

***EICEDRIVER®***

**1ED020I12FA**

**Single IGBT Driver IC**

**Power Management & Drives**



Never stop thinking.

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### Single IGBT Driver IC

#### Product Highlights

- Coreless transformer isolated driver
- Galvanic Insulation
- Integrated protection features
- Suitable for operation at high ambient temperature
- Cost effective technology
- Automotive Qualified



#### Features

- Single channel isolated IGBT Driver
- For 600V/1200V IGBTs
- 2A rail-to-rail output
- Vcesat-detection
- Active Miller Clamp

#### Typical

#### Application

- AC and Brushless DC Motor Drives
- High Voltage DC/DC-Converter
- UPS-Systems
- Welding

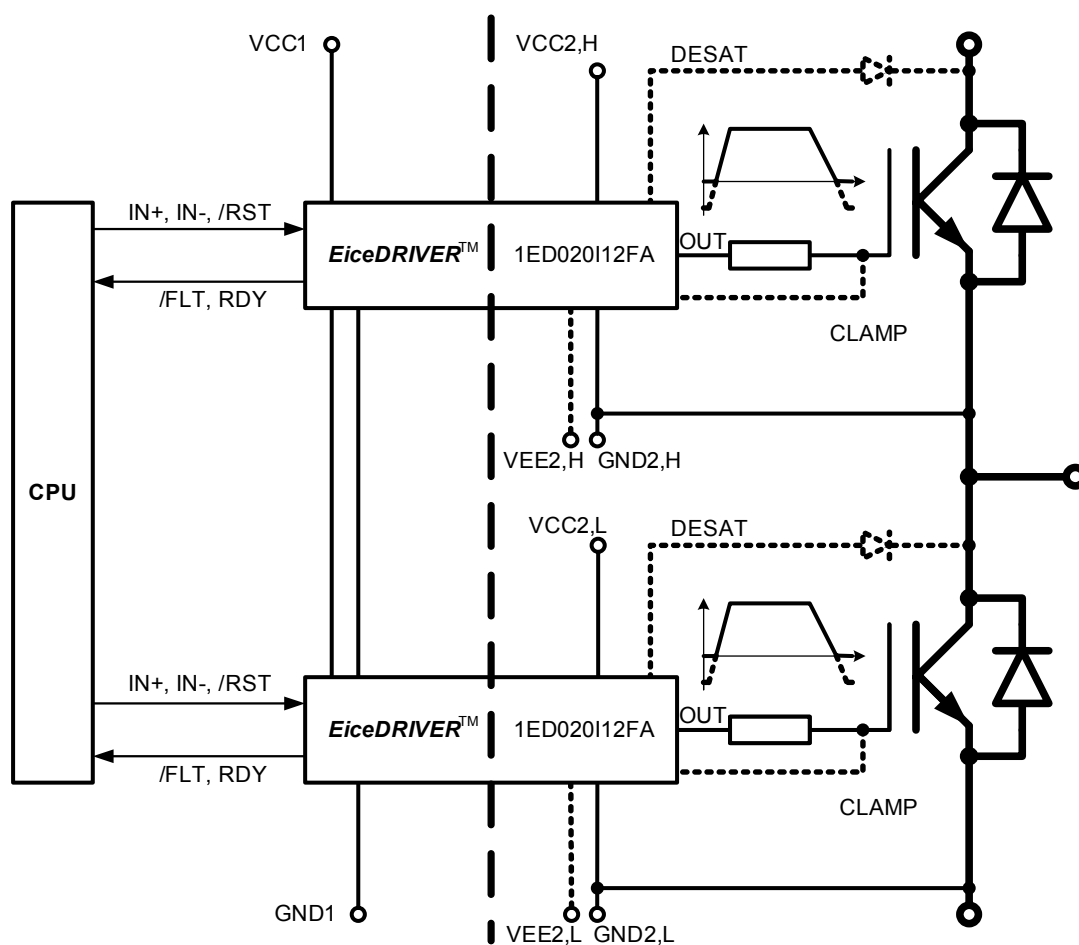
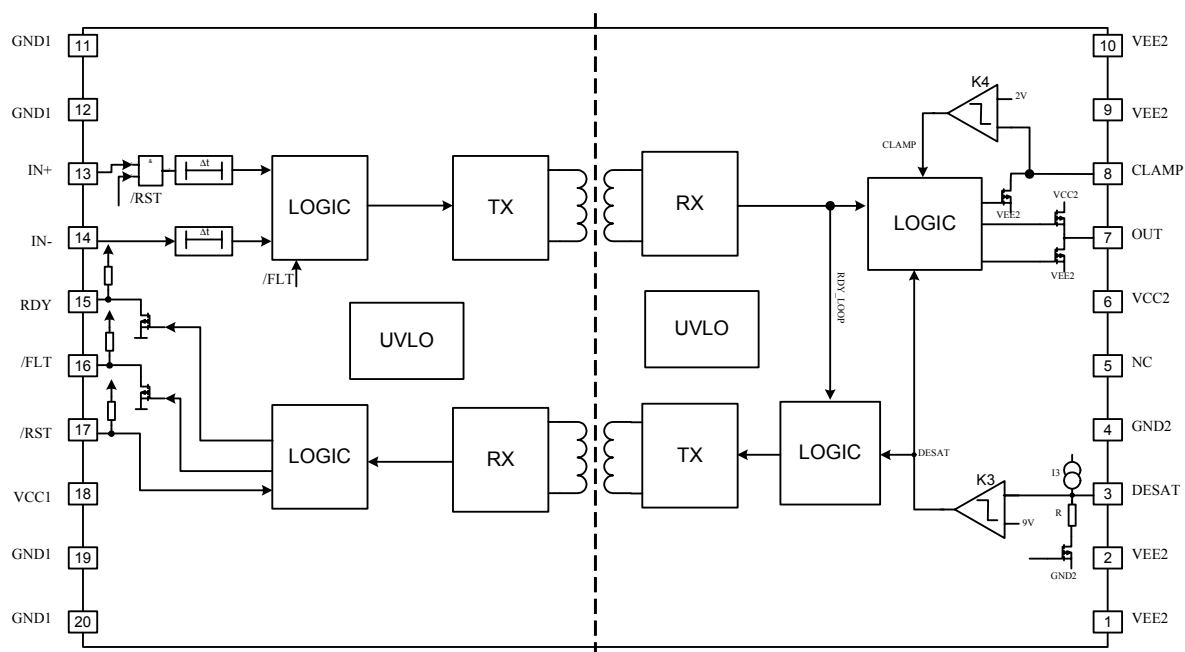


