SGM2523
Programmable Current Limit Switch

GENERAL DESCRIPTION

SGM2523 is a compact electronic fuse (eFuse) with a complete set of protection functions. The wide operating voltage range is specifically designed for many popular DC buses. The precision ±10% current limit, at room temperature, provides excellent accuracy and makes the SGM2523 well suited for many system protection applications. The programmable soft-start time controls the slew rate of the output voltage during the power-up procedure.

The SGM2523 protects input from undesired shorts and transients coming from the output.

The SGM2523 is available in a Green SOT-23-6 package and operates over a temperature range of -40℃ to +125℃.

APPLICATIONS

Hot Swap in Industry/Telecom
E-Meter
Automotive
USB Power Distribution
USB3.1 Power Delivery
Adapter Power Device

FEATURES

- **Wide Input Voltage Range from 2.6V to 22V with Surge up to 30V**
- **Low $R_{DS(ON)}$ for the Integrated Protection Switch: 75mΩ**
- **Programmable Soft-Start Time**
- **Programmable Current Limit from 100mA to 1.6A**
- **±10% Current Limit Accuracy at T_J = +25℃**
- **Short-Circuit Protection**
- **OCP Hiccup Protections:**
  - **SGM2523A: Limited Current Mode**
  - **SGM2523B: Shutdown Mode**
- **Thermal Shutdown Options:**
  - **SGM2523A: Auto-Retry**
  - **SGM2523B: Latch-Off**
- **Enable Interface Pin**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in a Green SOT-23-6 Package**

TYPICAL APPLICATION

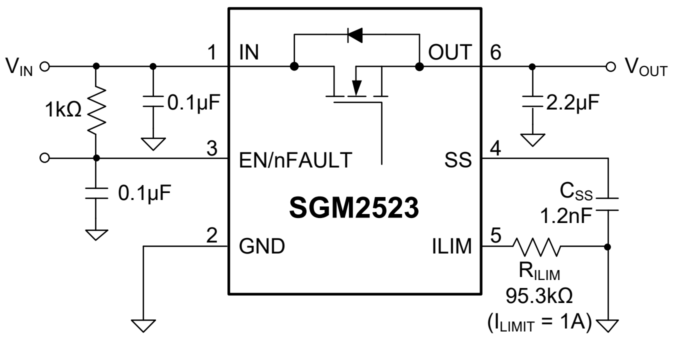


Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2523A	SOT-23-6	-40℃ to +125℃	SGM2523AXN6G/TR	MP2XX	Tape and Reel, 3000
SGM2523B	SOT-23-6	-40℃ to +125℃	SGM2523BXN6G/TR	CJDXX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XX = Date Code.

YYY X X

- X — Date Code - Week
- X — Date Code - Year
- YYY — Serial Number

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

IN, OUT, EN/nFAULT to GND .... -0.3V to 26V
SS, ILIM to GND .... -0.3V to 6V
Package Thermal Resistance
SOT-23-6, θ_{JA} .... 220℃/W
Junction Temperature ....+150℃
Storage Temperature Range........................-65℃ to +150℃
Lead Temperature (Soldering, 10s) ....+260℃
ESD Susceptibility
HBM..4000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range ....2.6V to 22V
Operating Ambient Temperature Range.......-40℃ to +125℃
Operating Junction Temperature Range......-40℃ to +125℃

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

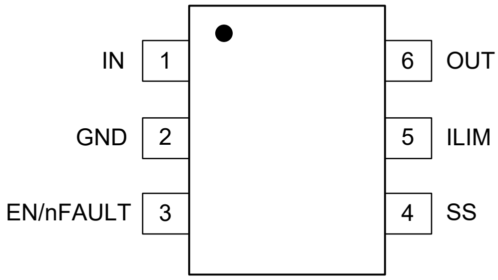
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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 CONFIGURATION

SGM2523 (TOP VIEW)



SOT-23-6

PIN DESCRIPTION

PIN	NAME	DESCRIPTION
1	IN	Power Input Pin. Power input and supply voltage of the device. Decouple high frequency noise by connecting at least a 0.1μF ceramic capacitor to ground.
2	GND	Ground.
3	EN/nFAULT	Enable Input or Alert Output (OTP, OCP, SCP). Asserting EN/nFAULT pin high enables the device. When any of over-temperature protection, over-current protection, or short-circuit protection occurs, the device sinks current from EN/nFAULT, pulling the pin down to alert the host (pin as output port).
4	SS	Soft-Start Pin. A capacitor from this pin to GND sets the slew rate of output voltage at device turn-on.
5	ILIM	Current Limit Program Pin. A resistor from this pin to GND will set the overload and short-circuit limit. Do not float this pin.
6	OUT	Power Output Pin. Power output of the device.

FUNCTIONAL BLOCK DIAGRAM

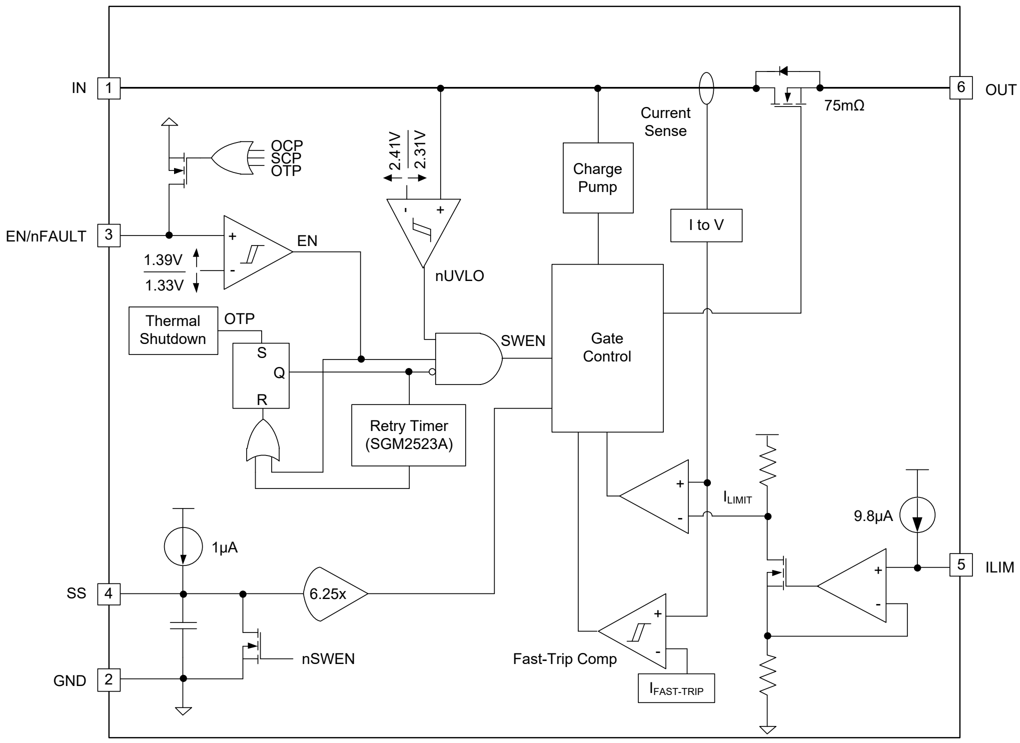


Figure 2. Functional Block Diagram

ELECTRICAL CHARACTERISTICS

(T_J = -40℃ to +125℃, V_{IN} = 2.6V to 22V, $V_{EN/nFAULT}$ = 2V, R_{ILIM} = 95.3kΩ, C_{SS} = Open, unless otherwise noted.)

