SGM2576/SGM2576B
Power Distribution Switches

GENERAL DESCRIPTION

The SGM2576 and SGM2576B are integrated typically 100mΩ power switch for self-powered and bus-powered Universal Series Bus (USB) applications.

The SGM2576 and SGM2576B integrate programmable current limiting to protect the upstream power supply from damage during over-current or short-circuit conditions. They have thermal shutdown that protect the device and load. Thermal shutdown shuts off the output MOSFET if the die temperature exceeds +150℃ until the die temperature drops to +130℃.

These devices employ soft-start circuit that minimizes inrush current in applications where highly capacitive loads are employed.

SGM2576 and SGM2576B are available in the Green SOT-23-5 package. They are rated over the -40℃ to +85℃ temperature range.

FEATURES

- **100mΩ (TYP) High-side N-Channel MOSFET**
- **Programmable Current Limit Range: 0.4A to 2.5A**
  1500mA ± 190mA@R_{ILIM} = 4.53kΩ
- **Input Voltage Range: 2.5V to 5.5V**
- **Low 23μA Quiescent Current**
- **Typical 0.1μA Shutdown Current**
- **Soft-Start Function**
- **Temperature Shutdown Protection**
- **Under-Voltage Lockout Protection for VIN**
- **No Reversed Leakage Current (Reverse Blocking)**
- **Automatic Output Discharge in Shutdown Mode (SGM2576 Only)**
- **500kΩ Pull-Down Resistor at EN Pin**
- **Evaluated to IEC 60950-1, Ed 2, Am1, Annex CC, Test Program 1 with CB Report**
- **Available in the Green SOT-23-5 Package**

APPLICATIONS

General Purpose Power Switching
USB Bus/Self Powered Hubs
USB Peripherals
ACPI Power Distribution
Smart Phone
LCD TV

TYPICAL APPLICATION

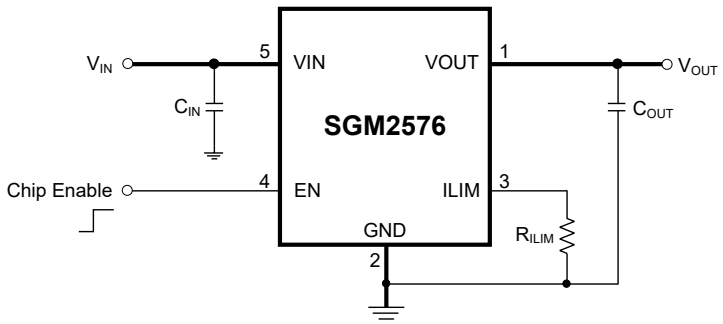


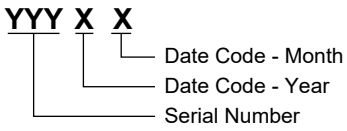
Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2576	SOT-23-5	-40℃ to +85℃	SGM2576YN5G/TR	SU3XX	Tape and Reel, 3000
SGM2576B	SOT-23-5	-40℃ to +85℃	SGM2576BYN5G/TR	ME4XX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XX = Date 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

All Pins 6V
Power Dissipation, P_D @ T_A = +25℃
SOT-23-5 ..... 0.3W
Package Thermal Resistance
SOT-23-5, θ_{JA} ..... 280℃/W
SOT-23-5, θ_{JC} ..... 93℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 2000V
MM 400V

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range ..... 2.5V to 5.5V
EN Voltage Range ..... -0.3V to 5.5V
All Other Pins ..... 0V to 5.5V
Junction Temperature Range ..... -40℃ to +125℃
Operating Temperature Range ..... -40℃ to +85℃

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

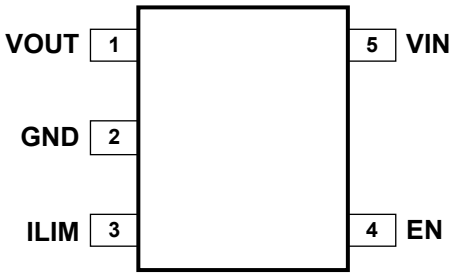
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

DISCLAIMER

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

PIN CONFIGURATION

SGM2576/SGM2576B (TOP VIEW)



SOT-23-5

PIN DESCRIPTION

PIN	NAME	FUNCTION
1	VOUT	Output Voltage.
2	GND	Ground.
3	ILIM	Current Limit Programming Pin. Connect a resistor R_{ILIM} from this pin to GND to program the current limit: $I_{LIM} = \frac{6800}{R_{ILIM}}$ (A)
4	EN	Chip Enable. Active HIGH for SGM2576 and SGM2576B. They have integrated a 500kΩ pull-down resistor at this pin.
5	VIN	Power Input Voltage.

