

## High voltage half bridge driver with oscillator

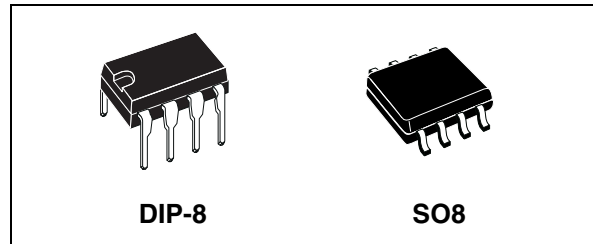
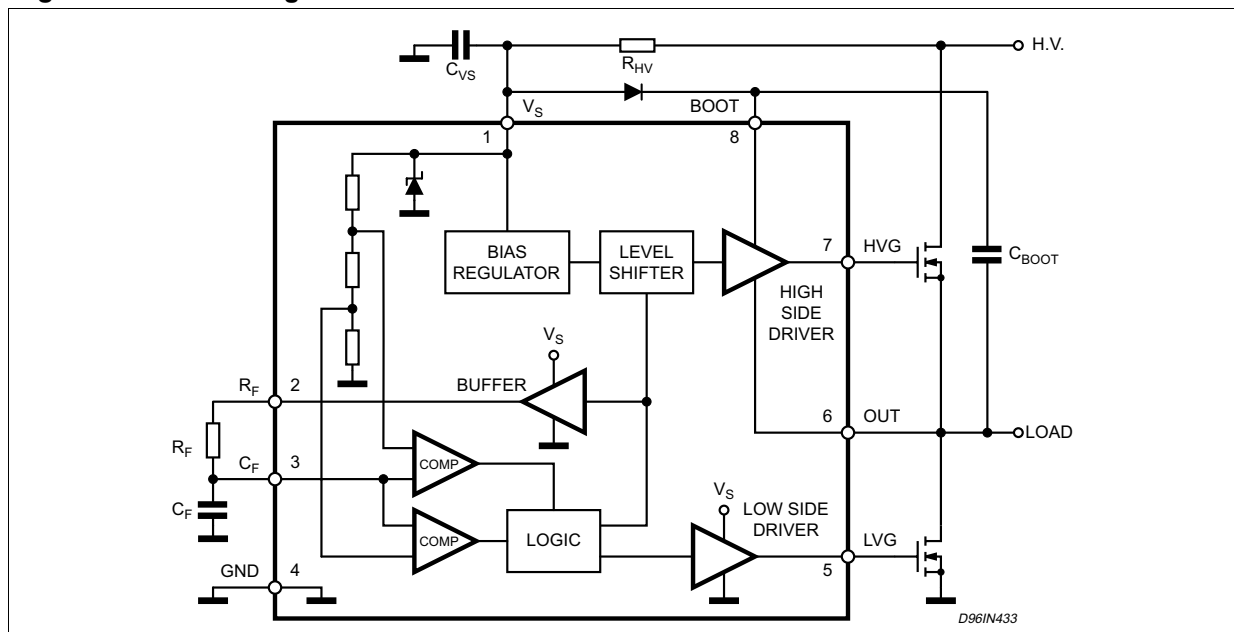
### Features

- High voltage rail up to 600 V
- BCD off line technology
- 15.6 V Zener clamp on  $V_S$
- Driver current capability:
  - Sink current = 270 mA
  - Source current = 170 mA
- Very low start up current: 150 mA
- Undervoltage lockout with hysteresis
- Programmable oscillator frequency
- Dead time 1.25  $\mu$ s (L6571A) or 0.72  $\mu$ s (L6571B)
- $dV/dt$  immunity up to  $\pm 50$  V/ns
- ESD protection

### Description

The device is a high voltage half bridge driver with built in oscillator. The frequency of the oscillator

**Figure 1. Block diagram**



can be programmed using external resistor and capacitor.

The internal circuitry of the device allows it to be driven also by external logic signal.

The output drivers are designed to drive external nchannel power MOSFET and IGBT. The internal logic assures a dead time to avoid cross-conduction of the power devices.

Two version are available: L6571A and L6571B. They differ in the internal dead time: 1.25 $\mu$ s and 0.72  $\mu$ s (typ.)

