

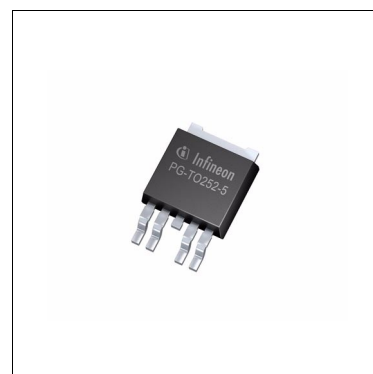
OPTIREG™ linear TLE4476D

Dual low-drop voltage regulator



Features

- Output 1: 350 mA, 3.3 V $\pm$ 4%
- Output 2: 430 mA, 5.0 V $\pm$ 4%
- Enable input for output 2
- Low quiescent current in OFF state
- Wide operation range: up to 42 V
- Reverse battery protection: up to 42 V
- Output protected against short-circuit
- Wide temperature range: -40°C to +170°C
- Overvoltage protection up to 65 V (< 400 ms)
- Overtemperature protection
- Overload protection
- Green Product (RoHS compliant)



Potential applications

General automotive applications.

Product validation

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

Description

The TLE4476D is a monolithic integrated voltage regulator providing two output voltages, Q1 is a 3.3 V output for loads up to 350 mA and Q2 is a 5 V output providing 430 mA. Output 2 can be switched ON/OFF via the enable input EN. The device is available in the PG-TO252-5 (DPAK) package.

The TLE4476D is designed to supply microprocessor systems under the severe conditions of automotive applications and is therefore equipped with additional protection functions against overload, short-circuit and overtemperature.