TEST CIRCUIT

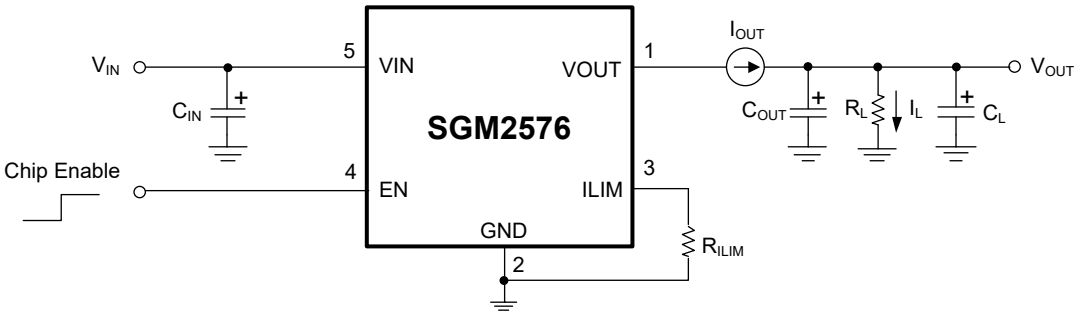


Figure 2. Test Circuit

ELECTRICAL CHARACTERISTICS

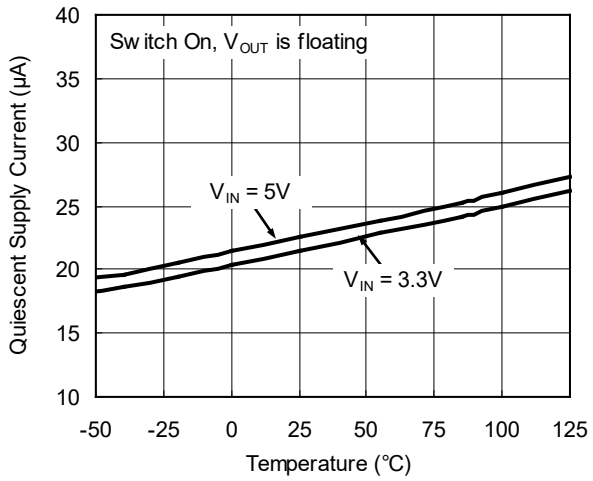
(At T_A = +25℃, V_{IN} = 5V, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range	V_{IN}		2.5		5.5	V
Quiescent Supply Current	I_Q	Switch on, VOUT = open		23	35	μA
Shutdown Supply Current	I_{SD}	Switch off, VOUT = open		0.1		μA
Output Leakage Current	$I_{LEAKAGE}$	Switch off, V_{OUT} = 0V		0.1		μA
Enable Input Threshold	V_{IH}	V_{IN} = 2.5V to 5.5V	1.6			V
	V_{IL}	V_{IN} = 2.5V to 5.5V			0.4	
Pull-Down Resistor at EN Pin	R_{PULL_DOWN}			500		kΩ
Switch Resistance	$R_{DS(ON)}$	V_{IN} = 5V, I_{OUT} = 500mA		100		mΩ
Output Turn-On Delay Time	t_{ON}	R_L = 10Ω, C_L = 1μF, Figure 5		2.3		ms
Output Turn-Off Delay Time	t_{OFF}	R_L = 10Ω, C_L = 1μF, Figure 5		25		μs
Current Limit Threshold	I_{LIM}	R_{ILIM} = 17kΩ		400		mA
		R_{ILIM} = 6.8kΩ		1000		
		R_{ILIM} = 4.53kΩ	1310	1500	1690	
		R_{ILIM} = 3.4kΩ		2000		
		R_{ILIM} = 2.7kΩ		2500		
Under-Voltage Lockout Threshold	V_{UVLO}	V_{IN} rising		2.15	2.3	V
Under-Voltage Lockout Threshold Hysteresis				0.1		V
VOUT Shutdown Discharge Resistance (SGM2576 Only)	R_{DIS}	Switch off		50		Ω
Thermal Shutdown Temperature		T_J increasing		150		℃
Thermal Shutdown Hysteresis				20		℃

