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# EiceDRIVER™

High voltage gate driver IC

## 6ED family - 2nd generation

3 phase 200 V and 600 V gate drive IC
6EDL04I06PT
6EDL04I06NT
6EDL04N06PT
6EDL04N02PR

EiceDRIVER™

## datasheet

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| Revision History | |
|---|---|
| **Page or Item** | **Subjects (major changes since previous revision)** |
| **<Revision 2.5>, 15.04.2015** | |
| all | Revised wording for test temperature |
| | |
| | |
| p. 22 | Inserted Figure 18 ITRIP input timing |
| p. 20 | Revised Figure 9 |
| | |

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**EiceDRIVER™**
**3 phase 200 V and 600 V gate drive IC**


# 1 Overview

### Main features

- Thin-film-SOI-technology
- Maximum blocking voltage +600V
- Separate control circuits for all six drivers
- CMOS and LSTTL compatible input (negative logic)
- Signal interlocking of every phase to prevent cross-conduction
- Detection of over current and under voltage supply
- externally programmable delay for fault clear after over current detection

### Product highlights

- Insensitivity of the bridge output to negative transient voltages up to -50V given by SOI-technology
- Ultra fast bootstrap diodes
- 'shut down' of all switches during error conditions

### Typical applications

- Home appliances
- Fans, pumps
- General purpose drives

### Product family

**Table 1 Members of 6ED family – 2nd generation**

| Sales Name | high side control input HIN1,2,3 and LIN1,2,3 | typ. UVLO-Thresholds | Bootstrap diode | Package |
|---|---|---|---|---|
| 6EDL04I06NT | negative logic | 11.7 V / 9.8 V | Yes | DSO28 |
| 6EDL04I06PT | positive logic | 11.7 V / 9.8 V | Yes | DSO28 |
| 6EDL04N06PT / 6EDL04N02PR | positive logic | 9 V / 8.1 V | Yes | DSO28 / TSSOP28 |

### Description

The device 6ED family – 2nd generation is a full bridge driver to control power devices like MOS-transistors or IGBTs in 3-phase systems with a maximum blocking voltage of +600 V. Based on the used SOI-technology there is an excellent ruggedness on transient voltages. No parasitic thyristor structures are present in the device. Hence, no parasitic latch-up may occur at all temperatures and voltage conditions.

The six independent drivers are controlled at the low-side using CMOS resp. LSTTL compatible signals, down to 3.3 V logic. The device includes an under-voltage detection unit with hysteresis characteristic and an over-current detection. The over-current level is adjusted by choosing the resistor value and the threshold level at pin ITRIP. Both error conditions (under-voltage and over-current) lead to a definite shut down off all six switches. An error signal is provided at the FAULT open drain output pin. The blocking time after over-current can be adjusted with an RC-network at pin RCIN. The input RCIN owns an internal current source of 2.8 µA. Therefore, the resistor $R_{RCIN}$ is optional. The typical output current can be given with 165 mA for pull-up and 375 mA for pull down. Because of system safety reasons a 310 ns interlocking time has been realised. The function of input EN can optionally be extended with an over-temperature detection, using an external NTC-resistor (see Fig.1). The

monolithic integrated bootstrap diode structures between pins VCC and VBx can be used for power supply of the high side.

