Constant Current Relay Driver

IFX52001

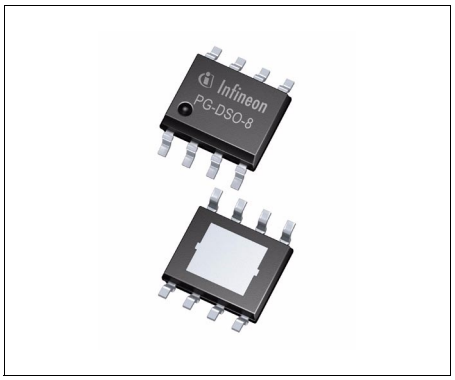
CCRD

Data Sheet

Rev.1.01, 2015-10-23

Standard Power

1 Overview



PG-DSO-8 (exposed pad)

Features

- Reduces relay hold current to min. 40 mA
- Functional at low supply voltage
- Active freewheeling path using relay integrated freewheeling resistor
- Overtemperature protection
- Green Product (RoHS compliant)

Description

The IFX52001 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 supply voltage.

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

The qualification of this product is based on JEDEC JESD47 and may reference existing qualification results of similar products. Such referencing is justified by the structural similarity of the products. The product is not qualified and manufactured according to the requirements of Infineon Technologies with regard to automotive and/or transportation applications. Infineon Technologies administrated a comprehensive quality management system according to the latest version of the ISO9001 and ISO/TS 16949.

The most updated certificates of the aforesaid ISO9001 and ISO/TS 16949 are available on the Infineon Technologies web page http://www.infineon.com/cms/en/product/technology/quality/

