

## Datasheet

### Features

- Level-shift high-side low-side dual channel driver
- Independent high-side and low-side TTL logic inputs
- 3 A & 4 A source / 6 A sink output current capability
- 120 V absolute maximum boot voltage
- Integrated bootstrap diode
- -10 V to 20 V input pin capability for increased robustness
- -5 A output pin reverse current capability
- -12 V absolute maximum negative voltage on HS
- 8 V to 17 V supply voltage operating range
- UVLO for both high-side and low-side driver
- Fast propagation delay (< 35 ns)
- 2 ns typical delay matching
- Enable / disable functionality in SON10 (3 x 3) package
- Offered in SON8 (4x4), SON10 (4x4) and SON10 (3x3) package
- Specified from -40°C to 125°C operating junction temperature range

### Potential applications

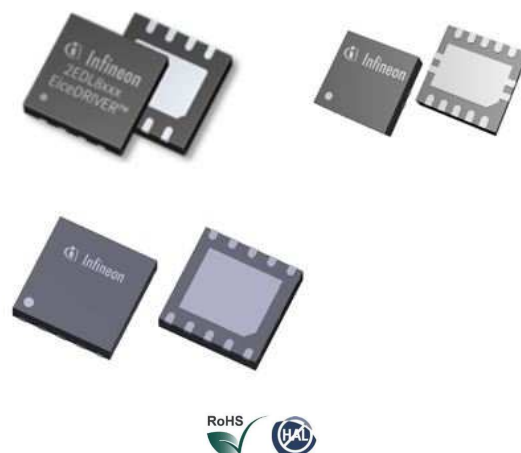
- Telecom/Datacom half and full bridge power converters
- Current-fed push-pull converters
- Buck converters
- Two-switch forward converters
- Active clamp forward converters
- Class D amplifiers
- DC motor drives

### Product validation

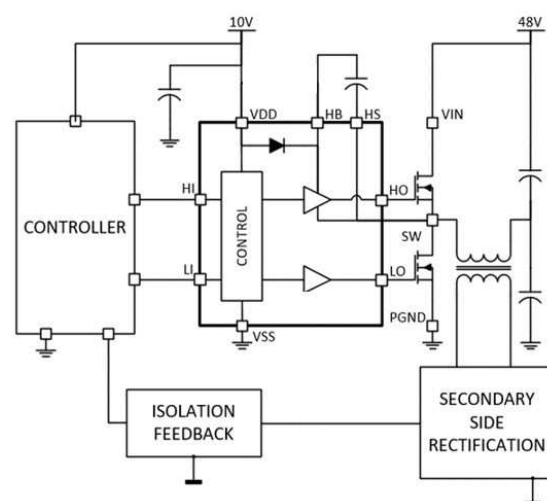
Qualified for industrial applications according to the relevant tests of JEDEC47/20/22.

### Description

The 2EDL803x is designed to drive both high-side and low-side MOSFETs in a half-bridge configuration. The floating high-side driver is capable of driving a high-side MOSFET operating up to 120 V bootstrap voltage. Version 4 provides full 4 A current capability, while version 3 provides 3 A. The high-side bias voltage is generated using a bootstrap technique using an integrated bootstrap diode. The inputs of the driver are TTL logic compatible and can withstand input common mode swing from -10 V up to 20 V. Independent inputs allow controlling high- and low-side domains independently. Undervoltage lockout (UVLO) on both high- and low-side supplies forces the corresponding outputs low in case of insufficient supply. The 2EDL803x is available in SON-8 pins 4 mm x 4 mm, SON-10 pins 4 mm x 4 mm and SON-10 pins 3 mm x 3 mm package.



Typical application diagram



**Table 1** Device information

| Part number  | Package      | Body size   |
|--------------|--------------|-------------|
| 2EDL803X-G4B | PG-VDSO8-5   | 4 mm x 4 mm |
| 2EDL803X-G3C | PG-VSON-10-4 | 3 mm x 3 mm |
| 2EDL803X-G4C | PG-VDSO10-2  | 4 mm x 4 mm |

## Table of contents

|          |                                        |    |
|----------|----------------------------------------|----|
|          | <b>Table of contents</b>               | 2  |
| <b>1</b> | <b>Package information</b>             | 4  |
| 1.1      | Ordering information                   | 4  |
| 1.2      | Pin configuration                      | 4  |
| 1.3      | Pin description                        | 5  |
| <b>2</b> | <b>General product characteristics</b> | 6  |
| 2.1      | Absolute maximum ratings               | 6  |
| 2.2      | ESD ratings                            | 7  |
| 2.3      | Recommended operating conditions       | 7  |
| 2.4      | Thermal mechanical characteristics     | 8  |
| 2.5      | Electrical characteristics             | 8  |
| 2.6      | Switching characteristics              | 11 |
| <b>3</b> | <b>Timing diagrams</b>                 | 13 |
| <b>4</b> | <b>Typical characteristics</b>         | 14 |
| <b>5</b> | <b>Product information</b>             | 17 |
| 5.1      | Block diagram                          | 17 |
| 5.2      | Functional description                 | 17 |
| 5.2.1    | Supply voltage                         | 18 |
| 5.2.2    | Input stage                            | 18 |
| 5.2.3    | Enable                                 | 18 |
| 5.2.4    | Driver outputs                         | 18 |
| 5.2.5    | Undervoltage lockout (UVLO)            | 19 |
| 5.2.6    | Minimum input pulse width              | 19 |
| <b>6</b> | <b>Application information</b>         | 20 |
| 6.1      | Design guidelines                      | 20 |
| 6.1.1    | Selection of bootstrap capacitor       | 21 |
| 6.1.2    | Selection of VDD bypass capacitor      | 22 |
| 6.1.3    | Selection of bootstrap resistor        | 22 |
| 6.1.4    | Selection of external bootstrap diode  | 23 |
| 6.1.5    | Selection of gate resistor             | 23 |
| 6.2      | PCB Layout guidelines                  | 24 |
| <b>7</b> | <b>Outline dimensions</b>              | 26 |
| 7.1      | PG-VDSO8-5                             | 26 |
| 7.2      | PG-VSON-10-4                           | 27 |
| 7.3      | PG-VDSO8-10-2                          | 28 |
| <b>8</b> | <b>Tape and reel</b>                   | 30 |
| 8.1      | PG-VDSO8-5                             | 30 |



Table of contents

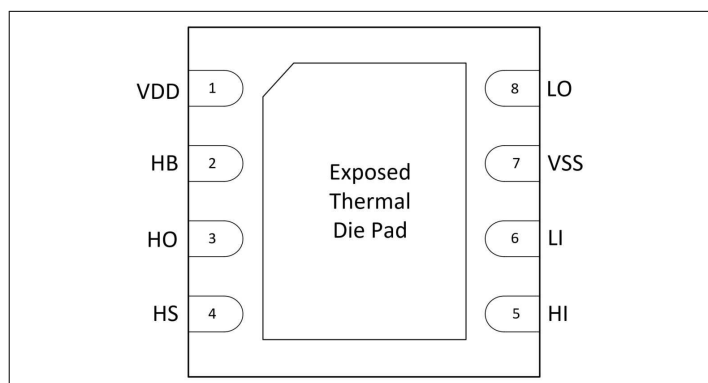
|     |                               |    |
|-----|-------------------------------|----|
| 8.2 | PG-VSON-10-4 .....            | 30 |
| 8.3 | PG-VDSON-10-2 .....           | 31 |
| 9   | <b>Revision history</b> ..... | 32 |
|     | <b>Disclaimer</b> .....       | 33 |

## 1 Package information

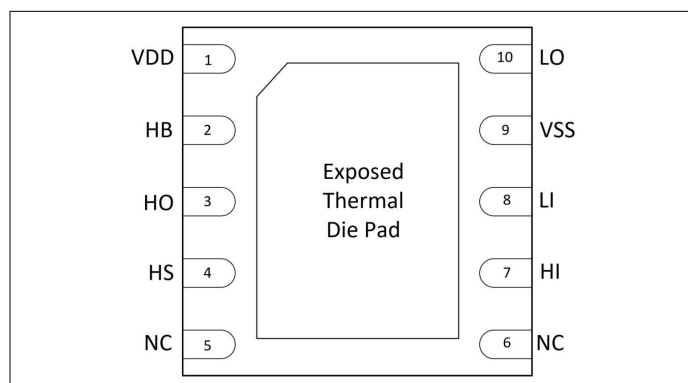
### 1.1 Ordering information

| Base part number | Package type  | Standard pack |          | Orderable part number | Marking code |
|------------------|---------------|---------------|----------|-----------------------|--------------|
|                  |               | Form          | Quantity |                       |              |
| 2EDL8034-G4B     | PG-VDSO8-8-5  | Tape and reel | 5000     | 2EDL8034G4BXTM A1     | 2ED 8034G4B  |
| 2EDL8033-G4B     |               |               |          | 2EDL8033G4BXTM A1     | 2ED 8033G4B  |
| 2EDL8034-G3C     | PG-VSON-10-4  | Tape and reel | 4000     | 2EDL8034G3CXTM A1     | 2EDL8 034G3  |
| 2EDL8033-G3C     |               |               |          | 2EDL8033G3CXTM A1     | 2EDL8 033G3  |
| 2EDL8034-G4C     | PG-VDSO8-10-2 | Tape and reel | 5000     | 2EDL8034G4CXTM A1     | 2ED 8034G4C  |
| 2EDL8033-G4C     |               |               |          | 2EDL8033G4CXTM A1     | 2ED 8033G4C  |

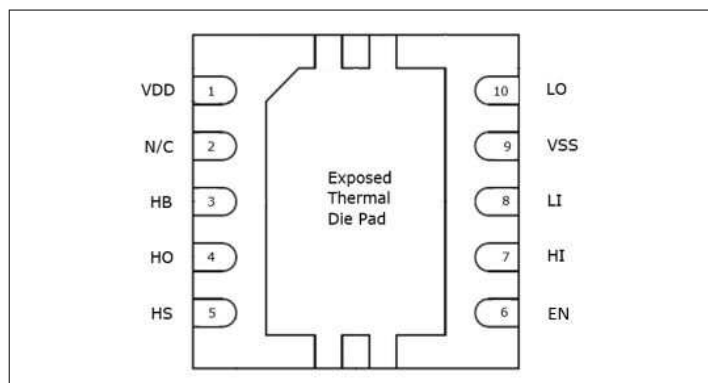
### 1.2 Pin configuration



**Figure 1** **VDSO8-8 4 mm x 4 mm, Top transparent view**



**Figure 2** **VDSO8-10 4 mm x 4 mm, Top transparent view**

**1 Package information**


**Figure 3** **VSON-10 3 mm x 3 mm, Top transparent view**

**1.3 Pin description**

| Pin name | VDSO-8 pin # | VSON-10 pin # | VDSO-10 pin # | Function                                                                                                                                                                                                |
|----------|--------------|---------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| VDD      | 1            | 1             | 1             | Gate drive supply                                                                                                                                                                                       |
| HB       | 2            | 3             | 2             | High-side gate driver bootstrap rail                                                                                                                                                                    |
| HO       | 3            | 4             | 3             | High-side gate driver source and sink current output                                                                                                                                                    |
| HS       | 4            | 5             | 4             | High-side FET source connection                                                                                                                                                                         |
| HI       | 5            | 7             | 7             | High-side driver control input                                                                                                                                                                          |
| LI       | 6            | 8             | 8             | Low-side driver control input                                                                                                                                                                           |
| VSS      | 7            | 9             | 9             | Ground return                                                                                                                                                                                           |
| LO       | 8            | 10            | 10            | Low-side gate driver source and sink current output                                                                                                                                                     |
| EN       | –            | 6             | –             | Enable input. When this pin is high or left-open, it enables the driver. If pulled low, it disables the driver. Pulling the EN pin to VDD is recommended for high-noise system if EN pin is not needed. |
| NC       | –            | 2             | 5,6           | Not connected                                                                                                                                                                                           |

## 2 General product characteristics

### 2.1 Absolute maximum ratings

Table 3

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. All voltage parameters are referenced to  $V_{SS}$  unless otherwise specified.

| Parameter                               | Symbol           | Values         |      |                | Unit | Note or condition      |
|-----------------------------------------|------------------|----------------|------|----------------|------|------------------------|
|                                         |                  | Min.           | Typ. | Max.           |      |                        |
| Supply input voltage                    | $V_{DD}$         | -0.3           | –    | 20             | V    |                        |
| High side supply voltage                | $V_{HB-HS}$      | -0.3           | –    | 20             | V    | Referenced to $V_{HS}$ |
| High side bootstrap voltage             | $V_{HB}$         | -0.3           | –    | 120            | V    | <sup>1)</sup>          |
| Phase voltage                           | $V_{HS}$         | -1             | –    | $V_{HB} + 0.3$ | V    |                        |
| Phase voltage (repetitive pulse)        | $V_{HS}$         | -12            |      | $V_{HB} + 0.3$ | V    | < 100 ns <sup>2)</sup> |
| HI and LI input voltage                 | $V_{HI}, V_{LI}$ | -10            | –    | 20             | V    |                        |
| EN input voltage                        | $V_{EN}$         | -10            | –    | 20             | V    |                        |
| Output voltage on LO                    | $V_{LO}$         | -0.3           | –    | $V_{DD} + 0.3$ | V    |                        |
| Output voltage on LO (repetitive pulse) | $V_{LO}$         | -2             | –    | $V_{DD} + 0.3$ | V    | < 100 ns <sup>2)</sup> |
| Output voltage on HO                    | $V_{HO}$         | $V_{HS} - 0.3$ | –    | $V_{HB} + 0.3$ | V    |                        |
| Output voltage on HO (repetitive pulse) | $V_{HO}$         | $V_{HS} - 2$   | –    | $V_{HB} + 0.3$ |      | < 100 ns <sup>2)</sup> |
| Peak reverse current on LO and HO       | $I_{OR}$         | –              | –    | 5              | A    | <sup>2) 3)</sup>       |

(table continues...)

