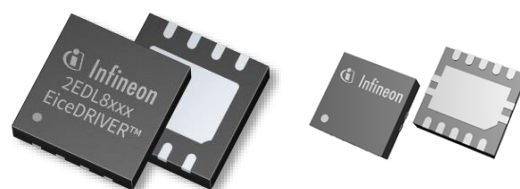


EiceDRIVER™ 2EDL8x2x

120 V Boot, 3 A/4 A, Junction-Isolated High Side and Low Side Gate Driver ICs

Features

- Level-shift high-side low-side dual channel driver
- (2EDL802x) Independently controlled high-side and low-side gate drivers
- (2EDL812x) Differential input for superb robustness with inherent shoot-through protection
- 3 A (2EDL8x23) or 4 A (2EDL8x24) source current capability for both high side and low side drivers
- Strong 5 A high side / 6 A low side sink current capability
- 120 V on-chip bootstrap diode
- Support operating frequency up to 1 MHz
- VDD/VHB under voltage lockout (UVLO)
- -10 V to 20 V Input pin capability for increased robustness
- (2EDL812x) -8 V to 15 V input pin common mode rejection
- -5 A output pin reverse current capability
- 8 V to 17 V supply voltage operating range
- Fast propagation delay
- <6 ns delay matching
- Offered in VDSO-8 (4 mm x 4 mm) and VSON-10 (3 mm x 3mm) package
- Lead free RoHS compliant package



Feature Comparison

PART	INPUT	LOW/HIGH SIDE PEAK PULL UP CURRENT	LOW SIDE PEAK PULL DOWN CURRENT	HIGH SIDE PEAK PULL DOWN CURRENT
2EDL8023	Independent	3A	6A	5A
2EDL8024	Independent	4A		
2EDL8123	Differential	3A	6A	5A
2EDL8124	Differential	4A		

Potential Applications

- DC-to-DC converter
- Isolated bus converter
- Synchronous rectification for SMPS
- Class-D Audio Amplifiers

Product Validation

Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

Description

2EDL8x2x is a high-side low-side driver designed for advanced switching converters such as in telecom and datacom applications. 2EDL802x takes in independent inputs with built-in hysteresis for enhanced noise immunity, whereas 2EDL812x takes in differential input with built-in hysteresis for enhanced noise immunity. 2EDL812x's inherent shoot-through protection ensures the robustness of the system. 6 ns maximum delay matching ensures volt-second balance and avoids magnetic core saturation.

Typical Application Diagram

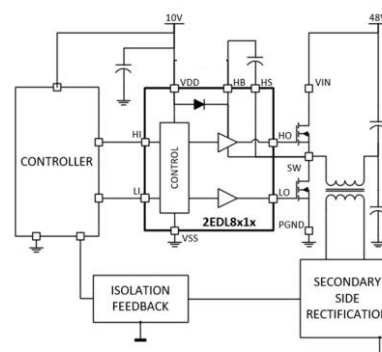



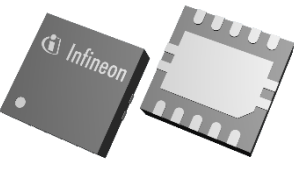


Table of contents

Features	1
Potential Applications Typical Application Diagram	1
Product Validation	1
Description	1
Table of contents	2
1 Package Information	3
1.1 Ordering Information	3
1.2 Pin Configuration and Descriptions	4
2 Block Diagram	5
3 Functional Description	6
3.1 Supply Voltage	6
3.2 Input Stage	6
3.3 Driver Outputs	7
3.4 Under Voltage Lockout (UVLO)	7
3.5 Minimum Pulse Width	8
3.6 Transient Detector	8
4 Characteristics	9
4.1 Absolute Maximum Ratings	9
4.2 ESD Ratings	9
4.3 Recommended Operating Conditions	9
4.4 Static Electrical Characteristics	10
4.5 Dynamic Electrical Characteristics	11
4.6 Thermal Mechanical Characteristics	11
5 Timing diagrams	12
6 Typical Characteristics	13
7 Application and Guidelines	16
7.1 Typical Application Diagram	16
7.2 Design Guidelines	17
7.2.1 Bootstrap Capacitor Selection	18
7.2.2 VDD Bypass Capacitor Selection	19
7.2.3 Bootstrap Resistor Selection	19
7.2.4 External Bootstrap Diode Selection	19
7.2.5 Gate Resistor Selection	19
7.3 PCB Layout Guidelines	20
8 Outline Dimensions	22
8.1 PG-VDSO-8-4 Package Outline	22
8.2 PG-VSON-10-4 Package Outline	23
9 Reel and Tape	24
References	25
Revision history	26
Disclaimer	27

1 Package Information

PG-VDSO8-8-4		
PG-VSON-10-4		

1.1 Ordering Information

Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
2EDL8023G	PG-VDSO8-8-4	Tape and Reel	6000	2EDL8023GXUMA1
2EDL8023G3C	PG-VSON-10-4	Tape and Reel	3000	2EDL8023G3CXUMA1
2EDL8024G	PG-VDSO8-8-4	Tape and Reel	6000	2EDL8024GXUMA1
2EDL8024G3C	PG-VSON-10-4	Tape and Reel	3000	2EDL8024G3CXUMA1
2EDL8123G	PG-VDSO8-8-4	Tape and Reel	6000	2EDL8123GXUMA1
2EDL8123G3C	PG-VSON-10-4	Tape and Reel	3000	2EDL8123G3CXUMA1
2EDL8124G	PG-VDSO8-8-4	Tape and Reel	6000	2EDL8124GXUMA1
2EDL8124G3C	PG-VSON-10-4	Tape and Reel	3000	2EDL8124G3CXUMA1

1.2 Pin Configuration and Descriptions

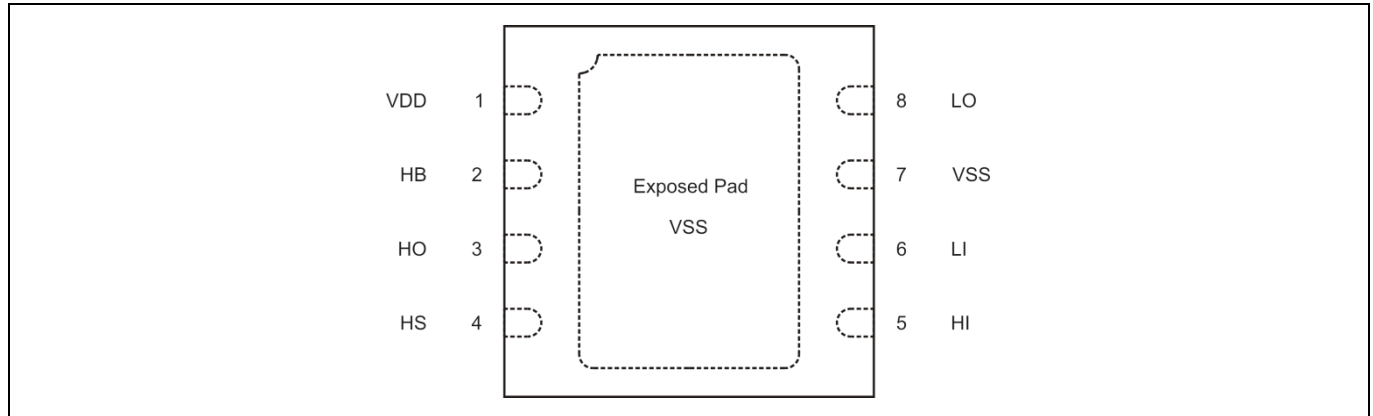


Figure 1 Pin Configuration of PG-VDSON-8-4, Top Transparent View

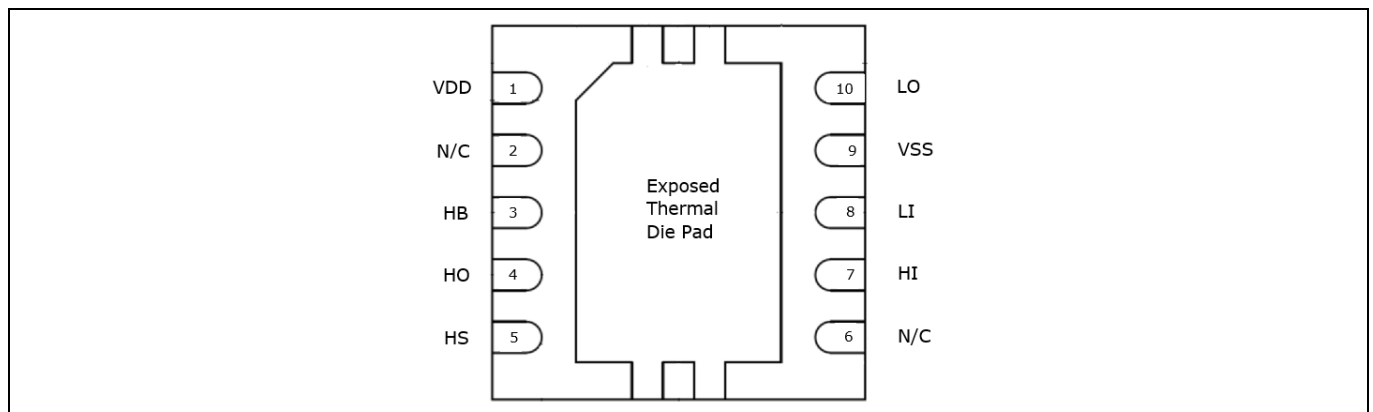


Figure 2 Pin Configuration of PG-VSON-10-4, Top Transparent View

Pin Name	VDSON-8 Pin #	VSON-10 Pin #	Pin Description
VDD	1	1	Gate drive supply
N/C	---	2,6	Not Connected
HB	2	3	High-side gate driver bootstrap rail
HO	3	4	High-side gate driver output
HS	4	5	High-side FET source connection
HI	5	7	High-side driver control input
LI	6	8	Low-side driver control input
VSS	7	9	Ground return, internally connected to exposed pad
LO	8	10	low-side gate driver output