Type	Package	Marking
TLE4476D	PG-TO252-5	4476D

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Block diagram

1 Block diagram

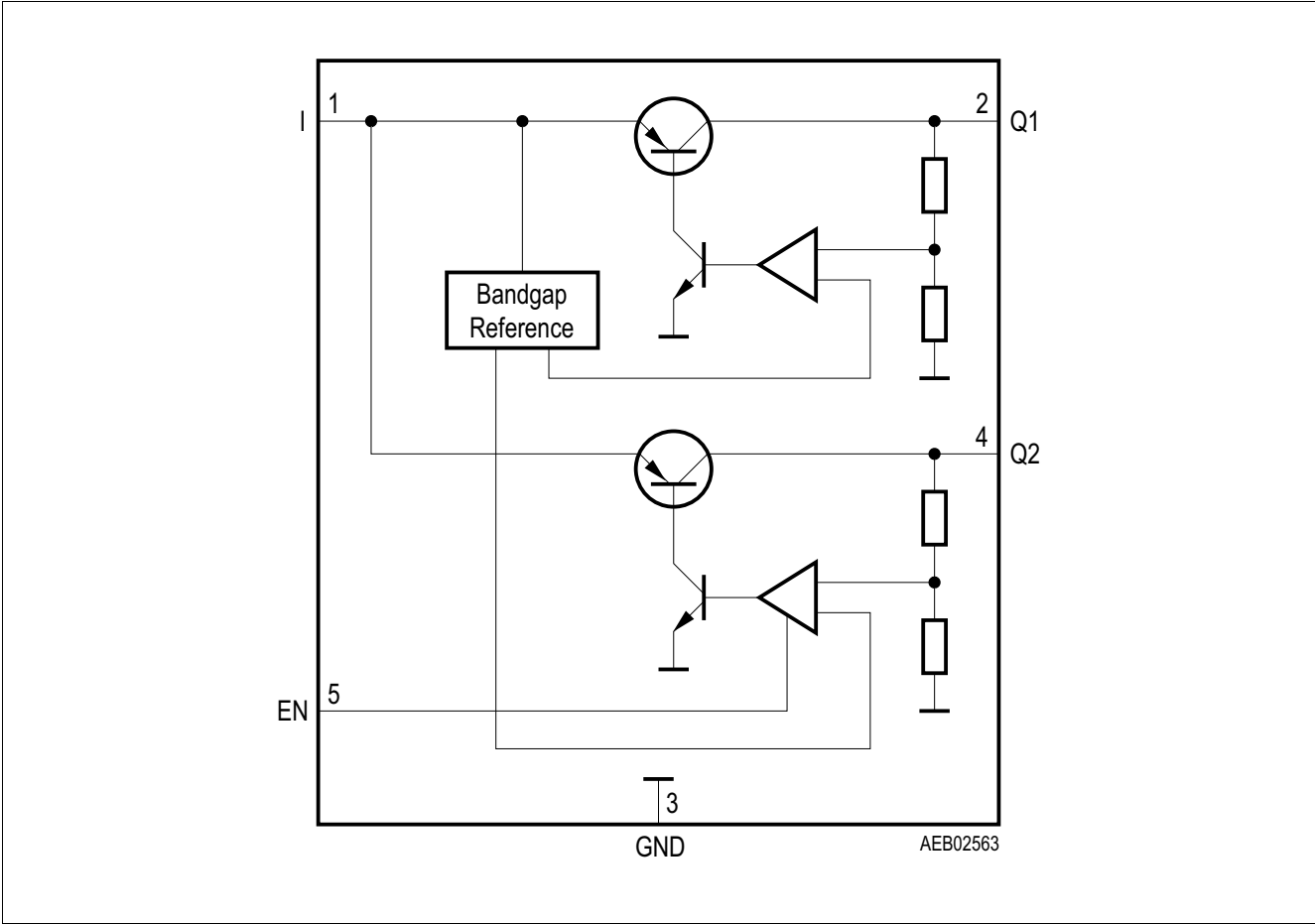


Figure 1 Block diagram

Pin configuration

2 Pin configuration

2.1 Pin assignment PG-TO252-5

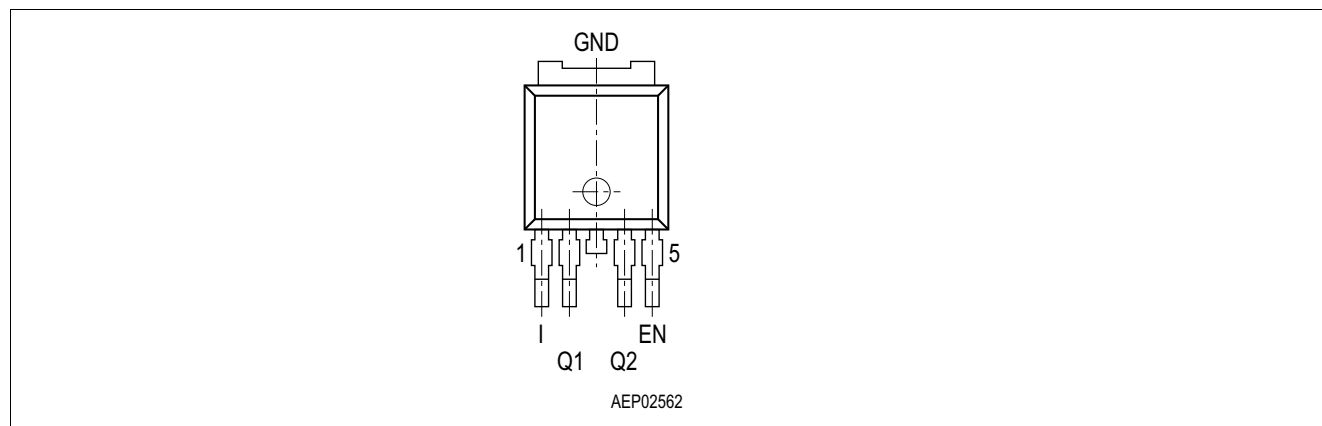


Figure 2

2.2 Pin definitions and functions PG-TO252-5

Table 1 Pin definitions and functions

Pin no.	Symbol	Function
1	I	Input voltage Block to GND directly at the IC with a ceramic capacitor
2	Q1	3.3 V output Block to GND with a capacitor $C_{Q1} \geq 10 \mu\text{F}$, $\text{ESR} < 2 \Omega$ at 10 kHz
3	GND	Ground
4	Q2	5 V output Block to GND with a capacitor $C_{Q2} \geq 10 \mu\text{F}$, $\text{ESR} < 3 \Omega$ at 10 kHz
5	EN	Enable input Switch Q2 ON (high signal) or OFF (low signal)

3 General product characteristics

3.1 Absolute maximum ratings

Table 2 Absolute maximum ratings

$T_j = -40^{\circ}\text{C}$ to $+170^{\circ}\text{C}$

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	$t < 400\text{ ms}$	P_3.1.2
Current	I_I	–	–	–	mA	Internally limited	P_3.1.3
3.3 V output Q1							
Voltage	V_{Q1}	-1	–	36	V	–	P_3.1.4
Current	I_{Q1}	–	–	–	mA	Internally limited	P_3.1.5
5 V output Q2							
Voltage	V_{Q2}	-1	–	36	V	–	P_3.1.6
Current	I_{Q2}	–	–	–	mA	Internally limited	P_3.1.7
Inhibit EN							
Voltage	V_{EN}	-42	–	42	V	–	P_3.1.8
Voltage	V_{EN}	–	–	65	V	$t < 400\text{ ms}$	P_3.1.9
Current	I_{EN}	–	–	–	mA	Internally limited	P_3.1.10
Temperatures							
Junction temperature	T_j	-50	–	170	°C	–	P_3.1.11
Storage temperature	T_{stg}	-50	–	150	°C	–	P_3.1.12

