

# **Tracking Regulator**

# TLE 4252



### Features

- Output tracking tolerance to reference  $\leq \pm 0.2\%$
- 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  $\leq T_i \leq$  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-drop voltage tracking regulator in a very small SMD package PG-TO252-5-11. 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 applied at the adjust input with high accuracy. The reference voltage applied directly to the adjust input or by an e.g. 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 e.g. the 5 V output of a main voltage regulator as reference with high accuracy.

The **TLE 4252** 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.

Туре	Package
TLE 4252 D	PG-TO252-5-11





# **Block Diagram**



Figure 1 **Internal Circuit Blocks** 





# Figure 2 Pin Configuration (Draft, subject to alternation!)

Table 1	Pin Definitions and Functions	(draft, subje	ect to alternation)
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Pin No.	Symbol	Function
1	I	<b>Supply voltage input</b> ; Input for battery or a pre-regulated voltage of a e.g. DC to DC converter.
2	EN	<b>Enable input for tracker;</b> 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	<b>Output voltage of tracker;</b> For a stable operation to avoid ringing at the output connect a capacitor of $C_Q \ge 10 \ \mu\text{F}$ and $0 \le \text{ESR} \le 5 \ \Omega$ to GND.



Parameter	Symbol	Limi	t Values	Unit	Remarks	
		Min.	Max.			
Supply Voltage Input	I				•	
Voltage	VI	-42	45	V	-	
Current	I	-	-	A	Limited internally	
Enable Input EN					•	
Voltage	$V_{EN}$	-42	45	V	-	
Current	I <sub>EN</sub>	_	_	А	Limited internally	
Adjust Input ADJ					•	
Voltage	$V_{ADJ}$	-42	45	V	-	
Current	I <sub>ADJ</sub>	– – A		А	Limited internally	
Output Q	•					
Voltage	VQ	-2	45	V	-	
Current	IQ	_	– A Limited inte		Limited internally	
Temperature	•					
Junction temperature	T <sub>j</sub>	-40	150	°C	-	
Storage temperature	T <sub>stg</sub>	-50 150 °C –		-		
ESD-Protection			ł	I		
Voltage	$V_{ESD}$	-2	2	kV	Human Body Model (HBM)	

## Table 2Absolute Maximum Ratings

Note: Maximum ratings are absolute ratings, exceeding one of these values may cause irreversible damage to the integrated circuit!



### Table 3Operating Range

Parameter	Symbol	Limit Values			Unit	Remarks	
		Min.	Тур.	Max.			
In- and Output Voltag	ge						
Supply voltage	VI	3.5	-	40	V	$V_{\rm I} > V_{\rm ADJ} + V_{\rm dr}$	
Enable input voltage	$V_{EN}$	0	-	40	V	-	
Adjust input voltage	$V_{ADJ}$	1.5	-	40	V	-	
Adjust input voltage	$V_{ADJ}$	0	-	1.5	V	$V_{\rm Q} \le V_{\rm ADJ} + \Delta V_{\rm Q}$	
Error amplifier common mode range	CMR	1.5	-	V <sub>I</sub> - 0.5	V	$V_{\rm Q} \leq V_{\rm ADJ} + \Delta V_{\rm Q}$ with $V_{\rm FB} = V_{\rm Q}$	
Temperature							
Junction temperature	Tj	-40	-	150	°C	_	
Thermal Resistance	PG-TO25	2-5-11					
Junction to ambient	R <sub>thj-a</sub>	_	-	144	K/W	Footprint only <sup>1)</sup>	
Junction to ambient	R <sub>thj-a</sub>	_	-	78	K/W	Heat sink area 300 mm <sup>2 1)</sup>	
Junction to ambient	R <sub>thj-a</sub>	_	-	55	K/W	Heat sink area 600 mm <sup>2 1)</sup>	
Junction to case	R <sub>thj-c</sub>	_	-	2	K/W	-	

1) Worst case regarding peak temperature; zero airflow; mounted on FR4;  $80 \times 80 \times 1.5 \text{ mm}^3$ ;  $35 \mu \text{ Cu}$ ;  $5 \mu \text{ Sn}$ 

Note: Within this operating range the IC is functional. The electrical characteristics, however, are not guaranteed over this full range given above.