**Table 3** (continued)

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. All voltage parameters are referenced to  $V_{SS}$  unless otherwise specified.

| Parameter                      | Symbol | Values |      |      | Unit | Note or condition |
|--------------------------------|--------|--------|------|------|------|-------------------|
|                                |        | Min.   | Typ. | Max. |      |                   |
| Operating junction temperature | $T_J$  | -40    | –    | 150  | °C   |                   |
| Storage temperature            | $T_S$  | -55    | –    | 150  | °C   |                   |

1) Verified with VDD supplied within the recommended operating voltage range.

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

3) For < 500 ns pulses.

## 2.2 ESD ratings

| Description                                                    | Symbol             | Value | Unit |
|----------------------------------------------------------------|--------------------|-------|------|
| Human Body Model sensitivity as per ANSI/ESDA/JEDEC JS-001     | ESD <sub>HBM</sub> | ±2000 | V    |
| Charged Device Model sensitivity as per ANSI/ESDA/JEDEC JS-002 | ESD <sub>CDM</sub> | ±1000 | V    |

## 2.3 Recommended operating conditions

**Table 4**

The following operating conditions must not be exceeded in order to ensure correct operation and reliability of the device. All voltage parameters are referenced to  $V_{SS}$  unless otherwise specified.

| Parameter                        | Symbol           | Values       |      |                | Unit | Note or condition        |
|----------------------------------|------------------|--------------|------|----------------|------|--------------------------|
|                                  |                  | Min.         | Typ. | Max.           |      |                          |
| Supply input voltage             | $V_{DD}$         | 8            | 12   | 17             | V    |                          |
| High side supply voltage         | $V_{HB-HS}$      | 8            | 12   | 17             | V    | Referenced to $V_{HS}$ . |
| High side bootstrap voltage      | $V_{HB}$         | $V_{HS} + 8$ | –    | $V_{HS} + 17$  | V    |                          |
| Phase voltage                    | $V_{HS}$         | -1           | –    | 100            | V    |                          |
| Phase voltage (repetitive pulse) | $V_{HS}$         | -12          | –    | 100            | V    | < 100 ns                 |
| HI and LI Input voltage          | $V_{HI}, V_{LI}$ | 0            | –    | $V_{DD} + 0.3$ | V    |                          |

(table continues...)

**Table 4** (continued)

The following operating conditions must not be exceeded in order to ensure correct operation and reliability of the device. All voltage parameters are referenced to  $V_{SS}$  unless otherwise specified.

| Parameter                      | Symbol       | Values |      |              | Unit | Note or condition      |
|--------------------------------|--------------|--------|------|--------------|------|------------------------|
|                                |              | Min.   | Typ. | Max.         |      |                        |
| EN input voltage               | $V_{EN}$     | 0      | –    | $V_{DD}+0.3$ | V    |                        |
| Output voltage on LO           | $V_{LO}$     | 0      | –    | 17           | V    |                        |
| Output voltage on HO           | $V_{HO-HS}$  | 0      | –    | 17           | V    | Referenced to $V_{HS}$ |
| HS slew rate                   | $HS_{dV/dT}$ | –      | –    | 50           | V/ns |                        |
| Operating junction temperature | $T_J$        | -40    | –    | 125          | °C   |                        |

## 2.4 Thermal mechanical characteristics

**Table 5** Thermal resistance

| Symbol     | Description                         | VDSON-8 | VSON-10 | VDSON-10 | UNIT | Conditions                           |
|------------|-------------------------------------|---------|---------|----------|------|--------------------------------------|
| $R_{thJC}$ | Junction-to-case thermal resistance | 4.6     | 4.7     | 4.6      | °C/W | Bottom                               |
| $R_{thJC}$ | Junction-to-case thermal resistance | 37      | 39.3    | 38.4     | °C/W | Top                                  |
| $R_{thJA}$ | junction-to-ambient                 | 57      | 61.4    | 57.5     | °C/W | Device soldered on PCB <sup>1)</sup> |

1) Device on 76.2 mm x 114.3 mm x 1.5 mm board (JEDEC 2s2p) with 6 cm<sup>2</sup> copper area for drain connection. PCB vertical in still air.

## 2.5 Electrical characteristics

**Table 6**

Unless otherwise specified:  $V_{DD} = V_{HB} = 12$  V,  $V_{HS} = V_{SS} = 0$  V. The minimum and maximum limits are valid over the full operating temperature range and are ensured by characterization and statistical correlation. Typical values are tested at  $T_C = 25$ °C.

| Parameter             | Symbol    | Values |      |      | Unit | Note or condition           |
|-----------------------|-----------|--------|------|------|------|-----------------------------|
|                       |           | Min.   | Typ. | Max. |      |                             |
| Supply current        |           |        |      |      |      |                             |
| VDD quiescent current | $I_{VDD}$ | –      | 290  | 380  | uA   | $V_{LI}$ and $V_{HI}$ = 0 V |

(table continues...)  
Datasheet

**Table 6** (continued)

Unless otherwise specified:  $V_{DD} = V_{HB} = 12\text{ V}$ ,  $V_{HS} = V_{SS} = 0\text{ V}$ . The minimum and maximum limits are valid over the full operating temperature range and are ensured by characterization and statistical correlation. Typical values are tested at  $T_C = 25^\circ\text{C}$ .

| Parameter                 | Symbol     | Values |      |      | Unit | Note or condition                                                          |
|---------------------------|------------|--------|------|------|------|----------------------------------------------------------------------------|
|                           |            | Min.   | Typ. | Max. |      |                                                                            |
| VDD operating current     | $I_{VDDO}$ | –      | 2.4  | 3.5  | mA   | $F_{sw} = 500\text{ kHz}$ , $C_{load} = 0\text{ nF}$                       |
| HB quiescent current      | $I_{HB}$   | –      | 185  | 250  | uA   | $V_{LI}$ and $V_{HI} = 0\text{ V}$                                         |
| HB operating current      | $I_{HBO}$  | –      | 2.0  | 3.5  | mA   | $F_{sw} = 500\text{ kHz}$ , $C_{load} = 0\text{ nF}$                       |
| HB to VSS leakage current | $I_{HBS}$  | –      | –    | 2    | uA   | $V_{DD} = V_{LI} = V_{HI} = 0\text{ V}$ , $V_{HS} = V_{HB} = 100\text{ V}$ |

**Input**

|                                 |          |     |     |     |    |                                           |
|---------------------------------|----------|-----|-----|-----|----|-------------------------------------------|
| Input voltage rising threshold  | $V_{IR}$ | 1.8 | 2.4 | 2.9 | V  | LI and HI Input voltage rising threshold  |
| Input voltage falling threshold | $V_{IF}$ | 1.0 | 1.5 | 2.1 | V  | LI and HI Input voltage falling threshold |
| Input voltage hysteresis        | $V_{IH}$ | –   | 0.9 | –   | V  |                                           |
| Input pull down resistance      | $R_{IN}$ | 100 | 200 | 300 | kΩ | $V_{LI}$ and $V_{HI} \leq 4\text{ V}$     |

**Enable**

|                                 |             |     |     |     |    |                          |
|---------------------------------|-------------|-----|-----|-----|----|--------------------------|
| Enable input rising threshold   | $V_{EN}$    | 1.5 | 2.3 | 2.8 | V  |                          |
| Enable input falling threshold  | $V_{DIS}$   | 0.6 | 1   | 1.3 | V  |                          |
| Enable input voltage hysteresis | $V_{ENHYS}$ | –   | 1.3 | –   | V  |                          |
| Enable pull up current          | $I_{EN}$    | –   | 8   | 10  | uA | $V_{EN} \leq 4\text{ V}$ |
| Time to enable the driver       | $T_{EN}$    | –   | 25  | 40  | ns | $V_{EN} = 2.8\text{ V}$  |
| Time to disable the driver      | $T_{DIS}$   | –   | 29  | 45  | ns | $V_{EN} = 0\text{ V}$    |

**Undervoltage lockout (UVLO)**

|                            |           |     |     |     |   |  |
|----------------------------|-----------|-----|-----|-----|---|--|
| VDD UVLO rising threshold  | $V_{DDR}$ | 6.8 | 7.3 | 7.8 | V |  |
| VDD UVLO falling threshold | $V_{DDF}$ | 6.2 | 6.7 | 7.2 | V |  |

(table continues...)

**Table 6** (continued)

Unless otherwise specified:  $V_{DD} = V_{HB} = 12\text{ V}$ ,  $V_{HS} = V_{SS} = 0\text{ V}$ . The minimum and maximum limits are valid over the full operating temperature range and are ensured by characterization and statistical correlation. Typical values are tested at  $T_C = 25^\circ\text{C}$ .

| Parameter                       | Symbol    | Values |      |      | Unit | Note or condition      |
|---------------------------------|-----------|--------|------|------|------|------------------------|
|                                 |           | Min.   | Typ. | Max. |      |                        |
| VDD UVLO threshold hysteresis   | $V_{DDH}$ | –      | 0.6  | –    | V    |                        |
| VHB-HS UVLO rising threshold    | $V_{HBR}$ | 5.8    | 6.3  | 6.8  | V    | Referenced to $V_{HS}$ |
| VHB-HS UVLO falling threshold   | $V_{HBF}$ | 5.2    | 5.7  | 6.2  | V    | Referenced to $V_{HS}$ |
| HB-HS UVLO threshold hysteresis | $V_{HBH}$ | –      | 0.6  | –    | V    |                        |

**Bootstrap diode**

|                              |          |     |     |     |          |                                                                                          |
|------------------------------|----------|-----|-----|-----|----------|------------------------------------------------------------------------------------------|
| Dynamic resistance           | $R_D$    | 2   | 4.2 | 6.5 | $\Omega$ | $I_{VDD-HB} = 100\text{ mA}$ , $I_{VDD-HB} = 80\text{ mA}$                               |
| Low current forward voltage  | $V_{FL}$ | 0.2 | 0.5 | 0.8 | V        | $I_{VDD-HB} = 100\text{ }\mu\text{A}$                                                    |
| High current forward voltage | $V_{FH}$ | 1.2 | 1.4 | 1.6 | V        | $I_{VDD-HB} = 100\text{ mA}$                                                             |
| Reverse recovery time        | $T_{rr}$ | –   | 10  | –   | ns       | $I_F = 20\text{ mA}$ , $I_{RR} = 500\text{ mA}$ , $T_C = 25^\circ\text{C}$ <sup>1)</sup> |

**Low-side gate driver**

|                           |           |      |      |      |   |                                                                 |
|---------------------------|-----------|------|------|------|---|-----------------------------------------------------------------|
| High level output voltage | $V_{LOH}$ | 0.05 | 0.1  | 0.20 | V | $I_O = -100\text{ mA}$ , $V_{LOH} = V_{DD} - V_{LO}$ , 2EDL8034 |
| High level output voltage | $V_{LOH}$ | 0.07 | 0.12 | 0.25 | V | $I_O = -100\text{ mA}$ , $V_{LOH} = V_{DD} - V_{LO}$ , 2EDL8033 |
| Low level output voltage  | $V_{LOL}$ | 0.03 | 0.05 | 0.1  | V | $I_O = 100\text{ mA}$                                           |
| Peak pull-up current      | $I_{PUL}$ | –    | 4    | –    | A | $V_{LO} = 0\text{ V}$ <sup>1)</sup> , 2EDL8034                  |
| Peak pull-up current      | $I_{PUL}$ | –    | 3    | –    | A | $V_{LO} = 0\text{ V}$ <sup>1)</sup> , 2EDL8033                  |
| Peak pull-down current    | $I_{PDL}$ | –    | 6    | –    | A | $V_{LO} = 12\text{ V}$ <sup>1)</sup>                            |

**High-side gate driver**

|                           |           |      |     |     |   |                                                                 |
|---------------------------|-----------|------|-----|-----|---|-----------------------------------------------------------------|
| High level output voltage | $V_{HOH}$ | 0.05 | 0.1 | 0.2 | V | $I_O = -100\text{ mA}$ , $V_{HOH} = V_{HB} - V_{HO}$ , 2EDL8034 |
|---------------------------|-----------|------|-----|-----|---|-----------------------------------------------------------------|

(table continues...)

**Table 6** (continued)

Unless otherwise specified:  $V_{DD} = V_{HB} = 12\text{ V}$ ,  $V_{HS} = V_{SS} = 0\text{ V}$ . The minimum and maximum limits are valid over the full operating temperature range and are ensured by characterization and statistical correlation. Typical values are tested at  $T_C = 25^\circ\text{C}$ .

| Parameter                 | Symbol    | Values |      |      | Unit | Note or condition                                               |
|---------------------------|-----------|--------|------|------|------|-----------------------------------------------------------------|
|                           |           | Min.   | Typ. | Max. |      |                                                                 |
| High level output voltage | $V_{HOH}$ | 0.07   | 0.12 | 0.25 | V    | $I_O = -100\text{ mA}$ , $V_{HOH} = V_{HB} - V_{HO}$ , 2EDL8033 |
| Low level output voltage  | $V_{HOL}$ | 0.03   | 0.05 | 0.1  | V    | $I_O = 100\text{ mA}$                                           |
| Peak pull-up current      | $I_{PUH}$ | –      | 4    | –    | A    | $V_{HO} = 0\text{ V}^{1)}$ , 2EDL8034                           |
| Peak pull-up current      | $I_{PUH}$ | –      | 3    | –    | A    | $V_{HO} = 0\text{ V}^{1)}$ , 2EDL8033                           |
| Peak pull-down current    | $I_{PDH}$ | –      | 6    | –    | A    | $V_{HO} = 12\text{ V}^{1)}$                                     |

1) Not subject to production test. Verified by design/characterization.