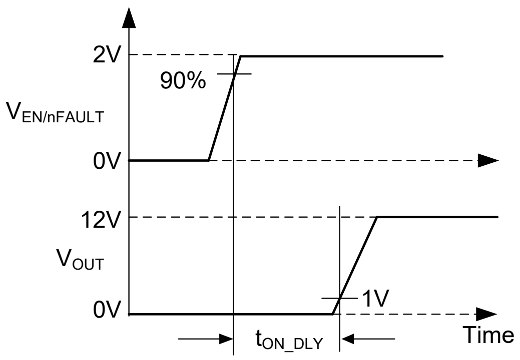
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage and Internal Under-Voltage Lockout						
Operating Input Voltage	V_{IN}		2.6		22	V
UVLO Threshold Voltage, Rising	V_{UVR}		2.30	2.42	2.60	V
UVLO Hysteresis	V_{UVHYS}			100		mV
Supply Current, Enabled	I_{Q_ON}	$V_{EN/nFAULT}$ = 2V, V_{IN} = 12V	100	150	230	μA
Supply Current, Disabled	I_{Q_OFF}	$V_{EN/nFAULT}$ = 0V, V_{IN} = 12V		0.8	2	μA
Enable and Fault Flag (En/nFAULT)						
EN/nFAULT Threshold Voltage, Rising	V_{ENR}		1.34	1.39	1.44	V
EN/nFAULT Threshold Voltage, Falling	V_{ENF}		1.28	1.33	1.38	V
EN/nFAULT Threshold Voltage to Reset Thermal Fault, Falling	V_{ENF_RST}				0.54	V
EN/nFAULT Input Leakage Current	$I_{EN/nFAULT}$	$V_{EN/nFAULT}$ = 0V to 18V	-100	0	100	nA
EN/nFAULT Pull-Down Resistance	$R_{EN/nFAULT}$	Device in fault condition, $V_{EN/nFAULT}$ = 0V, $I_{EN/nFAULT}$ = 100mA	15	29	60	Ω
Soft-Start: Output Ramp Control (SS)						
SS Charging Current	I_{SS}	V_{SS} = 0V	0.8	1	1.2	μA
SS to OUT Gain	$GAIN_{SS}$	$\Delta V_{OUT}/\Delta V_{SS}$	6.10	6.25	6.40	V/V
Current Limit Programming (ILIM)						
ILIM Pin Bias Current	I_{ILIM}		8.6	9.8	11	μA
Current Limit	I_{LIMIT}	R_{ILIM} = 10kΩ		0.1		A
		R_{ILIM} = 35.7kΩ	0.23	0.37	0.51	
		R_{ILIM} = 45.3kΩ	0.31	0.48	0.64	
		R_{ILIM} = 95.3kΩ, T_J = +25℃	0.93	1	1.07	
		R_{ILIM} = 95.3kΩ	0.90	1	1.10	
		R_{ILIM} = 150kΩ	1.28	1.6	1.75	
Fast-Trip Comparator Threshold	$I_{FAST-TRIP}$	R_{ILIM} in kΩ		2 × I_{LIMIT}		A
ILIM Open Resistor Detect Threshold	V_{ILIM_OPEN}	V_{ILIM} rising, R_{ILIM} = Open, V_{IN} = 5V to 22V	2.6	3.0	3.4	V
MOSFET-Power Switch						
FET On-Resistance	$R_{DS(ON)}$		40	75	125	mΩ
Pass FET Output (OUT)						
OUT Bias Current in Off State	I_{LKG_OUT}	$V_{EN/nFAULT}$ = 0V, V_{OUT} = 0V (Sourcing), T_J = -40℃ to +85℃	-0.5	0.1	0.5	μA
	I_{SINK_OUT}	$V_{EN/nFAULT}$ = 0V, V_{OUT} = 300mV (Sinking), T_J = -40℃ to +85℃	-0.5	0.2	0.5	
Thermal Shutdown (TSD)						
Thermal Shutdown Threshold, Rising	T_{TSD}			155		℃
Thermal Shutdown Hysteresis	T_{TSDHYS}			20		℃

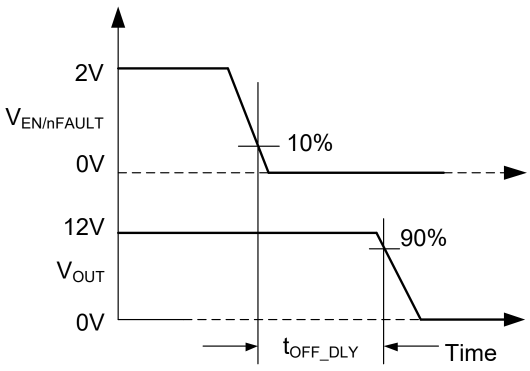
TIMING REQUIREMENTS

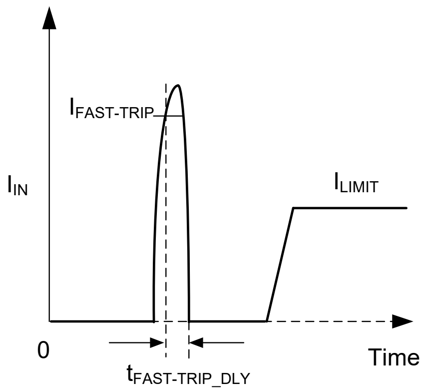
(T_J = +25℃, V_{IN} = 12V, $V_{EN/nFAULT}$ = 2V, R_{ILIM} = 95.3kΩ, C_{SS} = Open, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Enable and Fault Flag (En/nFAULT)						
Turn-On Delay	t_{ON_DLY}	EN/nFAULT↑ to V_{OUT} = 1V, C_{OUT} = 2.2μF		75		μs
Turn-Off Delay	t_{OFF_DLY}	EN/nFAULT↓ to V_{OUT} = 10.8V, C_{OUT} = 2.2μF		90		μs
Soft-Start: Output Ramp Control (SS)						
Output Ramp Time	t_{SS}	EN/nFAULT↑ to V_{OUT} = 11V, with C_{SS} = Open, C_{OUT} = 2.2μF	0.10	0.38	0.70	ms
		EN/nFAULT↑ to V_{OUT} = 11V, with C_{SS} = 1.2nF, C_{OUT} = 2.2μF	1.60	2.07	2.70	
Current Limit Programming (ILIM)						
Fast-Trip Comparator Delay	$t_{FAST-TRIP\_DLY}$	I_{OUT} > $I_{FAST-TRIP}$		0.3		μs
Thermal Shutdown (TSD)						
Retry Delay after Thermal Shutdown Recovery, T_J < [T_{TSD} - 20℃]	t_{TSD_DLY}	SGM2523A only, V_{IN} = 12V		700		ms
		SGM2523A only, V_{IN} = 2.6V		750		