Figure 1: Typical Application

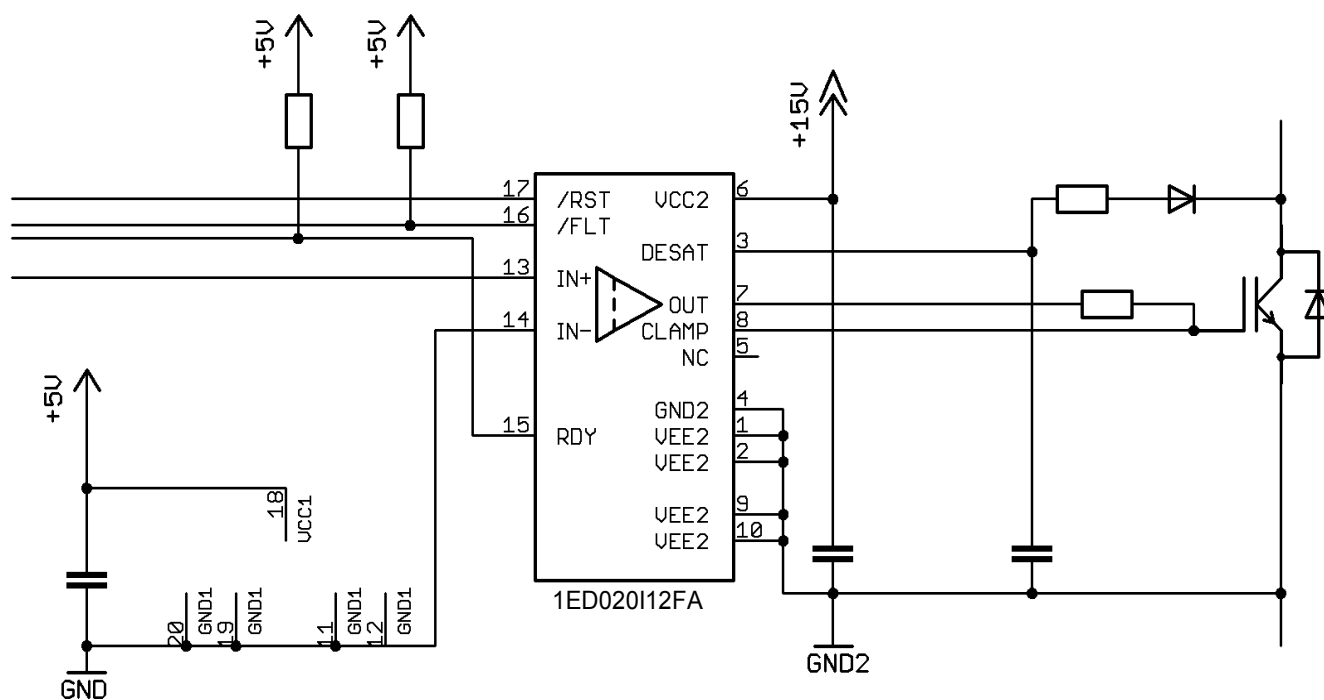
| Type        |  | Gate drive current | Package      |
|-------------|--|--------------------|--------------|
| 1ED020I12FA |  | +/- 2A             | PG-DSO-20-55 |

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# 1 Blockdiagram and Application



**Figure 2: Blockdiagram 1ED020I12FA**



**Figure 3: Application example**

## 2 Functional Description

### 2.1 Introduction

The 1ED020I12FA is an advanced IGBT gate driver that can be also used for driving power MOS devices. Control and protection functions are included to make possible the design of high reliability systems.

The device consists of two galvanic separated parts. The input chip can be directly connected to a standard 5V DSP or microcontroller with CMOS in/output and the output chip is connected to the high voltage side.

An effective active Miller clamp function avoids the need of negative gate driving in most applications and allows the use of a simple bootstrap supply for the high side driver.

A rail-to-rail driver output enables the user to provide easy clamping of the IGBTs gate voltage during short circuit of the IGBT. So an increase of short circuit current due to the feedback via the Miller capacitance can be avoided. Further, a rail-to-rail output reduces power dissipation.

The device also includes an IGBT desaturation protection with a FAULT status output.

A READY status output reports if the device is supplied and operates correctly.

### 2.2 Internal Protection Features

#### 2.2.1 Undervoltage Lockout (UVLO)

To ensure correct switching of IGBTs the device is equipped with an undervoltage lockout for both chips.

If the power supply voltage  $V_{VCC1}$  of the input chip drops below  $V_{UVLOL1}$  a turn-off signal is sent to the output chip before power-down. The IGBT is switched off and the signals at IN+ and IN- are ignored as long as  $V_{VCC1}$  reaches the power-up voltage  $V_{UVLOH1}$ .

If the power supply voltage  $V_{VCC2}$  of the output chip goes down below  $V_{UVLOL2}$  the IGBT is switched off and signals from the input chip are ignored as long as  $V_{VCC2}$  reaches the power-up voltage  $V_{UVLOH2}$ .

#### 2.2.2 READY status output

The READY output shows the status of three internal protection features.

- UVLO of the input chip
- UVLO of the output chip after a short delay
- Internal signal transmission

It is not necessary to reset the READY signal since its state only depends on the status of the former mentioned protection signals.

#### 2.2.3 Watchdog Timer

The 1ED020I12FA incorporates two level of signal transmission security implemented through two independent watchdog timers. First level ensures the short term signal integrity by resending the (turn on/off) signals with a watchdog period of typical 500ns. The second level monitors during normal operation the internal signal transmission. If the transmission fails for a given time, the IGBT is switched off and the READY output reports an internal error.

#### 2.2.4 Active Shut-Down

The Active Shut-Down feature ensures a safe IGBT off-state if the output chip is not connected to the power supply.

### 2.3 Non-Inverting and Inverting Inputs

There are two possible input modes to control the IGBT. At non-inverting mode IN+ controls the driver output while IN- is set to low. At inverting mode IN- controls the driver output while IN+ is set to high. A minimum input pulse width is defined to filter occasional glitches.

### 2.4 Driver Output

The output driver section uses only MOSFETs to provide a rail-to-rail output. This feature permits that tight control of gate voltage during on-state and short circuit can be maintained as long as the drivers supply is stable. Due to the low internal voltage drop, switching behaviour of the IGBT is predominantly governed by the gate resistor. Furthermore, it reduces the power to be dissipated by the driver.

## **2.5 External Protection Features**

### **2.5.1 Desaturation Protection**

A desaturation protection ensures the protection of the IGBT at short circuit. When the DESAT voltage goes up and reaches 9V, the output is driven low. Further, the FAULT output is activated until it is cleared by /RST. A programmable blanking time is used to allow enough time for IGBT saturation. Blanking time is provided by a highly precise internal current source and an external capacitor.

### **2.5.2 Active Miller Clamping**

A Miller clamp allows sinking the Miller current during a high dV/dt situation. Therefore, the use of a negative supply voltage can be avoided in many applications. During turn-off, the gate voltage is monitored and the clamp output is activated when the gate voltage goes below 2V (related to VEE2). The clamp is designed for a Miller current up to 1A.

### **2.5.3 Short Circuit Clamping**

During short circuit the IGBTs gate voltage tends to rise because of the feedback via the Miller capacitance. An additional protection circuit connected to OUT and CLAMP limits this voltage to a value slightly higher than the supply voltage. A current of maximum 500 mA for 10 $\mu$ s may be fed back to the supply through one of this paths. If higher currents are expected or a tighter clamping is desired external Schottky diodes may be added.

