

# TLE4247

Constant Current Relay Driver

Automotive Power



Never stop thinking

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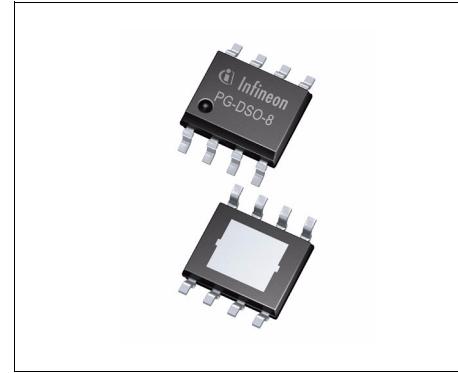
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## 1 Overview

### Features

- Reduces relay hold current to min. 40 mA
- Functional at low battery voltage.
- Active freewheeling path using relay integrated freewheeling resistor.
- Over temperature protection
- Green Product (RoHS compliant)
- AEC-Q100 qualified



PG-DSO-8 (exposed pad)

### Description

The TLE4247 is intended to drive relays with a constant current in order to reduce the coil current during relay hold phase. For relay activation, the IC pass element works as an activated switch for a limited period of time. After the activation time period has elapsed, the IC reduces the relay coil current to a lower constant value. Different operation modes allow adequate functionality also at very low or very high battery voltage.

The IC is suited to operate with relay coil inductance, freewheeling resistor, operating voltage and environment conditions as required in automotive applications. For details see operation range and electrical characteristics tables.

