

EiceDRIVER™

1ED020I12FA

Single IGBT Driver IC

Data Sheet

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Asic & Power ICs

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## Revision History

Page or Item	Subjects (major changes since previous revision)
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**Rev. 3.0, 2013-05-21**


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## 1 Overview

### Main Features

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

### Product Highlights

- Coreless transformer isolated driver
- Basic insulation according to DIN EN 60747-5-2
- Basic insulation recognized under UL1577
- Integrated protection features
- Suitable for operation at high ambient temperature
- Automotive Qualified

### Typical Application

- Drive inverters for HEV and EV
- Auxilliary inverters for HEV and EV
- High Power DC/DC inverters

### Description

The 1ED020I12FA is a galvanic isolated single channel IGBT driver in PG-DSO-20 package that provides an output current capability of typically 2A.

All logic pins are 5V CMOS compatible and could be directly connected to a microcontroller.

The data transfer across galvanic isolation is realized by the integrated Coreless Transformer Technology.

The 1ED020I12FA provides several protection features like IGBT desaturation protection, active Miller clamping and active shut down.



Product Name	Gate Drive Current	Package
1ED020I12FA	±2 A	PG-DSO-20

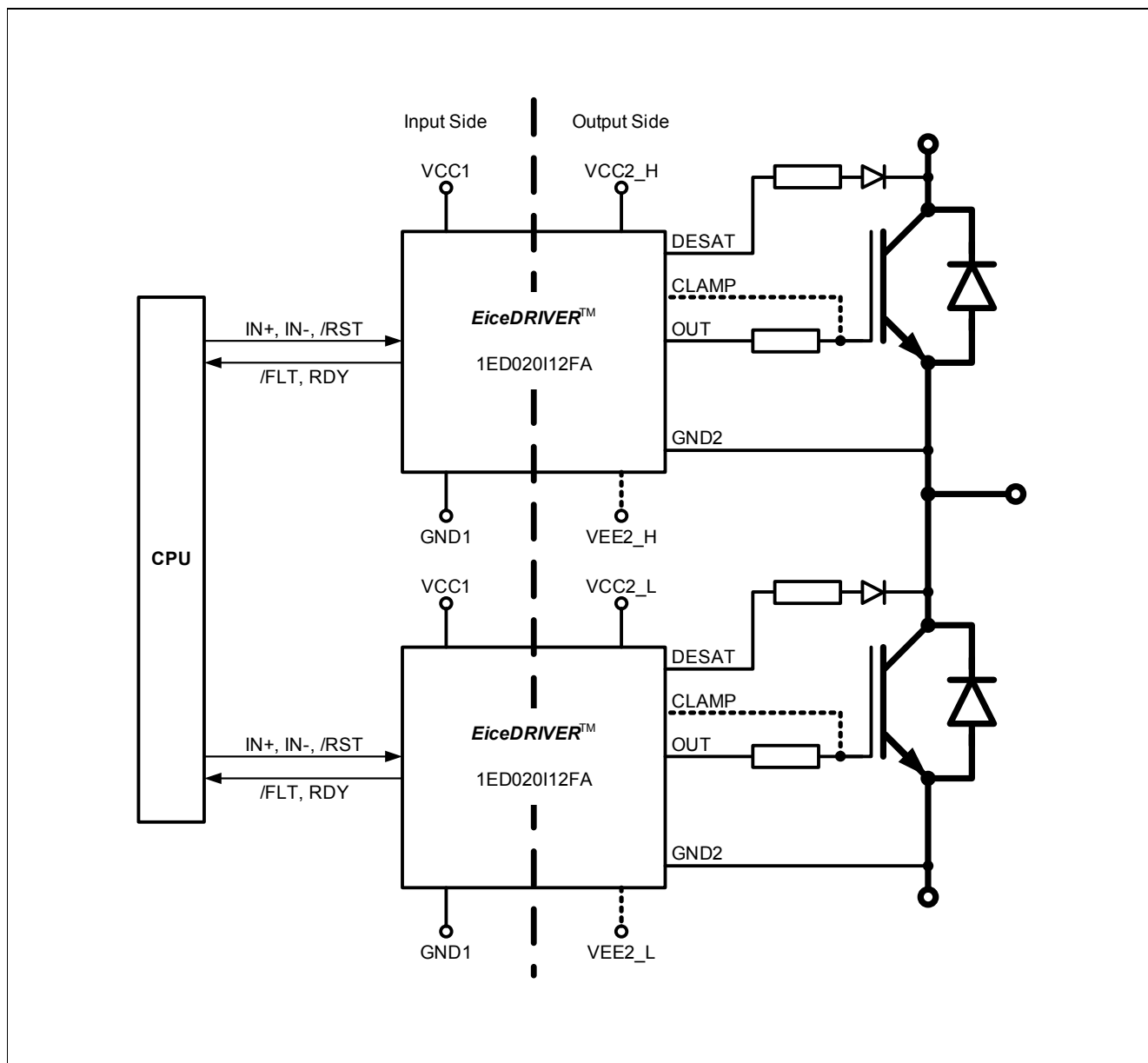


Figure 1 Typical Application



