# SteadiChips

# SC8927
# 2 Channels Bi-directional Motor Driver

## 1 Features

- H-Bridge Motor Driver
    - Drives 2-DC Motors or Other Loads
    - Low saturation voltage: 0.50V typ. At 400mA
- Low operating Current
- Low voltage operation:
    - $V_{DD\ min}$ =2.0V
- Low input current
- High output sinking and driving capability
- Small Package and Footprint
    - DFN-10(With Thermal Pad)
    - MSOP-10
- Protection Features
    - Thermal Shutdown(TSD)

## 2 Applications

- Battery-Powered:
- Cameras
- DSLR Lenses
- Consumer Products
- Toys
- Robotics
- Medical Devices

## 3 Description

The SC8927 provides an integrated motor driver solution for cameras, consumer products, toys, and other low-voltage or battery-powered motion control applications. The device has a two-channel H-bridge driver, and drives two DC motors, as well as other devices like shutter or iris on cameras. An internal charge pump generates gate drive voltages.

The SC8927 supplies up to 1.0-A of output current. The operates on a motor power supply voltage from 2.0 V to 5.5 V.
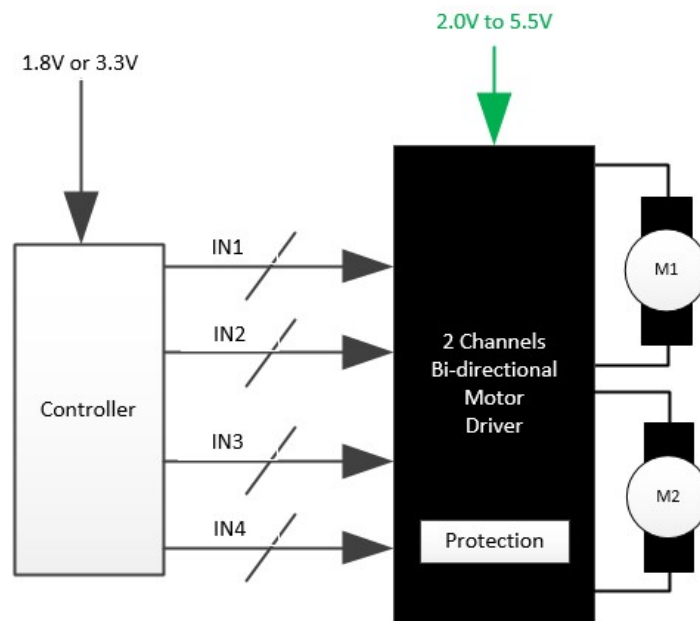
The SC8927 device has a PWM (IN/IN) input interface. Internal shutdown functions are provided for overtemperature.

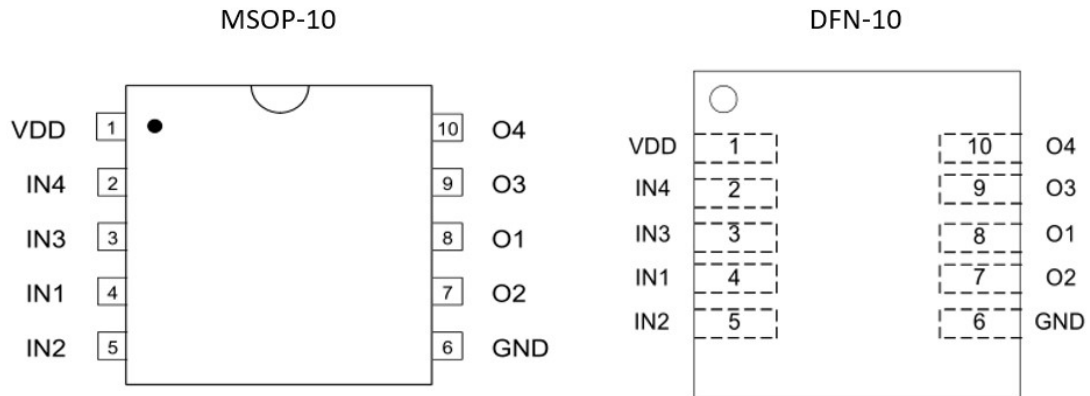The SC8927 is packaged in a 10-pin DFN package or a10-pin MSOP.

