Low Dropout Tracking Regulator

TLE 4252 G

Features

- Output tracking tolerance to reference ≤ ±0.2%
- Output voltage adjust down to 1.5 V
- 250 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 to GND and Battery
- Overtemperature protection
- Reverse polarity proof
- Green Product (RoHS compliant)
- AEC Qualified

Short Functional Description

The **TLE 4252** is a monolithic integrated low-dropout voltage tracking regulator in a PG-TO263-5 package. It is designed to supply off-board systems, e.g. sensors in engine management systems under the severe conditions of automotive applications. Therefore, the device is equipped with additional protection functions against reverse polarity and short circuit to GND and battery.

With supply voltages up to 40 V, the output voltage follows a reference voltage with high accuracy. The reference voltage can be applied directly to the adjust input or by an external resistor divider. The minimum reference voltage at the component's pin is 1.5 V.

The output is able to drive loads up to 250 mA following e.g. the 5 V output of a main voltage regulator as reference.

The **TLE 4252** tracking regulator can be switched into stand-by mode to reduce the current consumption to less than 2µA. This feature makes the IC suitable for low power battery applications.

This product is also available in a PG-TO252-5 package. See datasheet "TLE 4252 D".

Type	Package	Marking
TLE 4252 G	PG-TO263-5	TLE4252G

Block Diagram

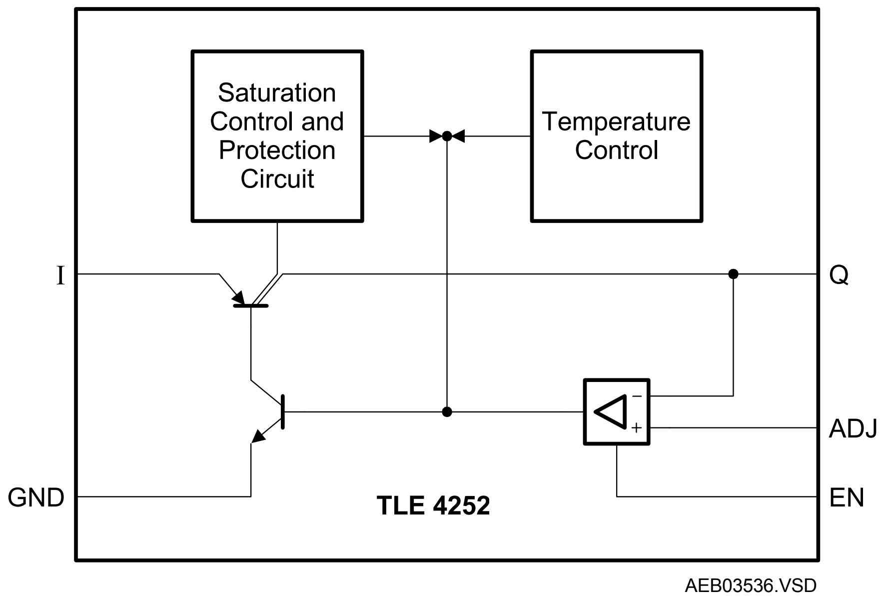


Figure 1 Internal Circuit Blocks

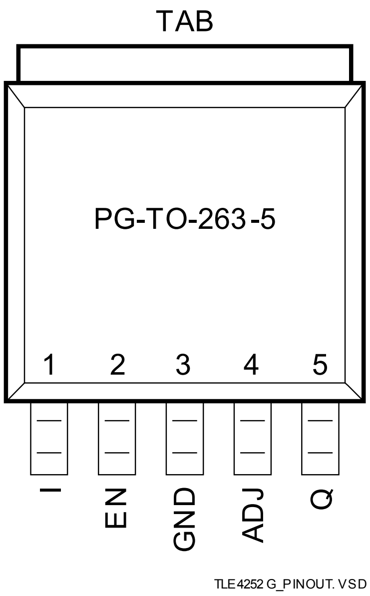


Figure 2 Pin Configuration

Table 1 Pin Definitions and Functions

Pin No.	Symbol	Function
1	I	**Supply Voltage Input;** Input for battery or a pre-regulated voltage of a e.g. a DC to DC converter. For compensating line influences, a capacitor to GND close to the IC pins is recommended.
2	EN	**Enable Input;** a high signal turns on the IC, with a low signal the tracking regulator is turned off.
3	GND	**Ground;** connect to TAB.
4	ADJ	**Adjust Input;** input for the reference voltage which can be connected directly or by voltage divider to the reference (see **"Application Information" on Page 8**).
5	Q	**Regulator Output;** block to GND with a capacitor close to the IC pins, respecting the values given for its capacitance C_Q and ESR in table **"Functional Range" on Page 5**.
TAB	–	Connect to GND and heatsink area.