## 2.6 Switching characteristics

**Table 7**

Unless otherwise specified:  $V_{DD} = V_{HB} = 12\text{ V}$ ,  $V_{HS} = V_{SS} = 0\text{ V}$ . The minimum and maximum limits are valid over the full operating temperature range and are ensured by characterization and statistical correlation. Typical values are tested at  $T_C = 25^\circ\text{C}$ .

| Parameter | Symbol | Values |      |      | Unit | Note or condition |
|-----------|--------|--------|------|------|------|-------------------|
|           |        | Min.   | Typ. | Max. |      |                   |

### Propagation delays

|                           |          |   |    |    |    |                                          |
|---------------------------|----------|---|----|----|----|------------------------------------------|
| Rising propagation delay  | $T_{DR}$ | – | 33 | 50 | ns | $C_{load} = 0$ , 50 %-50 % <sup>1)</sup> |
| Falling propagation delay | $T_{DF}$ | – | 33 | 50 | ns | $C_{load} = 0$ , 50 %-50 % <sup>2)</sup> |

### Delay matching

|                    |             |   |   |   |    |                                  |
|--------------------|-------------|---|---|---|----|----------------------------------|
| Delay matching ON  | $T_{DMON}$  | – | 2 | 6 | ns | between LO rising and HO falling |
| Delay matching OFF | $T_{DMOFF}$ | – | 2 | 6 | ns | between LO falling and HO rising |

### Output rise and fall time

|                  |       |   |     |   |    |                                                                 |
|------------------|-------|---|-----|---|----|-----------------------------------------------------------------|
| LO, HO rise time | $T_R$ | – | 4.4 | – | ns | $C_{load} = 1\text{ nF}$ , 10 % - 90 % <sup>3)</sup> , 2EDL8034 |
| LO, HO rise time | $T_R$ | – | 4.6 | – | ns | $C_{load} = 1\text{ nF}$ , 10 %-90 % <sup>3)</sup> , 2EDL8033   |

(table continues...)

**Table 7** (continued)

Unless otherwise specified:  $V_{DD} = V_{HB} = 12\text{ V}$ ,  $V_{HS} = V_{SS} = 0\text{ V}$ . The minimum and maximum limits are valid over the full operating temperature range and are ensured by characterization and statistical correlation. Typical values are tested at  $T_C = 25^\circ\text{C}$ .

| Parameter        | Symbol   | Values |      |      | Unit | Note or condition                                               |
|------------------|----------|--------|------|------|------|-----------------------------------------------------------------|
|                  |          | Min.   | Typ. | Max. |      |                                                                 |
| LO, HO rise time | $T_{R1}$ | –      | 131  | –    | ns   | $C_{load} = 100\text{ nF}$ , 25 %-75 % <sup>3)</sup> , 2EDL8034 |
| LO, HO rise time | $T_{R1}$ | –      | 195  | –    | ns   | $C_{load} = 100\text{ nF}$ , 25 %-75 % <sup>3)</sup> , 2EDL8033 |
| LO, HO fall time | $T_F$    | –      | 3.3  | –    | ns   | $C_{Load} = 1\text{ nF}$ , 10 %-90 % <sup>3)</sup>              |
| LO, HO fall time | $T_{F1}$ | –      | 106  | –    | ns   | $C_{LOAD} = 100\text{ nF}$ , 25 %-75 % <sup>3)</sup>            |

**Miscellaneous**

|                                                   |          |   |   |    |    |  |
|---------------------------------------------------|----------|---|---|----|----|--|
| Minimum input pulse width that changes the output | $T_{PW}$ | – | – | 40 | ns |  |
|---------------------------------------------------|----------|---|---|----|----|--|

- 1) Rising propagation delay from LI to LO and from HI to HO.  
 2) Falling propagation delay from LI to LO and from HI to HO.  
 3) Not subject to production test. Verified by design/characterization.

3 Timing diagrams

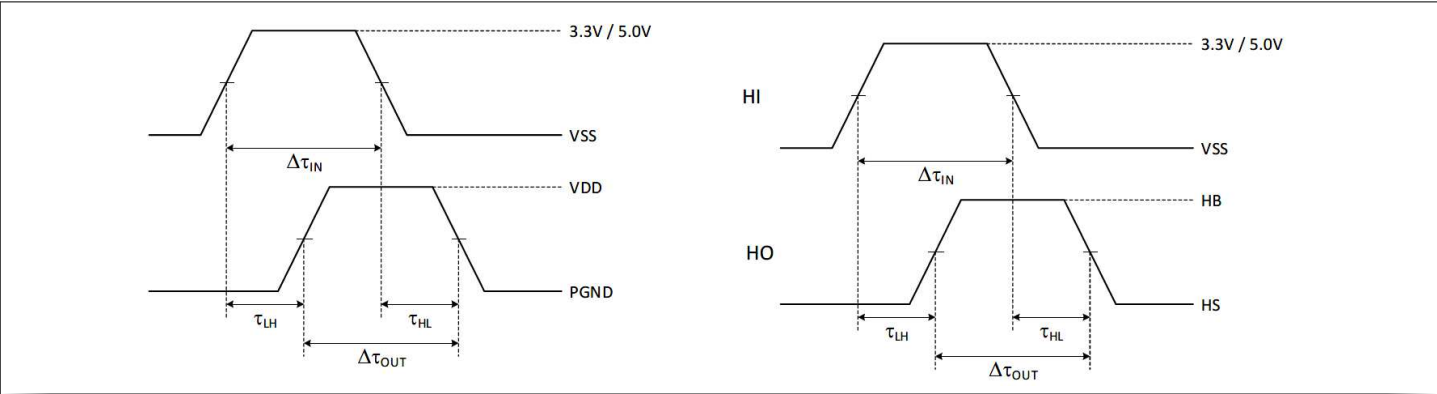


Figure 4 Propagation delay

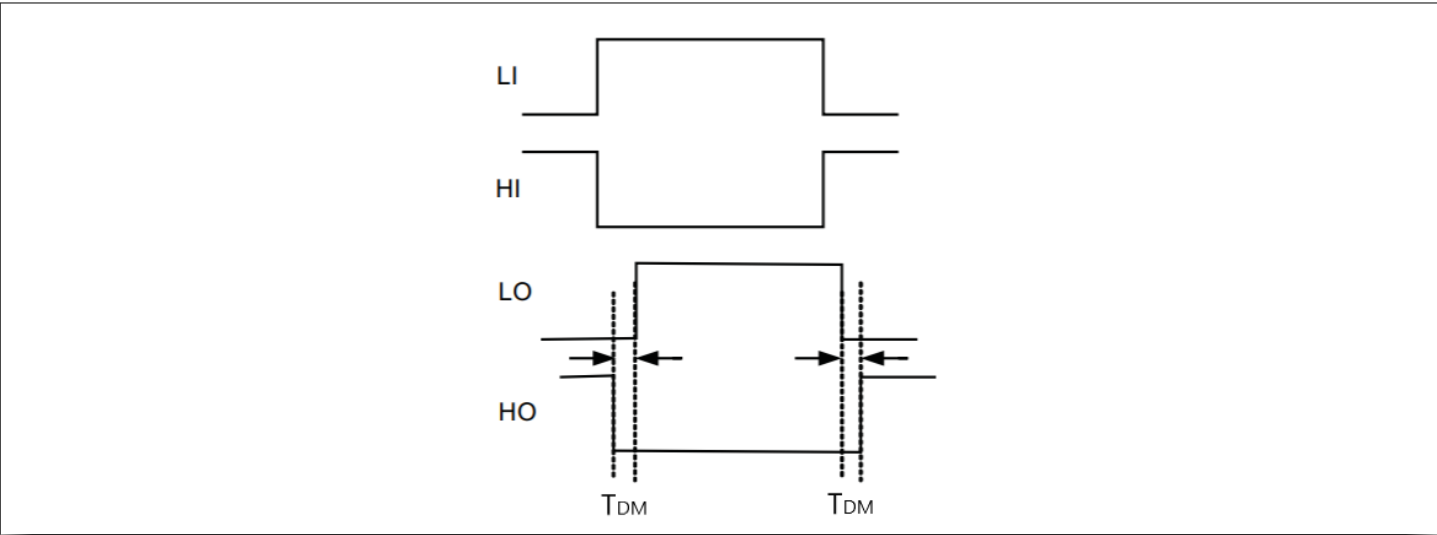


Figure 5 Delay matching

4 Typical characteristics

4 Typical characteristics

Unless otherwise specified:  $V_{DD} = V_{HB} = 12\text{ V}$ ,  $V_{HS} = V_{SS} = 0\text{ V}$ ,  $T_C = 25^\circ\text{C}$  and no load on the outputs.

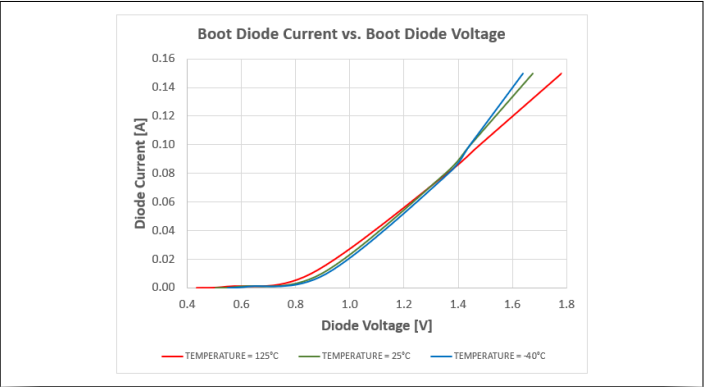


Figure 6 Diode current vs. diode voltage

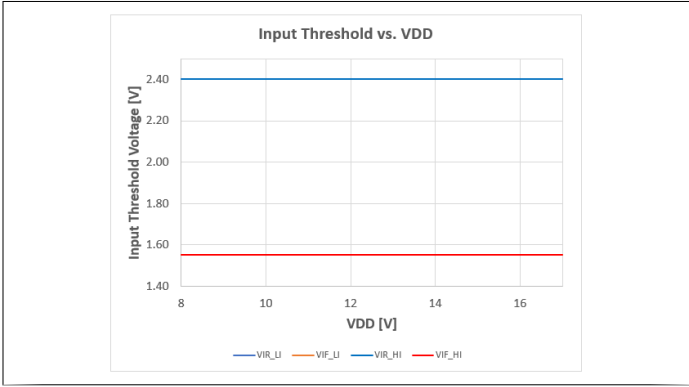


Figure 7 Input threshold vs. VDD

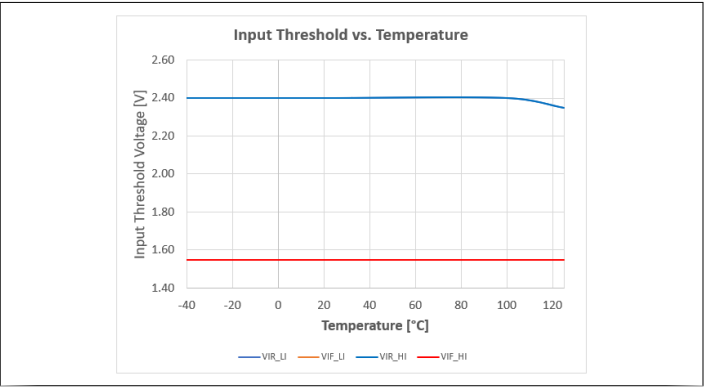


Figure 8 Input threshold vs. temperature

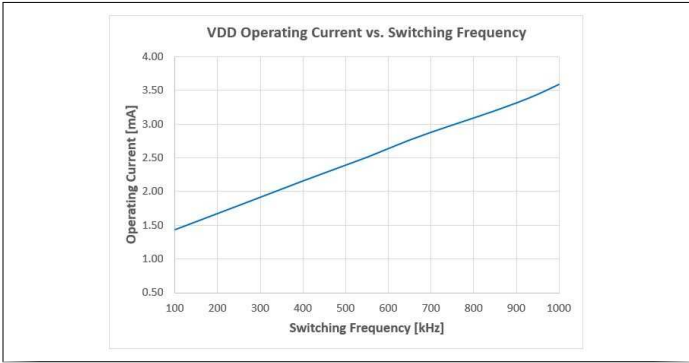


Figure 9 VDD operating current vs. switching frequency

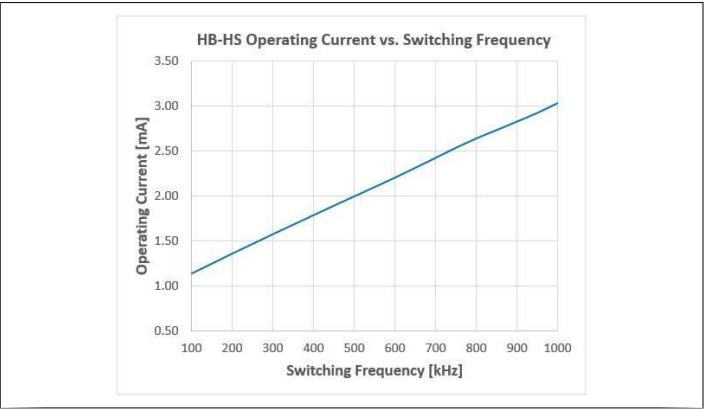


Figure 10 HB operating current vs. switching frequency

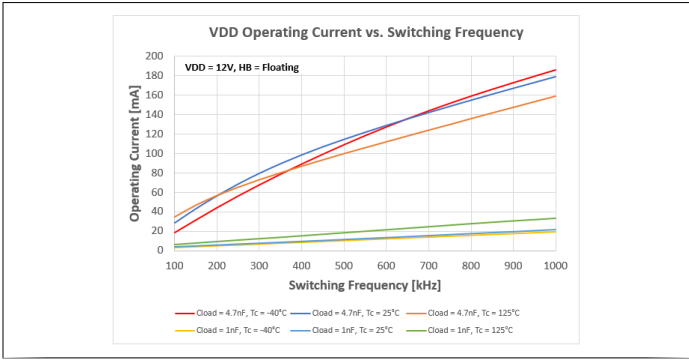


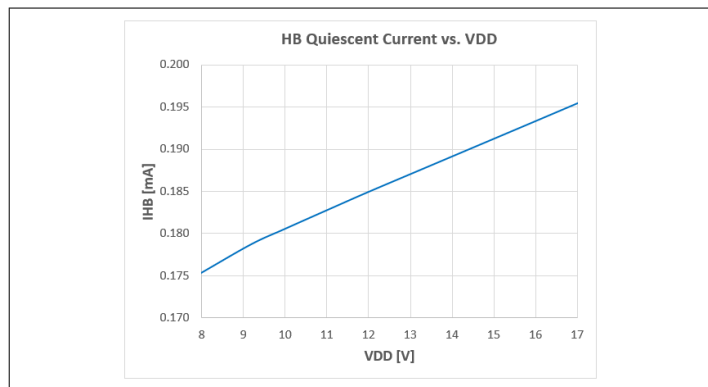
Figure 11 VDD operating current vs. switching frequency

