



SGM42610/SGM42611 Stepper Motor Driver ICs

GENERAL DESCRIPTION

The SGM42610/SGM42611 can drive solenoids, two DC motors, one DC motor in parallel connection, as well as a stepper motor in full-step or half-step. The devices can operate over a wide input voltage range of 2.5V to 16V.

Two versions (SGM42611A and SGM42611B) of the SGM42611 are offered. The SGM42611B has low power sleep mode which is provided to save power dissipation. If the EN pin is pulled low, the SGM42611B will enter into sleep mode after t_{SLEEP} .

The SGM42610 and SGM42611 are available in Green MSOP-10 (Exposed Pad) and SSOP-10 packages.

FEATURES

- **SGM42610: Quad Half-Bridge Driver**
- **SGM42611A: 4-Wire Input Stepper Driver**
- **SGM42611B: 2-Wire Input Stepper Driver**
- **Supply Voltage Range: 2.5V to 16V**
- **Integrated Protection Features**
 - ◆ VCC Under-Voltage Lockout (UVLO)
 - ◆ Over-Current Protection (OCP)
 - ◆ Thermal Shutdown (TSD)
 - ◆ Short-Circuit Protection (SCP)
 - ◆ Auto-Retry
- **Low Power Sleep Mode (SGM42611B Only)**
- **Available in Green MSOP-10 (Exposed Pad) and SSOP-10 Packages**

APPLICATIONS

Refrigerator
Clothes Dryer
Vacuum Cleaner
Scanner
Printer
PoE Point of Sales Terminal
Time Recorder

PACKAGE/ORDERING INFORMATION

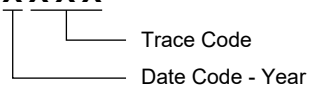
MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM42610	MSOP-10 (Exposed Pad)	-40°C to +85°C	SGM42610YPMS10G/TR	SGMRA0 YPMS10 XXXX	Tape and Reel, 4000
	SSOP-10	-40°C to +85°C	SGM42610YSS10G/TR	SGM42610 YSS10 XXXXX	Tape and Reel, 4000
SGM42611A	MSOP-10 (Exposed Pad)	-40°C to +85°C	SGM42611AYPMS10G/TR	SGMRA1 YPMS10 XXXX	Tape and Reel, 4000
	SSOP-10	-40°C to +85°C	SGM42611AYSS10G/TR	SGM42611A YSS10 XXXXX	Tape and Reel, 4000
SGM42611B	MSOP-10 (Exposed Pad)	-40°C to +85°C	SGM42611BYPMS10G/TR	SGMRA2 YPMS10 XXXX	Tape and Reel, 4000
	SSOP-10	-40°C to +85°C	SGM42611BYSS10G/TR	SGM42611B YSS10 XXXXX	Tape and Reel, 4000

MARKING INFORMATION

NOTE: XXXX = Date Code, Trace Code. XXXXX = Date Code, Trace Code and Vendor Code.

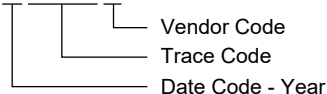
MSOP-10 (Exposed Pad)

XXXX



SSOP-10

XXXXX



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS

- Power Supply Voltage, V_{CC}-0.3V to 20V
- Output Voltage, V_{OUT}-0.3V to $V_{CC} + 0.3V$
- Logic Input Voltage, V_{IN} -0.3V to 6V
- Junction Temperature +150°C
- Storage Temperature Range..... -65°C to +150°C
- Lead Temperature (Soldering, 10s) +260°C
- ESD Susceptibility
- HBM..... 8000V
- CDM 1000V

RECOMMENDED OPERATING CONDITIONS

- Power Supply Voltage, V_{CC}2.5V to 16V
- Logic Input Voltage, V_{IN} 0V to 5.5V
- Continuous DC/RMS Output Current per Bridge 0.85A
- Operating Temperature Range -40°C to +85°C

OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to

absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

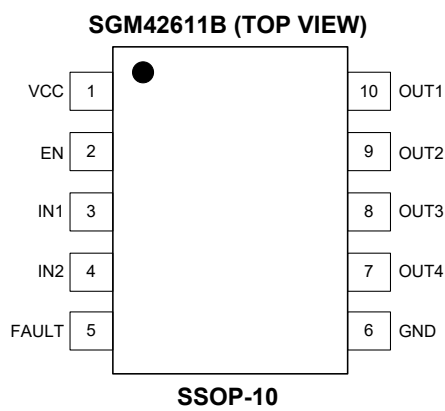
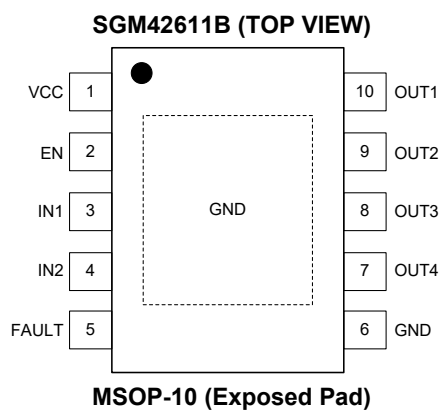
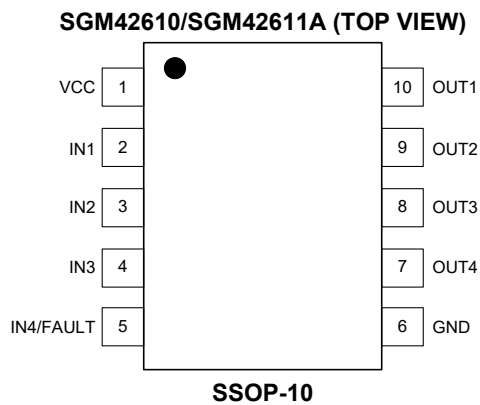
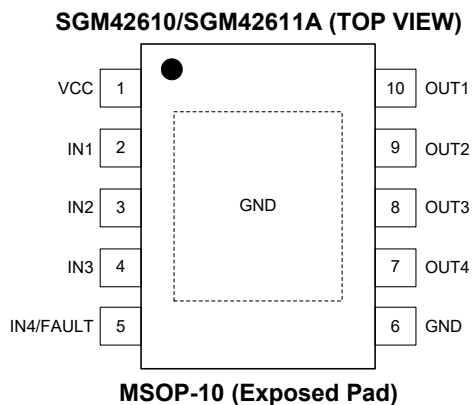
ESD SENSITIVITY CAUTION