PARAMETRIC MEASUREMENT INFORMATION



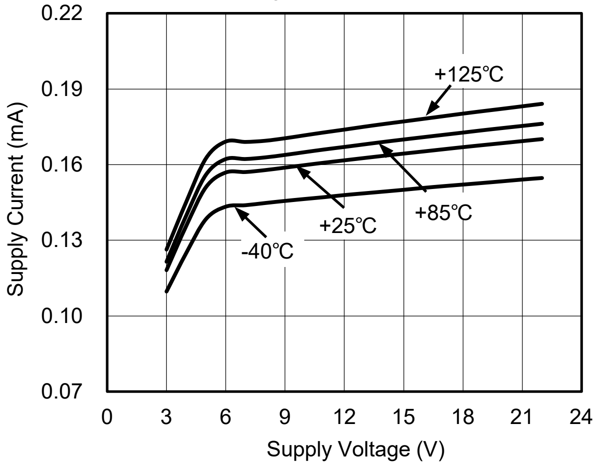




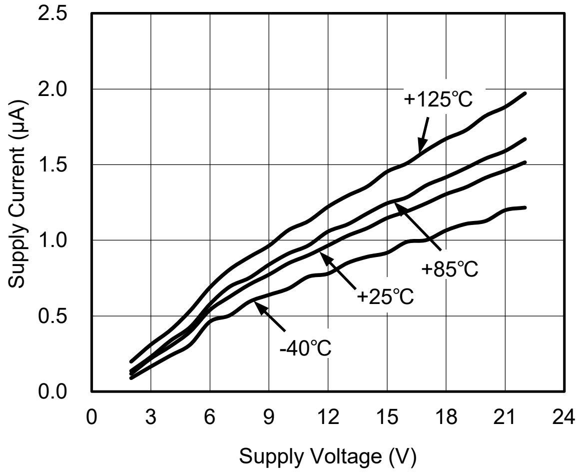
TYPICAL PERFORMANCE CHARACTERISTICS

T_J = +25℃, V_{IN} = 2.6V to 22V, $V_{EN/nFAULT}$ = 2V, R_{ILIM} = 95.3kΩ, C_{SS} = Open, unless otherwise noted.

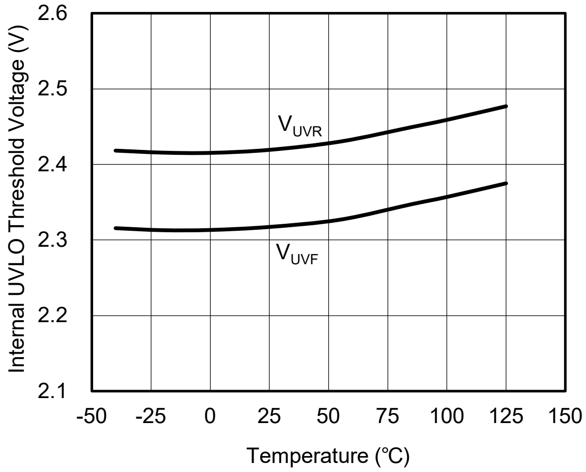
Input Supply Current vs. Supply Voltage during Normal Operation



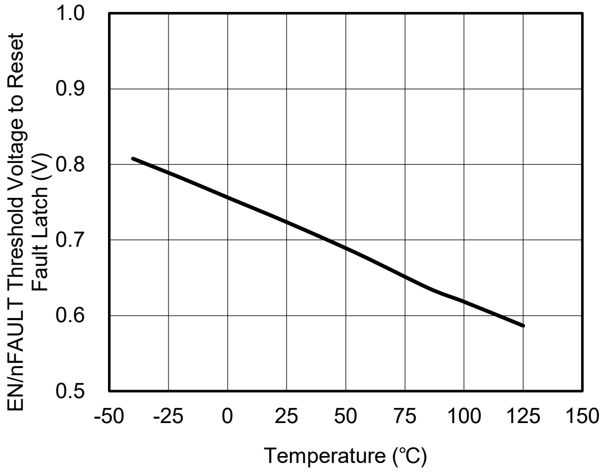
Input Supply Current vs. Supply Voltage at Shutdown



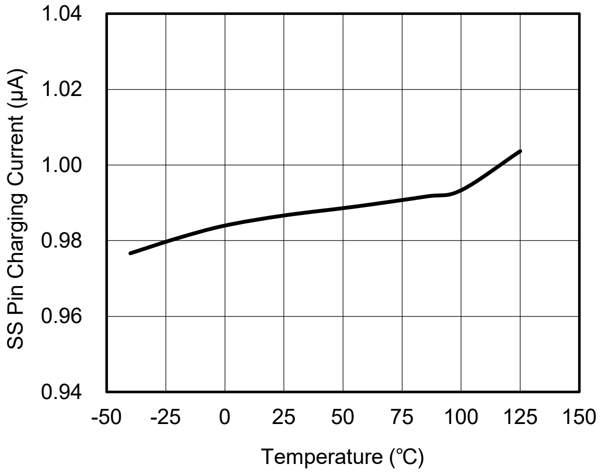
UVLO Threshold Voltage vs. Temperature



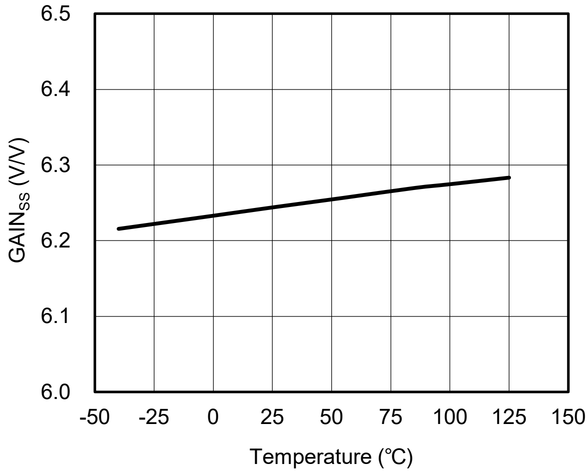
EN/nFAULT Threshold Voltage to Reset Fault Latch vs. Temperature