### Device Information

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|---|---|---|
| SC8927D | DFN (10) | 3.00 mm × 3.00 mm |
| SC8927S | MSOP (10) | 3.00 mm × 3.00 mm |

### Simplified Schematic

## 4　Pin Configuration and Functions

MSOP-10

DFN-10

| VDD | 1 | | 10 | O4 |
| IN4 | 2 | | 9 | O3 |
| IN3 | 3 | | 8 | O1 |
| IN1 | 4 | | 7 | O2 |
| IN2 | 5 | | 6 | GND |

| VDD | 1 | | 10 | O4 |
| IN4 | 2 | | 9 | O3 |
| IN3 | 3 | | 8 | O1 |
| IN1 | 4 | | 7 | O2 |
| IN2 | 5 | | 6 | GND |

**Pin Functions**

| PIN | | TYPE | DESCRIPTION | EXTERNAL COMPONENTS OR CONNECTIONS |
|---|---|---|---|---|
| NAME | NO. | | | |
| **POWER AND GROUND** | | | | |
| GND | 6 | PWR | Device ground | This pin must be connected to the PCB ground |
| VDD | 1 | PWR | Motor supply | Bypass to GND with a 0.1uF(minimum) ceramic capacitor |
| **CONTROL** | | | | |
| IN1 | 4 | I | Bridge input 1 | Logic high sets OUT1 high<br>Internal pulldown resistor |
| IN2 | 5 | I | Bridge input 2 | Logic high sets OUT2 high<br>Internal pulldown resistor |
| IN3 | 3 | I | Bridge input 1 | Logic high sets OUT3 high<br>Internal pulldown resistor |
| IN4 | 2 | I | Bridge input 2 | Logic high sets OUT4 high<br>Internal pulldown resistor |
| **OUTPUT** | | | | |
| OUT1 | 8 | O | Bridge output 1 | Connect to motor winding |
| OUT2 | 7 | O | Bridge output 2 | |
| OUT3 | 9 | O | Bridge output 3 | Connect to motor winding |
| OUT4 | 10 | O | Bridge output 4 | |

## 5 Specifications

### 5.1 Absolute Maximum Ratings

See[1][2]

| | | MIN | MAX | UNIT |
|---|---|---|---|---|
| | Power supply voltage, $V_{DD}$ | -0.3 | 5.5 | V |
| | Digital input pin voltage | -0.5 | $V_{DD}$+0.4 | V |
| | Peak motor drive output current | Internally limited | | A |
| $T_J$ | Operating junction temperature | -40 | 150 | ℃ |
| $T_{stg}$ | Storage temperature | -60 | 150 | ℃ |

(1)    Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2)    All voltage values are with respect to network ground terminal.

### 5. 2 Recommended Operating Conditions

| | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|
| $V_{DD}$ | power supply voltage | 2.0 | 3.0 | 5.5 | V |
| $V_{IN}$ | Logic level input voltage | 0 | | $V_{DD}$ | V |
| $I_{OUT}$ | Continuous motor drive output current | 0 | 0.6 | 1.0 | A |
| $T_A$ | Operating ambient temperature | -40 | | 85 | ℃ |

### 5.3 Thermal Information

| THERMAL METRIC | VALUE | | UNIT |
|---|---|---|---|
| | MSOP-10 | DFN-10 | |
| $R_{JA}$    Junction-to-ambient thermal resistance | 125.6 | 64.3 | ℃/W |
| $R_{JC}$    Junction-to-thermal resistance | 49.0 | 42.1 | ℃/W |

