SGM42411Q
Fully Protected Low-side Driver for Automotive Applications

GENERAL DESCRIPTION

The SGM42411Q is a low-side driver full protected by embedded protections and intended for a wide range of automotive applications. It is usually used to direct the resistance or inductive charge attached to one side of the battery. Built-in thermal shutdown, short-circuit, overload protection and over-voltage clamp protect the device in all kinds of harsh environments. If an overload condition occurs, the output current is limited to protect the device. During prolonged overloading, the device limits the dissipation energy to a safe level for heat interruption operations. The device has the function of thermal shutdown and automatic restart. Once the fault situation disappears, the device can operate normally, and the inductive load can be quickly demagnetized during decay time.

The device is AEC-Q100 qualified (Automotive Electronics Council (AEC) standard Q100 Grade 1) and it is suitable for automotive applications.

The SGM42411Q is available in a Green SOT-223-3 package.

FEATURES

- **AEC-Q100 Qualified for Automotive Applications**
  Device Temperature Grade 1
  T_A = -40℃ to +125℃
- **Full Set of Protections**
  - **Short-Circuit Protection**
  - **Over-Voltage Protection**
  - **ESD Protection**
  - **Overload Protection**
  - **Thermal Shutdown with Automatic Restart**
- **Output Clamp Voltage: 44V**
- **Continuous Drain Current: 2A (TYP)**
- **On-Resistance: 130mΩ (TYP)**
- **Power and Current Limitation**
- **SGM42411Q Available in a Green SOT-223-3 Package**

SIMPLIFIED SCHEMATIC

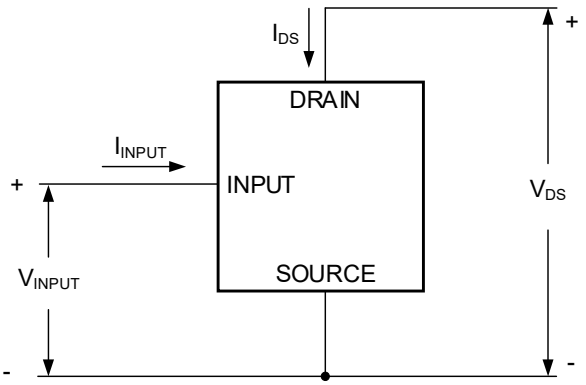


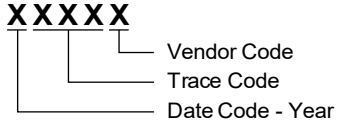
Figure 1. Current and Voltage Conventions

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE TOP MARKING	PACKING OPTION
SGM42411Q	SOT-223-3	-40℃ to +125℃	SGM42411QKC3G/TR	1GF XXXXX	Tape and Reel, 2500

MARKING INFORMATION

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



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

Logic Pin and Supply Pin 6V
Maximum Jump Start Voltage for Single Pulse Short-Circuit Protection, V_{DRAIN_JS} 28V
Drain-Source Voltage (V_{IN} = 0V), V_{DS} ..... Internally Clamped
DC Drain Current, I_{DS} ..... Internally Clamped
Reverse DC Drain Current, $-I_{DS}$ 4A
DC Supply Current, I_S ..... -1mA to 10mA
DC Input Current, I_{IN} ..... -1mA to 10mA
Single Pulse Avalanche Energy (L = 8.5mH, T_J = +150℃, R_L = 0Ω, V_{BATT} = 13.5V, I_{OUT} = I_{LIML}) 37mJ
Package Thermal Resistance (SGM42411Q Only)
SOT-223-3, θ_{JA} ..... 94.8℃/W
SOT-223-3, θ_{JB} ..... 18.1℃/W
SOT-223-3, θ_{JC} ..... 50.3℃/W
Package Thermal Characterization Parameter
SOT-223-3, ψ_{JT} ..... 7.5℃/W
SOT-223-3, ψ_{JB} ..... 16.4℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility (1) (2)
HBM ..... ±6000V
CDM ..... ±1000V

NOTES:

1. For human body model (HBM), all pins comply with AEC-Q100-002 specification.

2. For charged device model (CDM), all pins comply with AEC-Q100-011 specification.

RECOMMENDED OPERATING CONDITIONS

Operating Ambient Temperature Range ..... -40℃ to +125℃
Operating Junction Temperature Range ..... -40℃ to +150℃

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

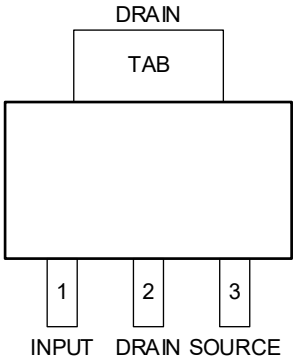
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance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

SGM42411Q (TOP VIEW)



SOT-223-3

PIN DESCRIPTION

PIN	NAME	FUNCTION
1	INPUT	Voltage Controlled Input Pin. Control the output switch state.
2	DRAIN	Drain.
3	SOURCE	Source.
TAB	DRAIN	Drain.