Type	Package	Marking
IFX52001	PG-DSO-8 (exposed pad)	IFX52001

2 Block Diagram

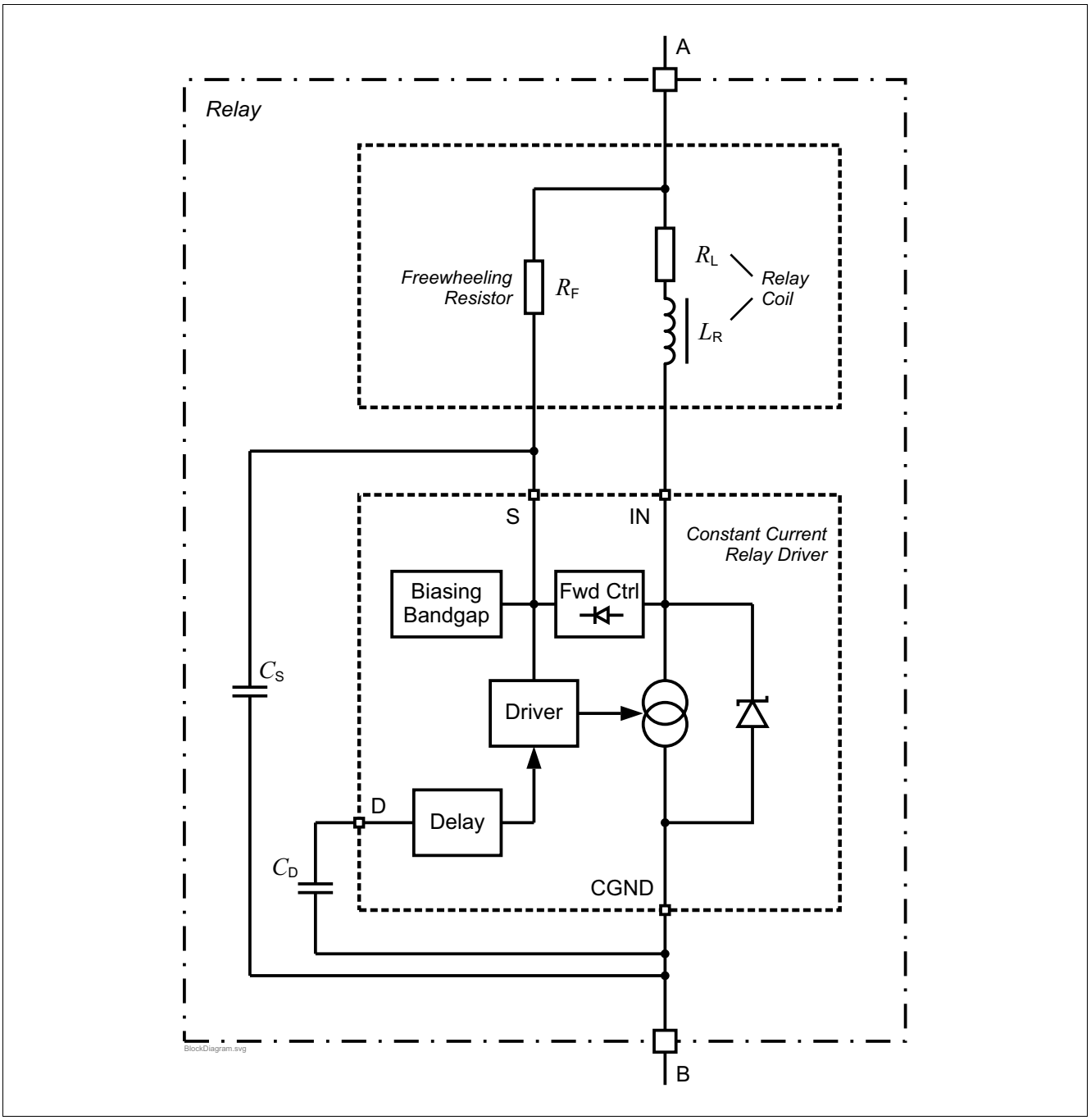


Figure 1 Block Diagram and Simplified Application Circuit

3 Pin Configuration

3.1 Pin Assignment

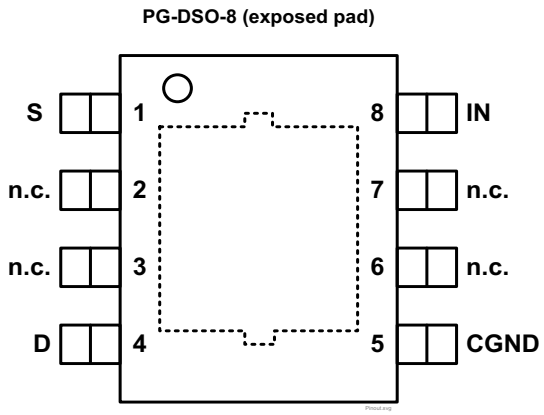


Figure 2 Pin Configuration

3.2 Pin Definitions and Functions

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

4 General Product Characteristics

4.1 Absolute Maximum Ratings

Table 1 Absolute Maximum Ratings [1)]

T_j = -40 °C to +125 °C; all voltages with respect to CGND, positive current flowing into pin (unless otherwise specified)

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Pin S (IC Supply)							
Voltage at pin S	V_S	-0.3	–	45	V	$V_S > V_{IN}$ or V_{IN} open; I_S externally not limited	P_4.1.1
Current into pin S	I_S	-400	–	–	mA	V_S < -0.3V	P_4.1.2
Pin IN (Relay Coil Current Input)							
Voltage at pin IN	V_{IN}	-0.3	–	30	V	$V_S > V_{IN}$ or V_S open; I_{IN} externally not limited	P_4.1.3
Current into pin IN	I_{IN}	-250	–	400	mA	–	P_4.1.4
Pin D (Delay)							
Voltage at pin D	V_D	-0.3	–	6.8	V	–	P_4.1.5
Temperatures							
Junction Temperature	T_j	-40	–	150	°C	–	P_4.1.6
Storage Temperature	T_{stg}	-55	–	150	°C	–	P_4.1.7
ESD Susceptibility							
ESD Resistivity to CGND	$V_{ESD,HBM}$	-2	–	2	kV	HBM[2)]	P_4.1.8
ESD Resistivity middle pins	$V_{ESD,CDM}$	-1	–	1	kV	CDM[3)]	P_4.1.9

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

Table 2 Functional Range

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
Supply Voltage	V_S	3	–	30	V	–	P_4.2.1
Input Capacitance	C_S	70	–	–	nF	typ. 100 nF/50 V recommended for compensating line influences	P_4.2.2
Delay Capacitance	C_D	250	–	–	nF	typ. 470 nF/6.3 V recommended	P_4.2.3
Junction Temperature	T_j	-40	–	125	°C	–	P_4.2.4
Relay Coil Inductance	L_R	–	–	1000	mH	–	P_4.2.5
Relay Coil Series Resistance	R_L	60	–	120	Ω	–	P_4.2.6
Relay Freewheeling Resistor	R_F	420	–	750	Ω	–	P_4.2.7

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[1)]