Notes

1. ESD-Protection according to MIL Std. 883: $\pm 2\text{ kV}$.
2. Stresses above those listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

3.2 Functional range

Table 3 Functional range

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Output 1 input voltage	V_{I1}	4.5	–	42	V	1)	P_3.2.1
Output 2 input voltage	V_{I1}	5.7	–	42	V	2)	P_3.2.2
3.3 V regulator output current	I_{O1}	0	–	350	mA	–	P_3.2.3

General product characteristics

Table 3 Functional range (cont'd)

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
5 V regulator output current	I_{O2}	0	–	430	mA	–	P_3.2.4
Junction temperature	T_j	-40	–	170	°C	³⁾	P_3.2.5

Thermal resistances

Junction case	$R_{th,j-case}$	–	–	3	K/W	–	P_3.2.6
Junction ambient	$R_{th,j-a}$	–	–	80	K/W	⁴⁾	P_3.2.7

- 1) Input voltage V_I required for operation of output Q1.
- 2) Input voltage V_I required for operation of output Q2.
- 3) The overtemperature protection is set to > 170°C. The voltage regulator may not be operated continuously at 170°C as device reliability will be reduced to 500 h statistical lifetime.
- 4) Worst case regarding peak temperature, zero airflow; mounted on a PCB 80 × 80 × 1.5 mm³, 35 µm Cu, 5 µm Sn, heat sink area 300 mm².

Note: *In the operating range the functions given in the circuit description are fulfilled.*

Electrical characteristics

4 Electrical characteristics

Table 4 Electrical Characteristics

$V_I = 13.5 \text{ V}$; $V_{EN} > V_{ENH}$; $T_j = -40^\circ\text{C}$ to $+150^\circ\text{C}$; unless otherwise specified.

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
3.3 V output Q1							
Output voltage	V_{Q1}	3.17	3.3	3.43	V	$1\text{ mA} < I_{Q1} < 250\text{ mA}$	P_4.0.1
Output current limitation	I_{Q1}	350	–	900	mA	¹⁾	P_4.0.2
Load regulation	ΔV_{Q1}	–	–	30	mV	$1\text{ mA} < I_{Q1} < 250\text{ mA}$	P_4.0.3
Line regulation	ΔV_{Q1}	–	–	20	mV	$I_{Q1} = 5\text{ mA}$; $6\text{ V} < V_I < 28\text{ V}$	P_4.0.4
Power supply ripple rejection	$PSRR$	–	60	–	dB	²⁾ $20\text{ Hz} < f_r < 20\text{ kHz}$; $V_r = 5\text{ V}_{pp}$	P_4.0.5
Output capacitor	C_{Q1}	10	–	–	μF	–	P_4.0.6
ESR of output capacitor	R_{ESRQ1}	–	–	2	Ω	At 10 kHz	P_4.0.7
5 V output Q2							
Output voltage	V_{Q2}	4.8	5.0	5.2	V	$1\text{ mA} < I_{Q2} < 330\text{ mA}$	P_4.0.8
Output current limitation	I_{Q2}	430	–	900	mA	¹⁾	P_4.0.9
Drop voltage; $V_{DRQ2} = V_I - V_{Q2}$	V_{DRQ2}	–	0.3	0.7	V	¹⁾ $I_{Q2} = 330\text{ mA}$	P_4.0.10
Load regulation	ΔV_{Q2}	–	–	50	mV	$5\text{ mA} < I_{Q2} < 330\text{ mA}$	P_4.0.11
Line regulation	ΔV_{Q2}	–	–	50	mV	$I_{Q2} = 5\text{ mA}$; $6\text{ V} < V_I < 28\text{ V}$	P_4.0.12
Power supply ripple rejection	$PSRR$	–	60	–	dB	²⁾ $20\text{ Hz} < f_r < 20\text{ kHz}$; $V_r = 5\text{ V}_{pp}$	P_4.0.13
Output capacitor	C_{Q2}	10	–	–	μF	–	P_4.0.14
ESR of output capacitor	R_{ESRQ2}	–	–	3	Ω	At 10 kHz	P_4.0.15
Current consumption							
Quiescent current; $I_q = I_I - I_{Q1}$	I_q	–	100	150	μA	$T_j < 85^\circ\text{C}$; $V_{EN} = 0\text{ V}$	P_4.0.16
Quiescent current; $I_q = I_I - I_{Q1} - I_{Q2}$	I_q	–	300	400	μA	$I_{Q1} = I_{Q2} = 300\text{ }\mu\text{A}$; $T_j < 85^\circ\text{C}$	P_4.0.17
Quiescent current; $I_q = I_I - I_{Q1} - I_{Q2}$	I_q	–	2.5	10	mA	$I_{Q1} = 150\text{ mA}$; $I_{Q2} = 300\text{ }\mu\text{A}$	P_4.0.18
Quiescent current; $I_q = I_I - I_{Q2} - I_{Q1}$	I_q	–	5	13	mA	$I_{Q1} = 300\text{ }\mu\text{A}$; $I_{Q2} = 250\text{ mA}$	P_4.0.19
Enable input EN							
EN ON voltage	$V_{EN\text{ ON}}$	1.8	–	–	V	$V_{Q2}\text{ ON}$	P_4.0.20
EN OFF voltage	$V_{EN\text{ OFF}}$	–	–	1.0	V	$V_{Q2}\text{ OFF}$	P_4.0.21
Input current	V_{EN}	–	20	30	μA	$V_{EN} = 13\text{ V}$	P_4.0.22