## **2.6 RESET**

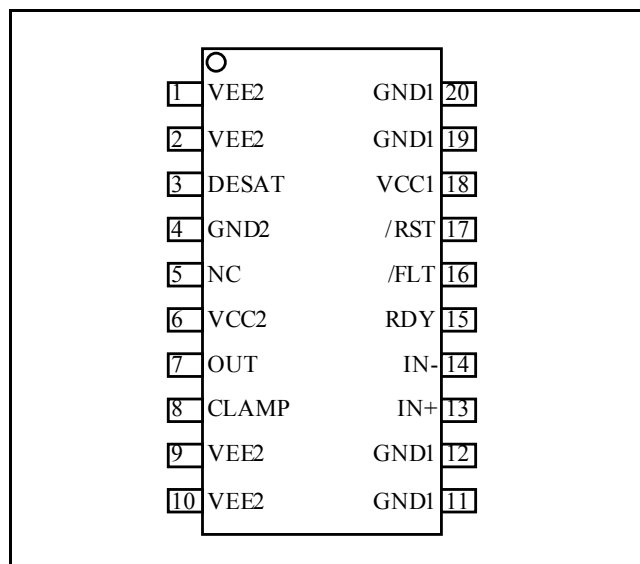
The reset input has two functions.

Firstly, /RST is in charge of setting back the FAULT output. If /RST is low longer than a given time, /FLT will be reseted at the rising edge of /RST; otherwise, it will remain unchanged. Moreover, it works as enable/shutdown of the input logic.

## 3 Pin Configuration and Functionality

### 3.1 Pin Configuration

| Pin | Symbol                  | Function                          |
|-----|-------------------------|-----------------------------------|
| 1   | VEE2                    | Negative power supply output side |
| 2   | VEE2                    | Negative power supply output side |
| 3   | DESAT                   | Desaturation protection           |
| 4   | GND2                    | Signal ground output side         |
| 5   | NC                      | Not connected                     |
| 6   | VCC2                    | Positive power supply output side |
| 7   | OUT                     | Driver output                     |
| 8   | CLAMP                   | Miller clamping                   |
| 9   | VEE2                    | Negative power supply output side |
| 10  | VEE2                    | Negative power supply output side |
| 11  | GND1                    | Signal ground input side          |
| 12  | GND1                    | Signal ground input side          |
| 13  | IN+                     | Non inverted driver input         |
| 14  | IN-                     | Inverted driver input             |
| 15  | RDY                     | Ready output                      |
| 16  | $\overline{\text{FLT}}$ | Fault output                      |
| 17  | $\overline{\text{RST}}$ | Reset input                       |
| 18  | VCC1                    | Positive power supply input side  |
| 19  | GND1                    | Signal ground input side          |
| 20  | GND1                    | Signal ground input side          |



**Figure 4: PG-DSO-20-55**

### 3.2 Pin Functionality

#### GND1

Ground connection of the input side.

#### IN+ Non-inverting driver input

IN+ control signal for the driver output if IN- is set to low. (The IGBT is on if IN+ = high and IN- = low)

A minimum pulse width is defined to make the IC robust against glitches at IN+. An internal Pull-Down-Resistor ensures IGBT Off-State.

#### IN- Inverting driver input

IN- control signal for driver output if IN+ is set to high. (IGBT is on if IN- = low and IN+ = high)

A minimum pulse width is defined to make the IC robust against glitches at IN-. An internal Pull-Up-Resistor ensures IGBT Off-State.

#### /RST (Reset) input

**Function 1:** Enable/shutdown of the input chip. (The IGBT is off if /RST = low). A minimum pulse width is defined to make the IC robust against glitches at IN-.

**Function 2:** Resets the DESAT-FAULT-state of the chip if /RST is low for a time  $T_{\text{RST}}$ .

An internal Pull-Up-Resistor is used to ensure FLT status output.

#### /FLT (Fault output)

Open-drain output to report a desaturation error of the IGBT (FLT is low if desaturation occurs)

#### RDY (Ready status)

Open-drain output to report the correct operation of the device. (RDY = high if both chips are above the UVLO level and the internal chip transmission is faultless)

#### VCC1

5V power supply of the input chip

#### VEE2

Negative power supply pins of the output chip. If no negative supply voltage is available, both pins have to be connected to GND2.



**DESAT (Desaturation)**

Monitoring of the IGBT saturation voltage ( $V_{CE}$ ) to detect desaturation caused by short circuits. If OUT is high,  $V_{CE}$  is above a defined value and a certain blanking time has expired, the desaturation protection is activated and the IGBT is switched off. The blanking time is adjustable by an external capacitor.

**CLAMP (Clamping)**

Ties the gate voltage to VEE2 after the IGBT has been switched off at a defined voltage to avoid a parasitic switch-on of the IGBT. During turn-off, the gate voltage is monitored and the clamp output is activated when the gate voltage goes below 2V (related to VEE2).

**GND2**

Reference ground of the output chip.

**OUT (Driver output)**

Output pin to drive an IGBT. The voltage is switched between VEE2 and VCC2. In normal operating mode Vout is controlled by IN+, IN- and /RST. During error mode (UVLO, internal error or DESAT) Vout is set to VEE2 independent of the input control signals.

**VCC2**

Positive power supply pin of the output side.

## 4 Electrical Parameters

### 4.1 Absolute Maximum Ratings

*Note: Absolute maximum ratings are defined as ratings, which when being exceeded may lead to destruction of the integrated circuit. Unless otherwise noted all parameters refer to GND1.*

| Parameter                                                           | Symbol          | Limit Values   |                                 | Unit | Remarks                            |
|---------------------------------------------------------------------|-----------------|----------------|---------------------------------|------|------------------------------------|
|                                                                     |                 | min.           | max.                            |      |                                    |
| Positive power supply output side                                   | $V_{VCC2}$      | -0.3           | 20                              | V    | <sup>1)</sup>                      |
| Negative power supply output side                                   | $V_{VEE2}$      | -12            | 0.3                             | V    | <sup>1)</sup>                      |
| Maximum power supply voltage output side<br>( $V_{VCC2}-V_{VEE2}$ ) | $V_{max2}$      | —              | 28                              | V    |                                    |
| Gate driver output                                                  | $V_{OUT}$       | $V_{VEE2}-0.3$ | $V_{max2}+0.3$                  | V    |                                    |
| Gate driver high output maximum current                             | $I_{OUT}$       |                | 2.4                             | A    | $t = 2\mu s$                       |
| Gate & Clamp driver low output maximum current                      | $I_{OUT}$       |                | 2.4                             | A    | $t = 2\mu s$                       |
| Maximum short circuit clamping time                                 | $t_{CLP}$       | —              | 10                              | us   | $I_{CLAMP/OUT} = 500mA$            |
| Positive power supply input side                                    | $V_{VCC1}$      | -0.3           | 6.5                             | V    |                                    |
| Logic input voltages<br>(IN+, IN-, RST)                             | $V_{LogicIN}$   | -0.3           | 6.5                             | V    |                                    |
| Opendrain Logic output voltage<br>(FLT)                             | $V_{FLT}$       | -0.3           | 6.5                             | V    |                                    |
| Opendrain Logic output voltage<br>(RDY)                             | $V_{RDY}$       | -0.3           | 6.5                             | V    |                                    |
| Opendrain Logic output current<br>(FAULT)                           | $I_{FLT}$       | —              | 10                              | mA   |                                    |
| Opendrain Logic output current<br>(RDY)                             | $I_{RDY}$       | —              | 10                              | mA   |                                    |
| Pin DESAT voltage                                                   | $V_{DESAT}$     | -0.3           | $V_{VCC2}+0.3$                  |      | <sup>1)</sup> $V_{VEE2} = -8V$     |
| Pin CLAMP voltage                                                   | $V_{CLAMP}$     | $V_{VEE2}-0.3$ | $V_{VCC2}+0.3$<br><sup>2)</sup> |      |                                    |
| Junction temperature                                                | $T_J$           | -40            | 150                             | °C   |                                    |
| Storage temperature                                                 | $T_S$           | -55            | 150                             | °C   |                                    |
| Power dissipation, Input chip                                       | $P_{D, IN}$     | —              | 100                             | mW   | <sup>3)</sup> @ $T_A = 25^\circ$   |
| Power dissipation, Output chip                                      | $P_{D, OUT}$    | —              | 700                             | mW   | <sup>2)3)</sup> @ $T_A = 25^\circ$ |
| Thermal resistance (Input chip active)                              | $R_{THJA, IN}$  | —              | 139                             | K/W  | <sup>2)</sup> @ $T_A = 25^\circ C$ |
| Thermal resistance (Output chip active)                             | $R_{THJA, OUT}$ | —              | 117                             | K/W  | <sup>2)</sup> @ $T_A = 25^\circ C$ |
| ESD Capability                                                      | $V_{ESD}$       | —              | 1                               | kV   | Human Body Model <sup>4)</sup>     |