Table 2 Absolute Maximum Ratings

Parameter	Symbol	Limit Values		Unit	Remarks
		Min.	Max.		
Supply Voltage Input I					
Voltage	V_I	-42	45	V	–
Current	I_I	–	–	A	Limited internally [1)]
Enable Input EN					
Voltage	V_{EN}	-42	45	V	–
Current	I_{EN}	–	–	A	Limited internally
Adjust Input ADJ					
Voltage	V_{ADJ}	-42	45	V	–
Current	I_{ADJ}	–	–	A	Limited internally
Output Q					
Voltage	V_Q	-2	45	V	–
Current	I_Q	–	–	A	Limited internally
Temperature					
Junction temperature	T_j	-40	150	°C	–
Storage temperature	T_{stg}	-50	150	°C	–
ESD-Protection					
Voltage	V_{ESD}	-2	2	kV	Human Body Model (HBM)

1) For reverse current flowing in case of negative supply voltage, see table **"Electrical Characteristics" on Page 6**. A reverse current may heat up the device. The integrated temperature protection is not operating at negative supply voltage.

Note: 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.

Note: 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

.

Table 3 Functional Range

Parameter	Symbol	Limit Values			Unit	Remarks
		Min.	Typ.	Max.		
In- and Output Voltage						
Supply voltage	V_I	3.5	–	40	V	$V_I > V_{ADJ} + V_{dr}$
Enable input voltage	V_{EN}	0	–	40	V	–
Adjust input voltage	V_{ADJ}	1.5	–	40	V	–
Error amplifier common mode range	CMR	1.5	–	V_I - 0.5	V	$V_Q \leq V_{ADJ} + \Delta V_Q$ with $V_{FB} = V_Q$
Output Capacitor						
Output Capacitor's Requirement	C_Q	10	–	–	µF	–
	$ESR(C_Q)$	–	–	5	Ω	1)
Temperature						
Junction temperature	T_j	-40	–	150	°C	–

1) Relevant ESR value at f = 10 kHz. Not subject to production test; specified by design.

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

.

Table 4 Thermal Resistance PG-TO263-5 1)

Parameter	Symbol	Limit Values			Unit	Remarks
		Min.	Typ.	Max.		
Junction to case	R_{thJC}	–	4.7	6	K/W	–
Junction to ambient	R_{thJA}	–	24	–	K/W	2s2p PCB 2)
		–	35	–	K/W	PCB heat sink area 600 mm^2 3)
		–	44	–	K/W	PCB heat sink area 300 mm^2 3)

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

2) Specified R_{thJA} value is according to Jedec JESD51-2,-5,-7 at natural convection on FR4 2s2p board; The Product (Chip+Package) was simulated on a 76.2 x 114.3 x 1.5 mm^3 board with 2 inner copper layers (2 x 70µm Cu, 2 x 35µm Cu). Where applicable, a thermal via array under the tab contacted the first inner copper layer.

3) Specified R_{thJA} value is according to Jedec JESD 51-3 at natural convection on FR4 1s0p board; The Product (Chip+Package) was simulated on a 76.2 x 114.3 x 1.5 mm3 board with 1 copper layer (1 x 70 µm Cu).

Table 5 Electrical Characteristics

V_I = 13.5 V; 1.5 V ≤ V_{ADJ} ≤ V_I - 0.6 V; -40 °C < T_j < 150 °C; unless otherwise specified

