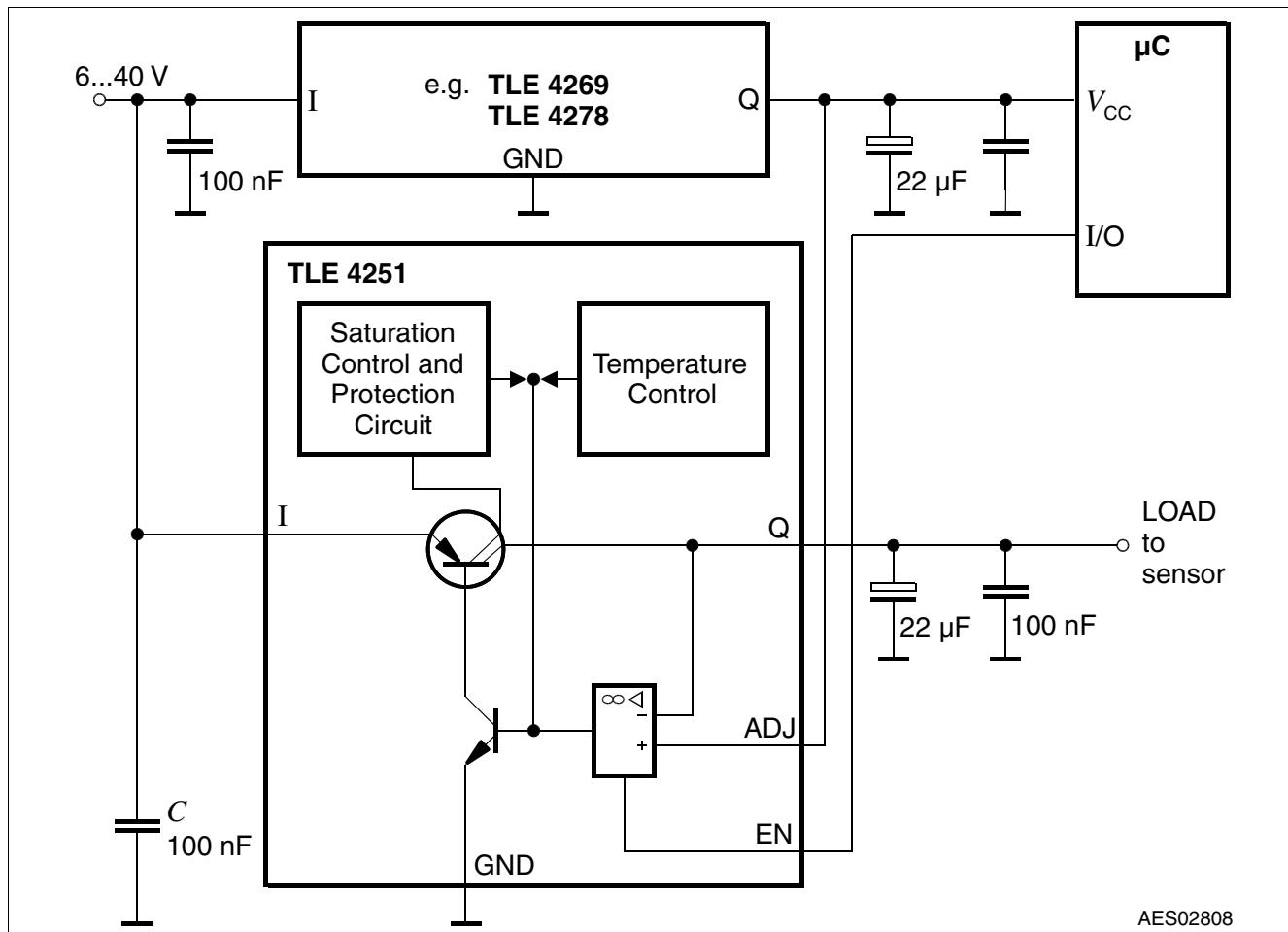
Figure 3   Application diagram

Note: *This is a very simplified example of an application circuit. The function must be verified in the real application.*

5.1 Further application information

• Please contact us for information regarding the FMEA pin

• Existing application note (title)