1) With respect to GND2.

2) may be exceeded during short circuit clamping

3) Output IC power dissipation is derated linearly at 8.5 mW/°C above 68°C. Input IC power dissipation does not require derating. See section 8.1 for reference layouts for these thermal data. Thermal performance may change significantly with layout and heat dissipation of components in close proximity.

4) According to EIA/JESD22-A114-B (discharging a 100pF capacitor through a 1.5kΩ series resistor).

## 4.2 Operating Parameters

Note: Within the operating range the IC operates as described in the functional description. Unless otherwise noted all parameters refer to GND1.

| Parameter                                                           | Symbol                | Limit Values   |                          | Unit        | Remarks       |
|---------------------------------------------------------------------|-----------------------|----------------|--------------------------|-------------|---------------|
|                                                                     |                       | min.           | max.                     |             |               |
| Positive power supply output side                                   | $V_{VCC2}$            | 13             | 20                       | V           | <sup>1)</sup> |
| Negative power supply output side                                   | $V_{VEE2}$            | -12            | 0                        | V           | <sup>1)</sup> |
| Maximum power supply voltage output side<br>( $V_{VCC2}-V_{VEE2}$ ) | $V_{max2}$            | —              | 28                       | V           |               |
| Positive power supply input side                                    | $V_{VCC1}$            | 4.5            | 5.5                      | V           |               |
| Logic input voltages<br>( $IN+$ , $IN-$ , $\overline{RST}$ )        | $V_{LogicIN}$         | -0.3           | 5.5                      | V           |               |
| Pin CLAMP voltage                                                   | $V_{CLAMP}$           | $V_{VEE2}-0.3$ | $V_{VCC2}$ <sup>2)</sup> | V           |               |
| Pin DESAT voltage                                                   | $V_{DESAT}$           | -0.3           | $V_{VCC2}$               | V           | <sup>1)</sup> |
| Ambient temperature                                                 | $T_A$                 | -40            | 125                      | °C          |               |
| Common mode transient immunity <sup>3)</sup>                        | $ \Delta V_{ISO}/dt $ | —              | 50                       | kV/ $\mu$ s | @ 500V        |

1) With respect to GND2.

2) may be exceeded during short circuit clamping

3) The parameter is not subject to production test - verified by design/characterization

## 4.3 Recommended Operating Parameters

Note: Unless otherwise noted all parameters refer to GND1.

| Parameter                         | Symbol     | Values | Unit | Remarks       |
|-----------------------------------|------------|--------|------|---------------|
|                                   |            |        |      |               |
| Positive power supply output side | $V_{VCC2}$ | 15     | V    | <sup>1)</sup> |
| Negative power supply output side | $V_{VEE2}$ | -8     | V    | <sup>1)</sup> |
| Positive power supply input side  | $V_{VCC1}$ | 5      | V    |               |

1) With respect to GND2.

## 4.4 Electrical Characteristics

Note: The electrical characteristics involve the spread of values for the supply voltages, load and junction temperature range from  $-40^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$ . Typical values represent the median values, which are related to production processes at  $T_J = 25^{\circ}\text{C}$ . Unless otherwise noted all voltages are given with respect to GND.

### 4.4.1 Voltage Supply.

| Parameter                                                    | Symbol       | Limit Values |      |      | Unit | Test Conditions                                                                                                                                                       |
|--------------------------------------------------------------|--------------|--------------|------|------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                              |              | min.         | typ. | max. |      |                                                                                                                                                                       |
| UVLO Threshold Input Chip                                    | $V_{UVLOH1}$ | —            | 4.1  | 4.3  | V    |                                                                                                                                                                       |
|                                                              | $V_{UVLOL1}$ | 3.5          | 3.8  | —    | V    |                                                                                                                                                                       |
| UVLO Hysteresis Input Chip<br>( $V_{UVLOH1} - V_{UVLOL1}$ )  | $V_{HYS1}$   | 0.15         | —    | —    | V    |                                                                                                                                                                       |
| UVLO Threshold Output Chip                                   | $V_{UVLOH2}$ | —            | 12.0 | 12.6 | V    |                                                                                                                                                                       |
|                                                              | $V_{UVLOL2}$ | 10.4         | 11.0 | —    | V    |                                                                                                                                                                       |
| UVLO Hysteresis Output Chip<br>( $V_{UVLOH1} - V_{UVLOL1}$ ) | $V_{HYS2}$   | 0.7          | 0.9  | —    | V    |                                                                                                                                                                       |
| Quiescent Current Input Chip                                 | $I_{Q1}$     | —            | 7    | 9    | mA   | $V_{VCC1} = 5\text{V}$<br>$IN+ = \text{High}, IN- = \text{Low}$<br>$\Rightarrow OUT = \text{High}, RDY = \text{High}, /FLT = \text{High}$                             |
| Quiescent Current Output Chip                                | $I_{Q2}$     | —            | 4    | 6    | mA   | $V_{VCC2} = 15\text{V}$<br>$V_{VEE2} = -8\text{V}$<br>$IN+ = \text{High}, IN- = \text{Low}$<br>$\Rightarrow OUT = \text{High}, RDY = \text{High}, /FLT = \text{High}$ |

