

# TPG2023 250V Half Bridge MOSFET/IGBT Gate Driver

## 1 Features and Benefits

- Floating channel designed for bootstrap operation
- Fully operational to +250 V
- 3.3V, 5V and 15V input logic compatible
- $dV/dt$  noise Immunity  $\pm 50$  V/nsec
- Allowable negative  $V_s$  capability: -9V
- Gate drive supply range from 6 V to 20V
- Cross-conduction prevention logic
  - Deadtime: 250ns
- Propagation delay
  - Ton/Toff = 150ns/150ns
  - Matching delay time 50ns
- Wide operating temperature range -40°C ~125°C
- Typically output Source/Sink current capability: 4A/4A
- Integrated Bootstrap diode
- RoSH compatible

## 2 Application

- Motor Control
- Air Conditioners/ Washing Machines
- General Purpose Inverters
- Micro/Mini Inverter Drives

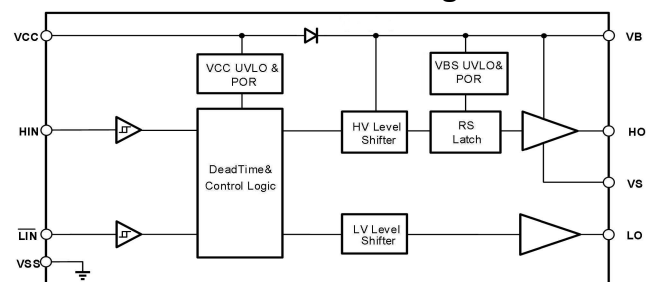
## 3 Description

The TPG2023 is a high voltage, high speed power MOSFET drivers with dependent high- and low-side referenced output channels. Proprietary HVIC and latch immune CMOS technologies enable ruggedized monolithic construction. The logic input is compatible with standard CMOS or LSTTL output, down to 3.3 V logic. The output drivers feature a high pulse current buffer stage designed for minimum driver cross-conduction. The floating channel can be used to drive an N-channel power MOSFET in the high-side configuration which operates up to 250 V.

## Device information

| Part Number | Package | Body size   |
|-------------|---------|-------------|
| TPG2023     | SOIC8   | 4.9mm*3.9mm |

## Functional Block Diagram



## 4 Selection Guide

| Part Number | Input logic                  | Shout-though prevention | Dead time | VBS UVLO | Ton/Toff (ns) | IO+/IO- (A) |
|-------------|------------------------------|-------------------------|-----------|----------|---------------|-------------|
| TPG2023     | HIN, $\overline{\text{LIN}}$ | YES                     | 250ns     | YES      | 150/150       | 4/4         |

## 5 Ordering Guide

| Part Number | Package | Package     | SPQ  |
|-------------|---------|-------------|------|
| TPG2023     | SOIC8   | Tape & Reel | 4000 |

## 6 Revision history

| Version | Content | Time       |
|---------|---------|------------|
| V1.0    | Create  | 2022.09.06 |

## 7 Function Pin Description

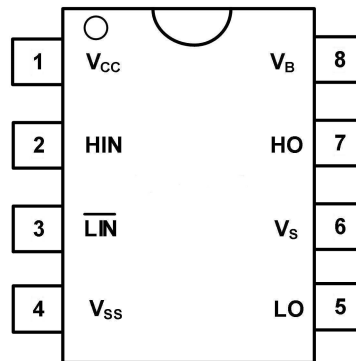


Figure7-1 8-Pin SOIC8 Top view

Table7-1 Lead Definitions

| Number | Symbol                  | Description                                                    |
|--------|-------------------------|----------------------------------------------------------------|
| 1      | V <sub>CC</sub>         | Low side and logic fixed supply                                |
| 2      | HIN                     | Logic input for high side gate driver output (HO), in phase    |
| 3      | $\overline{\text{LIN}}$ | Logic input for low side gate driver output (LO), out of phase |
| 4      | V <sub>SS</sub>         | Low side return                                                |
| 5      | LO                      | Low side gate drive output                                     |
| 6      | V <sub>s</sub>          | High side floating supply return                               |
| 7      | HO                      | High side gate drive output                                    |
| 8      | V <sub>B</sub>          | High side floating supply                                      |

## 8 Product specifications

### 8.1 Absolute Maximum Ratings

Exceeding the limit maximum rating may cause permanent damage to the device. All voltage parameters are rated with reference to VSS and an ambient temperature of 25°C.

