

## Motor Driver, Forward/Reverse, Low Saturation Voltage

### GENERAL DESCRIPTION

The SiLM9408 is a 2-channel low saturation voltage forward/reverse motor driver IC. It is optimal for motor drive in 12V and 24V system products and can drive either two DC motors, one DC motor using parallel connection, or it can drive a stepper motor in Full-step and Half-step.

Each H-bridge output consists of a pair of N-channel and P-channel MOSFETs, with circuitry that regulates the winding current. With proper PCB design, each H-bridge of the SiLM9408 can drive up to 0.8A RMS continuously at 25°C. The device can support peak currents of up to 1.2A per bridge.

Internal shutdown functions are provided for under-voltage lockout, and over temperature.

The SiLM9408 is available in a compact SSOP10 package.

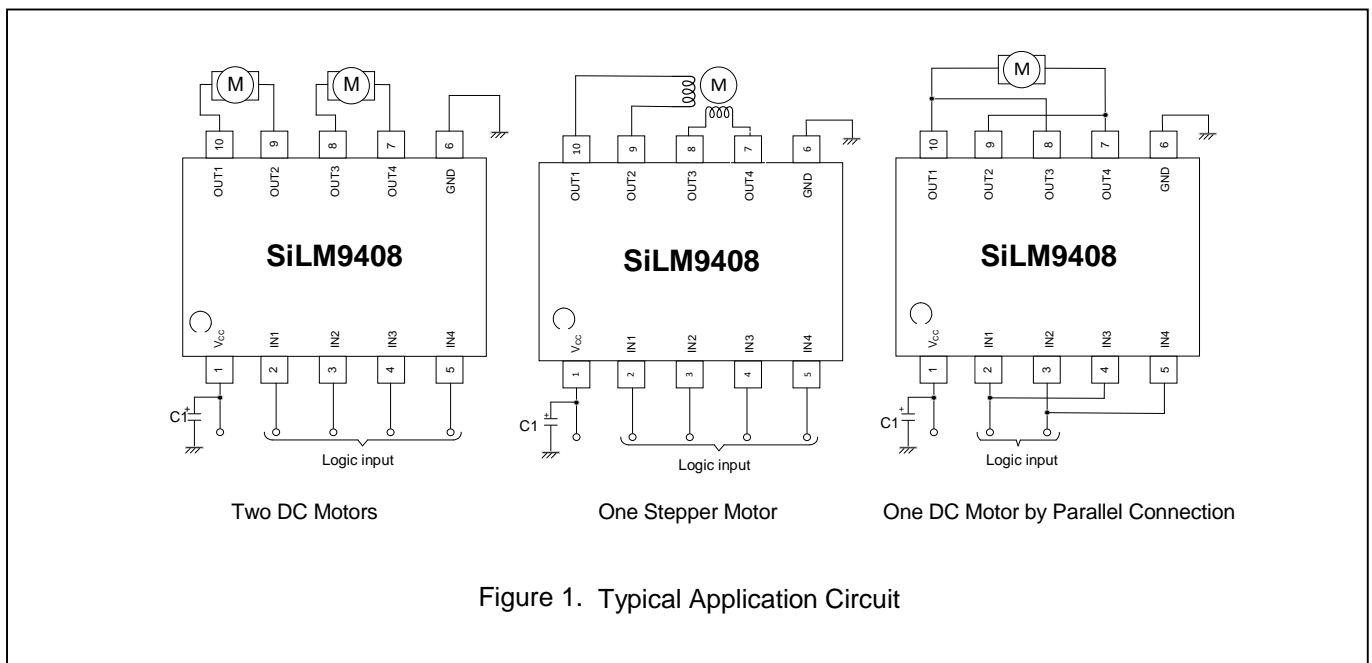
### FEATURES

- DMOS output transistor adoption (upper and lower total  $R_{ds(on)} = 0.9 \Omega$  Typ.).
- $V_{CC} (Max) = 26V$ ,  $I_o (Max) = 1.2A$ ,  $I_o (RMS) = 0.8A$ .
- 5V to 26V operating supply voltage range (The control system power supply is unnecessary.).
- The compact package (SSOP10) is adopted.
- It is possible to connect in parallel (parallel connection of drive channel).
- Built-in brake function.

