

Motor Driver, Forward/Reverse, Low Saturation Voltage

GENERAL DESCRIPTION

The SiLM9409 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 a stepper motor in Full-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 SiLM9409 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 SiLM9409 is available in a compact SSOP10 package.

FEATURES

- DMOS output transistor adoption (upper and lower total $R_{ds(on)}$ = 0.9 Ω 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

TYPICAL APPLICATIONS

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

TYPICAL APPLICATION CIRCUIT

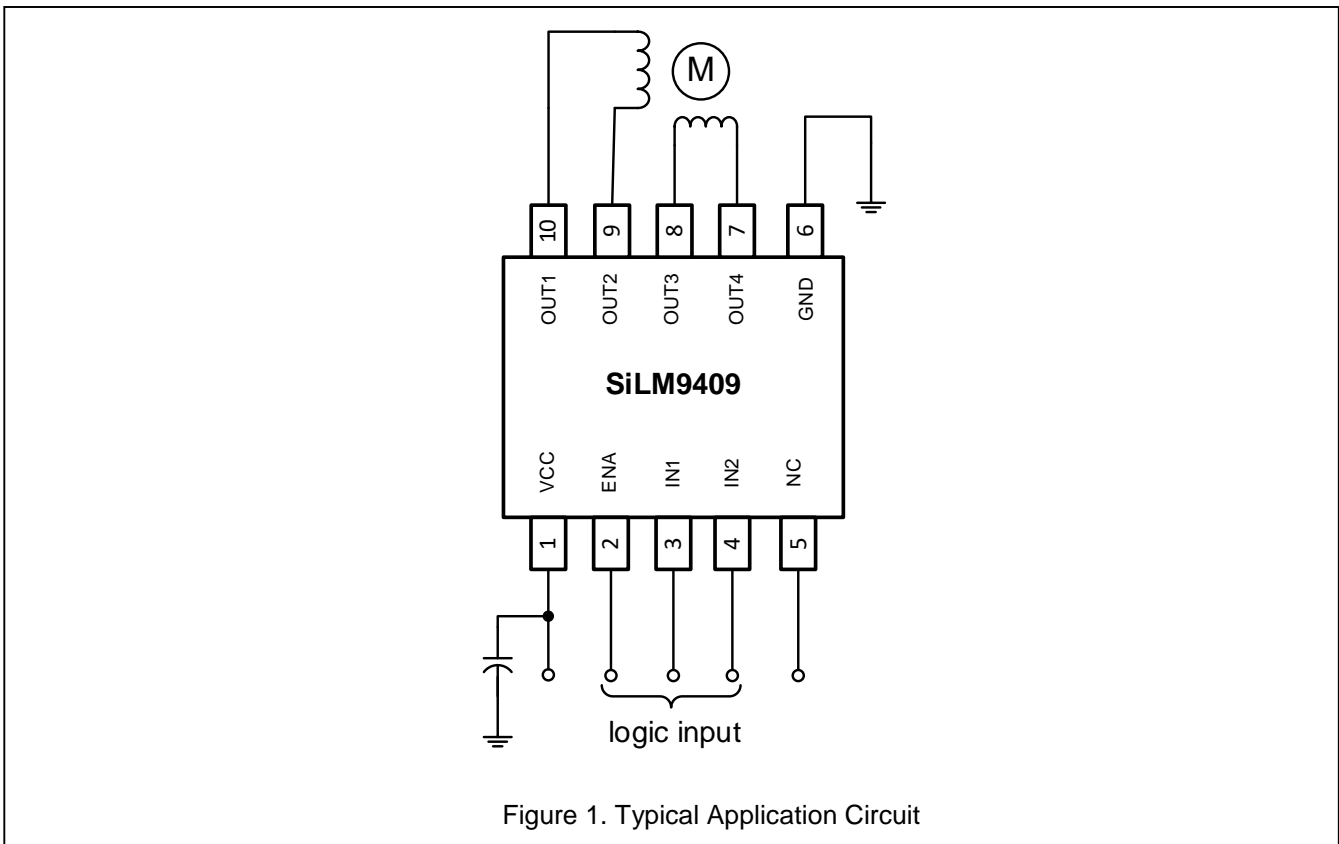
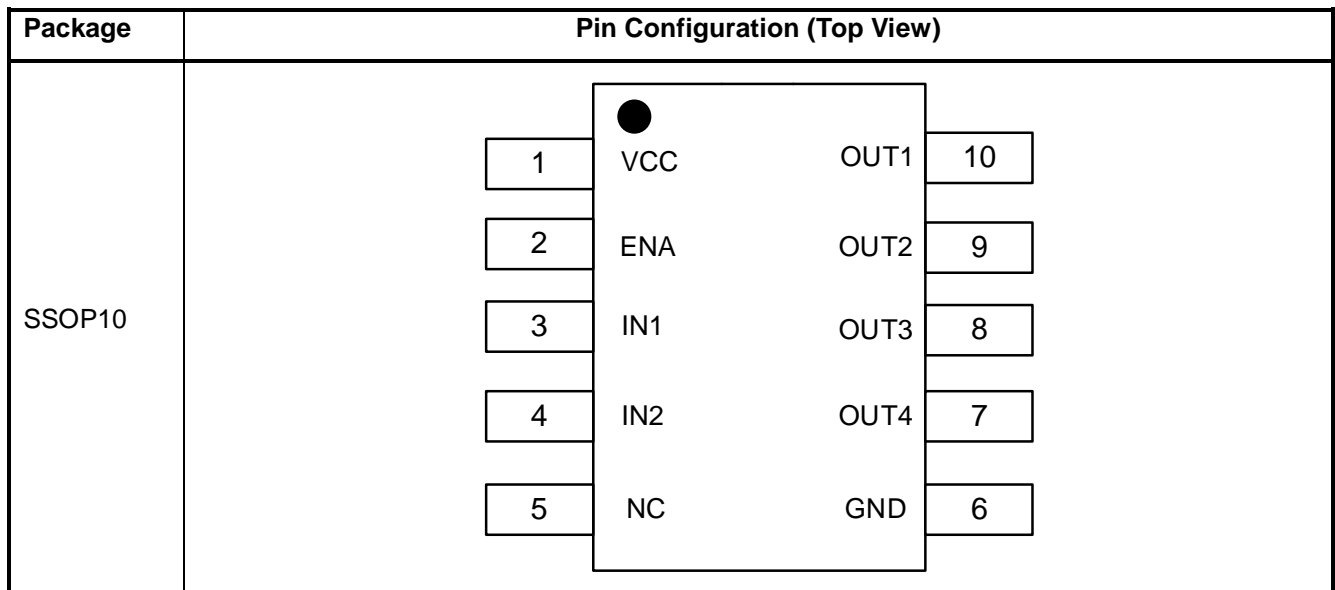