This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

PIN CONFIGURATIONS



PIN DESCRIPTION

PIN	NAME	TYPE	FUNCTION
SGM42610			
1	VCC	P	Supply Voltage. Connect a 10μF (MIN) bulk capacitor and a 100nF ceramic bypass capacitor between this pin and GND.
2	IN1	I	Bridge Input 1. Logic input for OUT1, internal pull-down.
3	IN2	I	Bridge Input 2. Logic input for OUT2, internal pull-down.
4	IN3	I	Bridge Input 3. Logic input for OUT3, internal pull-down.
5	IN4/FAULT	I/O	Bridge Input 4 or Alert Output (TSD, OCP). Logic input for OUT4, internal pull-down. If this pin is pulled high more than t_{FAULT} , it can be used to alert output.
6	GND	G	Ground.
7	OUT4	O	Output of the Bridge. Connect to motor winding.
8	OUT3	O	
9	OUT2	O	
10	OUT1	O	
SGM42611A			
1	VCC	P	Supply Voltage. Connect a 10μF (MIN) bulk capacitor and a 100nF ceramic bypass capacitor between this pin and GND.
2	IN1	I	Bridge Input 1. Logic input for OUT1 and OUT2, internal pull-down.
3	IN2	I	Bridge Input 2. Logic input for OUT1 and OUT2, internal pull-down.
4	IN3	I	Bridge Input 3. Logic input for OUT3 and OUT4, internal pull-down.
5	IN4/FAULT	I/O	Bridge Input 4 or Alert Output (TSD, OCP). Logic input for OUT3 and OUT4, internal pull-down. If this pin is pulled high more than t_{FAULT} , it can be used to alert output.
6	GND	G	Ground.
7	OUT4	O	Output of the Bridge. Connect to motor winding.
8	OUT3	O	
9	OUT2	O	
10	OUT1	O	
SGM42611B			
1	VCC	P	Supply Voltage. Connect a 10μF (MIN) bulk capacitor and a 100nF ceramic bypass capacitor between this pin and GND.
2	EN	I	Enable or Sleep Mode Input. Logic high on this pin enables the device. After the EN pin is pulled low more than t_{SLEEP} , the output drivers are disabled and the device will enter into a low power sleep mode, internal pull-down.
3	IN1	I	Bridge Input 1. H-bridge 1 PWM input controls the state of OUT1 and OUT2, internal pull-down.
4	IN2	I	Bridge Input 2. H-bridge 2 PWM input controls the state of OUT3 and OUT4, internal pull-down.
5	FAULT	O	Alert Output (TSD, OCP).
6	GND	G	Ground.
7	OUT4	O	Output of the Bridge. Connect to motor winding.
8	OUT3	O	
9	OUT2	O	
10	OUT1	O	

NOTE: I: input, O: output, I/O: input or output, G: ground, P: power for the circuit.