| Symbol              | Definition                                | MIN.                 | MAX.                  | Units |
|---------------------|-------------------------------------------|----------------------|-----------------------|-------|
| V <sub>B</sub>      | High side floating supply                 | -0.3                 | 275                   | V     |
| V <sub>S</sub>      | High side floating supply return          | V <sub>B</sub> - 25  | V <sub>B</sub> + 0.3  |       |
| V <sub>HO</sub>     | High side gate drive output               | V <sub>S</sub> - 0.3 | V <sub>B</sub> + 0.3  |       |
| V <sub>CC</sub>     | Low side and main power supply            | -0.3                 | 25                    |       |
| V <sub>LO</sub>     | Low side gate drive output                | -0.3                 | V <sub>CC</sub> + 0.3 |       |
| V <sub>IN</sub>     | Logic input of HIN & LIN                  | -0.3                 | V <sub>CC</sub> + 0.3 |       |
| dV <sub>S</sub> /dt | Allowable Offset Supply Voltage Transient | —                    | 50                    | V/ns  |

### 8.2 ESD rating

| Symbol | Definition    | MIN. | MAX. | Units |
|--------|---------------|------|------|-------|
| ESD    | HBM Model     | 1500 | —    | V     |
|        | Machine Model | 500  | —    | V     |

### 8.3 Rated power

| Symbol         | Definition                            | MIN. | MAX. | Units |
|----------------|---------------------------------------|------|------|-------|
| P <sub>D</sub> | Package Power Dissipation @ TA ≤ 25°C | —    | 625  | mW    |

### 8.4 Thermal information

| Symbol         | Definition                               | MIN. | MAX. | Units |
|----------------|------------------------------------------|------|------|-------|
| RthJA          | Thermal Resistance, Junction to Ambient  | --   | 200  | °C/W  |
| T <sub>J</sub> | Junction Temperature                     | —    | 150  | °C    |
| T <sub>S</sub> | Storage Temperature                      | -55  | 150  |       |
| T <sub>L</sub> | Lead Temperature (Soldering, 10 seconds) | —    | 300  |       |

### 8.5 Recommended Operating Conditions

For proper operation, the device should be used under the following recommended conditions. The bias ratings of VS and VSS are measured at a supply voltage of 15V, and unless otherwise specified, the ratings of all voltage parameters are referenced to VSS and the ambient temperature is 25°C.

| Symbol          | Definition                       | MIN.           | MAX.            | Units |
|-----------------|----------------------------------|----------------|-----------------|-------|
| V <sub>B</sub>  | High side floating supply        | VS + 6         | VS + 20         | V     |
| V <sub>S</sub>  | High side floating supply return | -9             | 250             |       |
| V <sub>HO</sub> | High side gate drive output      | V <sub>S</sub> | V <sub>B</sub>  |       |
| V <sub>CC</sub> | Low side and main power supply   | 6              | 20              |       |
| V <sub>LO</sub> | Low side gate drive output       | 0              | V <sub>CC</sub> |       |
| V <sub>IN</sub> | Logic input of HIN & LIN         | 0              | V <sub>CC</sub> |       |
| T <sub>A</sub>  | Ambient temperature              | -40            | 125             | °C    |

Note1: Transient negative VS can be used for VSS-50V with a pulse width of 50ns, guaranteed by design..

Note2: When the input pulse width is less than 1us, the input pulse cannot be transmitted normally .

## 8.6 Electrical Characteristics

Valid for temperature range at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = V_B = 15\text{V}$ ,  $C_L = 1\text{nF}$ , unless otherwise specified

### 8.6.1 Dynamical electrical characteristics

| Symbol    | Definition                 | MIN. | TYP. | MAX. | Units | Test Condition      |
|-----------|----------------------------|------|------|------|-------|---------------------|
| $t_{ON}$  | Turn-on propagation delay  | —    | 150  | 250  | ns    | $V_S = 0\text{V}$   |
| $t_{OFF}$ | Turn-off propagation delay | —    | 150  | 250  | ns    | $V_S = 250\text{V}$ |
| $t_R$     | Turn-on rise time          | —    | 50   | 100  | ns    |                     |
| $t_F$     | Turn-off fall time         | —    | 40   | 100  | ns    |                     |
| DT        | Deadtime                   | —    | 250  | --   | ns    |                     |
| MT        | Matching delay ON and OFF  | —    | —    | 50   | ns    |                     |