Table 3 Thermal Resistance

Parameter	Symbol	Values			Unit	Note or Test Condition	Number
		Min.	Typ.	Max.			
PG-DSO-8 (exposed pad):							
Junction to Case Bottom	R_{thJC}	–	10	–	K/W	–	P_4.3.1
Junction to Ambient	R_{thJA}	–	70	–	K/W	1)	P_4.3.2

1) EIA/JESD 52_2, FR4, 80 × 80 × 1.5 mm; 35 µm Cu, 5 µm Sn; 300 mm^2

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

5 Operation Modes

5.1 Description

The IFX52001 provides two different operation modes:

- Activation mode:
  For relay activation, the IC pass element works as an activated switch with lowest dropout voltage V_{DR} (see Figure 3 a).
- Hold mode:
  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).

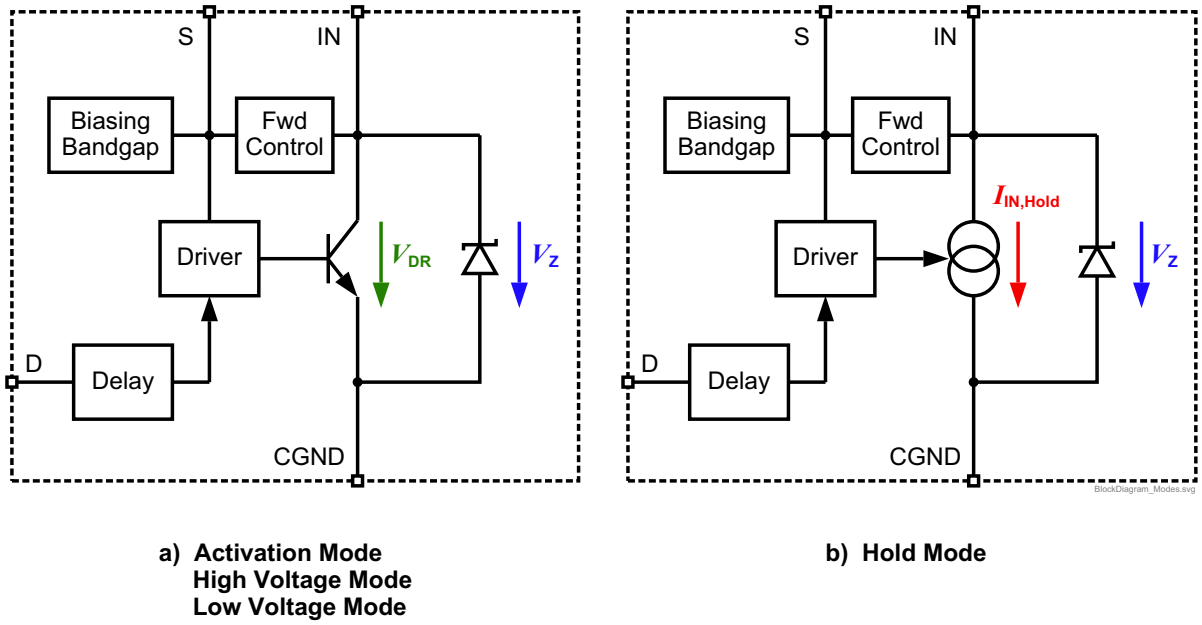
During commutation, the relay coil current flows from the IC input “IN” to “S” into the relay freewheeling resistor. A Zener structure protects the IC from overvoltage by limiting the input voltage transient to V_Z.

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 drops below the threshold $V_{S,Hold-Actv}$, the IC changes to active mode allowing maximum relay current at low supply 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 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 protects the IC from immediate destruction in fault condition by reducing 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 IC lifetime.



