

GENERAL DESCRIPTION

The SGM42507 is an integrated driver IC for driving motors and coils in industrial applications. The PH and EN/FAULT pins allow simple interfacing to controller circuits.

Internal protection functions are provided for under-voltage lockout (UVLO), over-current protection (OCP) and over-temperature protection (OTP). Fault conditions are indicated by the EN/FAULT pin.

The SGM42507A is available in a Green TSOT-23-6 package. The SGM42507B/C are available in Green SC70-6 and TSOT-23-6 packages. They operate over an ambient temperature range of -40°C to +125°C.

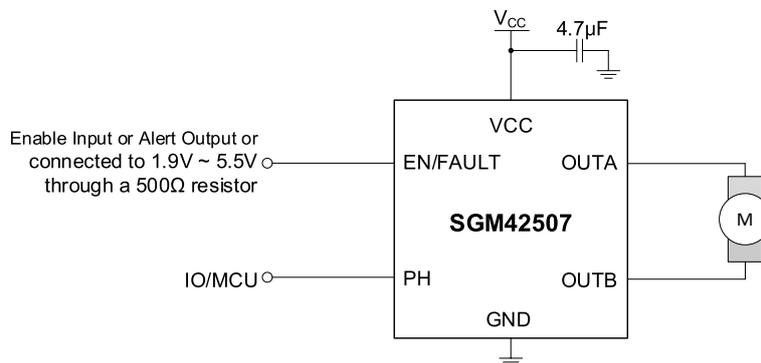
APPLICATIONS

- Robot
- Utility Meter
- Solenoid

FEATURES

- **Internal OC/UV/OT Protections**
 - ♦ **Over-Current Threshold Options:**
0.45A/0.9A/1.5A
 - ♦ **Under-Voltage Threshold Options:**
1.75V/2.8V/3.6V
 - ♦ **Over-Temperature Protection**
- **Up to 7.5V Supply Range for Applications**
Powered by:
 - ♦ **1 Li+/Poly Cell**
 - ♦ **2/3/4 Dry Cells**
 - ♦ **1/2 LiSOCl₂ Cell(s)**
- **Selectable Slow or Fast Decay Modes**
- **-40°C to +125°C Operating Temperature Range**
- **SGM42507A is Available in a Green TSOT-23-6 Package**
SGM42507B/C are Available in Green SC70-6 and TSOT-23-6 Packages

TYPICAL APPLICATION



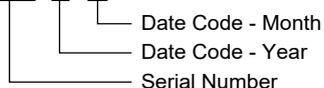
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM42507A-1.75	TSOT-23-6	-40°C to +125°C	SGM42507A-1.75XTN6G/TR	GM5XX	Tape and Reel, 3000
SGM42507A-2.8	TSOT-23-6	-40°C to +125°C	SGM42507A-2.8XTN6G/TR	GS0XX	Tape and Reel, 3000
SGM42507A-3.6	TSOT-23-6	-40°C to +125°C	SGM42507A-3.6XTN6G/TR	GS1XX	Tape and Reel, 3000
SGM42507B-1.75	SC70-6	-40°C to +125°C	SGM42507B-1.75XC6G/TR	GPBXX	Tape and Reel, 3000
	TSOT-23-6	-40°C to +125°C	SGM42507B-1.75XTN6G/TR	M09XX	Tape and Reel, 3000
SGM42507B-2.8	SC70-6	-40°C to +125°C	SGM42507B-2.8XC6G/TR	GW8XX	Tape and Reel, 3000
	TSOT-23-6	-40°C to +125°C	SGM42507B-2.8XTN6G/TR	M0AXX	Tape and Reel, 3000
SGM42507B-3.6	SC70-6	-40°C to +125°C	SGM42507B-3.6XC6G/TR	GW9XX	Tape and Reel, 3000
	TSOT-23-6	-40°C to +125°C	SGM42507B-3.6XTN6G/TR	M0BXX	Tape and Reel, 3000
SGM42507C-1.75	SC70-6	-40°C to +125°C	SGM42507C-1.75XC6G/TR	GWAXX	Tape and Reel, 3000
	TSOT-23-6	-40°C to +125°C	SGM42507C-1.75XTN6G/TR	M0CXX	Tape and Reel, 3000
SGM42507C-2.8	SC70-6	-40°C to +125°C	SGM42507C-2.8XC6G/TR	GWBXX	Tape and Reel, 3000
	TSOT-23-6	-40°C to +125°C	SGM42507C-2.8XTN6G/TR	M0DXX	Tape and Reel, 3000
SGM42507C-3.6	SC70-6	-40°C to +125°C	SGM42507C-3.6XC6G/TR	GCWXX	Tape and Reel, 3000
	TSOT-23-6	-40°C to +125°C	SGM42507C-3.6XTN6G/TR	M0EXX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XX = Date Code.

YYY X X



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.

SELECTABLE MODEL

Model	Over-Current Protection Threshold (A)	Under-Voltage Protection Threshold (V)
SGM42507A-1.75	1.5	1.75
SGM42507A-2.8	1.5	2.8
SGM42507A-3.6	1.5	3.6
SGM42507B-1.75	0.9	1.75
SGM42507B-2.8	0.9	2.8
SGM42507B-3.6	0.9	3.6
SGM42507C-1.75	0.45	1.75
SGM42507C-2.8	0.45	2.8
SGM42507C-3.6	0.45	3.6

ABSOLUTE MAXIMUM RATINGS

V _{CC}	-0.3V to 9V ⁽¹⁾
Digital Input Pin Voltage Range	-0.3V to 6V
Package Thermal Resistance	
SC70-6, θ _{JA}	245.8°C/W
TSOT-23-6, θ _{JA}	217.8°C/W
Junction Temperature.....	+150°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10s).....	+260°C
ESD Susceptibility	
HBM.....	5000V
MM.....	300V
CDM	1000V

NOTE 1: Guaranteed SGM42507 work at 7.5V DC and surge to 9V.