Type	Package	Marking
TLE4247 EL40	PG-DSO-8 (exposed pad)	4247-40

## 2 Block Diagram

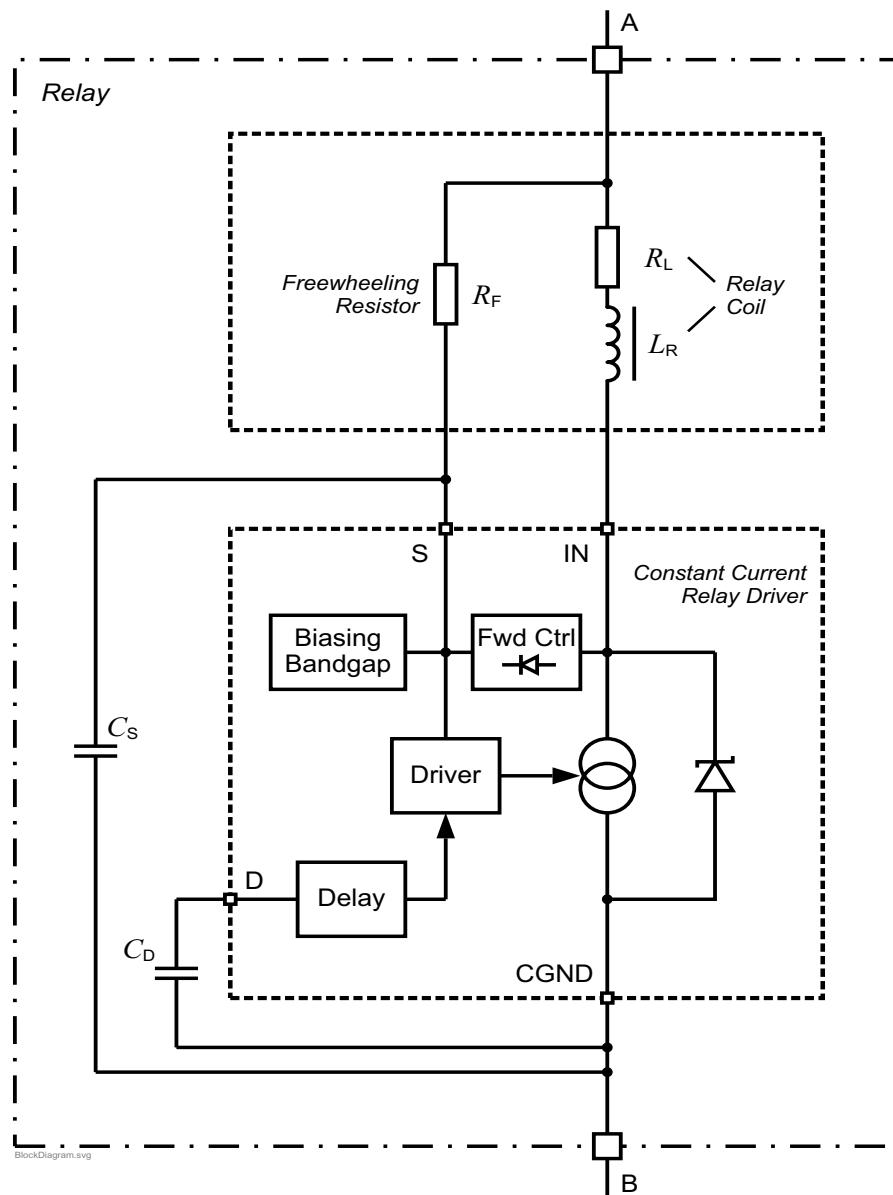


Figure 1 Block Diagram and Simplified Application Circuit

## 3 Pin Configuration

### 3.1 Pin Assignment

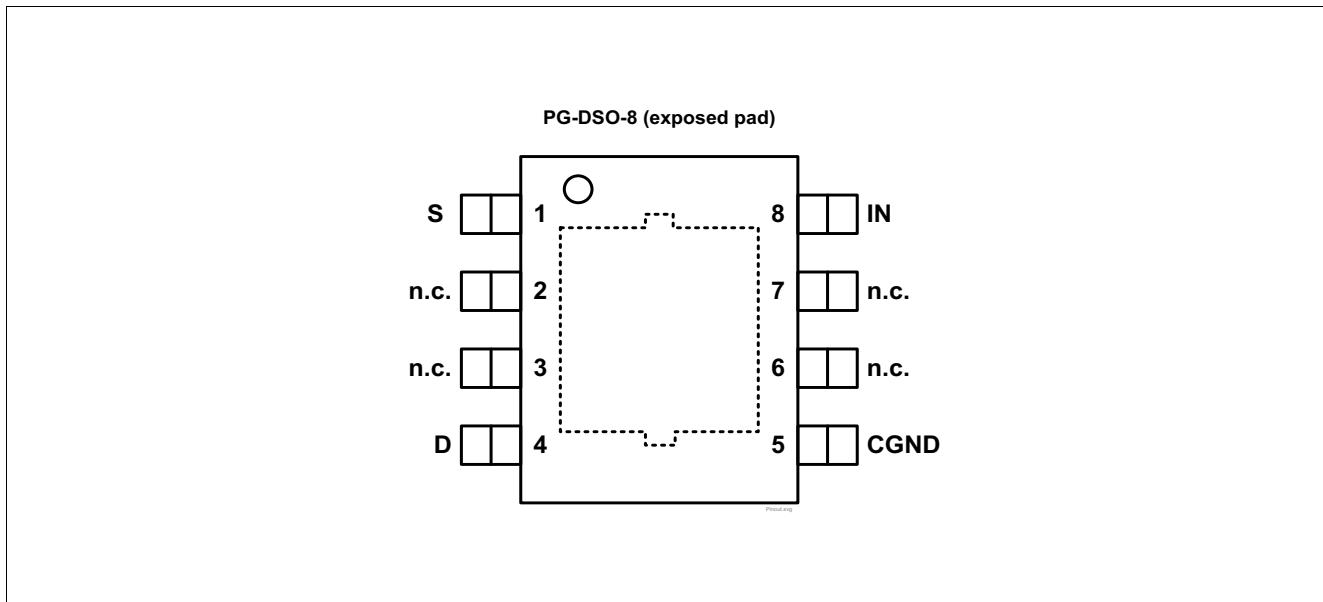


Figure 2 Pin Configuration

### 3.2 Pin Definitions and Functions

Pin	Symbol	Function
1	S	<b>IC Supply</b> ; connect to relay coil freewheeling resistor according to <a href="#">Figure 1</a> .
2, 3, 6, 7	n.c.	<b>Not Connected</b> ; connection to heat sink area and CGND recommended.
4	D	<b>Delay</b> ; for generating the activation time length, connect a ceramic capacitor between pin D and CGND.
5	CGND	<b>Relay Coil Current Output and IC Ground</b> ;
8	IN	<b>Relay Coil Current Input</b> ; connect to relay coil according to <a href="#">Figure 1</a> .
Exposed Pad	–	<b>Exposed Pad</b> ; interconnect with CGND and heat sink area on PCB.

## 4 General Product Characteristics

### 4.1 Absolute Maximum Ratings

#### Absolute Maximum Ratings <sup>1)</sup>

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

Pos.	Parameter	Symbol	Limit Values		Unit	Conditions
			Min.	Max.		
<b>Pin S (IC Supply)</b>						
4.1.1	Voltage at pin S	$V_S$	-0.3	45	V	$V_S > V_{IN}$ or $V_{IN}$ open; $I_S$ externally not limited
4.1.2	Current into pin S	$I_S$	-400	-	mA	$V_S < -0.3V$
<b>Pin IN (Relay Coil Current Input)</b>						
4.1.3	Voltage at pin IN	$V_{IN}$	-0.3	30	V	$V_S > V_{IN}$ or $V_S$ open; $I_{IN}$ externally not limited
4.1.4	Current into pin IN	$I_{IN}$	-250	400	mA	-
<b>Pin D (Delay)</b>						
4.1.5	Voltage at pin D	$V_D$	-0.3	6.8	V	
<b>Temperatures</b>						
4.1.6	Junction Temperature	$T_j$	-40	150	°C	-
4.1.7	Storage Temperature	$T_{stg}$	-55	150	°C	-
<b>ESD Susceptibility</b>						