ELECTRICAL CHARACTERISTICS

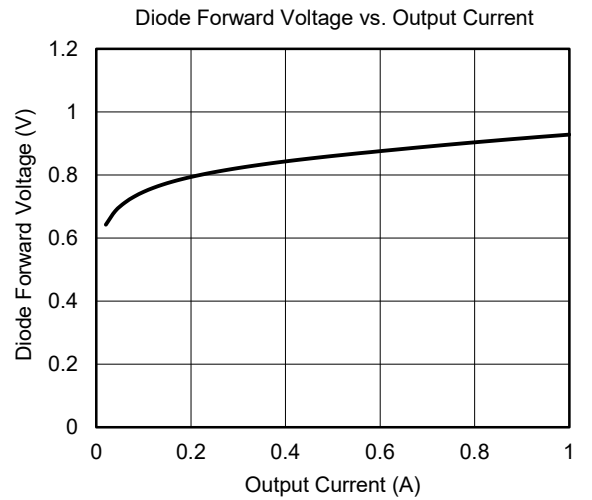
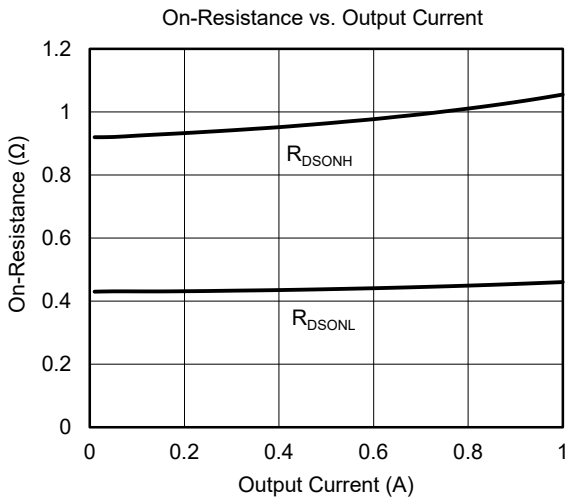
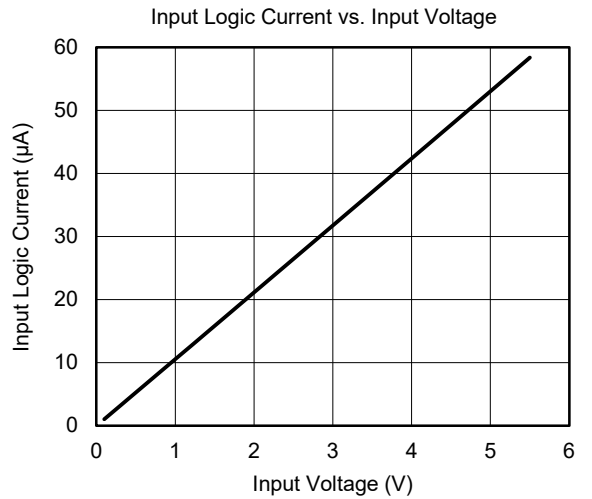
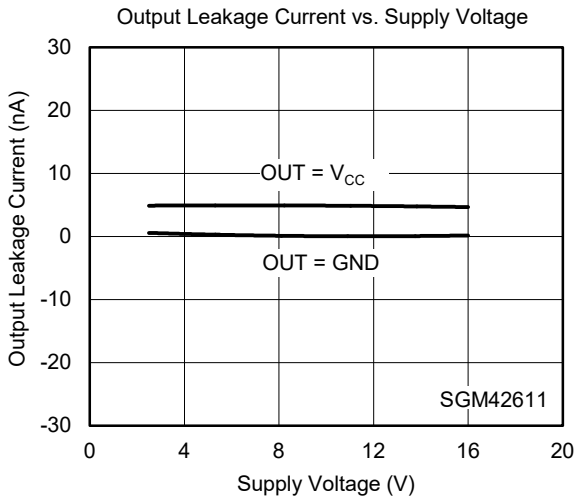
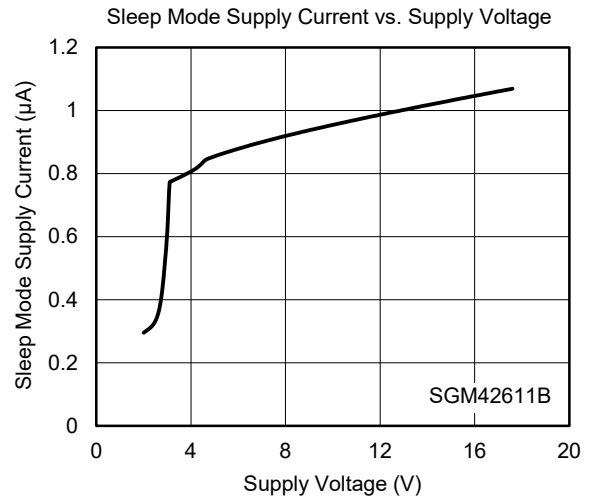
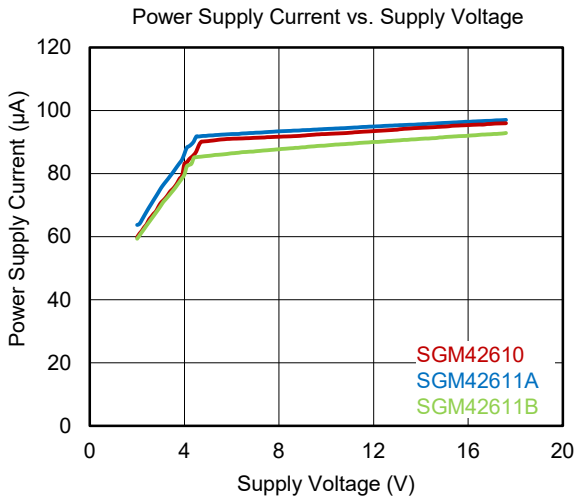
($V_{CC} = 12V$, $C_{VCC} = 10\mu F/100nF$, $T_J = -40^\circ C$ to $+85^\circ C$, typical values are at $T_J = +25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
Power Supplies							
Power Supply Voltage	V_{CC}		2.5		16	V	
VCC Under-Voltage Lockout Threshold	V_{UVLO}	V_{CC} rising			2.35	V	
		V_{CC} falling	1.85				
VCC Under-Voltage Lockout Hysteresis	V_{HYS}			200		mV	
Power Supply Current	I_{VCC}	$V_{CC} = 16V$, $INx = \text{floating}$	$T_J = +25^\circ C$		100	170	μA
			$T_J = -40^\circ C$ to $+85^\circ C$			210	
Sleep Mode Supply Current	I_{VCCQ}	SGM42611B, $V_{CC} = 16V$, $INx = EN = \text{floating}$	$T_J = +25^\circ C$		1.1	1.5	μA
			$T_J = -40^\circ C$ to $+85^\circ C$			3	
Turn-On Time ⁽¹⁾	t_{ON}	$V_{CC} > V_{UVLO}$		55		μs	
Logic Level Inputs							
Input Logic Low Voltage	V_{IL}				0.45	V	
Input Logic High Voltage	V_{IH}		1.5			V	
EN Input Logic Low Voltage	V_{ENL}				0.35	V	
EN Input Logic High Voltage	V_{ENH}		1.5			V	
Input Logic Low Current	I_{IL}	$V_{IN} = 0V$			± 1	μA	
Input Logic High Current	I_{IH}	$V_{IN} = 3.3V$		36	65	μA	
Pull-Down Resistance	R_{PD}			100		k Ω	
Propagation Delay	t_{PD}			400		ns	
Off-State Leakage Current	I_{OFF}				± 1	μA	
Sleep Mode (SGM42611B Only)							
Time to Enter Sleep Mode	t_{SLEEP}			5.5	9	ms	
Wake Time	t_{WAKE}	EN inactive high to H-bridge on		35		μs	
Motor Driver Outputs (OUTx)							
High-side FET On-Resistance	R_{DSONH}	$I_{OUT} = 0.85A$	$T_J = +25^\circ C$		1.07	1.7	Ω
			$T_J = -40^\circ C$ to $+85^\circ C$			2.7	
Low-side FET On-Resistance	R_{DSONL}	$I_{OUT} = -0.85A$	$T_J = +25^\circ C$		0.47	0.75	Ω
			$T_J = -40^\circ C$ to $+85^\circ C$			1.1	
Output Dead Time	t_{DEAD}			200		ns	
Body Diode Forward Voltage	V_D	SGM42611A, $I_{OUT} = 0.85A$	$T_J = +25^\circ C$		0.96	1.15	V
			$T_J = -40^\circ C$ to $+85^\circ C$			1.65	
FAULT Output (Open-Drain Output)							
Output Low Voltage	V_{OL}	$V_{CC} = 2.5V$, $I_{FAULT} = -1mA$		0.39	0.6	V	
Protection Circuits							
Over-Current Protection Trip Level	I_{OCP}	$T_J = +25^\circ C$	0.85	1.4		A	
Over-Current Deglitch Time	t_{OCP}			2		μs	
Over-Current Auto-Retry Time	t_{RETRY}			10		ms	
FAULT Ready Time	t_{FAULT}			45		ms	
Thermal Shutdown Temperature	T_{TSD}			160		$^\circ C$	
Thermal Shutdown Temperature Hysteresis	T_{HYS}			50		$^\circ C$	

