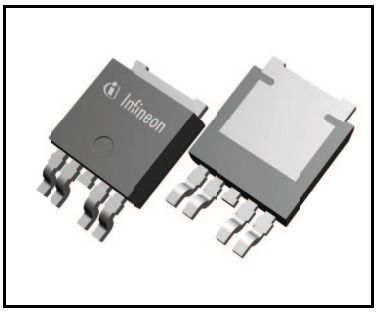
OPTIREG™ linear TLE4252D

Lowdrop voltage tracking regulator



Features

- Output tracking tolerance to reference ≤ ±0.2%
- Output voltage adjust down to 1.5 V
- Output current up to 250 mA
- Enable function
- Very low current consumption in OFF mode
- Wide operation range: up to 40 V
- Wide temperature range from -40°C ≤ T_j ≤ 150°C
- Output protected against short circuit to GND and battery
- Overtemperature protection
- Reverse polarity proof
- Green Product (RoHS-compliant)

Potential applications

- Automotive sensor supply
- Power switch for off-board load
- Protected sensor supply for off-board sensors
- Secondary voltage supply in automotive ECU
- High-precision voltage tracking
- Precision voltage replication

Product validation

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

Description

The OPTIREG™ linear TLE4252D is a monolithic integrated lowdrop voltage tracking regulator in a very small SMD package, PG-TO252-5. It is designed to supply off-board systems, for example, 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 of up to 40 V, the output voltage follows a reference voltage applied at the adjust input with high accuracy. The reference voltage applied directly to the adjust input or, for example, by an external resistor divider can be 1.5 V at minimum. The output is able to drive loads up to 250 mA at minimum while they follow, for example, the 5 V output of a main voltage regulator as reference with high accuracy.

The TLE4252D tracker can be switched into stand-by mode to reduce the current consumption to very low values. This feature makes the IC suitable for low power battery applications.

