# 600V Half Bridge Driver

## PRODUCT SUMMARY

- $V_{OFFSET}$          600 V max.
- $I_O$+/-              130 mA/270 mA
- $V_{OUT}$             10 V - 20 V
- $t_{on/off}$ **(typ.)**    160 ns/230 ns
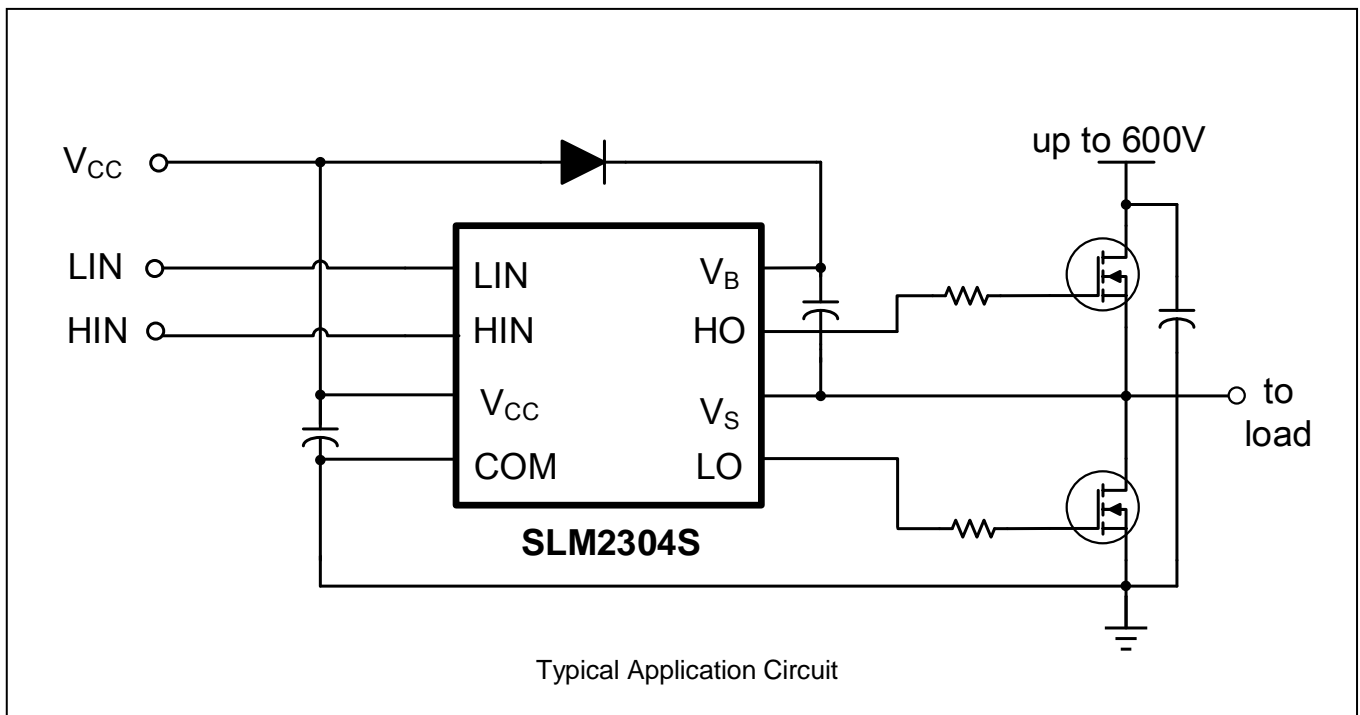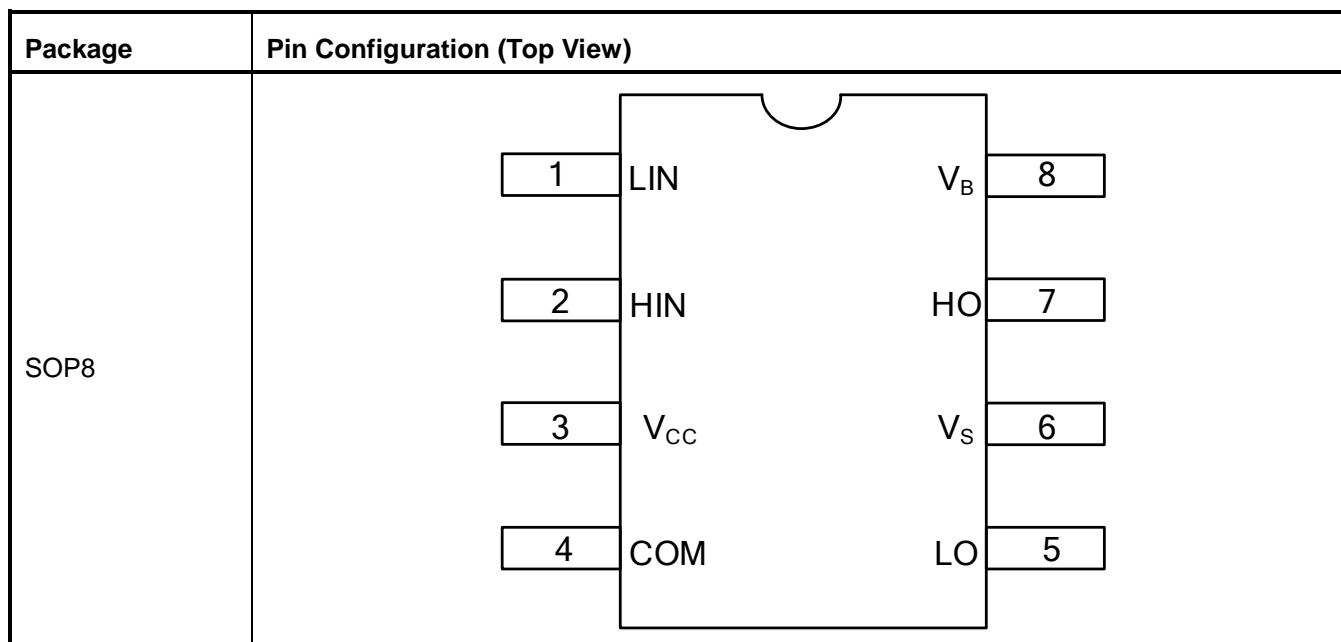- **Delay Matching (typ.)**    60 ns