NOTE: 1. t_{ON} applies when the device initially powers up.

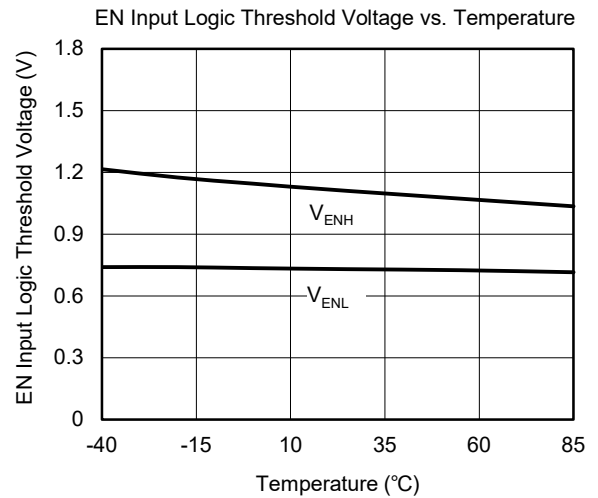
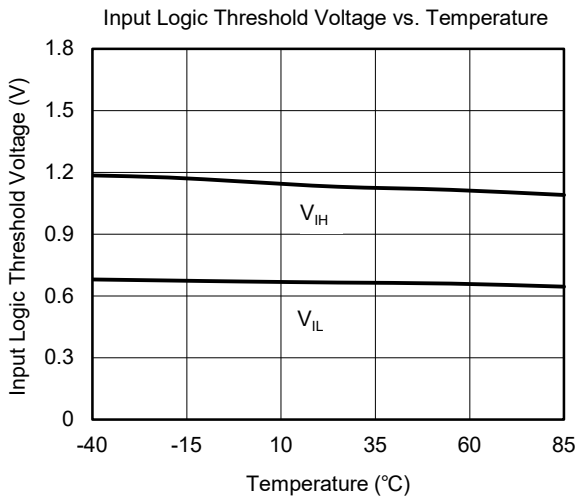
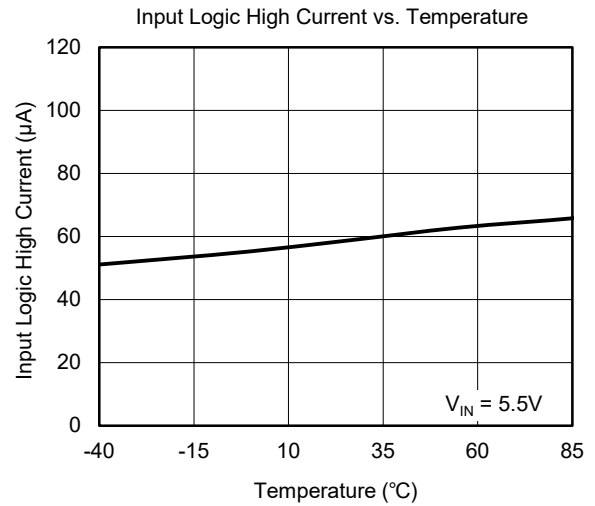
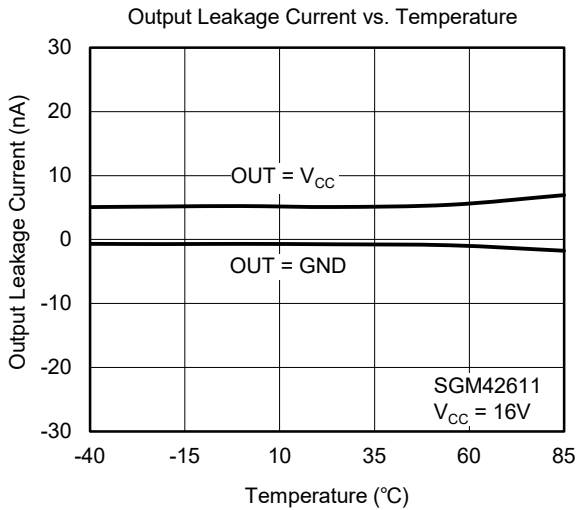
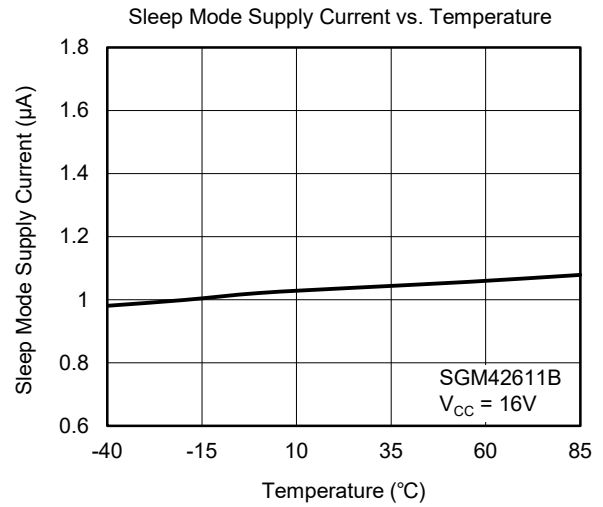
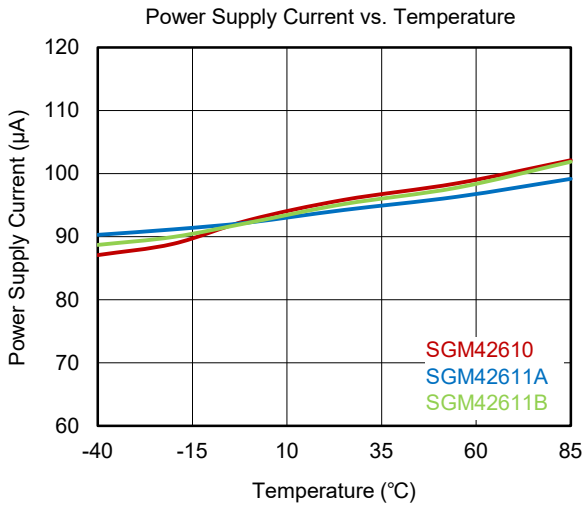
TYPICAL PERFORMANCE CHARACTERISTICS