2 Block Diagram

A simplified functional block diagram is given in the figure below

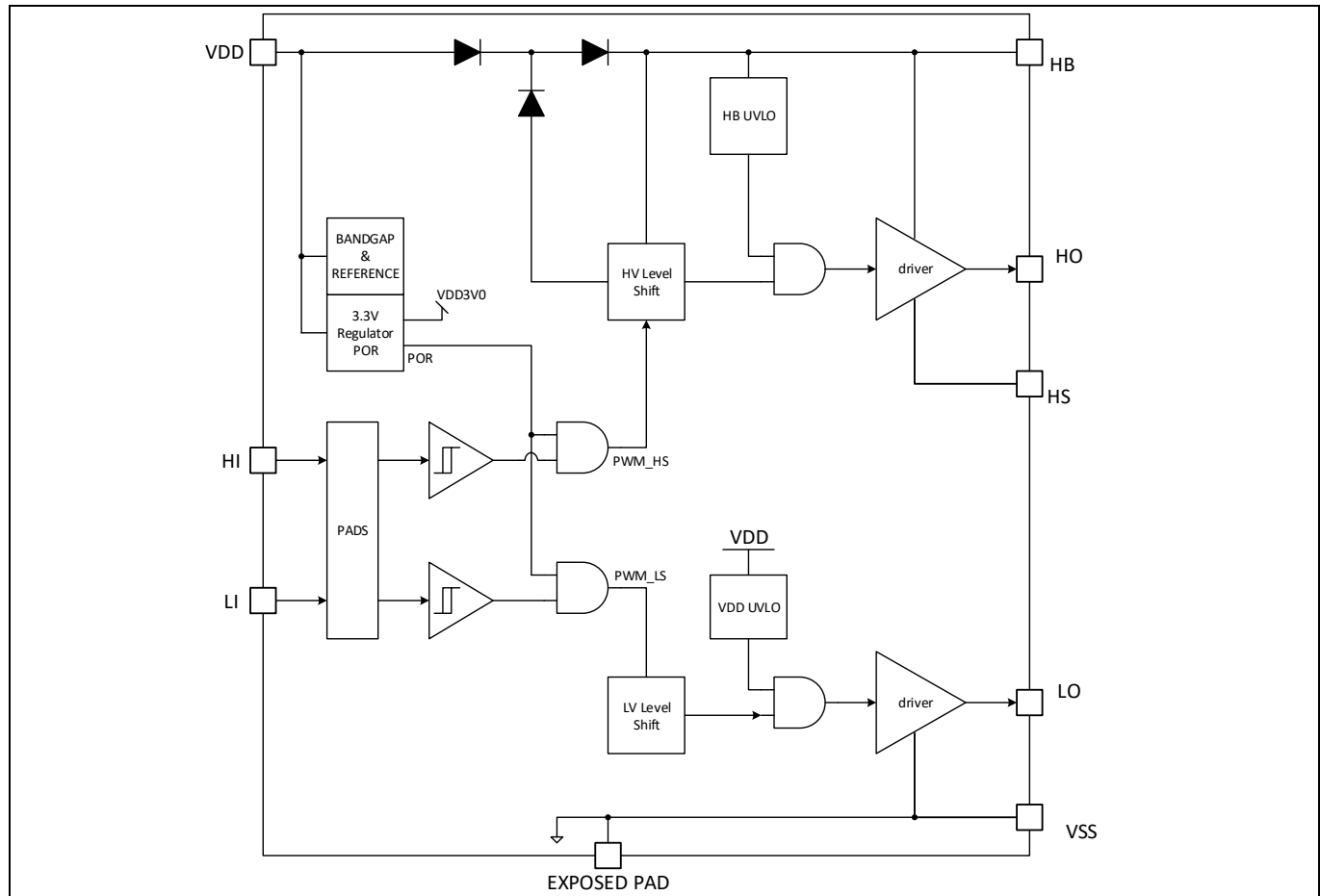


Figure 3 Block Diagram

3 Functional Description

The device is a level-shifted 2-channel driver designed to support topologies with high-side and low-side configurations. The high side is level shifted by the combination of an on-chip 120 V rated bootstrap diode and an external bootstrap capacitor. The device provides 3 A (2EDL8x23) or 4 A (2EDL8x24) peak source current capability for both high-side and low-side and a strong 5 A high-side and 6 A low-side sink current capability. This allows driving large power MOSFETs with minimum or optimized switching losses during the transition through the MOSFET's Miller Plateau.

2EDL802x's input pins support TTL logic levels independently of supply voltage. They are capable of withstanding voltages from -10 V to 20 V, allowing the device to interface with a broad range of analog and digital controllers. The input stage features built-in hysteresis for enhanced noise immunity. The low-side and high-side gate drivers are independently controlled and matched to typical 2 ns between the turn on and turn off of each other.

2EDL812x's input pins support TTL logic levels independently of supply voltage. They are capable of withstanding voltages from -10 V to 20 V and ground potential shifts from -8 V to 15 V, allowing the device to interface with a broad range of analog and digital controllers. The input stage features built-in hysteresis for enhanced noise immunity. The low-side and high-side gate drivers are differentially controlled and matched to typical 2 ns between the turn on and turn off of each other. The differential inputs provide inherent shoot-through protection and ensure high-side and low-side outputs are never on at the same time.

The switching node (HS pin) is able to handle negative voltages down to $-(24 - V_{DD})$ V which allows the high-side channel to be protected from inherent negative voltages caused by parasitic inductance and stray capacitance.

Under-voltage lockout circuits are provided for both high- and low-side drivers. UVLO protects the system by forcing the output low when the supply voltage is lower than the specified threshold.

The following sections describe key functionalities.

3.1 Supply Voltage

The absolute maximum supply voltage is 20 V. The minimum operating supply voltage is set by the undervoltage lockout function to a typical default value of 7.0 V. This lockout function protects power MOSFETs from running into linear mode with subsequent high power dissipation.

3.2 Input Stage

2EDL802x responds to the two input signals (HI and LI) independently according to the following truth table.

Table 1 2EDL802x Truth Table

LI	HI	LO	HO
L	L	L	L
H	L	H	L
L	H	L	H
H	H	H	H

The high-side and low-side outputs respond to high-side and low-side inputs independently.

2EDL812x device responds to the combination of two input signals (HI and LI) according to the following truth table.

Table 2 2EDL812x Truth Table

LI	HI	LO	HO
L	L	L	L
H	L	H	L
L	H	L	H
H	H	L	L

True differential input comes with inherent shoot through protection by preventing both low and high side to be on at the same time. It also provides noise immunity against ground bounce. The input stage is designed to operate reliably against -8 V / $+15\text{ V}$ ground voltage drift. Input logic hysteresis also helps combat disturbances to the input signal.

The differential voltage between the two input pins is rated at 8 V maximum because of the back-to-back ESD diodes that connect the two input pins together. Above this voltage, the ESD diodes start clamping which causes a current flow from the high voltage potential input pin to the low voltage potential input pin.

3.3 Driver Outputs

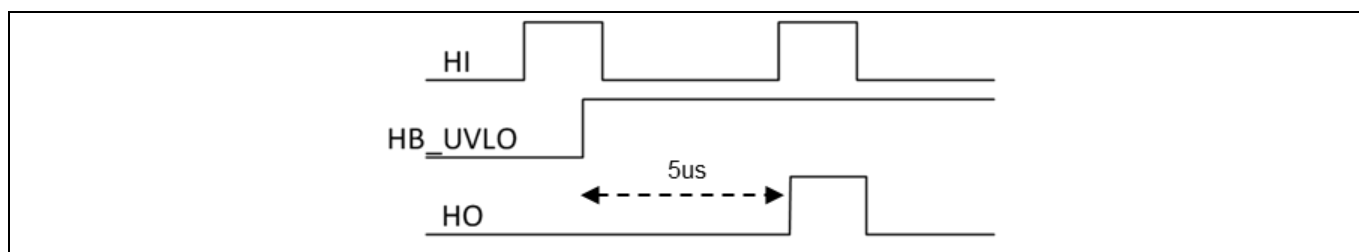
The low output impedances allow fast transition of the load transistor. Specifically, the ultra-low impedance pull down resistances, typically $0.5\ \Omega$ for the high side and $0.35\ \Omega$ for the low side, keep the gate of the load transistor down during fast transient events – avoiding dv/dt induced re-turn-on.

3.4 Under Voltage Lockout (UVLO)

The undervoltage lockout function ensures that the output can be switched to its high level only if the supply voltage exceeds the UVLO rising threshold voltage. Thus, it can be guaranteed, that the switch transistor is not switched on if the driving voltage is too low to completely switch on the device, thereby avoiding excessive power dissipation. The UVLO level is set to a typical value of 7.0 V with 0.5 V hysteresis for supply voltage (V_{DD}) and 5.75 V with 0.25 V hysteresis for high side boot voltage (V_{HB}).

UVLO threshold trigger is synchronous. The clock gating ensures minimum pulse width set by the controller is obeyed at all times. This increases robustness of the integrated boot diode due to the controllability of the reverse recovery behavior.

A $5\ \mu\text{s}$ delay time and a PWM synchronization scheme are implemented in the high-side UVLO to ensure that the load transistor is not operated with marginal gate drive voltage which can lead to high power dissipation. The synchronization is done in such a way that the HO output is blocked when UVLO is released while the HI is high. HO is only propagated when the UVLO is released while the HI is low.

**Figure 4 High-side UVLO implementation**

3.5 Minimum Pulse Width

The device responds to input level according to the truth table in section 3.2 as long as the logic signal complies with the minimum pulse width requirement. Signal pulse longer than the minimum allowable input pulse width yields valid output. Any output in response to shorter pulses or glitches should be disregarded and filtered out by the user. Under all allowable operations above input minimum pulse width of 40 ns, the output behaves one to one to the input with minimal pulse width distortion.

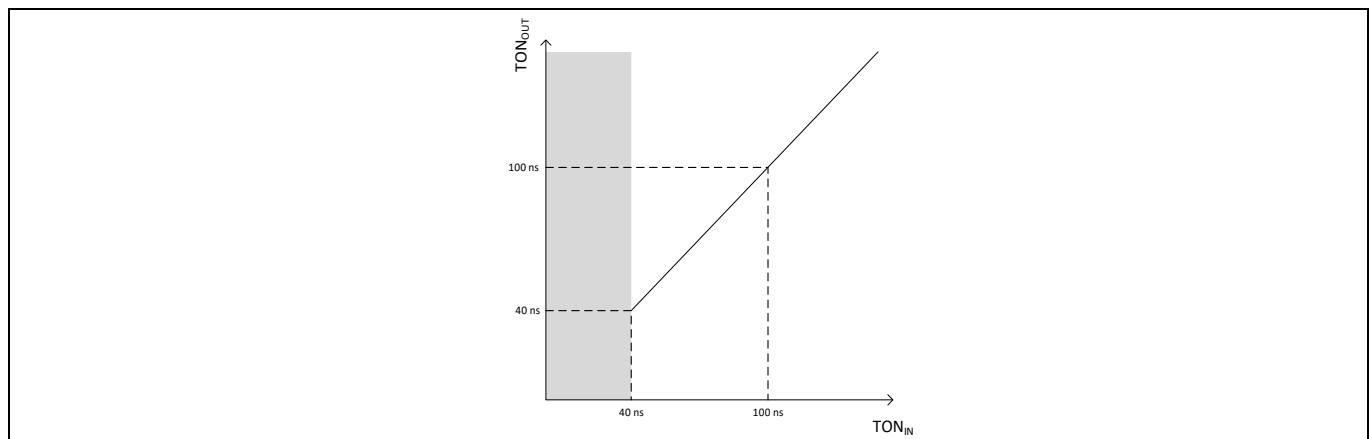


Figure 5 Minimum Pulse Width Input-output On-time Transfer Function

This diagram is illustrative only with typical value. Actual value and pulse width distortion are subject to process variation. Output pulse width could in some cases be shortened or extended to prevent retoggling. See Transient Detector section below.

3.6 Transient Detector

The transient detector block is designed to prevent re-toggling of the HO output in case of potential instability of the level shifter caused by phase node movement. For example, a fast-rising phase node voltage could pull the power ground (PGND) down. This could result in potential between HI and PGND being higher than the rising threshold of the high-side signal. Such a glitch or noise can be picked up by the driver and propagate through which can lead to a shoot-through event, transformer volt-second imbalance, and potential device destruction.

The following describes the basic operation of the block.

- The transient detector monitors the phase node and tracks its movement, and the rate of change over time for both rising and falling edge.
- Whenever the rate of change is larger than a certain dv/dt threshold¹, the transient detector is active and blocks the HO output from changing state.
- A High-side Input (HI) toggle triggers a decision to change the state, but HO waits until the transient detector's active state is removed, then the decision is propagated through.

Additional propagation delay caused by the transient detector is limited to one-half of the oscillation period, as the signal always propagates through whenever the transient detector sees a peak or valley where dv/dt approaches zero. See link to *Understanding the transient detector* [\[1\]](#) for more information.

¹ Reference slew rate threshold versus temperature under Chapter 6, Typical Characteristics.

4 Characteristics

4 Characteristics

4.1 Absolute Maximum Ratings

Stresses above the values listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

Symbol	Description	Min	Max	Unit
V_{DD}	¹ Driver Supply Voltage	-0.3	20	V
V_{HS}	Phase Voltage (DC)	-1	$V_{HB} + 0.3$	V
	Phase Voltage (Repetitive pulse < 100 ns) ²	$-(24 - V_{DD})$	$V_{HB} + 0.3$	V
V_{HB}	² High Side Bootstrap Voltage	-0.3	120	V
V_{HI}, V_{LI}	LI and HI Input Voltage	-10	20	V
V_I	³ Differential Input Voltage	---	8	V
V_{LO}	Output voltage on LO	-0.3	$V_{DD} + 0.3$	V
V_{HO}	Output voltage on HO	$V_{HS} - 0.3$	$V_{HB} + 0.3$	V
I_{OR}	⁴ LO and HO Peak Reverse Current	---	5	A
T_J	Operating Junction Temperature	-40	150	°C
T_S	Storage Temperature	-55	150	°C

4.2 ESD Ratings

Symbol	Description	Value	Unit
ESD_{HBM}	Human Body Model sensitivity as per ANSI/ESDA/JEDEC JS-001	2000	V
ESD_{CDM}	Charged Device Model sensitivity as per ANSI/ESDA/JEDEC JS-002	1000	V

4.3 Recommended Operating Conditions

The following operating conditions must not be exceeded in order to ensure correct operation and reliability of the device. All parameters specified in the subsequent tables refer to these operating conditions.