## 2 Block Diagram

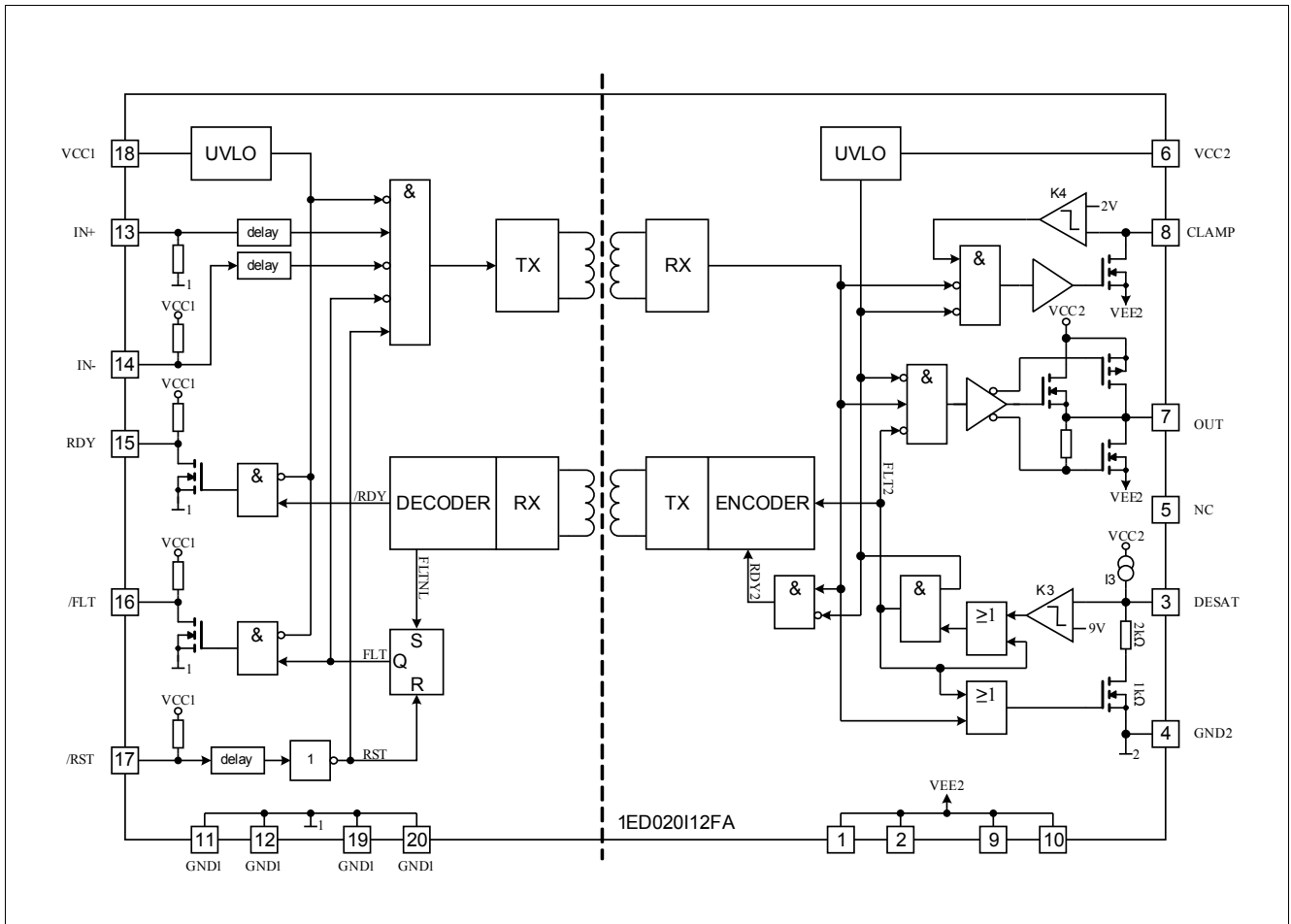


Figure 2 Block Diagram 1ED020I12FA

## 3 Pin Configuration and Functionality

### 3.1 Pin Configuration

**Table 1 Pin Configuration**

Pin No.	Name	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	Ground input side
12	GND1	Ground input side
13	IN+	Non inverted driver input
14	IN-	Inverted driver input
15	RDY	Ready output
16	/FLT	Fault output, low active
17	/RST	Reset input, low active
18	VCC1	Positive power supply input side
19	GND1	Ground input side
20	GND1	Ground input side

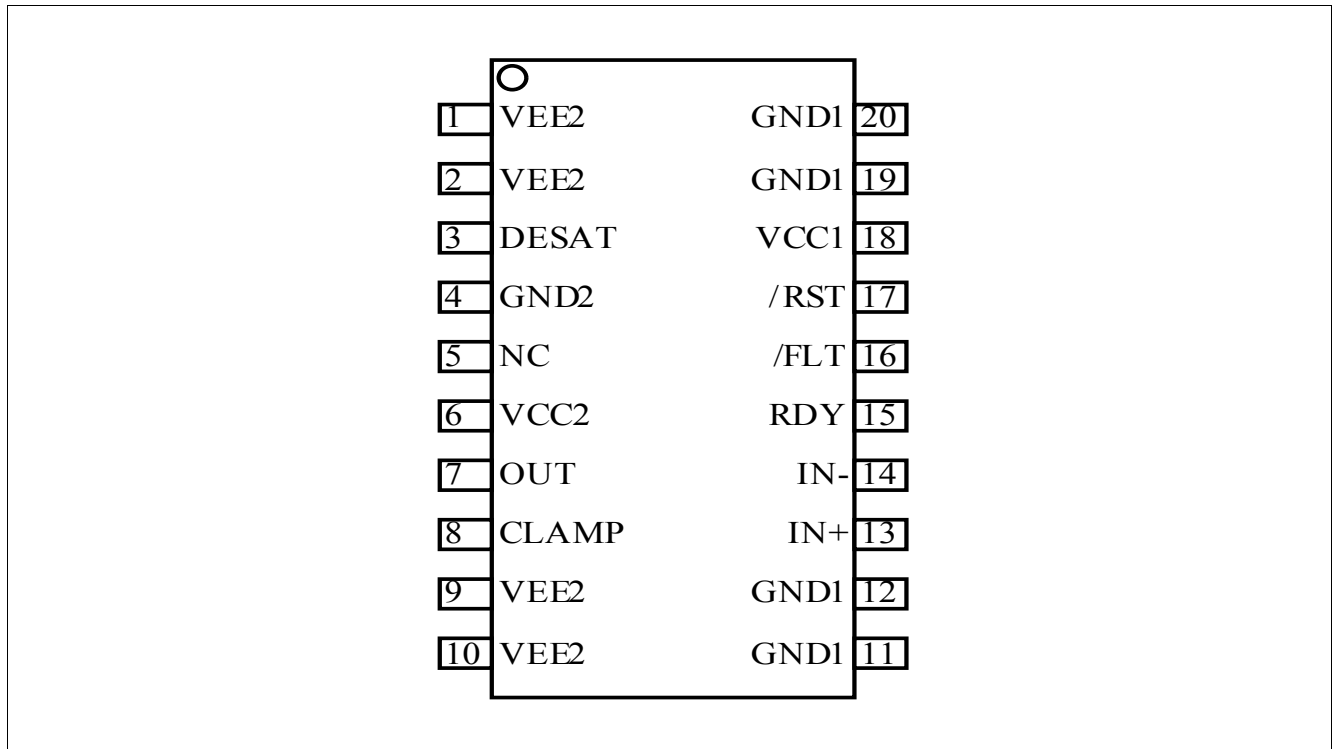


Figure 3 PG-DSO-20 (top view)

## 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 /RST.

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

5 V power supply of the input chip

**VEE2**

Negative power supply pins of the output chip. If no negative supply voltage is available, all VEE2 pins have to be connected to GND2.

**DESAT Desaturation Detection Input**

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 Miller Clamping**

Ties the gate voltage to ground 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 2 V below VEE2.

**GND2 Reference Ground**

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 Functional Description

### 4.1 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 5 V DSP or microcontroller with CMOS in/output and the output chip is connected to the high voltage side.

The 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 IGBT desaturation protection with FAULT status output.