$T_J = +25^\circ\text{C}$, $V_{CC} = 12\text{V}$, $C_{VCC} = 10\mu\text{F}/100\text{nF}$, unless otherwise noted.



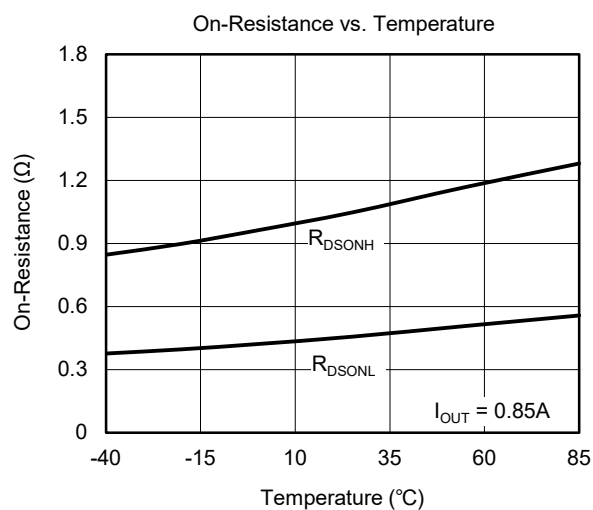
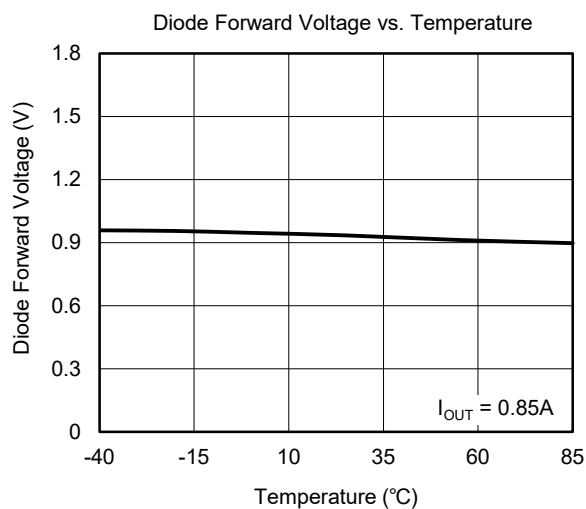
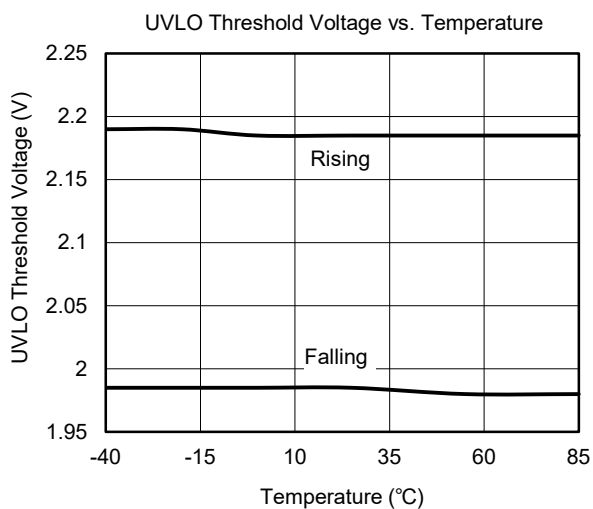
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$T_J = +25^\circ\text{C}$, $V_{CC} = 12\text{V}$, $C_{VCC} = 10\mu\text{F}/100\text{nF}$, unless otherwise noted.