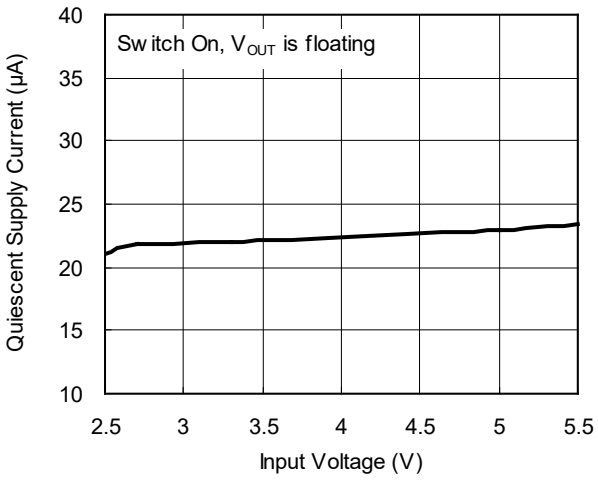
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_{IN} = 5V, unless otherwise noted.

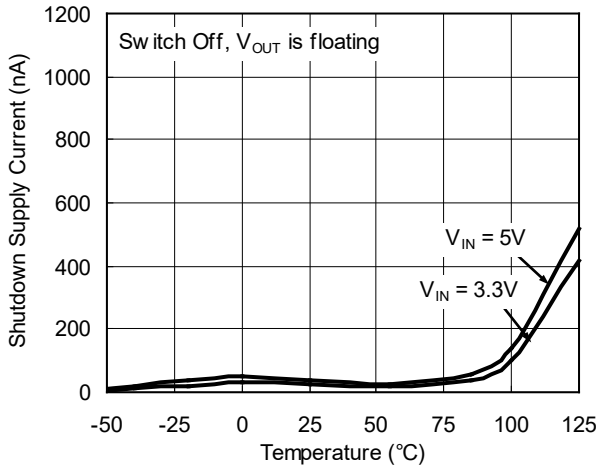
Quiescent Supply Current vs. Temperature



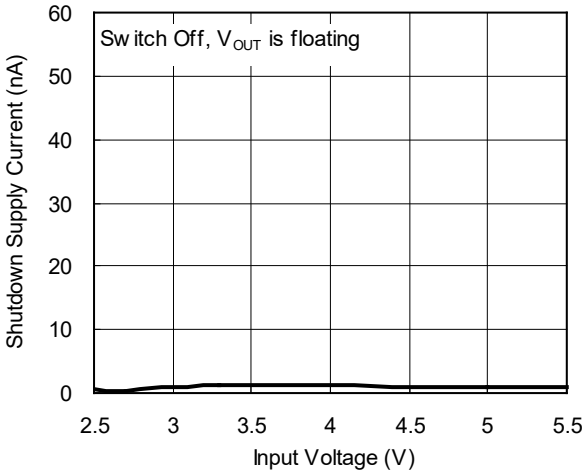
Quiescent Supply Current vs. Input Voltage