Symbol	Description	Min	Typ	Max	Unit
V_{HS}	Phase Voltage (DC)	-1	90	⁵ 100	V
	Phase Voltage (Repetitive pulse < 100 ns)	$-(24 - V_{DD})$	---	⁵ 100	V
V_{DD}	Driver Supply Voltage	8	10	17	V
V_{HB}	High Side Bootstrap Voltage	-0.3	---	⁵ 100 + V_{DD}	V
T_J	Junction Temperature	-40	---	125	°C

¹ All voltage ratings in this section referenced to ground.

² Not subject to production test. Verified by design/characterization.

³ Absolute voltage difference between HI and LI ($|V_{HI} - V_{LI}|$).

⁴ For < 500 ns pulses.

⁵ Maximum value is not subject to production test. Values were verified by design/characterization.

4 Characteristics

Symbol	Description	Min	Typ	Max	Unit
dv/dt	HS Slew Rate	---	---	50	V/ns
V _I	Differential Input Voltage	0	3.3	5	V
V _{ICMR}	Input Signal Common Mode Rejection (2EDL812x)	-8 + V _I /2	---	15 – V _I /2	V

4.4 Static Electrical Characteristics

V_{DD} = V_{HB} = 12 V, V_{HS} = V_{SS} = 0 V. T_C = 25°C unless otherwise specified.

The V_{IN} and I_{IN} parameters are referenced to V_{SS}.

Symbol	Description	Min	Typ	Max	Units	Conditions
V _{DDR}	V _{DD} UVLO Rising Threshold	6.6	7.0	7.4	V	–
V _{DDH}	V _{DD} UVLO Threshold Hysteresis	---	0.5	---	V	–
V _{HBR}	¹ V _{HB} UVLO Rising Threshold	5.5	5.75	6.0	V	–
V _{HBH}	V _{HB} UVLO Threshold Hysteresis	---	0.27 5	---	V	–
I _{HB}	Boot voltage Quiescent Current	---	0.55	0.7	mA	V _{LI} = V _{HI} = 0 V
I _{HBO}	Boot voltage Operating Current	---	2.8	3.1	mA	f = 500 kHz, C _{LOAD} = 0 nF, 2EDL8x23
		---	2.9	3.2		f = 500 kHz, C _{LOAD} = 0 nF, 2EDL8x24
I _{DD}	V _{DD} Quiescent Current	---	0.55	0.7	mA	V _{LI} = V _{HI} = 0 V
I _{DDO}	V _{DD} Operating Current	---	2.8	3.1	mA	f = 500 kHz, C _{LOAD} = 0 nF, 2EDL8x23
		---	2.9	3.2		f = 500 kHz, C _{LOAD} = 0 nF, 2EDL8x24
R _{IN}	Input Pulldown Resistance	54	68	82	kΩ	–
V _{IR}	Rising Input Voltage Threshold	1.6	2.25	2.9	V	–
V _{IF}	Falling Input Voltage Threshold	1.0	1.65	2.3	V	–
V _{IH}	Input Logic Voltage Hysteresis	---	0.6	---	V	–
R _{PUH}	High Side Pull Up Resistance	---	1.45	---	Ω	2EDL8x23
		---	1.0	---		2EDL8x24
R _{PDH}	High Side Pull Down Resistance	---	0.5	---	Ω	–
R _{PUL}	Low Side Pull Up Resistance	---	1.45	---	Ω	2EDL8x23
		---	1.0	---		2EDL8x24
R _{PDL}	Low Side Pull Down Resistance	---	0.35	---	Ω	–

¹ HB (high side bootstrap) related ratings referenced to V_{HS}.

4 Characteristics
4.5 Dynamic Electrical Characteristics
 $V_{DD} = V_{HB} = 12\text{ V}$, $V_{HS} = V_{SS} = 0\text{ V}$. $T_C = 25^\circ\text{C}$ unless otherwise specified.

Symbol	Description	Min	Typ	Max	Units	Conditions
I_{PUH}	¹ High Side Peak Pull Up Current	---	3	---	A	$V_{HO} = 0\text{ V}$, 2EDL8x23
		---	4	---		$V_{HO} = 0\text{ V}$, 2EDL8x24
I_{PDH}	¹ High Side Peak Pull Down Current	---	5	---	A	$V_{HO} = 12\text{ V}$
I_{PUL}	¹ Low Side Peak Pull Up Current	---	3	---	A	$V_{LO} = 0\text{ V}$, 2EDL8x23
		---	4	---		$V_{LO} = 0\text{ V}$, 2EDL8x24
I_{PDL}	¹ Low Side Peak Pull Down Current	---	6	---	A	$V_{LO} = 12\text{ V}$
T_{DR}	^{2,3} Rising Propagation Delay	---	45	54	ns	$C_{LOAD} = 0$
T_{DF}	^{4,3} Falling Propagation Delay	---	45	54	ns	$C_{LOAD} = 0$
T_{DM}	⁵ Delay Matching	---	2	6	ns	—
T_{PW}	⁶ Minimum Input Pulse Width	---	---	40	ns	—
T_{DRR}	⁷ Bootstrap Diode Turn off Time	---	10	---	ns	$I_F = 20\text{ mA}$, $I_{PRR} = 0.5\text{ A}$

4.6 Thermal Mechanical Characteristics

Symbol	Description		Min	Typ	Max	Units	Conditions
R_{thJC}	Junction to Case Thermal Resistance	VDSO-8	---	3	---	$^\circ\text{C/W}$	Bottom
			---	46	---	$^\circ\text{C/W}$	Top
		VSON-10	---	5.8	---	$^\circ\text{C/W}$	Bottom
			---	69	---	$^\circ\text{C/W}$	Top
R_{thJA}	⁸ Device on PCB	VDSO-8	---	42	---	$^\circ\text{C/W}$	6 cm ² cooling area
		VSON-10	---	60	---	$^\circ\text{C/W}$	

¹ Not subject to production test.

² Rising propagation delay from LI to LO and from HI to HO.

³ A transient detector blocks the toggling of the high side output when it detects moving phase node (due to transition and/or oscillation). It prevents unwanted retoggling but may increase propagation delay. See transient detector activation in Figure 8.

⁴ Falling propagation delay from LI to LO and from HI to HO.

⁵ Consolidated delay matching (1) ON: between LO rising and HO falling and (2) OFF: between LO falling and HO rising.

⁶ Minimum input pulse width that produces valid output signal.

⁷ External Schottky boot diode in parallel recommended for high dv/dt application.

⁸ Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 μm thick) copper area for drain connection. PCB vertical in still air.