SS Pin Charging Current vs. Temperature

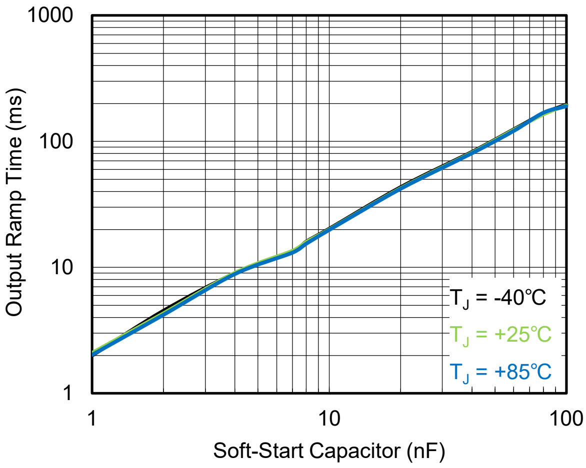


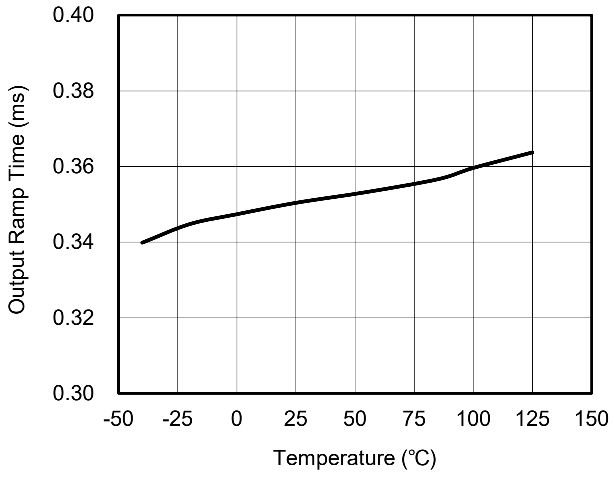
$GAIN_{SS}$ vs. Temperature

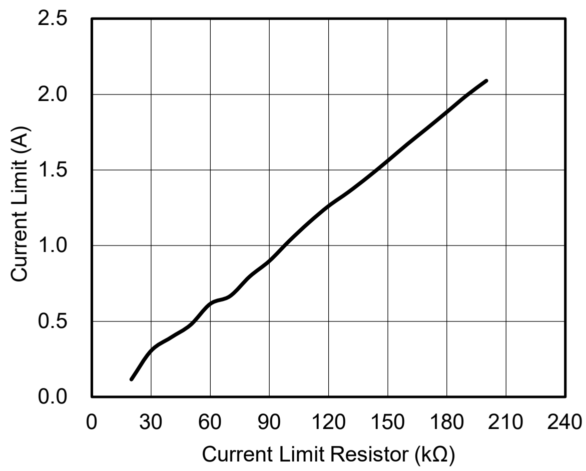


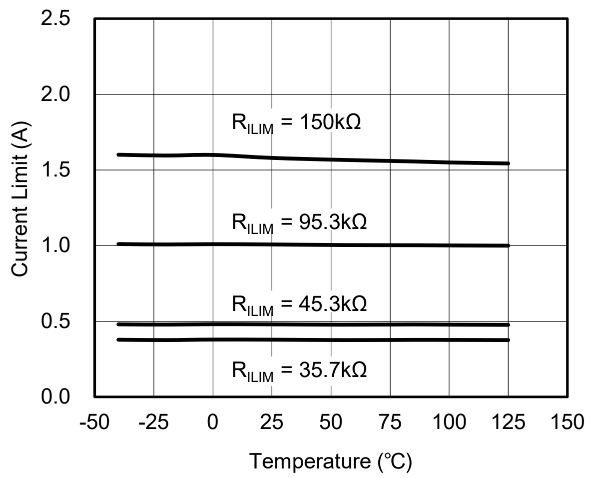
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

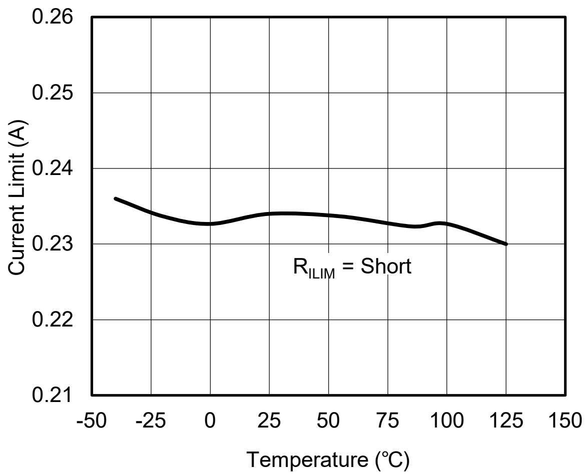
T_J = +25℃, V_{IN} = 2.6V to 22V, $V_{EN/nFAULT}$ = 2V, R_{ILIM} = 95.3kΩ, C_{SS} = Open, unless otherwise noted.

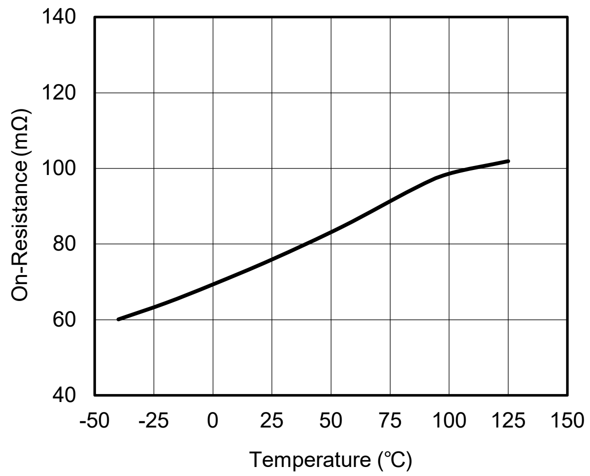








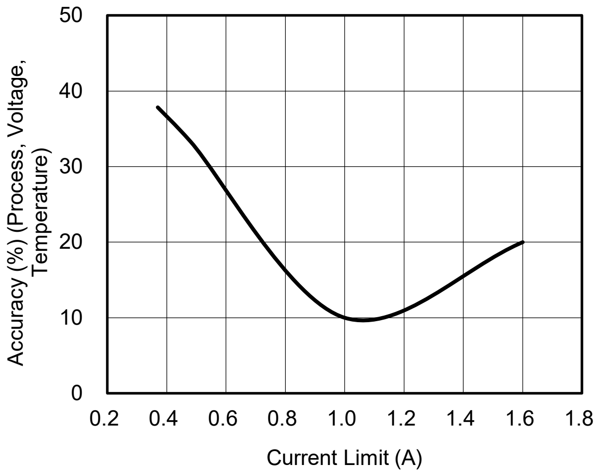




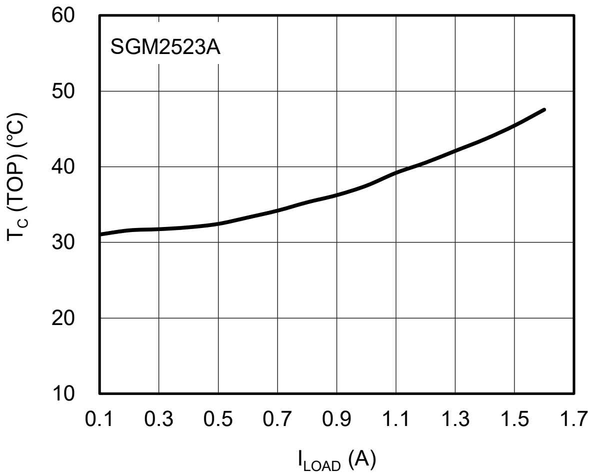
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_J = +25℃, V_{IN} = 2.6V to 22V, $V_{EN/nFAULT}$ = 2V, R_{ILIM} = 95.3kΩ, C_{SS} = Open, unless otherwise noted.