a) Activation Mode
High Voltage Mode
Low Voltage Mode

b) Hold Mode

Figure 3 Operation as Switch or as Current Source

Operation Modes

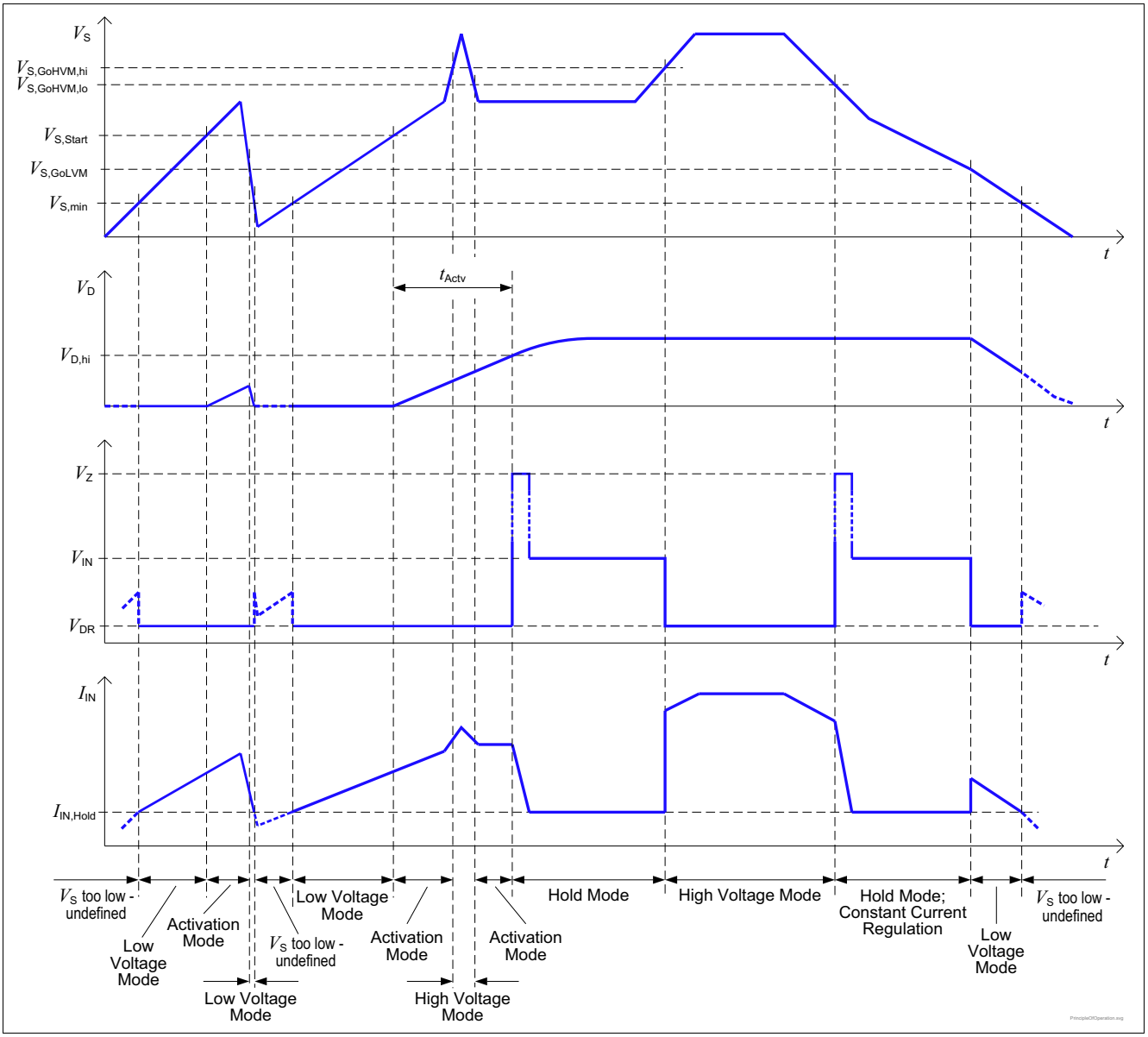


Figure 4 Principle of Operation

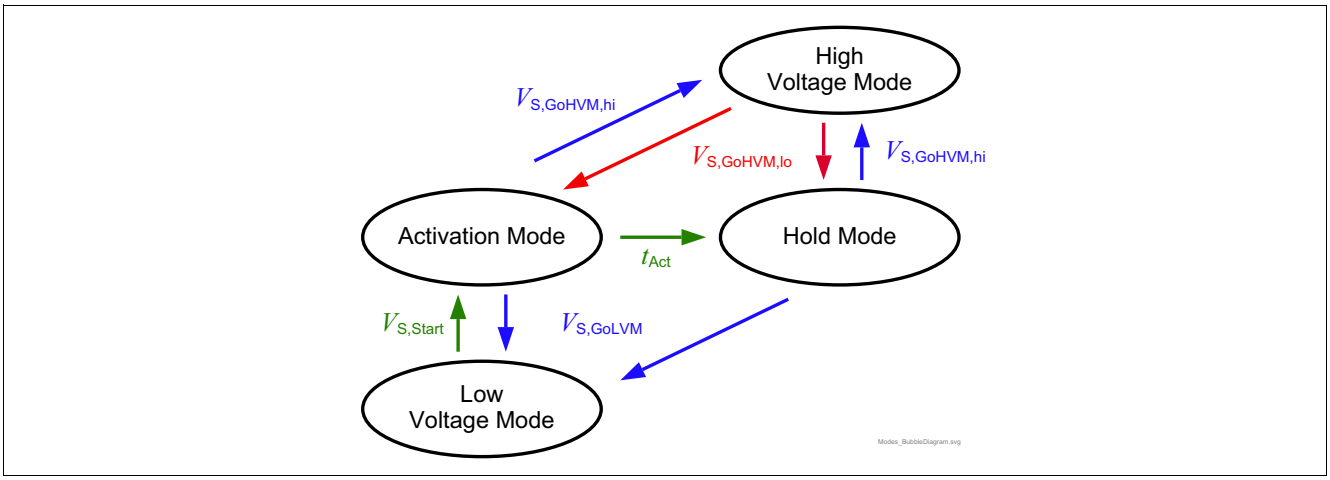


Figure 5 Conditions of Transitions between Modes, Definition of Parameters

5.2 Electrical Characteristics

Table 4 Electrical Characteristics, T_j = -40 °C to +125 °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.			
General							
Freewheeling path drop voltage	V_{IN-S}	–	1	2	V	I_{IN-S} = 400 mA	P_5.2.1
Input Zener Voltage	V_Z	30	–	45	V	I_Z = 50 mA	P_5.2.2
Overtemperature Shutdown Threshold [1]	$T_{j,sd}$	151	–	200	°C	T_j increasing due to power dissipation generated by the IC	P_5.2.3
Activation Mode, $V_S \geq V_{S,Start}$, unless otherwise specified							
Activation Mode Timing Start Supply Voltage Threshold	$V_{S,Start}$	7	8	9	V	V_S increasing	P_5.2.4
Activation Time Period	t_{Actv}	65	100	135	ms	C_D = 470 nF	P_5.2.5