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# 1 Maximum ratings

## 1.1 Absolute maximum ratings

**Table 1. Absolute maximum ratings**

| Symbol         | Parameter                       | Value                 | Unit |
|----------------|---------------------------------|-----------------------|------|
| $I_S^{(1)}$    | Supply current                  | 25                    | mA   |
| $V_{CF}$       | Oscillator resistor voltage     | 18                    | V    |
| $V_{LVG}$      | Low side switch gate output     | 14.6                  | V    |
| $V_{OUT}$      | High side switch source output  | -1 to $V_{BOOT} - 18$ | V    |
| $V_{HVG}$      | High side switch gate output    | -1 to $V_{BOOT}$      | V    |
| $V_{BOOT}$     | Floating supply voltage         | 618                   | V    |
| $V_{BOOT/OUT}$ | Floating supply vs OUT voltage  | 18                    | V    |
| $dV_{BOOT}/dt$ | VBOOT slew rate (Repetitive)    | $\pm 50$              | V/ns |
| $dV_{OUT}/dt$  | VOOUT slew rate (Repetitive)    | $\pm 50$              | V/ns |
| $T_{stg}$      | Storage temperature             | -40 to 150            | °C   |
| $T_J$          | Junction temperature            | -40 to 150            | °C   |
| $T_{amb}$      | Ambient temperature (Operative) | -40 to 125            | °C   |

1. The device has an internal zener clamp between GND and VS (typical 15.6 V). Therefore the circuit should not be driven by a DC low impedance power source.

*Note:* ESD immunity for pins 6, 7 and 8 is guaranteed up to 900 V (human body model)

## 1.2 Thermal data

**Table 2. Thermal data**

| Symbol     | Parameter                               | MDIP8 | SO8 | Unit |
|------------|-----------------------------------------|-------|-----|------|
| $R_{thJA}$ | Thermal resistance junction-ambient max | 100   | 150 | °C/W |

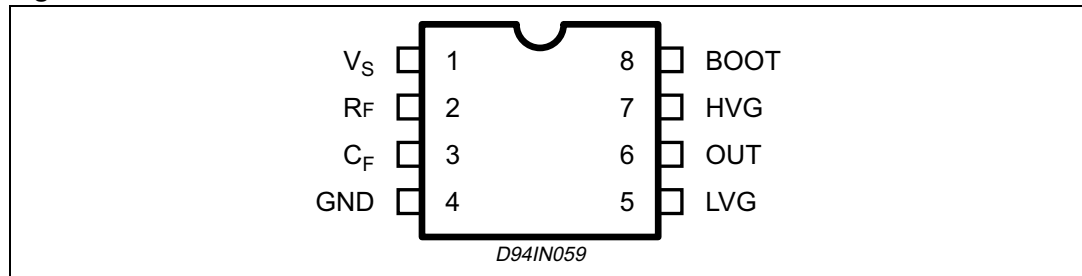
## 1.3 Recommended operating conditions

**Table 3. Recommended operating conditions**

| Symbol     | Parameter                      | Min. | Max.             | Unit |
|------------|--------------------------------|------|------------------|------|
| $V_S$      | Supply voltage                 | 10   | VCL              | V    |
| $V_{BOOT}$ | Floating supply voltage        | -    | 500              | V    |
| $V_{OUT}$  | High side switch source output | -1   | $V_{BOOT} - VCL$ | V    |
| $f_{out}$  | Oscillation frequency          |      | 200              | kHz  |

## 2 Pin connection

**Figure 2. Pin connection**



**Table 4. Pin description**

| N° | Pin  | Description                                                                                                                                                                                                                                                                      |
|----|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | VS   | Supply input voltage with internal clamp [typ. 15.6V]                                                                                                                                                                                                                            |
| 2  | RF   | Oscillator timing resistor pin. A buffer set alternatively to VS and GND can provide current to the external resistor RF connected between pin 2 and 3. Alternatively, the signal on pin 2 can be used also to drive another IC (i.e. another L6569/71 to drive a full H-bridge) |
| 3  | CF   | Oscillator timing capacitor pin. A capacitor connected between this pin and GND fixes (together with RF) the oscillating frequency. Alternatively an external logic signal can be applied to the pin to drive the IC.                                                            |
| 4  | GND  | Ground                                                                                                                                                                                                                                                                           |
| 5  | LVG  | Low side driver output. The output stage can deliver 170mA source and 270mA sink [typ.values].                                                                                                                                                                                   |
| 6  | OUT  | Upper driver floating reference                                                                                                                                                                                                                                                  |
| 7  | HVG  | High side driver output. The output stage can deliver 170mA source and 270mA sink [typ.values].                                                                                                                                                                                  |
| 8  | BOOT | Bootstrap voltage supply. It is the upper driver floating supply.                                                                                                                                                                                                                |

### 3 Electrical data

$V_S = 12V$ ;  $V_{BOOT} - V_{OUT} = 12V$ ;  $T_j = 25\text{ }^{\circ}\text{C}$ ; unless otherwise specified.