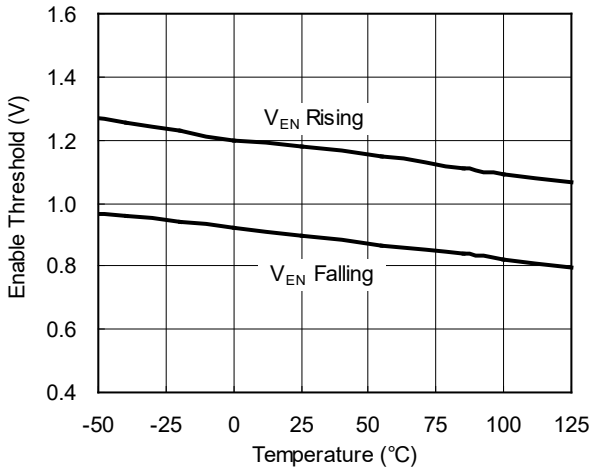
Shutdown Supply Current vs. Temperature



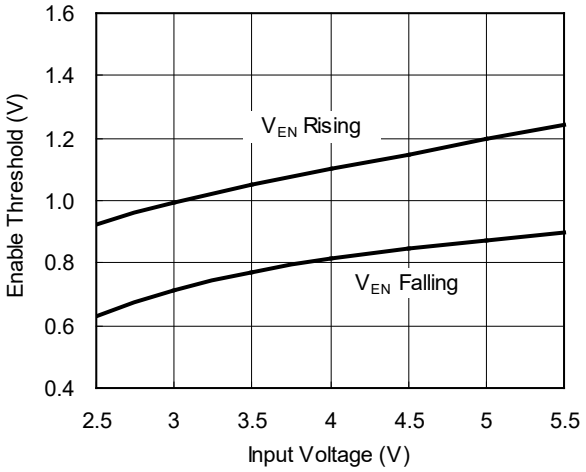
Shutdown Supply Current vs. Input Voltage



Enable Threshold vs. Temperature



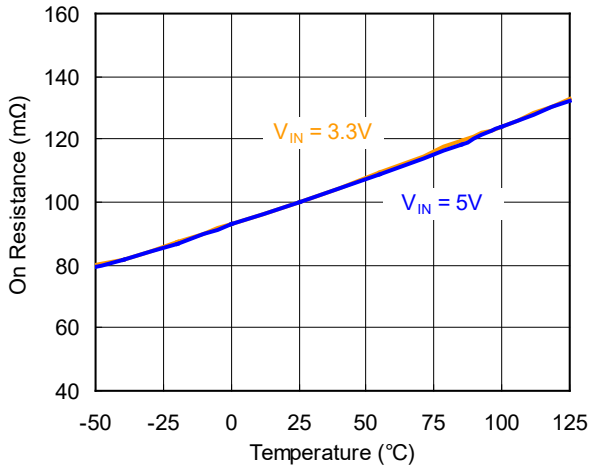
Enable Threshold vs. Input Voltage



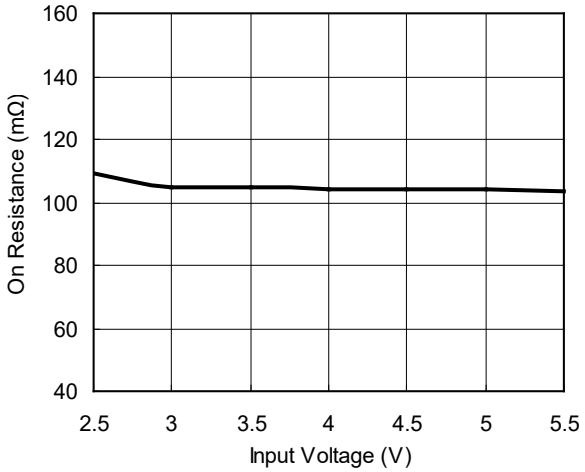
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{IN} = 5V, unless otherwise noted.