# EiceDRIVER™ 2EDL803X

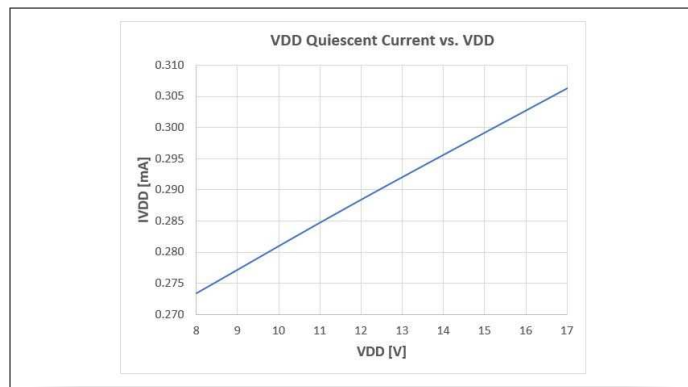
## 120 V boot, 3 A / 4 A, junction-isolated high-side and low-side gate driver IC



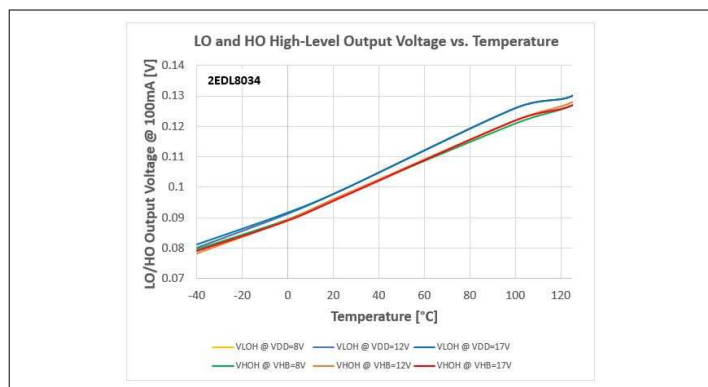
### 4 Typical characteristics



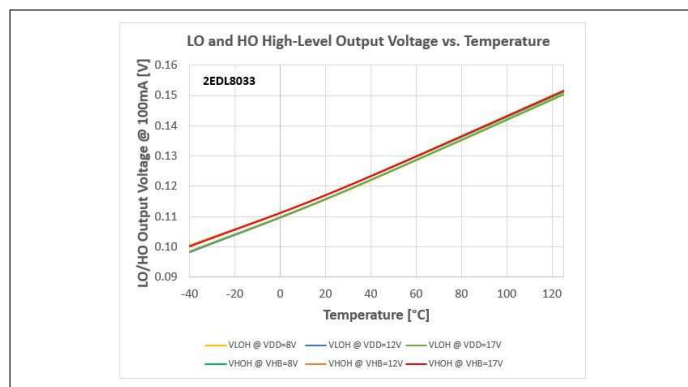
**Figure 12** HB quiescent current vs. VDD



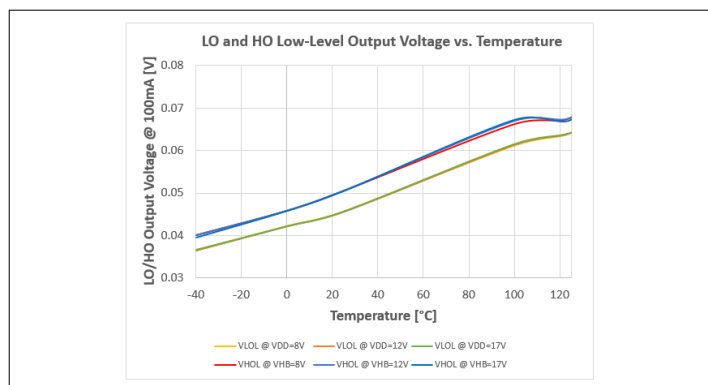
**Figure 13** VDD quiescent current vs. VDD



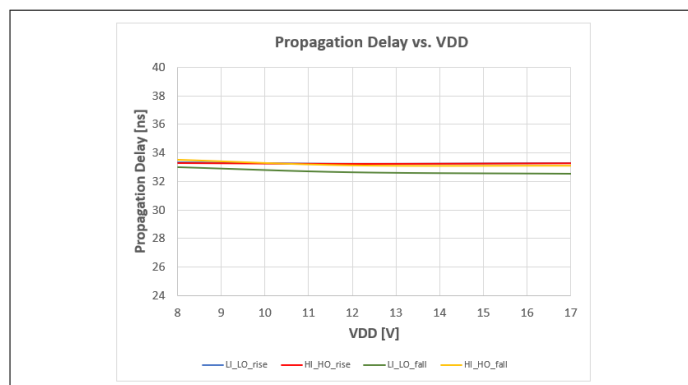
**Figure 14** LO/HO high-level output voltage vs. temperature



**Figure 15** LO/HO high-level output voltage vs. temperature



**Figure 16** LO/HO low-level output voltage vs. temperature



**Figure 17** Propagation delay vs. VDD

4 Typical characteristics

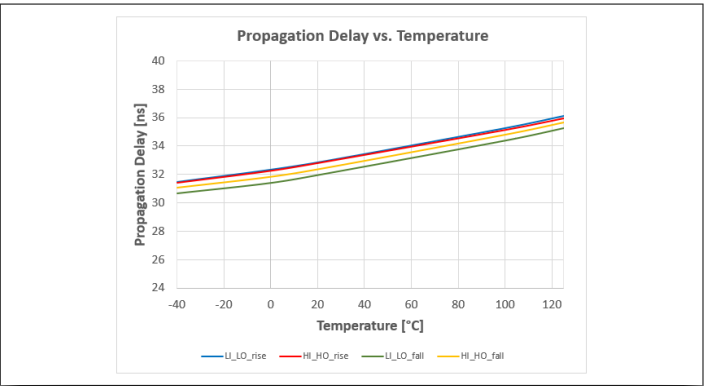


Figure 18 Propagation delay vs. temperature

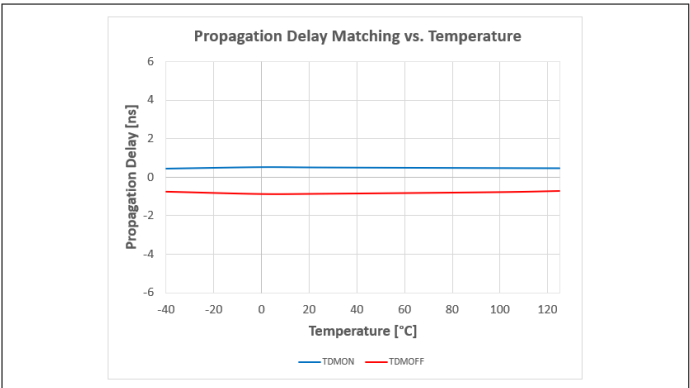


Figure 19 Propagation delay matching vs. temperature

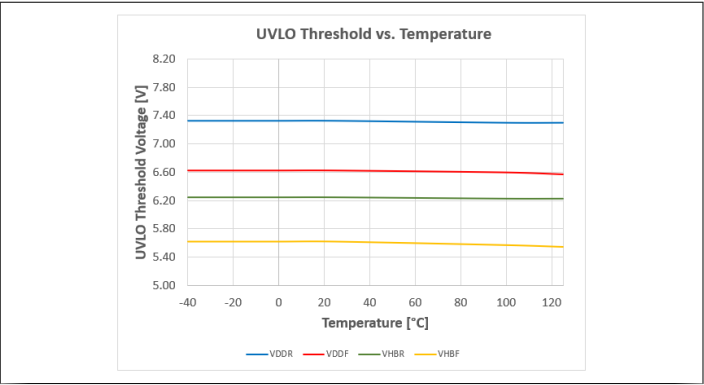


Figure 20 UVLO threshold vs. temperature

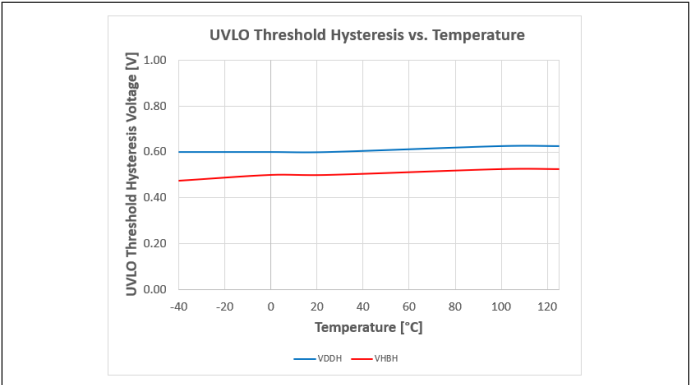


Figure 21 UVLO threshold hysteresis vs. temperature

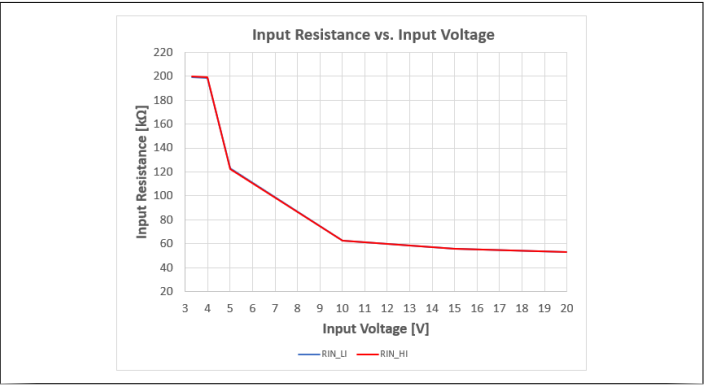
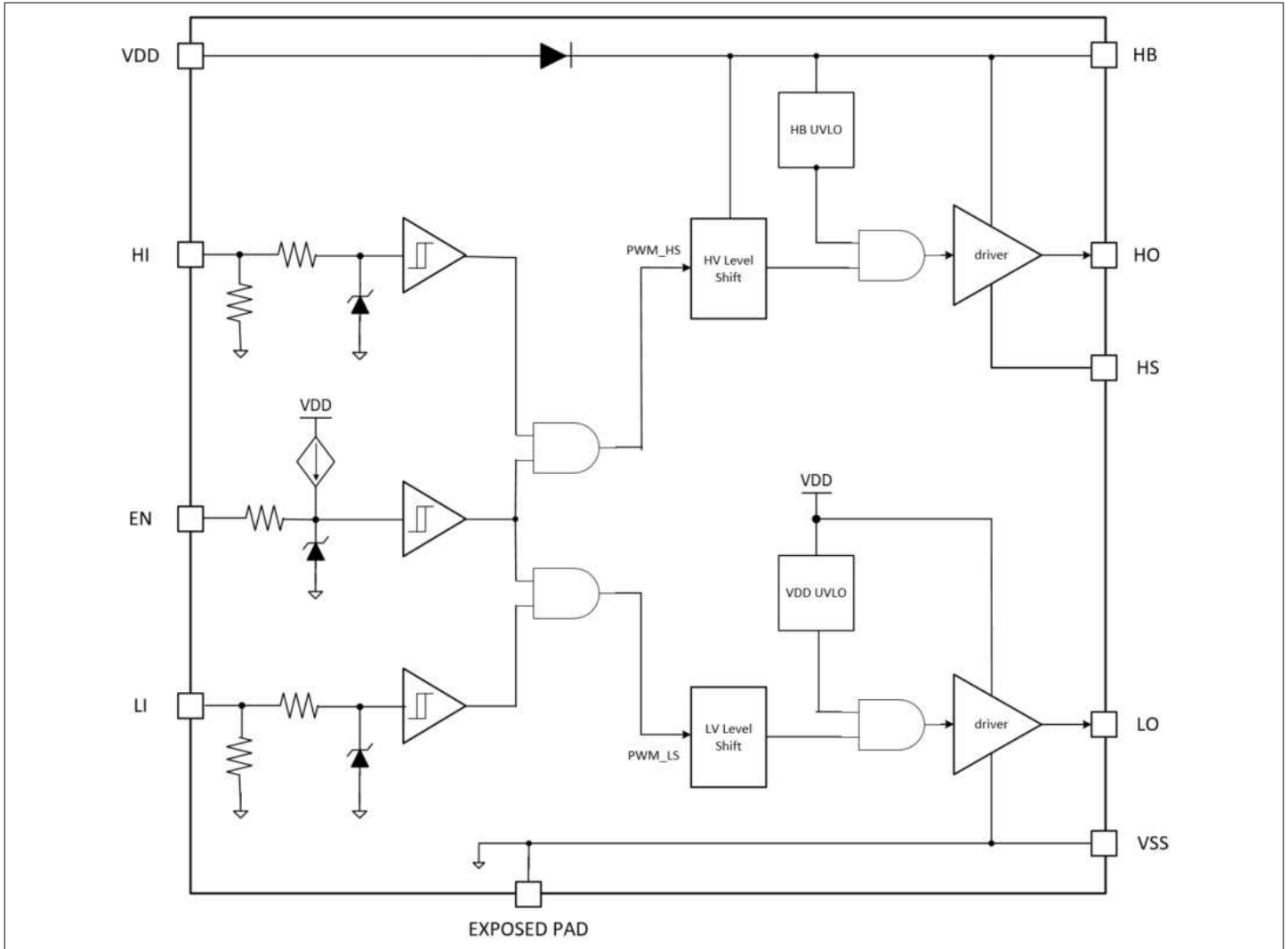


Figure 22 Input impedance vs. input voltage

## 5 Product information

### 5.1 Block diagram



**Figure 23**

### 5.2 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 and 4 A peak source current capability and a strong 6 A sink current capability for both high-side and low-side drivers. This allows driving large power MOSFETs with minimum or optimized switching losses during the transition through the MOSFET's miller plateau.

2EDL803x's input pins support TTL logic levels independently of supply voltage. They are capable to withstand 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.