RECOMMENDED OPERATING CONDITIONS

V _{CC}	1.9V to 7.5V
Digital Input Pin Voltage Range	0V to 5.5V
Operating Temperature Range	-40°C to +125°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.

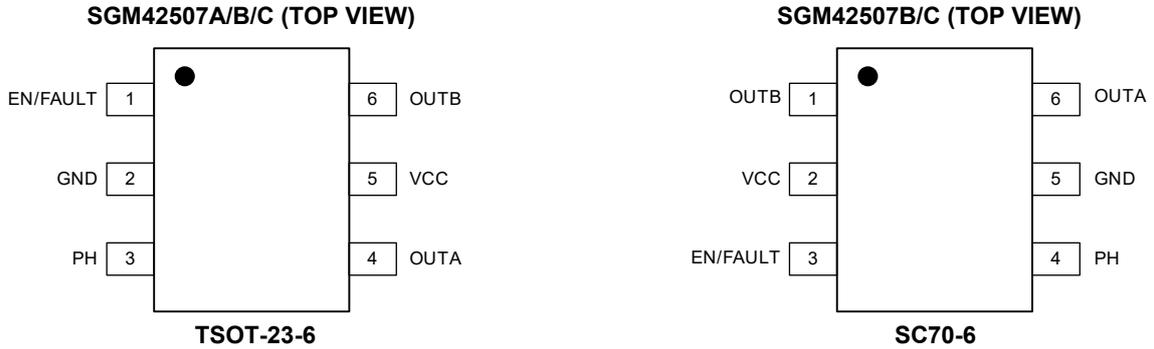
ESD SENSITIVITY CAUTION

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

NAME	TYPE	FUNCTION
EN/FAULT	I/O	Enable Input or Alert Output (OTP, OCP, UVLO) Pin. Logic high to enable normal operation, while logic low ($> t_{SLEEP}$) to enter low power dissipation sleep mode and reset all internal logic. Internal pull-down. This output is not valid when the device into minimum power dissipation sleep mode.
GND	G	Ground.
PH	I	Direction Input Pin ($V_{PH} \leq V_{CC}$). Logic high for sourcing from OUTA and sinking into OUTB, while logic low for reverse driving. Internal pull-down.
OUTA	O	H-Bridge Output A.
VCC	P	Power Input Pin. A 4.7 μ F (MIN) ceramic bypass capacitor connected to GND is recommended.
OUTB	O	H-Bridge Output B.

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

ELECTRICAL CHARACTERISTICS

($T_A = +25^\circ\text{C}$, $V_{CC} = 5\text{V}$, EN/FAULT pin is connected to 5V through a 500 Ω resistor, Full = -40°C to $+125^\circ\text{C}$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Power Supplies							
Power Supply Voltage	V_{CC}		+25 $^\circ\text{C}$	1.9		7.5	V
Digital Input Voltage Range (EN/FAULT, PH)	V_{IN}		+25 $^\circ\text{C}$	0		5.5	V
Power Supply Current	I_{VCC}	No PWM	+25 $^\circ\text{C}$		45	74	μA
Sleep Mode Supply Current	I_{VCCQ}	EN/FAULT = GND	+25 $^\circ\text{C}$		1.3	2	μA
VCC Under-Voltage Lockout Voltage	V_{UVLO}	SGM42507A/B/C-1.75	+25 $^\circ\text{C}$		1.7	1.9	V
		SGM42507A/B/C-2.8	+25 $^\circ\text{C}$		1.95	2.15	
		SGM42507A/B/C-3.6	+25 $^\circ\text{C}$		1.7	1.85	
VCC Under-Voltage Lockout Voltage Hysteresis	V_{HYS}		+25 $^\circ\text{C}$		100		mV
VCC Under-Voltage Protection Voltage	V_{UVP}	SGM42507A/B/C-1.75	+25 $^\circ\text{C}$		1.75	1.9	V
		SGM42507A/B/C-2.8	+25 $^\circ\text{C}$		2.8	3.05	
		SGM42507A/B/C-3.6	+25 $^\circ\text{C}$		3.6	3.75	
VCC Under-Voltage Protection Voltage Hysteresis	V_{HYS}		+25 $^\circ\text{C}$		100		mV
Logic Level Inputs							
Input Low Voltage	V_{IL}		Full			0.6	V
Input High Voltage	V_{IH}		Full	1.6			V
Input Low Current	I_{IL}	$V_{IN} = 0\text{V}$	+25 $^\circ\text{C}$	-500		500	nA
Input High Weak Pull-Down Current	I_{IH_weak}	$V_{IN} = 5.5\text{V}$	+25 $^\circ\text{C}$		60	85	μA
Input Low Strong Pull-Down Current	I_{IL_strong}	$V_{IN} = 1.1\text{V}$	+25 $^\circ\text{C}$		300	380	μA
Input Deglitch Time	t_{DEG}		+25 $^\circ\text{C}$		300		ns
EN/FAULT Output (Open-Drain Output)							
Output Low Voltage	V_{OL}	$V_{CC} = 1.8\text{V}$, $I_{OUT} = -5\text{mA}$	+25 $^\circ\text{C}$			170	mV
Output High Leakage Current	I_{OH}		+25 $^\circ\text{C}$			95	μA
H-Bridge FETs							
HS FET On-Resistance	$R_{DS(ON)}$	SGM42507A-X, $I_{OUT} = 200\text{mA}$	+25 $^\circ\text{C}$		375		m Ω
			Full			550	
		SGM42507B-X, $I_{OUT} = 200\text{mA}$	+25 $^\circ\text{C}$		385		
			Full			570	
		SGM42507C-X, $I_{OUT} = 200\text{mA}$	+25 $^\circ\text{C}$		400		
			Full			600	
LS FET On-Resistance	$R_{DS(ON)}$	SGM42507A-X, $I_{OUT} = -200\text{mA}$	+25 $^\circ\text{C}$		180		m Ω
			Full			335	
		SGM42507B-X, $I_{OUT} = -200\text{mA}$	+25 $^\circ\text{C}$		185		
			Full			360	
		SGM42507C-X, $I_{OUT} = -200\text{mA}$	+25 $^\circ\text{C}$		210		
			Full			395	
Off-State Leakage Current	I_{OFF}	$V_{OUT} = 0\text{V}$ or 7.5V	+25 $^\circ\text{C}$	-800		800	nA