### Table 4 Electrical Characteristics

 $V_{\rm I}$  = 13.5 V; 1.5 V  $\leq V_{\rm ADJ} \leq V_{\rm I}$  - 0.6 V; -40 °C  $< T_{\rm j}$  < 150 °C; unless otherwise specified

Parameter	Symbol	Limit Values			Unit	Test Condition		
		Min.	Тур.	Max.				
Regulator Performance, Tracker Output Q								
Output voltage tracking accuracy $\Delta V_{\rm Q} = V_{\rm ADJ} - V_{\rm Q}$	$\Delta V_{Q}$	-10	-	10	mV	4.5 V < V <sub>I</sub> < 26 V; 1 mA < I <sub>Q</sub> < 200 mA;		
Output voltage tracking accuracy	$\Delta V_{Q}$	-10	-	10	mV	3.5 V < V <sub>I</sub> < 32 V; 10 mA < I <sub>Q</sub> < 100 mA;		
$\Delta V_{\rm Q} = V_{\rm ADJ} - V_{\rm Q}$		-25	-	25	mV	$3.5 \text{ V} < V_1 < 4.5 \text{ V};$ 1 mA < $I_Q$ < 200 mA;		
Drop voltage	V <sub>dr</sub>	_	280	600	mV	$I_{Q} = 200 \text{ mA};$ $V_{ADJ} > 3.5 \text{ V};$ $V_{EN} = V_{EN, \text{ on}}^{1)}$		
Output current	IQ	250	350	500	mA	$V_{\rm Q} = 5.0 \ {\rm V}^{2)}$		
Output capacitor	CQ	10	-	-	μF	$0 \le ESR \le 5 \Omega$ at 10 kHz		
Current consumption $I_q = I_l - I_Q$	I <sub>q</sub>	-	10	25	mA	$I_{\rm Q}$ = 200 mA; $V_{\rm Q}$ = 5 V		
Current consumption $I_{q} = I_{I} - I_{Q}$	I <sub>q</sub>	-	100	150	μA	$I_{\rm Q}$ < 100 µA; $T_{\rm j}$ < 85 °C; $V_{\rm EN}$ = 5 V		
Quiescent current (stand-by) $I_q = I_1 - I_Q$	Iq	_	0	2	μA	$V_{\text{EN}} = 0 \text{ V};$ $V_{\text{EN/ADJ}} = 0 \text{ V};$ $T_{\text{j}} < 85 \text{ °C}$		
Reverse current	I <sub>r</sub>	-	0.5	5	mA	$V_{\rm Q} = 16 \text{ V}; V_{\rm I} = 0 \text{ V}$		
Load regulation	$\Delta V_{Q}$	-	-	10	mV	1 mA < I <sub>Q</sub> < 200 mA		
Line regulation	$\Delta V_{Q}$	-	-	10	mV	$5 V < V_1 < 32 V;$ $I_Q = 5 mA$		
Power supply ripple rejection	PSSR	-	60	-	dB	$f_{\rm I, \ ripple} = 100 \ {\rm Hz};$ $V_{\rm I, \ ripple} = 0.5 \ {\rm Vpp}^{3)}$		



# Table 4Electrical Characteristics (cont'd)

 $V_{\rm I}$  = 13.5 V; 1.5 V  $\leq V_{\rm ADJ} \leq V_{\rm I}$  - 0.6 V; -40 °C <  $T_{\rm j}$  < 150 °C; unless otherwise specified

Parameter	Symbol Limit Values			Unit	Test Condition	
		Min.	Тур.	Max.		
Adjust Input ADJ						
Input biasing current	I <sub>ADJ</sub>	_	0.1	0.5	μA	$V_{\rm ADJ} = 5 \ { m V}$
Enable Input EN						•
Device on voltage range	$V_{\rm EN, \ on}$	2.0	-	40	V	$V_{\rm Q}$ settled
Device off voltage range	$V_{\rm EN, \ off}$	0	-	0.8	V	V <sub>Q</sub> < 0.1 V
Input current	I <sub>EN</sub>	-1	2	5	μA	$V_{\rm EN}$ = 5 V
EN pull-down resistor	R <sub>EN</sub>	-	1.5	_	MΩ	_

1) Measured when the output voltage  $V_{\rm Q}$  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:

$$V_{\rm Q} = V_{\rm REF} \times \left(\frac{R_{\rm 2ADJ}}{R_{\rm 1ADJ} + R_{\rm 2ADJ}}\right) \tag{1}$$



# Diagrams

# Output Current Limit $I_{Q}$ versus Input Voltage $V_{I}$



## Current Consumption $I_q$ versus Output Current $I_Q$



Drop Voltage  $V_{\rm DR}$  versus Output Current  $I_{\rm O}$ 



# Drop Voltage $V_{\text{DR}}$ versus Junction Temperature $T_{\text{J}}$





# Package Outlines



### Figure 4 PG-TO252-5-11 (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).

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SMD = Surface Mounted Device

Dimensions in mm





Figure 5Foot Print for PG-TO-252-5-11 (Plastic Transistor Single Outline)



# **Revision History**

# **Revision History**

Version	Date	Changes
Rev. 1.4	2007-03-20	Initial version of RoHS-compliant derivate of TLE 4252 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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