

# Constant Current Relay Driver

IFX52001

CCRD

Data Sheet

Rev.1.01, 2015-10-23

Standard Power

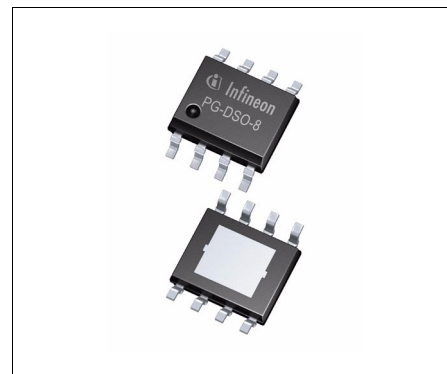
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## 1 Overview

### 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)



**PG-DSO-8 (exposed pad)**

### 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 |

## Block Diagram

## 2 Block Diagram

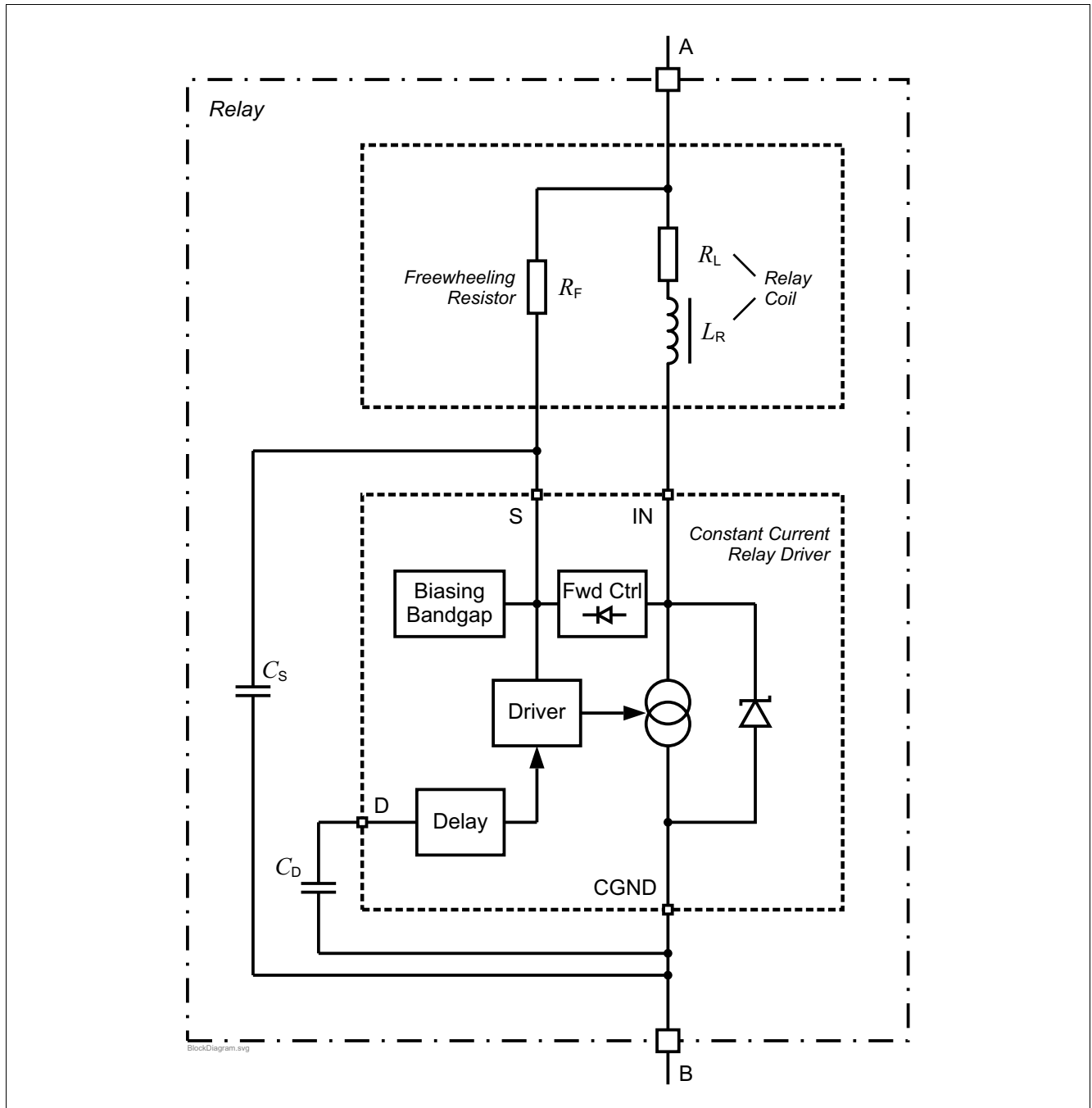


Figure 1 Block Diagram and Simplified Application Circuit

## Pin Configuration

### 3 Pin Configuration

#### 3.1 Pin Assignment

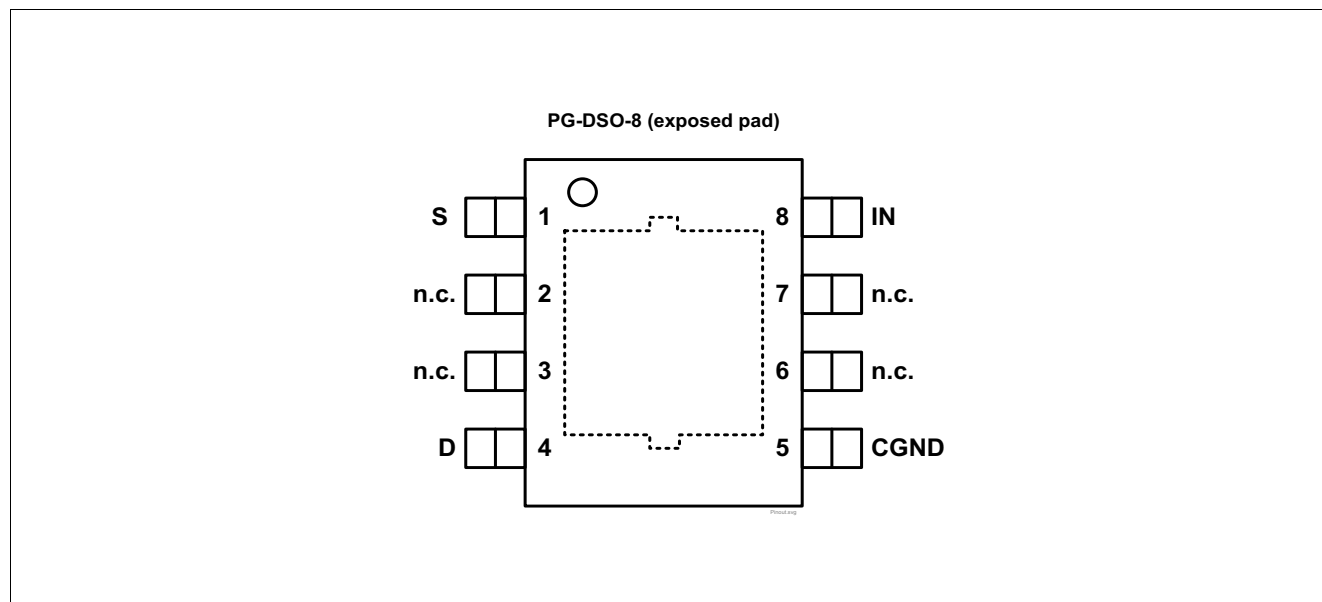


Figure 2 Pin Configuration

#### 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><br>connect to relay coil according to <a href="#">Figure 1</a> .            |
| Exposed Pad | –      | <b>Exposed Pad;</b><br>interconnect with CGND and heat sink area on PCB.                                     |

## General Product Characteristics

## 4 General Product Characteristics

### 4.1 Absolute Maximum Ratings

**Table 1 Absolute Maximum Ratings** <sup>1)</sup>

$T_j = -40\text{ °C to }+125\text{ °C}$ ; 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;<br>$I_S$ 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;<br>$I_{IN}$ 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 <sup>2)</sup>                                                | P_4.1.8 |
| ESD Resistivity middle pins       | $V_{ESD,CDM}$ | -1     | –    | 1    | kV   | CDM <sup>3)</sup>                                                | 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.