ELECTRICAL CHARACTERISTICS

(V_{IN} = 4.5V to 5.5V, T_J = -40℃ to +150℃, typical values are measured at T_J = +25℃, unless otherwise noted.)

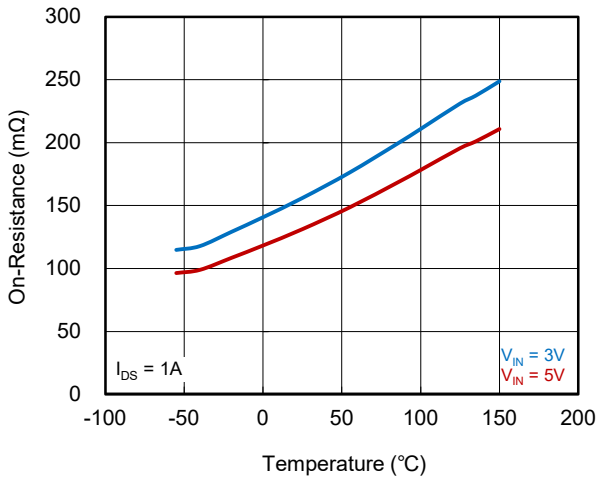
PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Power MOS Characteristics							
Operating Supply Voltage	V_{SUPPLY}			3.5	5	5.5	V
On-Resistance	R_{ON}	V_{IN} = 5V, I_{DS} = 1A	T_J = +25℃		130	170	mΩ
			T_J = +150℃			260	
Drain-Source Clamp Voltage	V_{CLAMP}	V_{IN} = 0V, I_{DS} = 20mA		41	44	49	V
Drain-Source Clamp Threshold Voltage	V_{CLTH}	V_{IN} = 0V, I_{DS} = 2mA		40			V
Off-State Output Current	I_{DSS}	V_{IN} = 0V, V_{DS} = 13V	T_J = +25℃			1	μA
			T_J = +150℃			3	μA
Source-Drain Diode							
Forward on Voltage	V_{SD}	I_{DS} = 1A, V_{IN} = 0V			0.87		V
Input Characteristics (1)							
Supply Current from Input Pin	I_{ISS}	On-state: V_{IN} = 5V, V_{DS} = 0V			39	85	μA
Input Clamp Voltage	V_{ICL}	I_S = 1mA		6.3		7.2	V
		I_S = -1mA			-0.6		V
Input Threshold Voltage	V_{INTH}	V_{DS} = V_{IN}, I_{DS} = 1mA		1		3.5	V
Switching Characteristics (V_{CC} = 13V) (1)							
Turn-On Delay Time	t_{D_ON}	R_L = 13Ω, V_{CC} = 13V			16.6		μs
Turn-Off Delay Time	t_{D_OFF}	R_L = 13Ω, V_{CC} = 13V			12.2		μs
Rise Time	t_R	R_L = 13Ω, V_{CC} = 13V			17		μs
Fall Time	t_F	R_L = 13Ω, V_{CC} = 13V			13		μs
Slew-Rate On	$-dV_{DS}/dt_{ON}$	80% to 20% V_{CC}			-0.65		V/μs
Slew-Rate Off	dV_{DS}/dt_{OFF}	20% to 80% V_{CC}			0.85		V/μs
Switching Energy Losses at Turn-On	W_{ON}	R_L = 13Ω, V_{CC} = 13V			44.4		μJ
Switching Energy Losses at Turn-Off	W_{OFF}	R_L = 13Ω, V_{CC} = 13V			38.4		μJ
Protection and Diagnostics							
DC Short-Circuit Current	I_{LIMH}	V_{DS} = 13V, V_{IN} = 5V		3.5	6	8.5	A
Short-Circuit Current during Thermal Cycling	I_{LIML}	V_{DS} = 13V, T_R < T_J < T_{SD}, V_{IN} = 5V			3.2		A
Step Response Current Limit	t_{DLIM}	V_{DS} = 13V, V_{INPUT} = 5V			21		μs
Shutdown Temperature	T_{SD}				170		℃
Reset Temperature	T_R				160		℃
Thermal Hysteresis (T_{SD} - T_R)	T_{HYS}				10		℃