## GENERAL DESCRIPTION

The SLM2304S is a high voltage, high speed power MOSFET and IGBT 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 or IGBT in the high-side configuration which operates up to 600 V.

## FEATURES

- Floating channel designed for bootstrap operation
- Fully operational to +600 V
- Tolerant to negative transient voltage, dV/dt immune
- Gate drive supply range from 10 V to 20 V
- 3.3 V, 5 V, and 15 V logic compatible
- Cross-conduction prevention logic
- Matched propagation delay for both channels
- UVLO for both high-side and low-side drivers
- Outputs in phase with inputs
- RoHS compliant
- SOP8 package

## TYPICAL APPLICATION CIRCUIT



Typical Application Circuit

**Si**LLUMIN

## PIN CONFIGURATION

| Package | Pin Configuration (Top View) |
|---------|------------------------------|
| SOP8 | <br><br>1 LIN     $V_B$ 8<br><br>2 HIN     HO 7<br><br>3 $V_{CC}$     $V_S$ 6<br><br>4 COM     LO 5<br><br> |

## PIN DESCRIPTION

| No. | Pin | Description |
|-----|-----|-------------|
| 1 | LIN | Logic input for low-side gate driver output (LO), in phase |
| 2 | HIN | Logic input for high-side gate driver output (HO), in phase |
| 3 | $V_{CC}$ | Low-side and logic fixed supply |
| 4 | COM | Low-side return |
| 5 | LO | Low-side gate drive output |
| 6 | $V_S$ | High-side floating supply return |
| 7 | HO | High-side gate drive output |
| 8 | $V_B$ | High-side floating supply |

## ORDERING INFORMATION

Industrial Range: -40°C to +125°C

| Order Part No. | Package | QTY |
|----------------|---------|-----|
| SLM2304SCA-13GTR | SOP8, Pb-Free | 2500/Reel |