### 8.6.2 Static electrical characteristics

Valid for temperature range at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = V_B = 15\text{V}$ ,  $C_L = 1\text{nF}$ , unless otherwise specified.

| Symbol      | Definition                                                      | MIN. | TYP. | MAX. | Units         | Test Condition                                              |
|-------------|-----------------------------------------------------------------|------|------|------|---------------|-------------------------------------------------------------|
| $V_{CCUV+}$ | VCC supply UVLO threshold                                       | —    | 5.5  | —    | V             |                                                             |
| $V_{CCUV-}$ |                                                                 | —    | 5.0  | —    | V             |                                                             |
| $V_{BSUV+}$ | VBS supply UVLO threshold                                       | —    | 5.5  | —    | V             |                                                             |
| $V_{BSUV-}$ |                                                                 | —    | 5.0  | —    | V             |                                                             |
| $I_{LK}$    | High-side floating supply leakage current                       | —    | —    | 50   | $\mu\text{A}$ | $V_B = V_S = 250\text{V}$                                   |
| $I_{QBS}$   | Quiescent VB supply current                                     | —    | 50   | 100  | $\mu\text{A}$ | $V_{IN} = 0\text{V}$ or $5\text{V}$                         |
| $I_{QCC}$   | Quiescent VCC supply current                                    | —    | 120  | 220  | $\mu\text{A}$ | $V_{IN} = 0\text{V}$ or $5\text{V}$                         |
| $V_{IH}$    | Logic "1" ( $\overline{HIN}$ & $\overline{LIN}$ ) input voltage | 2.5  | —    | —    | V             | $V_{CC} = 10\text{V}$ to $20\text{V}$                       |
| $V_{IL}$    | Logic "0" ( $\overline{HIN}$ & $\overline{LIN}$ ) input voltage | —    | —    | 0.8  | V             | $V_{CC} = 10\text{V}$ to $20\text{V}$                       |
| $V_{OH}$    | High level output voltage, $V_{BIAS} - V_O$                     | —    | —    | 1.5  | V             | $I_O = 0\text{A}$                                           |
| $V_{OL}$    | Low level output voltage, $V_O$                                 | —    | —    | 0.1  | V             | $I_O = 0\text{A}$                                           |
| $I_{IN+}$   | Logic "1" Input bias current                                    | —    | 25   | 40   | $\mu\text{A}$ | $\overline{HIN} = 5\text{V}$ , $\overline{LIN} = 0\text{V}$ |
| $I_{IN-}$   | Logic "0" Input bias current                                    | —    | 0    | 2    | $\mu\text{A}$ | $\overline{HIN} = 0\text{V}$ , $\overline{LIN} = 5\text{V}$ |
| $I_{O+}$    | Output high short circuit pulsed current                        | —    | 4    | —    | A             | $V_O = 0\text{V}$<br>$PW \leq 10\mu\text{s}$                |
| $I_{O-}$    | Output low short circuit pulsed current                         | —    | 4    | —    | A             | $V_O = 15\text{V}$<br>$PW \leq 10\mu\text{s}$               |
| $V_{BSD}$   | Bootstrap diode conduction voltage drop                         |      | 0.6  |      | V             | $I_{BSD} = 1\text{mA}$                                      |
| $R_{BSD}$   | Bootstrap diode conduction resistance                           |      | 200  |      | $\Omega$      | $I_{BSD} = 10\text{mA}$                                     |