### TYPICAL APPLICATIONS

- Refrigerator
- Flatbed Scanner, Document Scanner
- POS Printer, Label Printer
- PoE Point of Sales Terminal
- Clothes Dryer
- Vacuum Cleaner
- Time Recorder

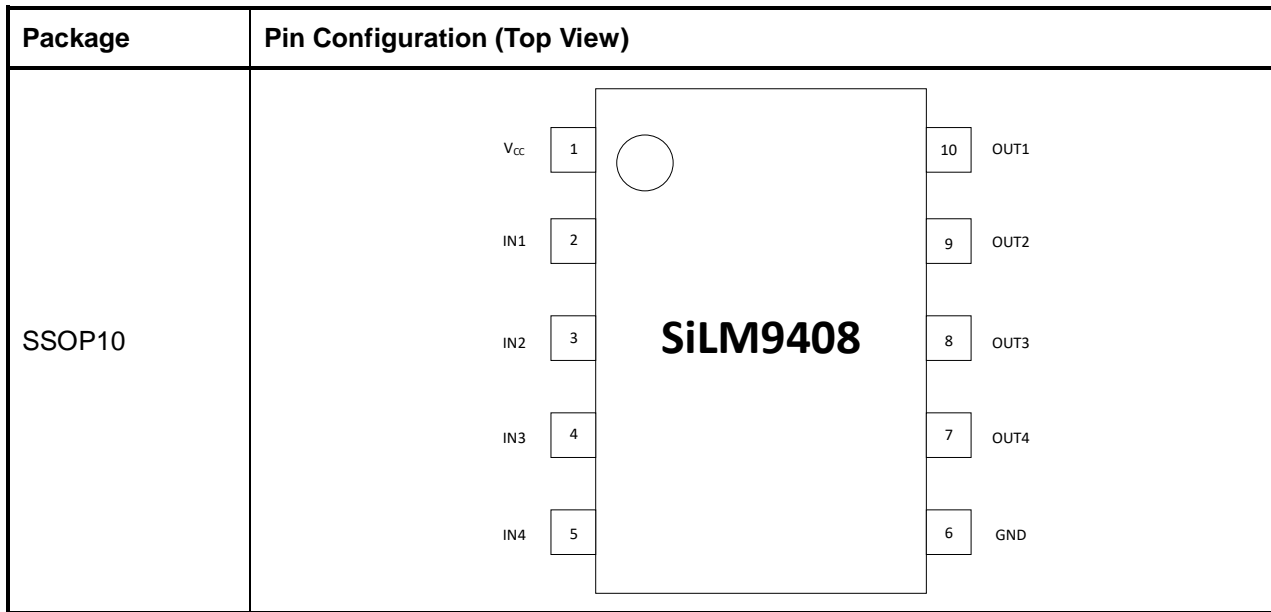
### TYPICAL APPLICATION CIRCUIT



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## PIN CONFIGURATION



## PIN DESCRIPTION

No.	Pin	Description
1	V <sub>CC</sub>	Power-supply voltage pin. A 10- $\mu$ F (minimum) ceramic bypass capacitor to GND is recommended.
2	IN1	Logic input pin of OUT1 and OUT2. Internal pull-down.
3	IN2	Logic input pin of OUT1 and OUT2. Internal pull-down.
4	IN3	Logic input pin of OUT3 and OUT4. Internal pull-down.
5	IN4	Logic input pin of OUT3 and OUT4. Internal pull-down.
6	GND	Device ground.
7	OUT4	Driving output pin. Motor coil is connected between terminal OUT3 (pin8).
8	OUT3	Driving output pin. Motor coil is connected between terminal OUT4 (pin7).
9	OUT2	Driving output pin. Motor coil is connected between terminal OUT1 (pin10).
10	OUT1	Driving output pin. Motor coil is connected between terminal OUT2 (pin9).