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

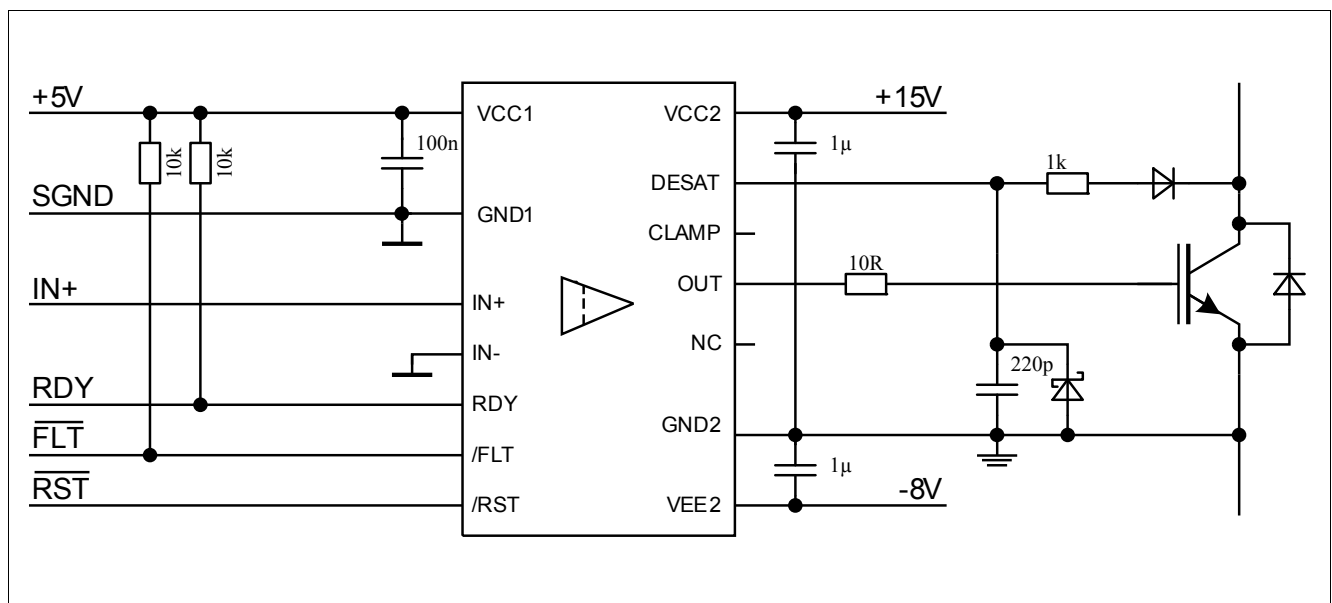


Figure 4 Application Example Bipolar Supply

### 4.2 Supply

The driver 1ED020I12FA is designed to support two different supply configurations, bipolar supply and unipolar supply.

In bipolar supply the driver is typically supplied with a positive voltage of 15V at VCC2 and a negative voltage of -8V at VEE2, please refer to [Figure 4](#). Negative supply prevents a dynamic turn on due to the additional charge which is generated from IGBT input capacitance times negative supply voltage. If an appropriate negative supply voltage is used, connecting CLAMP to IGBT gate is redundant and therefore typically not necessary.

For unipolar supply configuration the driver is typically supplied with a positive voltage of 15V at VCC2. Erratically dynamic turn on of the IGBT could be prevented with active Miller clamp function, so CLAMP output is directly connected to IGBT gate, please refer to [Figure 5](#).

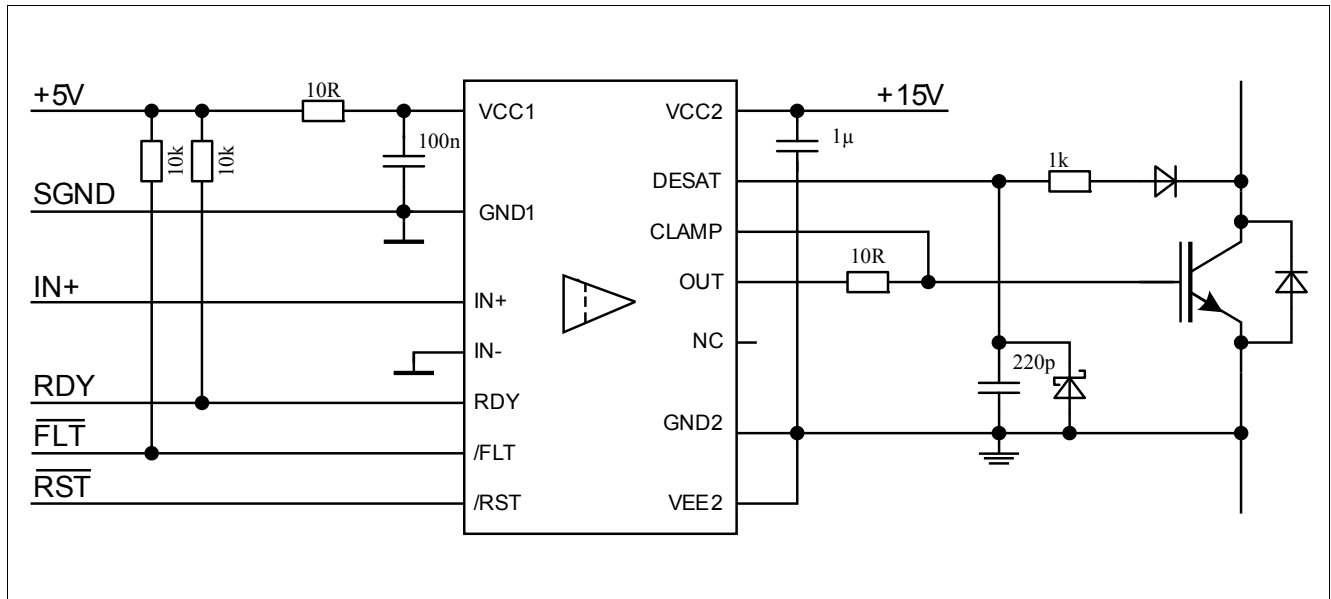


Figure 5 Application Example Unipolar Supply

## 4.3 Internal Protection Features

### 4.3.1 Undervoltage Lockout (UVLO)

To ensure correct switching of IGBTs the device is equipped with an undervoltage lockout for both chips, refer to [Figure 9](#).

If the power supply voltage  $V_{VCC1}$  of the input chip drops below  $V_{UVLO1}$  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  $V_{UVLO2}$  the IGBT is switched off and signals from the input chip are ignored as long as  $V_{VCC2}$  reaches the power-up voltage  $V_{UVLOH2}$ . VEE2 is not monitored, otherwise negative supply voltage range from 0 V to -12 V would not be possible.

### 4.3.2 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 after a short delay

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

### 4.3.3 Watchdog Timer

During normal operation the internal signal transmission is monitored by a watchdog timer. If the transmission fails for a given time, the IGBT is switched off and the READY output reports an internal error.

### 4.3.4 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, IGBT gate is clamped at OUT to VEE2.

## **4.4 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, please see [Figure 7](#). A minimum input pulse width is defined to filter occasional glitches.

## **4.5 Driver Output**

The output driver sections 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.

## **4.6 External Protection Features**

### **4.6.1 Desaturation Protection**

A desaturation protection ensures the protection of the IGBT at short circuit. When the DESAT voltage goes up and reaches 9 V, the output is driven low. Further, the FAULT output is activated, please refer to [Figure 8](#). 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.

### **4.6.2 Active Miller Clamp**

In a half bridge configuration the switched off IGBT tends to dynamically turn on during turn on phase of the opposite IGBT. A Miller clamp allows sinking the Miller current across a low impedance path in this high dV/dt situation. Therefore in many applications, the use of a negative supply voltage can be avoided.

During turn-off, the gate voltage is monitored and the clamp output is activated when the gate voltage goes below typical 2 V (related to VEE2). The clamp is designed for a Miller current up to 2 A.

### **4.6.3 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 µs 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.

## **4.7 RESET**

The reset inputs have 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 cleared at the rising edge of /RST, refer to [Figure 8](#); otherwise, it will remain unchanged. Moreover, it works as enable/shutdown of the input logic, refer to [Figure 7](#).