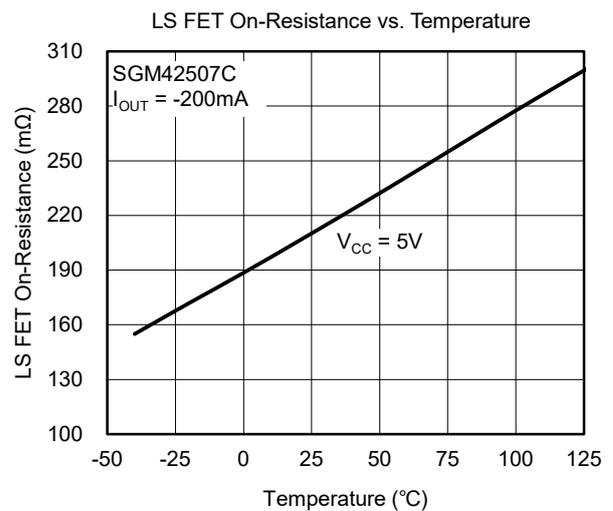
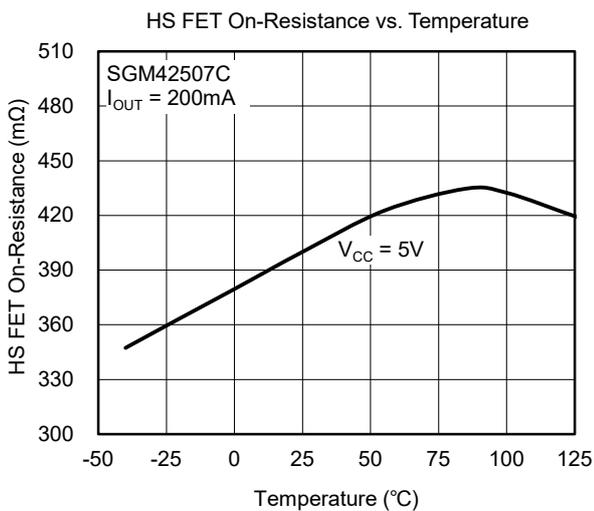
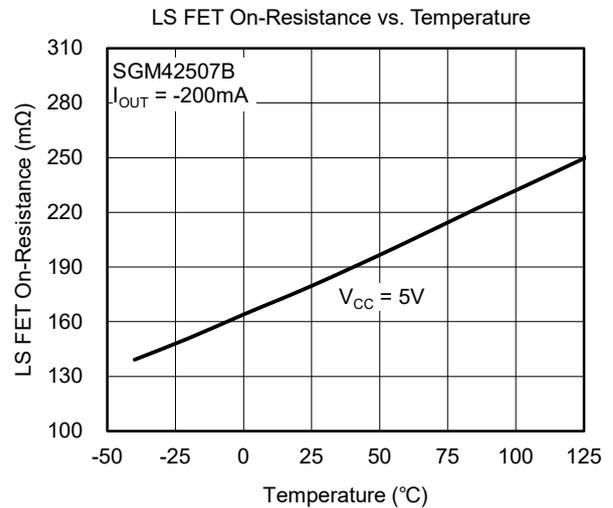
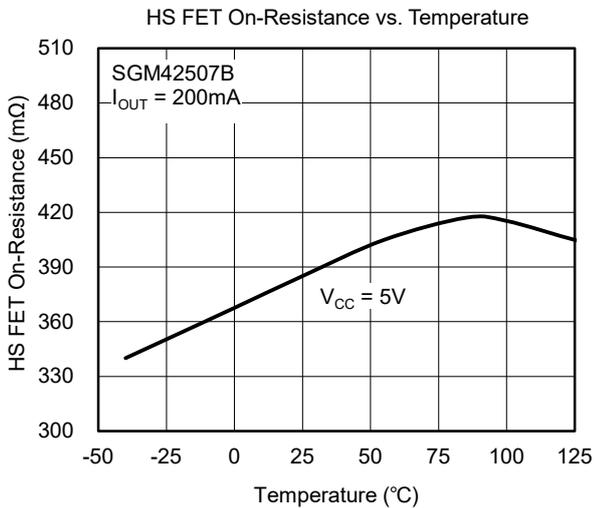
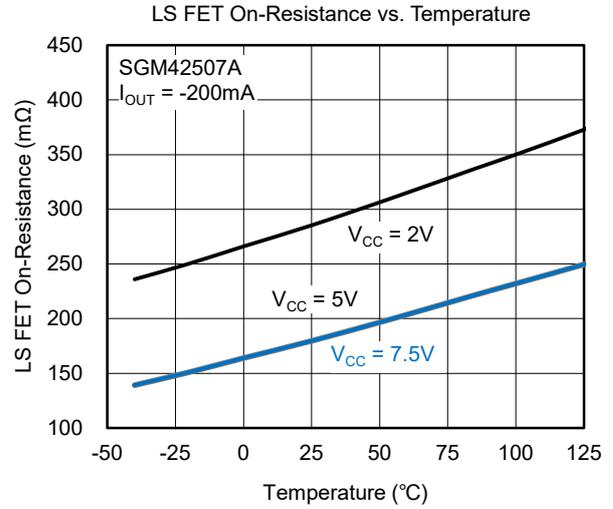
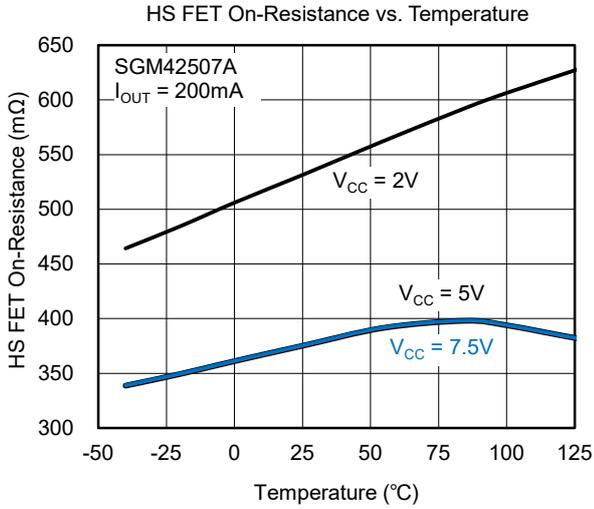
ELECTRICAL CHARACTERISTICS (continued)