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$T_J = +25^\circ\text{C}$, $V_{CC} = 12\text{V}$, $C_{VCC} = 10\mu\text{F}/100\text{nF}$, unless otherwise noted.



TRUTH TABLES

Table 1. SGM42610 Half-Bridge Driver

Inputs	Outputs
H	H
L	L
PWM	PWM

Table 2. SGM42611A Logic Truth Table (DC Motor Driver)

Inputs				Outputs				Function
IN1	IN2	IN3	IN4	OUT1	OUT2	OUT3	OUT4	
L	L	L	L	Off	Off	Off	Off	Standby
L	L	—	—	Off	Off	—	—	Standby
H	L			H	L			Forward
L	H			L	H			Reverse
H	H			L	L			Brake
—	—	L	L	—	—	Off	Off	Standby
		H	L			H	L	Forward
		L	H			L	H	Reverse
		H	H			L	L	Brake

Full-Step Mode

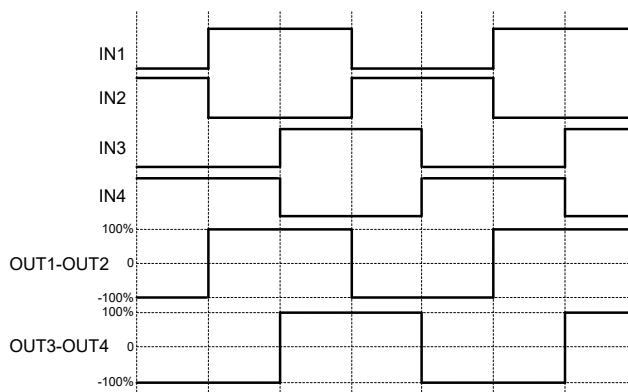


Figure 1. SGM42611A Current Wave Type in Full-Step Mode When Stepper Motor Parallel Input is Controlled

Half-Step Mode

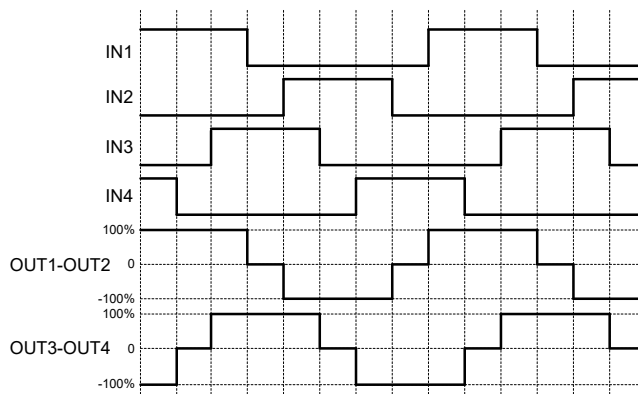


Figure 2. SGM42611A Current Wave Type in Half-Step Mode When Stepper Motor Parallel Input is Controlled

TRUTH TABLES (continued)

Table 3. SGM42611B Logic Truth Table (DC Motor Driver)

Inputs			Outputs				Function		
EN	IN1	IN2	OUT1	OUT2	OUT3	OUT4			
L	X	X	Off	Off	Off	Off	Standby/Low Power Sleep Mode		
H	L	—	H	L	—		Channel 1	Forward	
	H	—	L	H	—			Reverse	
	—	L	L	—		H	L	Channel 2	Forward
		H	H	—		L	H		Reverse

Full-Step Mode

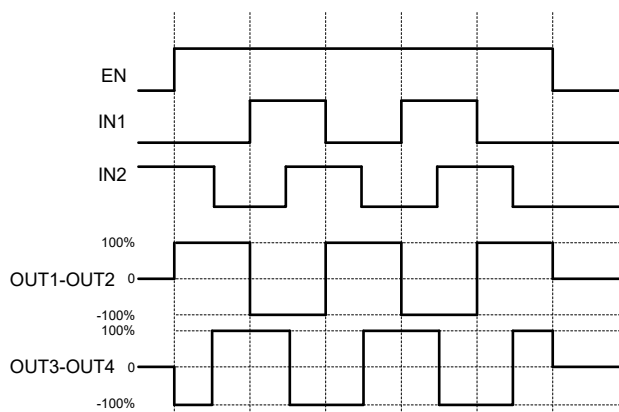


Figure 3. SGM42611B Current Wave Type in Full-Step Mode When Stepper Motor Parallel Input is Controlled