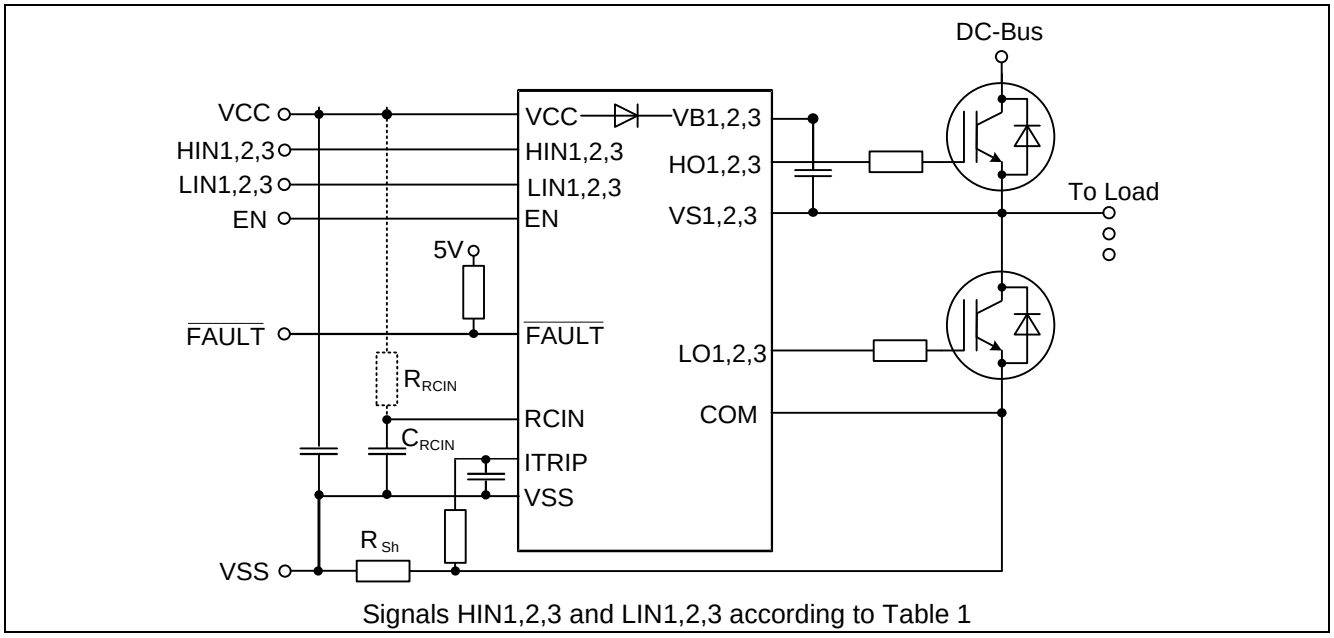



**Figure 1 Typical Application**

## 2 Blockdiagram

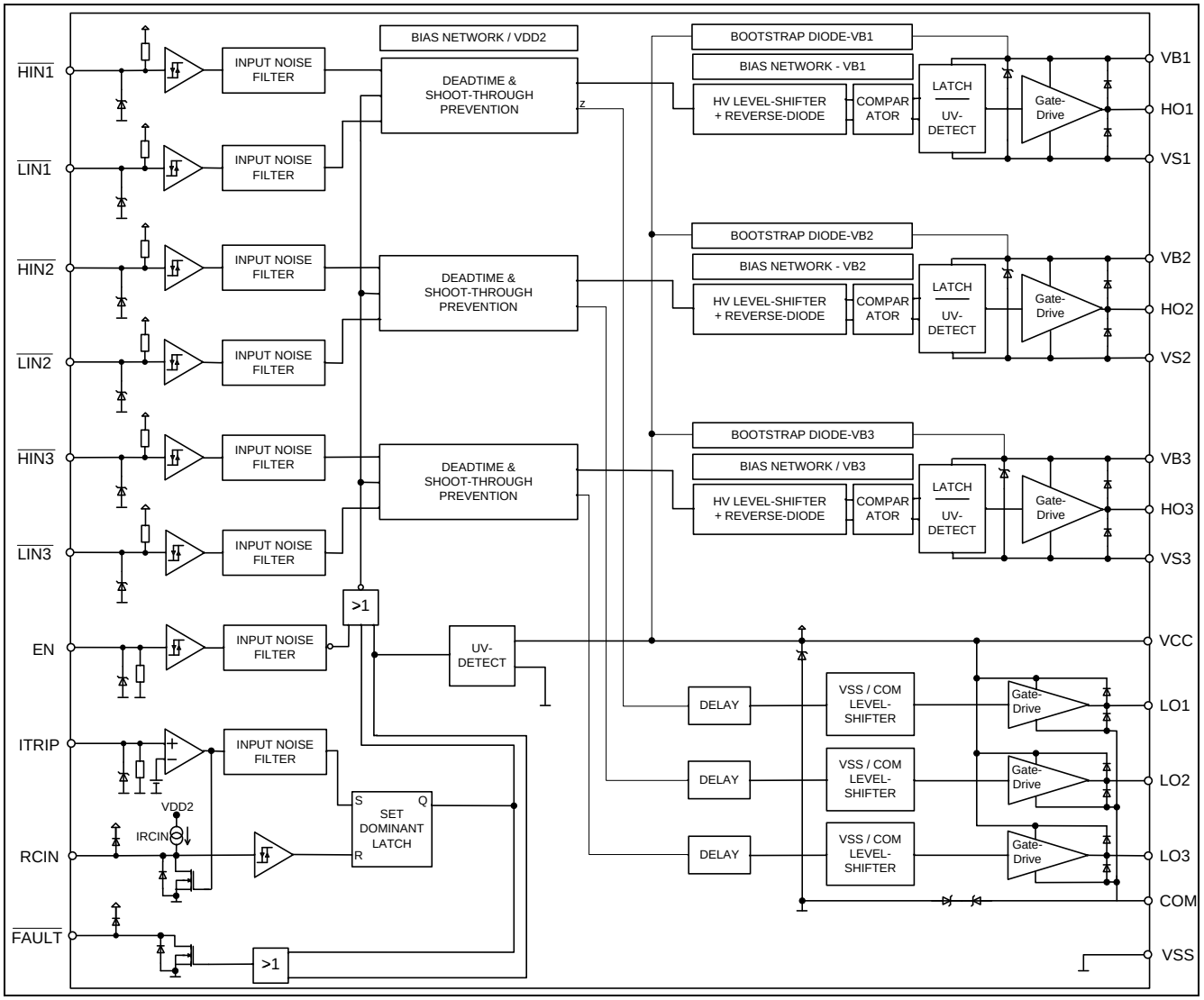



**Figure 2 Block diagram for 6EDL04I06NT**

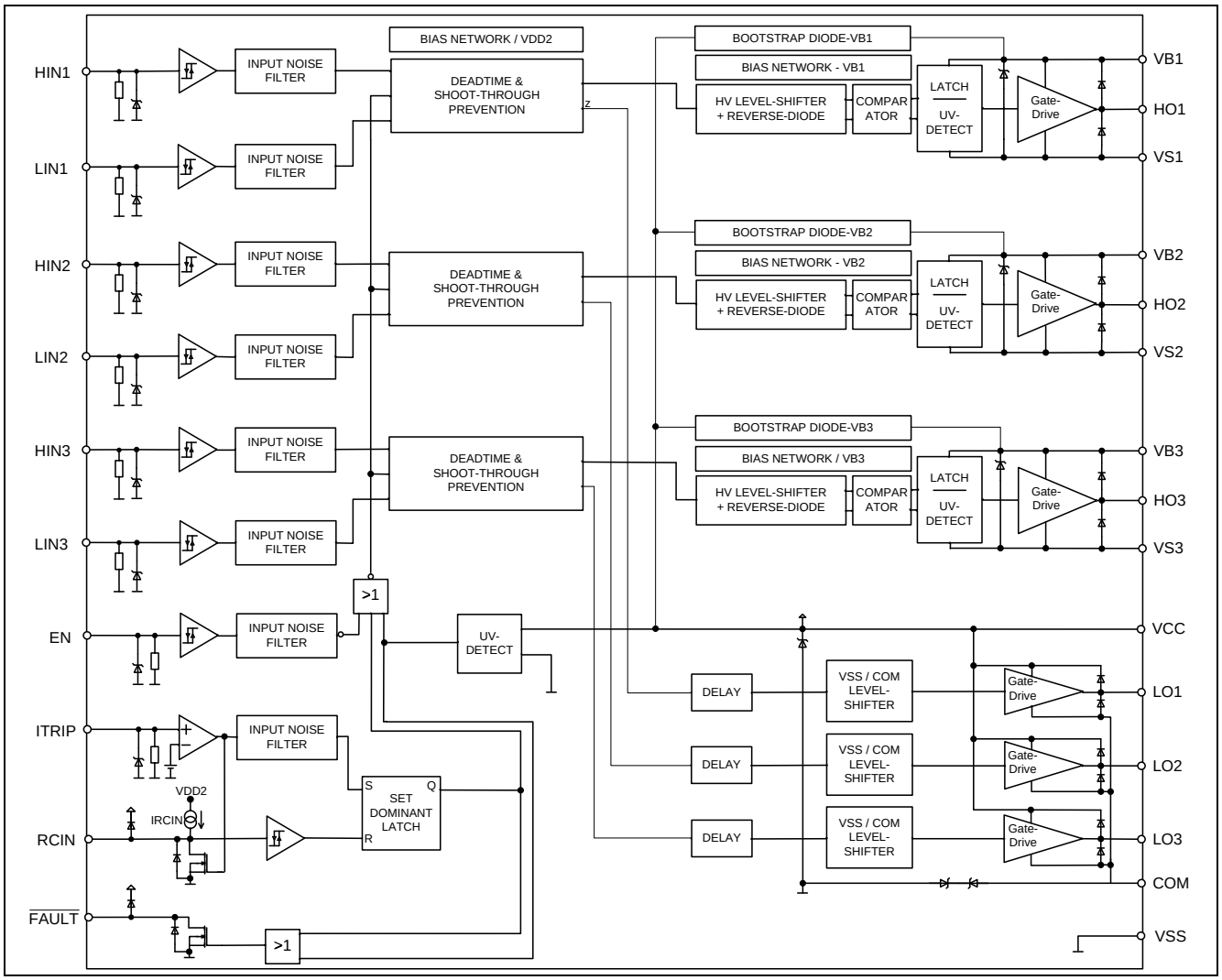



**Figure 3 Block Diagram for 6EDL04I06PT, and 6EDL04N06PT / 6EDL04N02PR**

# 3 Pin configuration, description, and functionality

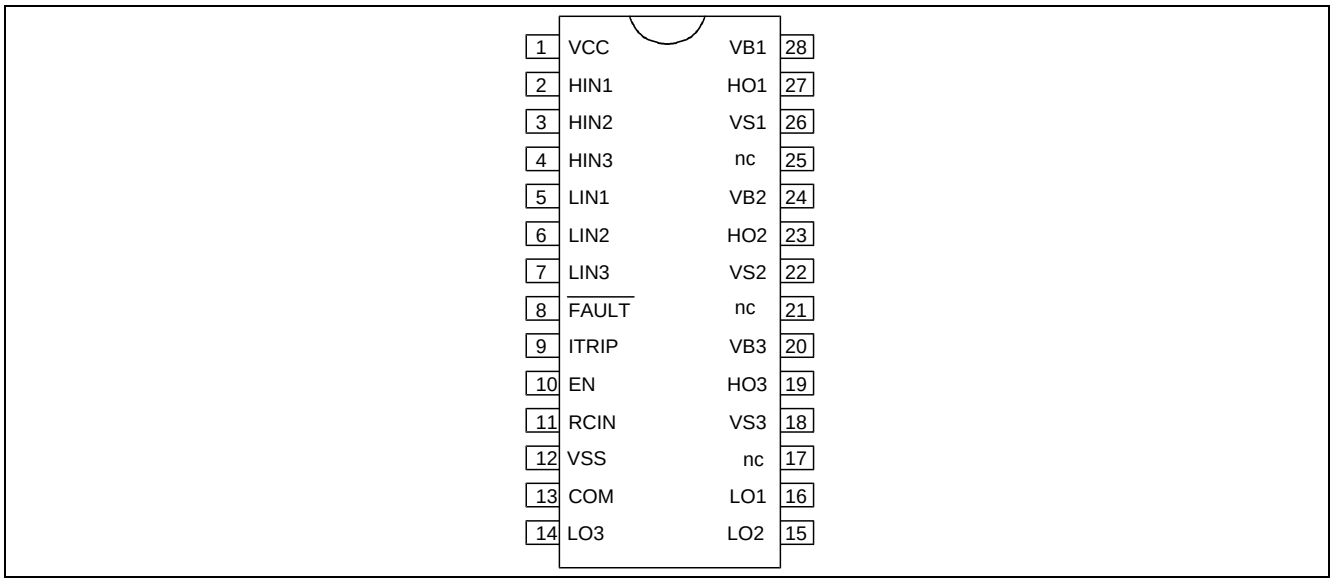



**Figure 4 Pin Configuration of 6ED family (signals HIN1,2,3 and LIN1,2,3 according to Table 1)**

**Table 2 xPin Description**

| Symbol | Description |
|---|---|
| VCC | Low side power supply |
| VSS | Logic ground |
| HIN1,2,3 | High side logic input (positive or negative logic according to Table 1 |
| LIN1,2,3 | Low side logic input (positive or negative logic according to Table 1 |
| /FAULT | Indicates over-current and under-voltage (negative logic, open-drain output) |
| EN | Enable I/O functionality (positive logic) |
| ITRIP | Analog input for over-current shut down, activates FAULT and RCIN to VSS |
| RCIN | External RC-network to define FAULT clear delay after FAULT-Signal ($T_{FLTCLR}$) |
| COM | Low side gate driver reference |
| VB1,2,3 | High side positive power supply |
| HO1,2,3 | High side gate driver output |
| VS1,2,3 | High side negative power supply |
| LO1,2,3 | Low side gate driver output |
| nc | Not connected |

## 3.1 Low Side and High Side Control Pins (Pin 2, 3, 4, 5, 6, 7)

The Schmitt trigger input threshold of them are such to guarantee LSTTL and CMOS compatibility down to 3.3 V controller outputs. Input Schmitt trigger and noise filter provide beneficial noise rejection to short input pulses according to Figure 5 and Figure 6.