Type	Package	Marking
TLE4252D	PG-TO252-5	TLE4252

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1 Block diagram

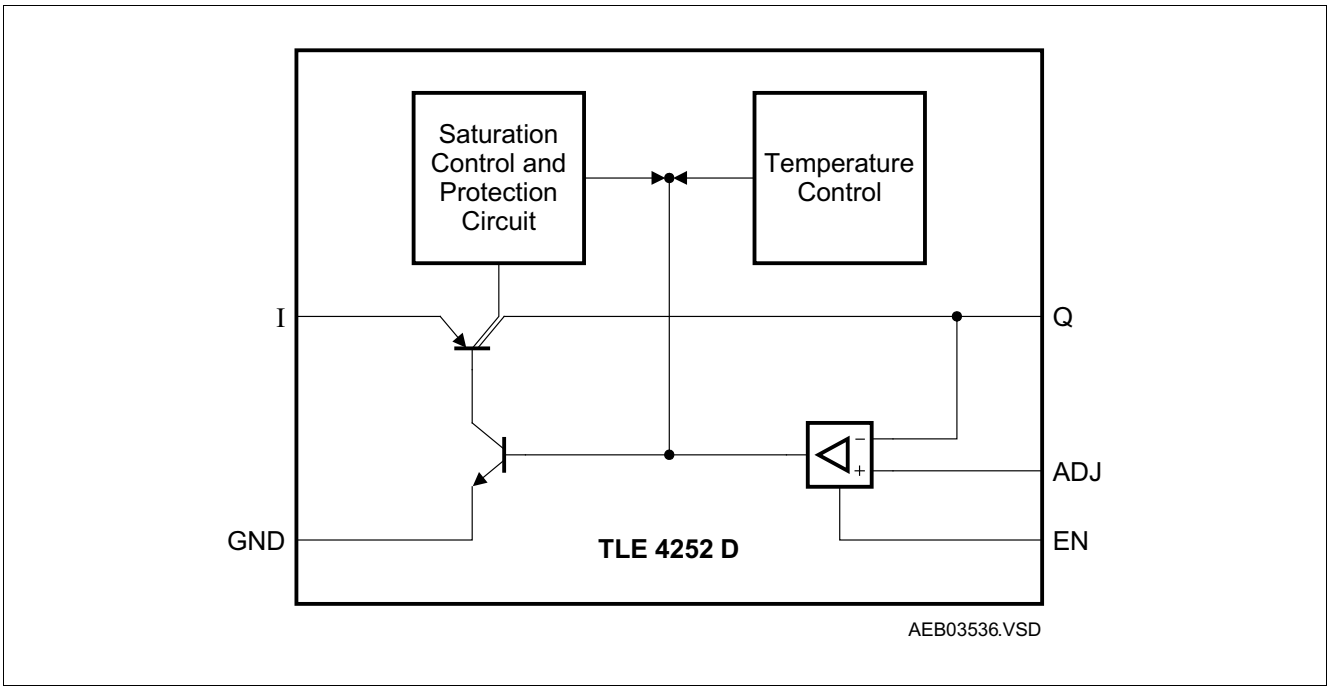


Figure 1 Block diagram

2 Pin configuration

2.1 Pin assignment

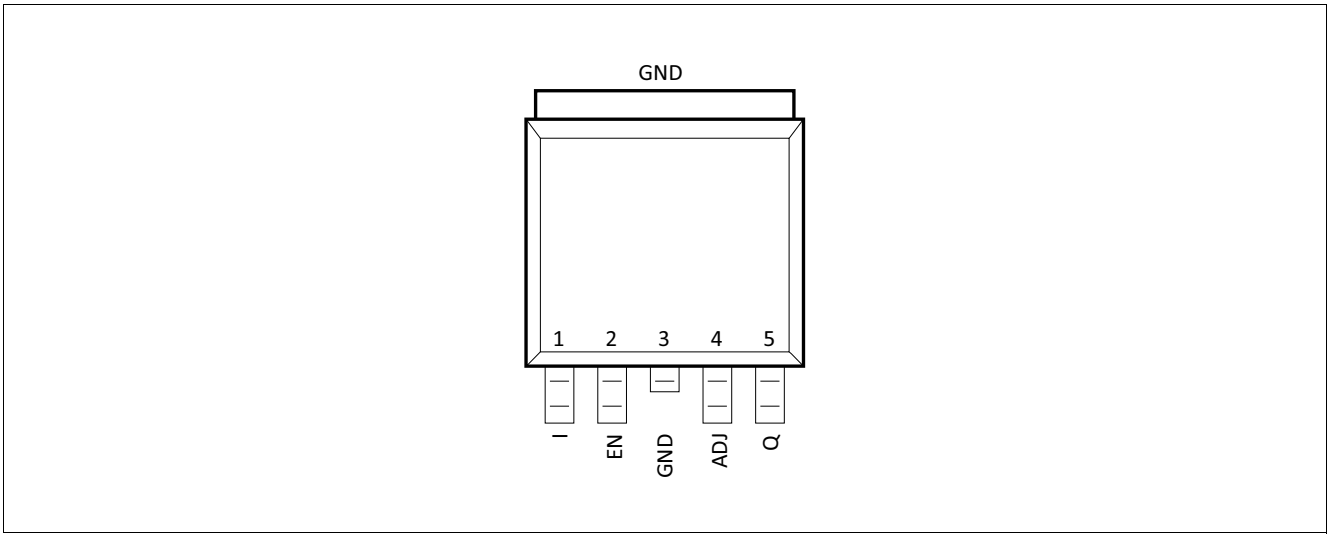


Figure 2 Pin configuration

2.2 Pin definitions and functions

Table 1 Pin definitions and functions

Pin	Symbol	Function
1	I	**Supply voltage input** Input for battery or a pre-regulated voltage of a, for example, DC to DC converter
2	EN	**Enable input for tracker** An active high signal turns on the device, with active low the tracker is turned off
3	GND	**Ground** Connected to the heatsink of the package
4	ADJ	**Adjust input for tracker** Input for the reference voltage which can be connected directly or by voltage divider to the reference (see **Application information**)
5	Q	**Output voltage of tracker** For a stable operation to avoid ringing at the output, connect a capacitor of $C_Q \geq 10$ µF and $0 \leq ESR \leq 5$ Ω to GND