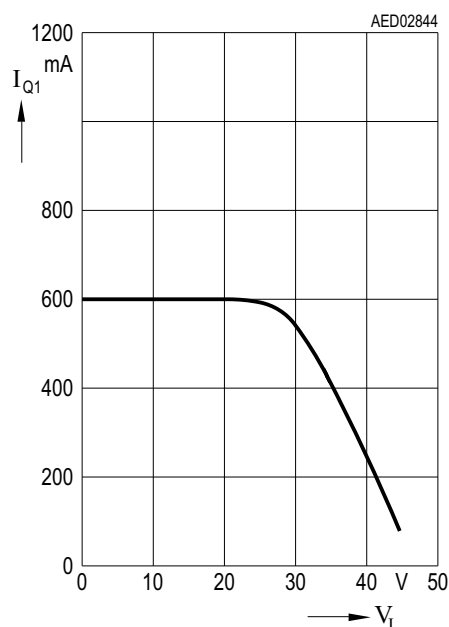
1) Measured when the output voltage V_Q has dropped 100 mV from the nominal value.

2) Guaranteed by design.

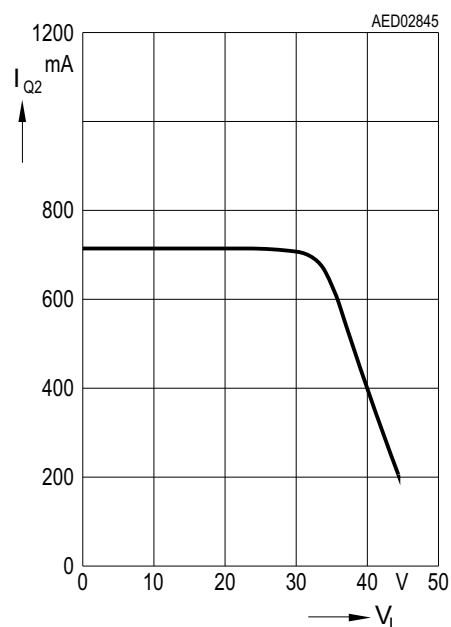
Electrical characteristics

4.1 Typical performance characteristics

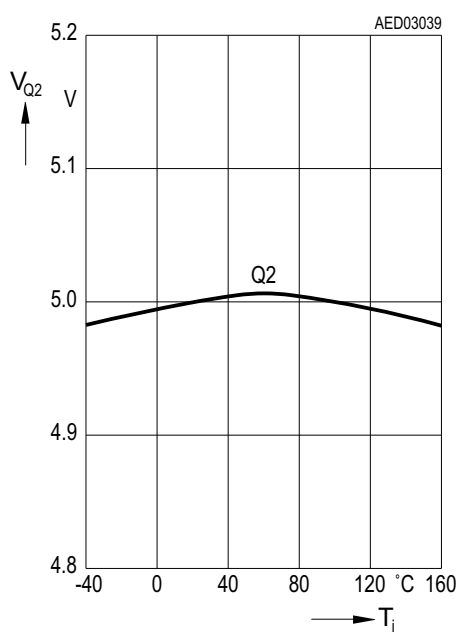
**Output current I_{Q1} versus
input voltage V_i**