**Table 5. Electrical characteristics**

| Symbol       | Pin | Parameter                                                                               | Test Condition                        | Min.         | Typ.         | Max.         | Unit                           |
|--------------|-----|-----------------------------------------------------------------------------------------|---------------------------------------|--------------|--------------|--------------|--------------------------------|
| $V_{SUV P}$  | 1   | VS turn on threshold                                                                    |                                       | 8.3          | 9            | 9.7          | V                              |
| $V_{SUV N}$  |     | VS turn off threshold                                                                   |                                       | 7.3          | 8            | 8.7          | V                              |
| $V_{SUV H}$  |     | VS hysteresis                                                                           |                                       | 0.7          | 1            | 1.3          | V                              |
| $V_{CL}$     |     | VS clamping voltage                                                                     | $I_S = 5\text{ mA}$                   | 14.6         | 15.6         | 16.6         | V                              |
| $I_{SU}$     |     | Start up current                                                                        | $V_S < V_{SUV N}$                     |              | 150          | 250          | $\mu\text{A}$                  |
| $I_q$        |     | Quiescent current                                                                       | $V_S > V_{SUV P}$                     |              | 500          | 700          | $\mu\text{A}$                  |
| $I_{BOOTLK}$ | 8   | Leakage current BOOT pin vs GND                                                         | $V_{BOOT} = 580V$                     |              |              | 5            | $\mu\text{A}$                  |
| $I_{OUTLK}$  | 6   | Leakage current OUT pin vs GND                                                          | $V_{OUT} = 562V$                      |              |              | 5            | $\mu\text{A}$                  |
| $I_{HVG SO}$ | 7   | High side driver source current                                                         | $V_{HVG} = 6V$                        | 110          | 175          |              | mA                             |
| $I_{HVG SI}$ |     | High side driver sink current                                                           | $V_{HVG} = 6V$                        | 190          | 275          |              | mA                             |
| $I_{LVG SO}$ | 5   | Low side driver source current                                                          | $V_{LVG} = 6V$                        | 110          | 175          |              | mA                             |
| $I_{LVG SI}$ |     | Low side driver sink current                                                            | $V_{LVG} = 6V$                        | 190          | 275          |              | mA                             |
| $V_{RFON}$   | 2   | RF high level output voltage                                                            | $I_{RF} = 1\text{mA}$                 | $V_S - 0.05$ |              | $V_S - 0.2$  | V                              |
| $V_{RF OFF}$ |     | RF low level output voltage                                                             | $I_{RF} = -1\text{mA}$                | 50           |              | 200          | mV                             |
| $V_{CFU}$    | 3   | CF upper threshold                                                                      |                                       | 7.7          | 8            | 8.2          | V                              |
| $V_{CFL}$    |     | CF lower threshold                                                                      |                                       | 3.80         | 4            | 4.3          | V                              |
| $t_d$        |     | Internal dead time                                                                      | L6571A<br>L6571B                      | 0.85<br>0.50 | 1.25<br>0.72 | 1.65<br>0.94 | $\mu\text{s}$<br>$\mu\text{s}$ |
| DC           |     | Duty cycle, ratio between dead Time + conduction time of high Side and low side drivers |                                       | 0.45         | 0.5          | 0.55         |                                |
| $I_{AVE}$    | 1   | Average current from Vs                                                                 | No Load, $f_s = 60\text{KHz}$         |              | 1.2          | 1.5          | mA                             |
| $f_{out}$    | 6   | Oscillation frequency                                                                   | $RT = 12\text{K}$ ; $CT = 1\text{nF}$ | 57           | 60           | 63           | kHz                            |

## 4 Oscillator frequency

The frequency of the internal oscillator can be programmed using external resistor and capacitor.