3 General product characteristics

3.1 Absolute maximum ratings

Table 2 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	–	–	–	A	Internally limited	P_3.1.2
Enable EN							
Voltage	V_{EN}	-42	–	45	V	–	P_3.1.3
Current	I_{EN}	–	–	–	A	Internally limited	P_3.1.4
Adjust ADJ							
Voltage	V_{ADJ}	-42	–	45	V	–	P_3.1.5
Current	I_{ADJ}	–	–	–	A	Internally limited	P_3.1.6
Output Q							
Voltage	V_Q	-2	–	45	V	–	P_3.1.7
Current	I_Q	–	–	–	A	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
ESD susceptibility							
Voltage	$V_{ESD,HBM}$	-2	–	2	kV	Human body model (HBM)	P_3.1.11

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 datasheet. Fault conditions are considered as outside normal operating range. Protection functions are not designed for continuous repetitive operation.*

3.2 Functional range

Table 3 Functional range

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Supply voltage	V_I	3.5	–	40	V	$V_I > V_{ADJ} + V_{dr}$	P_3.2.1
Enable input voltage	V_{EN}	0	–	40	V	–	P_3.2.2
Adjust input voltage	V_{ADJ}	1.5	–	40	V	–	P_3.2.3
Adjust input voltage	V_{ADJ}	0	–	1.5	V	$V_Q \leq V_{ADJ} + \Delta V_Q$	P_3.2.4
Error amplifier common mode range	*CMR*	1.5	–	V_I - 0.5	V	$V_Q \leq V_{ADJ} + \Delta V_Q$ with $V_{FB} = V_Q$	P_3.2.5
Junction temperature	T_j	-40	–	150	°C	–	P_3.2.6

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 4 Thermal resistance

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Junction to case	R_{thJC}	–	–	2	K/W	–	P_3.3.1
Junction to ambient	R_{thJA}	–	–	144	K/W	1) Footprint only	P_3.3.2
Junction to ambient	R_{thJA}	–	–	78	K/W	1) Heat sink area 300 mm^2	P_3.3.3
Junction to ambient	R_{thJA}	–	–	55	K/W	1) Heat sink area 600 mm^2	P_3.3.4

1) Worst case regarding peak temperature, zero airflow, mounted on PCB 80 × 80 × 1.5 mm^3, 35 µm Cu, 5 µm Sn.