## ORDERING INFORMATION

Industrial Range: -40°C to +125°C

Order Part No.	Package	QTY
SiLM9408MC-AH	SSOP10	2500/Reel

**FUNCTIONAL BLOCK DIAGRAM**

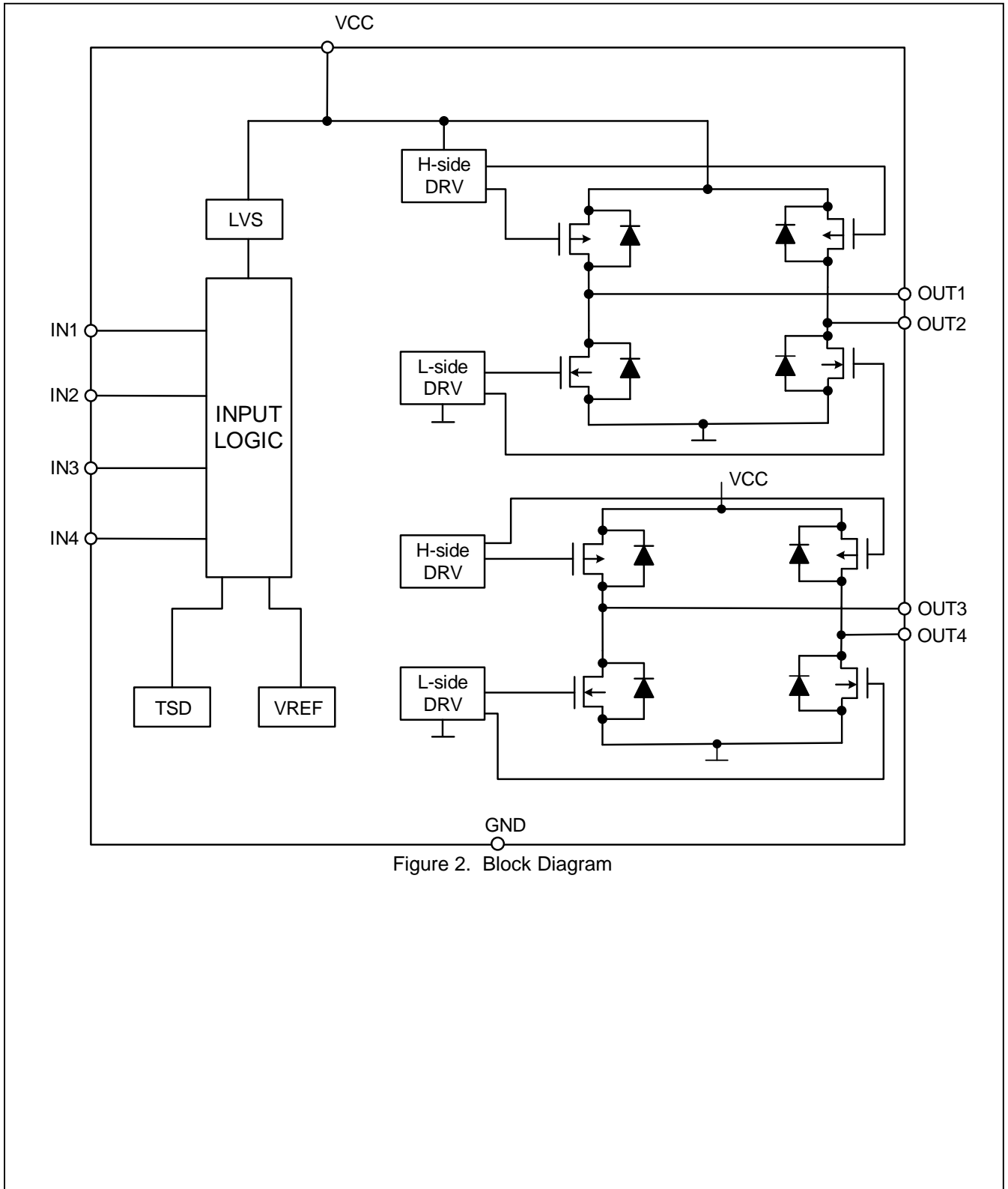


Figure 2. Block Diagram

**ABSOLUTE MAXIMUM RATINGS**

Symbol	Definition		Min.	Max.	Units
V <sub>CC</sub>	Maximum power supply voltage		-0.3	+30	V
V <sub>OUT</sub>	Output voltage (OUT1, OUT2, OUT3, OUT4)		-0.3	+30	
V <sub>IN</sub>	Input voltage (IN1, IN2, IN3, IN4)		-0.3	+6	
I <sub>GND</sub>	Maximum GND pin sink/source current.		---	+1.2	A
P <sub>D</sub>	Package power dissipation @ T <sub>A</sub> ≤ +25°C	SSOP10	---	1.0	W
θ <sub>JA</sub>	Thermal resistance, junction to ambient	SSOP10	---	80	°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	

**Note:**

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

**RECOMMENDED OPERATION CONDITIONS**

Symbol	Definition	Min.	Max.	Units
V <sub>CC</sub>	Power supply voltage	5.0	26	V
T <sub>A</sub>	Ambient temperature	-40	125	°C

**Note:**

The input/output logic timing diagram is shown in Figure 3. For proper operation the device should be used within the recommended conditions.