4.1.8	ESD Resistivity to CGND	$V_{ESD,HBM}$	-4	4	kV	HBM <sup>2)</sup>
4.1.9	ESD Resistivity middle pins	$V_{ESD,CDM}$	-1.5	1.5	kV	CDM <sup>3)</sup>

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

2) ESD susceptibility, Human Body Model "HBM" according to EIA/JESD 22-A114B

3) ESD susceptibility, Charged Device Model "CDM" according to EIA/JESD22-C101 or ESDA STM5.3.1

*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.*

*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.*

## 4.2 Functional Range

Pos.	Parameter	Symbol	Limit Values		Unit	Conditions
			Min.	Max.		
4.2.10	Supply Voltage	$V_S$	3	30	V	–
4.2.11	Input Capacitance	$C_S$	70	–	nF	typ. 100nF/50V recommended for compensating line influences
4.2.12	Delay Capacitance	$C_D$	250	–	nF	typ. 470nF/6.3V recommended
4.2.13	Junction Temperature	$T_j$	-40	150	°C	–
4.2.14	Relay Coil Inductance	$L_R$	–	1000	mH	–
4.2.15	Relay Coil Series Resistance	$R_L$	60	120	Ω	–
4.2.16	Relay Freewheeling Resistor	$R_F$	420	750	Ω	–

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.

## 4.3 Thermal Resistance<sup>1)</sup>

Pos.	Parameter	Symbol	Limit Values			Unit	Conditions
			Min.	Typ.	Max.		
<b>PG-DSO-8 (exposed pad):</b>							
4.3.1	Junction to Case Bottom	$R_{thJC}$	–	10	–	K/W	–
4.3.2	Junction to Ambient	$R_{thJA}$	–	70	–	K/W	<sup>1)</sup>

1) EIA/JESD 52\_2, FR4, 80 × 80 × 1.5 mm; 35µ Cu, 5µ Sn; 300 mm<sup>2</sup>

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

## 5 Operation Modes

### 5.1 Description

The TLE4247 provides two different operation modes: For relay activation, the IC pass element works as an activated switch with lowest dropout voltage  $V_{DR}$  (see Figure 3 a). After the activation time period  $t_{Actv}$  has elapsed, the IC switches to hold mode regulating the relay coil current to constant values (see Figure 3 b).