5 Timing diagrams

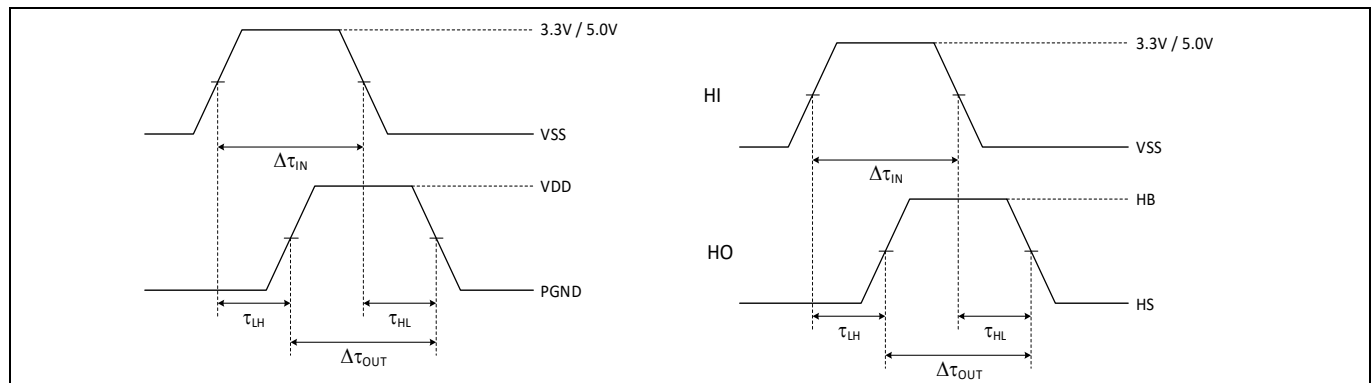


Figure 6 Propagation delay

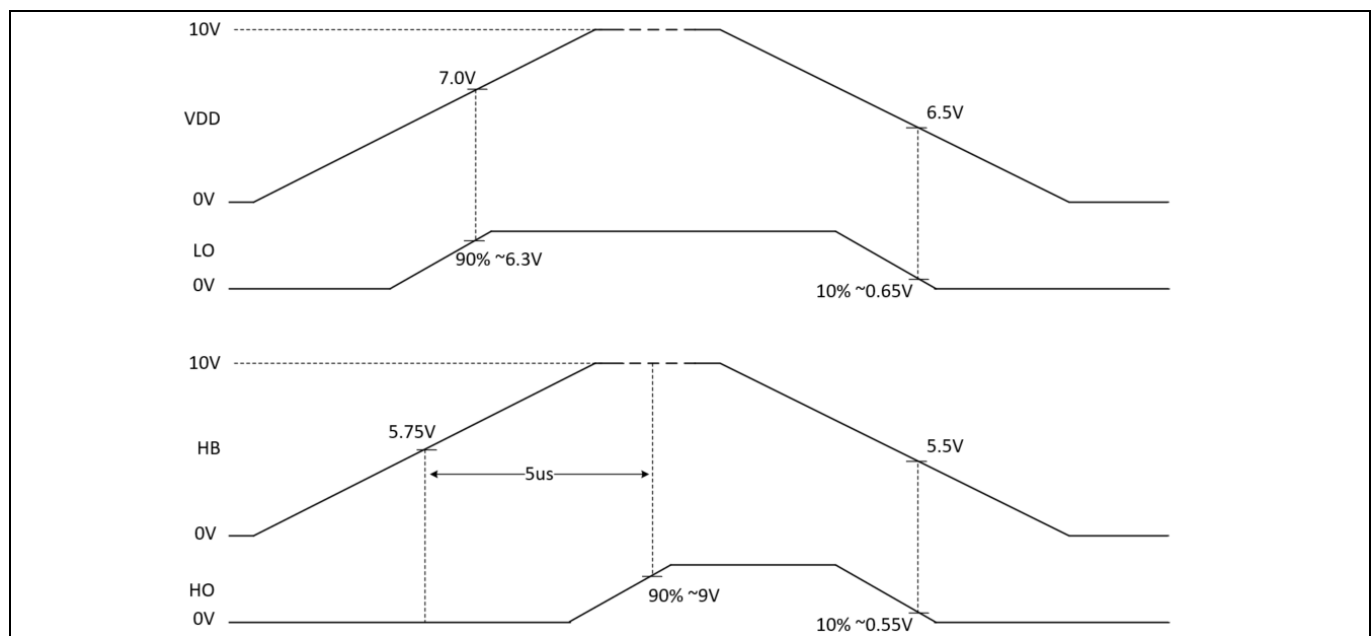


Figure 7 UVLO behavior

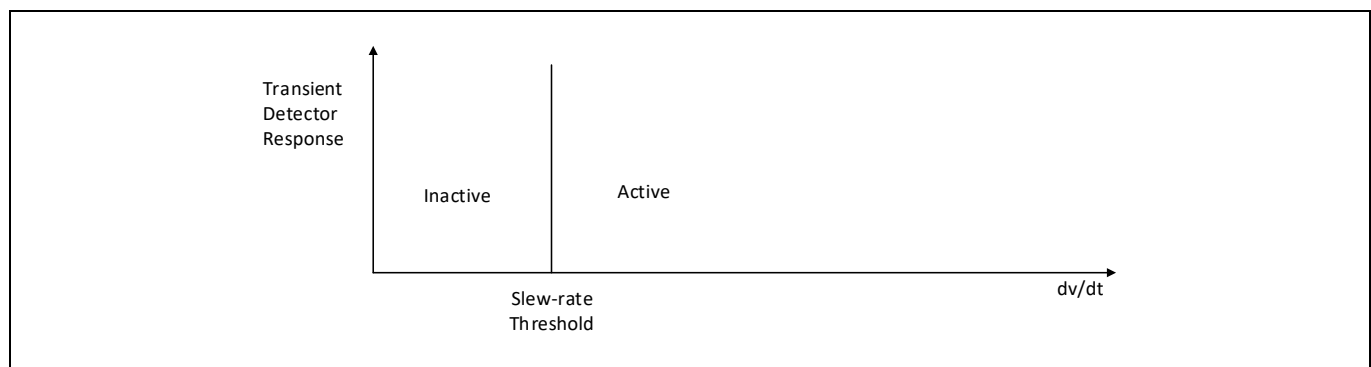
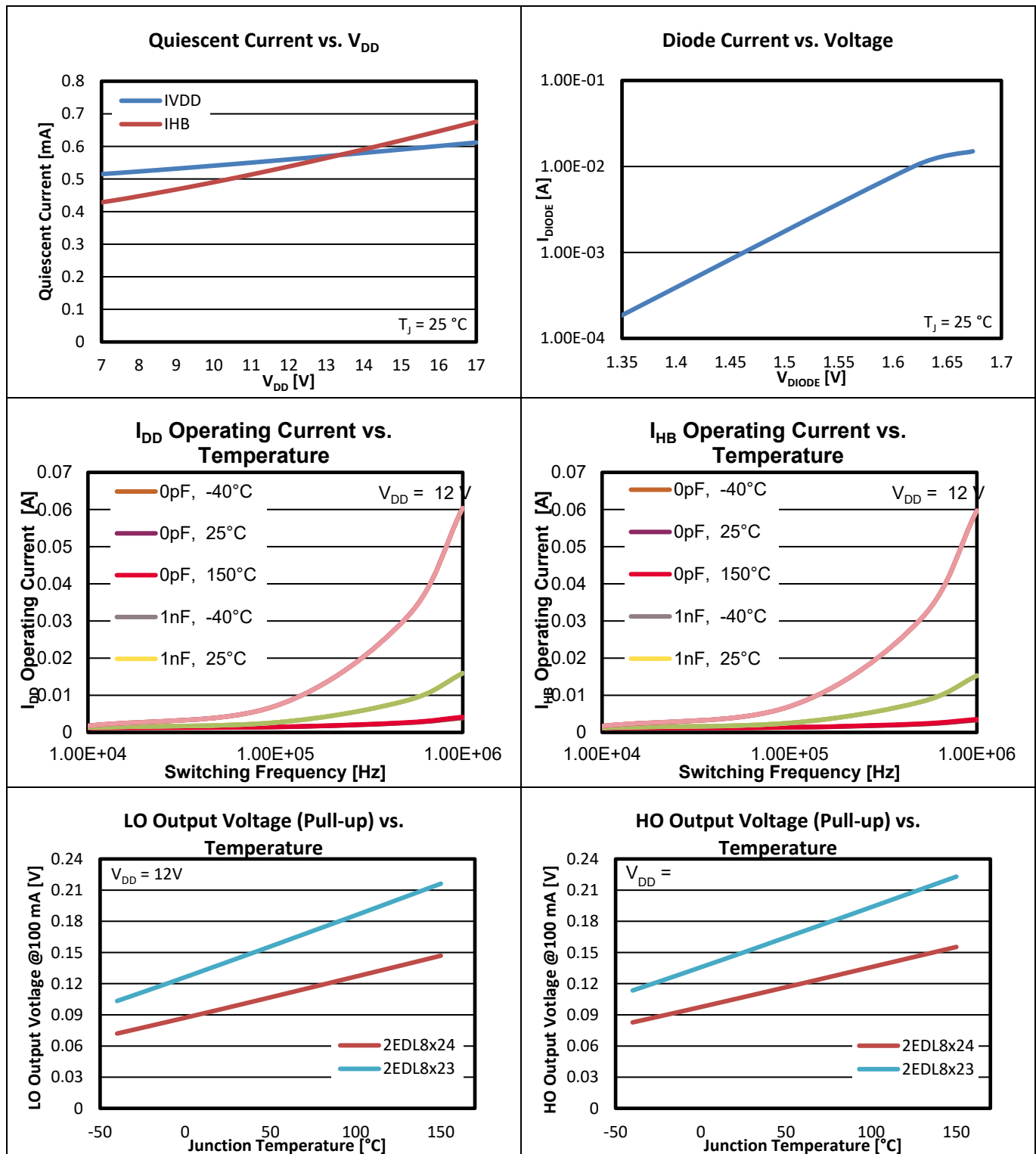
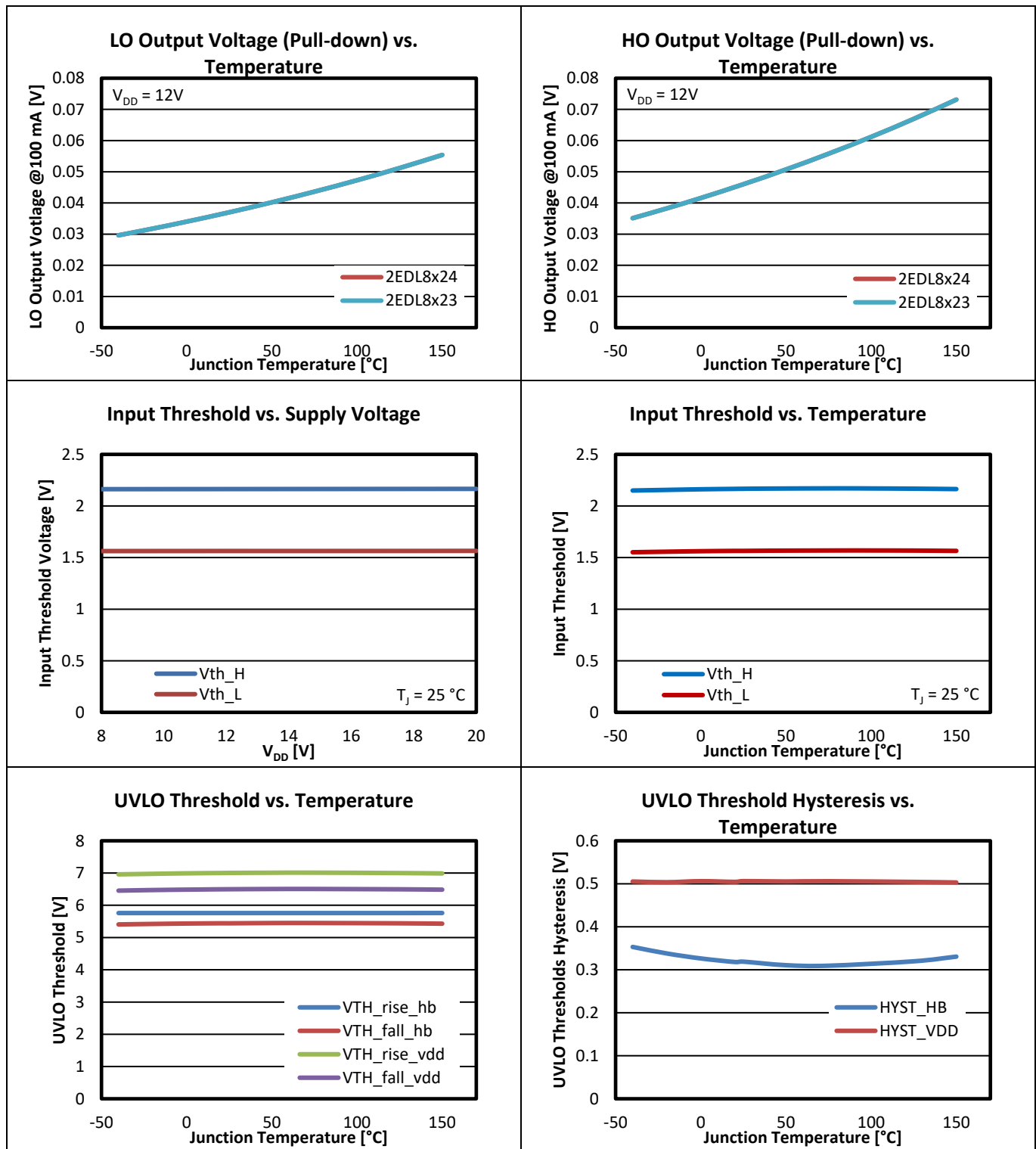


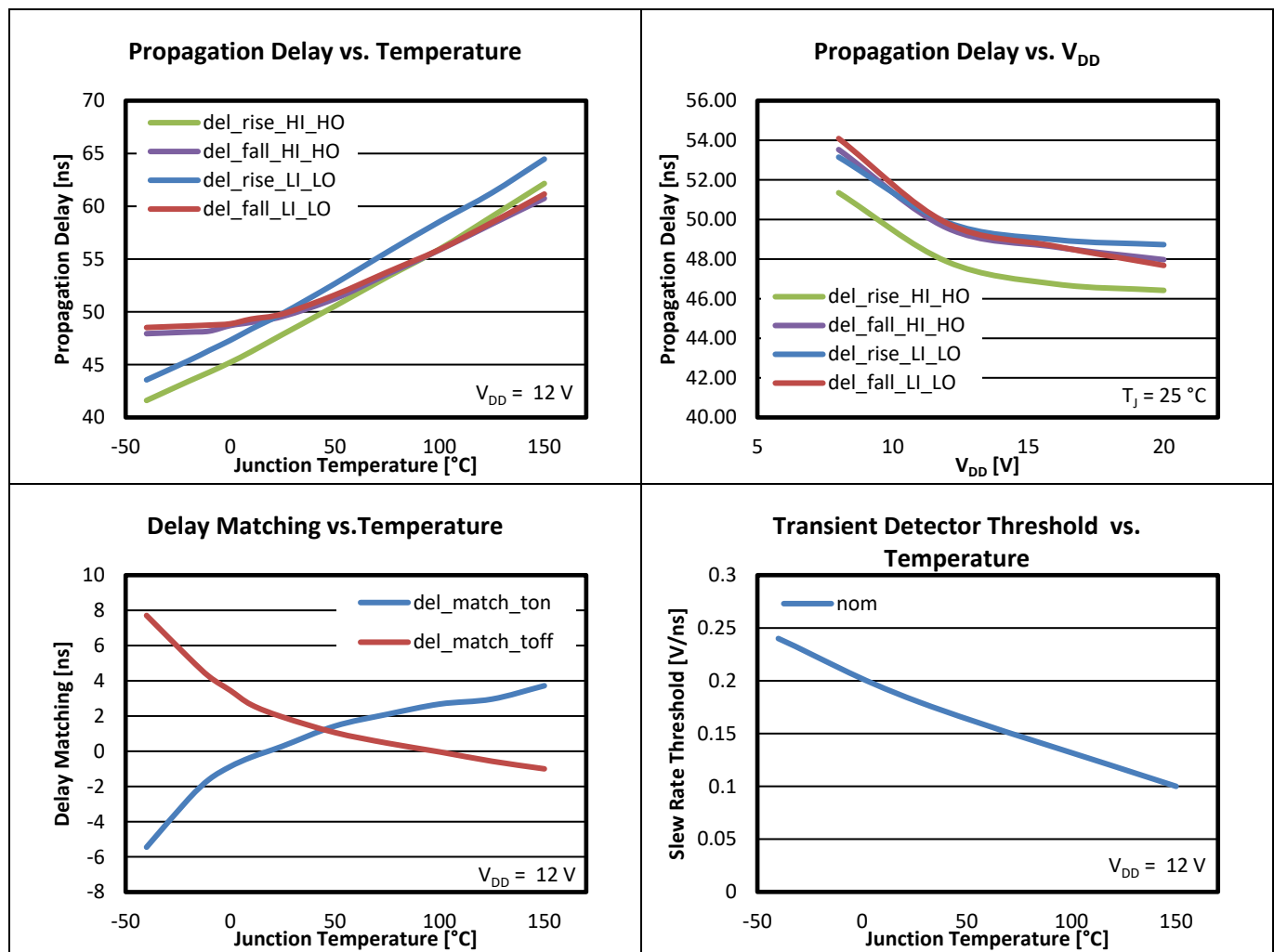
Figure 8 Transient Detector Response¹

¹ Reference slew rate threshold versus temperature under Chapter 6, Typical Characteristics