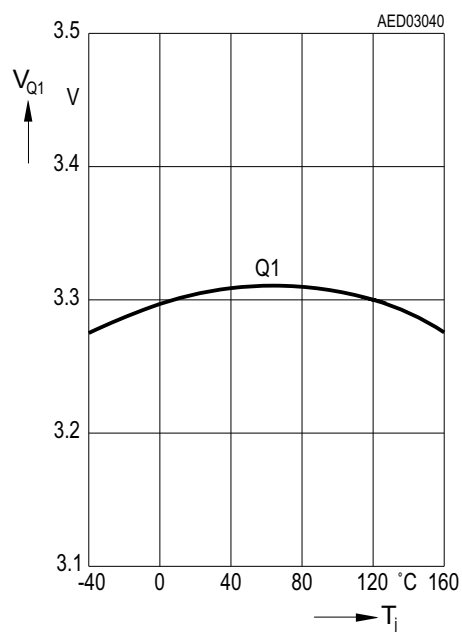
**Output current I_{Q2} versus
input voltage V_i enable ON**



**Output voltage V_{Q2}
versus temperature T_j**

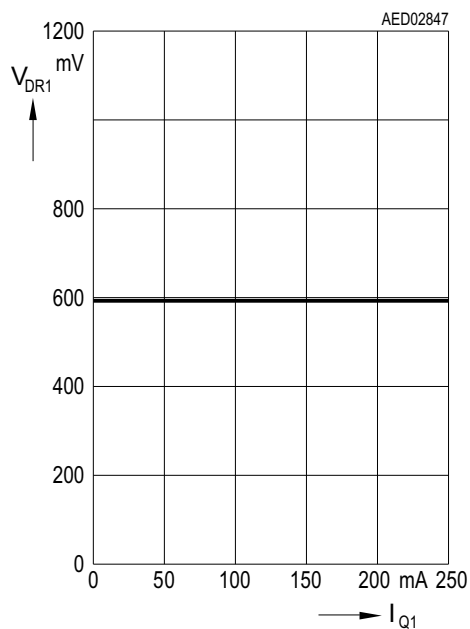


**Output voltage V_{Q1}
versus temperature T_j**

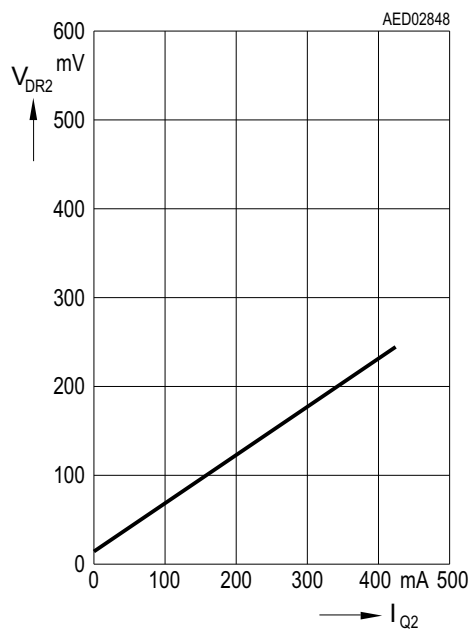


Electrical characteristics

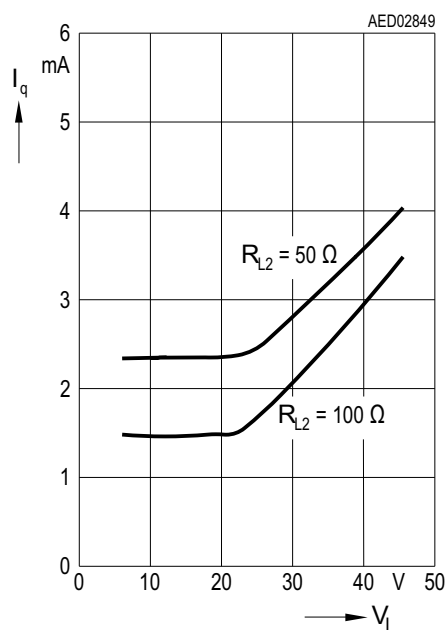
**Drop voltage V_{DR1} versus
output current I_{Q1}**