## 5.4 Electrical Characteristics

$T_A$ = 25°C, $V_{DD}$ = 3.0 V (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| POWER SUPPLY | | | | | | |
| $I_{DD0}$ | VDD sleep mode supply current | $V_{IN1,IN2,IN3,IN4}$=0V | | 0.1 | 10 | μA |
| $I_{DD1}$ | VDD operating supply current | $V_{IN1,IN2,IN3,IN4}$≠0V | | 0.2 | 0.5 | mA |
| $V_{UVLO}$ | VDD undervoltage lockout voltage | $V_{DD}$ rising | | | 2.5 | V |
| | | $V_{DD}$ falling | | | 2.3 | V |
| LOGIC-LEVEL INPUTS | | | | | | |
| $V_{IL}$ | Input low voltage | | -0.4 | | $0.2 * V_{DD}$ | V |
| $V_{IH}$ | Input high voltage | | $0.5 * V_{DD}$ | | $V_{DD}$+0.4 | V |
| $I_{IL}$ | Input low current | $V_{IN}$=0 | -5 | | 5 | μA |
| $I_{IH}$ | Input high current | $V_{IN}$=3V | | | 50 | μA |
| $R_{PD}$ | Pulldown resistance | | | 100 | | KΩ |
| H-BRIDGE FETS | | | | | | |
| $V_{OUT}$ | Output Voltage(upper + lower) | $I_{OUT}$=100mA | | 0.12 | 0.2 | V |
| | | $I_{OUT}$=200mA | | 0.28 | 0.4 | V |
| | | $I_{OUT}$=400mA | | 0.50 | 0.7 | V |
| $I_{OFF}$ | OFF-state leakage current | $V_{OUTx}$=0V | | | ±200 | nA |
| PROTECTION CIRCUITS | | | | | | |
| $t_{TSD}$[1] | Thermal shutdown temperature | Die temperature | 150 | 160 | 190 | ℃ |

(1)　Not tested in production;limits are based on characterization data

## 6 Detailed Description

### 6.1 Overview

The SC8927 device is a two-channel driver that can drive two DC motor or other devices like shutter on the cameras. The outputs are controlled using a PWM interface.

This device greatly reduces the component count of motor driver systems by integrating the necessary driver FETs and FET control circuitry into a single device. In addition, the SC8927 device adds protection features beyond traditional discrete implementations: undervoltage lockout, overcurrent protection, and thermal shutdown.

### 6.2 Functional Black Diagram
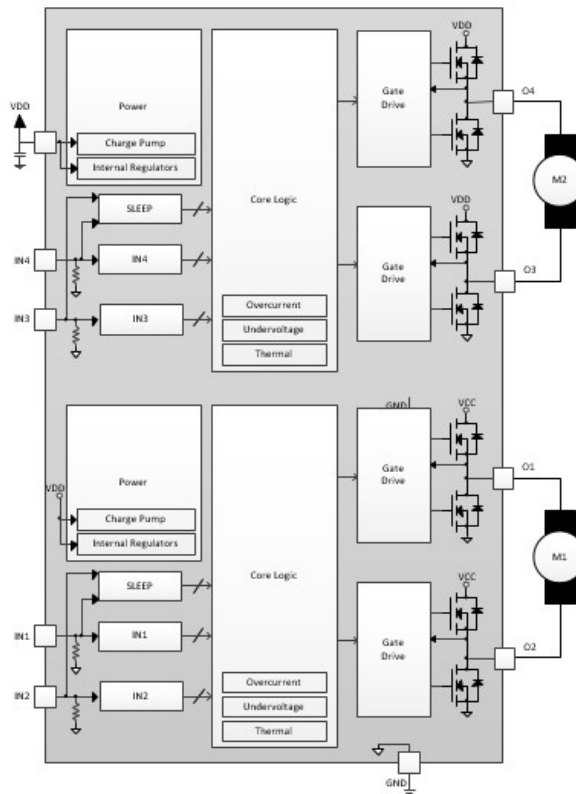
## 6.3 Feature Description

### 6.3.1 Bridge Control

The SC8927 device is controlled using a PWM input interface, also called an IN/IN interface. Each output is controlled by a corresponding input pin.