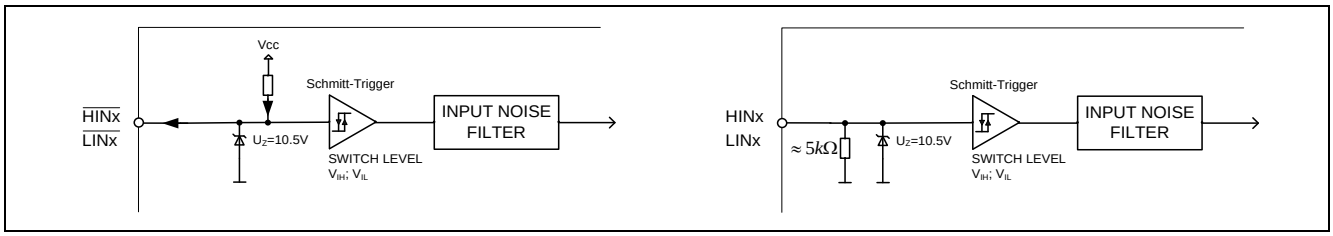



**Figure 5 Input pin structure for negative logic (left) and positive logic (right)**

An internal pull-up of about 75 kΩ (negative logic) pre-biases the input during supply start-up and a ESD zener clamp is provided for pin protection purposes. The zener diodes are therefore designed for single pulse stress only and not for continuous voltage stress over 10V. For versions with positive, a 5 kΩ pull-down resistor is used for this function.

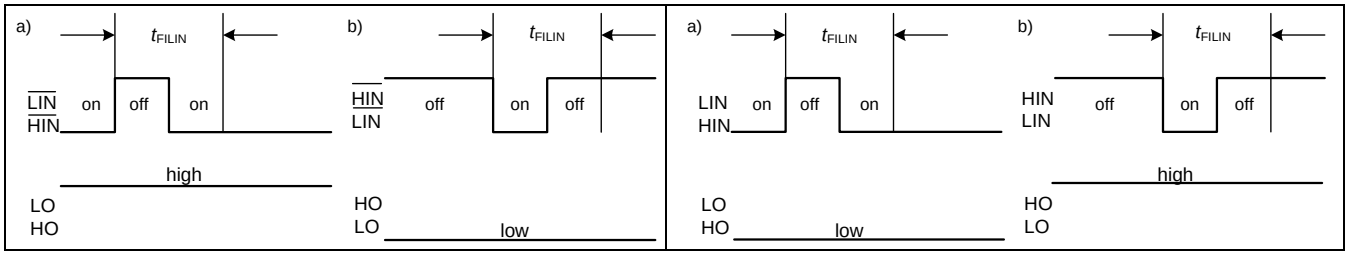



**Figure 6 Input filter timing diagram for negative logic (left) and positive logic (right)**

It is anyway recommended for proper work of the driver not to provide input pulse-width lower than 1 µs.

The 6ED family – 2nd generation provides additionally a shoot through prevention capability which avoids the simultaneous on-state of two channels of the same leg (i.e. HO1 and LO1, HO2 and LO2, HO3 and LO3). When two inputs of a same leg are activated, only one leg output is activated, so that the leg is kept steadily in a safe state. Please refer to the application note AN-Gatedrive-6ED2-1 for a detailed description.

A minimum dead time insertion of typ. 310 ns is also provided, in order to reduce cross-conduction of the external power switches.

## 3.2 EN (Gate Driver Enable, Pin 10)

The signal applied to pin EN controls directly the output stages. All outputs are set to LOW, if EN is at LOW logic level. The internal structure of the pin is given in Figure 7. The switching levels of the Schmitt-Trigger are here $V_{EN,TH+}$ = 2.1 V and $V_{EN,TH-}$ = 1.3 V. The typical propagation delay time is $t_{EN}$ = 780 ns. There is an internal pull down resistor (75 kΩ), which keeps the gate outputs off in case of broken PCB connection.

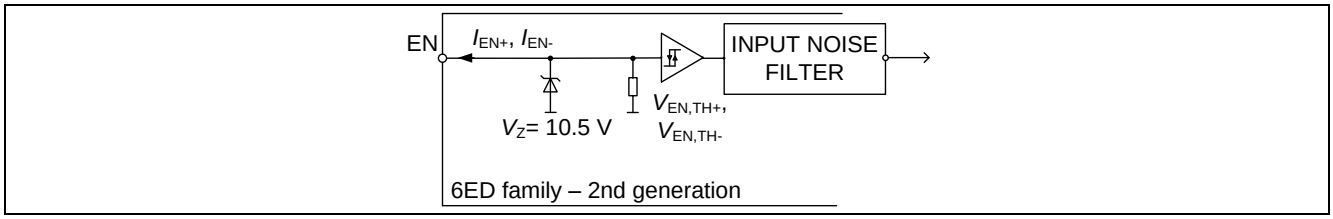



**Figure 7 EN pin structures**

## 3.3 /FAULT (Fault Feedback, Pin 8)

/Fault pin is an active low open-drain output indicating the status of the gate driver (see Figure 8). The pin is active (i.e. forces LOW voltage level) when one of the following conditions occur:

- Under-voltage condition of VCC supply: In this case the fault condition is released as soon as the supply voltage condition returns in the normal operation range (please refer to VCC pin description for more details).
- Over-current detection (ITRIP): The fault condition is latched until current trip condition is finished and RCIN input is released (please refer to ITRIP pin).

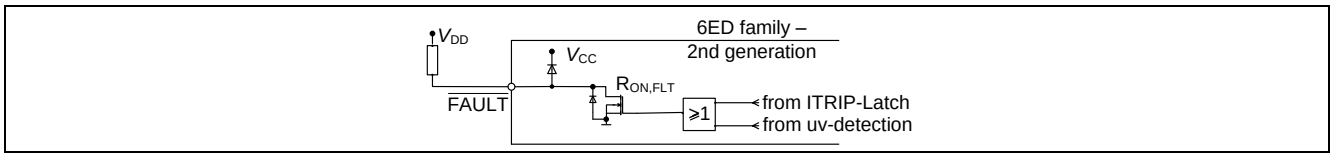



**Figure 8 /FAULT pin structures**

## 3.4 ITRIP and RCIN (Over-Current Detection Function, Pin 9, 11)

The 6ED family – 2nd generation provides an over-current detection function by connecting the ITRIP input with the motor current feedback. The ITRIP comparator threshold (typ 0.44 V) is referenced to VSS ground. A input noise filter (typ. $t_{ITRIPMIN}$ = 230 ns) prevents the driver to detect false over-current events.

Over-current detection generates a hard shut down of all outputs of the gate driver and provides a latched fault feedback at /FAULT pin. RCIN input/output pin is used to determine the reset time of the fault condition. As soon as ITRIP threshold is exceeded the external capacitor connected to RCIN is fully discharged. The capacitor is then recharged by the RCIN current generator when the over-current condition is finished. As soon as RCIN voltage exceeds the rising threshold of typ $V_{RCIN,TH}$ = 5.2 V, the fault condition releases and the driver returns operational following the ontrol input pins according to section 3.1. Please refer to AN-Gatedrive-6ED2-1 for details on setting RCIN time constant.

## 3.5 VCC, VSS and COM (Low Side Supply, Pin 1, 12,13)

VCC is the low side supply and it provides power both to input logic and to low side output power stage. Input logic is referenced to VSS ground as well as the under-voltage detection circuit. Output power stage is referenced to COM ground. COM ground is floating respect to VSS ground with a maximum range of operation of +/-5.7 V. A back-to-back zener structure protects grounds from noise spikes.

The under-voltage circuit enables the device to operate at power on when a typical supply voltage higher than $V_{CCUV+}$ is present.

The IC shuts down all the gate drivers power outputs, when the VCC supply voltage is below $V_{CCUV-}$ = 9.8 V respectively 8.1 V. This prevents the external power switches from critically low gate voltage levels during on-state and therefore from excessive power dissipation.

## 3.6 VB1,2,3 and VS1,2,3 (High Side Supplies, Pin 18, 20, 22, 24, 26, 28)

VB to VS is the high side supply voltage. The high side circuit can float with respect to VSS following the external high side power device emitter/source voltage. Due to the low power consumption, the floating driver stage can be supplied by bootstrap topology connected to VCC.

The device operating area as a function of the supply voltage is given in Figure 15 and Figure 16. Details on bootstrap supply section and transient immunity can be found in application note AN-Gatedrive-6ED2-1.

## 3.7 LO1,2,3 and HO1,2,3 (Low and High Side Outputs, Pin 14, 15, 16, 19, 23, 27)

Low side and high side power outputs are specifically designed for pulse operation such as gate drive of IGBT and MOSFET devices. Low side outputs (i.e. LO1,2,3) are state triggered by the respective inputs, while high side outputs (i.e. HO1,2,3) are edge triggered by the respective inputs. In particular, after an under voltage condition of the VBS supply, a new turn-on signal (edge) is necessary to activate the respective high side output, while after a under voltage condition of the VCC supply, the low side outputs switch to the state of their respective inputs.

# 4 Electrical Parameters

## 4.1 Absolute Maximum Ratings

All voltages are absolute voltages referenced to $V_{SS}$ -potential unless otherwise specified. All parameters are valid for $T_a$=25 °C.