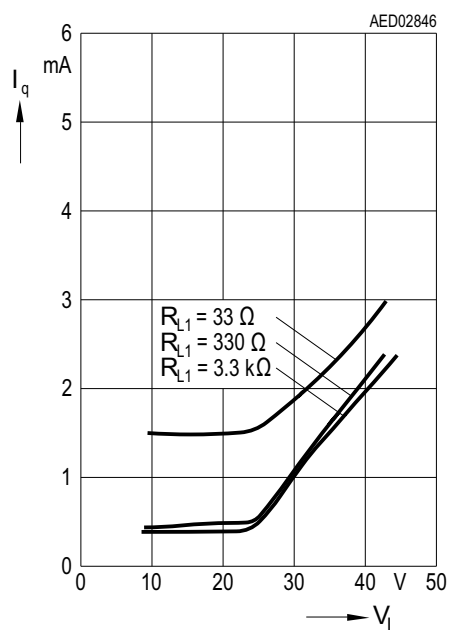
**Drop voltage V_{DR2} versus
output current I_{Q2} EN ON**



**Current consumption I_q
versus input voltage V_i**

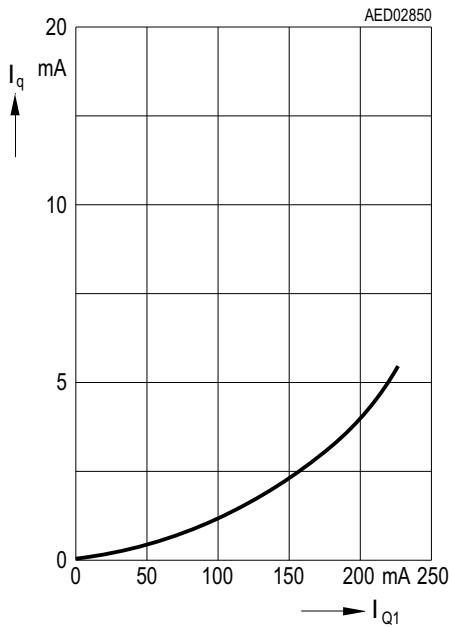


**Current consumption I_q
versus input voltage V_i**

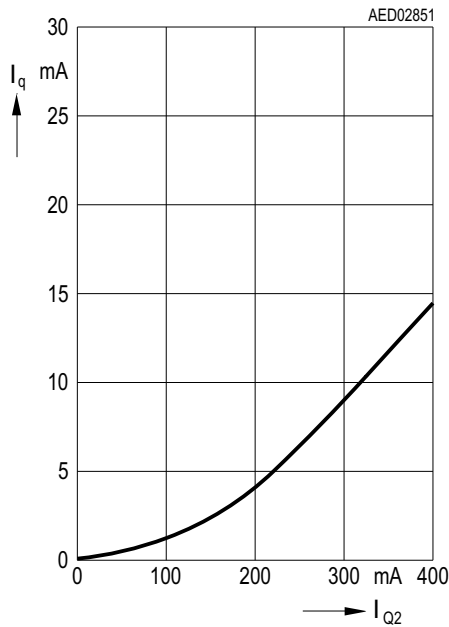


Electrical characteristics

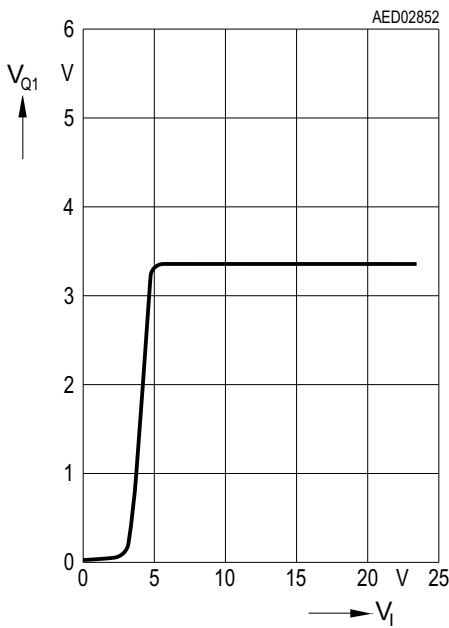
Current consumption I_q
versus output current I_{Q1}



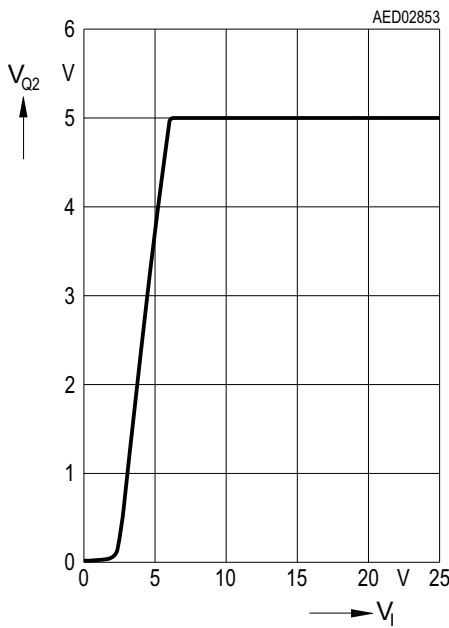
Current consumption I_q
versus output current I_{Q2}



Output voltage V_{Q1} versus
input voltage V_i



Output voltage V_{Q2} versus
input voltage V_i



Application information

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.