FUNCTIONAL BLOCK DIAGRAMS

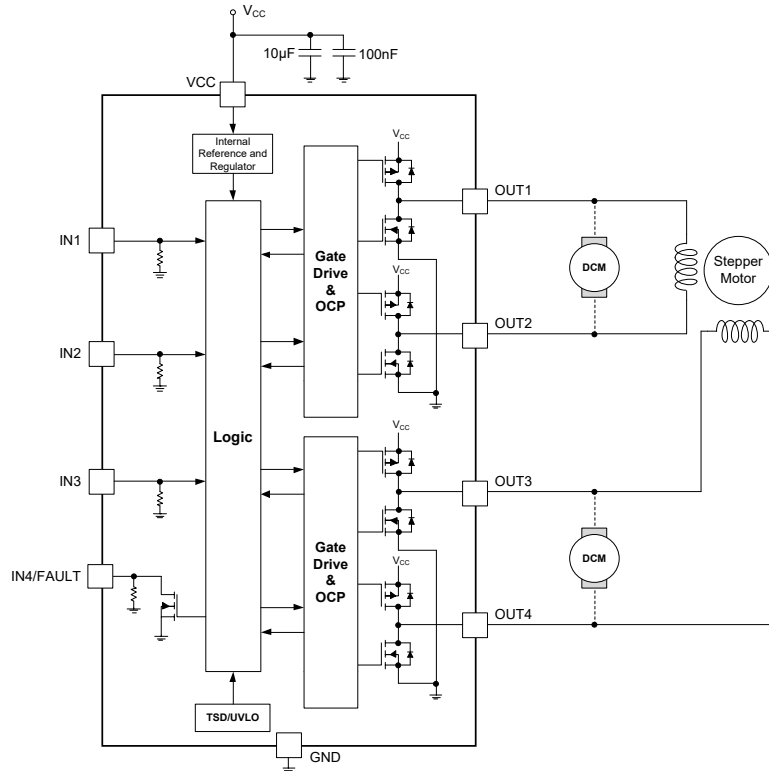


Figure 4. SGM42610/SGM42611A Block Diagram

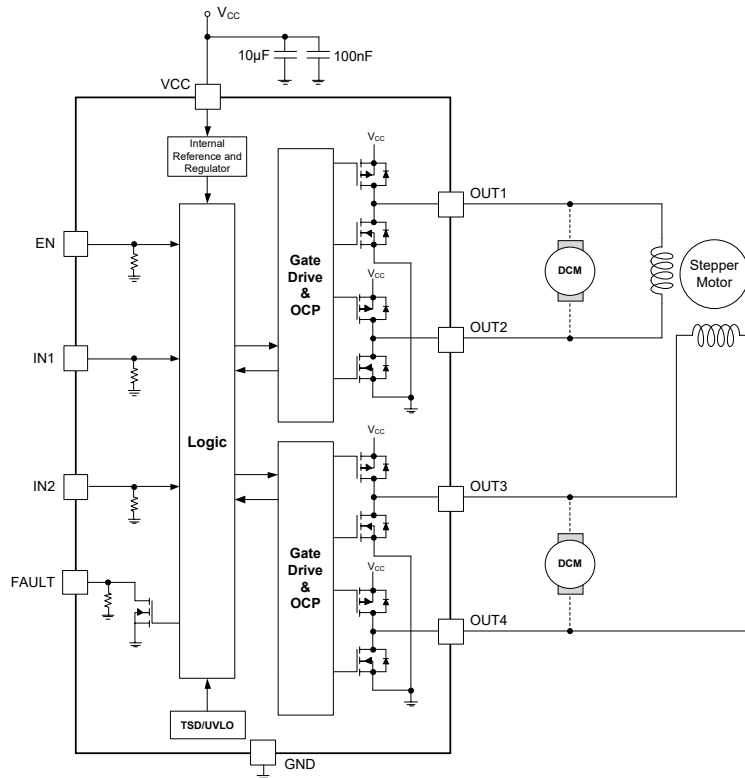


Figure 5. SGM42611B Block Diagram

DETAILED DESCRIPTION

IN/FAULT Operation

For SGM42610/11A, IN4/FAULT is an enable input or alert output pin. If this pin is pulled high more than t_{FAULT} , it can be used to alert output; in other cases, this pin is just as logic input controls state of OUTx.

For SGM42611B, the FAULT is a separate fault flag pin. When OCP or TSD occurs, the FAULT pin will be driven low.

Under-Voltage Lockout (UVLO)

If at any time, the voltage on the VCC pin falls below the under-voltage lockout threshold, all output drivers are disabled, and all internal logic will be reset. Operation will resume when V_{CC} rises above the UVLO threshold. The FAULT pin is not driven low in the event of an under-voltage condition.

EN Operation

The EN pin of SGM42611B is an enable or sleep mode input. When the EN pin is logic low for less than t_{SLEEP} , all output drivers are disabled, as shown in Table 3. After the EN pin is pulled low more than t_{SLEEP} , the device will enter into a low power sleep mode. In this state, the output drivers are disabled, all internal logic is reset, and internal clocks are stopped. All inputs are ignored until EN returns inactive high. The internal pull-down resistor of EN pin is approximately 100kΩ. The FAULT pin is not driven low in the event of a low power sleep mode.

Over-Current Protection (OCP)

An analog current limit circuit on each MOSFET limits the current through the MOSFET by limiting the gate drive. If this analog current limit persists for longer than the OCP deglitch time (t_{OCP}), all MOSFETs in the H-bridge will be disabled and the FAULT pin will be driven low. The driver will be re-enabled after the OCP retry period (t_{RETRY}) has passed. If the fault condition is still present, the cycle repeats. If the fault is no longer present, normal operation resumes and the FAULT pin becomes high again after 2ms. Please note that only the H-bridge in which the OCP is detected will be disabled while the other H-bridge will function normally (OUT1 and OUT2 form an H-bridge, OUT3 and OUT4 form another H-bridge).

Over-current conditions are detected independently on both high-side and low-side devices. For example, a short across the motor winding will all result in an over-current shutdown.

Thermal Shutdown (TSD)

If the die temperature exceeds safe limit, all output drivers are disabled and the FAULT pin will be driven low. Once the die temperature has fallen to a safe level operation will automatically resume.