**Table 3 Abs. maximum ratings**

| Parameter | | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|---|
| High side offset voltage(Note 1) | DSO28<br>TSSOP28 | $V_S$ | $V_{CC}$-$V_{BS}$-6 | 600<br>180 | V |
| High side offset voltage ($t_p$<500ns, Note 1) | | | $V_{CC}$ -$V_{BS}$ – 50 | – | |
| High side offset voltage(Note 1) | DSO28<br>TSSOP28 | $V_B$ | $V_{CC}$ – 6 | 620<br>200 | |
| High side offset voltage ($t_p$<500ns, Note 1) | | | $V_{CC}$ – 50 | – | |
| High side floating supply voltage ($V_B$ vs. $V_S$) (internally clamped) | | $V_{BS}$ | -1 | 20 | |
| High side output voltage ($V_{HO}$ vs. $V_S$) | | $V_{HO}$ | -0.5 | $V_B$ + 0.5 | |
| Low side supply voltage (internally clamped) | | $V_{CC}$ | -1 | 20 | |
| Low side supply voltage ($V_{CC}$ vs. $V_{COM}$) | | $V_{CCOM}$ | -0.5 | 25 | |
| Gate driver ground | | $V_{COM}$ | -5.7 | 5.7 | |
| Low side output voltage ($V_{LO}$ vs. $V_{COM}$) | | $V_{LO}$ | -0.5 | $V_{CCOM}$ + 0.5 | |
| Input voltage LIN,HIN,EN,ITRIP | | $V_{IN}$ | -1 | 10 | |
| FAULT output voltage | | $V_{FLT}$ | -0.5 | $V_{CC}$ + 0.5 | |
| RCIN output voltage | | $V_{RCIN}$ | -0.5 | $V_{CC}$ + 0.5 | |
| Power dissipation (to package) Note 2 | DSO28<br>TSSOP28 | $P_D$ | –<br>– | 1.3<br>0.6 | W |
| Thermal resistance<br>(junction to ambient, see section 6) | DSO28<br>TSSOP28 | $R_{th(j-a)}$ | –<br>– | 75<br>165 | K/W |
| Junction temperature | | $T_J$ | – | 125 | °C |
| Storage temperature | | $T_S$ | - 40 | 150 | |
| offset voltage slew rate (Note 3) | | $dV_S/dt$ | | 50 | V/ns |

Note :The minimum value for ESD immunity is 1.0kV (Human Body Model). ESD immunity inside pins connected to the low side (VCC, HINx, LINx, FAULT, EN, RCIN, ITRIP, VSS, COM, LOx) and pins connected inside each high side itself (VBx, HOx, VSx) is guaranteed up to 1.5kV (Human Body Model).

Note 1 : In case $V_{CC}$ > $V_B$ there is an additional power dissipation in the internal bootstrap diode between pins VCC and VBx. Insensitivity of bridge output to negative transient voltage up to –50V is not subject to production test – verified by design / characterization.

Note 2: Consistent power dissipation of all outputs. All parameters inside operating range.

Note 3: Not subject of production test, verified by characterisation

## 4.2 Required operation conditions

All voltages are absolute voltages referenced to $V_{SS}$ -potential unless otherwise specified. All parameters are valid for $T_a$=25 °C.

**Table 4 Required Operation Conditions**

| Parameter | | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|---|
| High side offset voltage (Note 1) | DSO28<br>TSSOP28 | $V_B$ | 7 | 620<br>200 | V |
| Low side supply voltage ($V_{CC}$ vs. $V_{COM}$) | DSO28<br>TSSOP28 | $V_{CCOM}$ | 10 | 25 | |

## 4.3 Operating Range

All voltages are absolute voltages referenced to $V_{SS}$ -potential unless otherwise specified. All parameters are valid for $T_a$=25 °C.

**Table 5 Operating range**

| Parameter | | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|---|
| High side floating supply offset voltage | | $V_S$ | $V_{CC}$ -<br>$V_{BS}$ -1 | 500 | V |
| High side floating supply offset voltage ($V_B$ vs. $V_{CC}$, statically) | | $V_{BCC}$ | -1.0 | 500 | |
| High side floating supply voltage ($V_B$ vs. $V_S$, Note 1) | 6EDL04I06NT<br>6EDL04I06PT | $V_{BS}$ | 13 | 17.5 | |
| | 6EDL04N06PT<br>6EDL04N02PR | | 10 | 17.5 | |
| High side output voltage ($V_{HO}$ vs. $V_S$) | | $V_{HO}$ | 10 | $V_{BS}$ | |
| Low side output voltage ($V_{LO}$ vs. $V_{COM}$) | | $V_{LO}$ | 0 | $V_{CC}$ | |
| Low side supply voltage | 6EDL04I06NT<br>6EDL04I06PT | $V_{CC}$ | 13 | 17.5 | |
| | 6EDL04N06PT<br>6EDL04N02PR | | 10 | 17.5 | |
| Low side ground voltage | | $V_{COM}$ | -2.5 | 2.5 | |
| Logic input voltages LIN,HIN,EN,ITRIP (Note 2) | | $V_{IN}$ | 0 | 5 | |
| FAULT output voltage | | $V_{FLT}$ | 0 | $V_{CC}$ | |
| RCIN input voltage | | $V_{RCIN}$ | 0 | $V_{CC}$ | |
| Pulse width for ON or OFF (Note 3) | | $t_{IN}$ | 1 | – | µs |
| Ambient temperature | | $T_a$ | -40 | 95 | °C |

Note 1 : Logic operational for $V_B$ ($V_B$ vs. $V_S$) > 7,0V

Note 2 : All input pins (HINx, LINx) and EN, ITRIP pin are internally clamped (see abs. maximum ratings)

Note 3 : In case of input pulse width at LINx and HINx below 1µ the input pulse may not be transmitted properly

## 4.4 Static logic function table

| VCC | VBS | RCIN | ITRIP | ENABLE | FAULT | LO1,2,3 | HO1,2,3 |
|---|---|---|---|---|---|---|---|
| $<V_{CCUV-}$ | X | X | X | X | 0 | 0 | 0 |
| 15V | $<V_{BSUV-}$ | X | 0 | 3.3 V | High imp | LIN1,2,3* | 0 |
| 15V | 15V | <3.2 V ↓ | 0 | 3.3 V | 0 | 0 | 0 |
| 15V | 15V | X | $> V_{IT,TH+}$ | 3.3 V | 0 | 0 | 0 |
| 15V | 15V | $> V_{RCIN,TH}$ | 0 | 3.3 V | High imp | LIN1,2,3* | HIN1,2,3* |
| 15V | 15V | $> V_{RCIN,TH}$ | 0 | 0 | High imp | 0 | 0 |

* according to Table 1

## 4.5 Static parameters

$V_{CC}$ = $V_{BS}$ = 15V unless otherwise specified. All parameters are valid for $T_a$=25 °C.

**Table 6 Static parameters**

| Parameter | | Symbol | Values | | | Unit | Test condition |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| High level input voltage | | $V_{IH}$ | 1.7 | 2.1 | 2.4 | V | |
| Low level input voltage | | $V_{IL}$ | 0.7 | 0.9 | 1.1 | | |
| EN positive going threshold | | $V_{EN,TH+}$ | 1.9 | 2.1 | 2.3 | | |
| EN negative going threshold | | $V_{EN,TH-}$ | 1.1 | 1.3 | 1.5 | | |
| ITRIP positive going threshold | | $V_{IT,TH+}$ | 380 | 445 | 510 | mV | |
| ITRIP input hysteresis | | $V_{IT,HYS}$ | 45 | 70 | | | |
| RCIN positive going threshold | | $V_{RCIN,TH}$ | - | 5.2 | 6.4 | V | |
| RCIN input hysteresis | | $V_{RCIN,HYS}$ | - | 2.0 | - | | |
| Input clamp voltage (HIN and LIN acc. Table 1, EN, ITRIP) | | $V_{IN,CLMAP}$ | 9 | 10.3 | 12 | | $I_{IN}$ = 4mA |
| Input clamp voltage at high impedance (/HIN, /LIN negative logic only) | | $V_{IN,FLOAT}$ | - | 5.3 | 5.8 | | controller output pin floating |
| High level output voltage | LO1,2,3<br>HO1,2,3 | $V_{OH}$ | -<br>- | $V_{CC}$ -0.7<br>$V_B$ -0.7 | $V_{CC}$ -1.4<br>$V_B$ -1.4 | | $I_O$ = 20mA |
| Low level output voltage | LO1,2,3<br>HO1,2,3 | $V_{OL}$ | -<br>- | $V_{COM}$+ 0.2<br>$V_S$+ 0.2 | $V_{COM}$+ 0.6<br>$V_S$ + 0.6 | | $I_O$ = -20mA |
| $V_{CC}$ and $V_{BS}$ supply undervoltage positive going threshold | 6EDL04I06NT<br>6EDL04I06PT | $V_{CCUV+}$<br>$V_{BSUV+}$ | 11 | 11.7 | 12.5 | | |
| | 6EDL04N06PT<br>6EDL04N02PR | | 8.3 | 9 | 9.8 | | |
| $V_{CC}$ and $V_{BS}$ supply undervoltage negative going threshold | 6EDL04I06NT<br>6EDL04I06PT | $V_{CCUV-}$<br>$V_{BSUV-}$ | 9.5 | 9.8 | 10.8 | V | |
| | 6EDL04N06PT<br>6EDL04N02PR | | 7.5 | 8.1 | 8.8 | | |