4 Electrical characteristics

4.1 Electrical characteristics

Table 5 Electrical characteristics

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

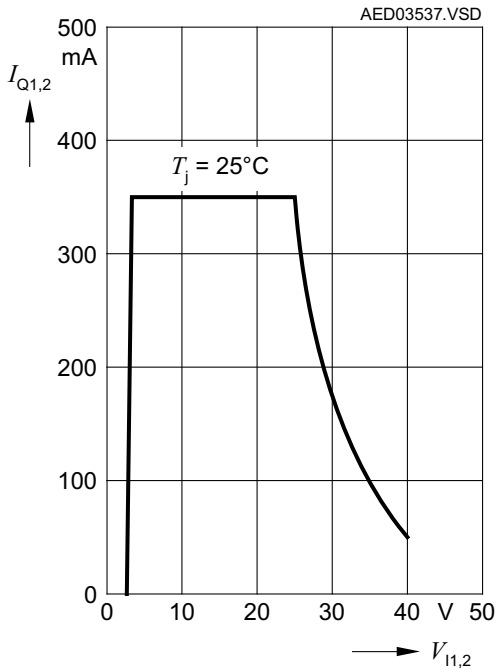
Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Regular performance, tracker output Q							
Output voltage tracking accuracy $\Delta V_Q = V_{ADJ} - V_Q$	ΔV_Q	-10	–	10	mV	4.5 V < V_I < 26 V; 1 mA < I_Q < 200 mA	P_4.1.1
Output voltage tracking accuracy $\Delta V_Q = V_{ADJ} - V_Q$	ΔV_Q	-10	–	10	mV	3.5 V < V_I < 32 V; 10 mA < I_Q < 100 mA	P_4.1.2
Output voltage tracking accuracy $\Delta V_Q = V_{ADJ} - V_Q$	ΔV_Q	-25	–	25	mV	3.5 V < V_I < 4.5 V; 1 mA < I_Q < 200 mA	P_4.1.3
Drop voltage	V_{dr}	–	280	600	mV	[1] I_Q = 200 mA; V_{ADJ} > 3.5 V; V_{EN} = $V_{EN,on}$	P_4.1.4
Output current	I_Q	250	350	500	mA	[2] V_Q = 5 V	P_4.1.5
Output capacitor	C_Q	10	–	–	µF	0 ≤ ESR ≤ 5 Ω at 10 kHz	P_4.1.6
Current consumption $I_q = I_I - I_Q$	I_q	–	10	25	mA	I_Q = 200 mA; V_Q = 5 V	P_4.1.7
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	P_4.1.8
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	P_4.1.9
Reverse current	I_R	–	0.5	5	mA	V_Q = 16 V; V_I = 0 V	P_4.1.10
Regulator performance							
Load regulation	ΔV_Q	–	–	10	mV	1 mA < I_Q < 200 mA	P_4.1.11
Line regulation	ΔV_Q	–	–	10	mV	5 V < V_I < 32 V; I_Q = 5 mA	P_4.1.12
Power supply ripple rejection	*PSRR*	–	60	–	dB	[3] $f_{I,ripple}$ = 100 Hz; $V_{I,ripple}$ = 0.5 V_{pp}	P_4.1.13
Adjust input							
Input biasing current	I_{ADJ}	–	0.1	0.5	µA	V_{ADJ} = 5 V	P_4.1.14
Enable input EN							
Enable on voltage range	$V_{EN, on}$	2	–	40	V	V_Q settled	P_4.1.15
Enable off voltage range	$V_{EN, off}$	0	–	0.8	V	V_Q < 0.1 V	P_4.1.16
Input current	I_{EN}	-1	2	5	µA	V_{EN} = 5 V	P_4.1.17
EN pull-down resistor	R_{EN}	–	1.5	–	MΩ	–	P_4.1.18

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 **Output current limit I_Q versus input voltage V_I**.
3) Not subject to production test, specified by design.