During commutation, the relay coil current flows from the IC input "IN" to "S" into the relay freewheeling resistor. A zener structure prevents the IC from overvoltage by limiting the input voltage transient to  $V_z$ .

The relay activation time period  $t_{Actv}$  is generated by charging the external capacitor  $C_D$  at pin D with a constant current. This time period starts once the IC supply voltage exceeds  $V_{S,Start}$ . In case the IC supply voltage  $V_S$  falls below the threshold  $V_{S,Hold-Actv}$ , the IC changes to active mode allowing maximum relay current flow at low vehicle battery voltage.

At low supply voltage, the IC switches to "Low Voltage Mode" with lowest current consumption. As in activation mode, the IC is working as a switch with lowest dropout voltage.

In order to prevent the IC from excessive power dissipation at high supply voltage, the IC is working as a switch (High Voltage Mode). A transition to Hold Mode during this mode is not possible.

An overtemperature protection circuit prevents the IC from immediate destruction under fault conditions by reducing the output current. A thermal balance below 200 °C junction temperature will be established. Please note that a junction temperature above 150 °C is outside the maximum ratings and reduces the IC lifetime.

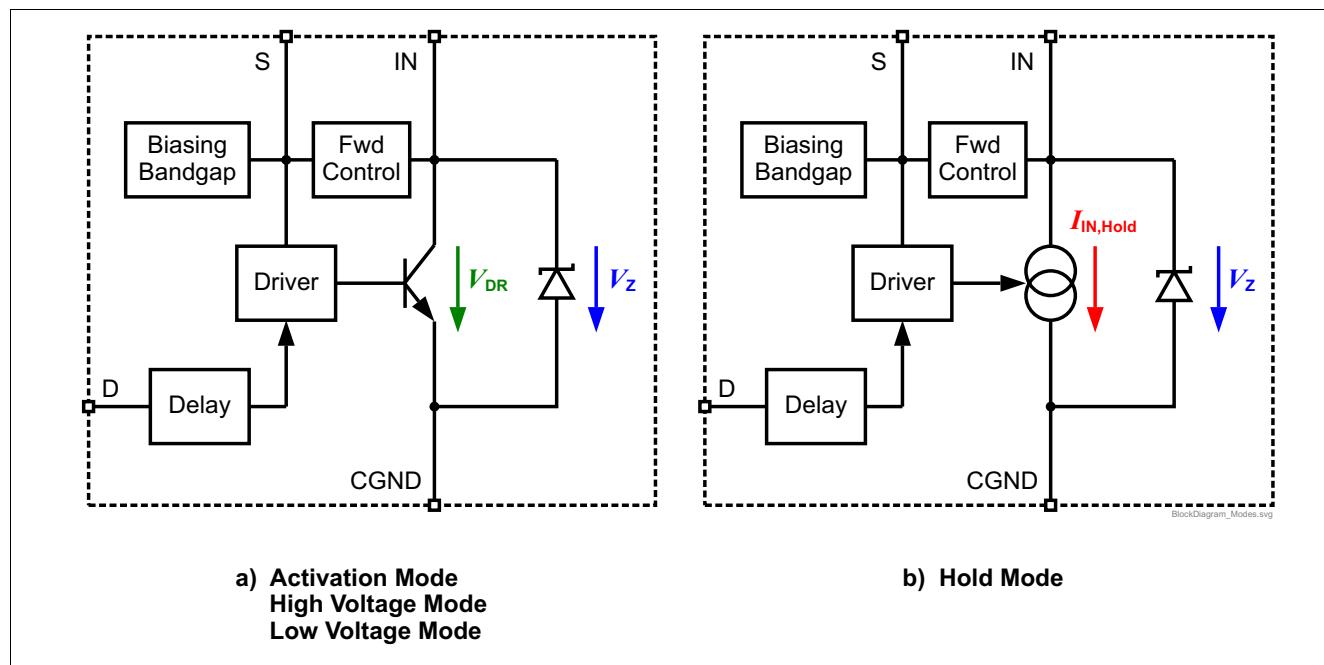


Figure 3 Operation as switch or current source

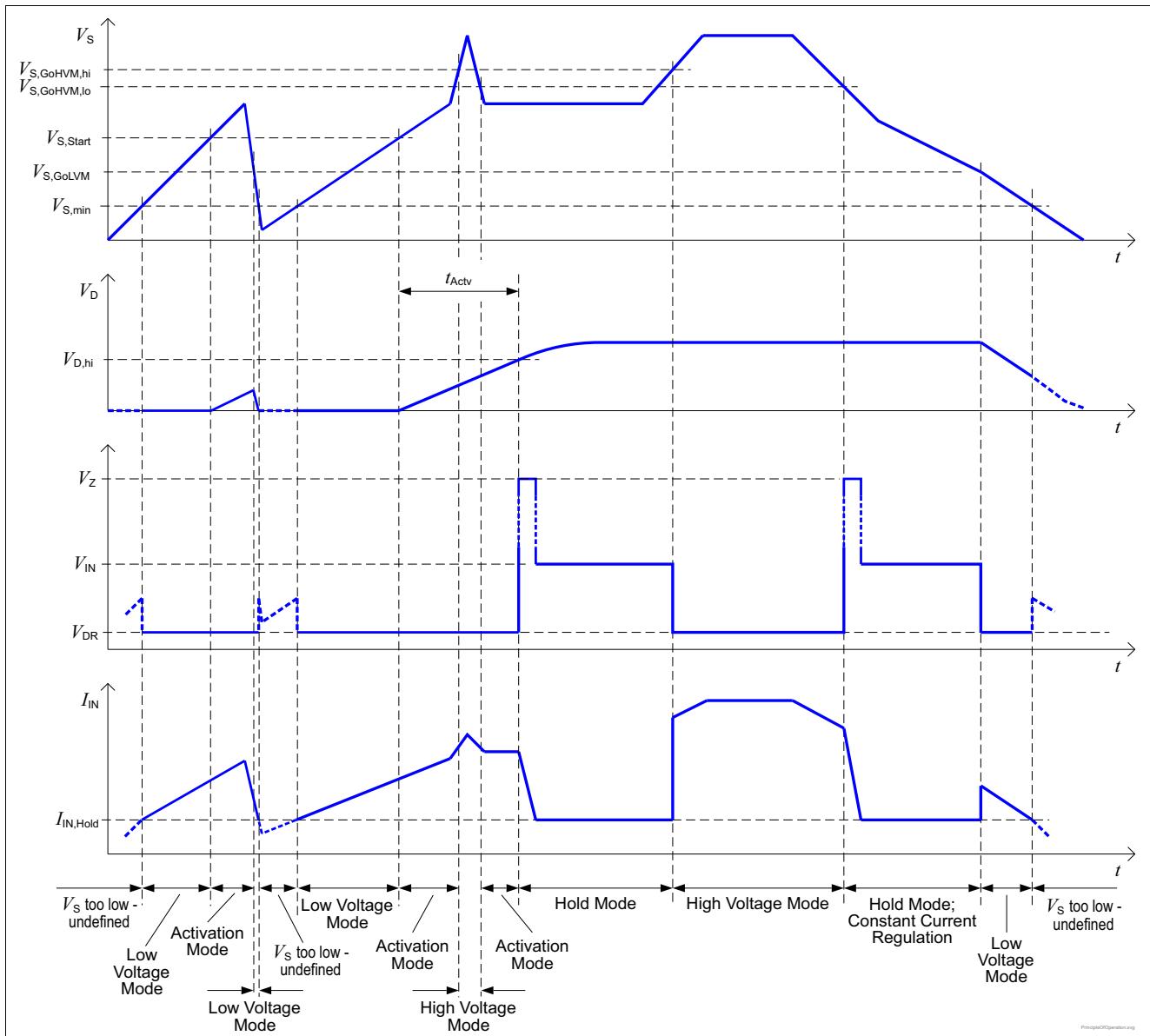