## FUNCTIONAL BLOCK DIAGRAM
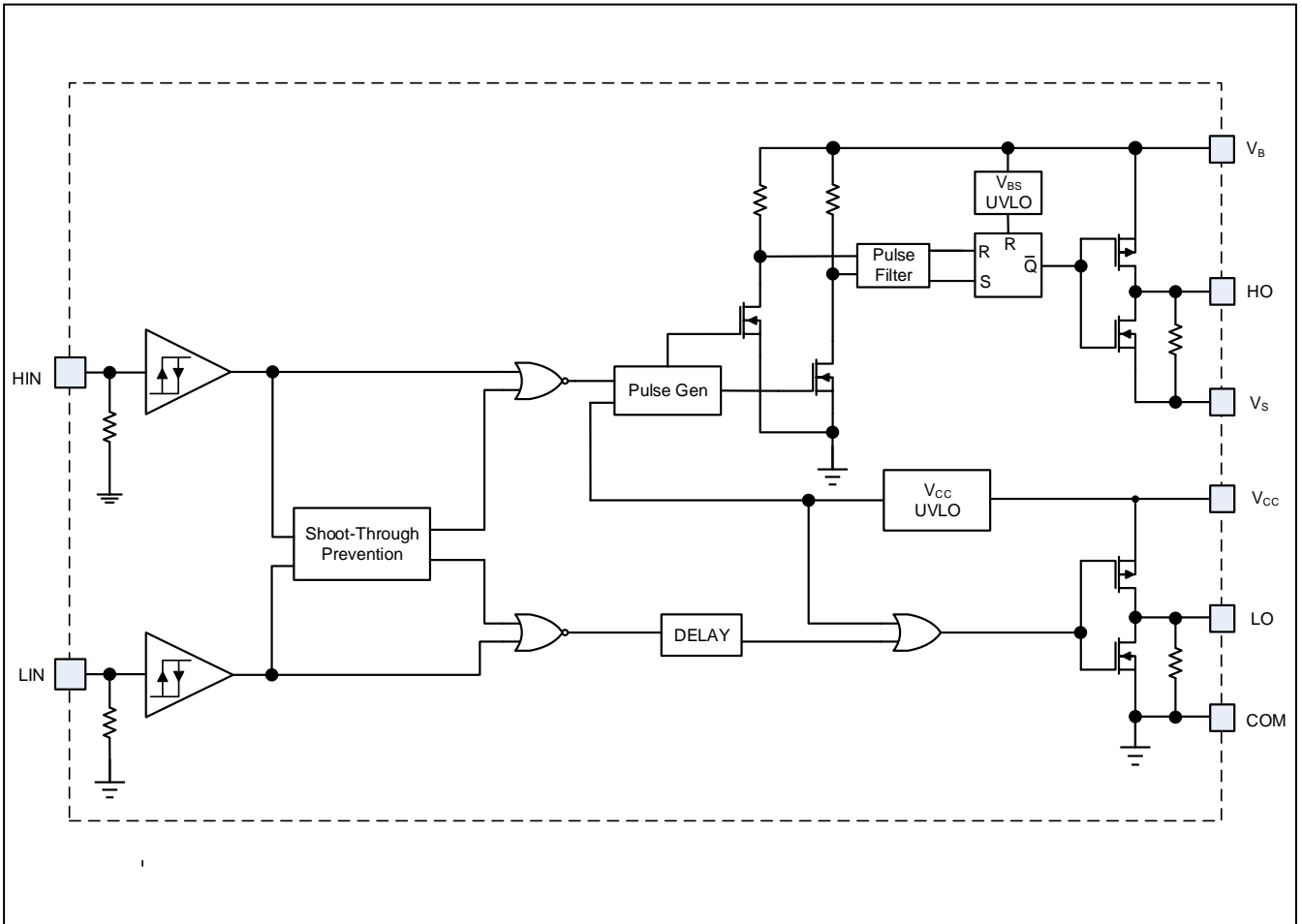
## ABSOLUTE MAXIMUM RATINGS

| Symbol | Definition | Min. | Max. | Units |
|--------|-----------|------|------|-------|
| $V_B$ | High-side floating absolute voltage | -0.3 | 625 | V |
| $V_S$ | High-side floating supply offset voltage | $V_B$ - 25 | $V_B$ + 0.3 | |
| $V_{HO}$ | High-side floating output voltage | $V_S$ - 0.3 | $V_B$ + 0.3 | |
| $V_{CC}$ | Low-side and logic fixed supply voltage | -0.3 | 25 | |
| $V_{LO}$ | Low-side output voltage | -0.3 | $V_{CC}$ + 0.3 | |
| $V_{IN}$ | Logic input voltage (HIN & LIN) | -0.3 | $V_{CC}$ + 0.3 | |
| $dV_S/dt$ | Allowable offset supply voltage transient | --- | 50 | V/ns |
| $P_D$ | Package power dissipation @ $T_A \leqslant$ +25°C | --- | 0.625 | W |
| $Rth_{JA}$ | Thermal resistance, junction to ambient | --- | 200 | °C/W |
| $T_J$ | Junction temperature | --- | 150 | °C |
| $T_S$ | Storage temperature | -55 | 150 | |
| $T_L$ | Lead temperature (soldering, 10 seconds) | --- | 300 | |

**Note:**

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are absolute voltages referenced to COM. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions.