The switching node (HS pin) is able to handle negative voltages down to -12 V which allows the high-side channel to be protected from inherent negative voltages caused by parasitic inductances and stray capacitances.

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

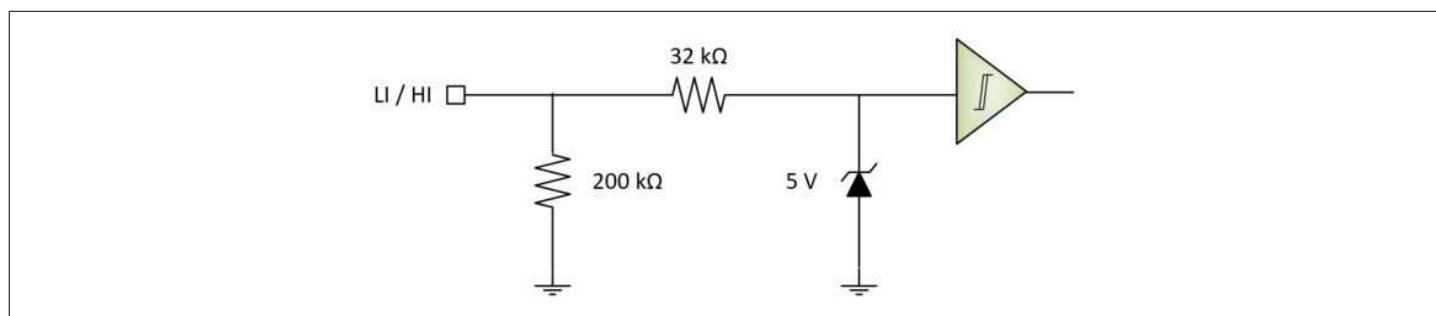
The following sections describe the key functionalities.

### 5.2.1 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 7.3 V. This lockout function protects power MOSFETs from running into linear mode with subsequent high power dissipation.

### 5.2.2 Input stage

The input pull-down resistance has a value of 200 k $\Omega$  typical when the HI and LI input voltage is  $\leq 4$  V. When it is above 4 V, the effective input resistance is lower because of the activation of the 5 V clamp as shown in the input stage diagram below. At an input voltage of 10 V, the effective input resistance is at 46 k $\Omega$  typical.



**Figure 24** Input stage diagram

2EDL803X device responds to the two inputs signals (HI and LI) independently according to [Table 8](#).

**Table 8** 2EDL803X truth table

| EN | LI | HI | LO | HO |
|----|----|----|----|----|
| L  | L  | L  | L  | L  |
|    | H  | L  | L  | L  |
|    | L  | H  | L  | L  |
|    | H  | H  | L  | L  |
| H  | L  | L  | L  | L  |
|    | H  | L  | H  | L  |
|    | L  | H  | L  | H  |
|    | H  | H  | H  | H  |

### 5.2.3 Enable

2EDL803X in SON10 (3 mm x 3 mm) package has an enable (EN) pin which enables or disables the output of the driver. The outputs are active when the voltage at the EN pin is above the rising threshold and are disabled when the EN pin voltage falls below the falling threshold. The EN input stage has built-in hysteresis for enhanced noise immunity. An internal pull-up current source connects the EN pin to VDD thus leaving the EN pin floating enables the output. If the EN pin is not actively controlled, it is recommended to pull up this pin to VDD especially for high-noise system. Externally pulling the EN pin to ground disables the output.

### 5.2.4 Driver outputs

The strong 3 A and 4 A source and 6 A sink current capability of both, the low-side and high-side output, allows for faster switching of the power MOSFETs thus leading to lower switching losses. The ultra-low pull down resistances, typically 0.5  $\Omega$  for both outputs, keep the gate of the power MOSFETs down during fast transient events thus avoiding

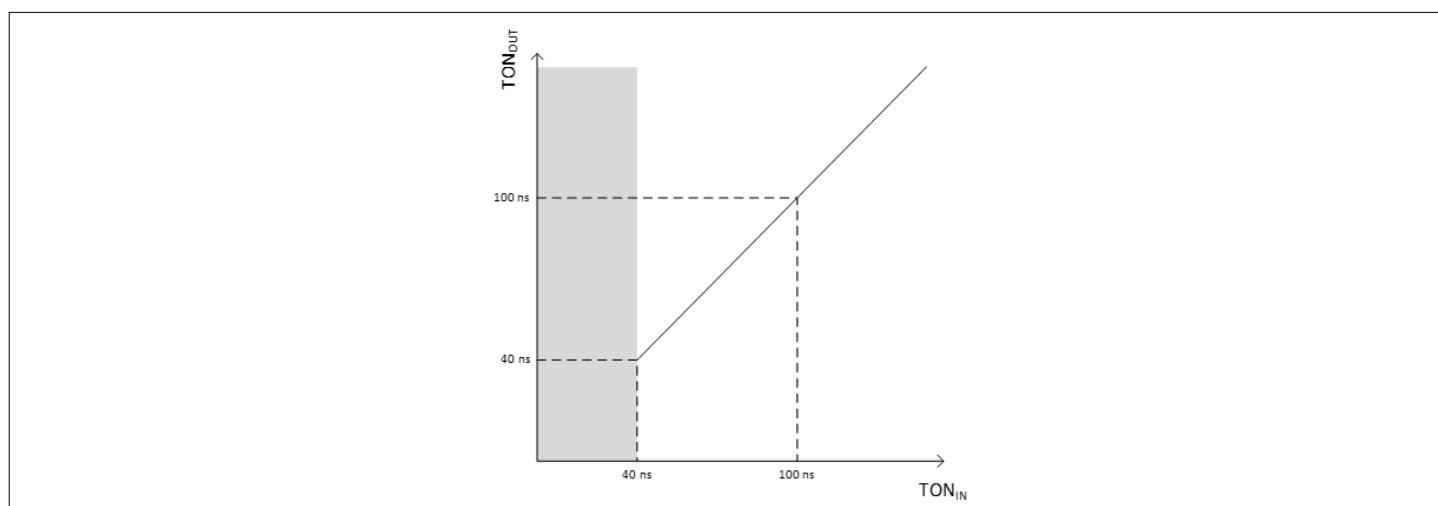
dv/dt induced turn on. The output stage can sustain negative transient pulse up to -2 V for 100 ns. The output stage is implemented using a PMOS for the pull-up and NMOS for the pull-down in a totem-pole configuration.

### 5.2.5 Undervoltage lockout (UVLO)

The UVLO 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 ensured that the power MOSFET 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 7.3 V with 0.6 V hysteresis for supply voltage ( $V_{DD}$ ) and 6.3 V with 0.6 V hysteresis for high-side boot voltage ( $V_{HB-HS}$ ).

### 5.2.6 Minimum input pulse width

The device responds to input level according to the truth table in input control section 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 operation above input minimum pulse width of 40 ns, the output behaves one to one to the input with minimal pulse width distortion.



**Figure 25** Minimum pulse width input-output on-time transfer function

## 6 Application information

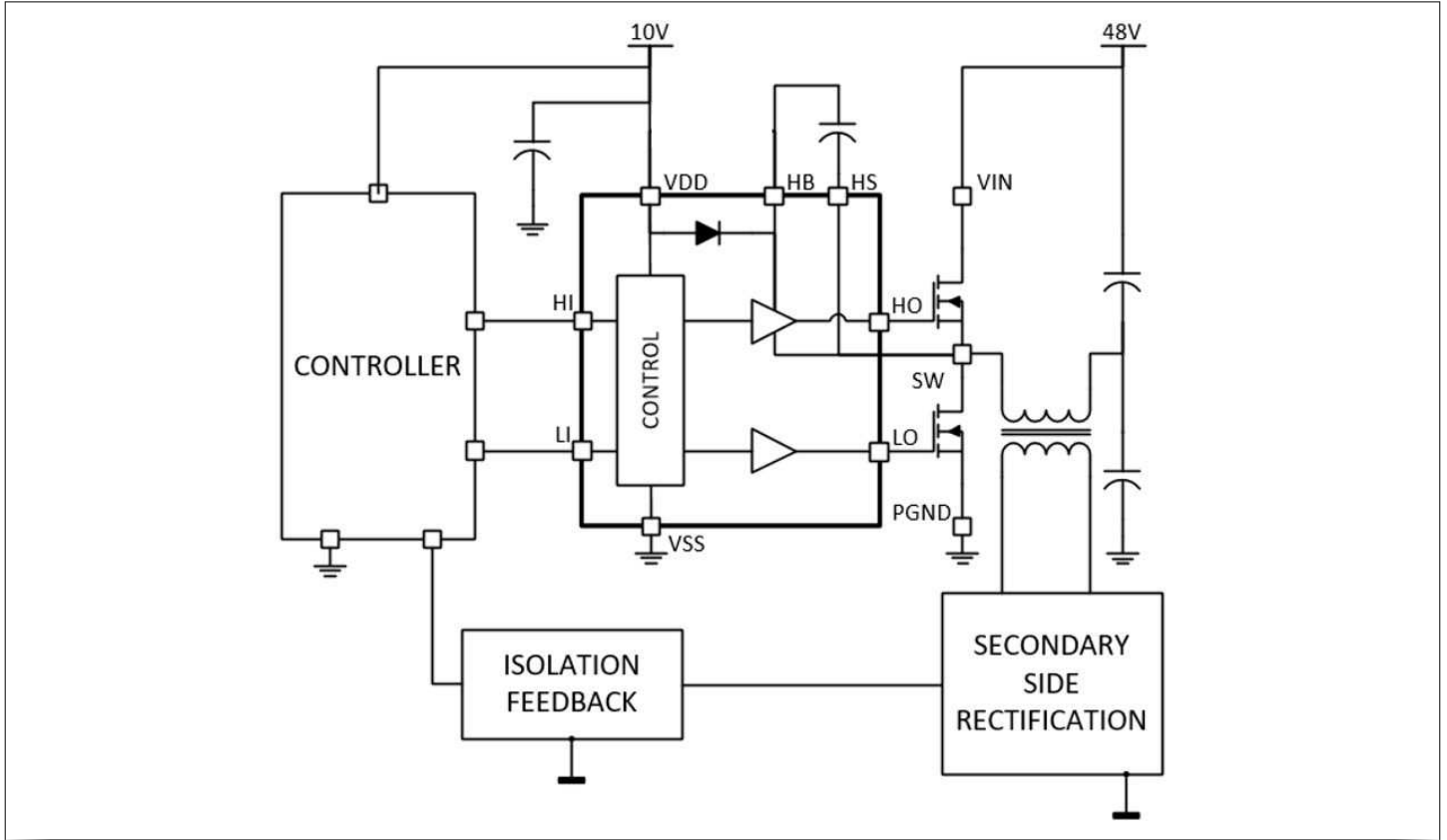


Figure 26 Typical application - primary side half-bridge

### 6.1 Design guidelines

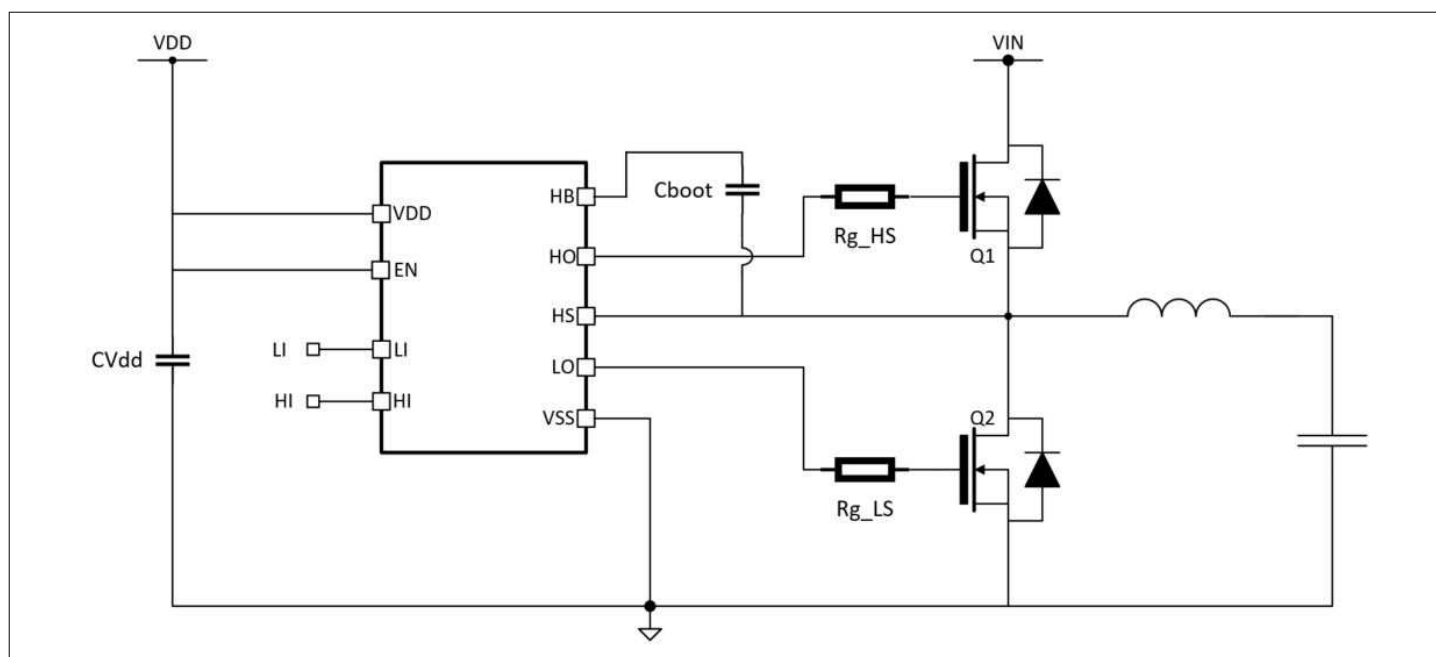
In a half-bridge configurations, a high-side bias that is referenced to the switch node is needed in order to drive the gate of the high-side MOSFET. One of the most common solutions due to its simplicity and low cost is the usage of a bootstrap circuit consisting of a diode (internal to the driver) and a capacitor as seen in [Figure 27](#). However, this method imposes limitation 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.