## General Product Characteristics

### 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  | $\Omega$ | –                                                             | P_4.2.6 |
| Relay Freewheeling Resistor  | $R_F$  | 420    | –    | 750  | $\Omega$ | –                                                             | 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<sup>1)</sup>

**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  | <sup>1)</sup>          | P_4.3.2 |

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

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.

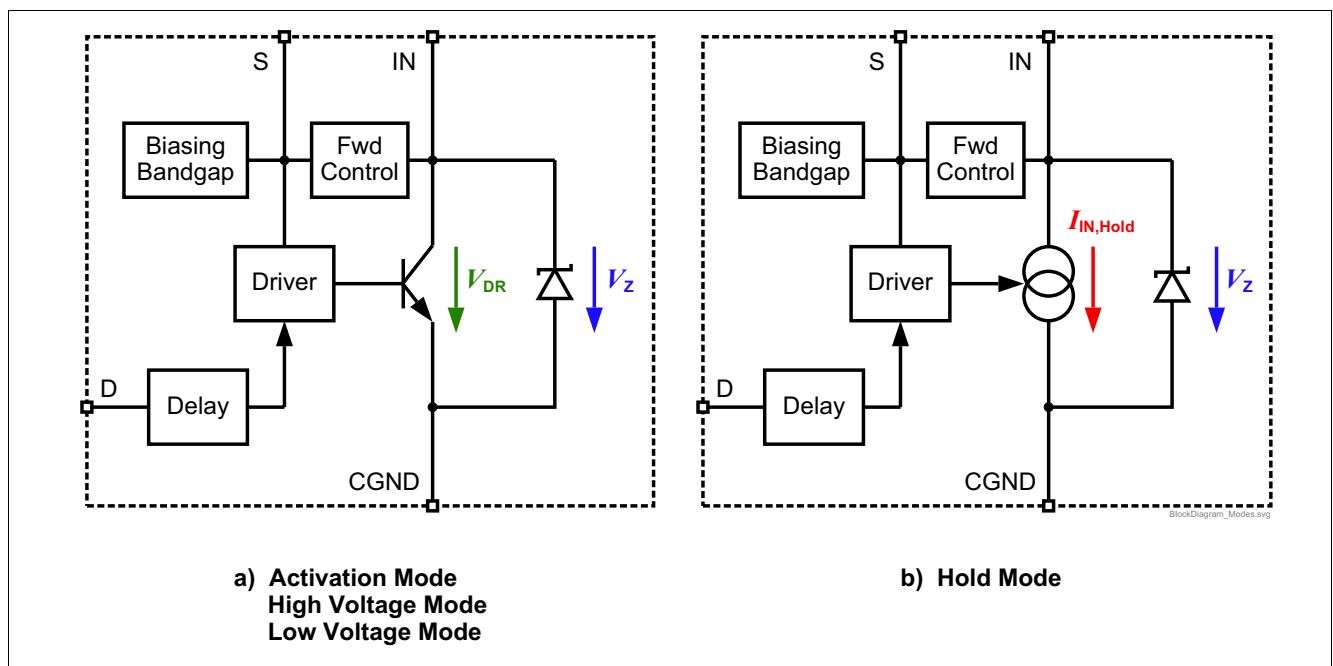


Figure 3 Operation as Switch or as Current Source

## Operation Modes

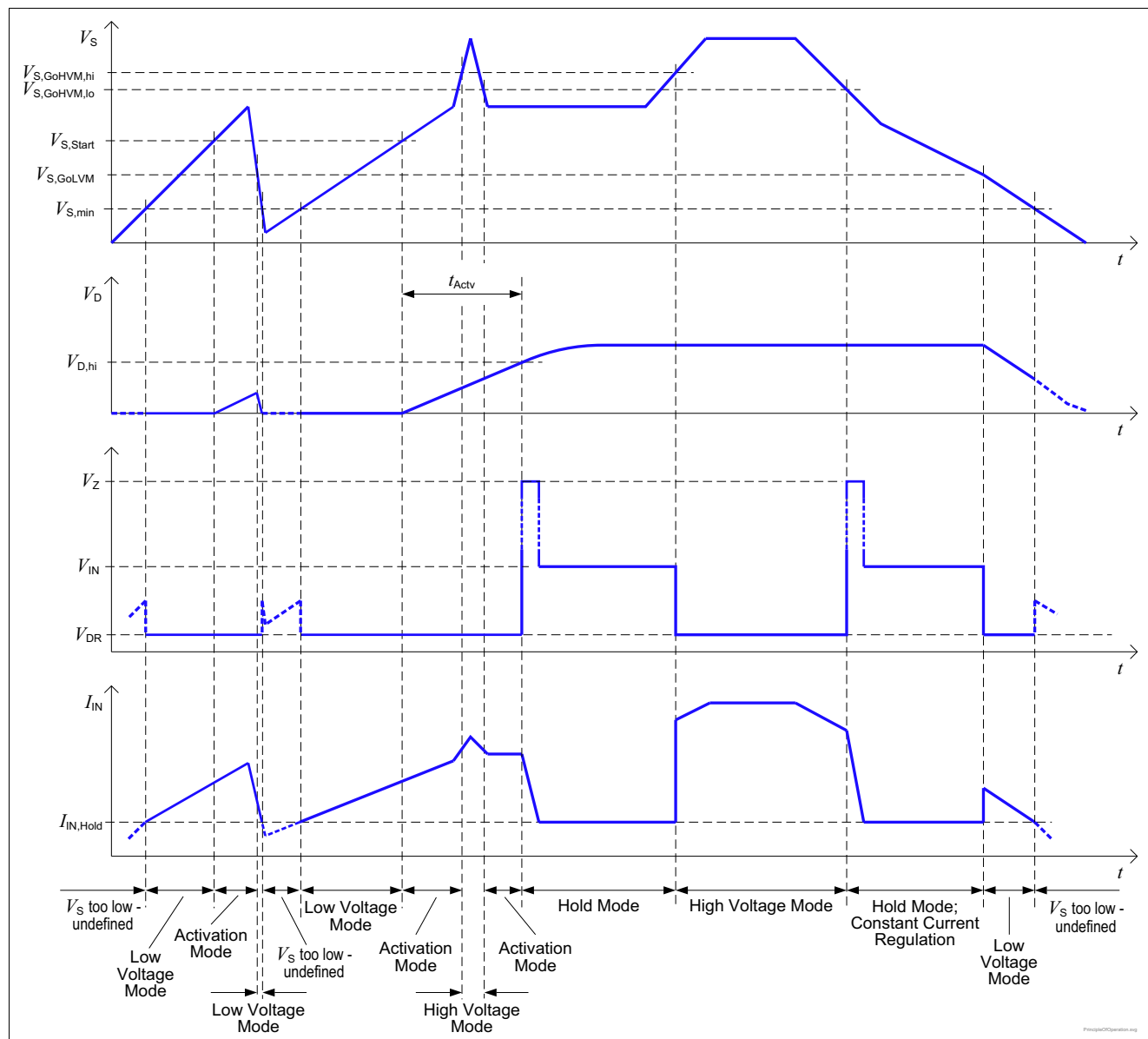


**Figure 4** Principle of Operation

## Operation Modes

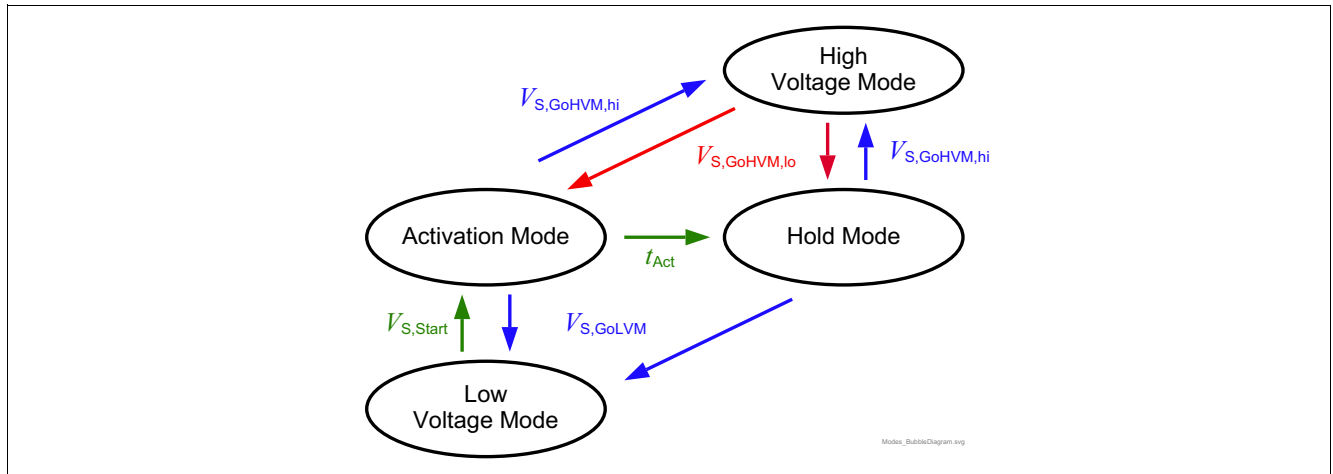


Figure 5 Conditions of Transitions between Modes, Definition of Parameters

## Operation Modes

### 5.2 Electrical Characteristics

**Table 4** Electrical Characteristics,  $T_j = -40\text{ °C}$  to  $+125\text{ °C}$ ,  
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    | $I_{IN-S} = 400\text{ mA}$                                            | P_5.2.1  |
| Input Zener Voltage                                                                    | $V_Z$              | 30     | –    | 45   | V    | $I_Z = 50\text{ mA}$                                                  | P_5.2.2  |