The nominal oscillator frequency can be calculated using the following equation:

**Equation 1**

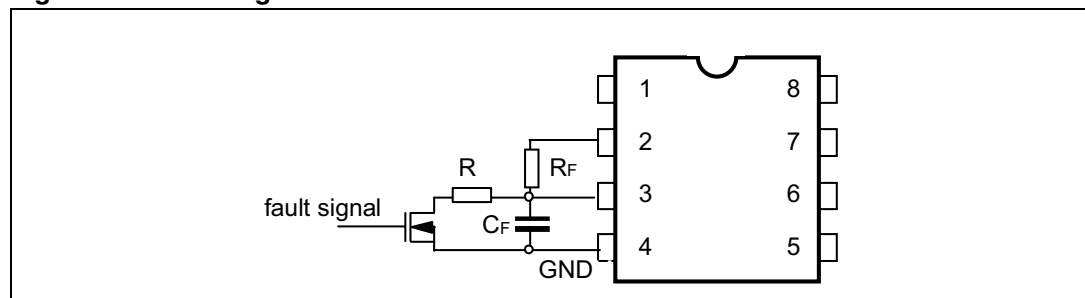
$$f_{osc} = \frac{1}{2 \cdot R_F \cdot C_F \cdot \ln 2} = \frac{1}{1.3863 \cdot R_F \cdot C_F}$$

Where  $R_F$  and  $C_F$  are the external resistor and capacitor.

The device can be driven in "shut down" condition keeping the  $C_F$  pin close to GND, but some cares have to be taken:

1. When  $C_F$  is to GND the high side driver is off and the low side is on
2. The forced discharge of the oscillator capacitor  $C_F$  must not be shorter than 1 $\mu$ s: a simple way to do this is to limit the current discharge with a resistive path imposing  $R \cdot C_F > 1 \mu s$  (see fig.1)

**Figure 3. Fault signal**



**Figure 4. Waveforms**

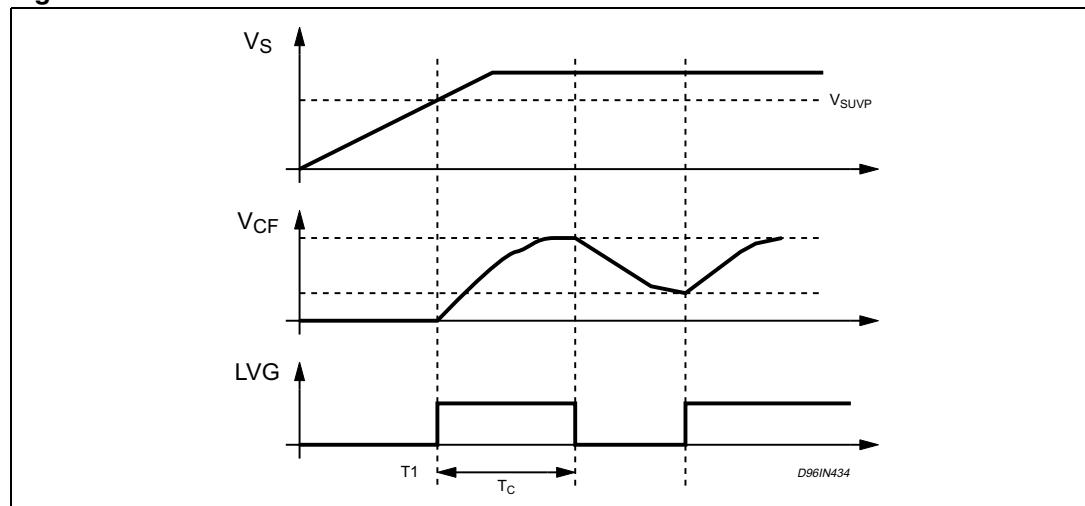


Figure 5. Typical dead time vs. temperature dependency (L6571A)