## 5 Electrical Parameters

### 5.1 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.*

**Table 2 Absolute Maximum Ratings**

Parameter	Symbol	Values		Unit	Note / Test Condition
		Min.	Max.		
Positive power supply output side	$V_{VCC2}$	-0.3	20	V	1)
Negative power supply output side	$V_{VEE2}$	-12	0.3	V	1)
Maximum power supply voltage output side ( $V_{VCC2} - V_{VEE2}$ )	$V_{max2}$	—	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	$\mu s$	$I_{CLAMP/OUT} = 500 \text{ mA}$
Positive power supply input side	$V_{VCC1}$	-0.3	6.5	V	—
Logic input voltages ( $IN+$ , $IN-$ , $\overline{RST}$ )	$V_{LogicIN}$	-0.3	6.5	V	—
Opendrain Logic output voltage ( $\overline{FLT}$ )	$V_{FLT\#}$	-0.3	6.5	V	—
Opendrain Logic output voltage (RDY)	$V_{RDY}$	-0.3	6.5	V	—
Opendrain Logic output current ( $\overline{FLT}$ )	$I_{FLT\#}$	—	10	mA	—
Opendrain Logic output current (RDY)	$I_{RDY}$	—	10	mA	—
Pin DESAT voltage	$V_{DESAT}$	-0.3	$V_{VCC2} + 0.3$	V	1)
Pin CLAMP voltage	$V_{CLAMP}$	-0.3	$V_{VCC2} + 0.3^{2)}$	V	3)
Junction temperature	$T_J$	-40	150	°C	—
Storage temperature	$T_S$	-55	150	°C	—
Power dissipation, per input part	$P_{D, IN}$	—	100	mW	4) $@T_A = 25^\circ C$
Power dissipation, per output part	$P_{D, OUT}$	—	700	mW	4) $@T_A = 25^\circ C$
Thermal resistance (Input part)	$R_{THJA, IN}$	—	139	K/W	4) $@T_A = 25^\circ C$
Thermal resistance (Output chip active)	$R_{THJA, OUT}$	—	117	K/W	4) $@T_A = 25^\circ C$
ESD Capability	$V_{ESD}$	—	1	kV	Human Body Model <sup>5)</sup>

1) With respect to GND2.

2) May be exceeded during short circuit clamping.

3) With respect to VEE2.



## Electrical Parameters Operating Parameters

- 4) Output IC power dissipation is derated linearly at 8.5 mW/°C above 68°C. Input IC power dissipation does not require derating. See **Figure 11** for reference layouts for these thermal data. Thermal performance may change significantly with layout and heat dissipation of components in close proximity.
- 5) According to EIA/JESD22-A114-B (discharging a 100 pF capacitor through a 1.5 kΩ series resistor).

## 5.2 Operating Parameters

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

**Table 3 Operating Parameters**

Parameter	Symbol	Values		Unit	Note / Test Condition
		Min.	Max.		
Positive power supply output side	$V_{VCC2}$	13	20	V	1)
Negative power supply output side	$V_{VEE2}$	-12	0	V	1)
Maximum power supply voltage output side ( $V_{VCC2} - V_{VEE2}$ )	$V_{max2}$	–	28	V	–
Positive power supply input side	$V_{VCC1}$	4.5	5.5	V	–
Logic input voltages (IN+, IN-, RST)	$V_{LogicIN}$	-0.3	5.5	V	–
Pin CLAMP voltage	$V_{CLAMP}$	$V_{VEE2} - 0.3$	$V_{VCC2}^{2)}$	V	–
Pin DESAT voltage	$V_{DESAT}$	-0.3	$V_{VCC2}$	V	1)
Pin TLSET voltage	$V_{TLSET}$	-0.3	$V_{VCC2}$	V	1)
Ambient temperature	$T_A$	-40	125	°C	–
Common mode transient immunity <sup>3)</sup>	$ dV_{ISO}/dt $	–	50	kV/μs	@ 500 V

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

## 5.3 Recommended Operating Parameters

*Note: Unless otherwise noted all parameters refer to GND1.*

**Table 4 Recommended Operating Parameters**

Parameter	Symbol	Value	Unit	Note / Test Condition
Positive power supply output side	$V_{VCC2}$	15	V	1)
Negative power supply output side	$V_{VEE2}$	-8	V	1)
Positive power supply input side	$V_{VCC1}$	5	V	–

1) With respect to GND2.

## 5.4 Electrical Characteristics

Note: The electrical characteristics include the spread of values in supply voltages, load and junction temperatures given below. Typical values represent the median values at  $T_A = 25^\circ\text{C}$ . Unless otherwise noted all voltages are given with respect to their respective GND (GND1 for pins 9 to 16, GND2 for pins 1 to 8).

### 5.4.1 Voltage Supply

Table 5 Voltage Supply

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
UVLO Threshold Input Chip	$V_{UVLOH1}$	–	4.1	4.3	V	–
	$V_{UVLOH1}$	3.5	3.8	–	V	–
UVLO Hysteresis Input Chip ( $V_{UVLOH1} - V_{UVLOL1}$ )	$V_{HYS1}$	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 ( $V_{UVLOH1} - V_{UVLOL1}$ )	$V_{HYS2}$	0.7	0.9	–	V	–
Quiescent Current Input Chip	$I_{Q1}$	–	7	9	mA	$V_{VCC1} = 5\text{ V}$ IN+ = High, IN- = Low =>OUT = High, RDY = High, /FLT = High
Quiescent Current Output Chip	$I_{Q2}$	–	4	6	mA	$V_{VCC2} = 15\text{ V}$ $V_{VEE2} = -8\text{ V}$ IN+ = High, IN- = Low =>OUT = High, RDY = High, /FLT = High

## 5.4.2 Logic Input and Output

Table 6 Logic Input and Output

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
IN+, IN-, $\overline{\text{RST}}$ Low Input Voltage	$V_{\text{IN+L}},$ $V_{\text{IN-L}},$ $V_{\text{RSTL\#}}$	–	–	1.5	V	–
IN+, IN-, $\overline{\text{RST}}$ High Input Voltage	$V_{\text{IN+H}},$ $V_{\text{IN-H}},$ $V_{\text{RSTH\#}}$	3.5	–	–	V	–
IN-, $\overline{\text{RST}}$ Input Current	$I_{\text{IN-}}, I_{\text{RST\#}}$	-400	-100	–	μA	$V_{\text{IN-}} = \text{GND1}$ $V_{\text{RST\#}} = \text{GND1}$
IN+ Input Current	$I_{\text{IN+}},$	–	100	400	μA	$V_{\text{IN+}} = \text{VCC1}$
RDY, $\overline{\text{FLT}}$ Pull Up Current	$I_{\text{PRDY}}, I_{\text{PFLT\#}}$	-400	-100	–	μA	$V_{\text{RDY}} = \text{GND1}$ $V_{\text{FLT\#}} = \text{GND1}$
Input Pulse Suppression IN+, IN-	$T_{\text{MININ+}},$ $T_{\text{MININ-}}$	30	40	–	ns	–
Input Pulse Suppression $\overline{\text{RST}}$ for ENABLE/SHUTDOWN	$T_{\text{MINRST}}$	30	40	–	ns	–
Pulse Width $\overline{\text{RST}}$ for Resetting $\overline{\text{FLT}}$	$T_{\text{RST}}$	800	–	–	ns	–
$\overline{\text{FLT}}$ Low Voltage	$V_{\text{FLTL}}$	–	–	300	mV	$I_{\text{SINK(FLT\#)}} = 5 \text{ mA}$
RDY Low Voltage	$V_{\text{RDYL}}$	–	–	300	mV	$I_{\text{SINK(RDY)}} = 5 \text{ mA}$