| Overtemperature Shutdown Threshold <sup>1)</sup>                                       | $T_{j, sd}$        | 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   | $C_D = 470\text{ nF}$                                                 | P_5.2.5  |
| Dropout Voltage Activation Mode                                                        | $V_{DR, Actv}$     | –      | 0.9  | 1.3  | V    | $I_{IN} = 200\text{ mA}$<br>$V_S = 9\text{ V}$                        | P_5.2.6  |
| Current consumption Activation Mode                                                    | $I_{S, Actv}$      | –      | 0.85 | 1.5  | mA   | $I_{IN} = 200\text{ mA}$<br>$V_S = 9\text{ V}$                        | 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   | $V_S = 9\text{ V}$                                                    | P_5.2.9  |
|                                                                                        |                    | –      | 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 |                    |        |      |      |      |                                                                       |          |
| 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:<br>$V_{S, GoLVM, hy} = V_{S, Start} - V_{S, GoLVM}$ | P_5.2.11 |
| Dropout voltage Low Voltage Mode                                                       | $V_{DR, LVM}$      | –      | 0.85 | 1.3  | V    | $I_{IN} = 40\text{ mA}$                                               | P_5.2.12 |
| Dropout voltage Low Voltage Mode                                                       | $V_{DR, LVM}$      | –      | 0.85 | 1.0  | V    | $I_{IN} = 40\text{ mA}; T_j = 25\text{ °C}$                           | P_5.2.13 |
| Current consumption Low Voltage Mode                                                   | $I_{S, LVM}$       | –      | 0.65 | 1.1  | mA   | $V_S = 3\text{ V}; I_{IN} = I_{IN, Hold}$                             | P_5.2.14 |
|                                                                                        |                    | –      | 0.85 | 1.4  | mA   | $V_S = 7\text{ V}; I_{IN} = I_{IN, Hold}$                             |          |

## Operation Modes

**Table 4** Electrical Characteristics,  $T_j = -40\text{ °C}$  to  $+125\text{ °C}$ ,  
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:<br>$V_{S,GoHVM,hy} = V_{S,GoHVM,hi} - V_{S,GoHVM,lo}$ | P_5.2.17 |
| Dropout Voltage High Voltage Mode                                      | $V_{DR,HVM}$     | –      | 1.1  | 1.6  | V    | $I_{IN} = 400\text{ mA}$ ; $V_S = 28\text{ V}$                          | P_5.2.18 |
| Current Consumption High Voltage Mode                                  | $I_{S,HVM}$      | –      | 1    | 1.8  | mA   | $I_{IN} = 400\text{ mA}$ ; $V_S = 28\text{ V}$                          | P_5.2.19 |