5.1 Application diagram

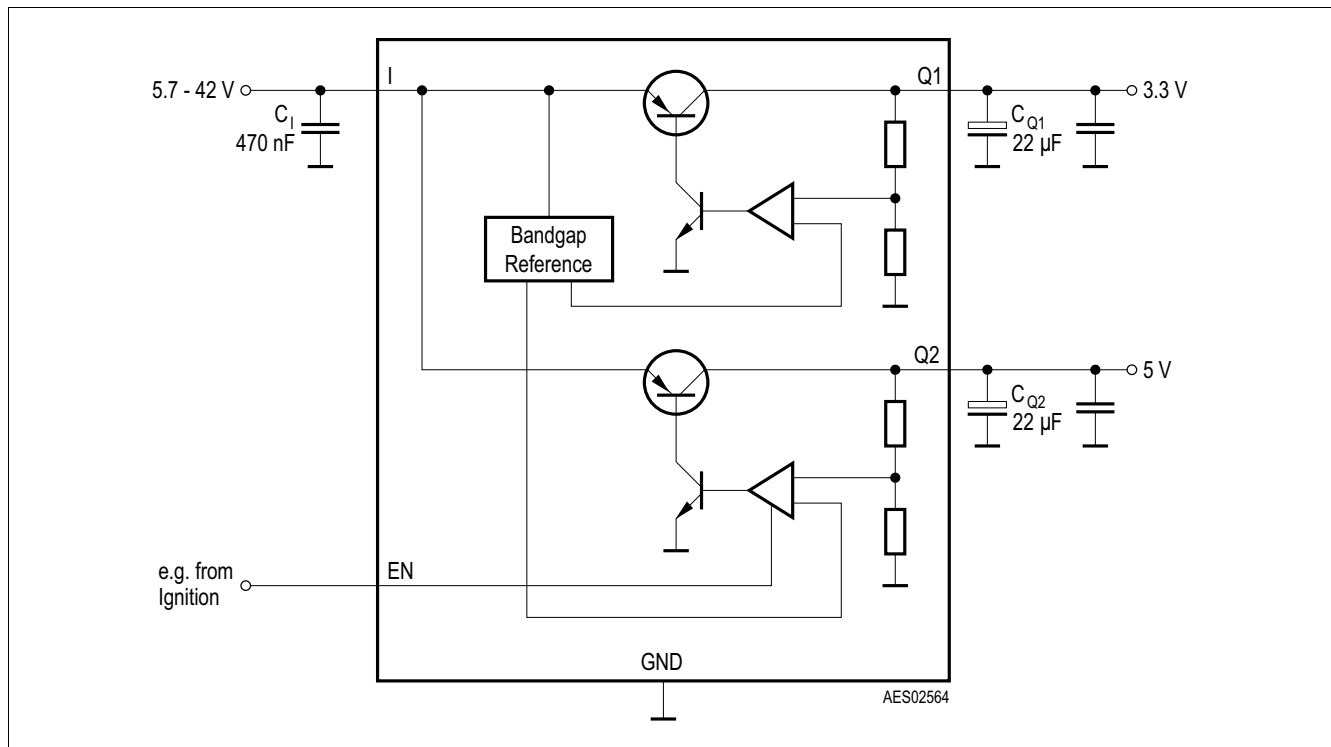


Figure 3 Application diagram

5.2 Selection of external components

5.2.1 Input, output

The input capacitor C_I is necessary for compensating line influences. Using a resistor of approx. 1Ω in series with C_I , the LC circuit of input inductivity and input capacitance can be damped. To stabilize the regulation circuits of the stand-by and main regulator, output capacitors C_{Q1} and C_{Q2} are necessary. Stability is guaranteed at values, $C_{Q1} \geq 10 \mu\text{F}$ ($\text{ESR} \leq 2 \Omega$) and $C_{Q2} \geq 10 \mu\text{F}$ ($\text{ESR} \leq 3 \Omega$) within the operating temperature range.

5.2.2 Enable

Using the enable feature output 2 (5 V output) can be switched ON or OFF. The enable input can be connected directly to terminal 30 (battery line) or 15 (ignition line). It is also possible to control the output 2 via the microcontroller.

5.3 Further application information

For further information you may contact <https://www.infineon.com>.