### 4.4.2 Logic Input and Output

| Parameter                                                    | Symbol                         | Limit Values |      |      | Unit | Test Conditions                                               |
|--------------------------------------------------------------|--------------------------------|--------------|------|------|------|---------------------------------------------------------------|
|                                                              |                                | min.         | typ. | max. |      |                                                               |
| $IN+, IN-, \overline{RST}$ Low Input Voltage                 | $V_{IN+L}, V_{IN-L}, V_{RSTL}$ | —            | —    | 1.5  | V    |                                                               |
| $IN+, IN-, \overline{RST}$ High Input Voltage                | $V_{IN+H}, V_{IN-H}, V_{RSTH}$ | 3.5          | —    | —    | V    |                                                               |
| $IN-, \overline{RST}$ Input Current                          | $I_{IN-}, I_{\overline{RST}}$  | —            | 100  | 400  | uA   | $V_{IN-} = \text{GND1}$<br>$V_{\overline{RST}} = \text{GND1}$ |
| $IN+$ Input Current                                          | $I_{IN+}$                      | —            | 100  | 400  | uA   | $V_{IN+} = V_{CC1}$                                           |
| $RDY, \overline{FLT}$ Pull Up Current                        | $I_{PRDY}, I_{\overline{FLT}}$ | —            | 100  | 400  | uA   | $V_{RDY} = \text{GND1}$<br>$V_{\overline{FLT}} = \text{GND1}$ |
| Input Pulse Suppression $IN+, IN-$                           | $T_{MININ+}, T_{MININ-}$       | 30           | 40   | —    | ns   |                                                               |
| Input Pulse Suppression $\overline{RST}$ for ENABLE/SHUTDOWN | $T_{MINRST}$                   | 30           | 40   | —    | ns   |                                                               |
| Pulse Width $\overline{RST}$ for Resetting $\overline{FLT}$  | $T_{RST}$                      | 800          | —    | —    | ns   |                                                               |
| $\overline{FLT}$ Low Voltage                                 | $V_{FLT}$                      | —            | —    | 300  | mV   | $I_{SINK(\overline{FLT})} = 5\text{mA}$                       |
| $RDY$ Low Voltage                                            | $V_{RDY}$                      | —            | —    | 300  | mV   | $I_{SINK(RDY)} = 5\text{mA}$                                  |

**Electrical Parameters**
**4.4.3 Gate Driver**

| Parameter                      | Symbol             | Limit Values           |                         |                         | Unit | Test Conditions                                                                            |
|--------------------------------|--------------------|------------------------|-------------------------|-------------------------|------|--------------------------------------------------------------------------------------------|
|                                |                    | min.                   | typ.                    | max.                    |      |                                                                                            |
| High Level Output Voltage      | V <sub>OUTH1</sub> | V <sub>VCC2</sub> -1.2 | V <sub>VCC2</sub> -0.8  | —                       | V    | I <sub>OUTH</sub> = -20mA                                                                  |
|                                | V <sub>OUTH2</sub> | V <sub>VCC2</sub> -2.5 | V <sub>VCC2</sub> -2    | —                       | V    | I <sub>OUTH</sub> = -200mA                                                                 |
|                                | V <sub>OUTH3</sub> | V <sub>VCC2</sub> -9   | V <sub>VCC2</sub> -5    | —                       | V    | I <sub>OUTH</sub> = -1A                                                                    |
|                                | V <sub>OUTH4</sub> |                        | V <sub>VCC2</sub> -10   | —                       | V    | I <sub>OUTH</sub> = -2A                                                                    |
| High Level Output Peak Current | I <sub>OUTH</sub>  | -1.5                   | -2                      | —                       | A    | IN+ = High, IN- = Low;<br>OUT = High                                                       |
| Low Level Output Voltage       | V <sub>OUTL1</sub> | —                      | V <sub>VEE2</sub> +0.04 | V <sub>VEE2</sub> +0.09 | V    | I <sub>OUTL</sub> = 20mA                                                                   |
|                                | V <sub>OUTL2</sub> | —                      | V <sub>VEE2</sub> +0.3  | V <sub>VEE2</sub> +0.85 | V    | I <sub>OUTL</sub> = 200mA                                                                  |
|                                | V <sub>OUTL3</sub> | —                      | V <sub>VEE2</sub> +2.1  | V <sub>VEE2</sub> +5.0  | V    | I <sub>OUTL</sub> = 1A                                                                     |
|                                | V <sub>OUTL4</sub> | —                      | V <sub>VEE2</sub> +7    | —                       | V    | I <sub>OUTL</sub> = 2A                                                                     |
| Low Level Output Peak Current  | I <sub>OUTL</sub>  | 1.5                    | 2                       | —                       | A    | IN+ = Low, IN- = Low;<br>OUT = Low,<br>V <sub>VCC2</sub> = 15V,<br>V <sub>VEE2</sub> = -8V |

**4.4.4 Active Miller Clamp**

| Parameter               | Symbol               | Limit Values |                         |                         | Unit | Test Conditions           |
|-------------------------|----------------------|--------------|-------------------------|-------------------------|------|---------------------------|
|                         |                      | min.         | typ.                    | max.                    |      |                           |
| Low Level Clamp Voltage | V <sub>CLAMPL1</sub> |              | V <sub>VEE2</sub> +0.03 | V <sub>VEE2</sub> +0.08 | V    | I <sub>OUTL</sub> = 20mA  |
|                         | V <sub>CLAMPL2</sub> |              | V <sub>VEE2</sub> +0.3  | V <sub>VEE2</sub> +0.8  | V    | I <sub>OUTL</sub> = 200mA |
|                         | V <sub>CLAMPL3</sub> |              | V <sub>VEE2</sub> +1.9  | V <sub>VEE2</sub> +4.8  | V    | I <sub>OUTL</sub> = 1A    |
| Low Level Clamp Current | I <sub>CLAMPL</sub>  | 2            | —                       | —                       | A    | <sup>1)</sup>             |
| Clamp Threshold Voltage | V <sub>CLAMP</sub>   | 1.6          | 2.1                     | 2.4                     | V    | Related to VEE2           |

1) The parameter is not subject to production test - verified by design/characterization

**4.4.5 Short Circuit Clamping**

| Parameter                                                             | Symbol                | Limit Values |      |      | Unit | Test Conditions                                                                                          |
|-----------------------------------------------------------------------|-----------------------|--------------|------|------|------|----------------------------------------------------------------------------------------------------------|
|                                                                       |                       | min.         | typ. | max. |      |                                                                                                          |
| Clamping voltage (OUT)<br>(V <sub>OUT</sub> -V <sub>VCC2</sub> )      | V <sub>CLPout</sub>   | —            | 0.8  | 1.3  | V    | IN+=High, IN-=Low,<br>OUT=High<br>I <sub>OUT</sub> = 500mA (pulse<br>test, t <sub>CLPmax</sub> = 10us)   |
| Clamping voltage (CLAMP)<br>(V <sub>VCLAMP</sub> -V <sub>VCC2</sub> ) | V <sub>CLPclamp</sub> | —            | 1.3  | —    | V    | IN+=High, IN-=Low,<br>OUT=High<br>I <sub>CLAMP</sub> = 500mA (pulse<br>test, t <sub>CLPmax</sub> = 10us) |
| Clamping voltage (CLAMP)                                              | V <sub>CLPclamp</sub> | —            | 0.7  | 1.1  | V    | IN+=High, IN-=Low,<br>OUT=High<br>I <sub>CLAMP</sub> = 20mA                                              |