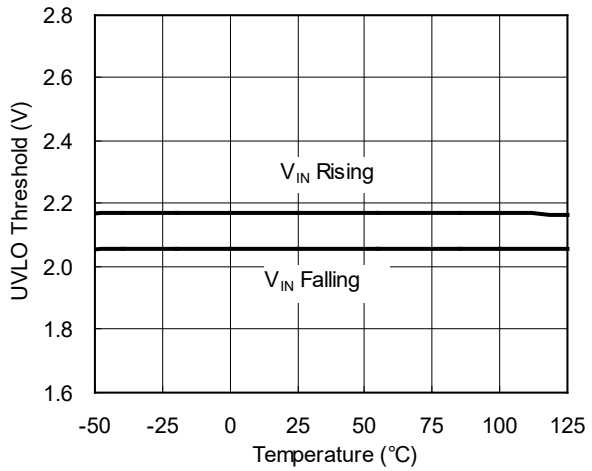
On Resistance vs. Temperature



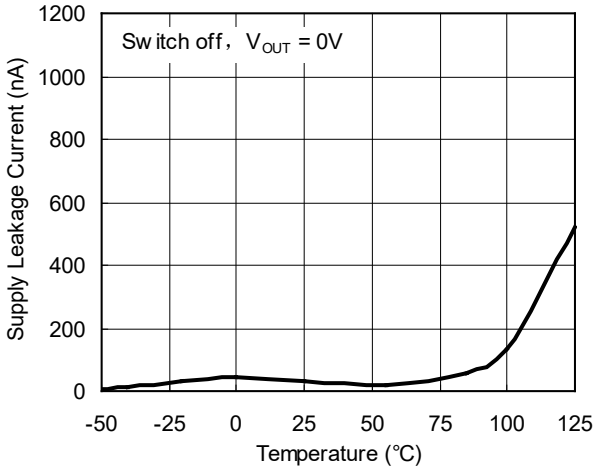
On Resistance vs. Input Voltage



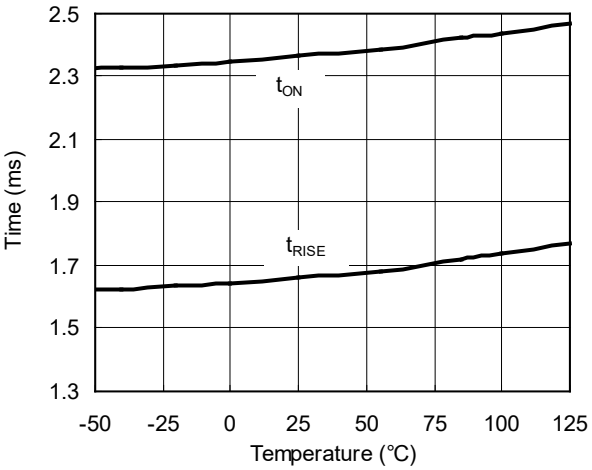
UVLO Threshold vs. Temperature



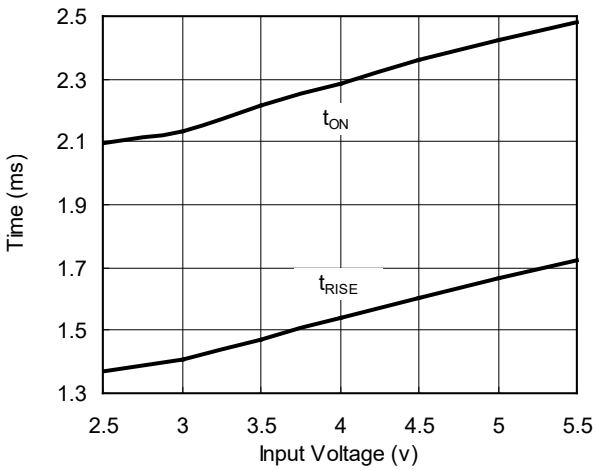
Supply Leakage Current vs. Temperature



Turn-On (Rise) Time vs. Temperature



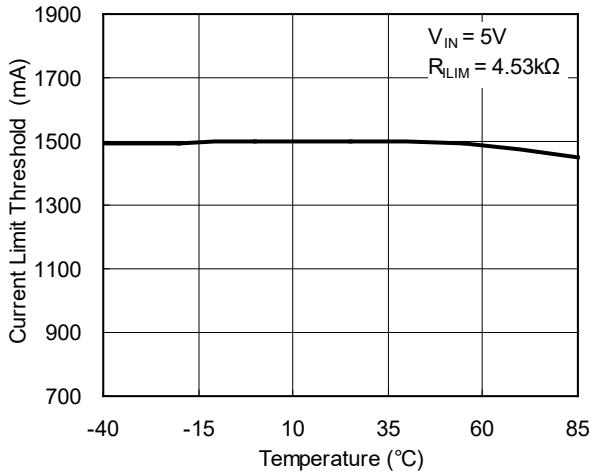
Turn-On (Rise) Time vs. Input Voltage



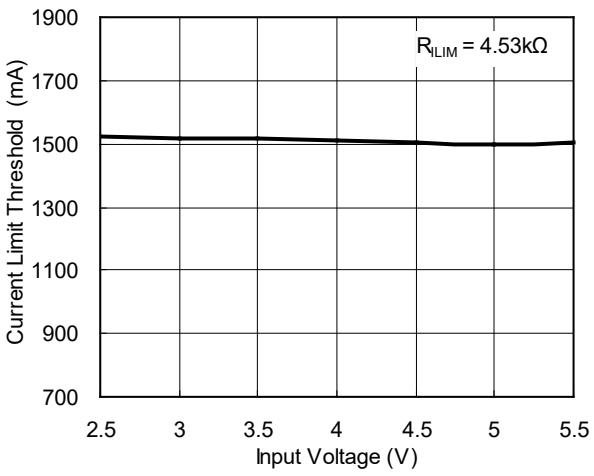
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{IN} = 5V, unless otherwise noted.