Parameter	Symbol	Limit Values			Unit	Test Condition
		Min.	Typ.	Max.		
Regulator Performance, Tracker Output Q						
Output voltage tracking accuracy $\Delta V_Q = V_{ADJ} - V_Q$	ΔV_Q	-10	–	10	mV	4.5 V < V_I < 26 V; 1 mA < I_Q < 200 mA;
Output voltage tracking accuracy $\Delta V_Q = V_{ADJ} - V_Q$	ΔV_Q	-10	–	10	mV	3.5 V < V_I < 32 V; 10 mA < I_Q < 100 mA;
		-25	–	25	mV	3.5 V < V_I < 4.5 V; 1 mA < I_Q < 200 mA;
Dropout voltage	V_{dr}	–	280	600	mV	I_Q = 200 mA; V_{ADJ} > 3.5 V; $V_{EN} = V_{EN,\,on}$ [1)]
Output current limitation	$I_{Q,lim}$	250	350	500	mA	V_Q = 5.0 V [2)]
Output capacitor	C_Q	10	–	–	µF	0 ≤ ESR ≤ 5 Ω at 10 kHz
Current consumption $I_q = I_I - I_Q$	I_q	–	10	25	mA	I_Q = 200 mA; V_Q = 5 V
Current consumption $I_q = I_I - I_Q$	I_q	–	100	150	µA	I_Q < 100 µA; T_j < 85 °C; V_{EN} = 5 V
Quiescent current (stand-by) $I_q = I_I - I_Q$	I_q	–	0	2	µA	V_{EN} = 0 V; $V_{EN/ADJ}$ = 0 V; T_j < 85 °C
Reverse current	I_r	–	0.5	5	mA	V_Q = 16 V; V_I = 0 V
Load regulation	ΔV_Q	–	–	10	mV	1 mA < I_Q < 200 mA
Line regulation	ΔV_Q	–	–	10	mV	5 V < V_I < 32 V; I_Q = 5 mA
Power supply ripple rejection	$PSSR$	–	60	–	dB	$f_{I,\,ripple}$ = 100 Hz; $V_{I,\,ripple}$ = 0.5 Vpp[3)]

Table 5 Electrical Characteristics (cont'd)

V_I = 13.5 V; 1.5 V ≤ V_{ADJ} ≤ V_I - 0.6 V; -40 °C < T_j < 150 °C; unless otherwise specified

Parameter	Symbol	Limit Values			Unit	Test Condition
		Min.	Typ.	Max.		
Adjust Input ADJ						
Input biasing current	I_{ADJ}	–	0.1	0.5	µA	V_{ADJ} = 5 V
Enable Input EN						
Device on voltage range	$V_{EN, on}$	2.0	–	40	V	V_Q settled
Device off voltage range	$V_{EN, off}$	0	–	0.8	V	V_Q < 0.1 V
Input current	I_{EN}	-1	2	5	µA	V_{EN} = 5 V
EN pull-down resistor	R_{EN}	–	1.5	–	MΩ	–

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

2) The current limit depends also on the input voltage, see graph output current vs. input voltage in the diagrams section.

3) Specified by design. Not subject to production test.