6 Package information

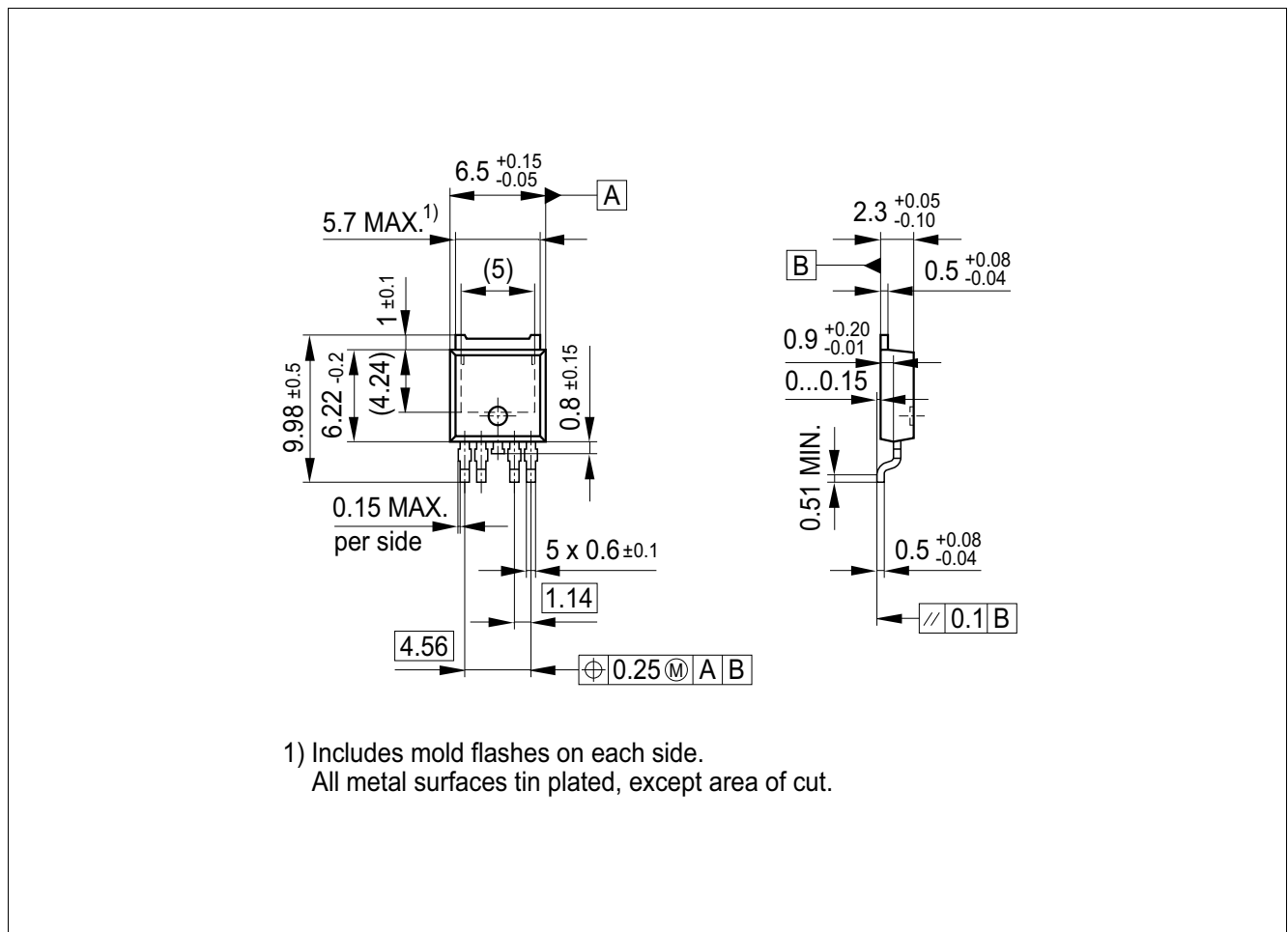


Figure 4 PG-TO252-5¹⁾

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

Revision history

7 Revision history

Revision	Date	Changes
Rev. 2.70	2024-10-25	Max temperature of EC table headers reverted back to correct value (150°C) which got set incorrectly during template update (Rev. 2.60) Editorial changes
Rev. 2.60	2023-08-07	Update template, layout, and structure Editorial changes
Rev. 2.50	2007-03-20	Initial version of RoHS-compliant derivate of TLE4476D Page 1: AEC certified statement added Page 1 and Page 12: RoHS compliance statement and Green Product feature added Page 1 and Page 12: Package changed to RoHS compliant version Legal Disclaimer updated

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