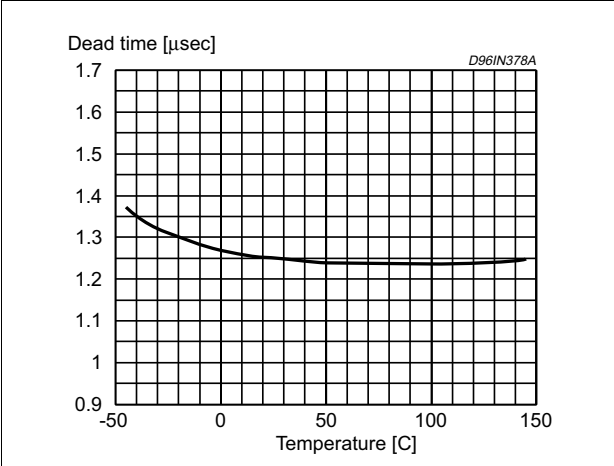


Figure 6. Typical rise and fall times vs. load capacitance

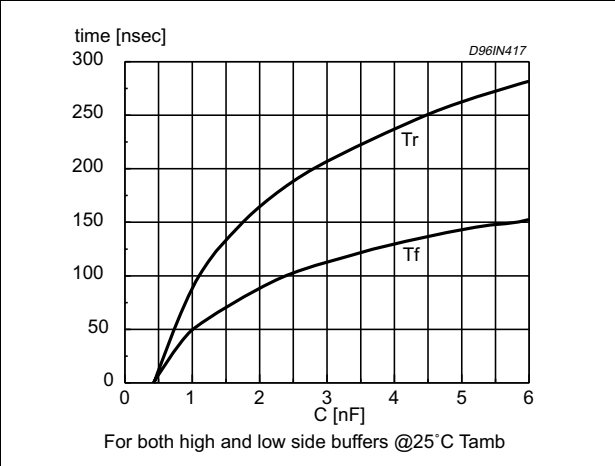


Figure 7. Typical frequency vs temperature dependency

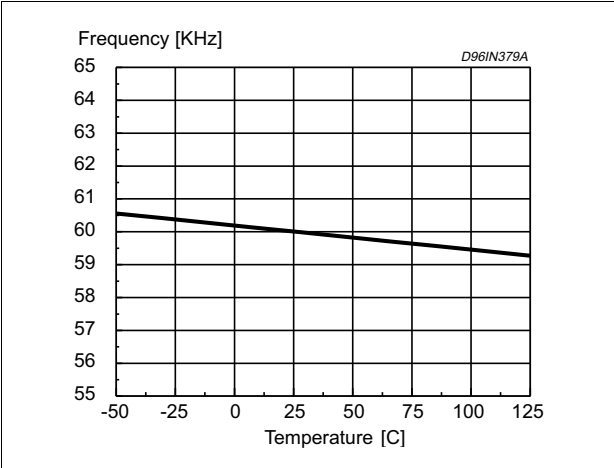


Figure 8. Quiescent current vs. supply voltage

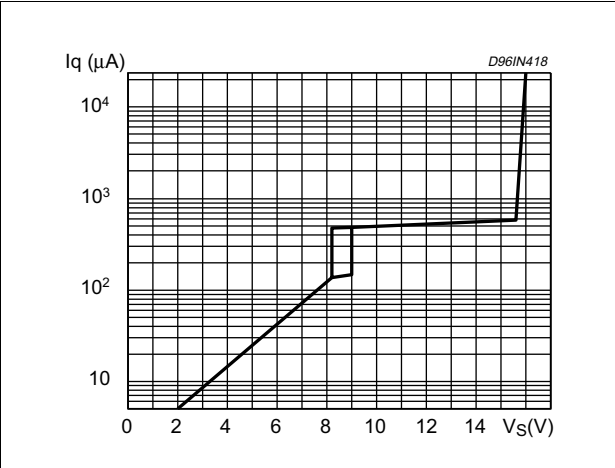
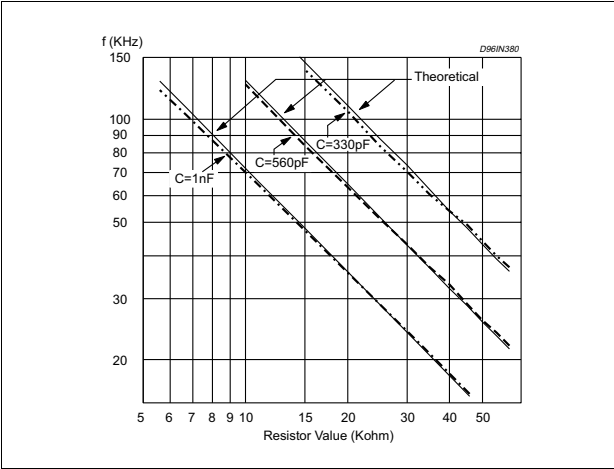