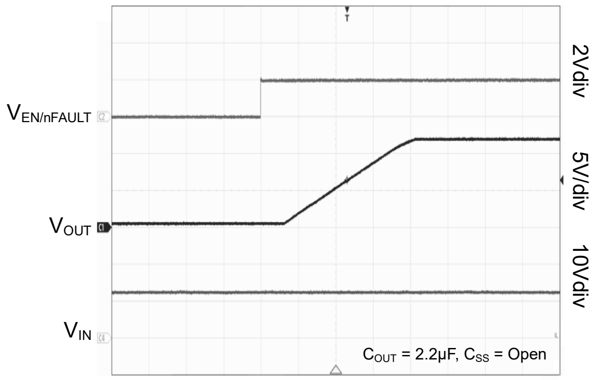
Current Limit Accuracy vs. Current Limit



T_C (TOP) vs. I_{LOAD}

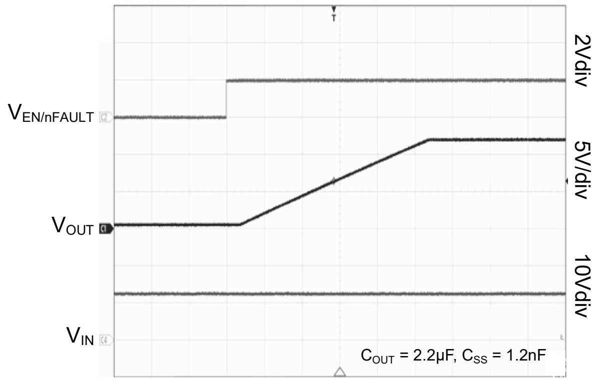


Turn-On with Enable



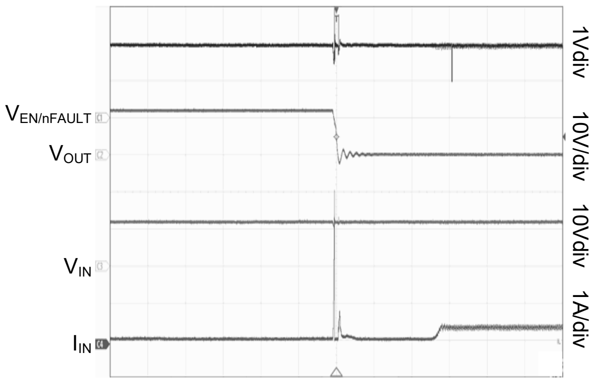
Time (100μs/div)

Turn-On with Enable



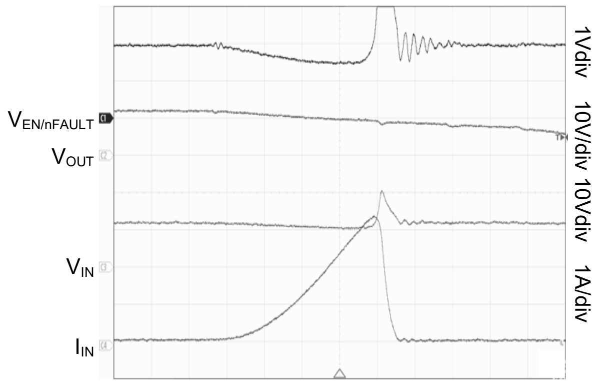
Time (500μs/div)

Hot-Short: Fast-Trip Response and Current Regulation



Time (20μs/div)

Hot-Short: Fast-Trip Response (Zoomed)



Time (200ns/div)

DETAILED DESCRIPTION

Overview

The SGM2523 is an intelligent eFuse with enhanced built-in protection circuit. It provides strong protections for all systems and applications from 2.6V to 22V. The SGM2523 integrates over-current and short-circuit protections. Precision current limit helps to minimize over design of the input power supply, while fast response short-circuit protection isolates the load from the input immediately when a short-circuit condition is detected. The device allows the user to program the over-current limit threshold between 0.1A and 1.6A via an external resistor. The SGM2523 is designed to protect systems such as white goods, STBs, DTVs, smart meters and gas analyzers.

The additional features include:

- Over-temperature protection will safely shut down the device in an over-current event
- Fault reporting for brown-out
- A choice of latch-off or auto-retry restart mode

Enable and Adjusting Under-Voltage Lockout (UVLO)

The EN/nFAULT pin controls the on/off state of the internal FET. A voltage $V_{EN/nFAULT} < V_{ENF}$ on this pin turns off the internal FET, thus disconnecting IN from OUT.

Toggling the EN/nFAULT pin below V_{ENF_RST} resets the SGM2523B that has latch-off due to a fault condition. The internal de-glitch delay on EN/nFAULT falling edge is kept at a low level to facilitate rapid detection of power failure. For applications where a higher de-glitch delay on EN/nFAULT is desired, or when the supply is particularly noisy, it is recommended to use an external filter capacitor from the EN/nFAULT terminal to GND.

As shown in Figure 3, the under-voltage locking threshold can be programmed from the power input terminal to the EN/nFAULT terminal to the GND using an external resistor divider. When an under-voltage or input power fail event is detected, the internal FET is quickly turned off. If the under-voltage lockout function is not needed, the EN/nFAULT pin should be connected to the IN terminal. The EN/nFAULT terminal should not be left floating.

SGM2523 implements internal under-voltage lockout (UVLO) circuitry on the IN pin. The device gets disabled when the IN terminal voltage falls below internal UVLO threshold V_{UVF}.

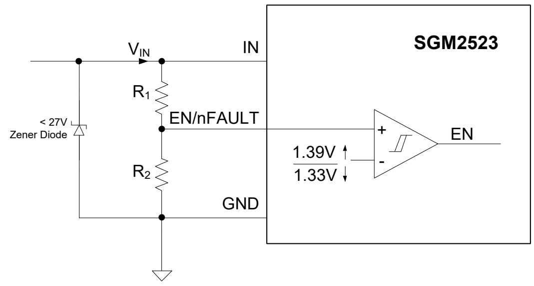


Figure 3. UVLO Thresholds Set by R_1 and R_2

When the switching voltage of SGM2523 is more than 15V, a Zener diode of no more than 27V (> 0.5W) should be added to prevent the input voltage spike from damaging the device (as shown in Figure 3).