**Table 6 Static parameters**

| Parameter | | Symbol | Values | | | Unit | Test condition |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| $V_{CC}$ and $V_{BS}$ supply undervoltage lockout hysteresis | 6EDL04I06PT 6EDL04I06PT | $V_{CCUVH}$ $V_{BSUVH}$ | 1.2 | 1.9 | - | V | |
| | 6EDL04N06PT 6EDL04N02PR | | 0.5 | 0.9 | - | | |
| High side leakage current betw. VS and VSS | | $I_{LVS+}$ | | 1 | 12.5 | µA | $V_S$ = 600V |
| High side leakage current betw. VS and VSS | | $I_{LVS+}$[1] | - | 10 | - | | $T_J$=125°C,$V_S$=600V |
| High side leakage current between VSx and VSy (x=1,2,3 and y=1,2,3) | | $I_{LVS-}$[1] | - | 10 | - | | $T_J$ = 125°C $V_{Sx}$ - $V_{Sy}$ = 600V |
| Quiescent current $V_{BS}$ supply (VB only) | | $I_{QBS1}$ | - | 210 | 400 | | HO=low |
| Quiescent current $V_{BS}$ supply (VB only) | | $I_{QBS2}$ | - | 210 | 400 | | HO=high |
| Quiescent current $V_{CC}$ supply (VCC only) | 6EDL04I06NT | $I_{QCC1}$ | - | 1.1 | 1.8 | mA | $V_{LIN}$=float. (all) $V_{VSx}$=50V (only bootstrap types) |
| | 6EDL04I06PT 6EDL04N06PT 6EDL04N02PR | | - | 0.75 | 1.5 | | |
| Quiescent current $V_{CC}$ supply (VCC only) | 6EDL04I06NT | $I_{QCC2}$ | - | 1.3 | 2 | | $V_{LIN}$=0, $V_{HIN}$=3.3 V $V_{VSx}$=50V |
| | 6EDL04I06PT 6EDL04N06PT 6EDL04N02PR | | | 0.75 | 1.5 | | $V_{LIN}$=3.3 V, $V_{HIN}$=0 $V_{VSx}$=50V |
| Quiescent current $V_{CC}$ supply (VCC only) | 6EDL04I06NT | $I_{QCC3}$ | - | 1.3 | 2 | | $V_{LIN}$=3.3 V, $V_{HIN}$=0 $V_{VSx}$=50V |
| | 6EDL04I06PT 6EDL04N06PT 6EDL04N02PR | | | 0.75 | 1.5 | | $V_{LIN}$=3.3 V, $V_{HIN}$=0 $V_{VSx}$=50V |
| Input bias current | 6EDL04I06NT | $I_{LIN+}$ | - | 70 | 100 | µA | $V_{LIN}$=3.3 V |
| | 6EDL04I06PT 6EDL04N06PT 6EDL04N02PR | | 400 | 700 | 1100 | | |
| Input bias current | 6EDL04I06NT | $I_{LIN-}$ | - | 110 | 200 | µA | $V_{LIN}$=0 |
| | 6EDL04I06PT 6EDL04N06PT 6EDL04N02PR | | | 0 | | | |
| Input bias current | 6EDL04I06NT | $I_{HIN+}$ | - | 70 | 100 | | $V_{HIN}$=3.3 V |
| | 6EDL04I06PT 6EDL04N06PT 6EDL04N02PR | | 400 | 700 | 1100 | | |
| Input bias current | 6EDL04I06NT | $I_{HIN-}$ | - | 110 | 200 | | $V_{HIN}$=0 |
| | 6EDL04I06PT 6EDL04N06PT 6EDL04N02PR | | | 0 | | | |
| Input bias current (ITRIP=high) | | $I_{ITRIP+}$ | | 45 | 120 | | $V_{ITRIP}$=3.3 V |
| Input bias current (EN=high) | | $I_{EN+}$ | - | 45 | 120 | | $V_{ENABLE}$=3.3 V |
| Input bias current RCIN (internal current source) | | $I_{RCIN}$ | | 2.8 | | | $V_{RCIN}$ = 2 V |

[1] Not subject of production test, verified by characterisation

**Table 6 Static parameters**

| Parameter | Symbol | Values | | | Unit | Test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Mean output current for load capacity charging in range from 3 V (20%) to 6 V (40%) | $I_{O+}$ | 120 | 165 | - | mA | $C_L$=10 nF |
| Peak output current turn on (single pulse) | $I_{Opk+}$ [1] | | 240 | | | $R_L$ = 0 Ω, $t_p$ <10 µs |
| Mean output current for load capacity discharging in range from 12 V (80%) to 9 V (60%) | $I_{O-}$ | 250 | 375 | - | | $C_L$=10 nF |
| Peak output current turn off (single pulse) | $I_{Opk-}$ [1] | | 420 | | | $R_L$ = 0 Ω, $t_p$ <10 µs |
| Bootstrap diode forward voltage between VCC and VB | $V_{F,BSD}$ | - | 1.0 | 1.3 | V | $I_F$=0.5 mA |
| Bootstrap diode forward current between VCC and VB | $I_{F,BSD}$ | 27 | 51 | 75 | mA | $V_F$=4 V |
| Bootstrap diode resistance | $R_{BSD}$ | 24 | 40 | 60 | Ω | $V_{F1}$=4 V, $V_{F2}$=5 V |
| RCIN low on resistance of the pull down transistor | $R_{on,RCIN}$ | - | 40 | 100 | | $V_{RCIN}$=0.5 V |
| FAULT low on resistance of the pull down transistor | $R_{on,FLT}$ | - | 45 | 100 | | $V_{FAULT}$=0.5 V |

[1] Not subject of production test, verified by characterisation

## 4.6 Dynamic parameters

$V_{CC}$ = $V_{BS}$ = 15 V, $V_S$ = $V_{SS}$ = $V_{COM}$ unless otherwise specified. All parameters are valid for $T_a$=25 °C.

**Table 7 Dynamic parameters**

| Parameter | | Symbol | Values | | | Unit | Test condition |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| Turn-on propagation delay | | $t_{on}$ | 400 | 530 | 800 | ns | $V_{LIN/HIN}$ = 0 or 3.3 V |
| Turn-off propagation delay | 6EDL04I06NT 6EDL04I06PT | $t_{off}$ | 360 | 490 | 760 | | |
| | 6EDL04N06PT 6EDL04N02PR | | 400 | 530 | 800 | | |
| Turn-on rise time | | $t_r$ | - | 60 | 100 | | $V_{LIN/HIN}$ = 0 or 3.3 V $C_L$ = 1 nF |
| Turn-off fall time | | $t_f$ | - | 26 | 45 | | |
| Shutdown propagation delay ENABLE | | $t_{EN}$ | - | 780 | 1100 | | $V_{EN}$=0 |
| Shutdown propagation delay ITRIP | | $t_{ITRIP}$ | 400 | 670 | 1000 | | $V_{ITRIP}$=1 V |
| Input filter time ITRIP | | $t_{ITRIPMIN}$ | 155 | 230 | 380 | | |
| Propagation delay ITRIP to FAULT | | $t_{FLT}$ | - | 420 | 700 | | |
| Input filter time at LIN/HIN for turn on and off | | $t_{FILIN}$ | 120 | 300 | - | | $V_{LIN/HIN}$ = 0 & 3.3 V |
| Input filter time EN | | $t_{FILEN}$ | 300 | 600 | - | | |
| Fault clear time at RCIN after ITRIP-fault, ($C_{RCin}$=1nF) | | $t_{FLTCLR}$ | 1.0 | 1.9 | 3.0 | ms | $V_{LIN/HIN}$ = 0 & 3.3 V $V_{ITRIP}$ = 0 |
| Dead time | | DT | 150 | 310 | - | ns | $V_{LIN/HIN}$ = 0 & 3.3 V |
| Matching delay ON, max(ton)-min(ton), ton are applicable to all 6 driver outputs | | $MT_{ON}$ | - | 20 | 100 | | external dead time > 500 ns |
| Matching delay OFF, max(toff)-min(toff), toff are applicable to all 6 driver outputs | | $MT_{OFF}$ | - | 40 | 100 | | external dead time >500 ns |
| Output pulse width matching. $Pw_{in}$-$PW_{out}$ | 6EDL04I06NT 6EDL04I06PT | PM | | 40 | 100 | | $PW_{in}$ > 1 µs |
| | 6EDL04N06PT 6EDL04N02PR | | | 10 | 100 | | |