Application Information

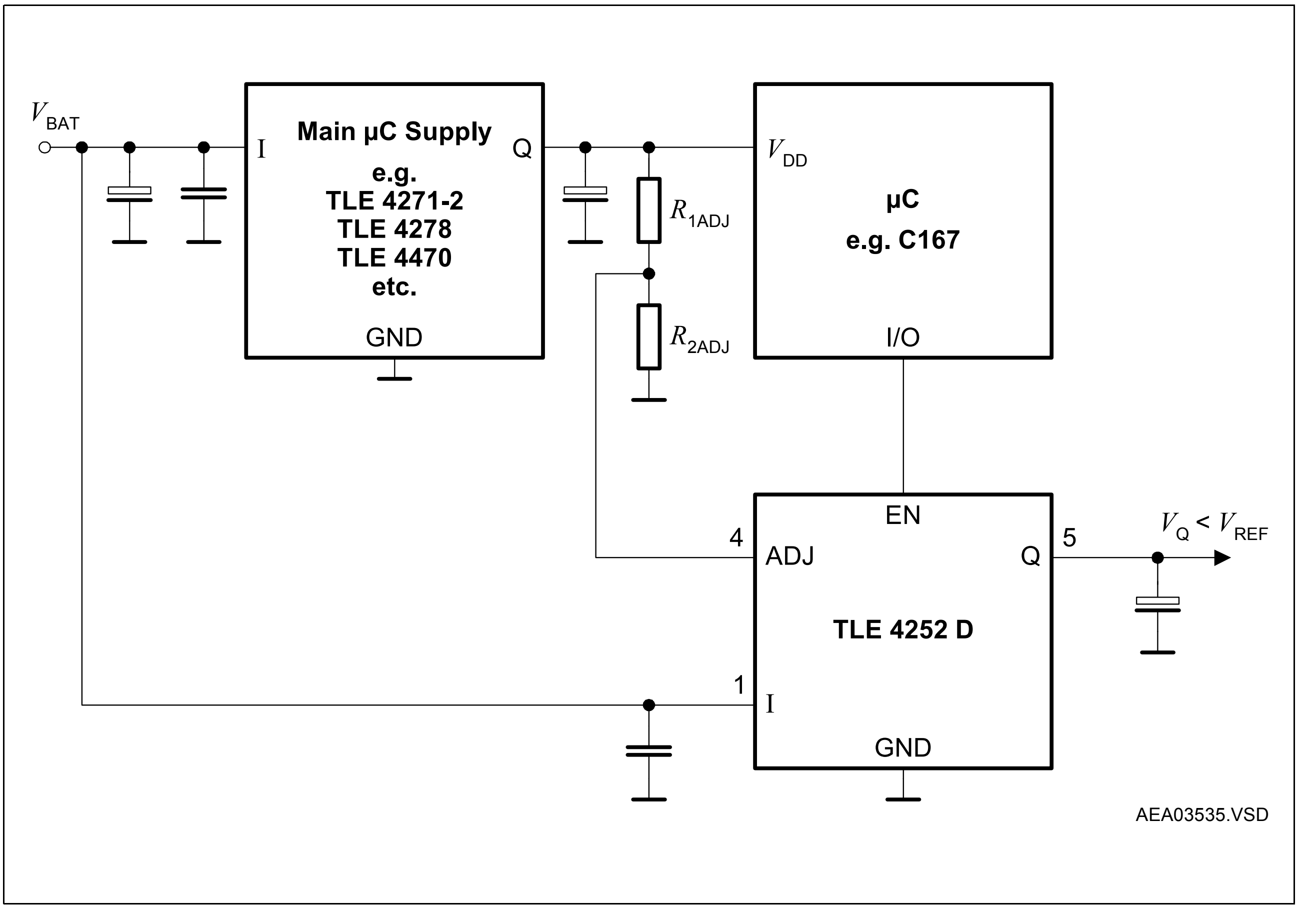


Figure 3 Application Circuit: Output Voltage < Reference Voltage

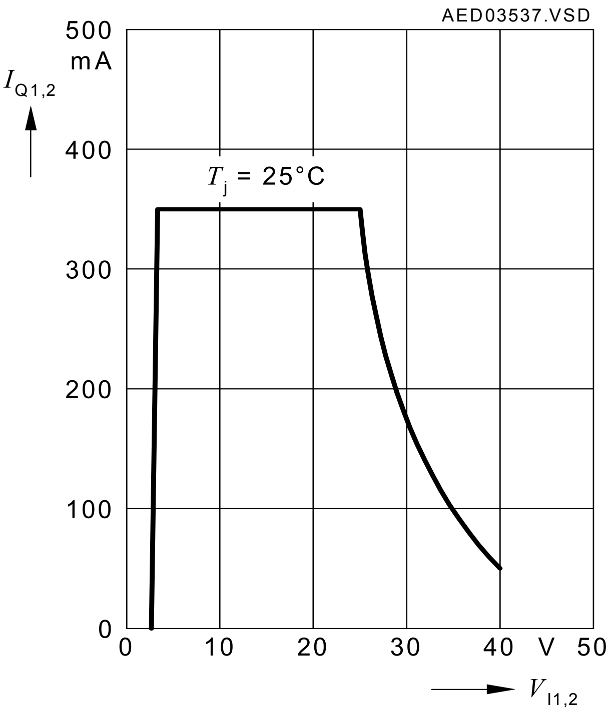
Figure 3 shows a typical application circuit with $V_Q < V_{REF}$. Of course, also $V_Q = V_{REF}$ is feasible by directly connecting the reference pin of the TLE 4252 D to the appropriate voltage level without voltage divider.