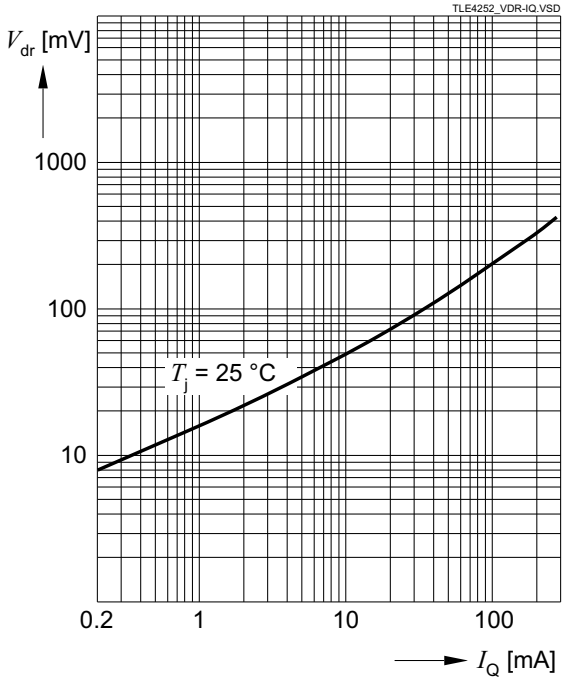
4.1.1 Typical performance graphs

Typical performance characteristics

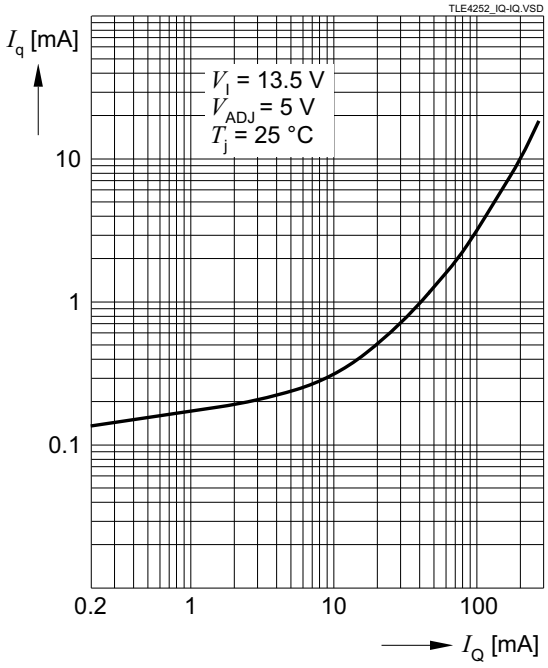
Output current limit I_Q versus input voltage V_I



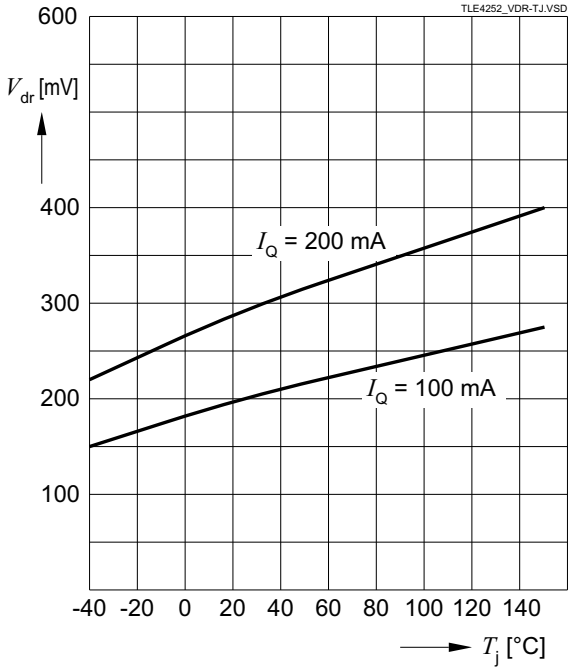
Drop voltage V_{dr} versus output current I_Q



Current consumption I_q versus output current I_Q



Drop voltage V_{dr} versus junction temperature T_j



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.