NOTE:

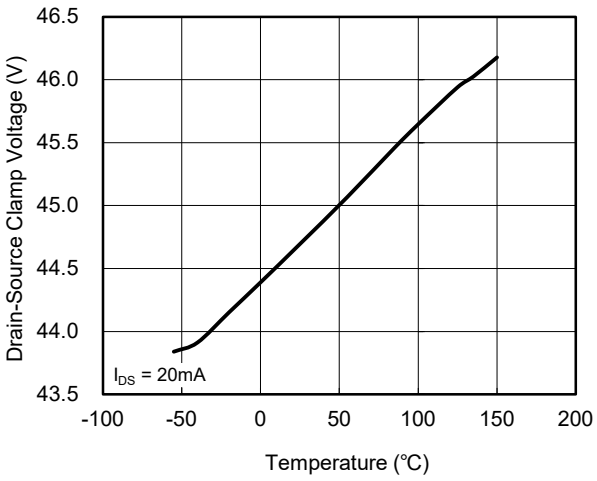
1. V_{IN} = 3.5V to 5.5V.

TYPICAL PERFORMANCE CHARACTERISTICS

On-Resistance vs. Temperature



Drain-Source Clamp Voltage vs. Temperature



SWITCHING CHARACTERISTICS

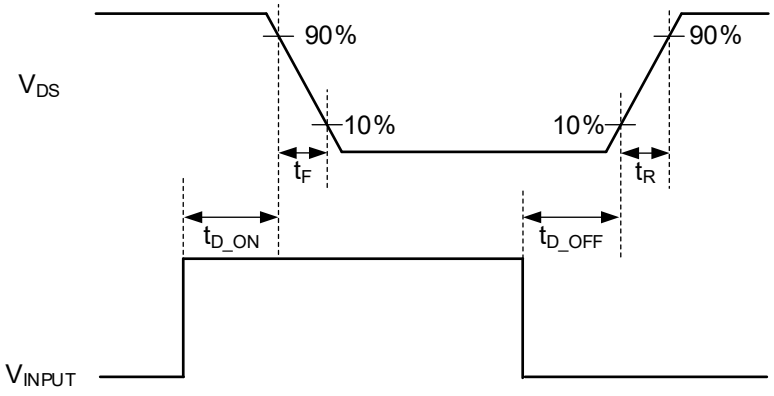


Figure 2. Switching Characteristics

TYPICAL APPLICATION CIRCUIT

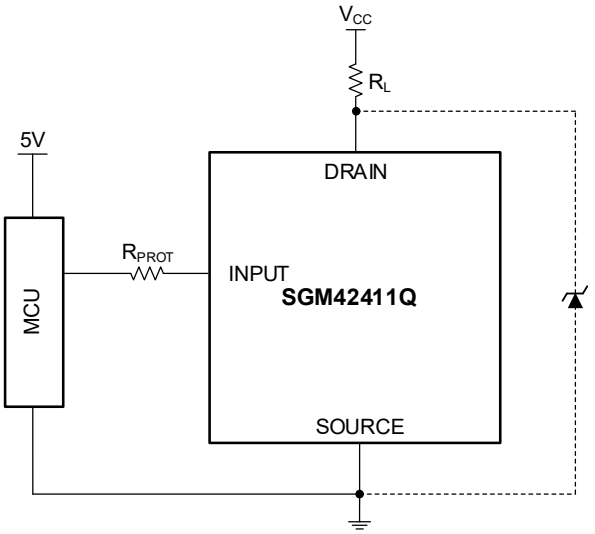


Figure 3. Application Schematic (SOT-223-3 Package)

NOTE: 1. For better surge protection, it is recommended to add a TVS (e.g. SGM18HU1ANXUGI2G) in parallel between the Drain and Source pin.