Dropout Voltage Activation Mode	$V_{DR,Actv}$	–	0.9	1.3	V	I_{IN} = 200 mA V_S = 9 V	P_5.2.6
Current consumption Activation Mode	$I_{S,Actv}$	–	0.85	1.5	mA	I_{IN} = 200 mA V_S = 9 V	P_5.2.7
Hold Mode, $V_{S,GoHVM} \geq V_S \geq V_{S,GoLVM}$, unless otherwise specified							
Relay coil hold current	$I_{IN,Hold}$	40	50	60	mA	–	P_5.2.8
Current consumption Hold Mode	$I_{S,Hold}$	–	0.85	1.5	mA	V_S = 9 V	P_5.2.9
		–	1	1.8	mA	V_S = 18 V	
Low Voltage Mode, $V_{S,Start} \geq V_S$ 3 V, unless otherwise specified							
Go to Low Voltage Mode Threshold	$V_{S,GoLVM}$	6	7	8	V	V_S decreasing	P_5.2.10
Go to Low Voltage Mode Hysteresis	$V_{S,GoLVM,hy}$	0.7	1	–	V	Calculated value: $V_{S,GoLVM,hy}$ = $V_{S,Start}$ - $V_{S,GoLVM}$	P_5.2.11
Dropout voltage Low Voltage Mode	$V_{DR,LVM}$	–	0.85	1.3	V	I_{IN} = 40 mA	P_5.2.12
Dropout voltage Low Voltage Mode	$V_{DR,LVM}$	–	0.85	1.0	V	I_{IN} = 40 mA; T_j = 25 °C	P_5.2.13
Current consumption Low Voltage Mode	$I_{S,LVM}$	–	0.65	1.1	mA	V_S = 3 V; I_{IN} = $I_{IN,Hold}$	P_5.2.14
		–	0.85	1.4	mA	V_S = 7 V; I_{IN} = $I_{IN,Hold}$	