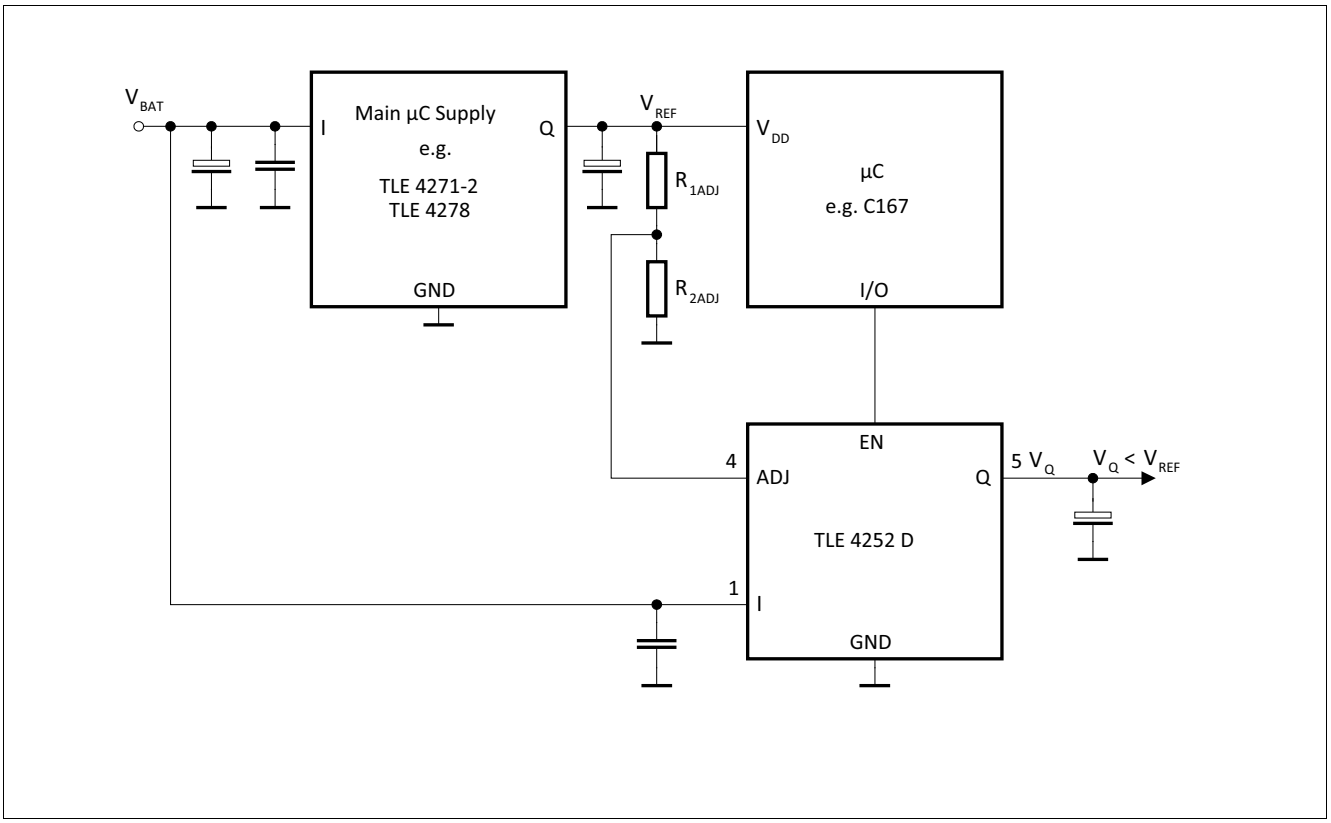


Figure 3 Application diagram: output voltage less than the reference voltage

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

Figure 3 shows a typical application circuit with $V_Q < V_{REF}$.

The output voltage can be calculated by

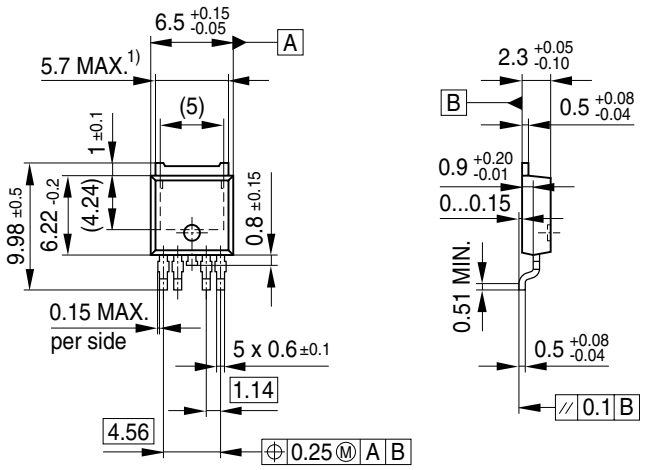
$$V_Q = V_{REF} \times \left(\frac{R_{2ADJ}}{R_{1ADJ} + R_{2ADJ}} \right) \quad (5.1)$$

Of course, also $V_Q = V_{REF}$ is feasible by connecting the adjust pin of the TLE4251D directly to the appropriate voltage level without voltage divider.

5.1 Further application information

For further information visit **https://www.infineon.com**

6 Package information



1) Includes mold flashes on each side.
All metal surfaces tin plated, except area of cut.