The output voltage calculates to:

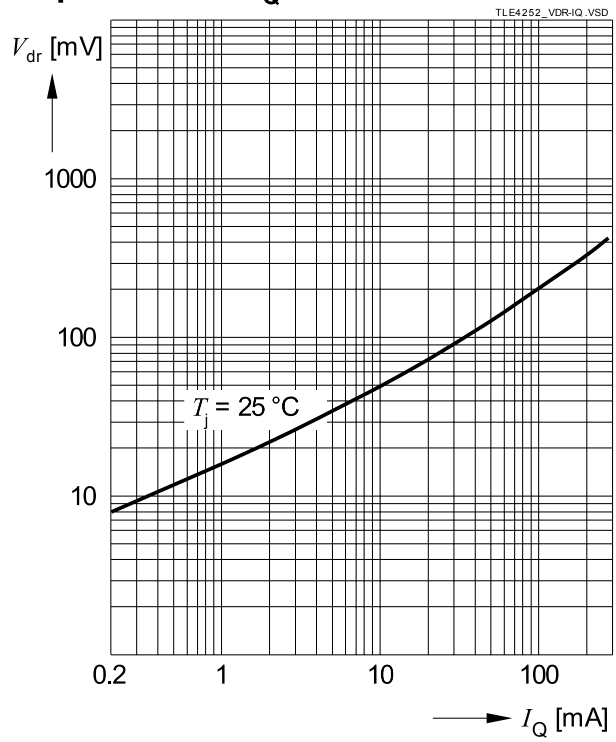
$$V_Q = V_{REF} \times \left(\frac{R_{2ADJ}}{R_{1ADJ} + R_{2ADJ}} \right) \quad (1)$$

Typical Performance Characteristics

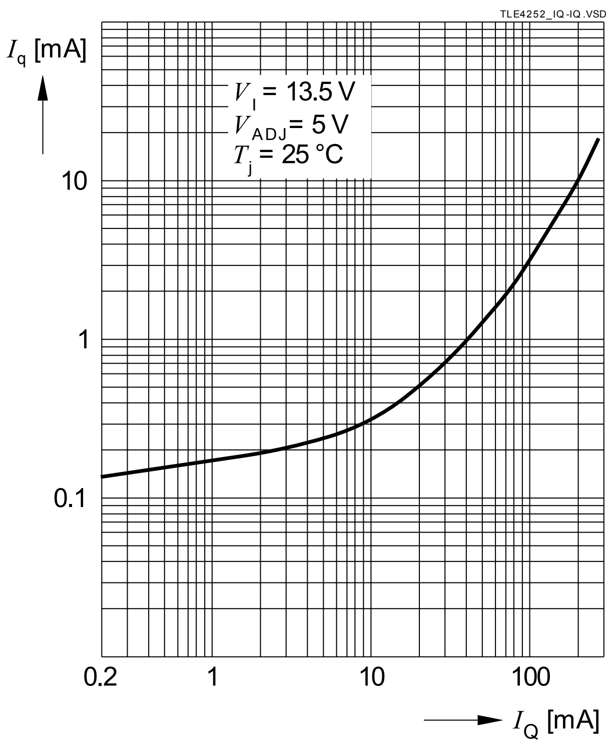
Output Current Limit I_Q versus Input Voltage V_I



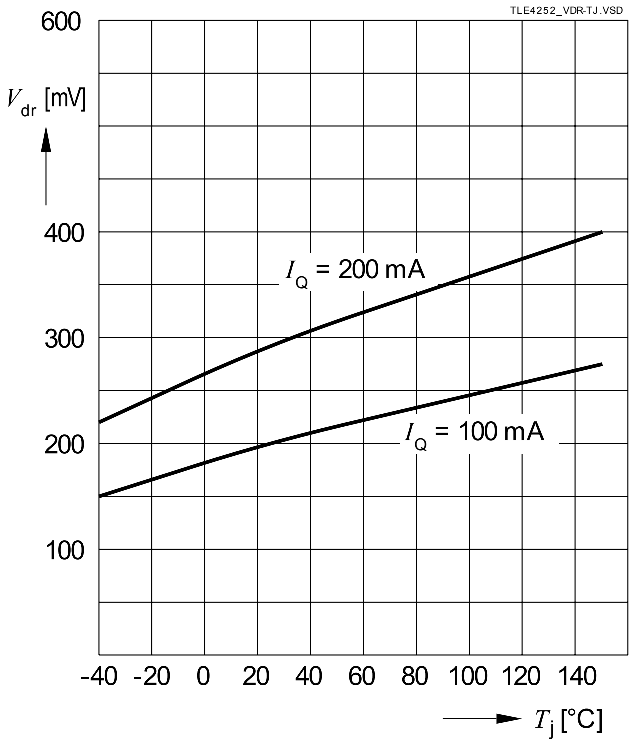
Drop Voltage V_{DR} versus Output Current I_Q