# 5 Timing diagrams

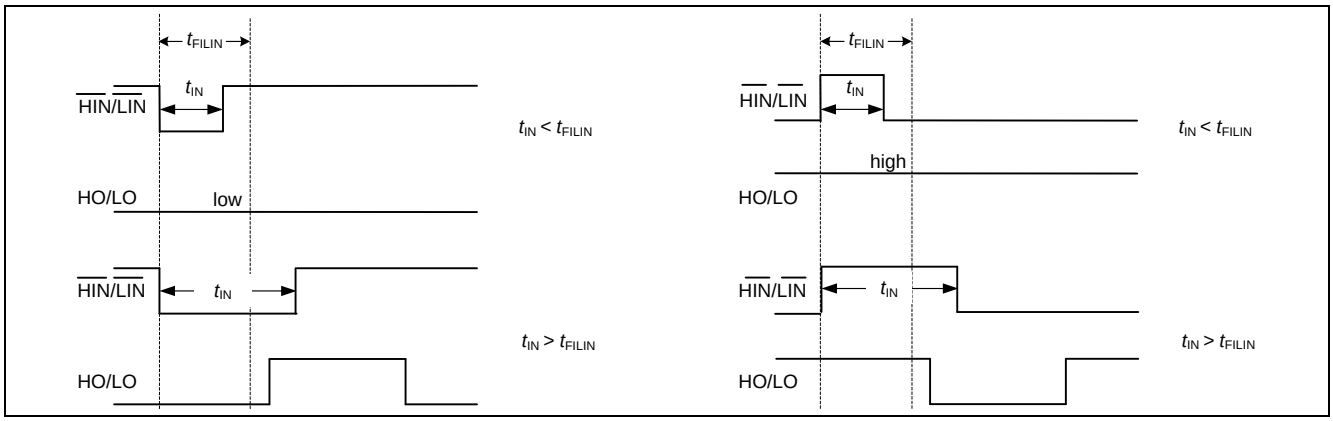



**Figure 9 Timing of short pulse suppression (6EDL04I06NT)**

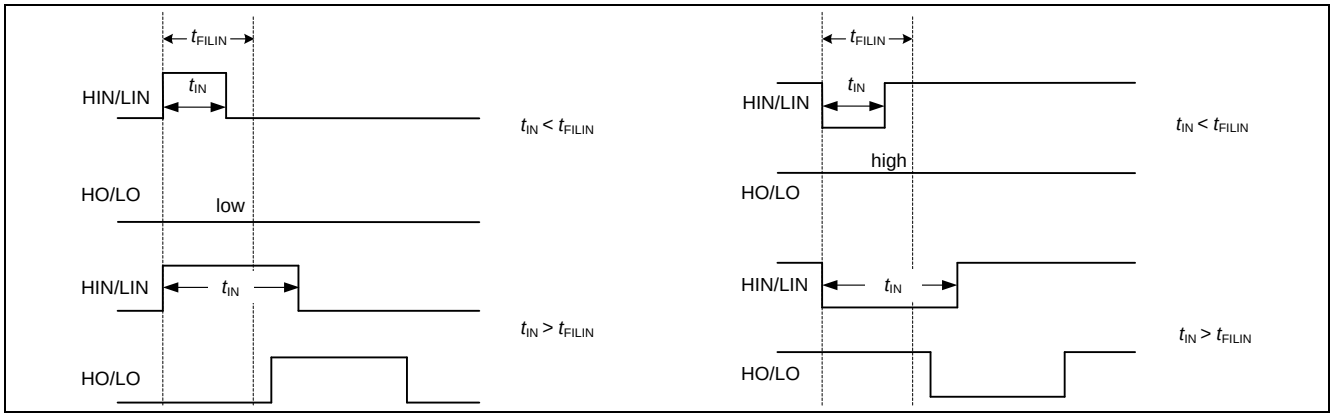



**Figure 10 Timing of short pulse suppression (6EDL04I06PT, 6EDL04N06PT, 6EDL04N02PR)**

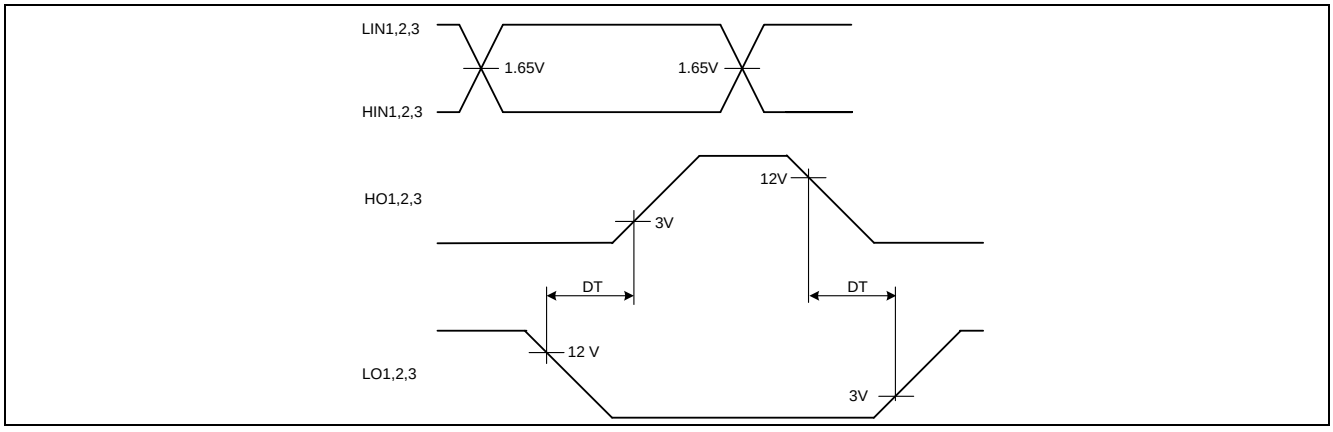



**Figure 11 Timing of of internal deadtime (input logic according to Table 1)**

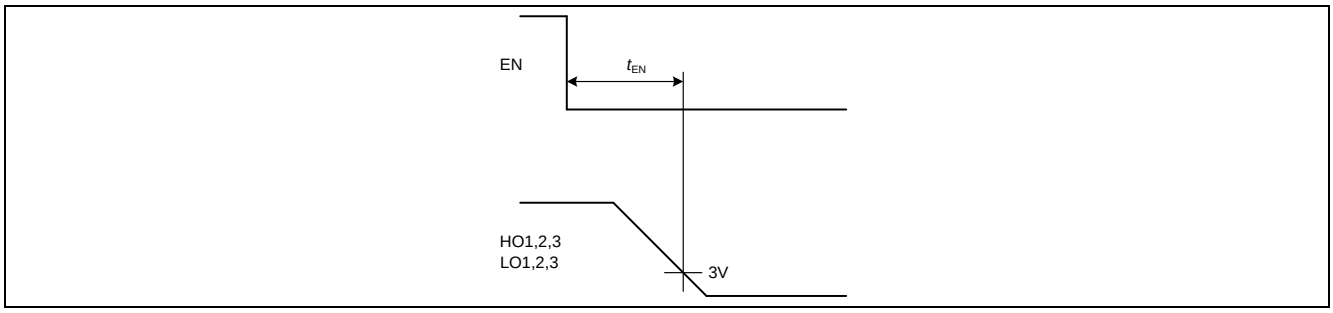



**Figure 12 Enable delay time definition**

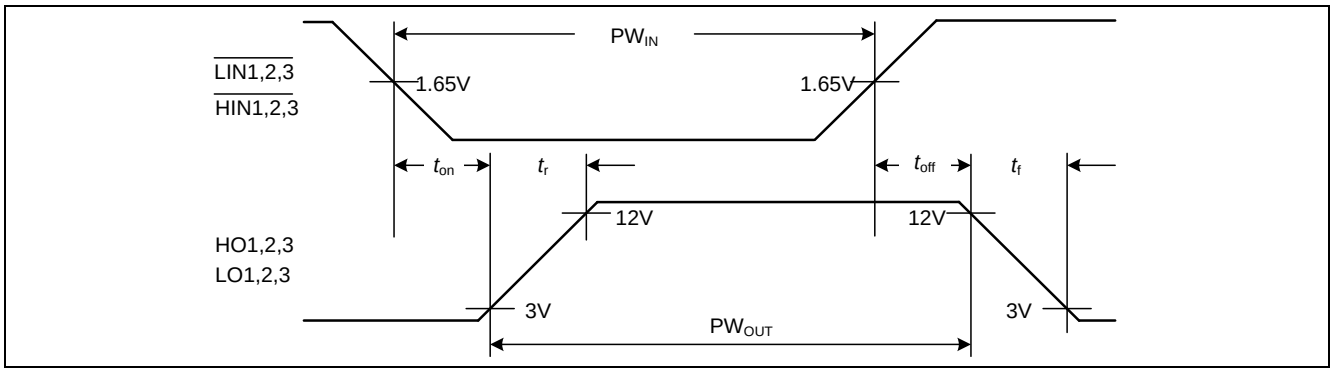



**Figure 13 Input to output propagation delay times and switching times definition (6EDL04I06NT)**

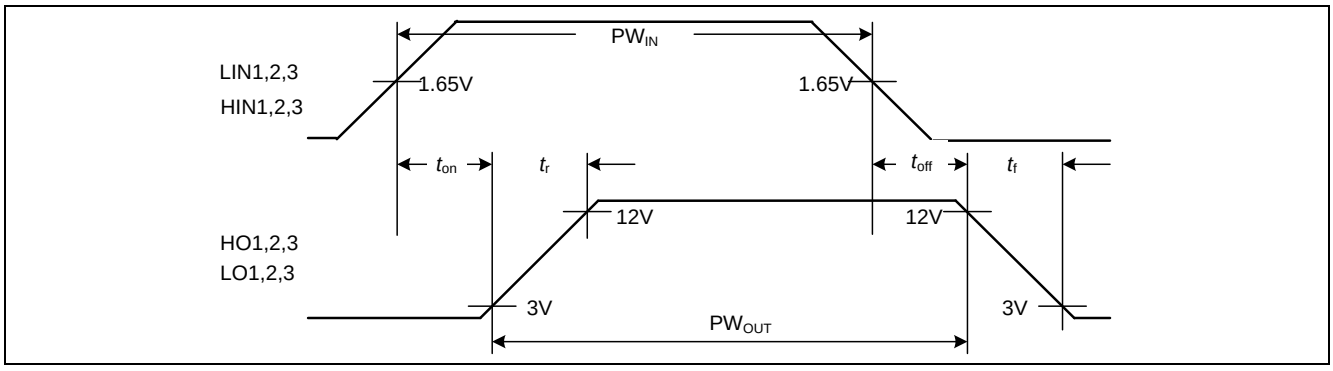



**Figure 14 Input to output propagation delay times and switching times definition (6EDL04I06PT, 6EDL04N06PT, 6EDL04N02PR)**