EN/nFAULT as Output Port

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

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

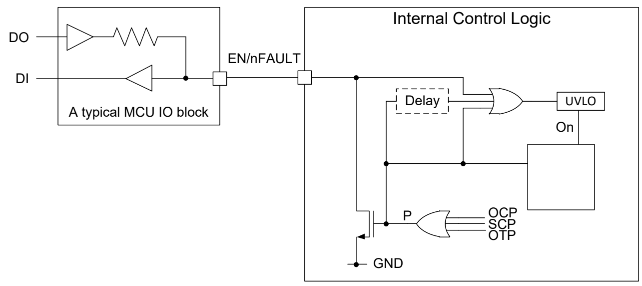


Figure 4. EN/nFAULT Application

In-Rush Current Control

The SGM2523 is designed to control the in-rush current when the device is enable or power-on. An external capacitor from the SS pin to GND defines the slew rate of the output voltage at power-on (as shown in Figure 5). The equation governing slew rate at start-up is shown in Equation 1:

$$I_{SS} = \frac{C_{SS}}{GAIN_{SS}} \times \frac{dV_{OUT}}{dt} \quad (1)$$

where:

I_{SS} = 1μA (TYP)

dV_{OUT}/dt = Desired output slew rate

$GAIN_{SS} = \Delta V_{OUT}/\Delta V_{SS}$ = 6.25

C_{SS} (MAX) must be less than 1μF.

DETAILED DESCRIPTION (continued)

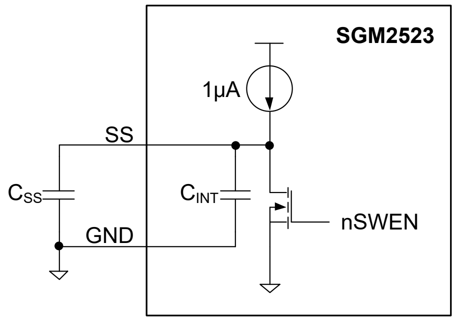


Figure 5. Output Ramp Time t_{SS} is Set by C_{SS}

The total ramp time (t_{SS}) of V_{OUT} from 0 to V_{IN} can be calculated using Equation 2:

$$t_{SS} = 16.1 \times 10^4 \times V_{IN} \times C_{SS} \quad (2)$$

where C_{SS} is in Farad.
The in-rush current, $I_{IN\text{-}RUSH}$ can be calculated as

$$I_{IN\text{-}RUSH} = C_{OUT} \times \frac{V_{IN}}{t_{SS}} \quad (3)$$

The SS pin can be left floating to obtain a predetermined slew rate (t_{SS}) on the output. When terminal is left floating, the device sets an internal slew rate of ~50V/ms for output (V_{OUT}) ramp.

For systems where load is present during start-up, the current never exceeds the over-current limit set by R_{ILIM} resistor for the application.

Overload and Short-Circuit Protections

At all times load current is monitored by directly sensing the current flowing through the internal MOSFET. During overload events, current is limited to the current limit (I_{LIMIT}) programmed by R_{ILIM} resistor:

$$I_{LIMIT} = 10.5 \times 10^{-3} \times R_{ILIM} \quad (4)$$

$$R_{ILIM} = \frac{I_{LIMIT}}{10.5 \times 10^{-3}} \quad (5)$$

where:
I_{LIMIT} is overload current limit in Ampere.
R_{ILIM} is the current limit programming resistor in kΩ.

SGM2523 offers two distinct over-current protection levels: the current limit (I_{LIMIT}) and the fast-trip threshold ($I_{FAST\text{-}TRIP}$). The fast-trip and current limit operations are shown in Figure 6.

Bias current on ILIM pin directly controls current limit behavior of the device, and PCB routing of this node must be kept away from any noisy (switching) signals.

Overload Protection

For overload conditions, the internal current limit amplifier regulates the output current to I_{LIMIT}. The output voltage drops during current limit regulation, which leads to the increase of power consumption. SGM2523 allows ILIM pin floating operation. If ILIM pin is floating, the current limit will be set as fixed 0.2A internally.

When the over-current limit condition lasts more than 2ms, the SGM2523A enters the hiccup mode with 2ms on time and 700ms off time, whereas the SGM2523B enters shutdown mode.

Short-Circuit Protection

During a transient short-circuit event, the current flowing through the device will increase rapidly. Due to the limited bandwidth of the current limit amplifier, it can not respond quickly to this event, so the device contains a fast-trip comparator, with a threshold $I_{FAST\text{-}TRIP}$. When the current through the internal FET exceeds $I_{FAST\text{-}TRIP}$ ($I_{OUT} > I_{FAST\text{-}TRIP}$), this comparator shuts down the FET within 0.3μs and terminates the rapid short-circuit peak current. The $I_{FAST\text{-}TRIP}$ threshold is dependent on programmed overload current limit and function of R_{ILIM}. See Equation 6 for the calculation.

$$I_{FAST\text{-}TRIP} = 2 \times I_{LIMIT} \quad (6)$$

where:
$I_{FAST\text{-}TRIP}$ is fast-trip current limit in Ampere.

The fast-trip circuit holds the internal FET off for only a few microseconds, after which the device attempts to return to normal, allowing the current limit loop to adjust the output current to I_{LIMIT}. Then, device behaves similar to overload condition.

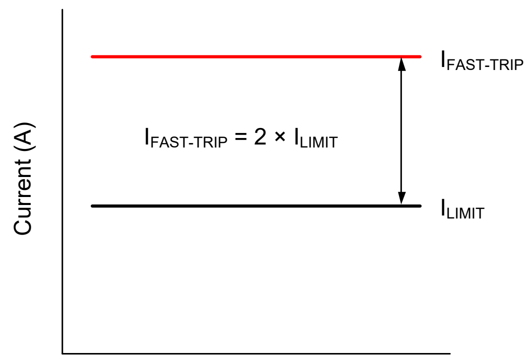


Figure 6. Over-Current Protection Levels

DETAILED DESCRIPTION (continued)

Start-Up with Short on Output

During start-up into an output short condition, the current is limited to I_{LIMIT}. This feature helps in quick fault isolation and ensures stability of the DC bus.

IN, OUT and GND Pins

The IN pin should be connected to the power source. It is recommended to install a ceramic bypass capacitor close the device to reduce bus transient. The recommended operating voltage range is 2.6V to 22V. The OUT pin should be connected to the load. V_{OUT} in the on-condition is calculated using the Equation 7:

$$V_{OUT} = V_{IN} - (R_{DS(ON)} \times I_{OUT}) \quad (7)$$

where $R_{DS(ON)}$ is the on-resistance of the internal FET.

GND terminal is the most negative voltage in the circuit and is used as a reference for all voltage references unless otherwise specified.

Thermal Shutdown

Internal over-temperature shutdown disables/turns off the FET when T_J > 155℃ (TYP). The SGM2523B latches off the internal FET, whereas SGM2523A commences an auto-retry cycle t_{TSD_DLY} milliseconds after T_J drops below [T_{TSD} - 20℃]. During the thermal shutdown, the fault pin EN/nFAULT is pulled low to signal a fault condition.

Shutdown Control

The internal FET and the load current can be remotely switched off by taking the EN/nFAULT pin below its V_{ENF} threshold.