Figure 4 Principle of Operation

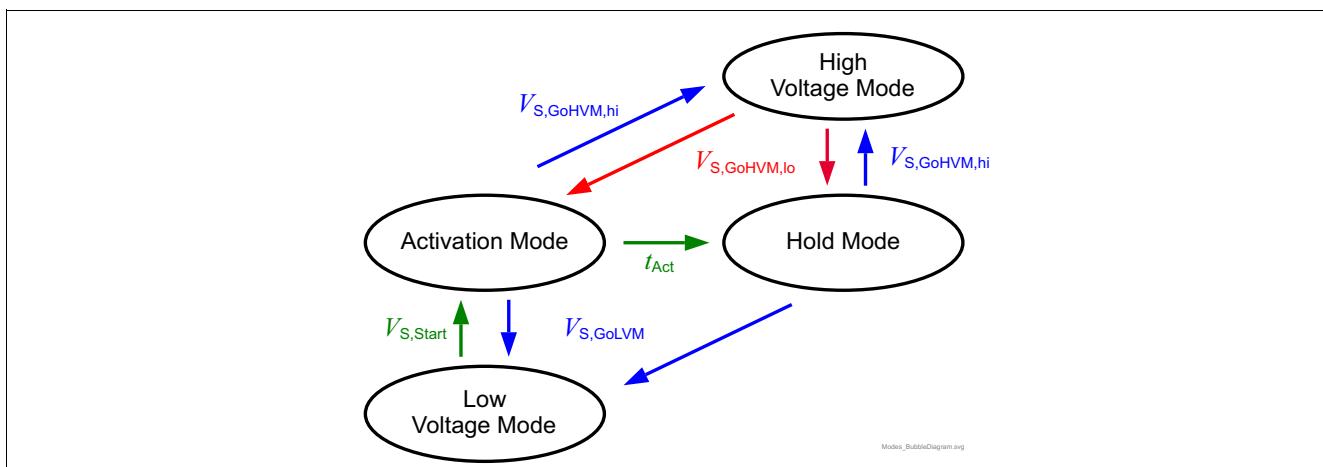


Figure 5 Conditions of transition between modes, definition of parameters

## 5.2 Electrical Characteristics Tables

$T_j = -40 \text{ }^\circ\text{C to } +150 \text{ }^\circ\text{C}$ ,

all voltages with respect to ground, positive current flowing into pin (unless otherwise specified)

Pos.	Parameter	Symbol	Limit Values			Unit	Conditions
			Min.	Typ.	Max.		

### General

5.2.1	Freewheeling path drop voltage	$V_{IN-S}$		1	2	V	$I_{IN-S} = 400 \text{ mA}$
5.2.2	Input Zener Voltage	$V_Z$	30		45	V	$I_Z = 50 \text{ mA}$
5.2.3	Overtemperature Shutdown Threshold <sup>1)</sup>	$T_{j,SD}$	151	—	200	°C	$T_j$ increasing due to power dissipation generated by the IC.