## RECOMMENDED OPERATIONG CONDITIONS

| Symbol | Definition | Min. | Max. | Units |
|--------|-----------|------|------|-------|
| $V_B$ | High-side floating absolute voltage | $V_S$ + 10 | $V_S$ + 20 | V |
| $V_S$ | High-side floating supply offset voltage | | 600 | |
| $V_{HO}$ | High-side floating output voltage | $V_S$ | $V_B$ | |
| $V_{CC}$ | Low-side and logic fixed supply voltage | 10 | 20 | |
| $V_{LO}$ | Low-side output voltage | 0 | $V_{CC}$ | |
| $V_{IN}$ | Logic input voltage (HIN & LIN) | 0 | $V_{CC}$ | |
| $T_A$ | Ambient temperature | - 40 | 125 | °C |

**Note:**

For proper operation the device should be used within the recommended conditions. The $V_S$ offset rating is tested with all supplies biased at a 15 V differential.

# DYNAMIC ELECTRICAL CHARACTERISTICS

$V_{BIAS}$ ($V_{CC}$, $V_{BS}$) = 15 V, $C_L$ = 1000 pF and $T_A$ = 25°C unless otherwise specified.

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------|------|------|------|------|
| $t_{on}$ | Turn-on propagation delay | $V_S$ = 0 V | --- | 160 | 220 | |
| $t_{off}$ | Turn-off propagation delay | $V_S$ = 600 V | --- | 230 | 300 | |
| $t_r$ | Turn-on rise time | | --- | 70 | 170 | ns |
| $t_f$ | Turn-off fall time | | --- | 35 | 90 | |
| MT | Delay matching, HS & LS turn-on/off | | --- | --- | 60 | |

# STATIC ELECTRICAL CHARACTERISTICS

$V_{BIAS}$ ($V_{CC}$, $V_{BS}$) = 15 V and $T_A$ = 25°C unless otherwise specified. The $V_{IN}$, $V_{TH}$, and $I_{IN}$ parameters are referenced to COM. The $V_O$ and $I_O$ parameters are referenced to COM and are applicable to the respective output leads: HO or LO.

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------|------|------|------|------|
| $V_{IH}$ | Logic "1" input voltage | $V_{CC}$ = 10 V to 20V | 2.5 | --- | --- | |
| $V_{IL}$ | Logic "0" input voltage | | --- | --- | 0.8 | V |
| $V_{OH}$ | High level output voltage, $V_{BIAS}$ - $V_O$ | $I_O$ = 2 mA | --- | 0.05 | 0.2 | |
| $V_{OL}$ | Low level output voltage, $V_O$ | | --- | 0.02 | 0.1 | |
| $I_{LK}$ | Offset supply leakage current | $V_B$ = $V_S$ = 600 V | --- | --- | 50 | |
| $I_{QBS}$ | Quiescent $V_{BS}$ supply current | $V_{IN}$ = 0 V | --- | 60 | 75 | |
| $I_{QCC}$ | Quiescent $V_{CC}$ supply current | | --- | 230 | 300 | µA |
| $I_{IN+}$ | Logic "1" input bias current | $V_{IN}$ = 5V | --- | 8 | 20 | |
| $I_{IN-}$ | Logic "0" input bias current | $V_{IN}$ = 0V | --- | --- | 5 | |
| $V_{CCUV+}$ | $V_{CC}$ supply undervoltage positive going threshold | | 8 | 8.9 | 9.8 | |
| $V_{CCUV-}$ | $V_{CC}$ supply undervoltage negative going threshold | | 7.4 | 8.2 | 9 | |
| $V_{BSUV+}$ | $V_{BS}$ supply undervoltage positive going threshold | | 8 | 8.9 | 9.8 | V |
| $V_{BSUV-}$ | $V_{BS}$ supply undervoltage negative going threshold | | 7.4 | 8.2 | 9 | |