Table of Contents

General Description	1
Features	1
Typical Applications	1
Typical Application Circuit	1
Pin Configuration.....	3
Pin Description.....	3
Ordering Information.....	3
Functional Block Diagram	4
Absolute Maximum Ratings	5
Recommended Operation Conditions	5
Dynamic Electrical Characteristics	6
Static Electrical Characteristics	6
Application Information	7
Output Control Logic.....	7
Timing	7
Current Waveforms	8
Thermal Shutdown	8
Package Case Outlines	9
Revision History	10

PIN CONFIGURATION

PIN DESCRIPTION

No.	Name	Function Description
1	V _{CC}	Power-supply voltage pin. A 10-uF (minimum) ceramic bypass capacitor to GND is recommended.
2	ENA	Motor drive control enable pin. "0" stand-by current when ENA=LOW. Output is corresponding to input control logic when ENA=HIGH.
3	IN1	Logic input pin of OUT1 and OUT2. Internal pull-down.
4	IN2	Logic input pin of OUT3 and OUT4. Internal pull-down.
5	NC	No connection.
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
SiLM9409MC-AH	SSOP10	2500/Reel

FUNCTIONAL BLOCK DIAGRAM

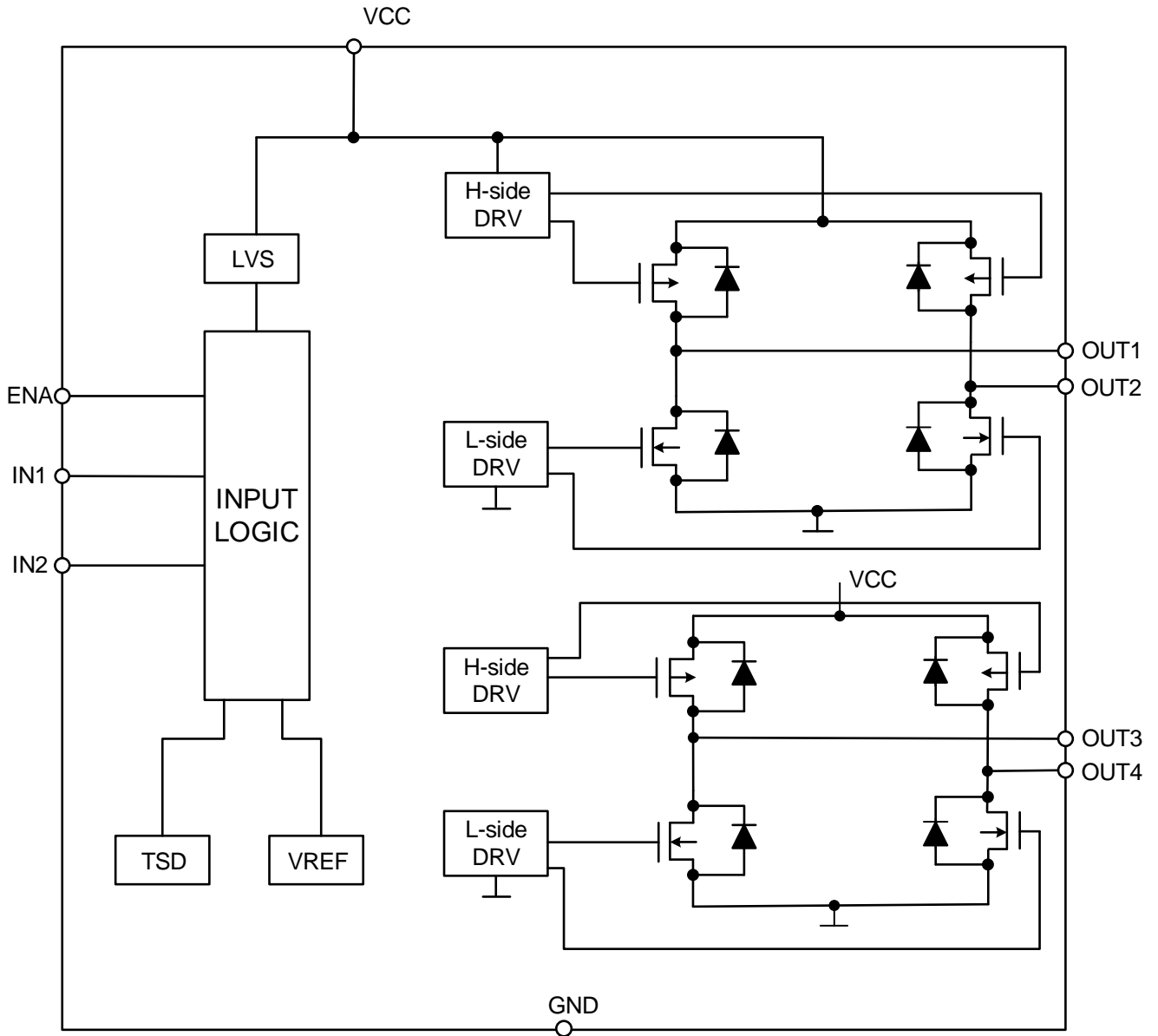


Figure 2. Block Diagram

ABSOLUTE MAXIMUM RATINGS

Symbol	Definition		Min.	Max.	Units
V _{CC}	Maximum power supply voltage		-0.3	+30	V
V _{OUT}	Output voltage (OUT1, OUT2, OUT3, OUT4)		-0.3	+30	
V _{IN}	Input voltage (ENA, IN1, IN2)		-0.3	+6	
I _{GND}	Maximum GND pin sink/source current.		---	+1.2	A
P _D	Package power dissipation @ T _A ≤ +25°C	SSOP10	---	1.0	W
θ _{JA}	Thermal resistance, junction to ambient	SSOP10	---	80	°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 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 _{CC}	Power supply voltage	5.0	26	V
T _A	Ambient temperature	-40	125	°C

Note:

The Input /output logic time diagram is shown in Figure 4. 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	$V_{CC} = 12 / 24\text{ V}$, 16Ω to GND, 10% to 90% V_{CC}		26		
t_f	Turn-off fall time	$V_{CC} = 12 / 24\text{ V}$, 16Ω 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)	$V_{CC} = 12 / 24\text{ V}$, ENA = "0"	---	---	1	μA
I_{CC1}	Operating current (no load)	$V_{CC} = 12 / 24\text{ V}$, ENA = "1"	---	1.5	2.3	mA
I_{IN}	Input current	$V_{CC} = 12 / 24\text{ V}$, $V_{IN} = 5\text{ V}$	40	56	65	μA
T_{SD}	Thermal shutdown temperature		150	160	170	$^\circ\text{C}$
T_{SD_HYS}	Thermal shutdown hysteresis			25		$^\circ\text{C}$
$R_{DS(on)}$	Output ON resistance (high-side and low-side total)	$I_{OUT} = 0.8\text{ A}$		900		m Ω
I_{OLEAK}	Output leakage current	$V_O = 30\text{ V}$	---	---	10	μA
V_D	Diode forward voltage	$I_D = 0.8\text{ A}$	---	1.0	1.2	V

APPLICATION INFORMATION

Output Control Logic

INPUT			OUTPUT				STATE
ENA	IN1	IN2	OUT1	OUT2	OUT3	OUT4	
L	-	-	OFF	OFF	OFF	OFF	Stand-by
H	L	L	H	L	H	L	STEP 1
	H	L	L	H	H	L	STEP 2
	H	H	L	H	L	H	STEP 3
	L	H	H	L	L	H	STEP 4

Figure 3. Control Logic

Timing

About the switch time from the stand-by state to the state of operation, this SiLM9408 has completely stopped operating when ENA pin is logic "0". After the time of reset of about 7 μ s of internal setting, it shifts to a prescribed output status corresponding to the state of the input when ENA pin is logic "1".

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

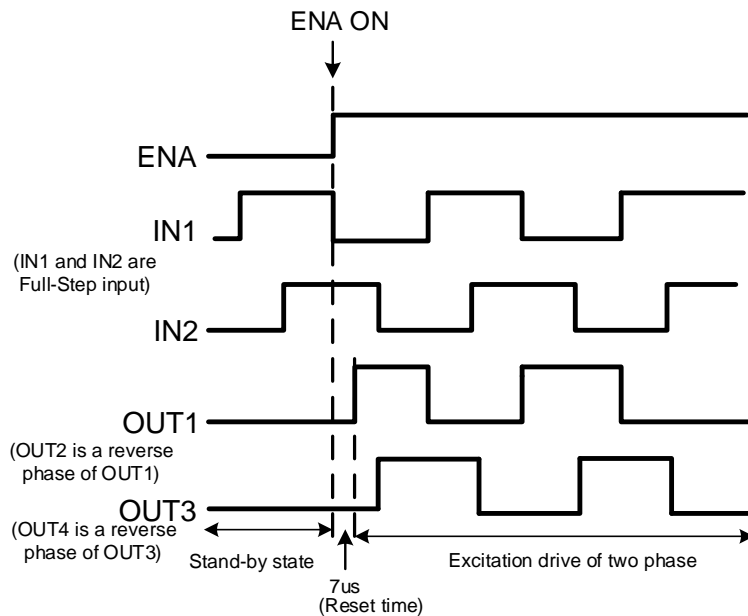


Figure 4. Control Timing

Current Waveforms

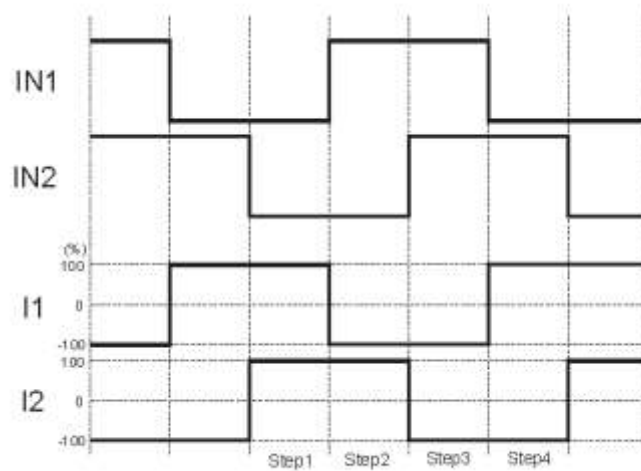


Figure 5. Full-step Mode

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 exceeds 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