**Electrical Parameters**
**4.4.6 Dynamic Characteristics**

| Parameter                                                          | Symbol        | Limit Values |      |                   | Unit | Test Conditions                                                        |
|--------------------------------------------------------------------|---------------|--------------|------|-------------------|------|------------------------------------------------------------------------|
|                                                                    |               | min.         | typ. | max.              |      |                                                                        |
| Input to output propagation delay ON                               | $T_{PDON}$    | 160          | 185  | 750 <sup>1)</sup> | ns   | $V_{VCC1}=5V$                                                          |
| Input to output propagation delay OFF                              | $T_{PDOFF}$   | 145          | 165  | 185               | ns   | $V_{VCC2}=15V, V_{VEE2}=-8V$                                           |
| Input to output propagation delay distortion                       | $T_{PDISTO}$  | -50          | -20  | 555 <sup>1)</sup> | ns   | $C_{LOAD}=100pF$<br>$V_{IN+}=50\%, V_{OUT}=50\%$<br>@ $T_A=25^\circ C$ |
| Input to output propagation delay ON variation due to temp         | $T_{PDONt}$   | 160          | 190  | 990 <sup>1)</sup> | ns   | $V_{VCC1}=5V$                                                          |
| Input to output propagation delay OFF variation due to temp        | $T_{PDOFFt}$  | 160          | 190  | 220               | ns   | $V_{VCC2}=15V, V_{VEE2}=-8V$<br>$C_{LOAD}=100pF$                       |
| Input to output propagation delay distortion variation due to temp | $T_{PDISTOt}$ | -30          | 0    | 800 <sup>1)</sup> | ns   | $V_{IN+}=50\%, V_{OUT}=50\%$<br>@ $T_A=125^\circ C$                    |
| Input to output propagation delay ON variation due to temp         | $T_{PDONt}$   | 160          | 190  | 990 <sup>1)</sup> | ns   | $V_{VCC1}=5V$                                                          |
| Input to output propagation delay OFF variation due to temp        | $T_{PDOFFt}$  | 130          | 160  | 190               | ns   | $V_{VCC2}=15V, V_{VEE2}=-8V$<br>$C_{LOAD}=100pF$                       |
| Input to output propagation delay distortion variation due to temp | $T_{PDISTOt}$ | -60          | -30  | 770 <sup>1)</sup> | ns   | $V_{IN+}=50\%, V_{OUT}=50\%$<br>@ $T_A=-40^\circ C$                    |
| Rise Time                                                          | $T_{RISE}$    | 10           | 30   | 60                | ns   | $V_{VCC2}=15V, V_{VEE2}=-8V$<br>$C_{LOAD}=1nF$<br>VL 10% , VH 90%      |
|                                                                    |               | 200          | 400  | 800               | ns   | $V_{VCC2}=15V, V_{VEE2}=-8V$<br>$C_{LOAD}=34nF$<br>VL 10% , VH 90%     |
| Fall Time                                                          | $T_{FALL}$    | 10           | 50   | 90                | ns   | $V_{VCC2}=15V, V_{VEE2}=-8V$<br>$C_{LOAD}=1nF$<br>VL 10% , VH 90%      |
|                                                                    |               | 200          | 450  | 600               | ns   | $V_{VCC2}=15V, V_{VEE2}=-8V$<br>$C_{LOAD}=34nF$<br>VL 10% , VH 90%     |

- 1) The maximum value of input to output propagation delay ON occurs only in case of electromagnetic interferences, typically the input to output delay is 205ns at  $T_A=25^\circ C$ , one worst case watchdog clock cycle shorter (see chapter 2.2.3). The turn OFF-signal is prioritized/dominant and will not show up this behavior.

**Electrical Parameters**
**4.4.7 Desaturation protection**

| Parameter                            | Symbol                | Limit Values |      |      | Unit | Test Conditions                                                                          |
|--------------------------------------|-----------------------|--------------|------|------|------|------------------------------------------------------------------------------------------|
|                                      |                       | min.         | typ. | max. |      |                                                                                          |
| Blanking Capacitor Charge Current    | $I_{\text{DESATC}}$   | 225          | 250  | 275  | uA   | $V_{\text{VCC2}}=15\text{V}, V_{\text{VEE2}}=-8\text{V}$<br>$V_{\text{DESAT}}=2\text{V}$ |
| Blanking Capacitor Discharge Current | $I_{\text{DESATD}}$   | 1            | 2    | —    | mA   | $V_{\text{VCC2}}=15\text{V}, V_{\text{VEE2}}=-8\text{V}$<br>$V_{\text{DESAT}}=6\text{V}$ |
| Desaturation Reference Level         | $V_{\text{DESAT}}$    | 8.3          | 9    | 9.5  | V    | $V_{\text{VCC2}}=15\text{V}, V_{\text{VEE2}}=-8\text{V}$                                 |
| Desaturation Reference Level         | $V_{\text{DESAT}}$    | 7.6          | 8.6  | 9.5  | V    | $V_{\text{VCC2}}=15\text{V}, V_{\text{VEE2}}=0\text{V}$                                  |
| Desaturation Sense to OUT Low Delay  | $T_{\text{DESATOUT}}$ | —            | 100  | 150  | ns   | $V_{\text{OUT}}=90\%$<br>$C_{\text{LOAD}}=1\text{nF}$                                    |
| Desaturation Sense to FLT Low Delay  | $T_{\text{DESATFLT}}$ | —            |      | 2.25 | us   | $V_{\text{FLT}}=10\%; I_{\text{FLT}}=5\text{mA}$                                         |
| Desaturation Low Voltage             | $V_{\text{DESATL}}$   | 0.4          | 0.6  | 0.95 | V    | IN+=Low, IN-=Low,<br>OUT=Low                                                             |

**4.4.8 Active Shut Down**

| Parameter                | Symbol                  | Limit Values |      |      | Unit | Test Conditions                                          |
|--------------------------|-------------------------|--------------|------|------|------|----------------------------------------------------------|
|                          |                         | min.         | typ. | max. |      |                                                          |
| Active Shut Down Voltage | $V_{\text{ACTSD}}^{1)}$ | —            | —    | 4    | V    | $I_{\text{OUT}}=-200\text{mA},$<br>$V_{\text{CC2}}$ open |

1) With reference to VEE2

## 5 Insulation Characteristics

### 5.1 Complies with DIN EN 60747-5-2 (VDE 0884 Teil 2): 2003-01. Basic Insulation

| Description                                                                                                                                                                                                                                | Symbol            | Characteristic        | Unit              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------|-------------------|
| Installation classification per EN 60664-1, Table 1<br>for rated mains voltage $\leq 150 \text{ V}_{\text{RMS}}$<br>for rated mains voltage $\leq 300 \text{ V}_{\text{RMS}}$<br>for rated mains voltage $\leq 600 \text{ V}_{\text{RMS}}$ |                   | I-IV<br>I-III<br>I-II |                   |
| Climatic Classification                                                                                                                                                                                                                    |                   | 40/125/21             |                   |
| Pollution Degree (EN 60664-1)                                                                                                                                                                                                              |                   | 2                     |                   |
| Minimum External Clearance                                                                                                                                                                                                                 | CLR               | 8                     | mm                |
| Minimum External Creepage                                                                                                                                                                                                                  | CPG               | 8                     | mm                |
| Minimum Comparative Tracking Index                                                                                                                                                                                                         | CTI               | 175                   |                   |
| Maximum Repetitive Insulation Voltage                                                                                                                                                                                                      | $V_{\text{IORM}}$ | 1420                  | $V_{\text{PEAK}}$ |
| Highest Allowable Overvoltage <sup>1)</sup>                                                                                                                                                                                                | $V_{\text{IOTM}}$ | 6000                  | $V_{\text{PEAK}}$ |
| Maximum Surge Insulation Voltage                                                                                                                                                                                                           | $V_{\text{IOSM}}$ | 6000                  | V                 |