FUNCTIONAL BLOCK DIAGRAM

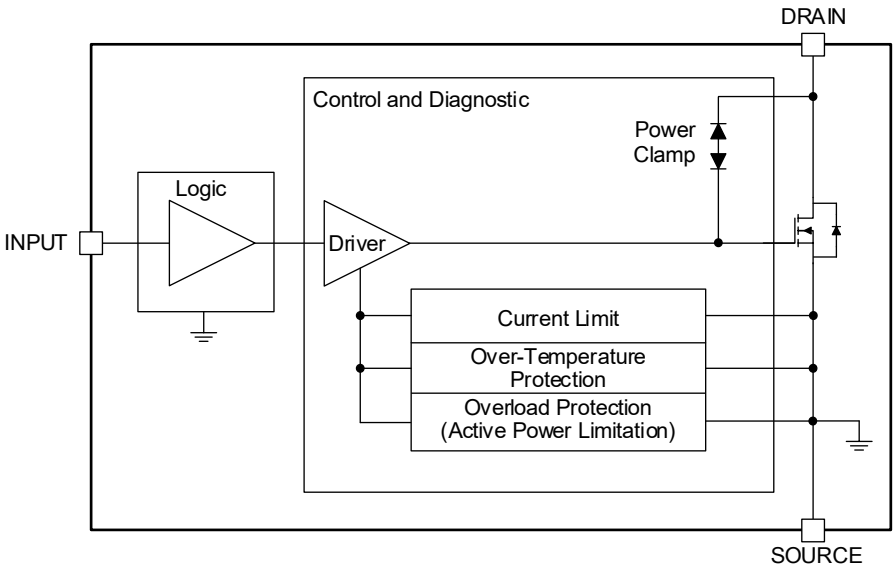


Figure 4. Block Diagram

APPLICATION INFORMATION

MCU I/O Protection

In some severe conditions, such as the ISO7637-2 test, a negative pulse occurs on the GND pin. This pulse can cause damage on the connected microcontroller. Serial resistors are recommended to protect the microcontroller, when choosing the serial resistor, there are several factors need to consider, such as MCU I/O leakage current, low-side driver input threshold level, MCU I/O latch-up current limit. Please refer to example calculation below:

$$0.7/I_{LATCHUP} \le R_{PROT} \le (V_{OH\mu C} - V_{INTH})/I_{ISSMAX}$$

where $I_{LATCHUP} \ge 20mA$, $V_{OH\mu C} \ge 4.5V$, $35\Omega \le R_{PROT} \le 21k\Omega$.
Recommended values: $R_{PROT} = 1k\Omega$.

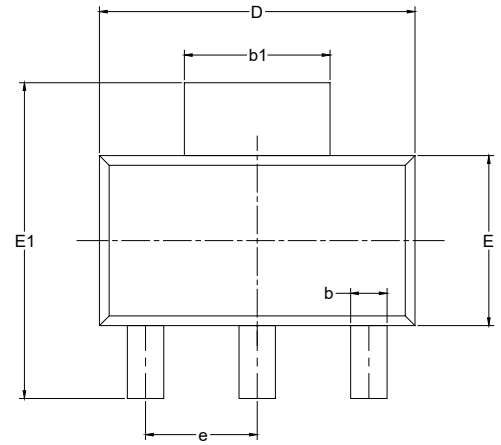
REVISION HISTORY

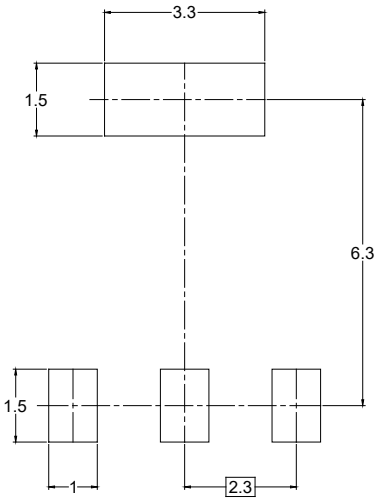
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original to REV.A (APRIL 2026)	Page
Changed from product preview to production data	All

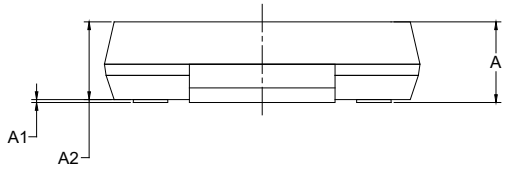
PACKAGE OUTLINE DIMENSIONS

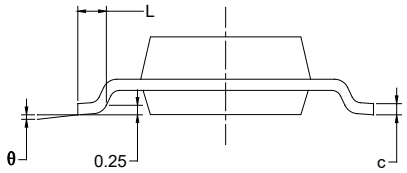
SOT-223-3





RECOMMENDED LAND PATTERN (Unit: mm)