Table 1 shows the logic for the SC8927 device.

**Table 1. SC8927 Device Logic**

| IN1/IN3 | IN2/IN4 | O1/O3 | O2/O4 | MODE |
|---------|---------|-------|-------|------|
| L | L | OFF | OFF | Standly |
| H | L | H | L | Forward |
| L | H | L | H | Reverse |
| H | H | – | – | Keep the previous mode (Forward/Reverse) |

Note:" – " indicates a "don't care" input

### 6.3.2 Power Supplies and Input Pins

The input pins can be driven within the recommended operating conditions with or without the VDD. No leakage current path exists to the supply. Each input pin has a weak pulldown resistor (approximately 100 kΩ) to ground.

### 6.3.3 Protection Circuits

The SC8927 is fully protected against VDD undervoltage, overcurrent, and overtemperature events.

### VDD undervoltage lockout

If at any time the voltage on the VDD pin falls below the undervoltage lockout threshold voltage, all FETs in the H-bridge are disabled. Operation resumes when the VDD pin voltage rises above the UVLO threshold.

### Overcurrent protection (OCP)

An analog current-limit circuit on each FET limits the current through the FET by removing the gate drive. If this analog current limit persists for longer than tDEG, all FETs in the H-bridge are disabled. Operation resumes automatically after tRETRY has elapsed. Overcurrent conditions are detected on both the high-side and low-side devices. A short to the VDD pin, GND, or from the OUT1 pin to the OUT2 pin results in an overcurrent condition.

### Thermal shutdown (TSD)

If the die temperature exceeds safe limits, all FETs in the H-bridge are disabled. After the die temperature falls to a safe level, operation automatically resumes.

### Table 2. Fault Behavior

| FAULT | CONDITION | H-BRIDGE | INTERNAL CIRCUIT | RECOVERY |
|---|---|---|---|---|
| VDD undervoltage(UVLO) | $V_{DD}<2.3V$ | Disabled | Disabled | $V_{DD}>2.5V$ |
| Overcurrent(OCP) | $I_{OUT}>1.2A(MIN)$ | Disabled | Operating | $t_{OCR}$ |
| Thermal Shutdown(TSD) | $T_J>150°C(MIN)$ | Disabled | Operating | $T_J<150°C$ |

## 7 Application and Implementation

**NOTE**

Information in the following applications sections is not part of the SteadiChips Component specification, and SteadiChips does not warrant its accuracy or completeness. SteadiChips's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 7.1 Application Information

The SC8927 device is device is used to drive one DC motor or other devices like solenoids. The following design procedure can be used to configure the SC8927 device.