6 Typical Characteristics







7 Application and Guidelines

7.1 Typical Application Diagram

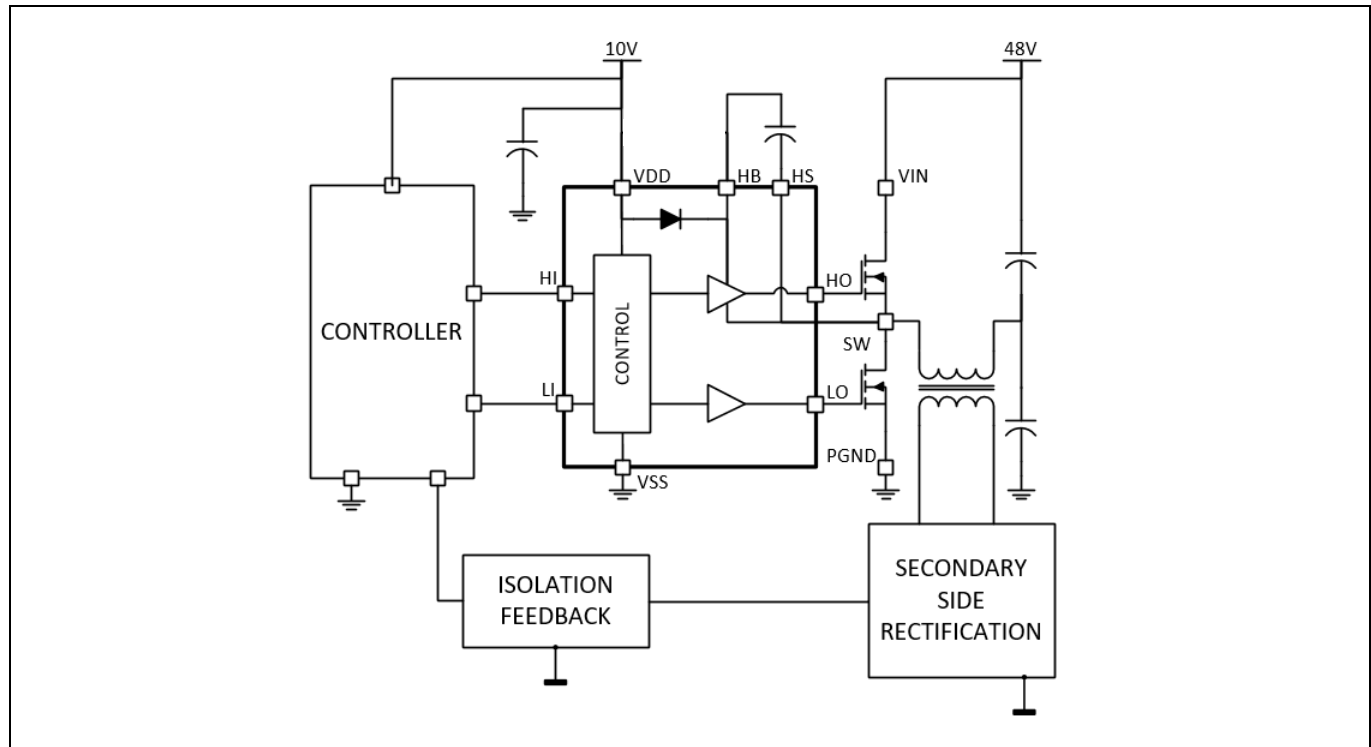


Figure 9 Typical Application 1 - Primary Side Half-bridge

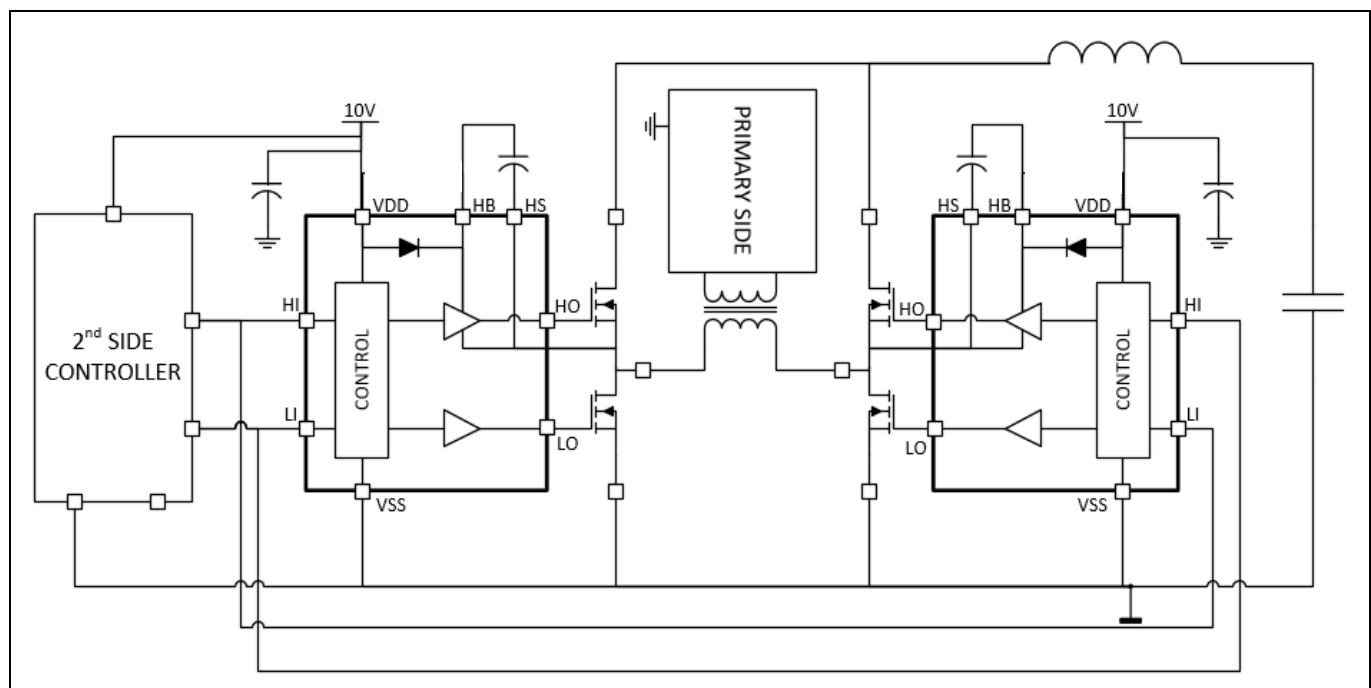


Figure 10 Typical Application 2 - Full-bridge Secondary Side Rectification

7.2 Design Guidelines

In a half-bridge configuration, a high-side bias which is referenced to the switch node is needed to drive the gate of the high-side MOSFET. One of the most common solutions due to its simplicity and low cost is the usage of a bootstrap circuit consisting of a resistor, a diode (internal to the driver) and a capacitor as seen in **Figure 11**. However, this method imposes limitations on the power converter's duty cycle due to the requirement of recharging the bootstrap capacitor. This limitation can be mitigated through the proper selection of the bootstrap components.

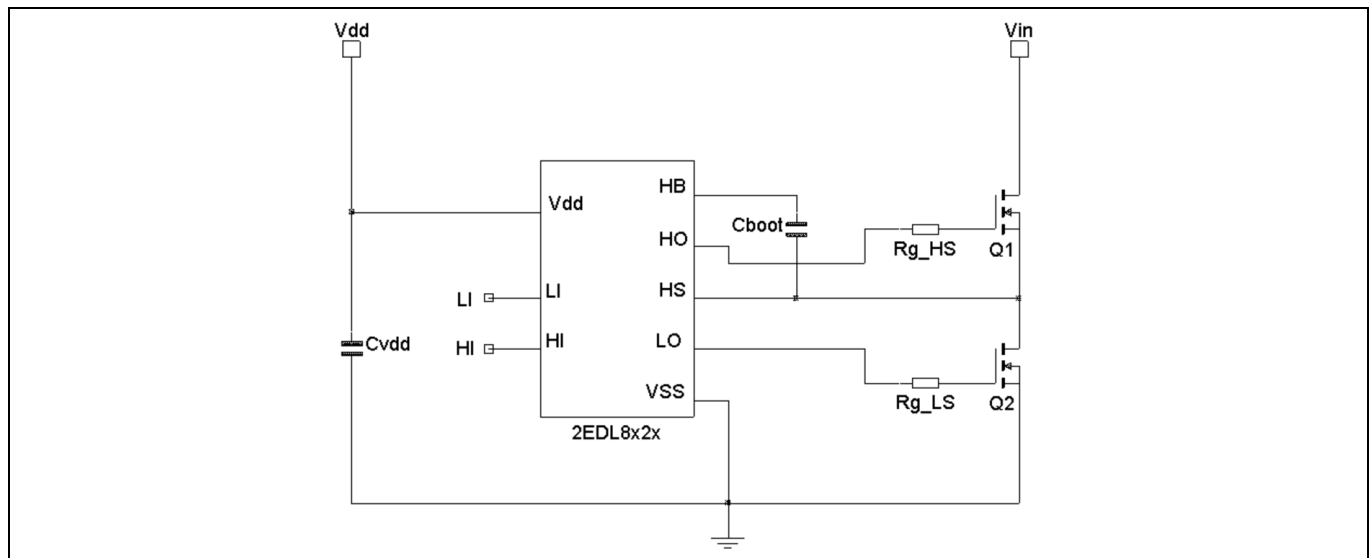


Figure 11 Gate drive circuitry using 2EDL8x2x to drive MOSFET in a half-bridge configuration

The bootstrap circuit operation is defined by two main periods:

Charging period: When the low-side MOSFET (Q2) is ON and the high-side MOSFET (Q1) is OFF, the switch node/HS pin is pulled to ground creating a charging path for the bootstrap capacitor (C_{boot}) through the Vdd bypass capacitor (C_{vdd}), and the internal bootstrap diode. For high dV/dt applications, it is recommended to use an external bootstrap diode.

Discharging period: When the low-side MOSFET (Q2) is turned OFF and the high-side MOSFET (Q1) starts conducting, the switch node/HS pin is pulled to the high voltage V_{in} thus the internal bootstrap diode gets reverse biased. The bootstrap capacitor (C_{boot}) will then discharge some of its stored charges to the gate of the high-side MOSFET as well as to other contributing factors such as the MOSFET's gate-source leakage current, floating section quiescent current, floating section leakage current and the internal bootstrap diode reverse bias leakage current.

Typical waveform for the voltage across C_{boot} as a function of time is shown in **Figure 12** where the various contributions have been distinguished. The voltage across C_{boot} increases during the charging period and then it drops with a high negative dV/dt as it charges the gate of the high-side MOSFET (Q1). After which, the C_{boot} voltage continues to drop but with a much lower slope because only the high-side bias current and some leakage current is discharging the C_{boot} during this phase.