The bootstrap circuit operation is defined by two main periods:

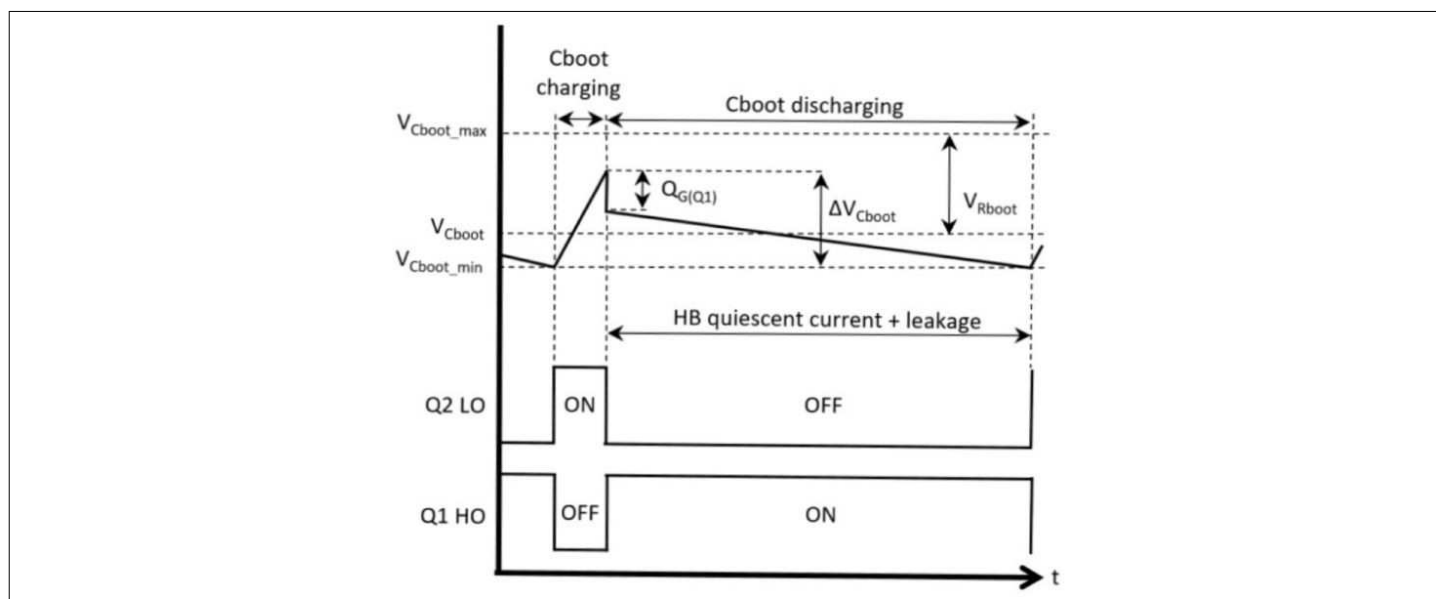
**Charging period:** When the low-side MOSFET ( Q2 ) is ON and the high-side MOSFET ( Q1 ) is OFF, the switch node/HS pin is pulled to ground creating a charging path for the bootstrap capacitor ( Cboot ) through the Vdd bypass capacitor ( CVdd ) and the internal bootstrap diode. For high dV/dt application, 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 Vin thus the internal bootstrap diode gets reverse biased. The bootstrap capacitor ( Cboot ) 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 Cboot as a function of time is shown in [Figure 28](#) where the various contributions have been distinguished. The voltage across Cboot 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 this, the Cboot voltage continues to drop but with a much lower slope because only the high-side bias current and some leakage current is discharging the Cboot during this phase.



**Figure 27** Gate drive circuitry using 2EDL803X to drive MOSFETs in a half-bridge configuration



**Figure 28**      **Typical  $C_{boot}$  waveform**

### 6.1.1.1 Selection of bootstrap capacitor

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 does not fall below the high-side UVLO threshold during transient and normal operations. First, determine the maximum allowable voltage drop ( $\Delta V_{\text{Cboot\_max}}$ ) when the high-side MOSFET (Q1) is on which is given by the following formula:

$$\Delta V_{Cboot\ max} = V_{dd} - V_F - V_{HBR} - V_{HBH}$$

### Equation 1

Where:

**6 Application information**

$V_{dd}$  = Gate driver supply voltage

$V_F$  = Bootstrap diode forward voltage drop

$V_{HBR}$  = 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.

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

**Equation 2**

Where:

$Q_G$  = High-side MOSFET (Q1) total gate charge

$I_{HB}$  = HB maximum quiescent current

$I_{HBS}$  = HB to VSS leakage current

$D_{max}$  = Maximum duty cycle

$F_{sw}$  = Switching frequency

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

$$C_{boot\_min} \geq \frac{Q_T}{\Delta V_{Cboot\_max}}$$

**Equation 3****6.1.2 Selection of VDD bypass capacitor**

The  $V_{dd}$  bypass capacitor provides the charge for the bootstrap capacitor during the charging period. As a rule of thumb, the  $V_{dd}$  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  $V_{dd}$  capacitor. It should be placed as close as possible to the VDD and VSS pins of the gate driver.

$$C_{Vdd} \geq 10 \sim 20 \times C_{boot}$$

**Equation 4****6.1.3 Selection of bootstrap resistor**

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:

$$I_{Pk\_Rboot} = \frac{V_{dd} - V_F}{R_{boot}}$$

**Equation 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:

$$R_{boot} \leq \frac{t_{min}}{4 \times C_{boot}}$$

**Equation 6**

Where:

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

**6.1.4 Selection of external bootstrap diode**

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.

**6.1.5 Selection of gate resistor**

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.

$$I_{HSRC} = \frac{V_{dd} - V_F}{R_{PUH} + R_{G\_HS} + R_{G\_int}}$$

**Equation 7**

$$I_{HSNK} = \frac{V_{dd} - V_F}{R_{PDH} + R_{G\_HS} + R_{G\_int}}$$

**Equation 8**

$$I_{LSRC} = \frac{V_{dd}}{R_{PUL} + R_{G\_LS} + R_{G\_int}}$$

**Equation 9**

$$I_{LSNK} = \frac{V_{dd}}{R_{PDL} + R_{G\_LS} + R_{G\_int}}$$

**Equation 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

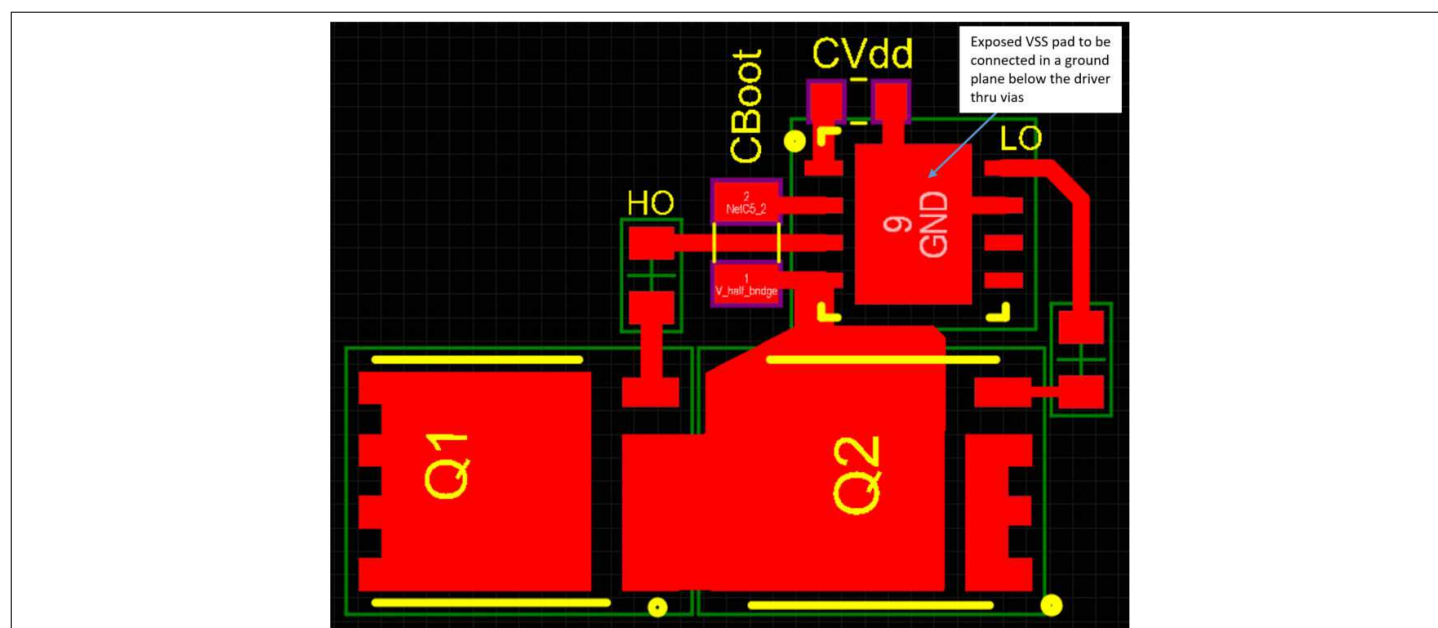
$R_{G\_LS}$  = Low-side external gate resistance

$R_{G\_int}$  = MOSFET internal gate resistance

## 6.2 PCB Layout guidelines

To maximize the performance of EiceDRIVER™ 2EDL803X, the following are some recommendations for optimizing the PCB layout:

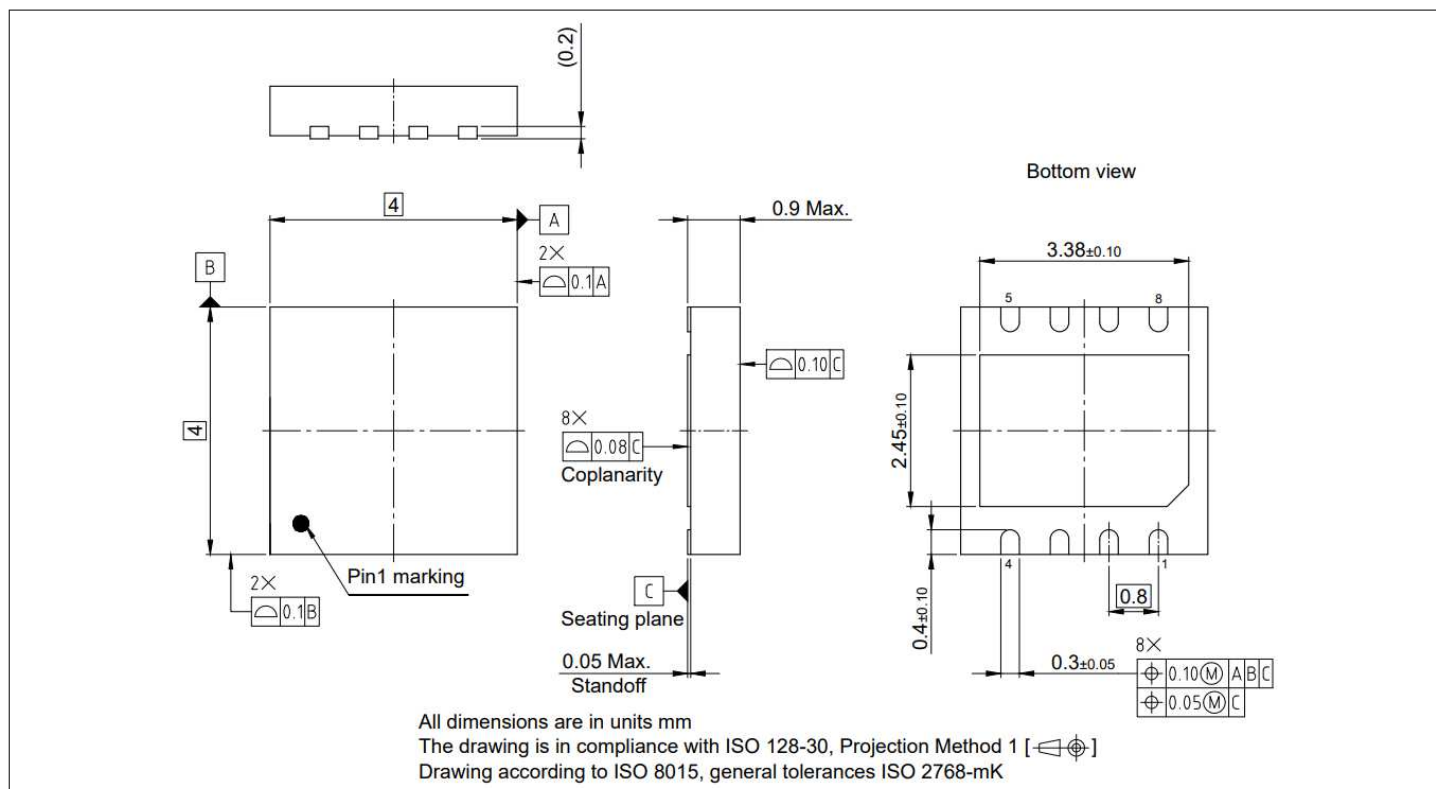
- Use a low-ESR decoupling capacitors on VDD-GND and HB-HS and placed it as close as possible to the VDD-GND and HB-HS pins of the driver
- An option for a series boot resistor is recommended to control the high-side MOSFET slew rate and therefore the low-side MOSFET overshoot. The boot loop path including 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.
- 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 29**      **2EDL803X Layout example**

## 7 Outline dimensions

For further information on package types, recommendation for board assembly, please go to:  
[www.infineon.com/packages](http://www.infineon.com/packages)