### 7.2 Typical Application
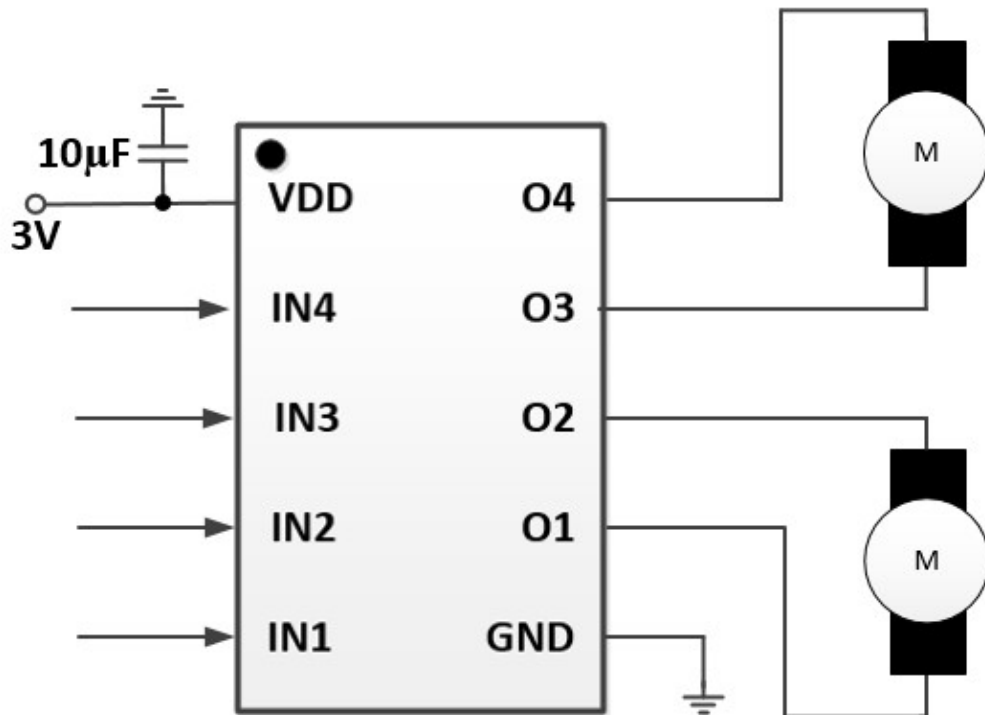


**Figure 2. Schematic of SC8927 Application**

## 8 Power Supply Recommendations

### 8.1 Bulk Capacitance

Having appropriate local bulk capacitance is an important factor in motor-drive system design. It is generally beneficial to have more bulk capacitance, while the disadvantages are increased cost and physical size.

The amount of local capacitance needed depends on a variety of factors, including:

• The highest current required by the motor system

• The power-supply capacitance and ability to source current

• The amount of parasitic inductance between the power supply and motor system

• The acceptable voltage ripple

• The type of motor used (brushed dc, brushless dc, stepper)

• The motor braking method

The inductance between the power supply and motor drive system limits the rate at which current can change from the power supply. If the local bulk capacitance is too small, the system responds to excessive current demands or dumps from the motor with a change in voltage. When adequate bulk capacitance is used, the motor voltage remains stable and high current can be quickly supplied.

The data sheet generally provides a recommended value, but system-level testing is required to determine the appropriate size of bulk capacitor.
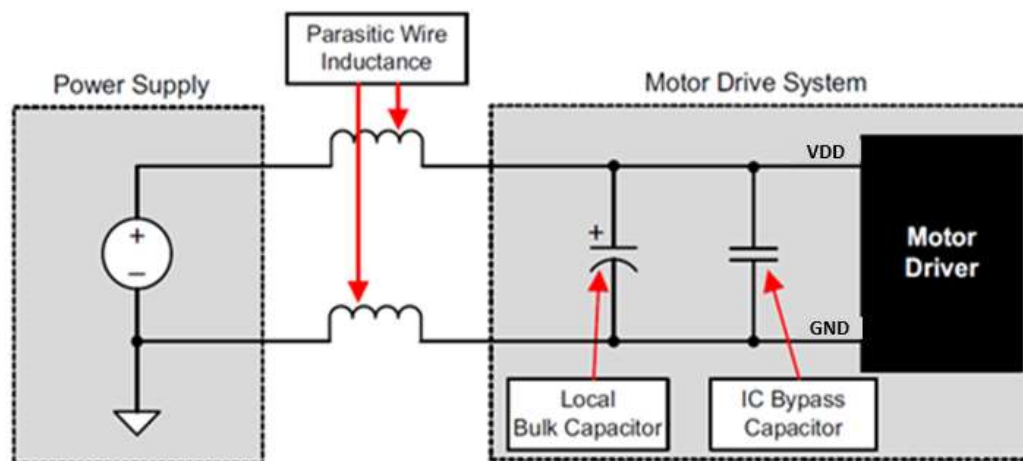


**Figure 3. Example Setup of Motor Drive System With External Power Supply**

The voltage rating for bulk capacitors should be higher than the operating voltage, to provide margin for cases when the motor transfers energy to the supply

## 9 Layout

### 9.1 Layout Guidelines

The VDD pins should be bypassed to GND using low-ESR ceramic bypass capacitors with a recommended value of 10 µF rated for the VM and VDD supplies. These capacitors should be placed as close to the VDD pins as possible with a thick trace or ground plane connection to the device GND pin.