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

## 6 Package Outlines

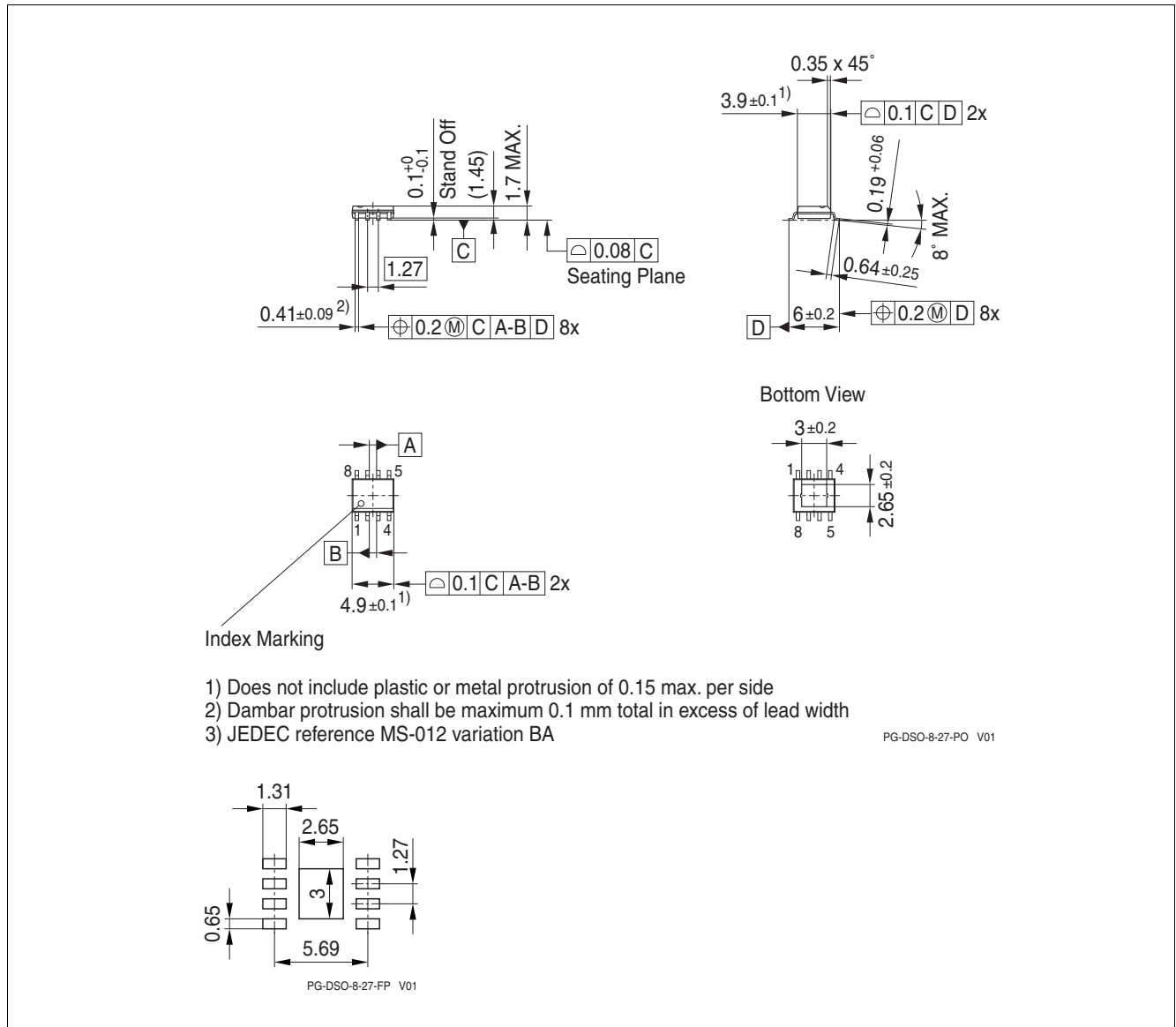


**Figure 6 PG-DSO-8 (exposed pad) Outline and Recommended Footprint for Reflow Soldering**

### 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

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**Revision History****7 Revision History**

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

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