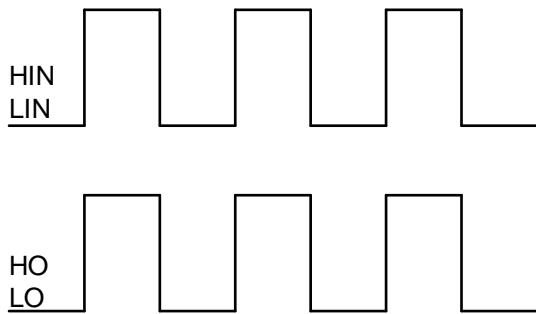| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------|------|------|------|------|
| $I_{O+}$ | Output high short circuit pulsed current | $V_O = 0V$, $V_{IN}$ =Logic "1", PW $\leqslant$ 10 µs | 130 | 290 | | mA |
| $I_{O-}$ | Output low short circuit pulsed current | $V_O$ =15V, $V_{IN}$=Logic "0", PW $\leqslant$ 10 µs | 270 | 600 | | |

Figure 1. Input/Output Timing Diagram
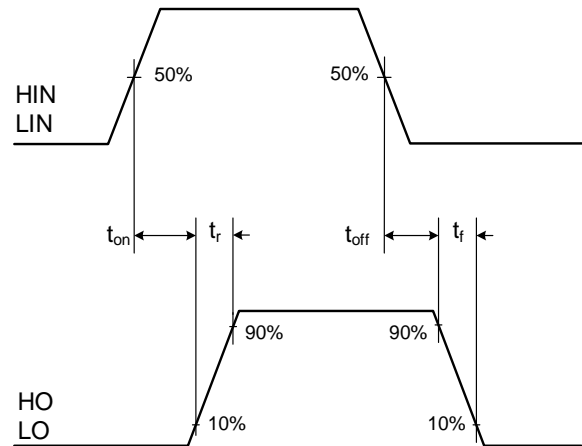
Figure 2. Switching Time Waveform
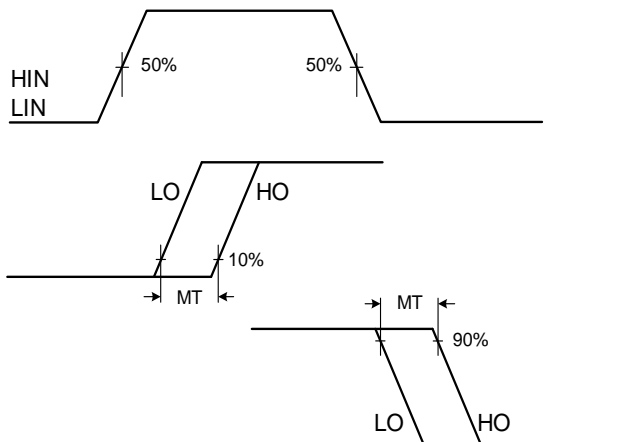
Figure 3. Delay Matching Waveform