### 9.2 Layout Example
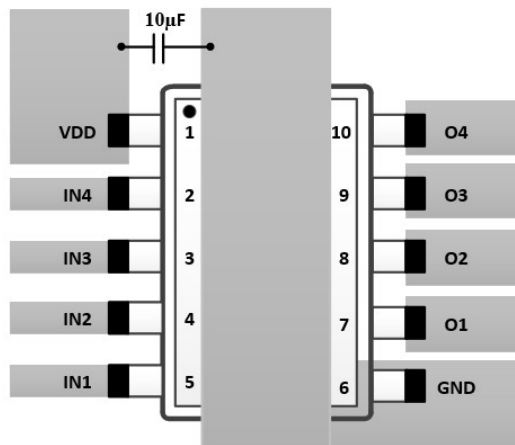


**Figure 4. Simplified Layout Example**

### 9.3 Power Dissipation

Power dissipation in the SC8927 is dominated by the power dissipated in the output FET resistance, or $R_{DS(on)}$. Average power dissipation when running both H-bridges can be roughly estimated by Equation 1:

$$P_{TOT} = R_{DS(ON)} \times (I_{OUT(RMS)})^2 \tag{1}$$

where

- $P_{TOT}$ is the total power dissipation
- $R_{DS(ON)}$ is the resistance of the HS plus LS FETs
- $I_{OUT(RMS)}$ is the RMS or DC output current being supplied to the load

The maximum amount of power that can be dissipated in the device is dependent on ambient temperature and heatsinking.

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**NOTE**

The value of $R_{DS(ON)}$ increases with temperature, so as the device heats, the power dissipation increases.

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The SC8927 device has thermal shutdown protection. If the die temperature exceeds approximately 150°C, the device is disabled until the temperature drops to a safe level.

Any tendency of the device to enter thermal shutdown is an indication of either excessive power dissipation, insufficient heatsinking, or too high an ambient temperature.
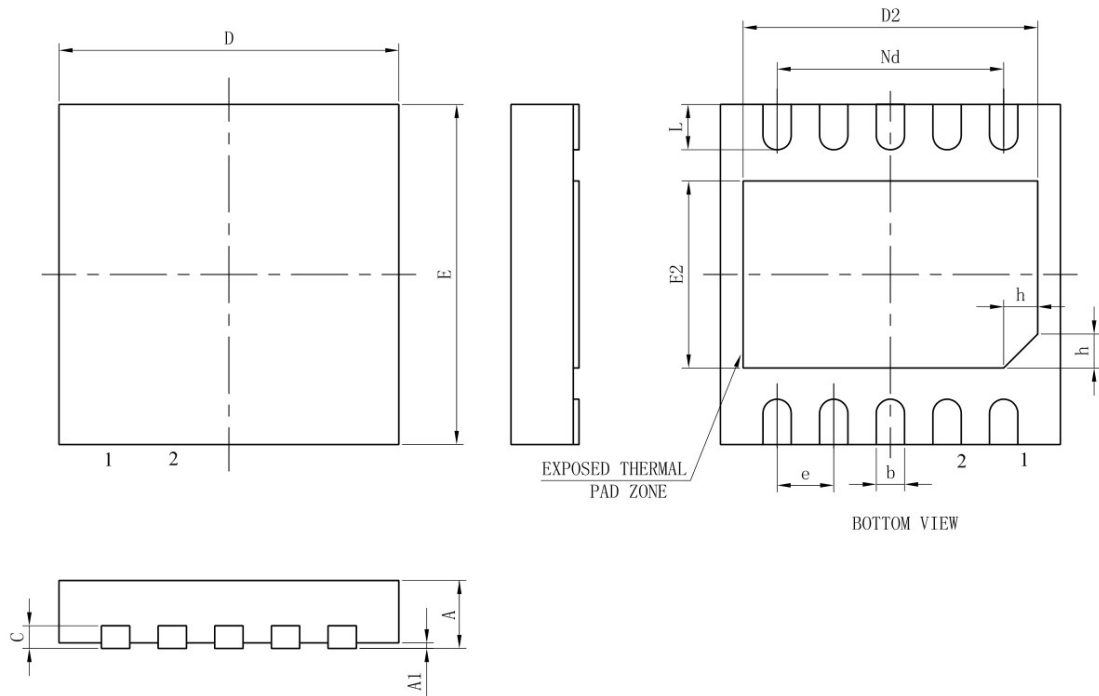
**10    Package Outline**