(T_A = +25°C, V_{CC} = 5V, EN/FAULT pin is connected to 5V through a 500Ω resistor, Full = -40°C to +125°C, unless otherwise noted.)

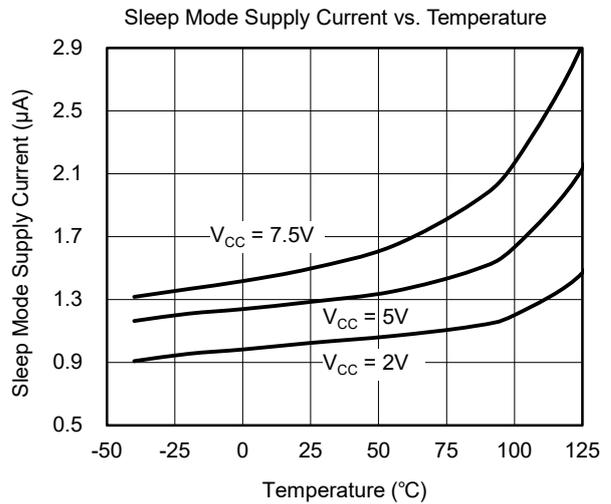
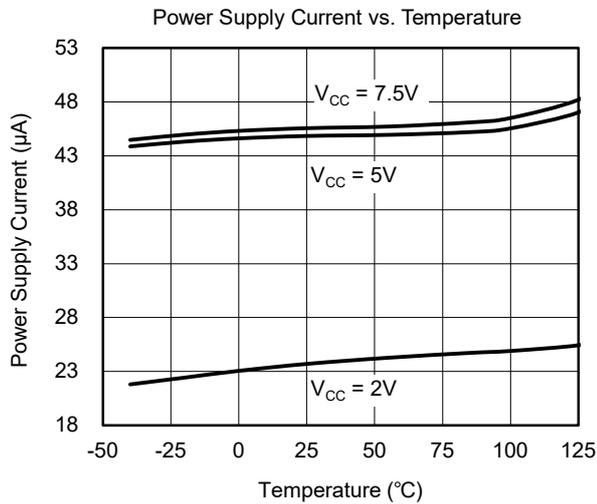
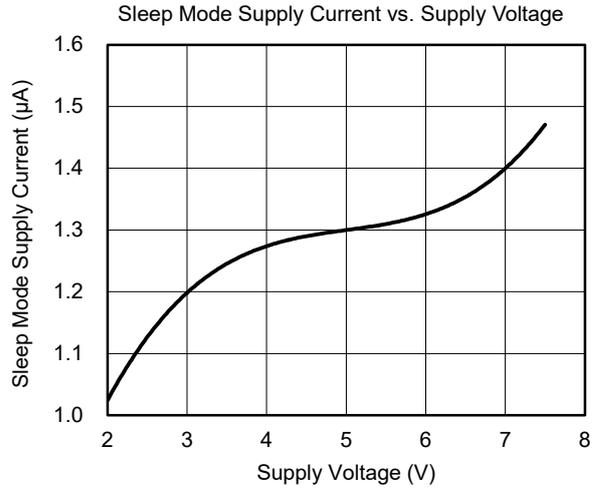
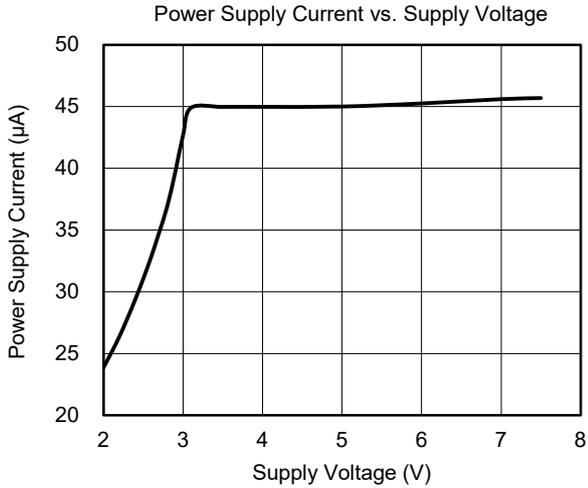
PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Motor Driver							
Rise Time	t _R	R _L = 16Ω to GND, 10% to 90% V _{CC}	+25°C		125		ns
Fall Time	t _F	R _L = 16Ω to V _{CC} , 90% to 10% V _{CC}	+25°C		155		ns
Propagation Delay INx to OUTx	t _{PROP}		+25°C		1		μs
Dead Time ⁽¹⁾	t _{DEAD}		+25°C		255		ns
Protection Circuits							
Over-Current Protection Trip Level	I _{OCP}	SGM42507A-X	+25°C		1.5		A
		SGM42507B-X	+25°C		0.9		
		SGM42507C-X	+25°C		0.45		
Thermal Shutdown							
Thermal Shutdown Temperature	T _{TSD}				165		°C
Thermal Shutdown Temperature Hysteresis	T _{HYS}				30		°C
nSLEEP Mode							
Time to Enter Sleep Mode	t _{SLEEP}		+25°C	60		105	ms
Wake Time	t _{WAKE}	EN/FAULT inactive high to H-bridge on	+25°C			4.5	ms

NOTE: 1. Internal dead time. External implementation is not necessary.