## DYNAMIC ELECTRICAL CHARACTERISTICS

$V_{CC} = 12\text{ V}$  and  $T_A = 25^\circ\text{C}$  unless otherwise specified.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
$t_{on}$	Turn-on propagation delay	$V_{CC} = 12 / 24\text{ V}$		560		ns
$t_{off}$	Turn-off propagation delay	$V_{CC} = 12 / 24\text{ V}$		440		
$t_r$	Turn-on rise time	$V_{CC} = 12 / 24\text{ V}$ , $16\Omega$ to GND, 10% to 90% $V_{CC}$		26		
$t_f$	Turn-off fall time	$V_{CC} = 12 / 24\text{ V}$ , $16\Omega$ to GND, 90% to 10% $V_{CC}$		26		
DT	Deadtime, LS turn-off to HS turn-on & HS turn-on to LS turn-off	$V_{CC} = 12 / 24\text{ V}$		220		

## STATIC ELECTRICAL CHARACTERISTICS

$V_{CC} = 12\text{ V}$  and  $T_A = 25^\circ\text{C}$  unless otherwise specified.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
$V_{CC}$	Power supply voltage		5.0	---	26	V
$V_{CCUV+}$	$V_{CC}$ supply undervoltage positive going threshold	$V_{CC} = 12 / 24\text{ V}$	4.3	4.7	4.95	V
$V_{CCUV-}$	$V_{CC}$ supply undervoltage negative going threshold		4.1	4.3	4.7	
$V_{IH}$	Logic "1" input voltage		1.8	---	---	
$V_{IL}$	Logic "0" input voltage		---	---	0.7	
$I_{CC0}$	Quiescent current (standby mode)	$V_{CC} = 12 / 24\text{ V}$ , $IN1=IN2=IN3=IN4="0"$	---	---	1	$\mu\text{A}$
$I_{CC1}$	Operating current (no load)	$V_{CC} = 12 / 24\text{ V}$ , $IN1+IN2+IN3+IN4="1"$	---	1.5	2.3	mA
$I_{IN}$	Input current	$V_{CC} = 12 / 24\text{ V}$ , $V_{IN1/IN2/IN3/IN4} = 5\text{ V}$	40	56	65	$\mu\text{A}$
$T_{SD}$	Thermal shutdown temperature		150	160	170	$^\circ\text{C}$
$T_{SD\_HYS}$	Thermal shutdown hysteresis			25		$^\circ\text{C}$
$R_{DSON}$	Output ON resistance (high-side and low-side total)	$I_{OUT} = 0.8\text{ A}$		900		m $\Omega$
$I_{OLEAK}$	Output leakage current	$V_O = 30\text{ V}$	---	---	10	$\mu\text{A}$
$V_D$	Diode forward voltage	$I_D = 0.8\text{ A}$	---	1.0	1.2	V

## APPLICATION INFORMATION

### Output Control Logic

INPUT				OUTPUT				Remarks
IN1	IN2	IN3	IN4	OUT1	OUT2	OUT3	OUT4	
L	L	L	L	OFF	OFF	OFF	OFF	Stand-by
L	L			OFF	OFF			1CH Stand-by Forward Reverse Brake
H	L			H	L			
L	H			L	H			
H	H			L	L			
		L	L			OFF	OFF	2CH Stand-by Forward Reverse Brake
		H	L			H	L	
		L	H			L	H	
		H	H			L	L	

### Timing

About the switch time from the stand-by state to the state of operation, when IN1, IN2, IN3, IN4 are logic "0", the SiLM9408 has completely stopped operating. After the time of reset of about 7 $\mu$ s of internal setting, it shifts to a prescribed output status corresponding to the state of the input when the signal enters the input terminal.

During the reset time, all output turning off is maintained.