### 5.4.3 Gate Driver

**Table 7 Gate Driver**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
High Level Output Voltage	$V_{\text{OUTH1}}$	$V_{\text{CC2}} - 1.2$	$V_{\text{CC2}} - 0.8$	–	V	$I_{\text{OUTH}} = -20 \text{ mA}$
	$V_{\text{OUTH2}}$	$V_{\text{CC2}} - 2.5$	$V_{\text{CC2}} - 2.0$	–	V	$I_{\text{OUTH}} = -200 \text{ mA}$
	$V_{\text{OUTH3}}$	$V_{\text{CC2}} - 9$	$V_{\text{CC2}} - 5$	–	V	$I_{\text{OUTH}} = -1 \text{ A}$
	$V_{\text{OUTH4}}$		$V_{\text{CC2}} - 10$	–	V	$I_{\text{OUTH}} = -2 \text{ A}$
High Level Output Peak Current	$I_{\text{OUTH}}$	-1.5	-2.0	–	A	IN+ = High, IN- = Low; OUT = High
Low Level Output Voltage	$V_{\text{OUTL1}}$	–	$V_{\text{VEE2}} + 0.04$	$V_{\text{VEE2}} + 0.09$	V	$I_{\text{OUTL}} = 20 \text{ mA}$
	$V_{\text{OUTL2}}$	–	$V_{\text{VEE2}} + 0.3$	$V_{\text{VEE2}} + 0.85$	V	$I_{\text{OUTL}} = 200 \text{ mA}$
	$V_{\text{OUTL3}}$	–	$V_{\text{VEE2}} + 2.1$	$V_{\text{VEE2}} + 5$	V	$I_{\text{OUTL}} = 1 \text{ A}$
	$V_{\text{OUTL4}}$	–	$V_{\text{VEE2}} + 7$	–	V	$I_{\text{OUTL}} = 2 \text{ A}$
Low Level Output Peak Current	$I_{\text{OUTL}}$	1.5	2.0	–	A	IN+ = Low, IN- = Low; OUT = Low, $V_{\text{VCC2}} = 15 \text{ V}$ , $V_{\text{VEE2}} = -8 \text{ V}$

### 5.4.4 Active Miller Clamp

**Table 8 Active Miller Clamp**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Low Level Clamp Voltage	$V_{\text{CLAMPL1}}$	–	$V_{\text{VEE2}} + 0.03$	$V_{\text{VEE2}} + 0.08$	V	$I_{\text{OUTL}} = 20 \text{ mA}$
	$V_{\text{CLAMPL2}}$	–	$V_{\text{VEE2}} + 0.3$	$V_{\text{VEE2}} + 0.8$	V	$I_{\text{OUTL}} = 200 \text{ mA}$
	$V_{\text{CLAMPL3}}$	–	$V_{\text{VEE2}} + 1.9$	$V_{\text{VEE2}} + 4.8$	V	$I_{\text{OUTL}} = 1 \text{ A}$
Low Level Clamp Current	$I_{\text{CLAMPL}}$	2	–	–	A	<sup>1)</sup>
Clamp Threshold Voltage	$V_{\text{CLAMP}}$	1.6	2.1	2.4	V	Related to VEE2

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

### 5.4.5 Short Circuit Clamping

Short circuit clamping characteristics are measured with  $IN+ = \text{High}$ ,  $IN- = \text{Low}$  and  $OUT = \text{High}$ .

**Table 9 Short Circuit Clamping**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Clamping voltage (OUT) ( $V_{OUT} - V_{VCC2}$ )	$V_{CLPout}$	—	0.8	1.3	V	$I_{pulse}$ test, $t_{CLPmax} = 10 \mu s$
Clamping voltage (CLAMP) ( $V_{VCLAMP} - V_{VCC2}$ )	$V_{CLPclamp}$	—	1.3	—	V	$I_{CLAMP} = 500 \text{ mA}$ (pulse test, $t_{CLPmax} = 10 \mu s$ )
Clamping voltage (CLAMP)	$V_{CLPclamp}$	—	0.7	1.1	V	$I_{CLAMP} = 20 \text{ mA}$

### 5.4.6 Dynamic Characteristics

Dynamic characteristics are measured with  $V_{VCC1} = 5 \text{ V}$ ,  $V_{VCC2} = 15 \text{ V}$  and  $V_{VEE2} = -8 \text{ V}$ .

**Table 10 Dynamic Characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input $IN+$ , $IN-$ to output propagation delay ON	$T_{PDON}$	180	205	225	ns	$C_{LOAD} = 100 \text{ pF}$ $V_{IN+} = 50\%$ , $V_{OUT} = 50\% @ 25^\circ\text{C}$
Input $IN+$ , $IN-$ to output propagation delay OFF	$T_{PDOFF}$	155	175	195	ns	
Input $IN+$ , $IN-$ to output propagation delay distortion ( $T_{PDOFF} - T_{PDON}$ )	$T_{PDISTO}$	-60	-30	0	ns	
Input $IN+$ , $IN-$ to output propagation delay ON variation due to temp	$T_{PDONt}$	190	220	250	ns	$C_{LOAD} = 100 \text{ pF}$ $V_{IN+} = 50\%$ , $V_{OUT} = 50\% @ 125^\circ\text{C}$
Input $IN+$ , $IN-$ to output propagation delay OFF variation due to temp	$T_{PDOFFt}$	170	200	230	ns	
Input $IN+$ , $IN-$ to output propagation delay distortion ( $T_{PDOFF} - T_{PDON}$ )	$T_{PDISTOt}$	-50	-20	10	ns	
Input $IN+$ , $IN-$ to output propagation delay ON variation due to temp	$T_{PDONt}$	185	215	245	ns	$C_{LOAD} = 100 \text{ pF}$ $V_{IN+} = 50\%$ , $V_{OUT} = 50\% @ -40^\circ\text{C}$
Input $IN+$ , $IN-$ to output propagation delay OFF variation due to temp	$T_{PDOFFt}$	140	170	200	ns	
Input $IN+$ , $IN-$ to output propagation delay distortion ( $T_{PDOFF} - T_{PDON}$ )	$T_{PDISTOt}$	-85	-50	-15	ns	

**Table 10 Dynamic Characteristics (cont'd)**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Rise Time	$T_{RISE}$	10	30	60	ns	$C_{LOAD} = 1 \text{ nF}$ $V_L 10\%, V_H 90\%$
		200	400	800	ns	$C_{LOAD} = 34 \text{ nF}$ $V_L 10\%, V_H 90\%$
Fall Time	$T_{FALL}$	10	50	90	ns	$C_{LOAD} = 1 \text{ nF}$ $V_L 10\%, V_H 90\%$
		200	350	600	ns	$C_{LOAD} = 34 \text{ nF}$ $V_L 10\%, V_H 90\%$

### 5.4.7 Desaturation Protection

**Table 11 Desaturation Protection**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Blanking Capacitor Charge Current	$I_{DESATC}$	225	250	275	μA	$V_{VCC2} = 15 \text{ V}$ , $V_{VEE2} = -8 \text{ V}$ $V_{DESAT} = 2 \text{ V}$
Blanking Capacitor Discharge Current	$I_{DESATD}$	1	2	–	mA	$V_{VCC2} = 15 \text{ V}$ , $V_{VEE2} = -8 \text{ V}$ $V_{DESAT} = 6 \text{ V}$
Desaturation Reference Level	$V_{DESAT}$	8.3	9	9.5	V	$V_{VCC2} = 15 \text{ V}$
Desaturation Sense to OUT Low Delay	$T_{DESATOUT}$	–	100	150	ns	$V_{OUT} = 90\%$ $C_{LOAD} = 1 \text{ nF}$
Desaturation Sense to FLT Low Delay	$T_{DESATFLT}$	–	–	2.25	μs	$V_{FLT\#} = 10\%$ ; $I_{FLT\#} = 5 \text{ mA}$
Desaturation Low Voltage	$V_{DESATL}$	0.4	0.6	0.95	V	IN+ = Low, IN- = Low, OUT = Low

## 5.4.8 Active Shut Down

**Table 12 Active Shut Down**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Active Shut Down Voltage	$V_{ACTSD}^{1)}$	–	–	4.0	V	$I_{OUT} = -200\text{ mA}$ , $V_{CC2}$ open

1) With reference to VEE2

## 6 Insulation Characteristics

Insulation characteristics are guaranteed only within the safety maximum ratings which must be ensured by protective circuits in application. Surface mount classification is class A in accordance with CECC00802.