**10.1 MSOP-10**
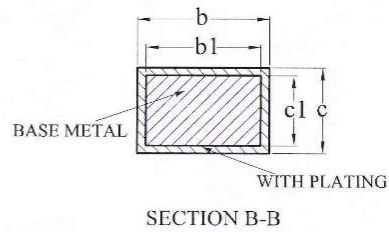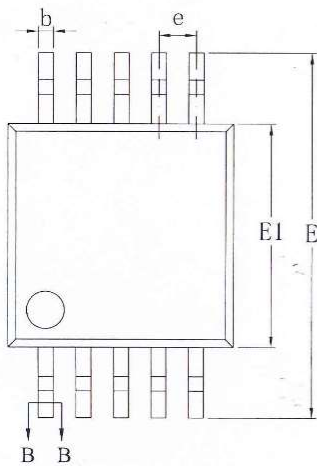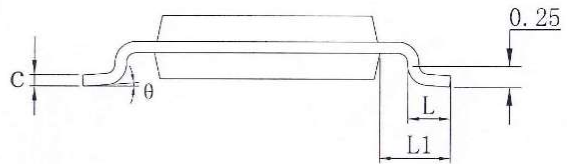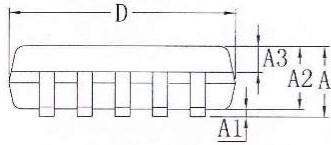
| SYMBOL | MILLIMETER | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | — | — | 1.10 |
| A1 | 0.05 | — | 0.15 |
| A2 | 0.75 | 0.85 | 0.95 |
| A3 | 0.30 | 0.35 | 0.40 |
| b | 0.18 | — | 0.26 |
| b1 | 0.17 | 0.20 | 0.23 |
| c | 0.15 | — | 0.19 |
| c1 | 0.14 | 0.15 | 0.16 |
| D | 2.90 | 3.00 | 3.10 |
| E | 4.70 | 4.90 | 5.10 |
| E1 | 2.90 | 3.00 | 3.10 |
| e | 0.50BSC | | |
| L | 0.40 | — | 0.70 |
| L1 | 0.95REF | | |
| θ | 0 | — | 8° |

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**10.2 DFN-10**



EXPOSED THERMAL
PAD ZONE

BOTTOM VIEW

| SYMBOL | MILLIMETER | | |
|--------|------|------|------|
| | MIN | NOM | MAX |
| A | 0.70 | 0.75 | 0.80 |
| A1 | — | 0.02 | 0.05 |
| b | 0.18 | 0.25 | 0.30 |
| c | 0.18 | 0.20 | 0.25 |
| D | 2.90 | 3.00 | 3.10 |
| D2 | 2.40 | 2.50 | 2.60 |
| e | 0.50BSC | | |
| Nd | 2.00BSC | | |
| E | 2.90 | 3.00 | 3.10 |
| E2 | 1.45 | 1.55 | 1.65 |
| L | 0.30 | 0.40 | 0.50 |
| h | 0.20 | 0.25 | 0.30 |
| L/F载体尺寸 (mil) | 106*75 | | |