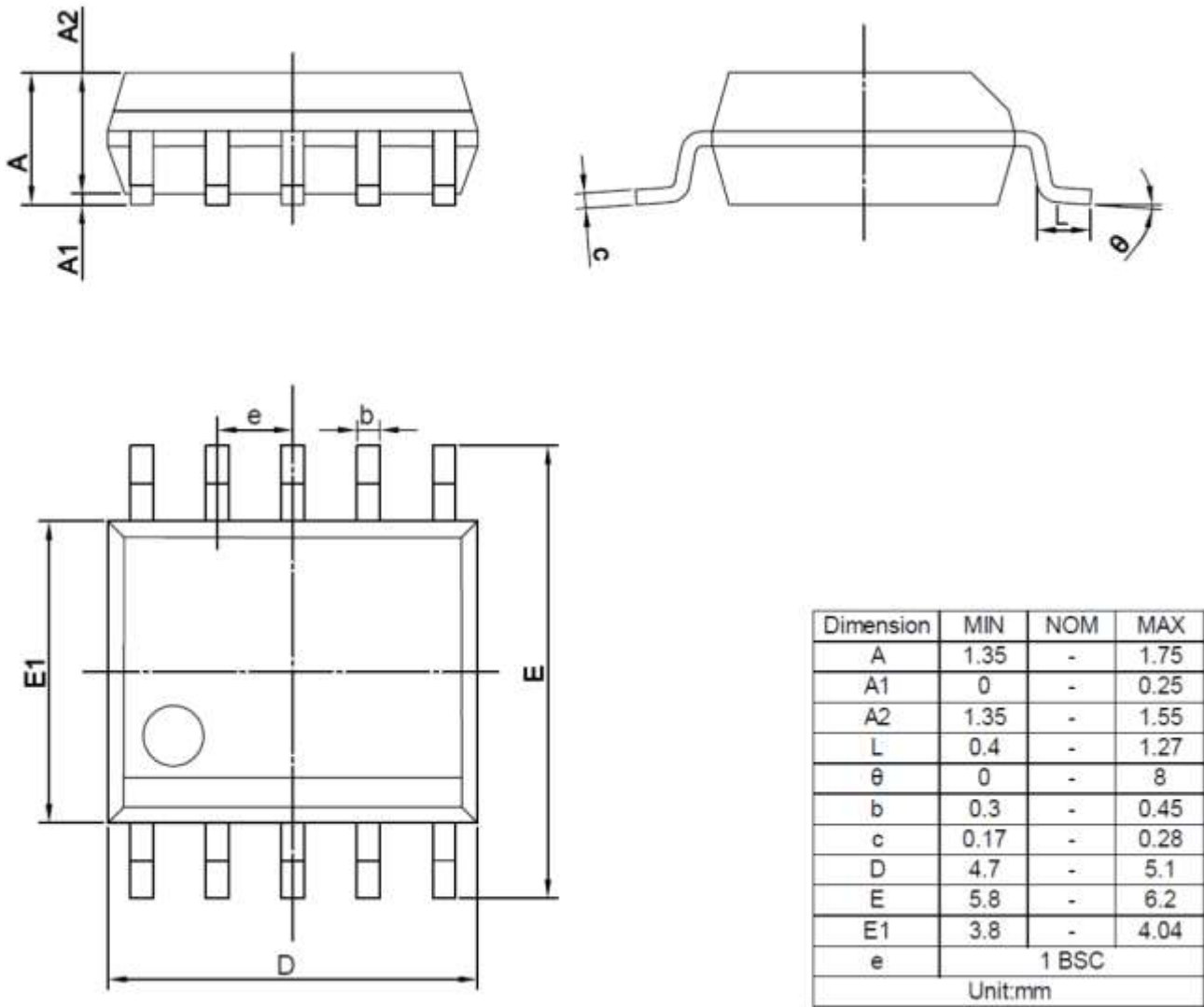


Figure 6. SSOP10 Outline Dimensions

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)
Rev 1.0 datasheet, 2023-09-23	
Whole document	Initial datasheet release
Rev 1.1 datasheet, 2024-02-20	
Page 6	Update electrical data