TYPICAL PERFORMANCE CHARACTERISTICS



TYPICAL PERFORMANCE CHARACTERISTICS (continued)



FUNCTIONAL BLOCK DIAGRAM

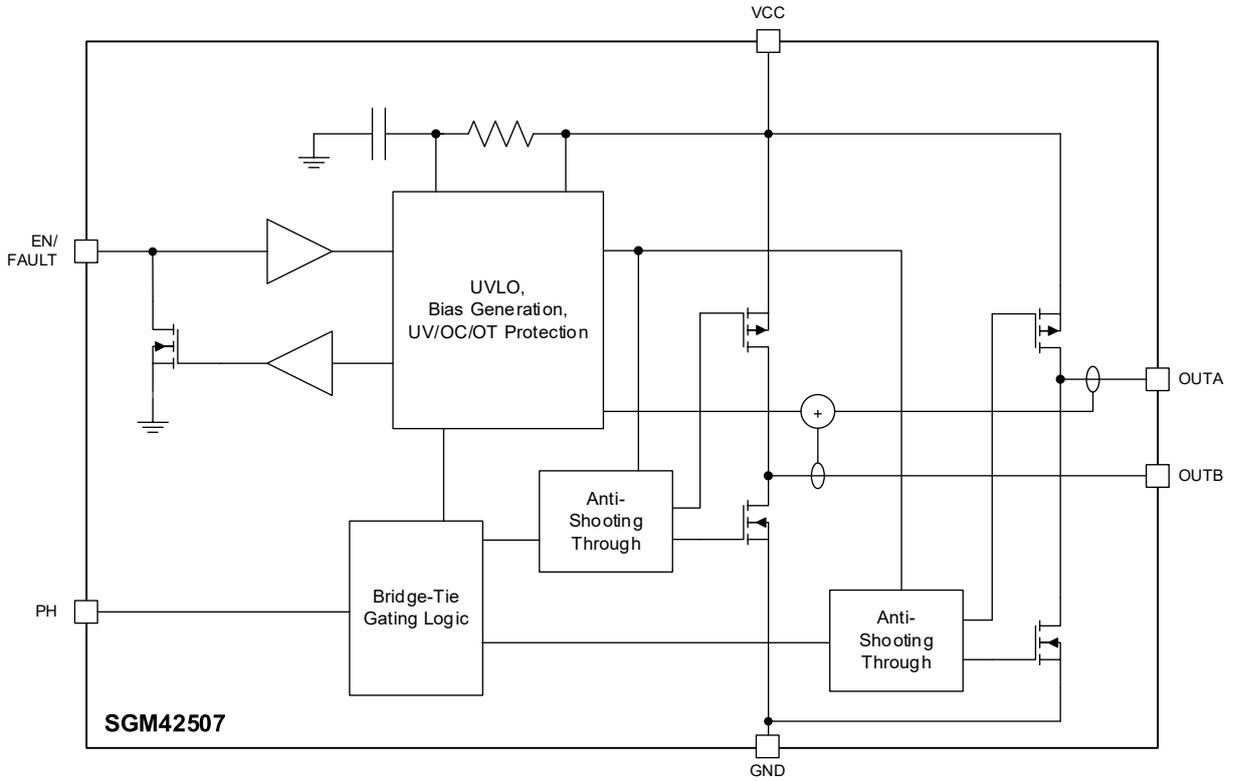
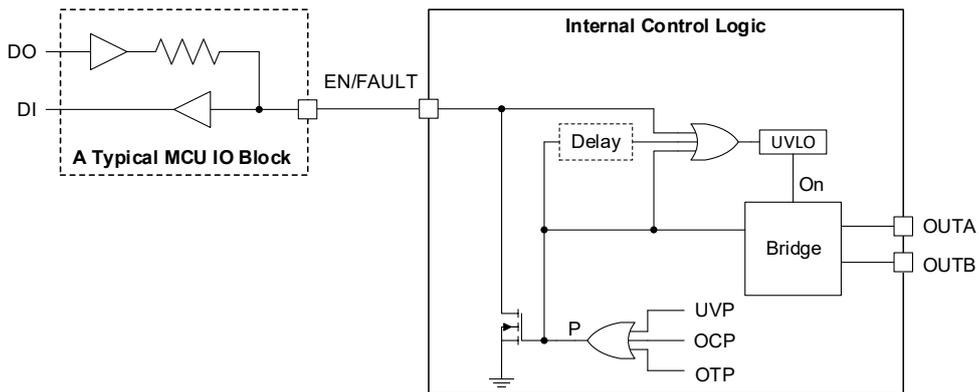


Figure 1. Block Diagram

INTERNAL CONTROL LOGIC



DETAILED DESCRIPTION

H-Bridge Control and Sleep Mode

The device integrates a single H-bridge for driving motor/coil applications. When the power stage output is enabled, PH pin controls the output driving direction. When PH = 1, both the OUTA high-side MOSFET and OUTB low-side MOSFET are on. When PH = 0, both OUTA low-side MOSFET and OUTB high-side MOSFET are on.

The EN/FAULT pin has dual functions, one for the input enable pin and the other for OCP/OTP/UVF output fault report pin. When EN/FAULT is used to report an OCP/OTP/UVF fault, pull up this pin externally. It is recommended that the EN/FAULT pin be pulled up to 1.9V ~ 5.5V through a 500Ω resistor to ensure that the EN/FAULT pin has enough sinking capability to pull down when fault condition occurs.