### 5.2 Complies with UL 1577

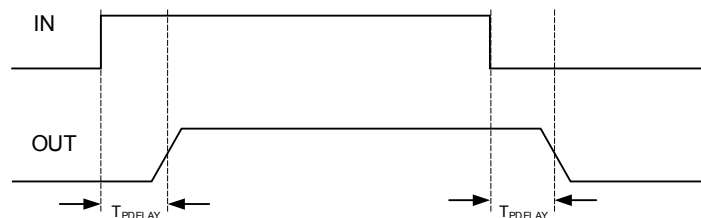
| Description                         | Symbol           | Characteristic | Unit             |
|-------------------------------------|------------------|----------------|------------------|
| Insulation Withstand Voltage / 1min | $V_{\text{ISO}}$ | 3750           | $V_{\text{rms}}$ |
| Insulation Test Voltage / 1sec      | $V_{\text{ISO}}$ | 4500           | $V_{\text{rms}}$ |

### 5.3 Reliability

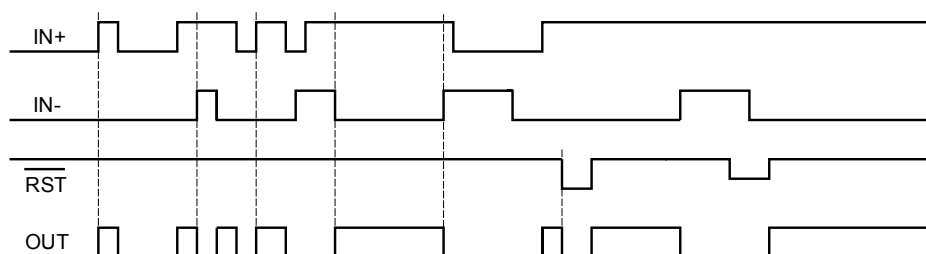
For Qualification Report please contact your local Infineon Technologies office.