Figure 4 PG-TO252-5[1] (Plastic transistor, single outline)

1) Dimensions in mm

Package information

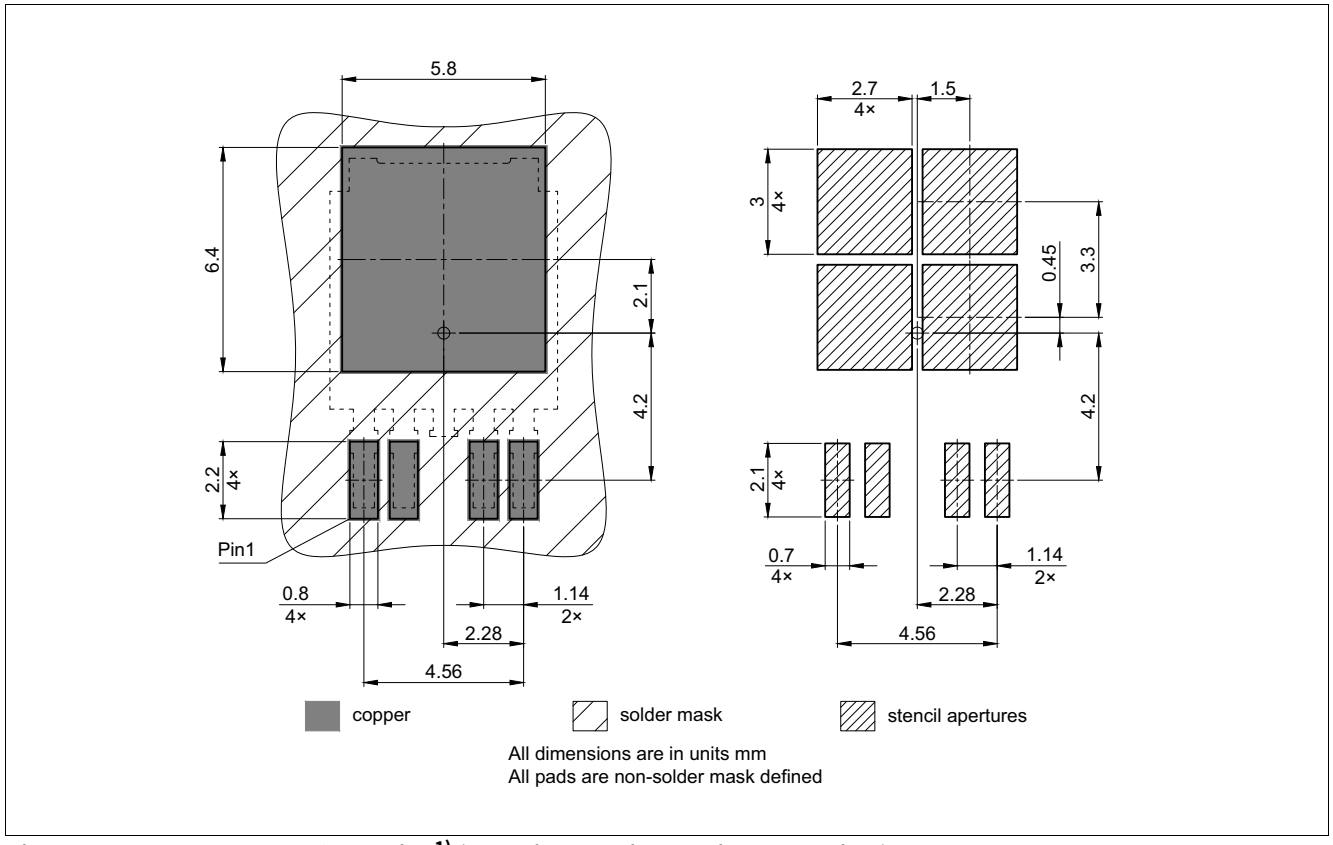


Figure 5 PG-TO252-5 footprint[1] (Plastic transistor, single outline)

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 (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

7 Revision history

Revision	Date	Changes
Rev. 1.41	2024-03-14	Editorial changes and template update
Rev. 1.4	2007-03-20	Initial version of RoHS-compliant derivate of TLE4252D Page 1: AEC certified statement added Page 1 and Page 10: RoHS compliance statement and Green Product feature added Page 1 and Page 10: Package changed to RoHS compliant version Legal Disclaimer updated

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