Figure 9. Typical and theoretical oscillator frequency vs resistor value



# 5 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

Figure 10. DIP-8 mechanical data

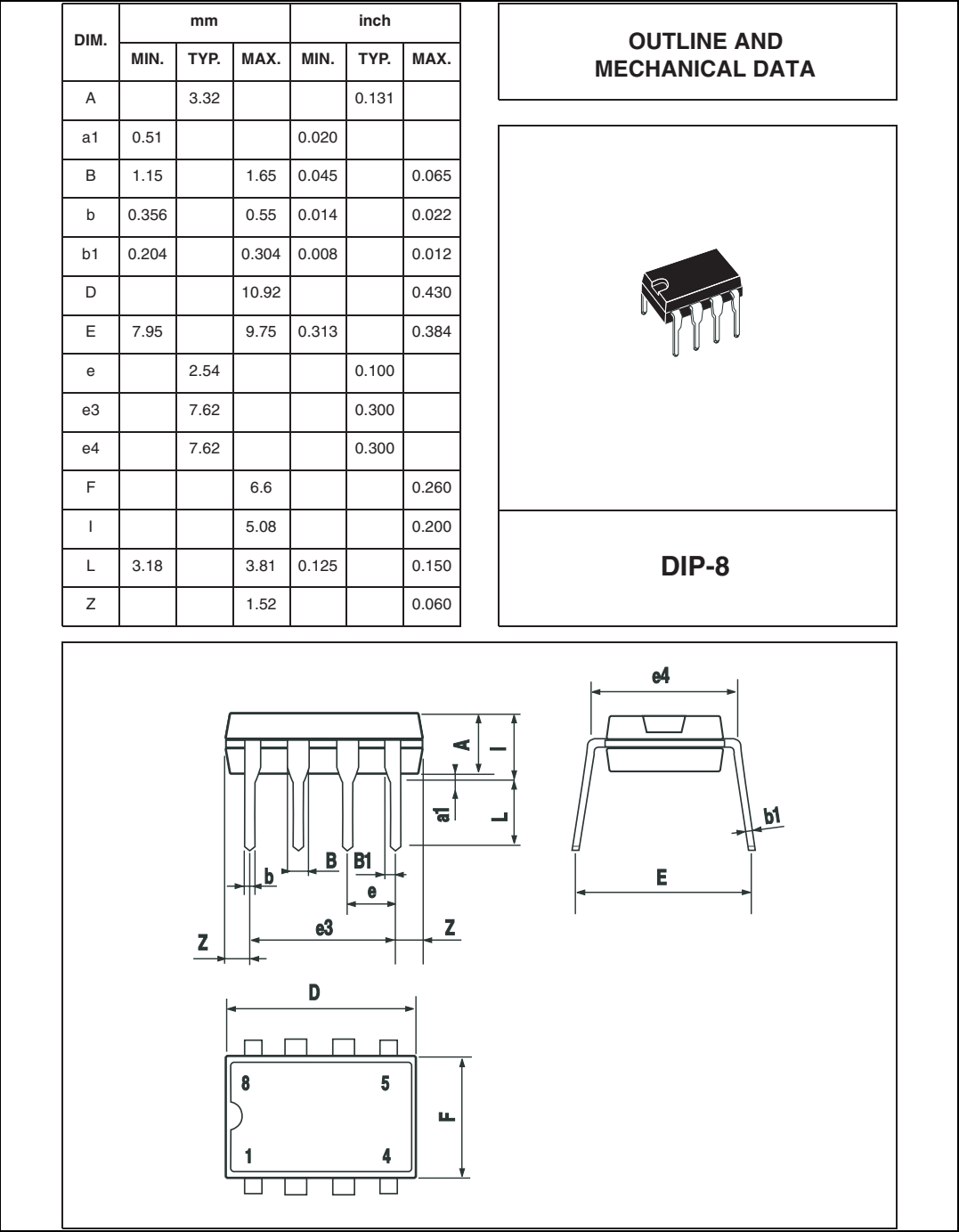
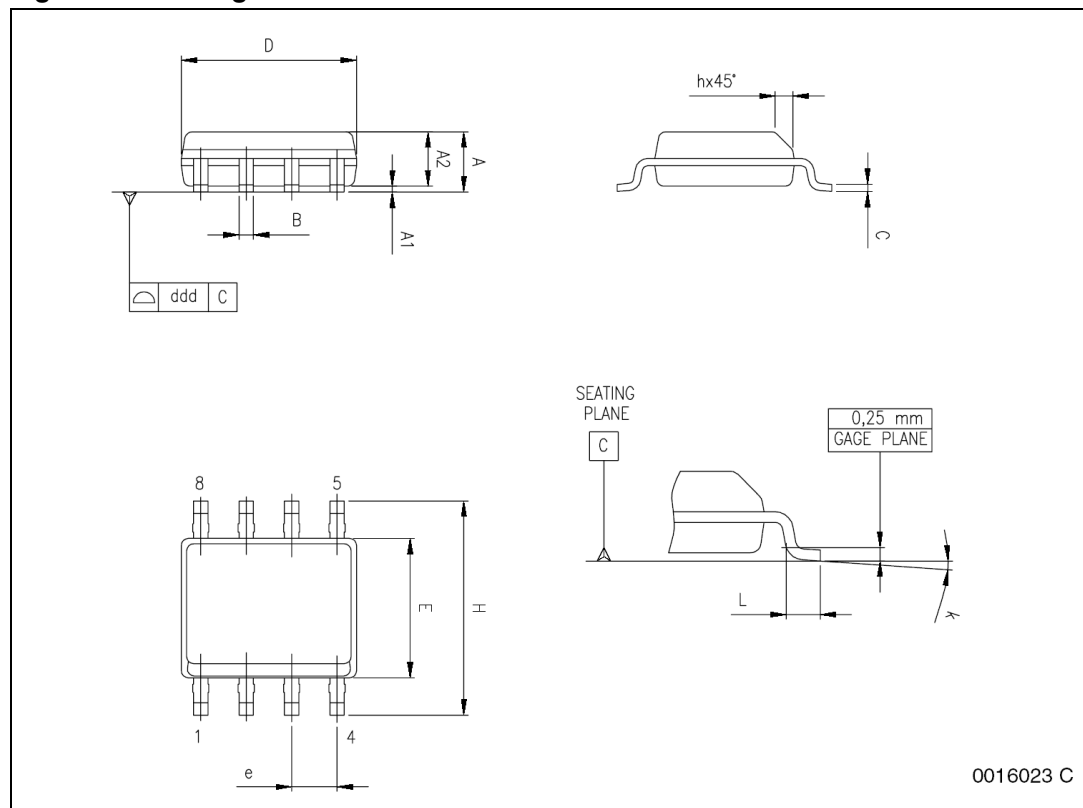