• For further information you may contact **https://www.infineon.com**

6   Package information
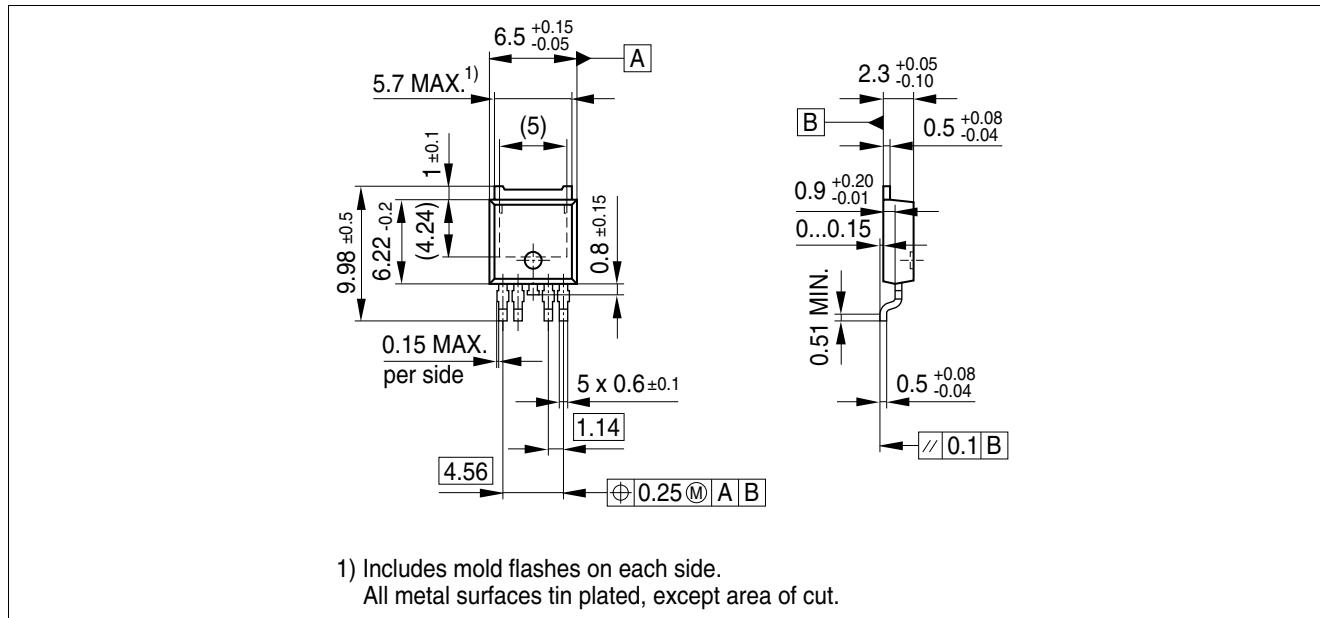
Figure 4   PG-TO252-5 [1)](Plastic transistor single outline)
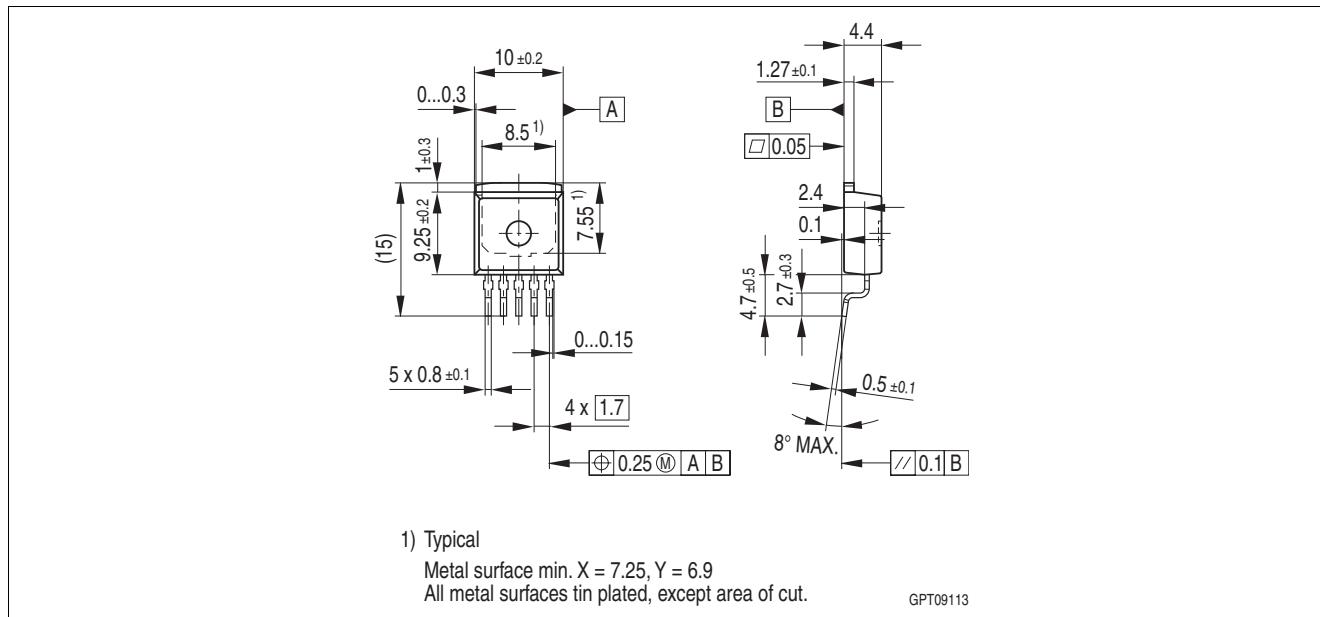
Figure 5   PG-TO263-5 [1)](Plastic transistor single outline)

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).

Further information on packages

https://www.infineon.com/packages

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1)   Dimensions in mm

7 Revision history

Revision	Date	Changes
Rev. 3.10	2023-07-05	Updated marking on page 1, added OPTIREG^{TM} linear Editorial change Added footnote on P_4.1.12, removed TLE4470 from application diagram
Rev. 3.0	2022-05-31	Updated layout and template Editorial changes
Rev. 2.9	2007-03-20	Initial version of RoHS-compliant derivate of TLE4251 Page 1: AEC certified statement added Page 1 and page 11: RoHS compliance statement and Green product feature added Page 1 and page 11: Package changed to RoHS compliant version Legal Disclaimer updated

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