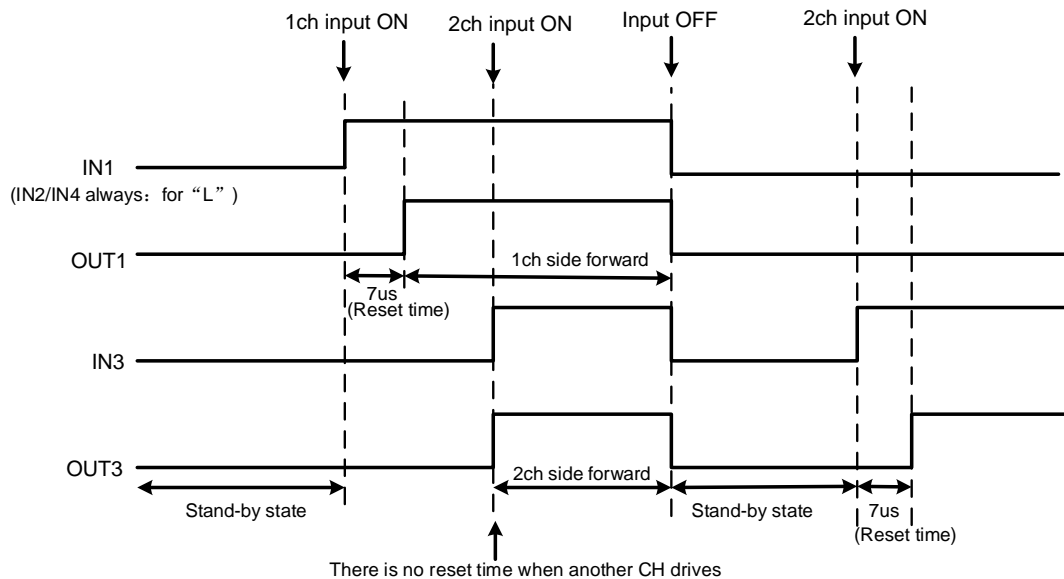


Figure 3. Control Timing

**Current Waveforms**

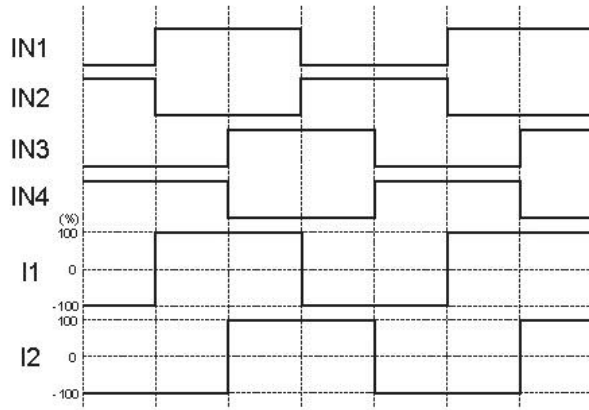


Figure 4. Full-step Mode

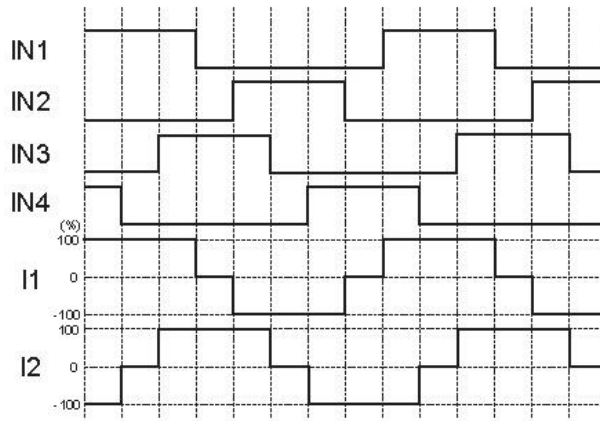


Figure 5. Half-step Mode

**Thermal Shutdown**

The thermal shutdown circuit is incorporated and the output is turned off when junction temperature exceeds 160°C. As the temperature falls by hysteresis, the output turned on again.

The thermal shutdown circuit doesn't guarantee the protection of the final product because it operates when the temperature exceed the junction temperature of  $T_{jmax}=150^{\circ}C$ .