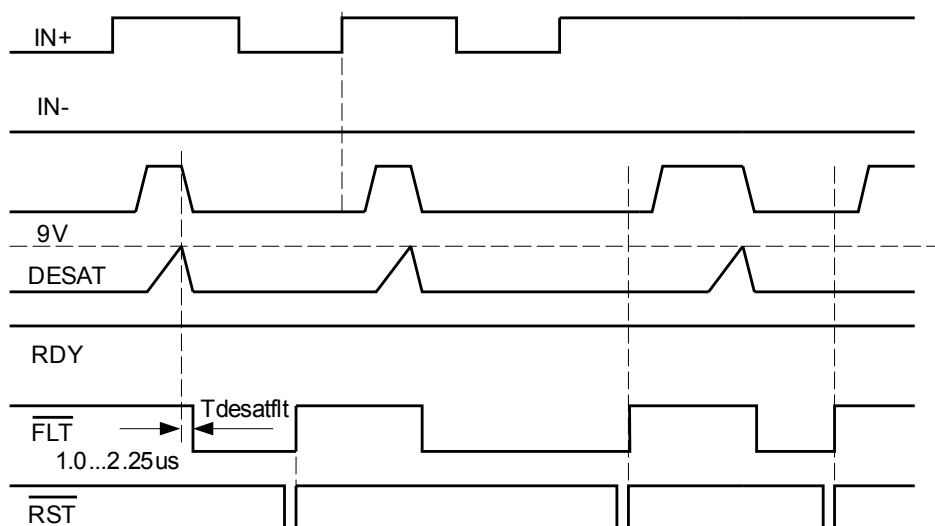
## 6 Timing Diagrams



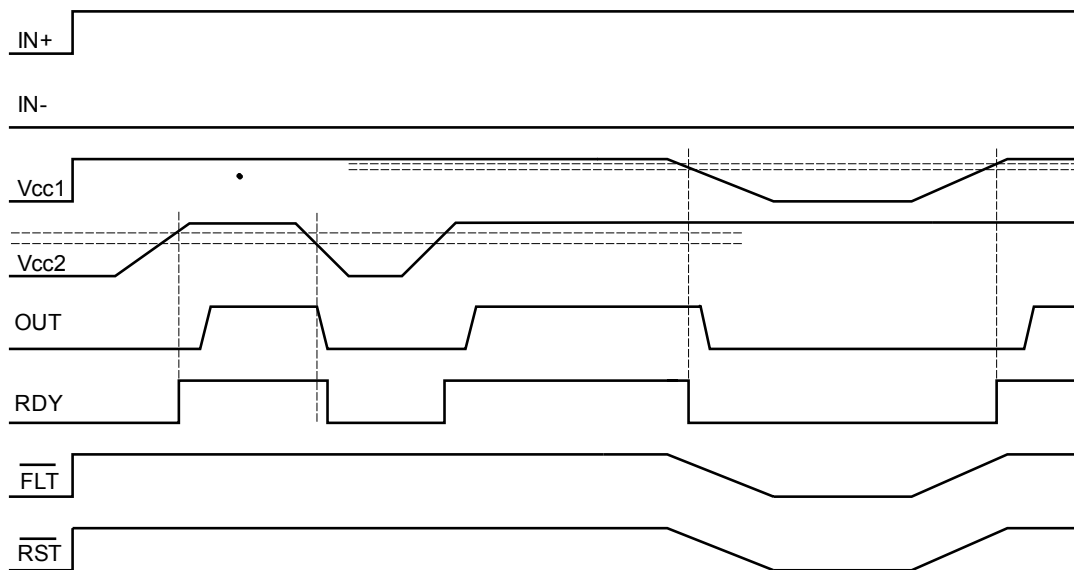
**Figure 5: propagation delay**



**Figure 6: Turn-on and Turn-off**

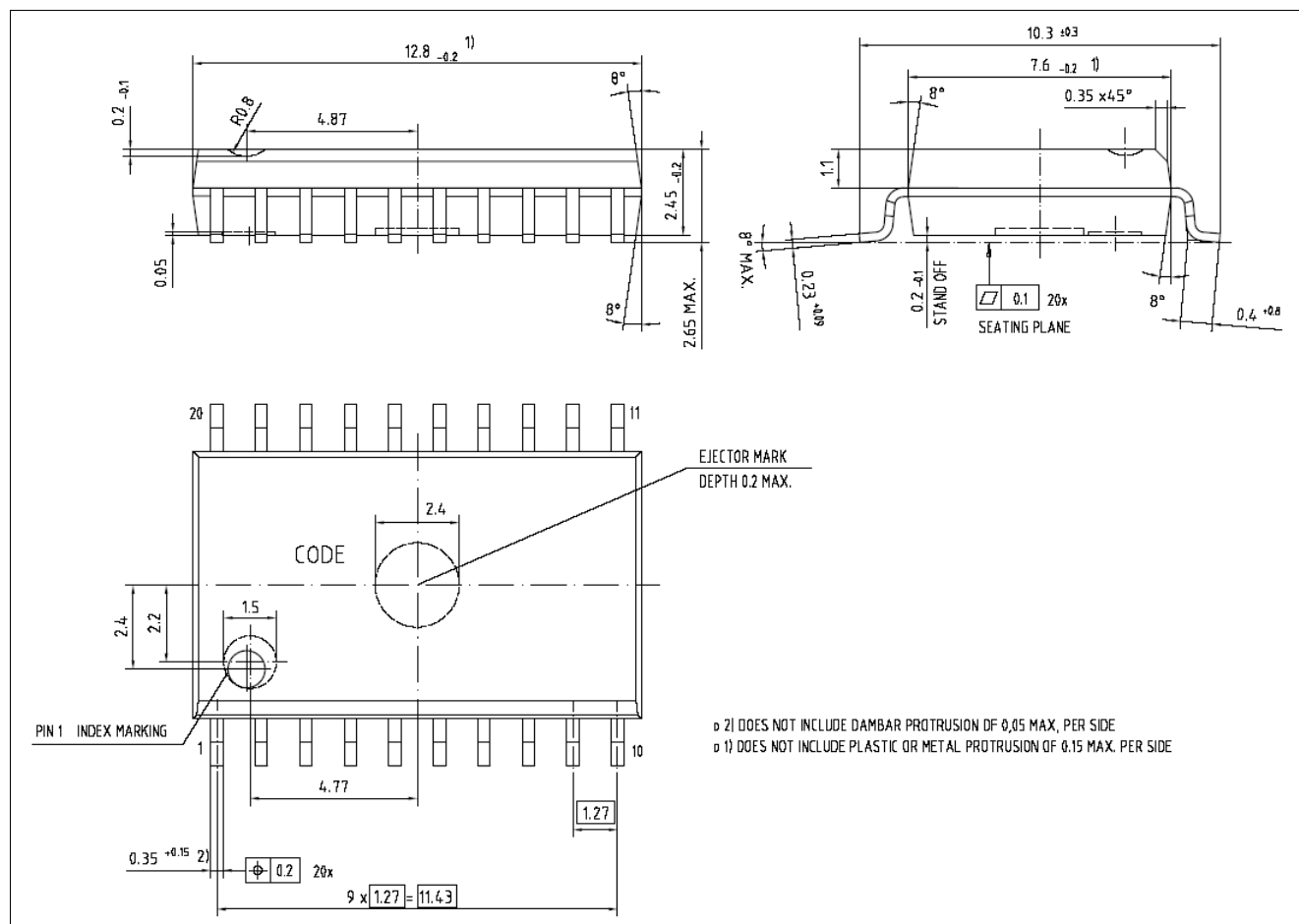


**Figure 7: Desaturation Fault**



**Figure 8: UVLO**

## 7 Package Outlines

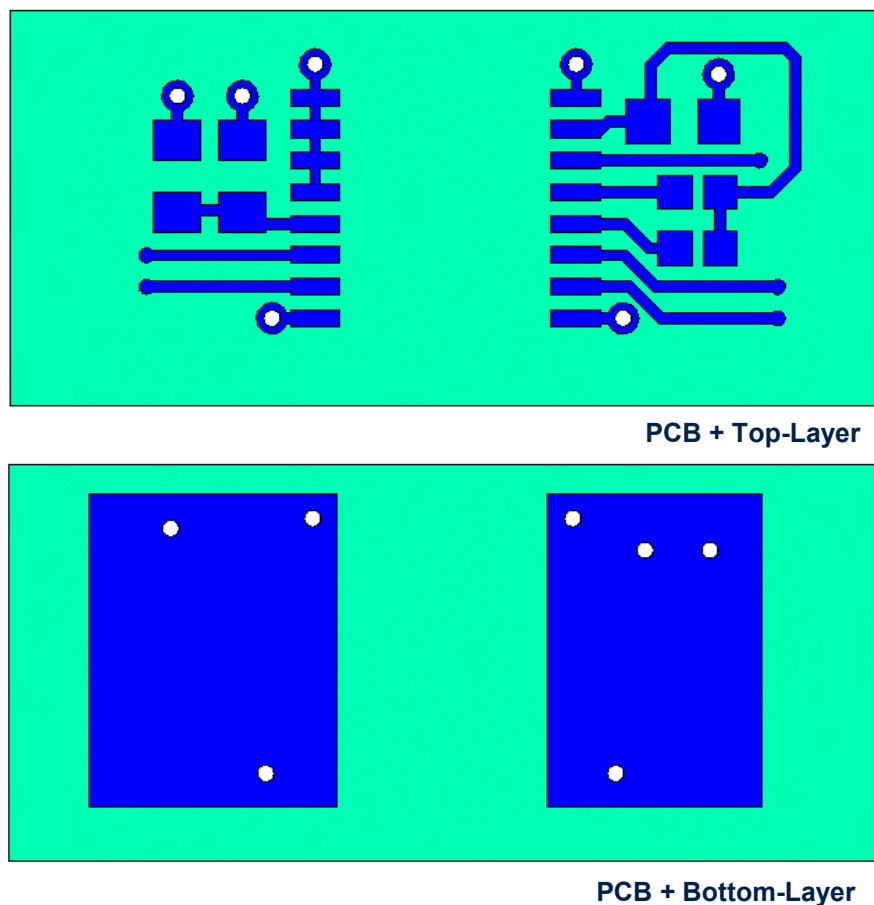


**Figure 9: PG-DSO-20-55 (Plastic Dual Small Outline Package)**

## 8 Application Notes

### 8.1 Reference Layout for Thermal Data

The PCB layout shown in figure 12 represents the reference layout used for the thermal characterisation. Pins 11, 12, 19 and 20 (GND1) and pins 1, 2, 9 and 10 (VEE2) require ground plane connections for achieving maximum power dissipation. The 1ED020I12FA is conceived to dissipate most of the heat generated through this pins.



**Figure 10: Reference layout for thermal data (Copper thickness 102µm)**

### 8.2 Printed Circuit Board Guidelines

Following factors should be taken into account for an optimum PCB layout.

- Sufficient spacing should be kept between high voltage isolated side and low voltage side circuits.
- The same minimum distance between two adjacent high-side isolated parts of the PCB should be maintained to increase the effective isolation and reduce parasitic coupling.
- In order to ensure low supply ripple and clean switching signals, bypass capacitor trace lengths should be kept as short as possible.



# Total Quality Management

Qualität hat für uns eine umfassende Bedeutung. Wir wollen allen Ihren Ansprüchen in der bestmöglichen Weise gerecht werden. Es geht uns also nicht nur um die Produktqualität – unsere Anstrengungen gelten gleichermaßen der Lieferqualität und Logistik, dem Service und Support sowie allen sonstigen Beratungs- und Betreuungsleistungen.

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