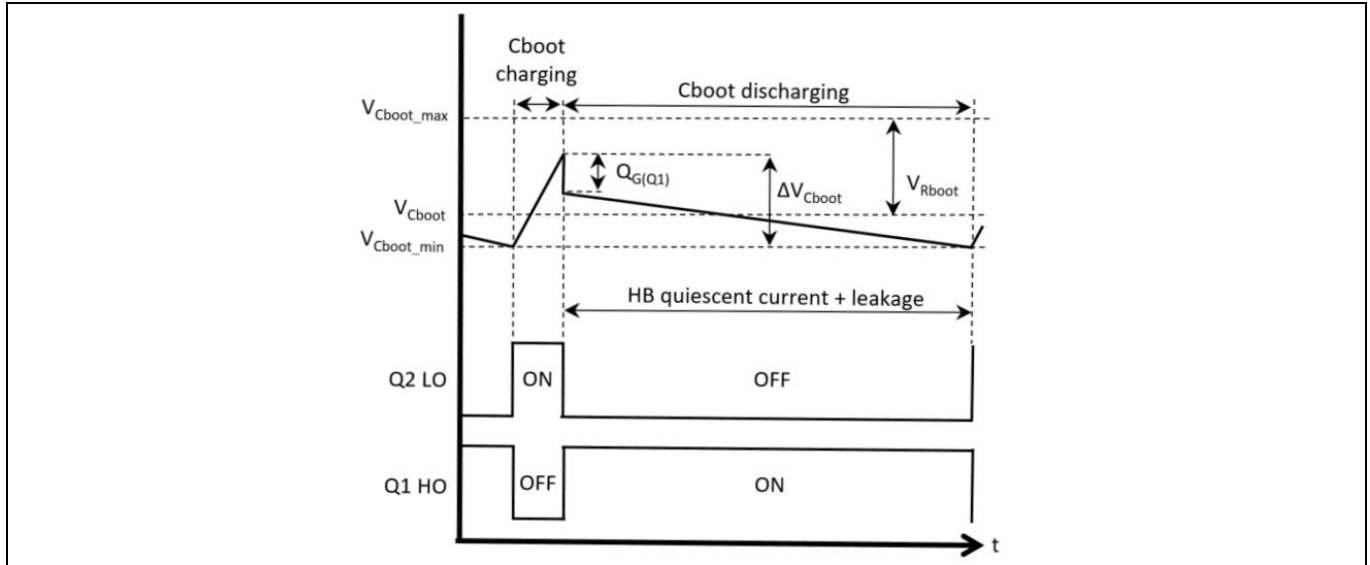


Figure 12 Typical C_{boot} waveform

7.2.1 Bootstrap Capacitor Selection

The bootstrap capacitor provides the necessary charge to drive the high-side MOSFET and thus it needs to be sized in such a way that the maximum voltage drop across this capacitor will not fall below the high-side UVLO threshold during transient and normal operations. First, determine the maximum allowable voltage drop (ΔV_{Cboot_max}) when the high-side MOSFET (Q1) is on which is given by the following formula:

$$\Delta V_{Cboot_max} = V_{dd} - V_F - V_{HBR} - V_{HBH} \quad (1)$$

Where:

V_{dd} = Gate driver supply voltage

V_F = Bootstrap diode forward voltage drop with typical value of 1.25 V at

$I_F=100 \mu A$ and 2.15 V at $I_F=100 \text{ mA}$, $T_J=25^\circ C$

V_{HBR} = HB UVLO rising threshold

V_{HBH} = HB UVLO threshold hysteresis

Next, determine the total charge (Q_T) that must be delivered by the bootstrap capacitor at maximum duty cycle. As mentioned, there are several factors that contribute to the discharge of the bootstrap capacitor such as the Q1's total gate charge, Q1's gate-source leakage current, HB quiescent current, HB leakage current, bootstrap diode reverse bias leakage current and bootstrap capacitor leakage current (if using an electrolytic capacitor). For sake of simplicity, only Q1's total gate charge and HB quiescent and leakage current are considered as the other sources of leakage are negligible in comparison.

$$Q_T = Q_G + \frac{I_{HB}}{F_{sw}} + I_{HBS} \times \frac{D_{max}}{F_{sw}} \quad (2)$$

Where:

Q_G = high-side MOSFET (Q1) total gate charge

I_{HB} = HB maximum quiescent current

I_{HBS} = HB to VSS leakage current with a typical value of 1.25 mA at 90 V HB

voltage and $T_J=25^{\circ}\text{C}$

D_{max} = maximum duty cycle

F_{sw} = switching frequency

The minimum bootstrap capacitor value can then be calculated using the formula:

$$C_{boot_min} \geq \frac{Q_T}{\Delta V_{Cboot_max}} \quad (3)$$

7.2.2 VDD Bypass Capacitor Selection

The Vdd bypass capacitor provides the charge for the bootstrap capacitor during the charging period. As a rule of thumb, the Vdd bypass capacitor should be sized to be at least 10~20 times larger than the bootstrap capacitor. This equates to a voltage ripple of 5~10% in the Vdd capacitor.

$$C_{Vdd} \geq 10 \sim 20 \times C_{boot} \quad (4)$$

7.2.3 Bootstrap Resistor Selection

The bootstrap resistor limits the current in the bootstrap diode during start-up when the bootstrap capacitor is initially completely discharged. The peak current through this resistor is given by:

$$I_{Pk_Rboot} = \frac{V_{DD} - V_F}{R_{boot}} \quad (5)$$

The bootstrap resistor together with the bootstrap capacitor introduces a time constant and should be sized appropriately to achieve the desired start-up time. For this calculation, it is assumed that the bootstrap capacitor is fully charged after 4 time constant. With this, R_{boot} can be calculated using the following formula:

$$R_{boot} \leq \frac{t_{min}}{4 \times C_{boot}} \quad (6)$$

Where:

t_{min} = minimum on time of the low-side MOSFET (Q2)

7.2.4 External Bootstrap Diode Selection

For high dV/dT applications, an external bootstrap diode is recommended to be in parallel with the internal bootstrap diode. A fast recovery or Schottky diode with low forward voltage drop is recommended in order to minimize the losses and leakage current. It should be chosen such that it can handle the peak transient current from Equation (5) during start-up conditions and the blocking voltage rating should be higher than the maximum input voltage (V_{in}) with enough derating.

7.2.5 Gate Resistor Selection

The turn-on and turn-off external gate resistors control the turn-on and turn-off current of the gate driver providing an external way to control the switching speed of the MOSFET for purposes such as voltage overshoot

control, ringing reduction, EMI mitigation, spurious turn-on protection, shoot-through protection etc. The following formulas show the effect of the external gate resistor to the output current capability of the gate driver.

$$I_{HSRC} = \frac{V_{DD} - V_F}{R_{PUH} + R_{G_HS} + R_{G_int}} \quad (7)$$

$$I_{HSNK} = \frac{V_{DD} - V_F}{R_{PDH} + R_{G_HS} + R_{G_int}} \quad (8)$$

$$I_{LSRC} = \frac{V_{DD}}{R_{PUL} + R_{G_LS} + R_{G_int}} \quad (9)$$

$$I_{LSNK} = \frac{V_{DD}}{R_{PDL} + R_{G_LS} + R_{G_int}} \quad (10)$$

Where:

I_{HSRC} = High-side peak source current
 I_{HSNK} = High-side peak sink current
 I_{LSRC} = Low-side peak source current
 I_{LSNK} = Low-side peak sink current
 R_{PUH} = High-side pull-up resistance
 R_{PDH} = High-side pull-down resistance
 R_{PUL} = Low-side pull-up resistance
 R_{PDL} = Low-side pull-down resistance
 V_{DD} = Gate driver supply voltage
 V_F = Bootstrap diode forward voltage drop
 R_{G_HS} = High-side external gate resistance
 R_{G_LS} = Low-side external gate resistance
 R_{G_int} = MOSFET internal gate resistance

For a detailed discussion on how to optimize the gate resistors, a dedicated application note with link in the reference section, e.g. [\[2\]](#), can be viewed.

7.3 PCB Layout Guidelines

In order to maximize the performance of EiceDRIVER™ 2EDL8x2x, below are some recommendations on how to optimize the PCB layout

- Use low-ESR decoupling capacitors on VDD-GND and HB-HS and place it as close as possible to the VDD-GND and HB-HS pins of the driver
- An option for a series boot resistor is recommended to control the high side MOSFET slew rate and therefore the low side MOSFET overshoot. The boot loop path including the VDD capacitor, boot diode, boot series resistor and boot capacitor should be as small as possible
- It is recommended to have an external boot diode placement for high dv/dt application.
- Placement for gate resistor is also recommended to control the switching speed of the MOSFET. Both the gate resistor and the MOSFET should be placed as close as possible to the driver in order to minimize the gate loop inductance.
- Use copper plane underneath the exposed GND pad of the driver and connect it to buried copper plane(s) with multiple thermal vias for better heat dissipation into the PCB.

EiceDRIVER™ 2EDL8x2x

120 V Boot, 3 A/4 A, Junction-Isolated High Side and Low Side Gate Driver ICs

7 Application and Guidelines

- Connection to the HS pin of the driver from the high side MOSFET source and low side MOSFET drain should be as short and wide as possible and avoid connecting it directly through the high switching current path.
- LO and HO traces should be as short and wide as possible
- Avoid letting the LI and HI signal trace to come close to high dV/dT traces which might induce significant noise.