$T_{SD} = 160^{\circ}C$  (TYP)

$T_{SD\_HYS} = 25^{\circ}C$  (TYP)



**PACKAGE CASE OUTLINES**

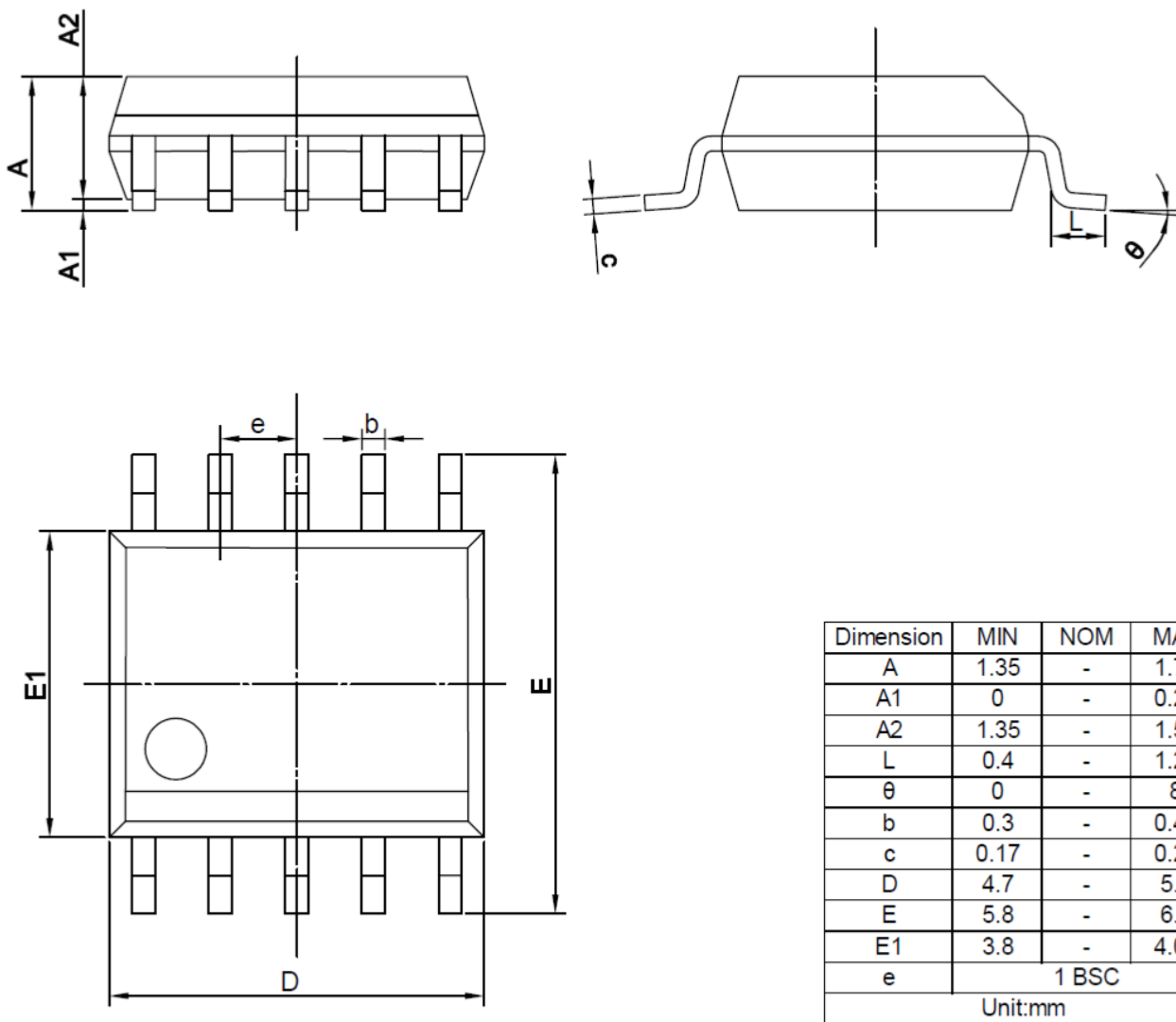


Figure 6. SSOP10 Outline Dimensions

**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)
<b>Rev 1.0 datasheet, 2023-09-23</b>	
Whole document	Initial datasheet release
<b>Rev 1.1 datasheet, 2024-01-19</b>	
Page 6	Update electrical data