Table 1. SO-8 mechanical data

| Dim.  | mm.                  |      |      | inch  |       |       |
|-------|----------------------|------|------|-------|-------|-------|
|       | Min                  | Typ  | Max  | Min   | Typ   | Max   |
| A     | 1.35                 |      | 1.75 | 0.053 |       | 0.069 |
| A1    | 0.10                 |      | 0.25 | 0.004 |       | 0.010 |
| A2    | 1.10                 |      | 1.65 | 0.043 |       | 0.065 |
| B     | 0.33                 |      | 0.51 | 0.013 |       | 0.020 |
| C     | 0.19                 |      | 0.25 | 0.007 |       | 0.010 |
| D (1) | 4.80                 |      | 5.00 | 0.189 |       | 0.197 |
| E     | 3.80                 |      | 4.00 | 0.15  |       | 0.157 |
| e     |                      | 1.27 |      |       | 0.050 |       |
| H     | 5.80                 |      | 6.20 | 0.228 |       | 0.244 |
| h     | 0.25                 |      | 0.50 | 0.010 |       | 0.020 |
| L     | 0.40                 |      | 1.27 | 0.016 |       | 0.050 |
| k     | 0° (min.), 8° (max.) |      |      |       |       |       |
| ddd   |                      |      | 0.10 |       |       | 0.004 |

1. Dimensions D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15mm (.006inch) in total (both side).

Figure 11. Package dimensions



## 6 Order information

**Table 6. Ordering information**

| Order codes  | Package | Packaging     |
|--------------|---------|---------------|
| L6571A       | DIP-8   | Tube          |
| L6571AD      | SO8     |               |
| L6571AD013TR |         | Tape and reel |
| L6571B       | DIP-8   | Tube          |
| L6571BD      | SO8     |               |
| L6571BD013TR |         | Tape and reel |

## 7 Revision history

**Table 7. Document revision history**

| Date        | Revision | Changes                                    |
|-------------|----------|--------------------------------------------|
| 14-Jan-2004 | 5        | No history because migration               |
| 15-Jan-2010 | 6        | Updated <a href="#">Table 6 on page 10</a> |

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