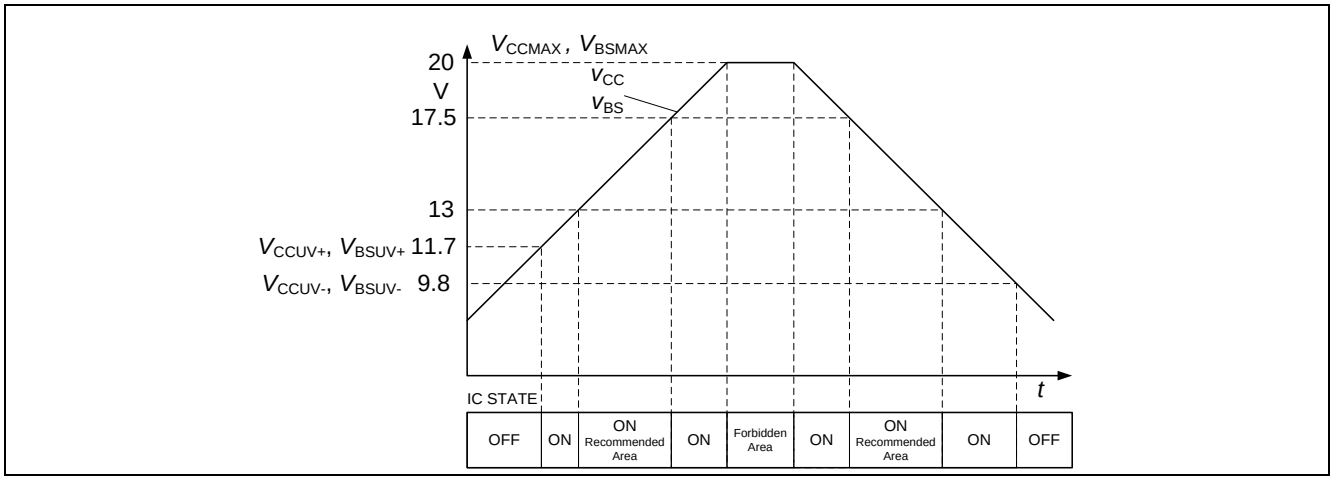



**Figure 15 Operating areas (6EDL04I06NT, 6EDL04I06PT)**

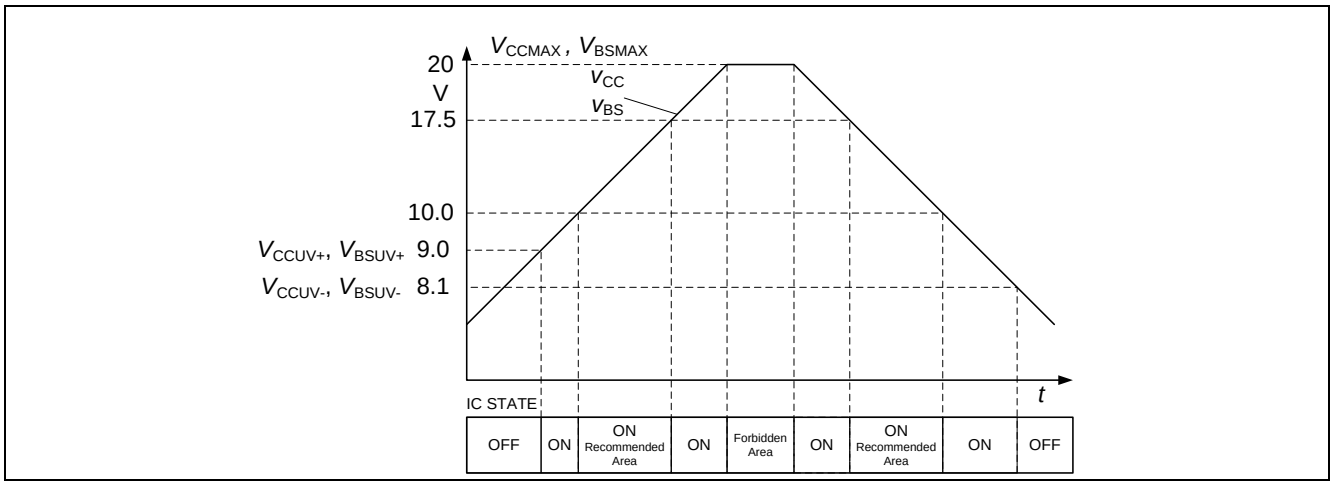



**Figure 16 Operating Areas (6EDL04N06PT, 6EDL04N02PR)**

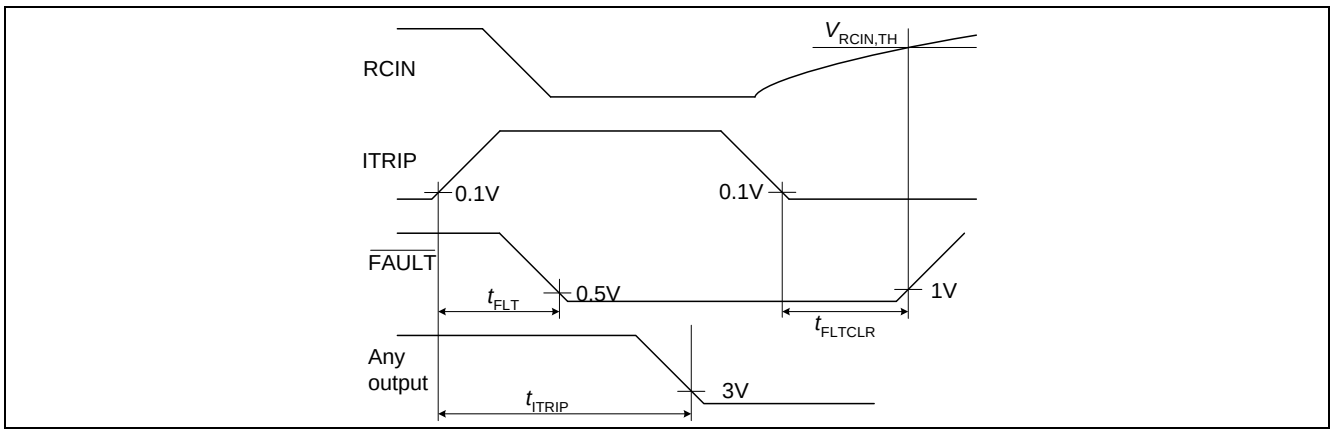



**Figure 17 ITRIP-Timing**

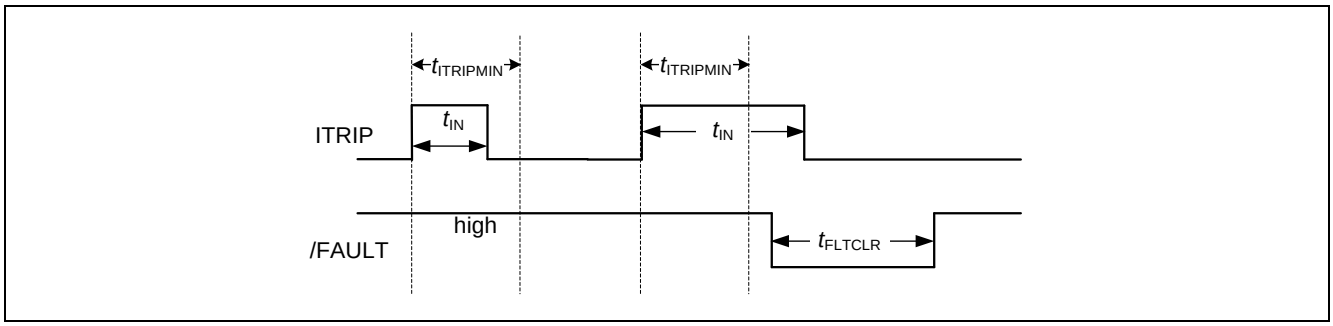
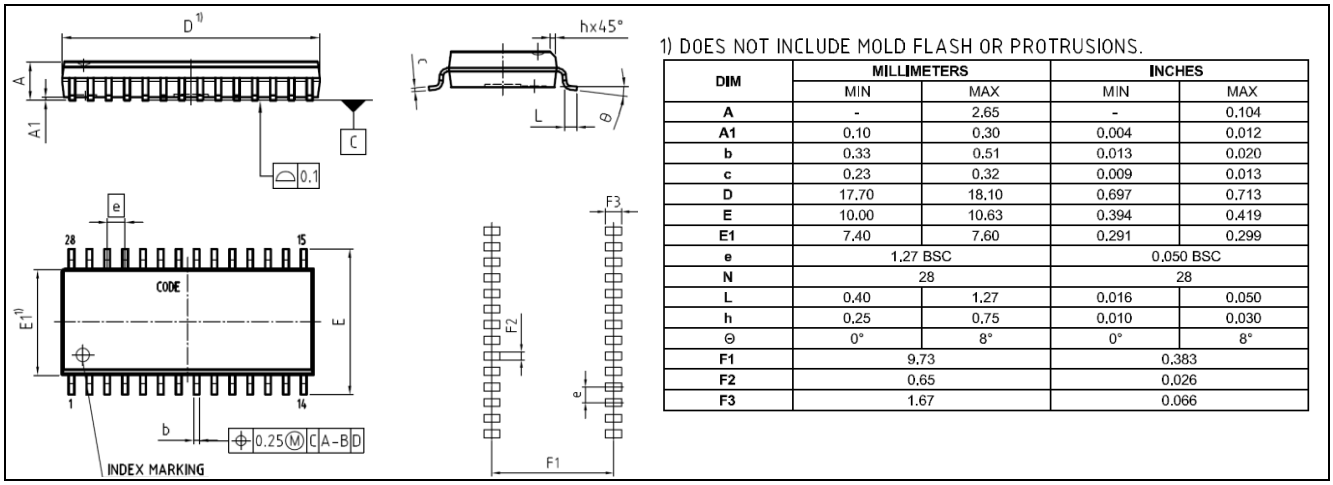



**Figure 18 ITRIP Input Timing**

# 6 Package

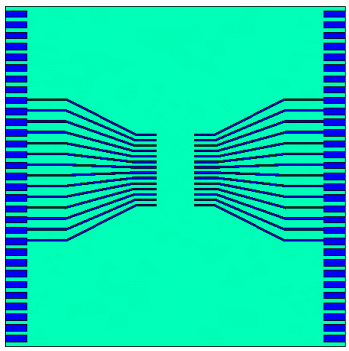
## 6.1 PG-DSO-28




1) DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | - | 2.65 | - | 0.104 |
| A1 | 0.10 | 0.30 | 0.004 | 0.012 |
| b | 0.33 | 0.51 | 0.013 | 0.020 |
| c | 0.23 | 0.32 | 0.009 | 0.013 |
| D | 17.70 | 18.10 | 0.697 | 0.713 |
| E | 10.00 | 10.63 | 0.394 | 0.419 |
| E1 | 7.40 | 7.60 | 0.291 | 0.299 |
| e | 1.27 BSC | | 0.050 BSC | |
| N | 28 | | 28 | |