### 7.1 PG-VDSO-8-5



**Figure 30 PG-VDSO-8-5 outline dimensions**

7 Outline dimensions

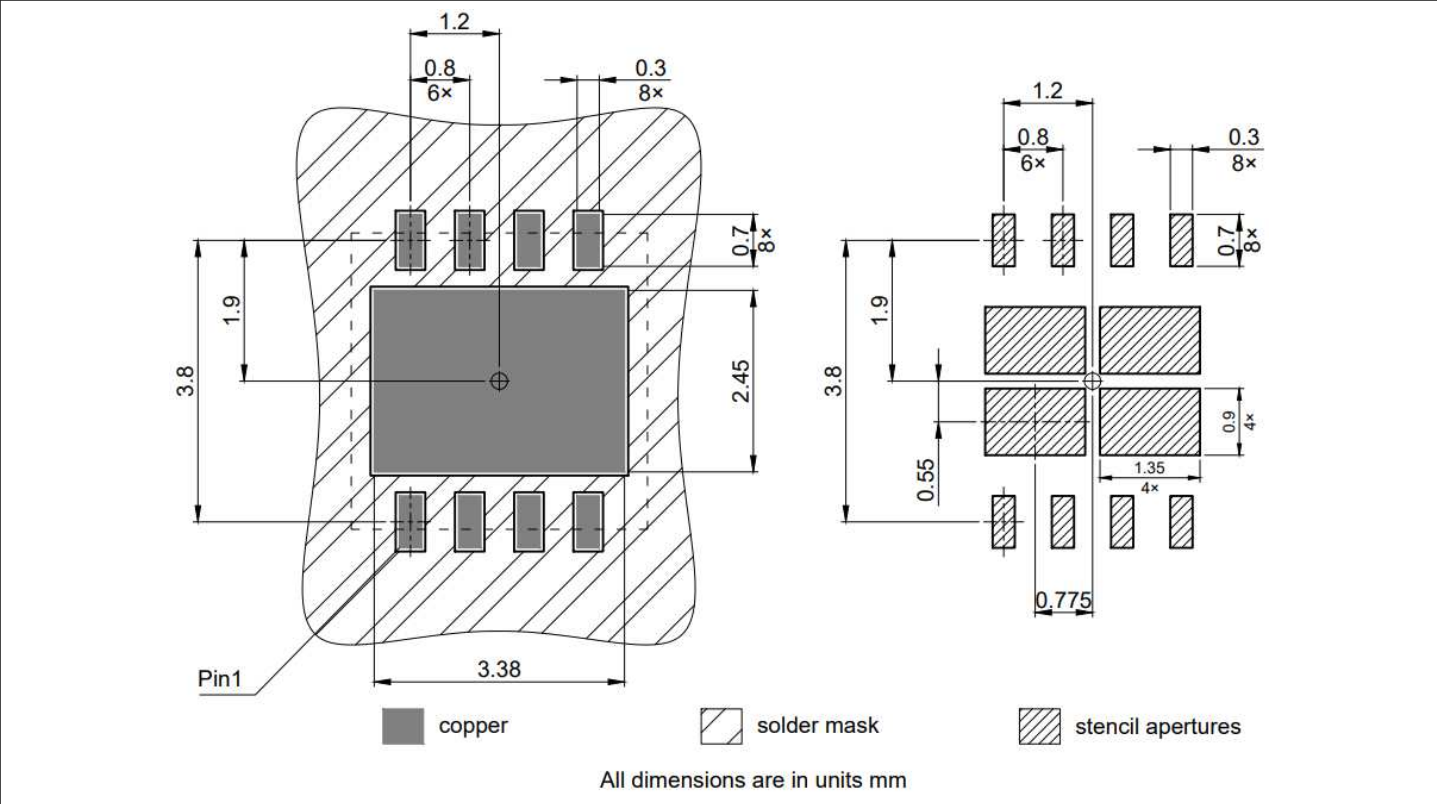


Figure 31 PG-VDSO8-5 footprint dimensions

7.2 PG-VSON-10-4

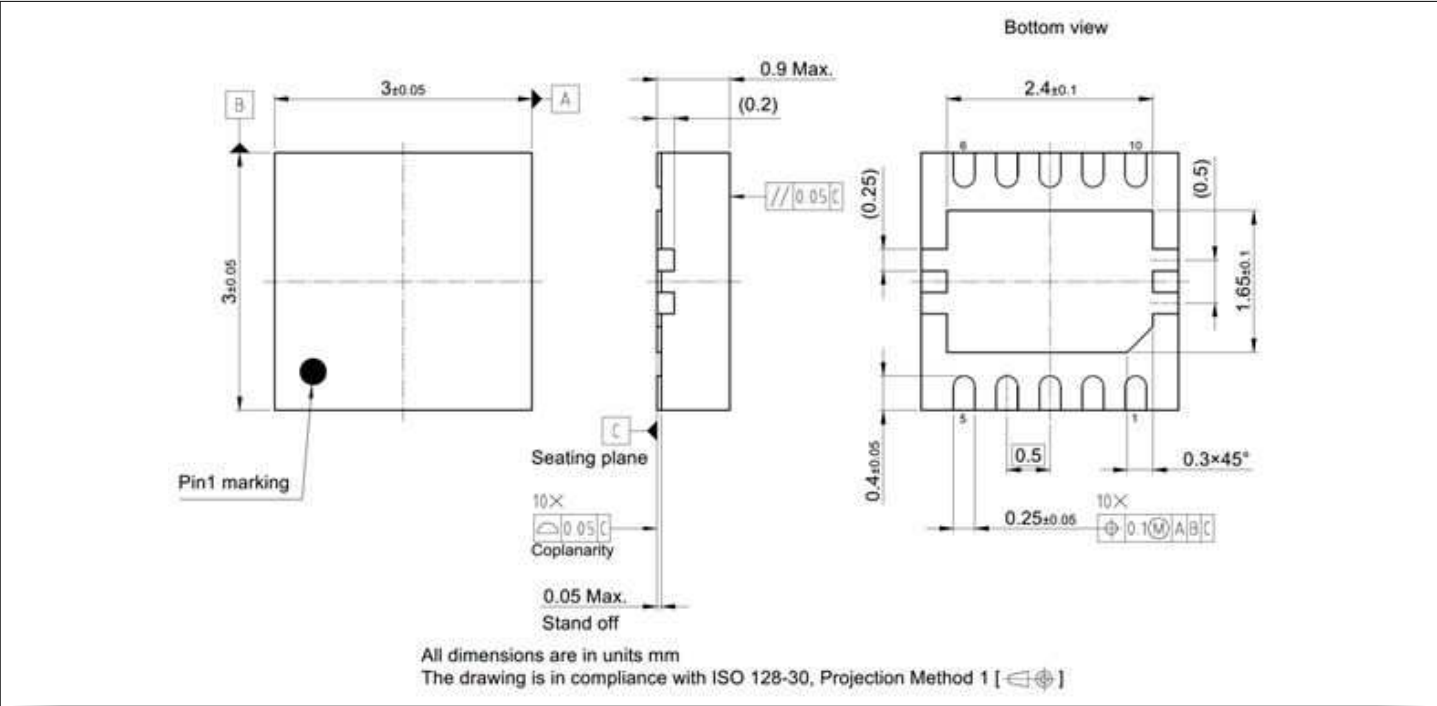


Figure 32 PG-VSON-10-4 outline dimensions

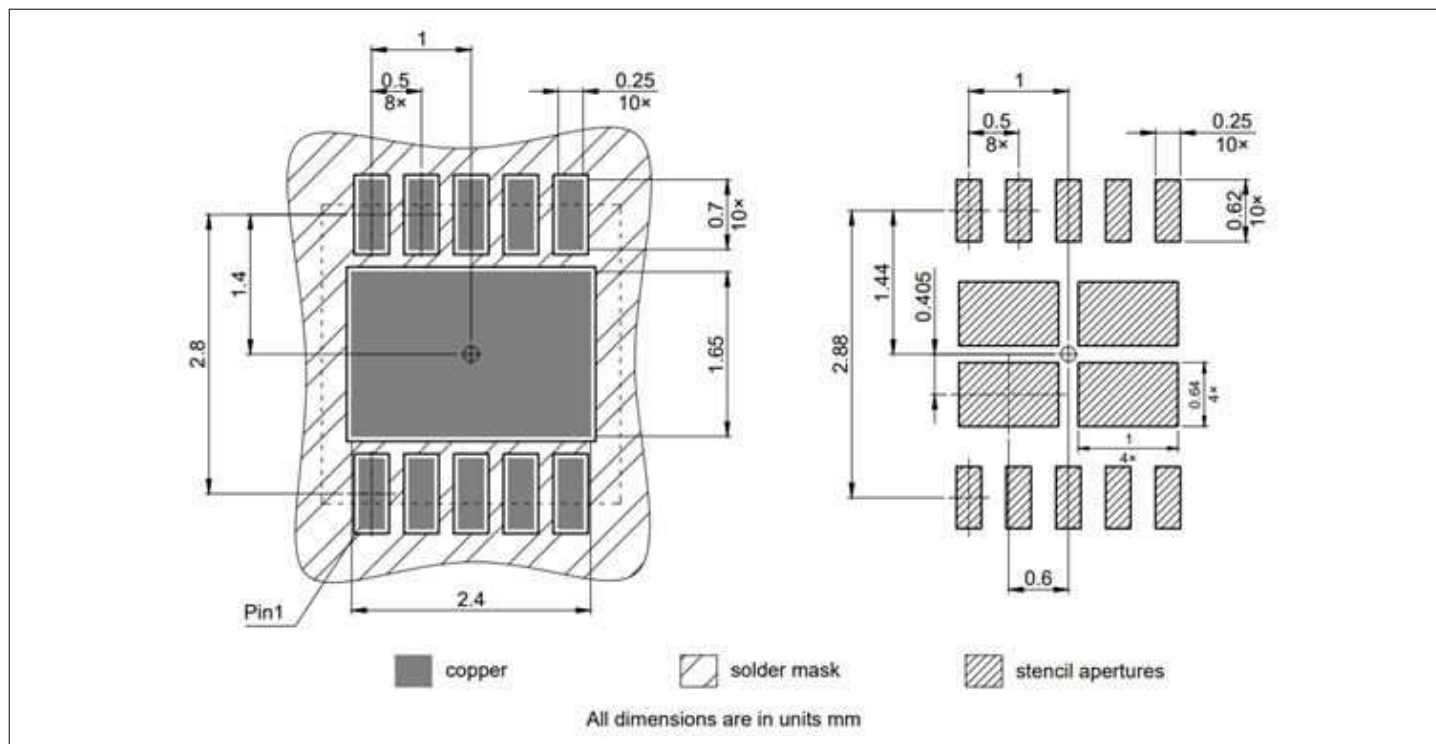


Figure 33 PG-VSON-10-4 footprint dimensions

### 7.3 PG-VDSON-10-2

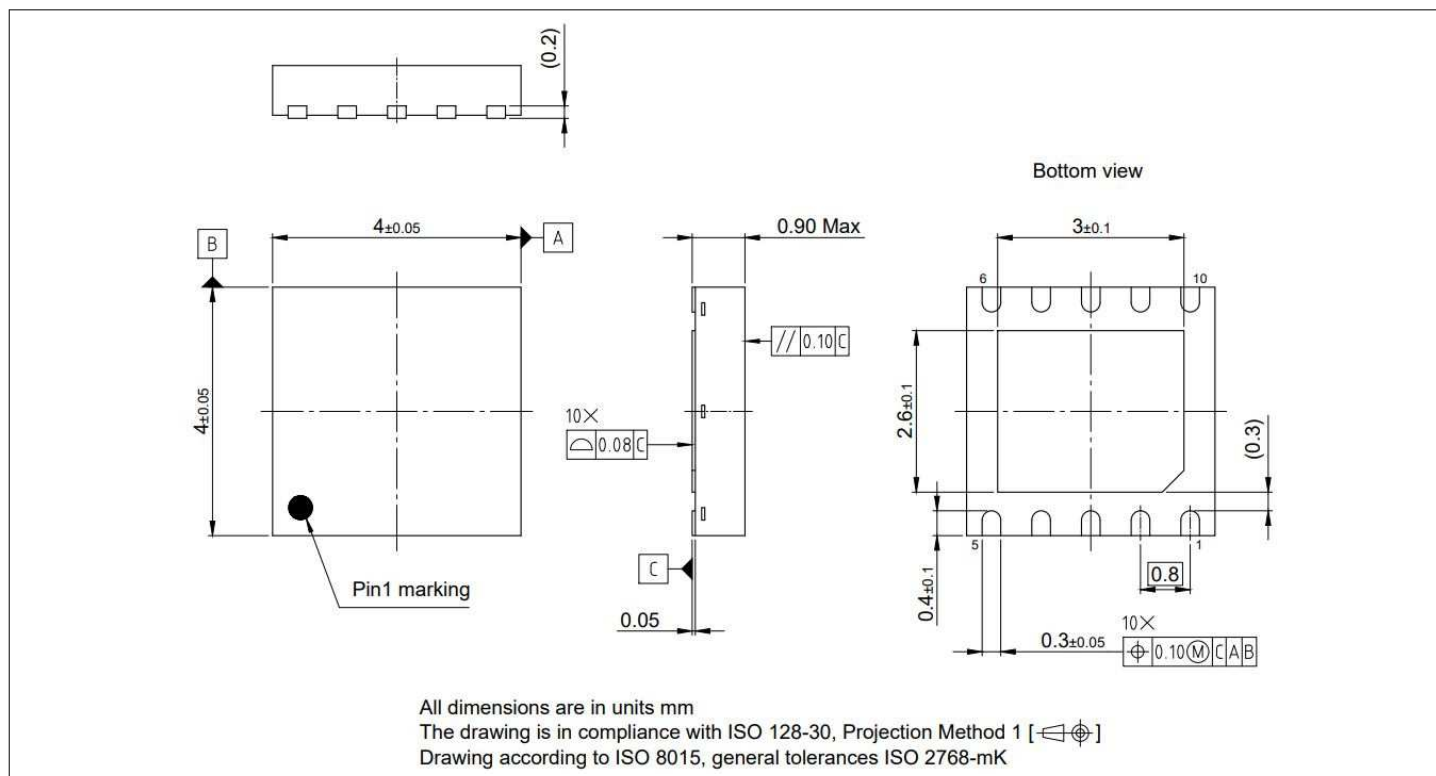
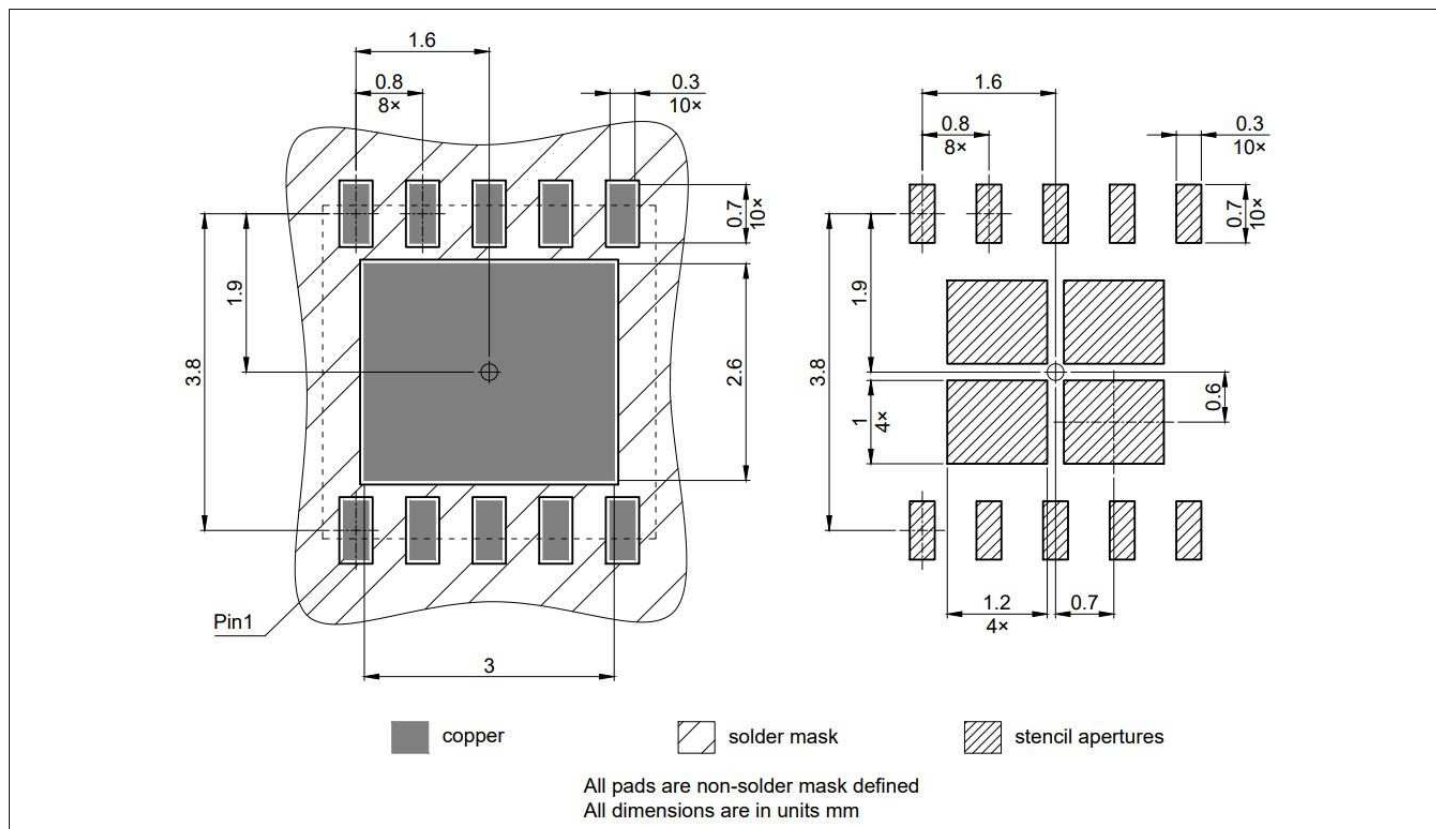