EN/FAULT as Output Port:

When any of over-current protection, under-voltage protection or over-temperature protection occurs, the device sinks current from EN/FAULT, pulling the pin down to alert the host.

EN/FAULT changes back to an input port, only after the device is released from a protection action.

EN/FAULT as Input Port:

EN/FAULT = 1 enables driving load in the direction set by PH input, as shown in Table 1 (a, b).

When EN/FAULT changes from 1 to 0, the state of PH is latched at this time. After the current direction of the load is consistent with the PH, the output stages will drive both OUTA and OUTB to ground, as shown in Table 1 (c). If the duration of EN/FAULT = 0 is greater than t_{SLEEP} , the device will enter low power dissipation sleep mode, and keep both OUTA and OUTB to ground.

After EN/FAULT becomes 0, if PH changes even once at any time during EN/FAULT = 0, the output stages will immediately drive both OUTA and OUTB to high-impedance state, as shown in Table 1 (d, e). If the duration of EN/FAULT = 0 is greater than t_{SLEEP} , the device will enter low power dissipation sleep mode, and keep both OUTA and OUTB to high-impedance state.

Table 1. H-Bridge Logic

STATE	EN/FAULT	PH	OUTA	OUTB	FUNCTION
(a)	1	1	H	L	Forward
(b)	1	0	L	H	Reverse
(c)	0	X	L	L	Slow Decay/Brake
(d)	0	1→0	Z	Z	Fast Decay/Coast
(e)	0	0→1	Z	Z	Fast Decay/Coast

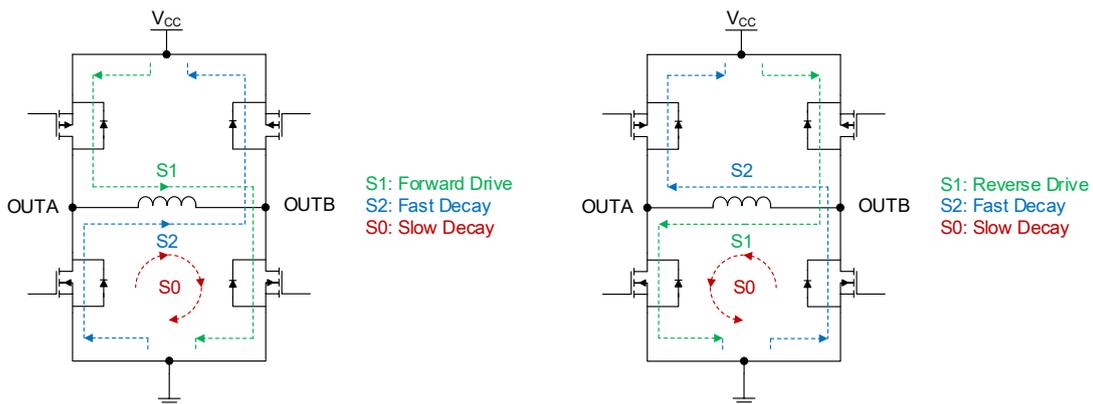


Figure 2. Decay Modes

DETAILED DESCRIPTION (continued)

PWM Motor Drivers

Speed/direction control is typically performed by providing an external PWM signal to the EN/FAULT or PH pin. If PWM signal is applied to EN/FAULT pin, the device works in single-side PWM mode, and PH pin control the direction. Please refer to Table 2 and Figure 3 for more details.

If PWM signal is applied to PH pin, the device works in complementary PWM mode, and EN/FAULT pin needs to be set to high for activating the output. Please refer to Table 2 and Figure 4 for more details.

Table 2. PWM Control of Motor Speed

EN/FAULT	PH	OUTA, OUTB	FUNCTION	PWM MODE
PWM ⁽¹⁾	H	OUTA = PWM, OUTB = GND	Forward PWM Control of Motor Speed	Single-side PWM Mode
PWM ⁽¹⁾	L	OUTA = GND, OUTB = PWM	Reverse PWM Control of Motor Speed	Single-side PWM Mode
H	PWM (D < 50%)	OUTA = -PWM, OUTB = +PWM	Reverse PWM Control of Motor Speed	Complementary PWM Mode
H	PWM (D > 50%)	OUTA = +PWM, OUTB = -PWM	Forward PWM Control of Motor Speed	Complementary PWM Mode

NOTE: 1. The duration of EN/FAULT = L must be less than t_{SLEEP} , in a PWM period. Otherwise the device may enter the low power dissipation sleep mode.