| L | 0.40 | 1.27 | 0.016 | 0.050 |
| h | 0.25 | 0.75 | 0.010 | 0.030 |
| Θ | 0° | 8° | 0° | 8° |
| F1 | 9.73 | | 0.383 | |
| F2 | 0.65 | | 0.026 | |
| F3 | 1.67 | | 0.066 | |

**Figure 19 Package drawing**



| | | |
|---|---|---|
| Dimensions | 80.0 × 80.0 × 1.5 mm³ | $\lambda_{therm}$ [W/m·K] |
| Material | FR4 | 0.3 |
| Metal (Copper) | 70µm | 388 |

**Figure 20 PCB reference layout**

## 6.2 PG-TSSOP-28

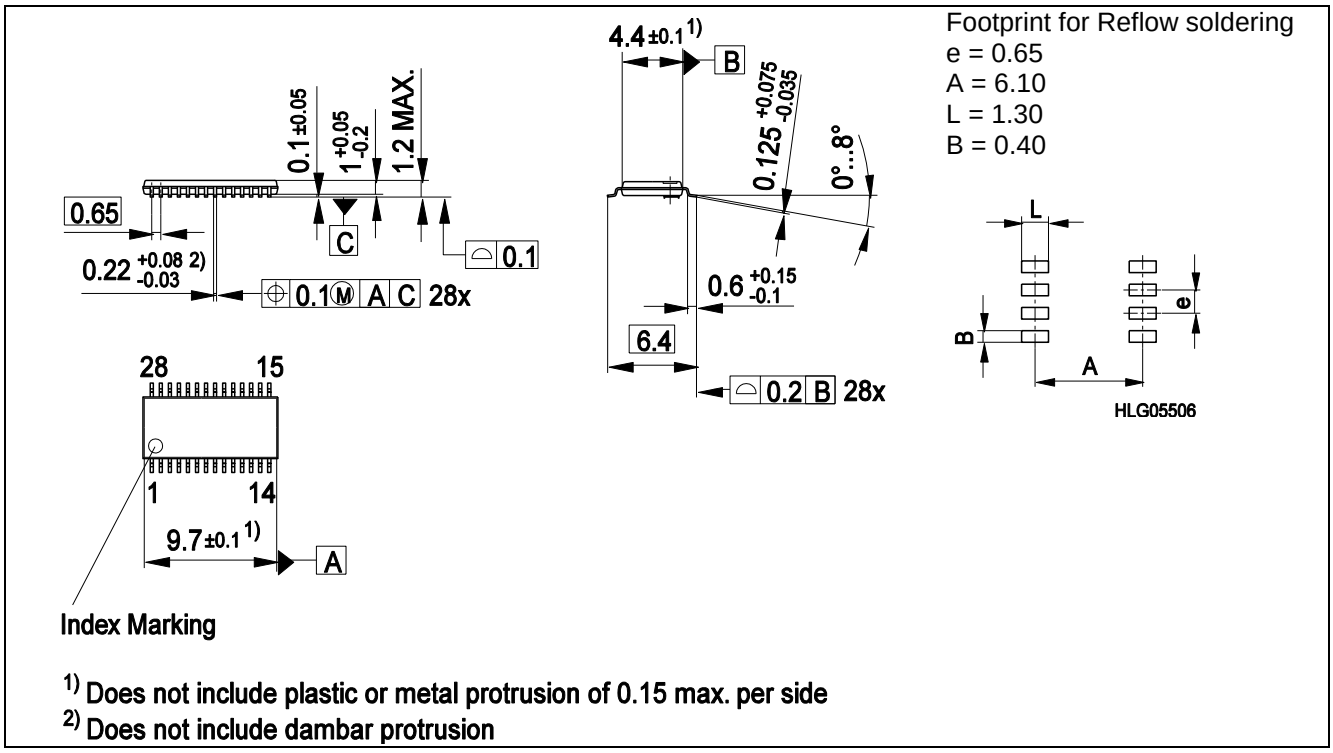



**Figure 21 Package drawing**

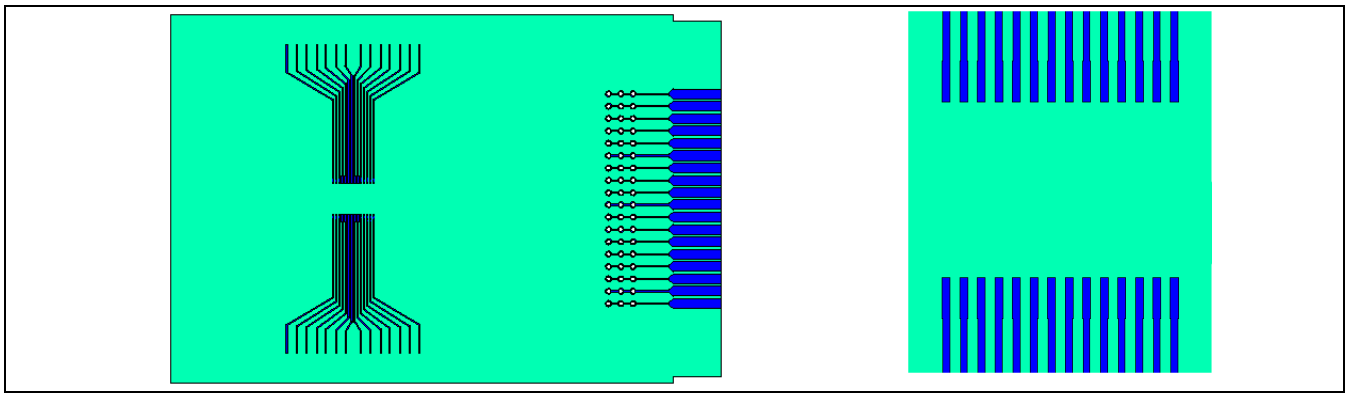


**Figure 22 PCB reference layout (according to JEDEC 1s0P)**
**left: Reference layout**
**right: detail of footprint**

**Table 8 Data of reference layout**

| Dimensions | Material | Metal (Copper) |
|---|---|---|
| 76.2 × 114.3 × 1.5 mm³ | FR4 ($\lambda_{therm}$ = 0.3 W/mK) | 70µm ($\lambda_{therm}$ = 388 W/mK) |