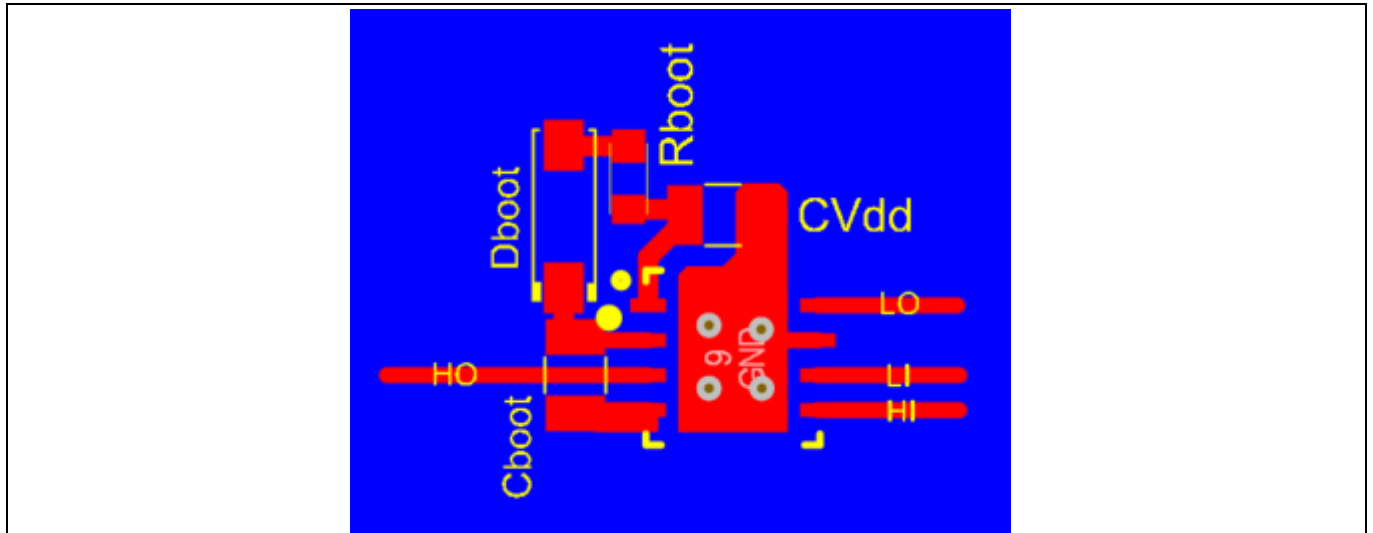


Figure 13 2EDL8x2x Layout Example

8 Outline Dimensions

8.1 PG-VDSO8-4 Package Outline

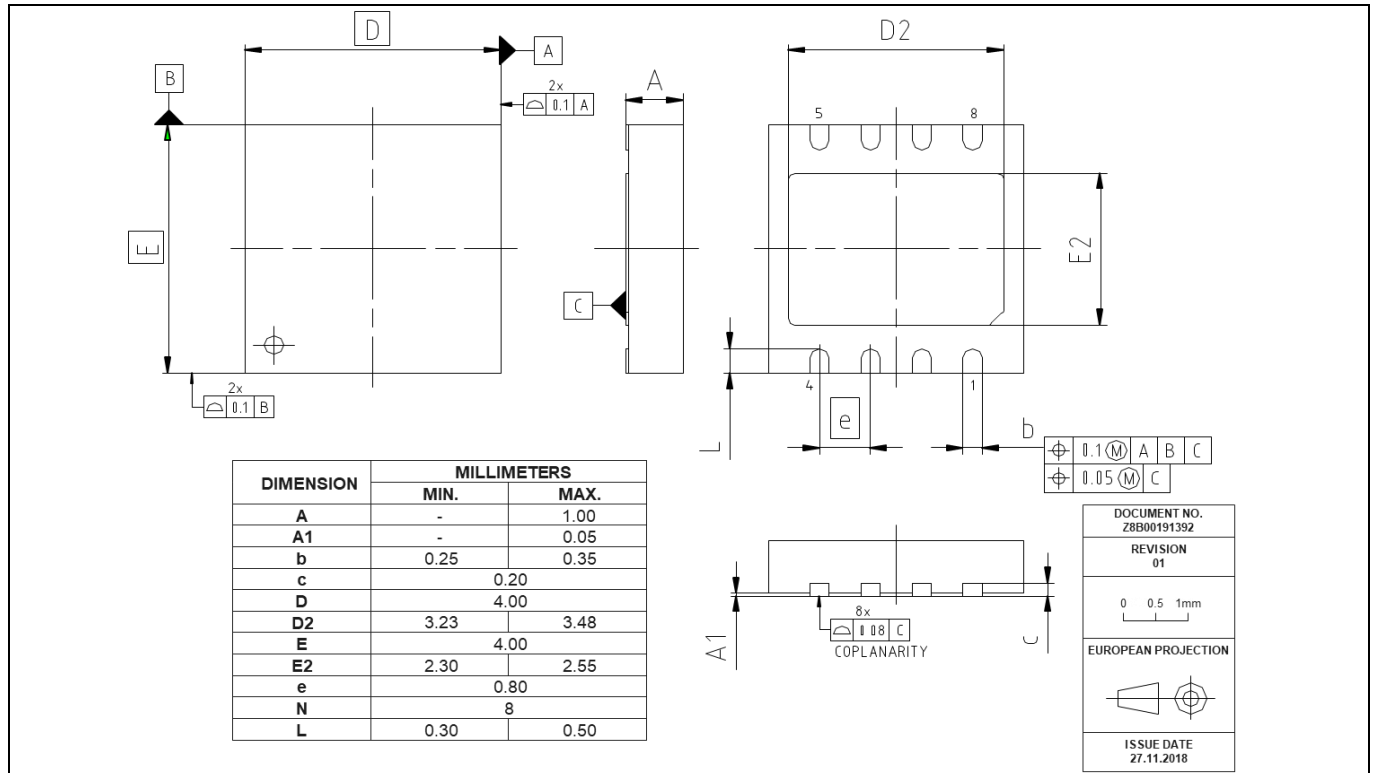


Figure 14 PG-VDSO8-4 Outline Dimensions

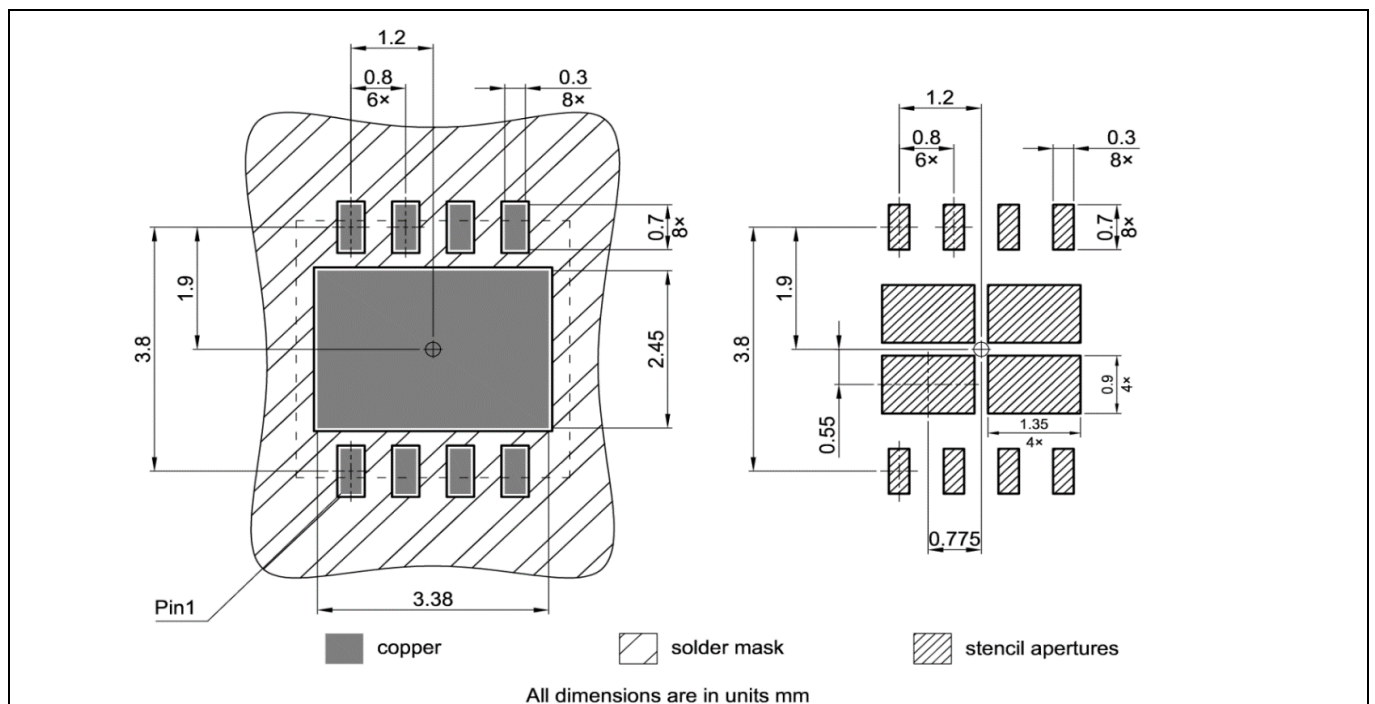


Figure 15 PG-VDSO8-4 Footprint Dimensions

8.2 PG-VSON-10-4 Package Outline

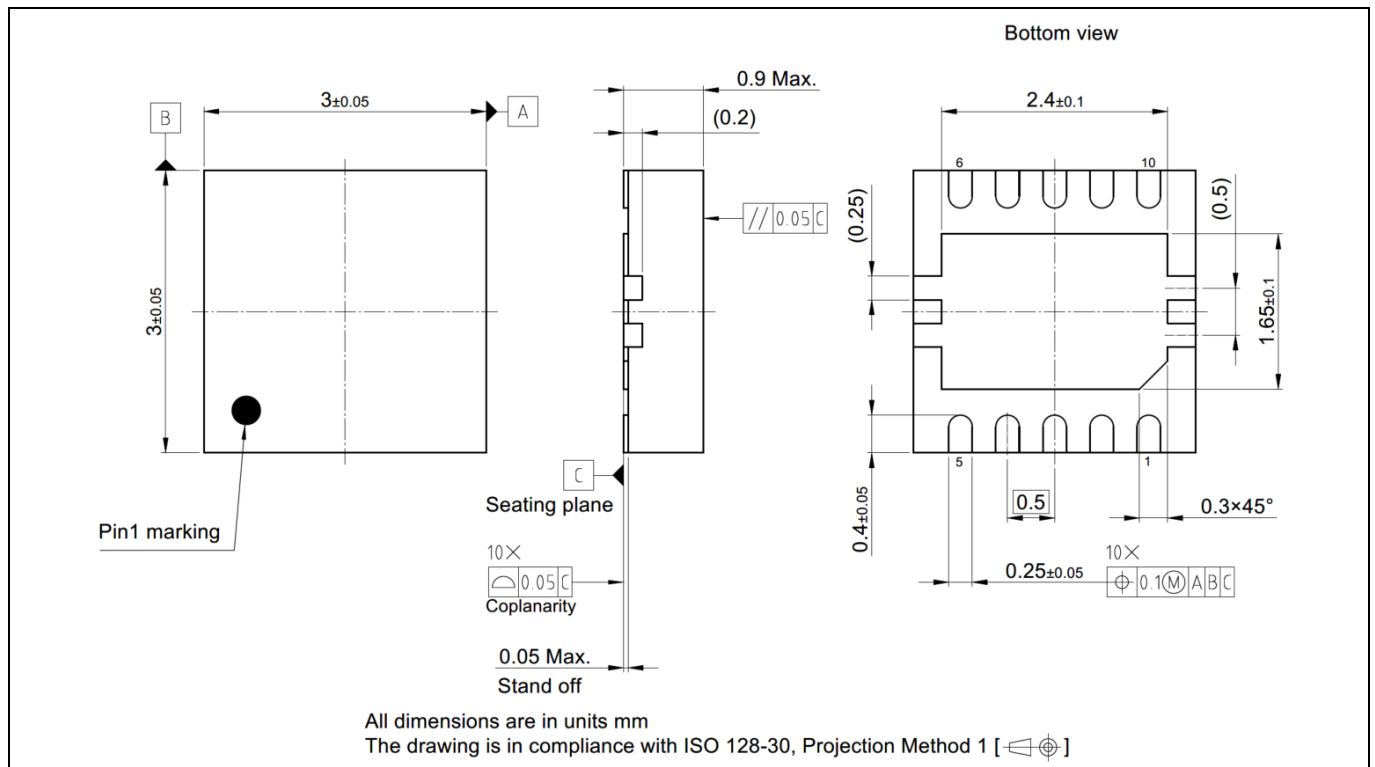


Figure 16 PG-VSON-10-4 Outline Dimensions

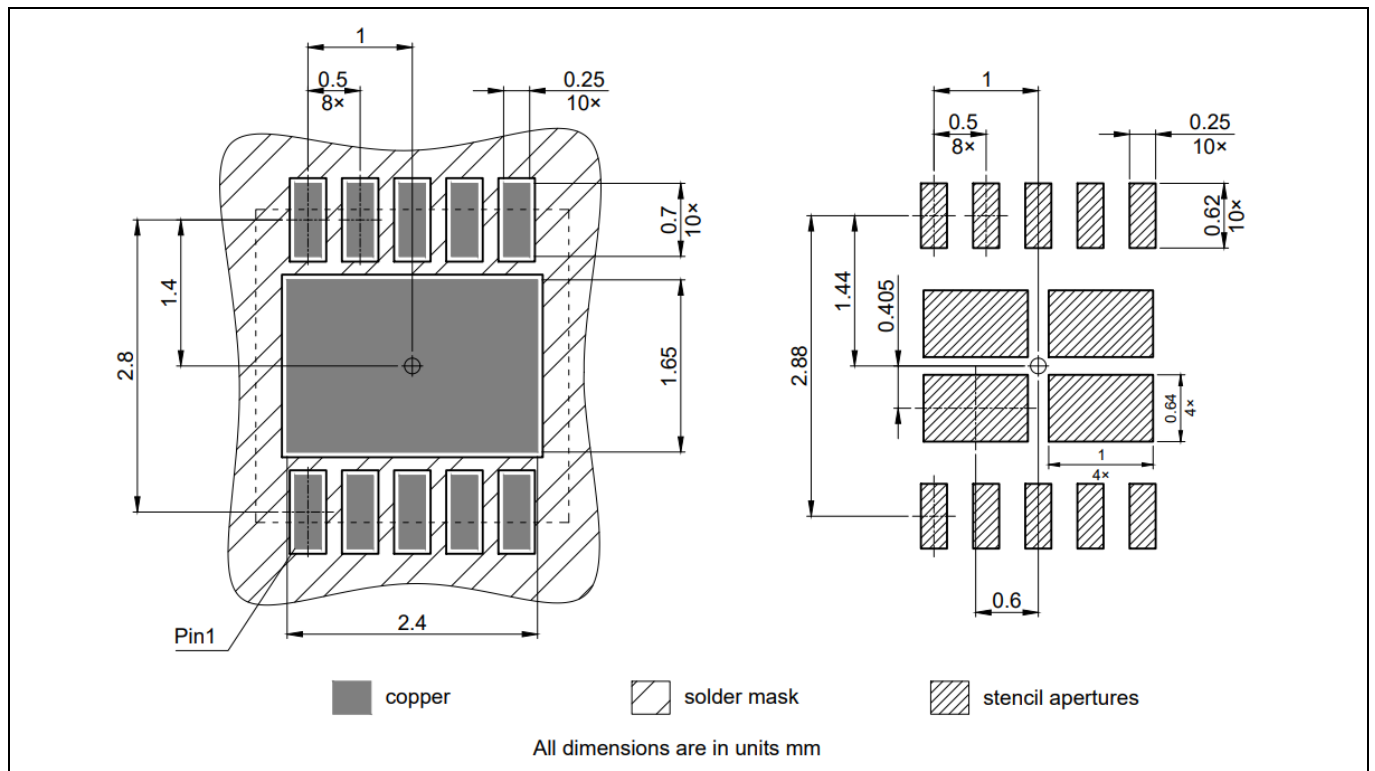


Figure 17 PG-VSON-10-4 Footprint Dimensions

9 Reel and Tape

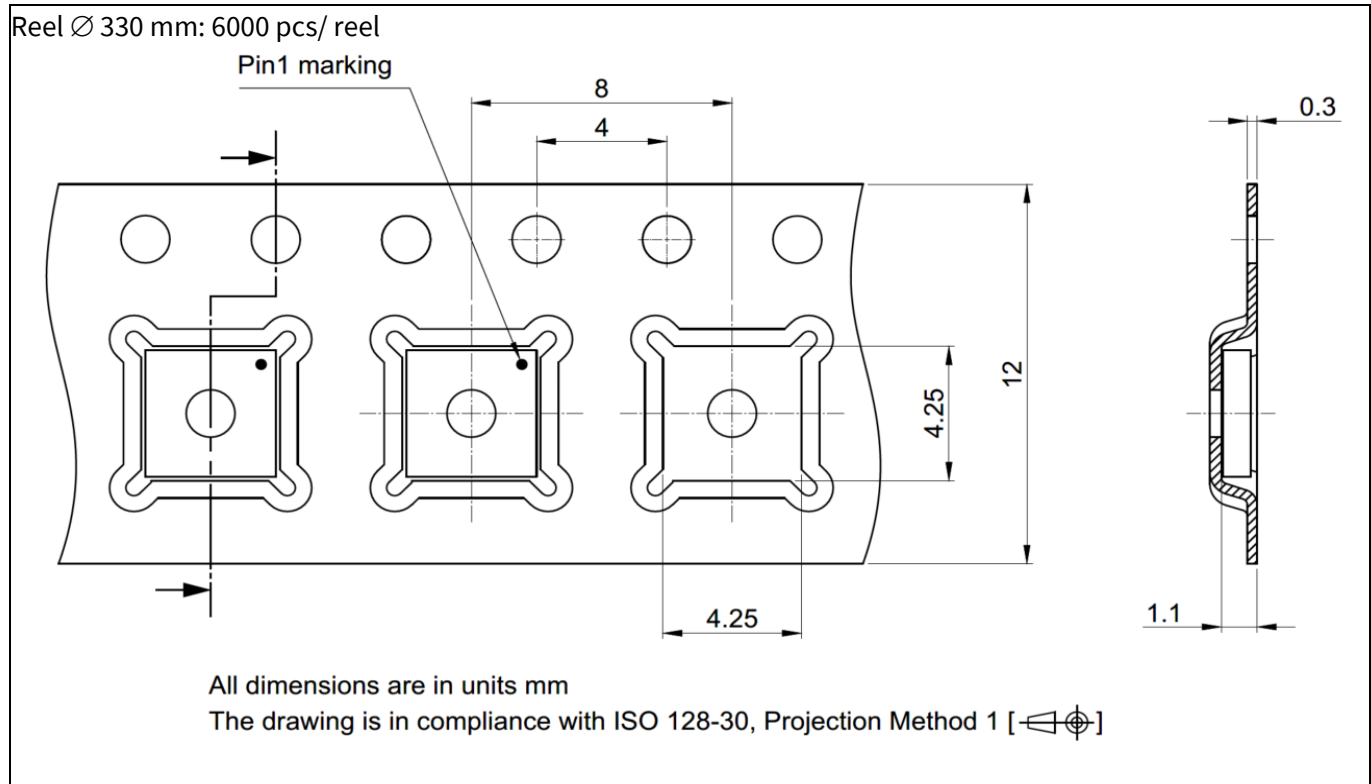


Figure 18 PG-VDSO8-4 Reel and Tape

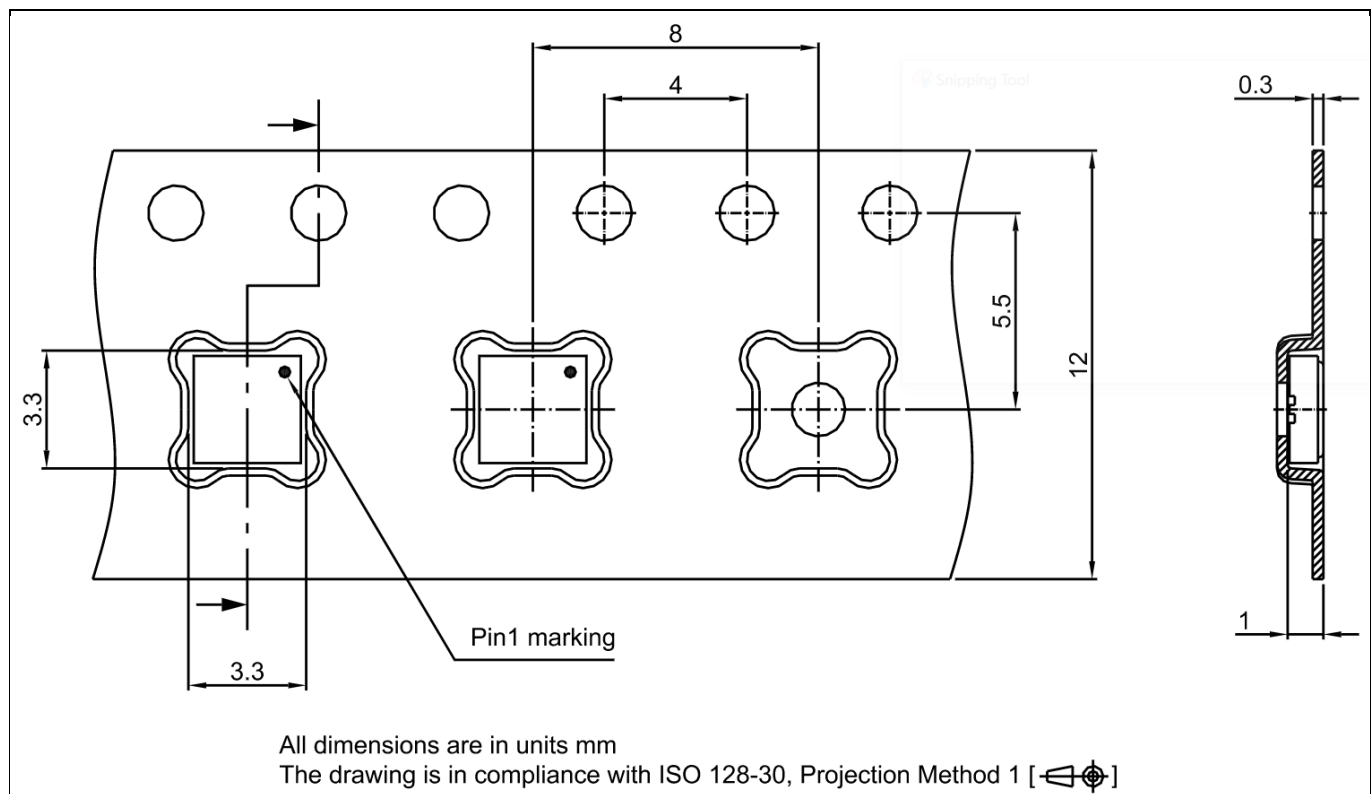


Figure 19 PG-VSON-10-4 Reel and Tape

References

- [1] Alan Huang, *Understanding the transient detector*, Infineon Technologies AG, Neubiberg 2020
- [2] A2015-06 EiceDRIVER™ – gate resistor for power devices

Revision history

Document revision	Date	Description of changes
Rev.2.9	2025-10-22	Template update and editorial changes Chapter 4.3: <ul style="list-style-type: none">• V_{HS} Phase Voltage (DC) typical value to 90 V• V_{HS} Phase Voltage (DC) maximum value to 100 V• V_{HS} Phase Voltage (Repetitive Pulse < 100 ns) maximum value to 100 V• V_{HB} High Side Bootstrap Voltage maximum value to $100V + V_{DD}$
Rev.2.8	2022-09-23	Update UVLO illustration and description
Rev.2.7	2022-05-12	Update marking pin in Tape and Reel and 3D drawing for PG-VSON-10-4
Rev.2.6	2022-04-25	Add repetitive pulse note, minimum DC rating for HS, differential input voltage, minimum input rising threshold, maximum input falling, description leakage current, removed 2EDL812x voltage description, rename "input control" and fix footnote numbering.
Rev.2.5	2021-10-11	Include VSON-10 3x3 package details
Rev.2.4	2020-12-30	Update Tape and Reel specification
Rev.2.3	2020-10-20	Update footprint, LO/HO Pull-up resistance, LO/HO Output voltage, maximum delay spec, HB operating current and remove external diode in diagrams
Rev.2.2	2020-07-28	Separate table for ESD rating and remove footnote 1 under Abs Max Rating

Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

Edition 2025-10-22

Published by

Infineon Technologies AG
81726 Munich, Germany

© 2025 Infineon Technologies AG.
All Rights Reserved.

Do you have a question about this document?

Email:

erratum@infineon.com

Z8F80842574

Important Notice

Products which may also include samples and may be comprised of hardware or software or both ("Product(s)") are sold or provided and delivered by Infineon Technologies AG and its affiliates ("Infineon") subject to the terms and conditions of the frame supply contract or other written agreement(s) executed by a customer and Infineon or, in the absence of the foregoing, the applicable Sales Conditions of Infineon. General terms and conditions of a customer or deviations from applicable Sales Conditions of Infineon shall only be binding for Infineon if and to the extent Infineon has given its express written consent.