### Activation Mode, $V_S \geq V_{S,Start}$ , unless otherwise specified

5.2.4	Activation Mode Timing Start Supply Voltage Threshold	$V_{S,Start}$	7	8	9	V	$V_S$ increasing
5.2.5	Activation Time Period	$t_{Actv}$	65	100	135	ms	$C_D = 470 \text{ nF}$
5.2.6	Dropout Voltage Activation Mode	$V_{DR,Actv}$	—	0.9	1.3	V	$I_{IN} = 200 \text{ mA}$ $V_S = 9\text{V}$
5.2.7	Current consumption Activation Mode	$I_{S,Actv}$	—	0.85	1.5	mA	$I_{IN} = 200 \text{ mA}$ $V_S = 9\text{V}$

### Hold Mode, $V_{S,GoHVM} \geq V_S \geq V_{S,GoLVM}$ , unless otherwise specified

5.2.8	Relay coil hold current	$I_{IN,Hold}$	40	50	60	mA	—
5.2.9	Current consumption Hold Mode	$I_{S,Hold}$	—	0.85	1.5	mA	$V_S = 9\text{V}$
			—	1	1.8	mA	$V_S = 18\text{V}$

### Low Voltage Mode, $V_{S,Start} \geq V_S \geq 3 \text{ V}$ , unless otherwise specified

5.2.10	Go to Low Voltage Mode Threshold	$V_{S,GoLVM}$	6	7	8	V	$V_S$ decreasing
5.2.11	Go to Low Voltage Mode Hysteresis	$V_{S,GoLVM,hy}$	0.7	1	—	V	Calculated value: $V_{S,GoLVM,hy} = V_{S,Start} - V_{S,GoLVM}$
5.2.12	Dropout voltage Low Voltage Mode	$V_{DR,LVM}$	—	0.85	1.3	V	$I_{IN} = 40 \text{ mA}$
5.2.13	Dropout voltage Low Voltage Mode	$V_{DR,LVM}$	—	0.85	1.0	V	$I_{IN} = 40 \text{ mA}$ ; $T_j = 25^\circ\text{C}$
5.2.14	Current consumption Low Voltage Mode	$I_{S,LVM}$	—	0.65	1.1	mA	$V_S = 3\text{V}$ ; $I_{IN} = I_{IN,Hold}$
			—	0.85	1.4	mA	$V_S = 7\text{V}$ ; $I_{IN} = I_{IN,Hold}$