## PACKAGE CASE OUTLINES



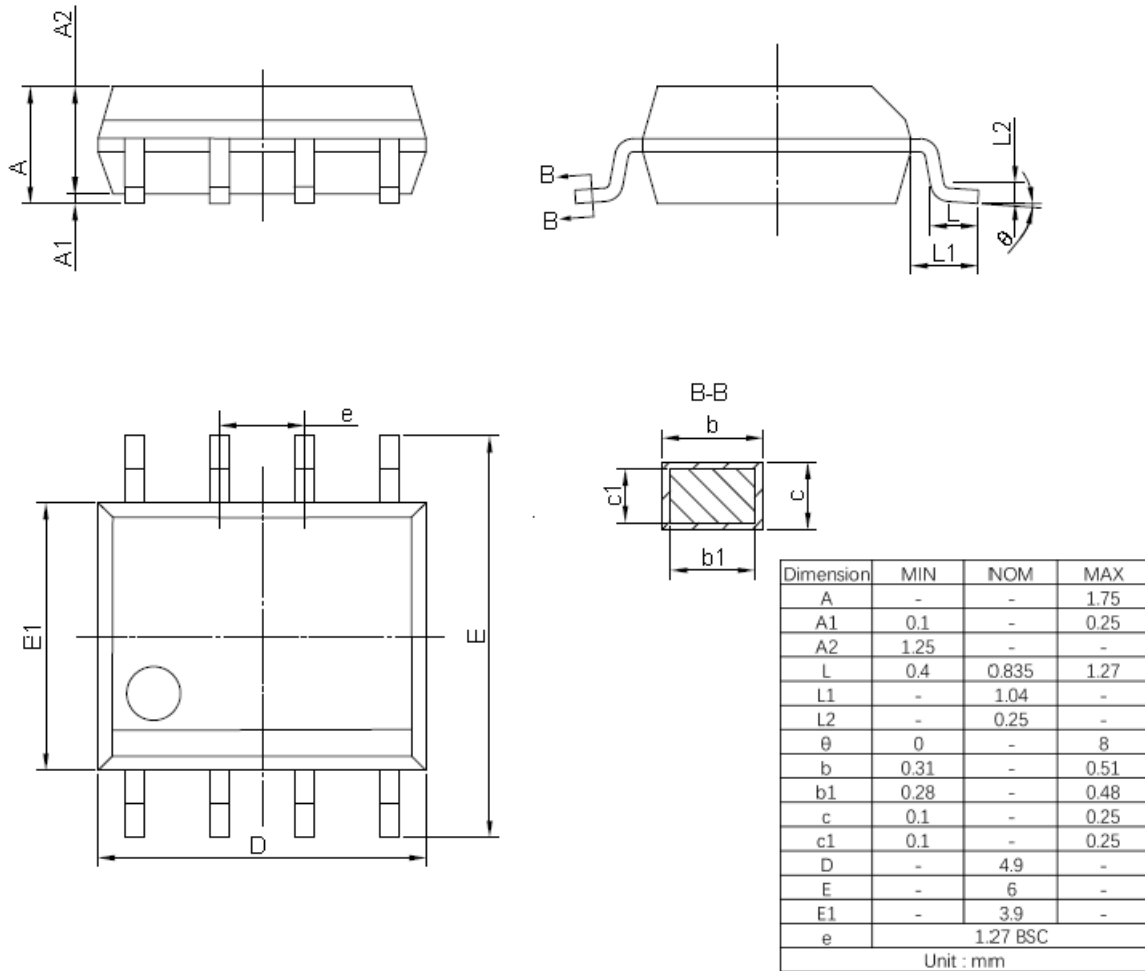| Dimension | MIN | NOM | MAX |
|-----------|------|-------|------|
| A | - | - | 1.75 |
| A1 | 0.1 | - | 0.25 |
| A2 | 1.25 | - | - |
| L | 0.4 | 0.835 | 1.27 |
| L1 | - | 1.04 | - |
| L2 | - | 0.25 | - |
| θ | 0 | - | 8 |
| b | 0.31 | - | 0.51 |
| b1 | 0.28 | - | 0.48 |
| c | 0.1 | - | 0.25 |
| c1 | 0.1 | - | 0.25 |
| D | - | 4.9 | - |
| E | - | 6 | - |
| E1 | - | 3.9 | - |
| e | 1.27 BSC | | |
| Unit : mm | | | |

Figure 4. SOP8 Outline Dimensions

## REVISION HISTORY

Note: page numbers for previous revisions may differ from page numbers in current version

| Page or Item | Subjects (major changes since previous revision) |
|---|---|
| **Rev 1.0 Datasheet, 2019-8-27** | |
| Whole document | New company logo released |
| Page 1 | Remove "Figure 1. "and "June 2019" |
| **Rev 1.1 Datasheet, 2019-10-21** | |
| Page 1 | Change "high side and low side driver" to "half bridge driver" |
| Page 1 | Change "independent" to "dependent" |
| **Rev 1.2 Datasheet,2021-7-2** | |
| Whole document | Format and Logo change |
| Page 2 | Remove SLM2304SCA-GT and SLM2304SDA-GT in the ordering information |
| Page 3 | Updated the function block |
| Page 5 | Change the IQVCC value in the Static Electrical Characteristics |
| Page 5 | Change the condition of the $I_{QCC}$ and $I_{QBS}$: remove $V_{IN}$=5V |
| Page 5 | Change the $I_{IN+}$ value in the Static Electrical Characteristics |
| Page1, Page 7 | Remove 8-Lead PDIP package |
| Page 7 | Remove Tape & Reel 8-Lead SOIC |
| **Rev 1.3 Datasheet, 2021-9-24** | |
| Page 5 | Change the $t_{off}$ value in the Dynamic Electrical Characteristics |
| **Rev 1.4 Datasheet, 2022-9-28** | |
| Whole datasheet | Change package name from SOIC-8 to SOP8 |
| Page 7 | Update the package case outlines. |