This coupler is suitable for “basic insulation” only within the safety ratings. Compliance with the safety ratings shall be ensured by means of suitable protective circuits.

### 6.1 Certified according to DIN EN 60747-5-2 (VDE 0884 Teil 2): 2003-01. Basic Insulation

**Table 13** According to DIN EN 60747-5-2

Description	Symbol	Characteristic	Unit
Installation classification per EN 60664-1, Table 1 for rated mains voltage $\leq 150 V_{RMS}$ for rated mains voltage $\leq 300 V_{RMS}$ for rated mains voltage $\leq 600 V_{RMS}$		I-IV I-III 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	$V_{IORM}$	1420	$V_{PEAK}$
Highest Allowable Overvoltage	$V_{IOTM}$	6000	$V_{PEAK}$
Maximum Surge Insulation Voltage	$V_{IOSM}$	6000	V

### 6.2 Recognized under UL 1577

**Table 14** Recognized under UL 1577

Description	Symbol	Characteristic	Unit
Insulation Withstand Voltage / 1 min	$V_{ISO}$	3750	$V_{rms}$
Insulation Test Voltage / 1 s	$V_{ISO}$	4500	$V_{rms}$

### 6.3 Reliability

For Qualification Report please contact your local Infineon Technologies office.



## 7 Timing Diagramms

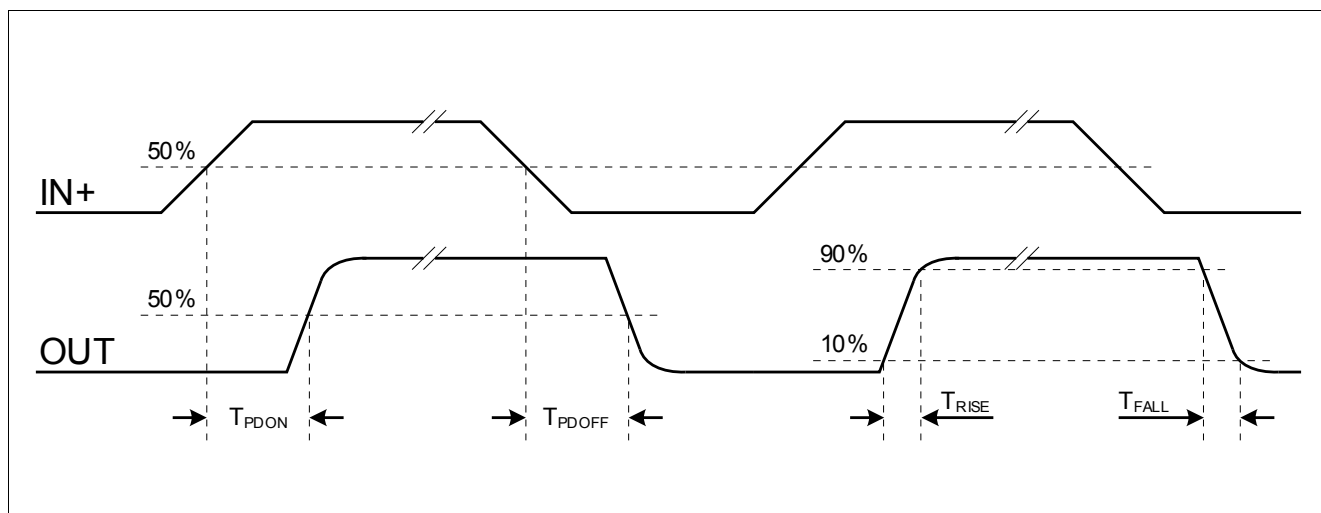


Figure 6 Propagation Delay, Rise and Fall Time

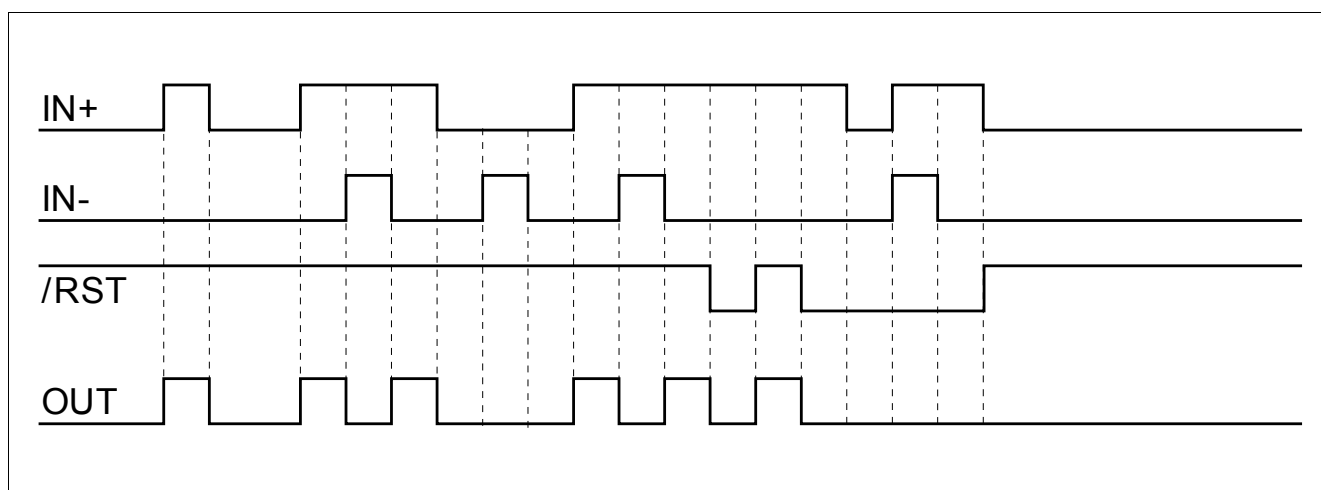


Figure 7 Typical Switching Behavior

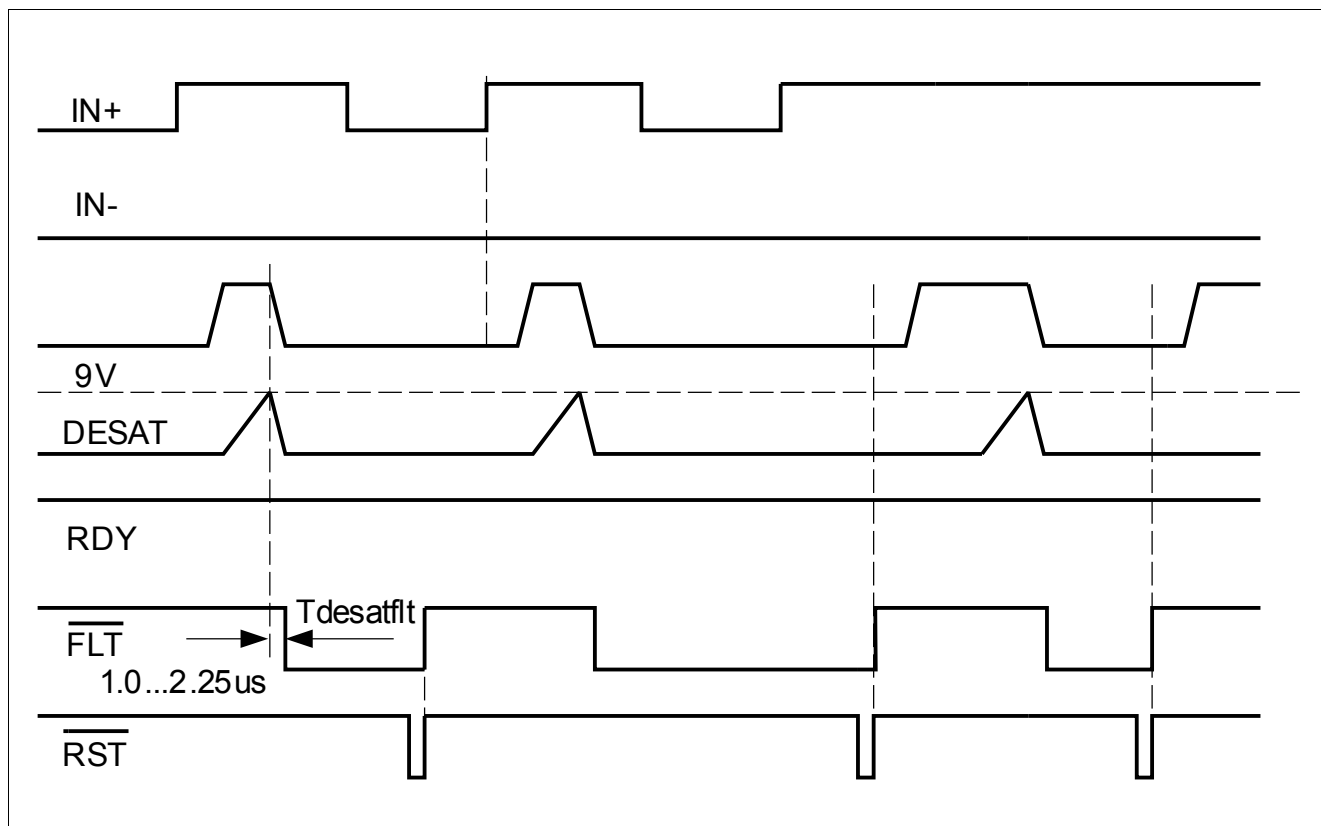


Figure 8 DESAT Switch-Off Behavior

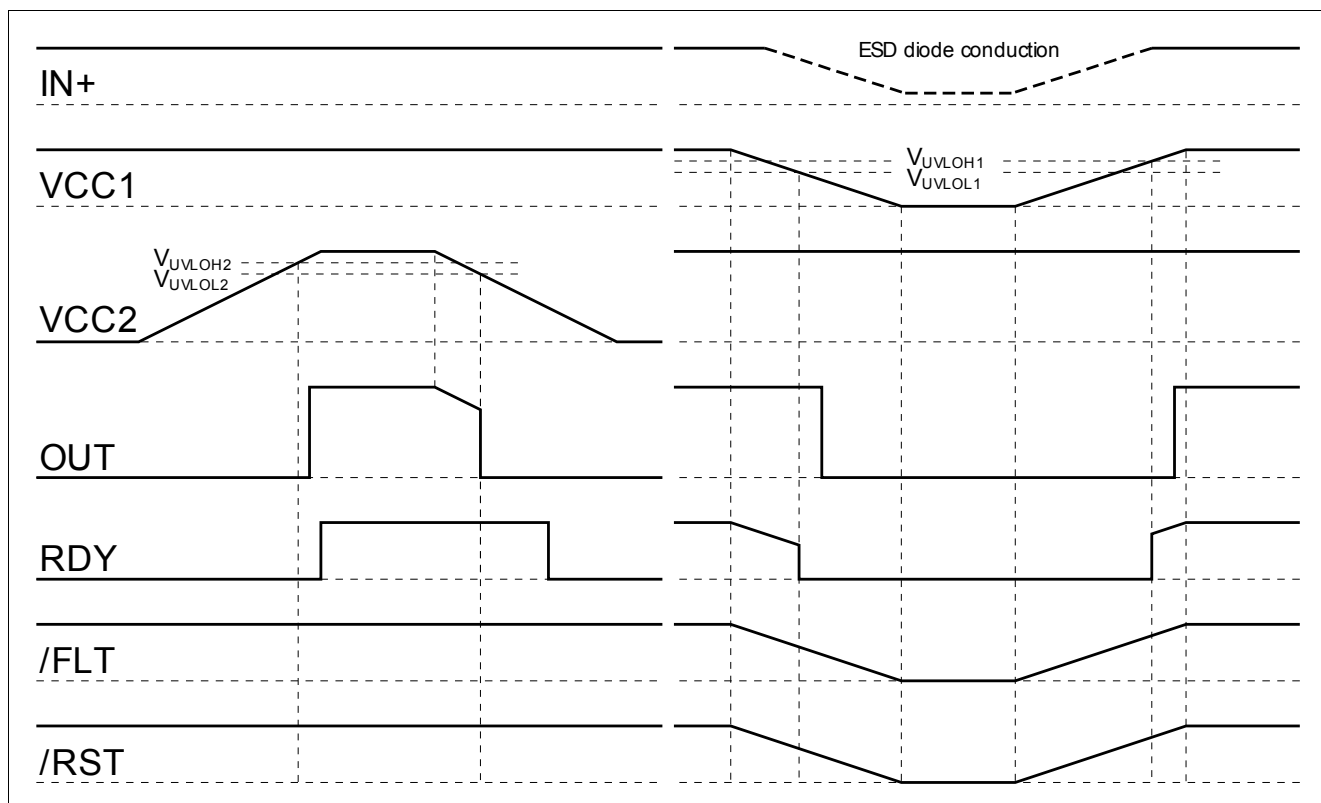
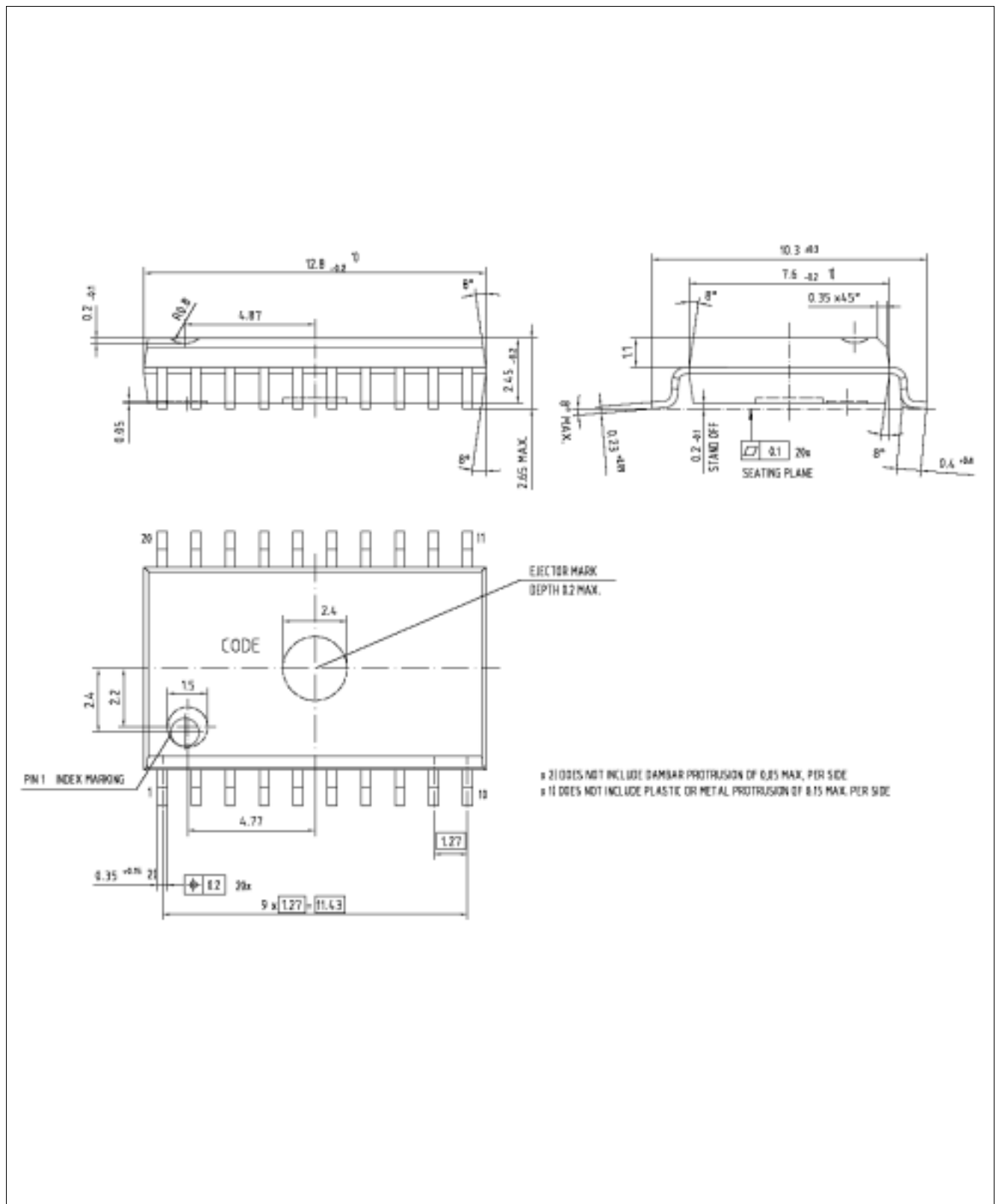