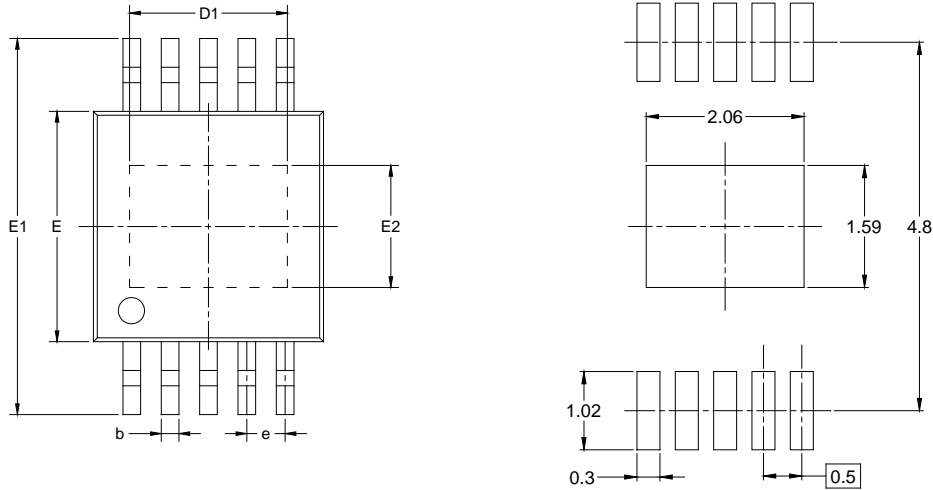
REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

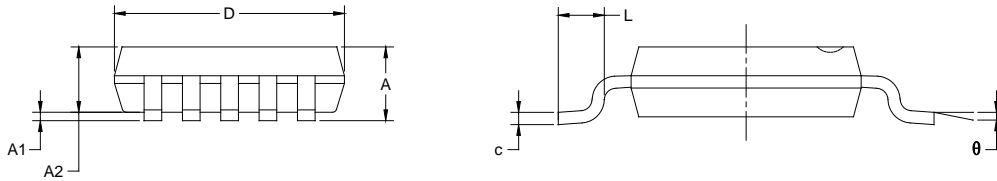
Changes from Original (APRIL 2022) to REV.A	Page
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PACKAGE OUTLINE DIMENSIONS

MSOP-10 (Exposed Pad)



RECOMMENDED LAND PATTERN (Unit: mm)



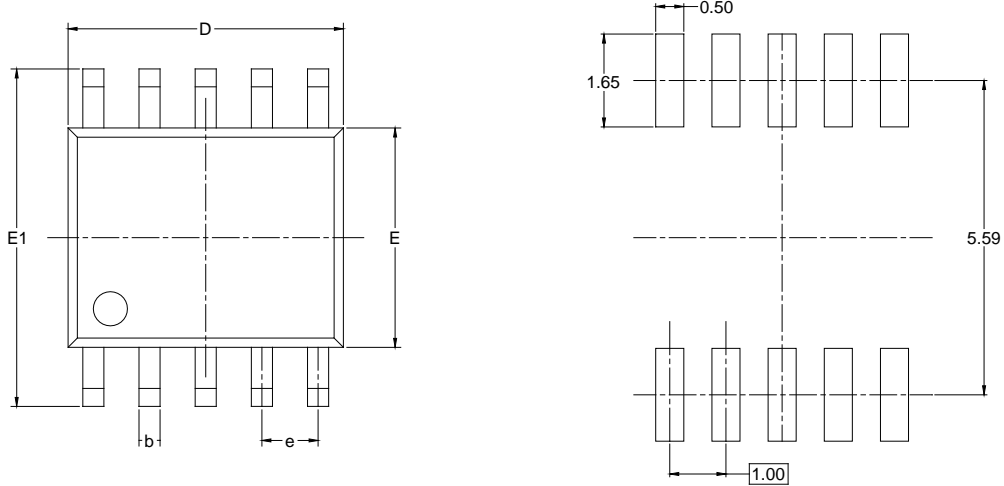
Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	0.820	-	1.100
A1	0.020	-	0.150
A2	0.750	-	0.950
b	0.170	-	0.280
c	0.080	-	0.230
D	2.900	-	3.100
D1	1.700	-	2.416
E	2.900	-	3.100
E1	4.750	-	5.050
E2	1.450	-	1.730
e	0.500 BSC		
L	0.400	-	0.800
θ	0°	-	8°

NOTES:

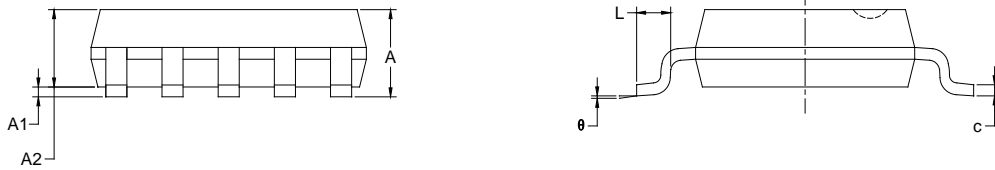
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

SSOP-10



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	1.350	-	1.750
A1	0.100	-	0.250
A2	1.350	-	1.550
b	0.300	-	0.450
c	0.170	-	0.250
D	4.700	-	5.100
E	3.800	-	4.000
E1	5.800	-	6.200
e	1.000 BSC		
L	0.400	-	1.270
θ	0°	-	8°

NOTES:

1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
MSOP-10 (Exposed Pad)	13"	12.4	5.20	3.30	1.50	4.0	8.0	2.0	12.0	Q1
SSOP-10	13"	12.4	6.60	5.30	1.90	4.0	8.0	2.0	12.0	Q1

DD0001

PACKAGE INFORMATION

CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
13"	386	280	370	5

DD0002