Operational Overview of Device Functions

The device functionality for various conditions is shown in Table 1.

Table 1. Operational Overview of Device Functions

Device	SGM2523
Start-Up	In-rush ramp controlled by capacitor at SS pin.
	In-rush limited to I_{LIMIT} level as set by $R_{ILIM.}$
	If T_J > T_{TSD} device shuts off.
Over-Current Response	Current is limited to I_{LIMIT} level as set by $R_{ILIM.}$
	Power dissipation increases as V_{IN} - V_{OUT} grows.
	Device turns off when T_J > $T_{TSD.}$
	SGM2523A will attempt restart t_{TSD_DLY} ms after T_J < [T_{TSD} -20°C].
	SGM2523B remains off.
Short-Circuit Response	Fast shut off when I_{LOAD} > $I_{FAST-TRIP.}$
	Quick restart and current limited to I_{LIMIT}, follows standard start-up cycle.

The SGM2523 provides simple solutions for current limit, in-rush current control and supervision of power rails for wide range of applications operating at 2.6V to 22V and delivering up to 1.6A.

SYSTEM EXAMPLES

Protection and Current Limit for Primary-Side Regulated Power Supplies

In many applications, such as smart phones, portable hand-held devices, white goods, set-top boxes and game machines, the primary-side power supplies and adapter are dominant. These power supplies provide efficient, low cost and low component count solutions for power requirements from 5W to 30W. However, these come with drawbacks of:

• No secondary-side protection which can stop short-circuit and other key faults immediately.
• Can not provide precision current limit for overload transients.
• Have poor output voltage regulation for sudden change in AC input voltages, triggering output over-voltage condition.

Many of the above applications require precision output current limit and secondary-side protection, which requires current sensing on the secondary-side. This requires the use of precision operational amplifiers for additional circuit implementation. This increases the complexity of the solution and also results in sensing losses. The SGM2523 with integrated low-ohmic N-channel FET provides a simple and efficient solution. Figure 7 shows the typical implementation using of the SGM2523.

During short-circuit conditions, the internal fast comparator of SGM2523 turns off the internal FET within typical 0.3μs as soon as current exceeds $I_{FAST-TRIP}$, set by the current limit R_{ILIM} resistor.

In addition to the above function, the SGM2523 provides in-rush current limit during the output ramp up procedure.

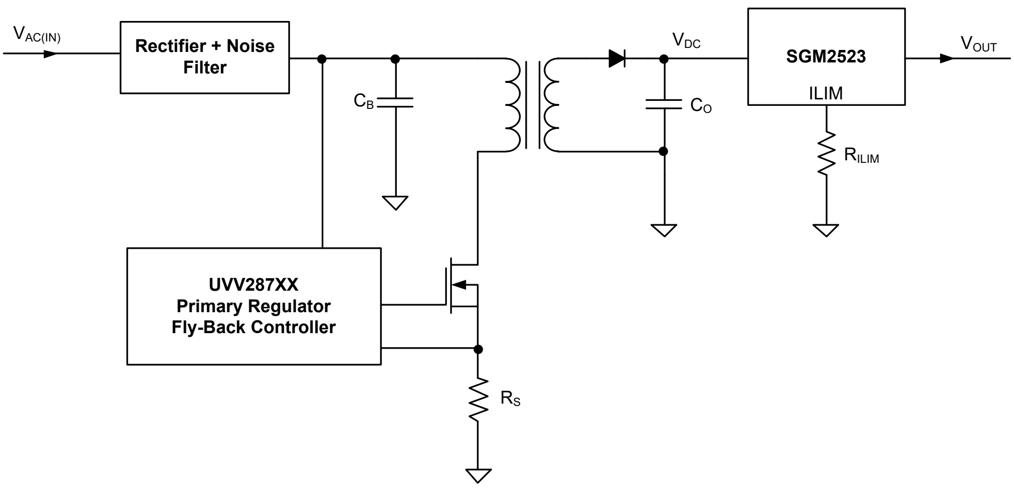


Figure 7. Current Limit and Protection for AC-DC Power Supplies

SYSTEM EXAMPLES (continued)

Precision Current Limit in Intrinsic Safety Applications

Intrinsic safety (IS) is becoming an urgent need for safe operation of electrical and electronic equipment in hazardous areas. IS requires that the total energy available in the equipment is not sufficient to ignite an explosive environment. Energy can be electric in the form of sparks, or it can be hot, in the form of hot surfaces. This requires precision current limits to ensure that the set current limits are not exceeded over a wide operating temperature range and variable environmental conditions. Applications such as gas analyzers, medical devices (such as electrocardiographs), portal industrial equipment, wired distribution systems, and hand-held power tools all need to meet these critical safety standards. The SGM2523 device can be used as simple protection solution for each of the internal rails. Figure 8 shows the typical implementation using of the SGM2523.

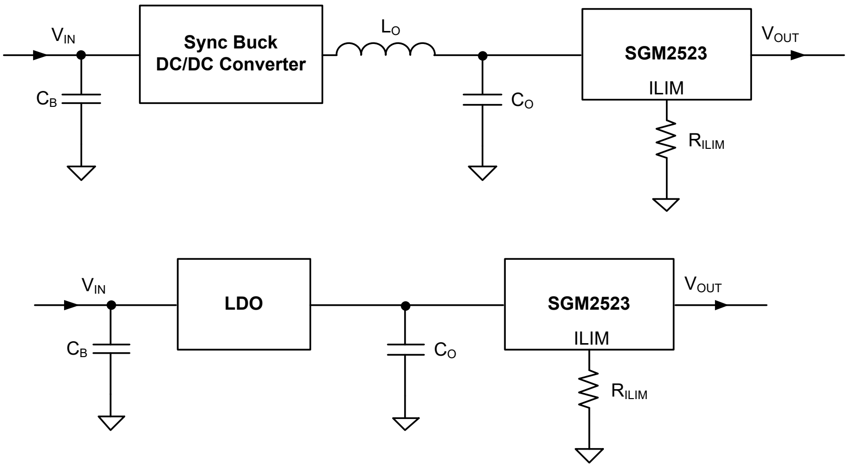


Figure 8. Precision Current Limit and Protection of Internal Rails

Smart Load Switch

The intelligent load switch is a series of MOSFETs used to switch the load (resistance or inductance). It also provides protection in case of failure. A typical discrete implementation is shown in Figure 9. Discrete solutions have a higher number of components and require complex circuits to meet the needs of each protection fault. SGM2523 can be used as a smart power switch for applications operating range from 2.6V to 22V. SGM2523 provides programmable soft-start, programmable current limits, over-temperature protection, a fault flag, and under-voltage lockout.

Figure 9 shows typical implementation and usage of the SGM2523 as a load switch. This configuration can be used for driving a solenoid and fan control. It is recommended to use a freewheeling diode across the load when load is highly inductive.