## 9 Function Description

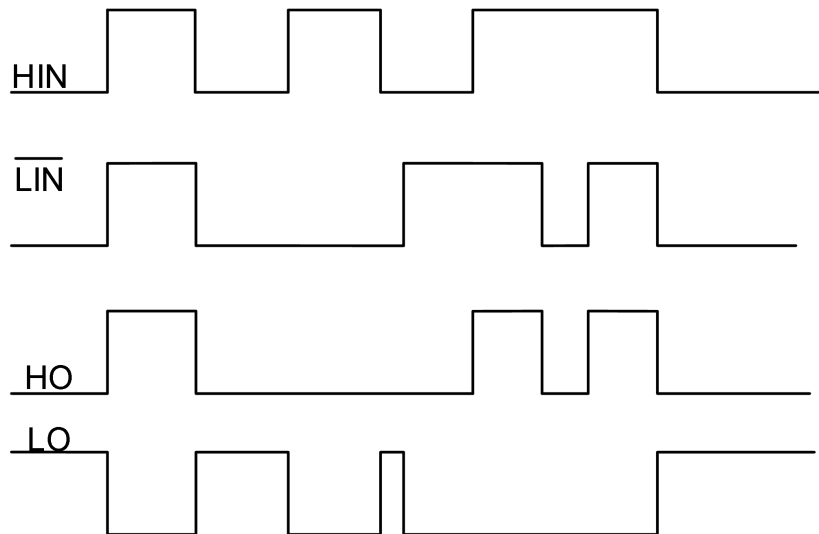


Figure 9-1 TPG2023 Input and output timing waveform

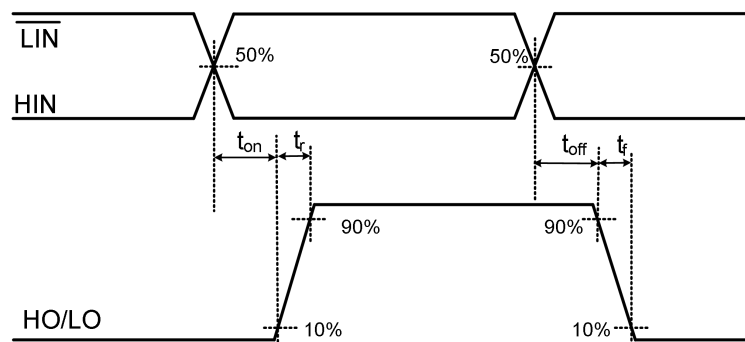


Figure 9-2 Propagation Time Waveform Definition

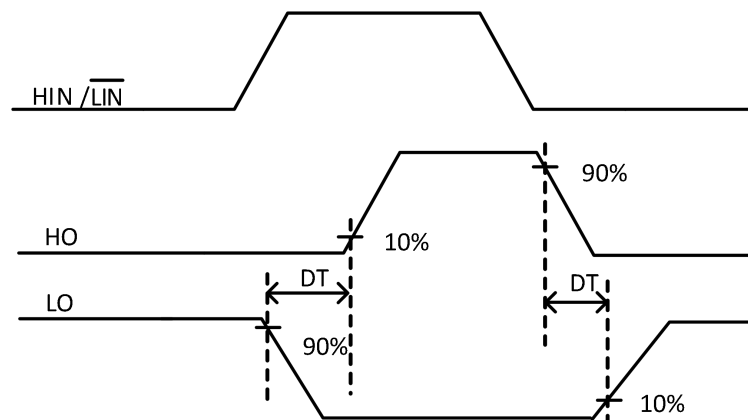


Figure9-3 Cross Conduction Prevention Delay Time Waveform Definition

## 10 Description

### 10.1 Function Block Diagram

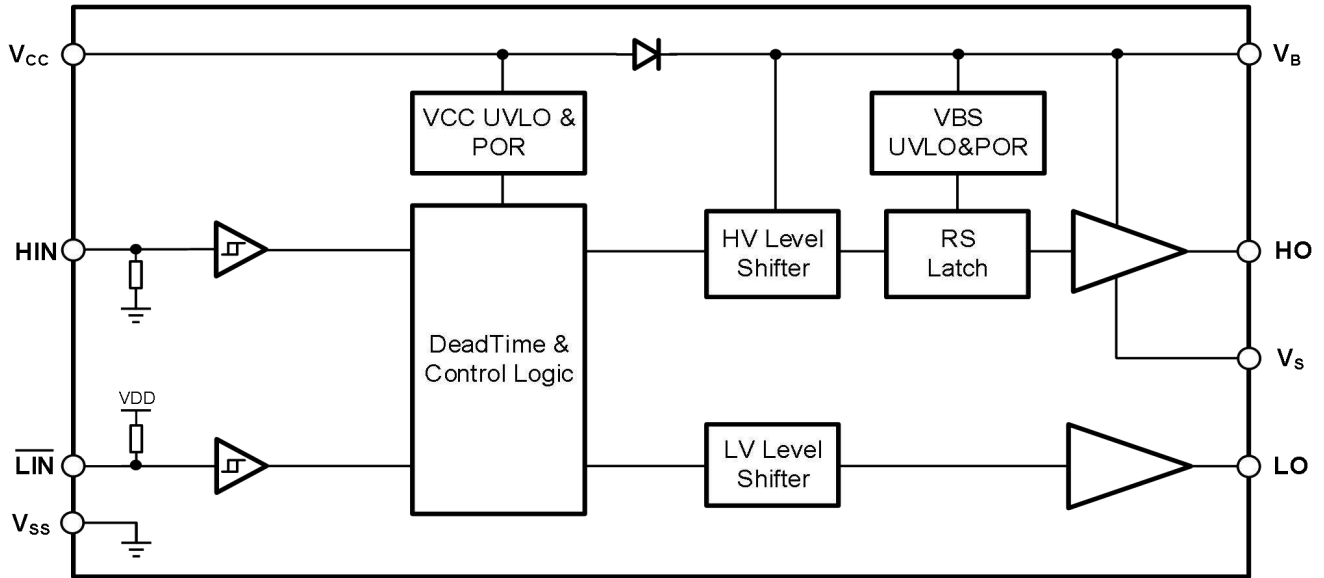


Figure10-1 Function Block Diagram of TPG2023

### 10.2 Application message

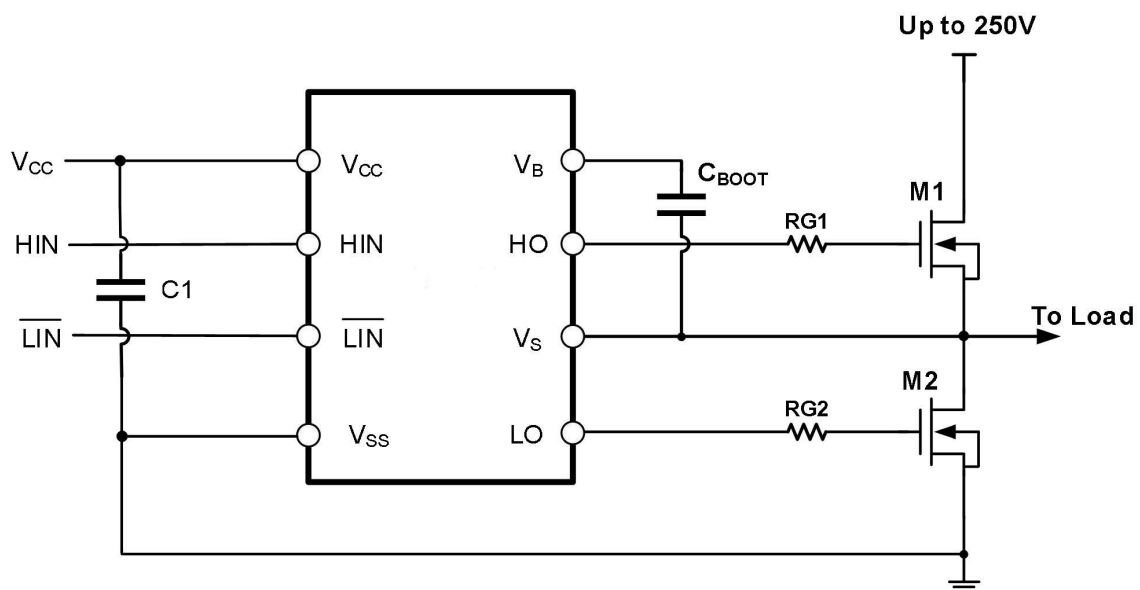


Figure10-2 Typical application circuit of TPG2023

## 12. Package Information

### SOIC-8 Package Dimensions

| Size<br>Symbol | MIN(mm) | TYP(mm) | MAX(mm) | Size<br>Symbol | MIN(mm) | TYP(mm) | MAX(mm) |
|----------------|---------|---------|---------|----------------|---------|---------|---------|
| A              | -       | -       | 1.75    | D              | 4.70    | 4.90    | 5.10    |
| A1             | 0.10    | -       | 0.225   | E              | 5.80    | 6.00    | 6.20    |
| A2             | 1.30    | 1.40    | 1.50    | E1             | 3.70    | 3.90    | 4.10    |
| A3             | 0.60    | 0.65    | 0.70    | e              | 1.27BSC |         |         |
| b              | 0.39    | -       | 0.48    | h              | 0.25    | -       | 0.50    |
| b1             | 0.38    | 0.41    | 0.43    | L              | 0.50    |         |         |
| c              | 0.21    | -       | 0.26    | L1             | 1.05BSC | -       | -       |
| c1             | 0.19    | 0.20    | 0.21    | θ              | 0       | -       | 8°      |

### SOIC -8 Package Outlines