Figure 34 PG-VDSON-10-2 Outline dimensions



**Figure 35 PG-VDSO-10-2 Footprint dimensions**

8 Tape and reel

8.1 PG-VDSO8-5

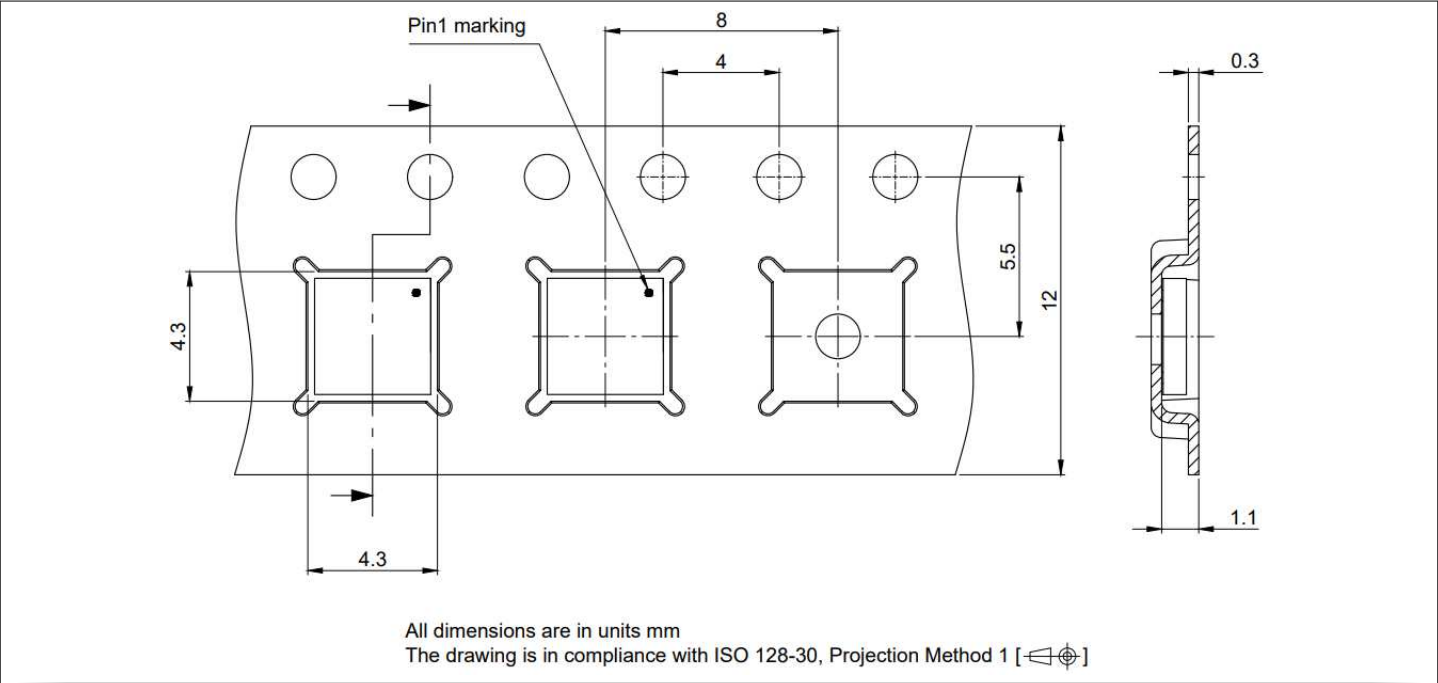


Figure 36 PG-VDSO8-5 tape and reel

8.2 PG-VSON-10-4

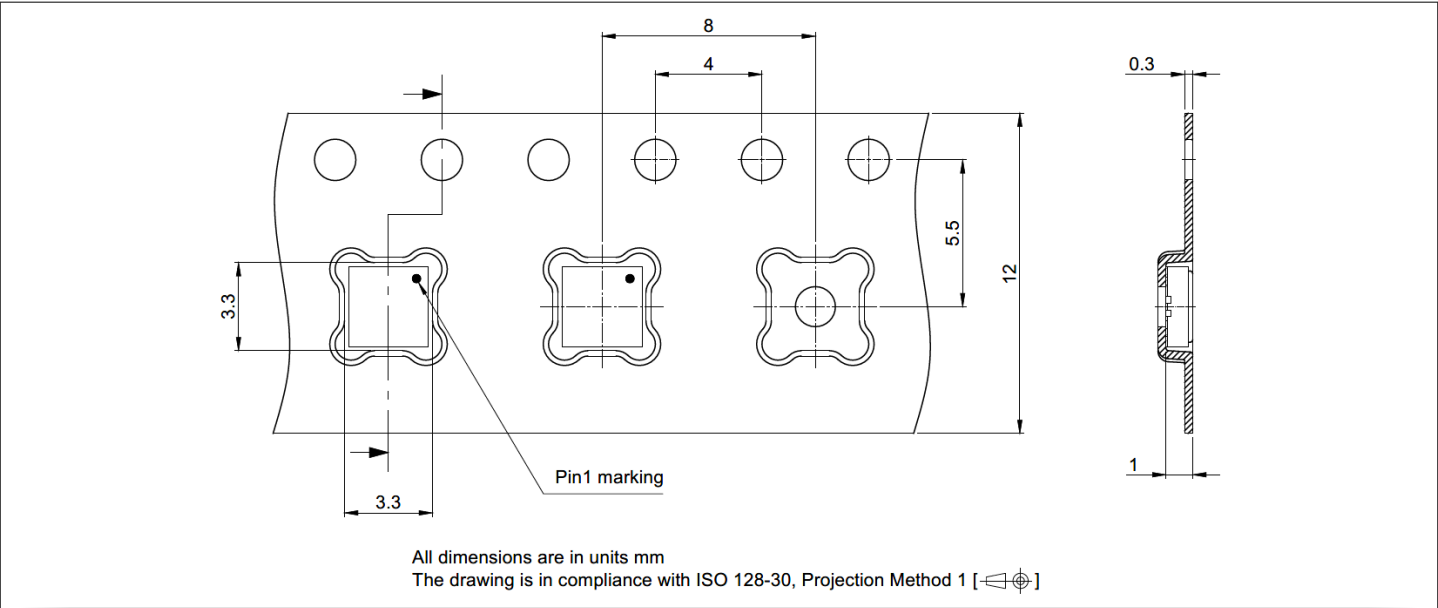
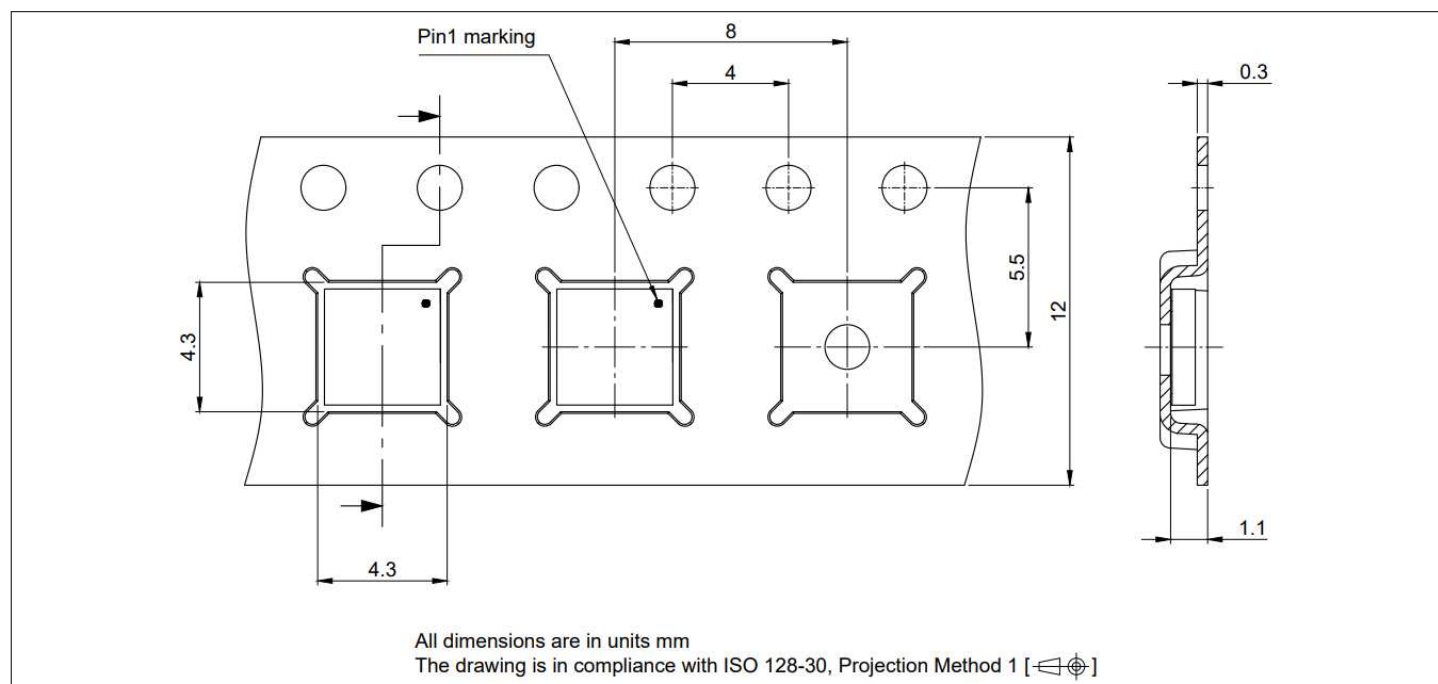


Figure 37 PG-VSON-10-4 tape and reel

### 8.3 PG-VDSO-10-2



**Figure 38 PG-VDSO-10-2 tape and reel**

## Revision History

2EDL803x

**Revision: 2023-04-21, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision)                                   |
|----------|------------|--------------------------------------------------------------------------------|
| 2.0      | 2023-03-22 | Release of final version                                                       |
| 2.1      | 2023-04-21 | Modified the EN pin description in the pin and functional description section. |

### Trademarks

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

### We Listen to Your Comments

Any information within this document that you feel is wrong, unclear or missing at all? Your feedback will help us to continuously improve the quality of this document. Please send your proposal (including a reference to this document) to:

**erratum@infineon.com**

### Published by

**Infineon Technologies AG**

**81726 München, Germany**

**© 2023 Infineon Technologies AG**

**All Rights Reserved.**

### Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

### Information

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office ([www.infineon.com](http://www.infineon.com)).

### Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support, automotive, aviation and aerospace device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Infineon:](#)

[2EDL8034G3CXTMA1](#)