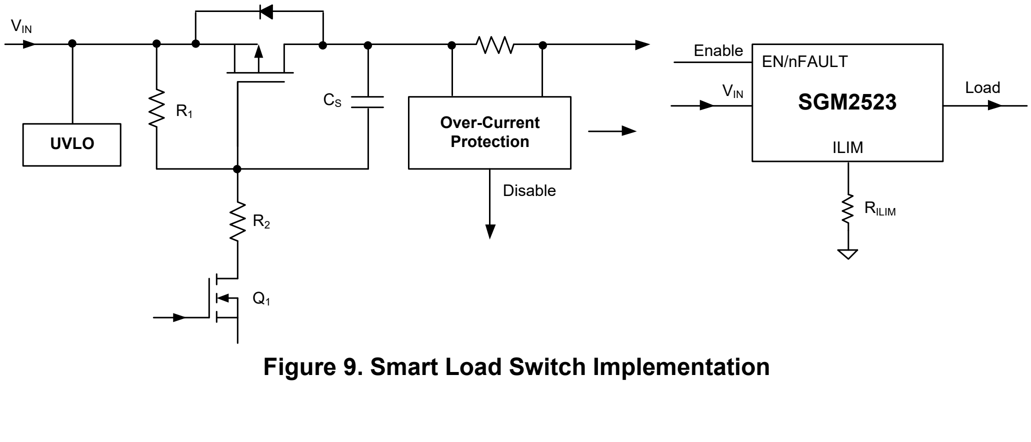


Figure 9. Smart Load Switch Implementation

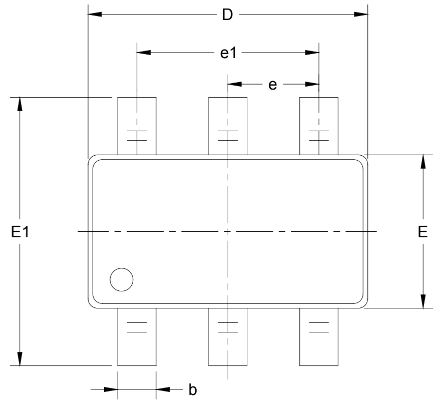
REVISION HISTORY

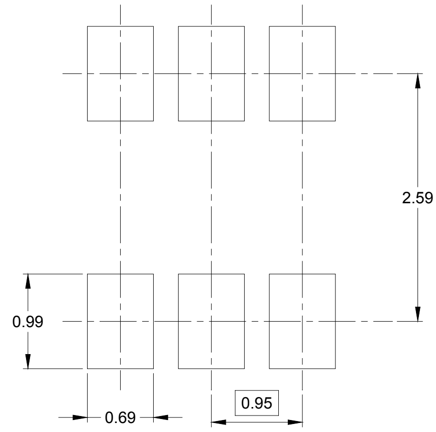
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (NOVEMBE 2020) to REV.A	Page
Changed from product preview to production data	All

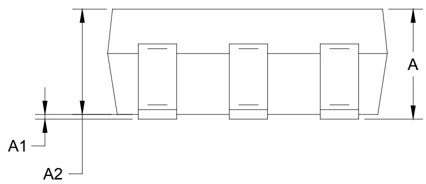
PACKAGE OUTLINE DIMENSIONS

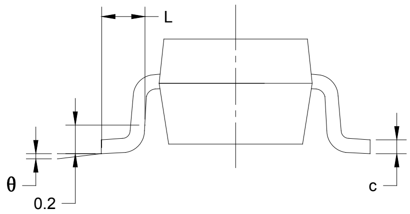
SOT-23-6





RECOMMENDED LAND PATTERN (Unit: mm)

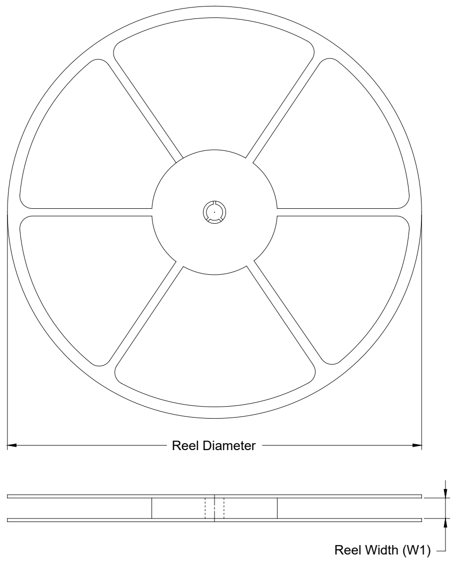




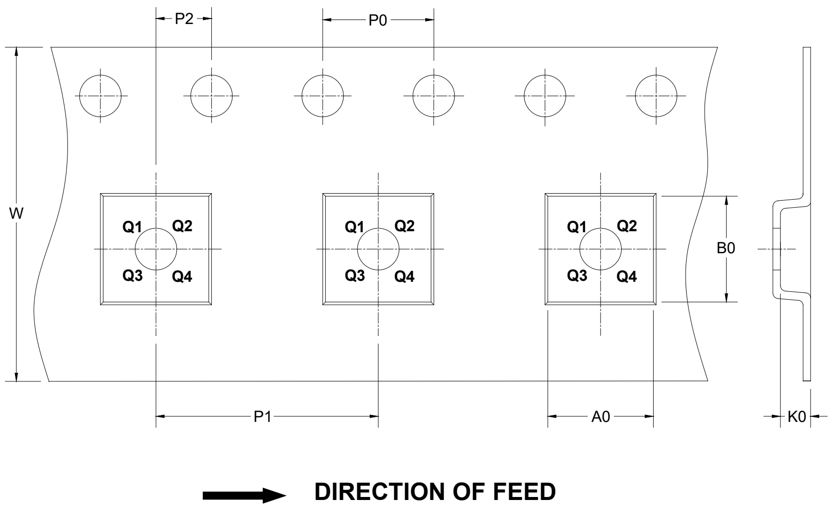
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



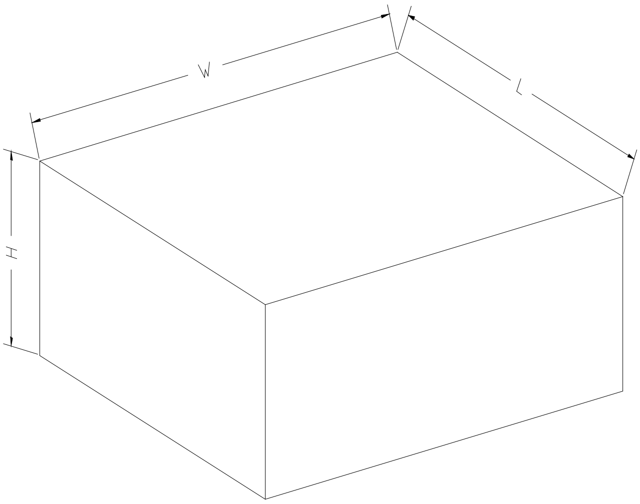
NOTE: The picture is only for reference. Please make the object as the standard.

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
SOT-23-6	7″	9.5	3.17	3.23	1.37	4.0	4.0	2.0	8.0	Q3

DD0001

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