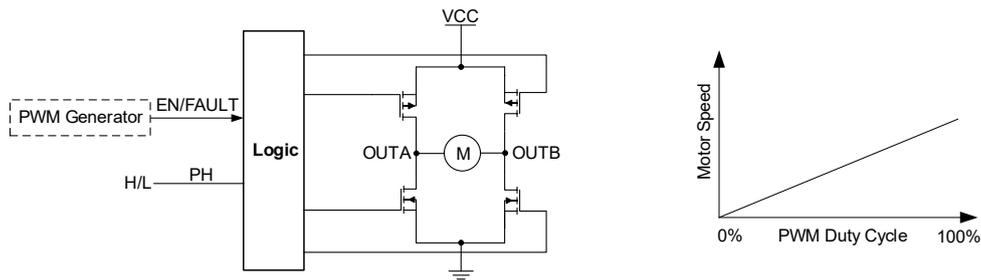


Figure 3. Loading PWM Signal to EN/FAULT Port

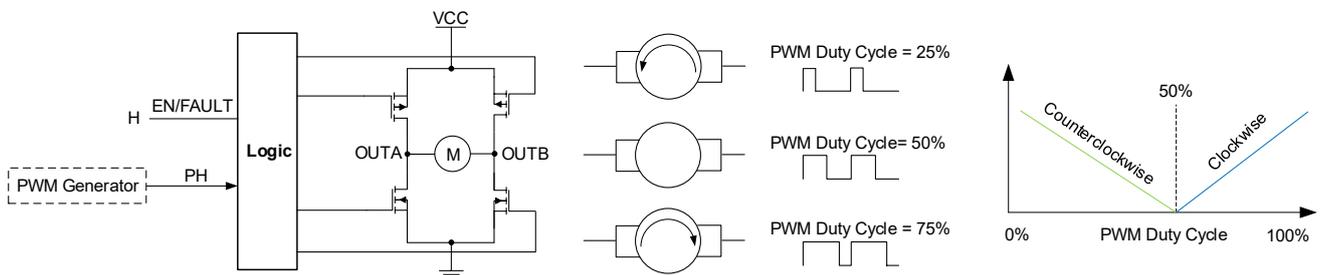


Figure 4. Loading PWM Signal to PH Port

DETAILED DESCRIPTION (continued)

Over-Current Protection

During motor startup or stall situation, the output current may increase quickly, and may trigger the device over-current protection. If the output current goes higher than I_{OCP} for longer than 40 μ s OCP blanking time, an OCP event will be triggered, the EN/FAULT pin is pulled low reporting the fault, and both the OUTA and OUTB will be driven to ground or power supply. After the current decreases below the OCP threshold plus given hysteresis, the output resumes driving automatically. The average output current of device is higher than the threshold current, maintaining the torque during motor startup or stall condition.

Under-Voltage and Over-Temperature Protections

If the voltage on VCC pin falls below its under-voltage lockout threshold, the OUTA and OUTB will be driven to GND. The device resumes operation when the power supply goes back above UVLO thresholds. If a junction over-temperature occurs in the device, the OUTA and OUTB will be driven to high-impedance, effectively preventing device damage.

Internal Pull-Down on Inputs

Both of PH and EN/FAULT pins have a continuous weak pull-down and a conditional strong pull-down. The conditional strong pull-down function is active when

input low is recognized and inactive while input high is recognized. This ensures a known and stable status even the input pin is floating, while keeping a low sinking current when the input is driven high.

FMEA Fault Tolerance

Details are described in the table below.

Table 3. Adjacent Pin Short Effect

Short Pins	Effect
VCC-PH	Equals to PH = 1. If EN/FAULT is high, OUTA to OUTB driving is selected, and all protections function normally.
PH-GND	Equals to PH = 0. If EN/FAULT is high, OUTB to OUTA driving is selected, and all protections function normally.
VCC-EN/FAULT	Equals to EN/FAULT = 1. EN/FAULT = 1 enables driving load in the direction set by PH, while all protections function normally.
EN/FAULT-GND	Equals to EN/FAULT = 0. The device will drive both OUTA and OUTB to ground/high-impedance state, or enter low power dissipation sleep mode.
OUTx-GND	The device will enter the over-current protection mode.
VCC-OUTx	The device will enter the over-current protection mode.
OUTA-OUTB	The device will enter the over-current protection mode.

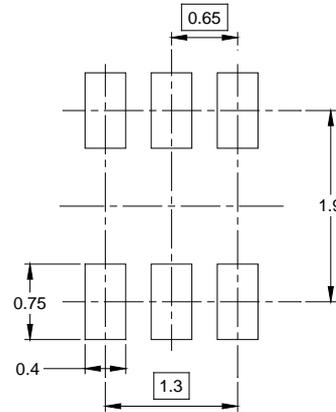
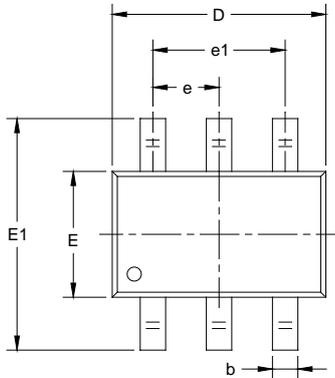
REVISION HISTORY

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

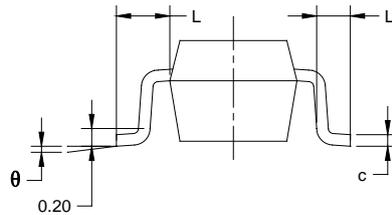
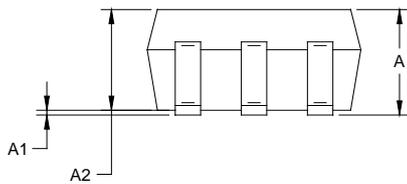
MAY 2023 – REV.A to REV.A.1	Page
Updated Package Outline Dimensions section	13
Changes from Original (NOVEMBER 2018) to REV.A	
Changed from product preview to production data.....	All

PACKAGE OUTLINE DIMENSIONS

SC70-6



RECOMMENDED LAND PATTERN (Unit: mm)