For the avoidance of doubt, Infineon disclaims all warranties of non-infringement of third-party rights and implied warranties such as warranties of fitness for a specific use/purpose or merchantability.

Infineon shall not be responsible for any information with respect to samples, the application or customer's specific use of any Product or for any examples or typical values given in this document.

The data contained in this document is exclusively intended for technically qualified and skilled customer representatives. It is the responsibility of the customer to evaluate the suitability of the Product for the intended application and the customer's specific use and to verify all relevant technical data contained in this document in the intended application and the customer's specific use. The customer is responsible for properly designing, programming, and testing the functionality and safety of the intended application, as well as complying with any legal requirements related to its use.

Unless otherwise explicitly approved by Infineon, Products may not be used in any application where a failure of the Products or any consequences of the use thereof can reasonably be expected to result in personal injury. However, the foregoing shall not prevent the customer from using any Product in such fields of use that Infineon has explicitly designed and sold it for, provided that the overall responsibility for the application lies with the customer.

Infineon expressly reserves the right to use its content for commercial text and data mining (TDM) according to applicable laws, e.g. Section 44b of the German Copyright Act (UrhG). If the Product includes security features:

Because no computing device can be absolutely secure, and despite security measures implemented in the Product, Infineon does not guarantee that the Product will be free from intrusion, data theft or loss, or other breaches ("Security Breaches"), and Infineon shall have no liability arising out of any Security Breaches.

If this document includes or references software:

The software is owned by Infineon under the intellectual property laws and treaties of the United States, Germany, and other countries worldwide. All rights reserved. Therefore, you may use the software only as provided in the software license agreement accompanying the software.

If no software license agreement applies, Infineon hereby grants you a personal, non-exclusive, non-transferable license (without the right to sublicense) under its intellectual property rights in the software (a) for software provided in source code form, to modify and reproduce the software solely for use with Infineon hardware products, only internally within your organization, and (b) to distribute the software in binary code form externally to end users, solely for use on Infineon hardware products. Any other use, reproduction, modification, translation, or compilation of the software is prohibited. For further information on the Product, technology, delivery terms and conditions, and prices, please contact your nearest Infineon office or visit <https://www.infineon.com>