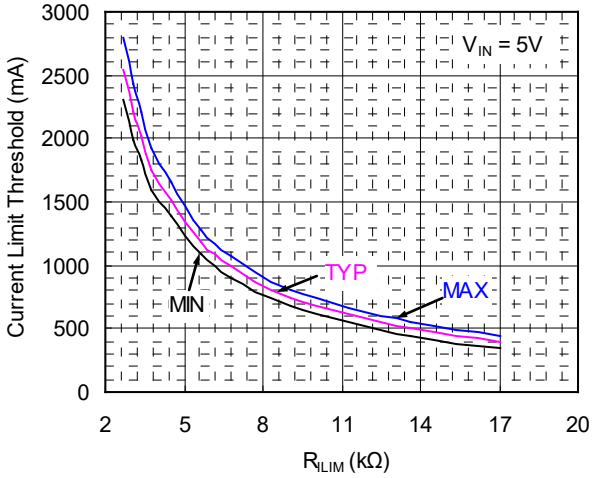
Current Limit Threshold vs. Temperature



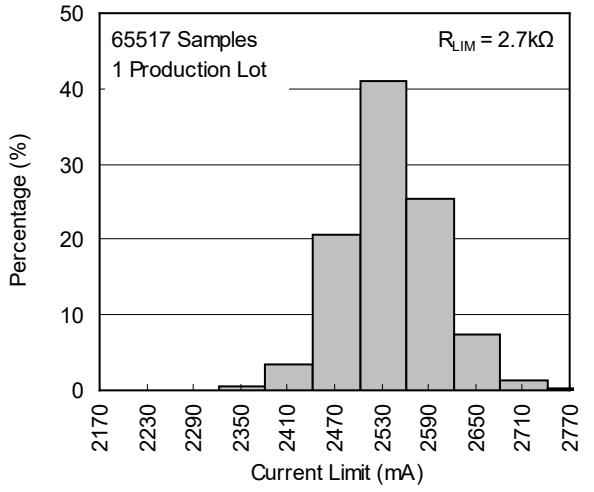
Current Limit Threshold vs. Input Voltage



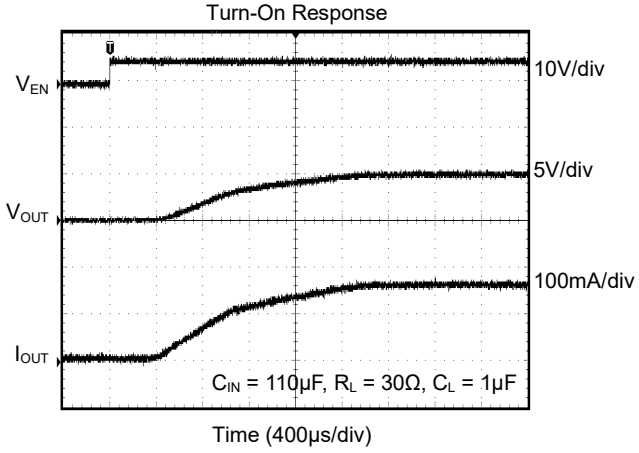
Current Limit Threshold vs. R_{ILIM}



Current Limit Distribution

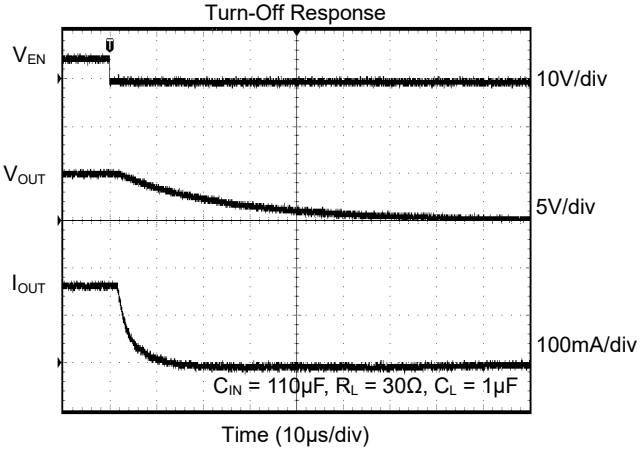


Turn-On Response



Time (400μs/div)