Current Consumption I_q versus Output Current I_Q



Drop Voltage V_{DR} versus Junction Temperature T_J



Package Outlines

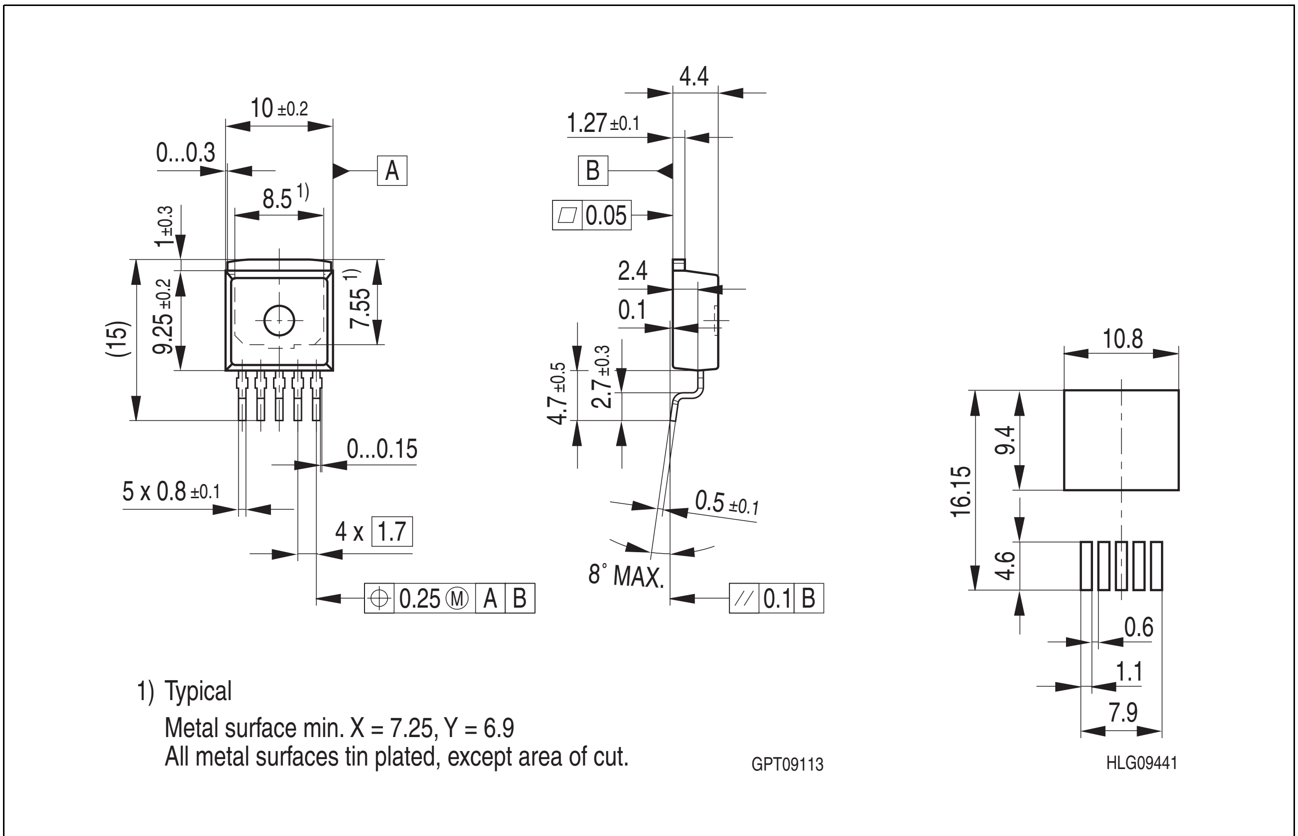


Figure 4 PG-TO263-5-1 Outline and Footprint (Reflow Soldering)

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).

For further information on Infineon packages, please visit our website: http://www.infineon.com/packages.

Dimensions in mm

Revision History

Version	Date	Changes
Rev. 1.0	2008-05-09	Final datasheet TLE 4252 G. Corrected swaped numbers at Table 4 "Thermal Resistance PG-TO263-5" on Page 5 (value for 300mm^2 vs. 600mm^2).
Rev. 0.9	2008-04-22	Initial Preliminary Datasheet of TLE 4252 G (PG-TO263-5).

Edition 2008-05-09

Published by
Infineon Technologies AG
81726 Munich, Germany

Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

Information

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office (**www.infineon.com**).

Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.