Figure 9 UVLO Behavior

## 8 Package Outlines



## 9 Application Notes

### 9.1 Reference Layout for Thermal Data

The PCB layout shown in [Figure 11](#) 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.

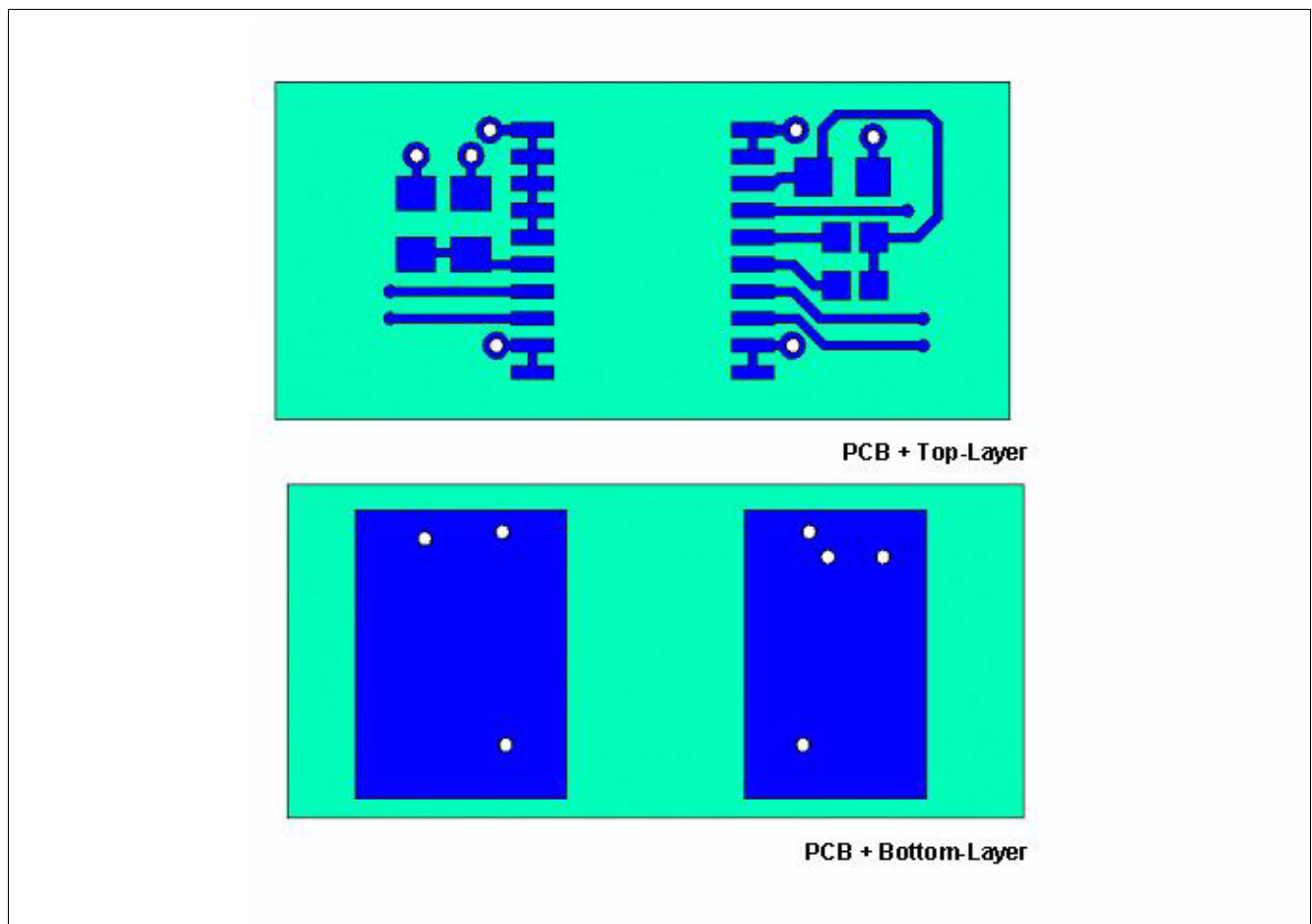


Figure 11 Reference Layout for Thermal Data (Copper thickness 102 µm)

### 9.2 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.
- Lowest trace length for VEE2 to GND2 decoupling could be achieved with capacitor closed to pins 2 and 4.

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