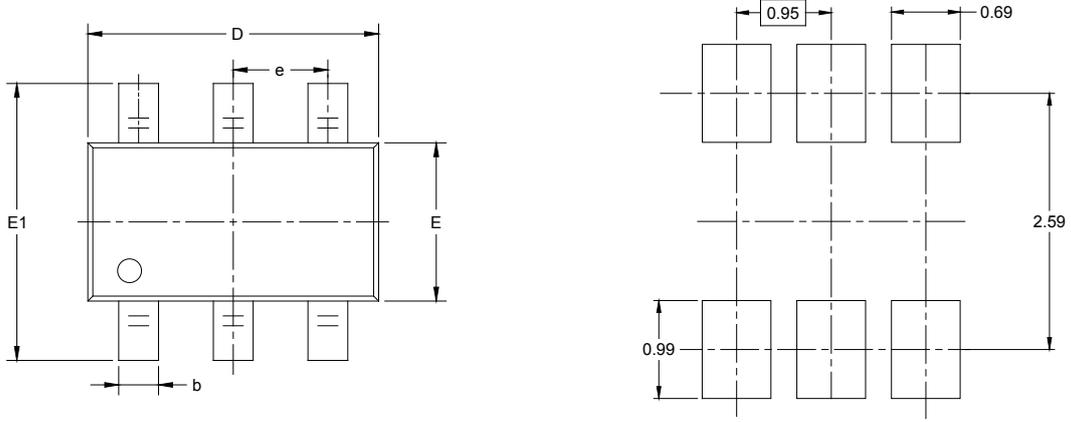
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	0.043
A1	0.000	0.100	0.000	0.004
A2	0.800	1.000	0.031	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.220	0.003	0.009
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.65 TYP		0.026 TYP	
e1	1.300 BSC		0.051 BSC	
L	0.525 REF		0.021 REF	
L1	0.260	0.460	0.010	0.018
θ	0°	8°	0°	8°

NOTES:

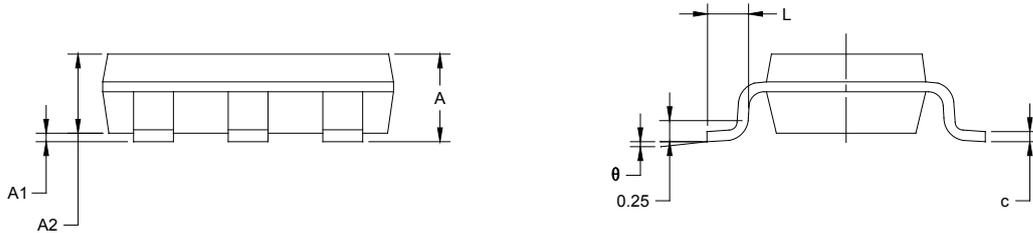
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

TSOT-23-6



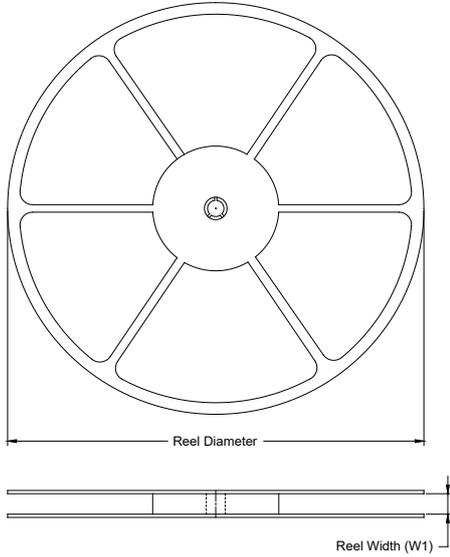
RECOMMENDED LAND PATTERN (Unit: mm)



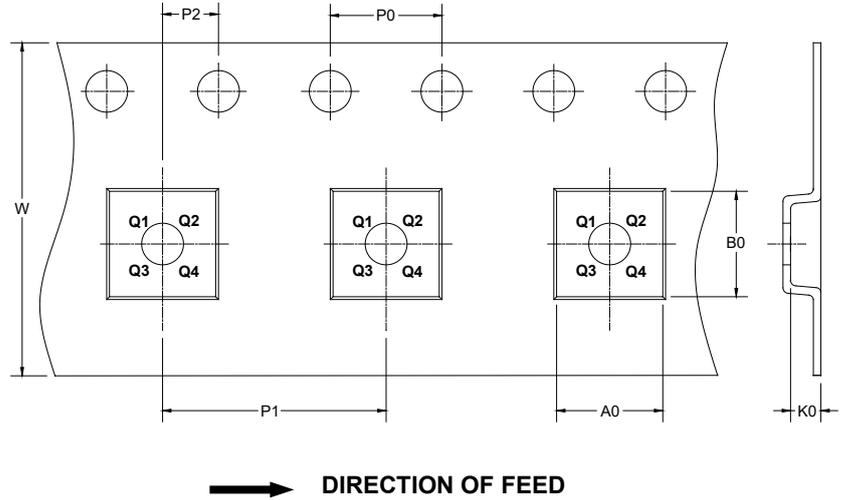
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.000		0.043
A1	0.000	0.100	0.000	0.004
A2	0.700	0.900	0.028	0.039
b	0.300	0.500	0.012	0.020
c	0.080	0.200	0.003	0.008
D	2.850	2.950	0.112	0.116
E	1.550	1.650	0.061	0.065
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

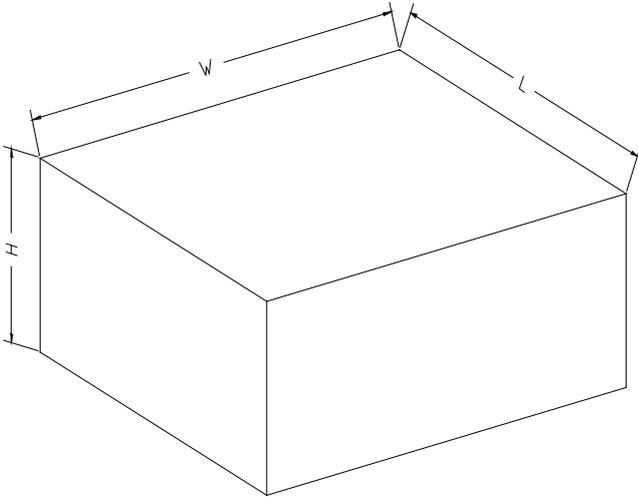
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SC70-6	7"	9.5	2.40	2.50	1.20	4.0	4.0	2.0	8.0	Q3
TSOT-23-6	7"	9.5	3.20	3.10	1.10	4.0	4.0	2.0	8.0	Q3

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
7" (Option)	368	227	224	8
7"	442	410	224	18

DD0002