Table 4 Electrical Characteristics, T_j = -40 °C to +125 °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.			
High Voltage Mode, $V_S \geq V_{S,GoHVM,}$, unless otherwise specified							
Go to High Voltage Mode Upper Threshold	$V_{S,GoHVM,hi}$	19	–	21	V	V_S increasing	P_5.2.15
Go to High Voltage Mode Lower Threshold	$V_{S,GoHVM,lo}$	18	–	20	V	V_S decreasing	P_5.2.16
Go to High Voltage Mode Hysteresis	$V_{S,GoHVM,hy}$	0.7	1	–	V	Calculated value: $V_{S,GoHVM,hy}$ = $V_{S,GoHVM,hi}$ - $V_{S,GoHVM,lo}$	P_5.2.17
Dropout Voltage High Voltage Mode	$V_{DR,HVM}$	–	1.1	1.6	V	I_{IN} = 400 mA; V_S = 28 V	P_5.2.18
Current Consumption High Voltage Mode	$I_{S,HVM}$	–	1	1.8	mA	I_{IN} = 400 mA; V_S = 28 V	P_5.2.19

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

6 Package Outlines

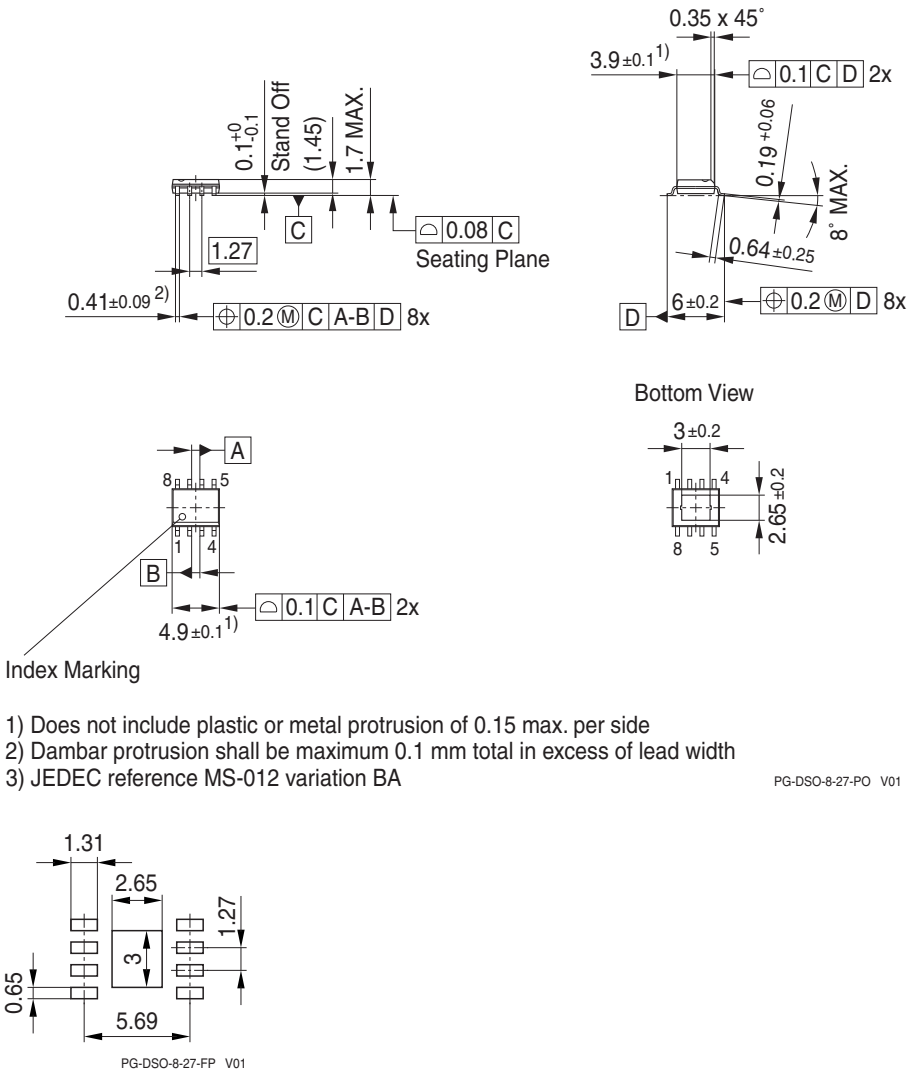


Figure 6 PG-DSO-8 (exposed pad) Outline and Recommended Footprint for Reflow Soldering

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 alternative packages, please visit our website:
http://www.infineon.com/packages.

Dimensions in mm

7 Revision History

Revision	Date	Changes
1.01	2015-10-23	Data sheet updated to new style guide. Editorial changes.
1.0	2011-03-31	Initial Data Sheet

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