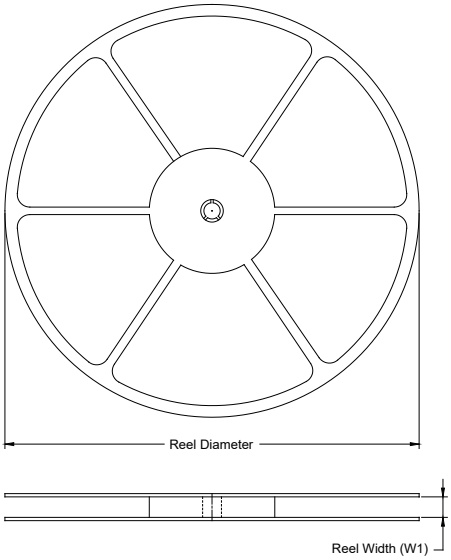


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.800		0.071
A1	0.020	0.100	0.001	0.004
A2	1.500	1.700	0.059	0.067
b	0.660	0.840	0.026	0.033
b1	2.900	3.100	0.114	0.122
c	0.230	0.350	0.009	0.014
D	6.300	6.700	0.248	0.264
E	3.300	3.700	0.130	0.146
E1	6.700	7.300	0.264	0.287
e	2.300 BSC		0.091 BSC	
L	0.750		0.030	
θ	0°	10°	0°	10°

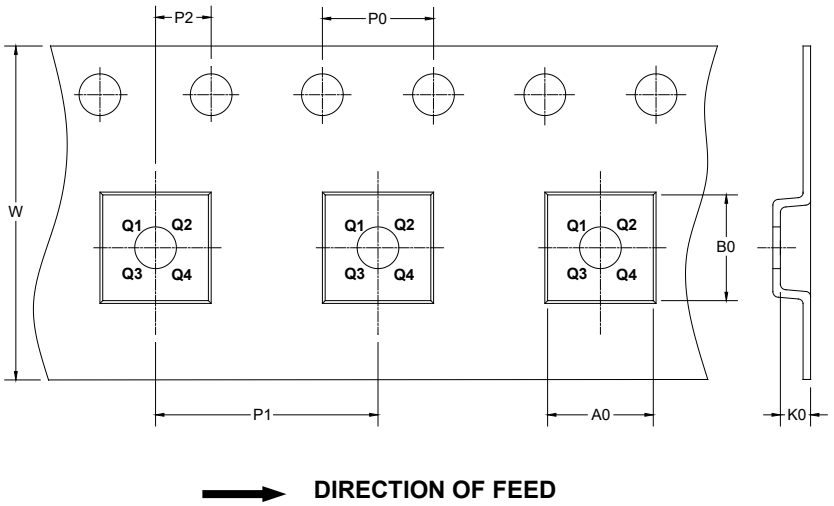
NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



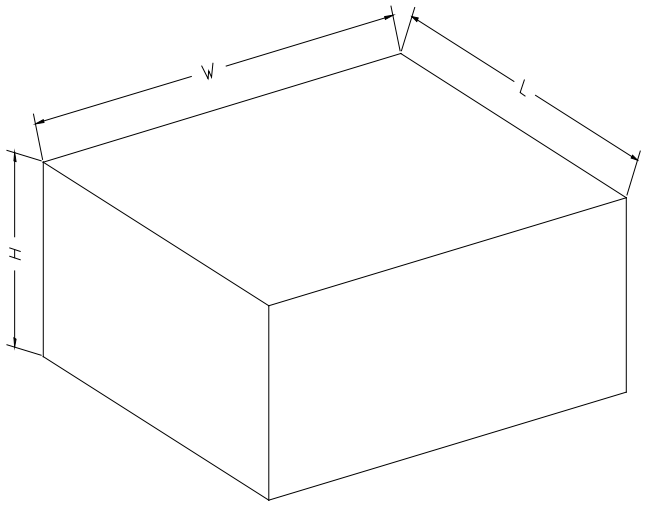
NOTE: The picture is only for reference. Please make the object as the standard.

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
SOT-223-3	13"	12.4	6.55	7.25	1.90	4.0	8.0	2.0	12.0	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
13″	386	280	370	5

DD0002