## Operation Modes

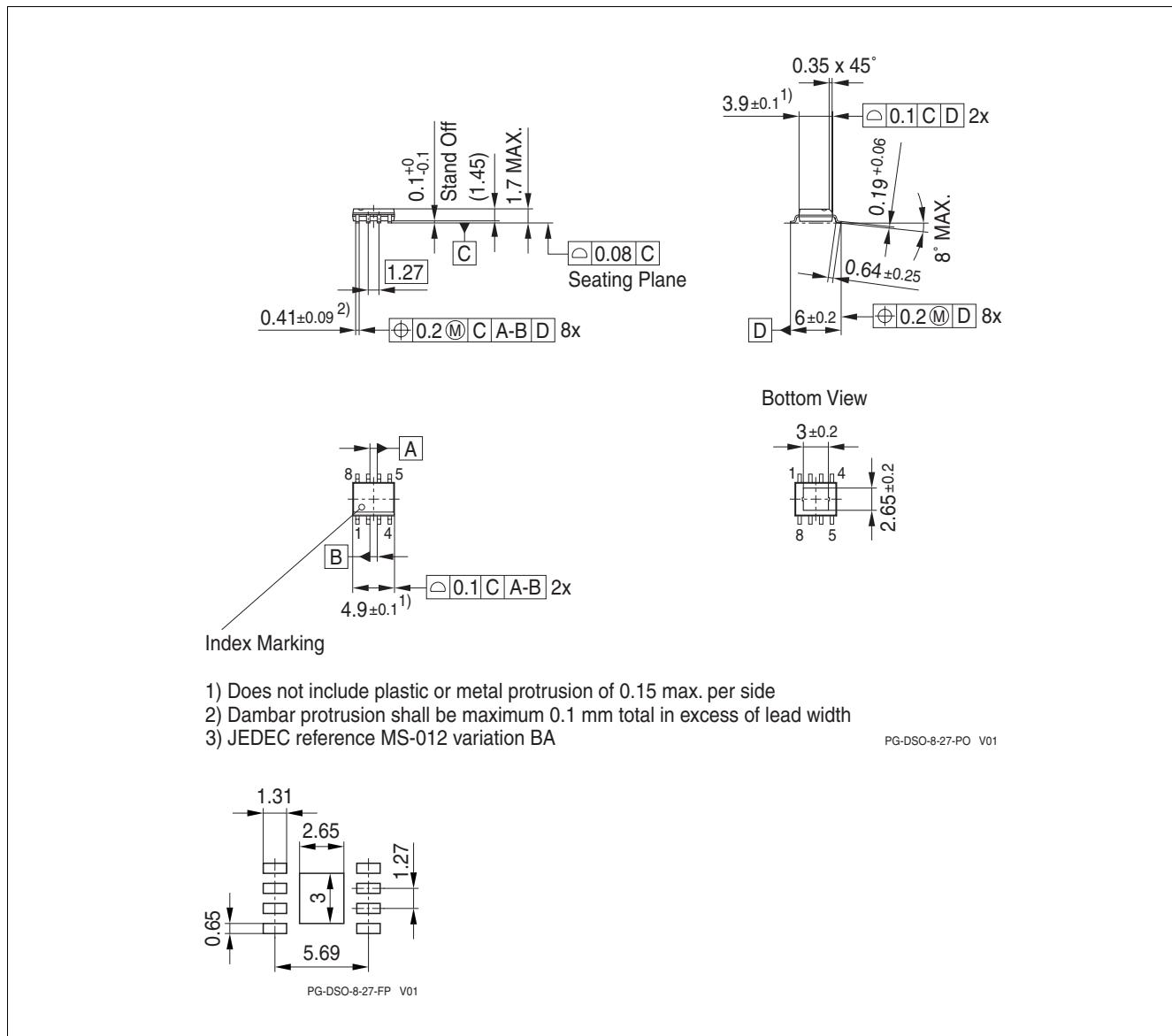
 $T_j = -40 \text{ } ^\circ\text{C to } +150 \text{ } ^\circ\text{C}$ ,

all voltages with respect to ground, positive current flowing into pin (unless otherwise specified)

Pos.	Parameter	Symbol	Limit Values			Unit	Conditions
			Min.	Typ.	Max.		
<b>High Voltage Mode, <math>V_S \geq V_{S,\text{GoHVM}}</math>, unless otherwise specified</b>							
5.2.15	Go to High Voltage Mode Upper Threshold	$V_{S,\text{GoHVM,hi}}$	19	—	21	V	$V_S$ increasing
5.2.16	Go to High Voltage Mode Lower Threshold	$V_{S,\text{GoHVM,lo}}$	18	—	20	V	$V_S$ decreasing
5.2.17	Go to High Voltage Mode Hysteresis	$V_{S,\text{GoHVM,hy}}$	0.7	1	—	V	Calculated value: $V_{S,\text{GoHVM,hy}} = V_{S,\text{GoHVM,hi}} - V_{S,\text{GoHVM,lo}}$
5.2.18	Dropout Voltage High Voltage Mode	$V_{\text{DR,HVM}}$	—	1.1	1.6	V	$I_{\text{IN}} = 400 \text{ mA}; V_S = 28\text{V}$
5.2.19	Current Consumption High Voltage Mode	$I_{S,\text{HVM}}$	—	1	1.8	mA	$I_{\text{IN}} = 400 \text{ mA}; V_S = 28\text{V}$

1) Specified by design, not subject to production test.

## 6 Package Outlines



**Figure 6 PG-DSO-8 (exposed pad) Outline and recommended footprint for reflow soldering**

### Green Product

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

## 7 Revision History

Revision	Date	Changes
1.01	2010-05-04	Final Datasheet.

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