Turn-Off Response

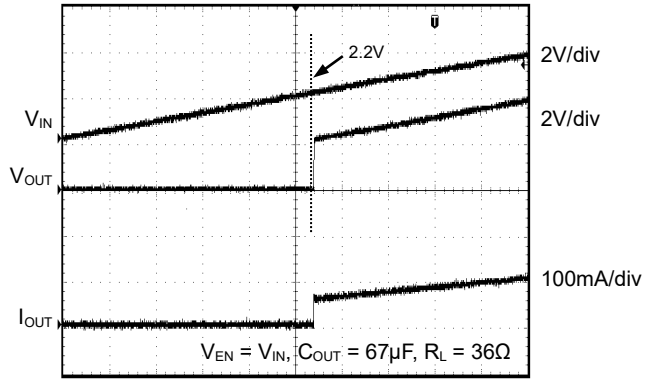


Time (10μs/div)

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

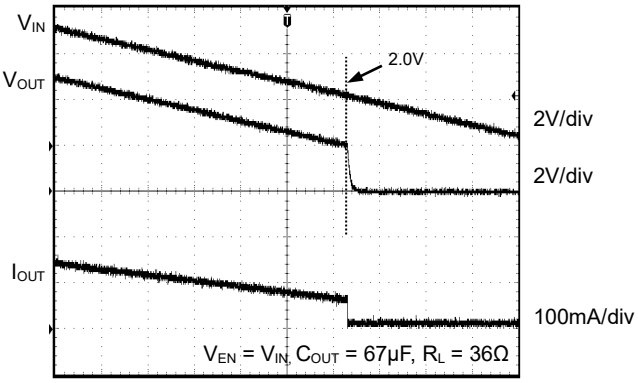
At T_A = +25℃, V_{IN} = 5V, unless otherwise noted.

UVLO at V_{IN} Rising



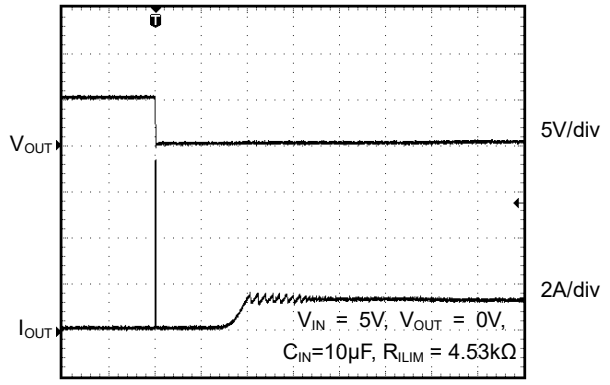
Time (100ms/div)

UVLO at V_{IN} Falling



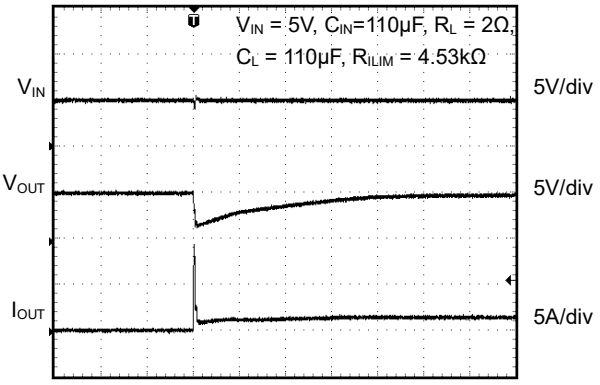
Time (40ms/div)

Short-Circuit Response



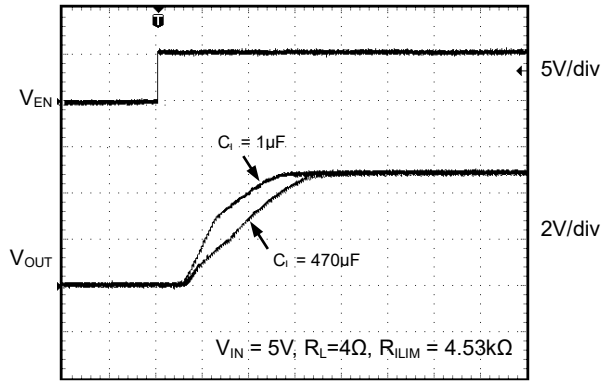
Time (400μs/div)

Resistance Load Inrush Response



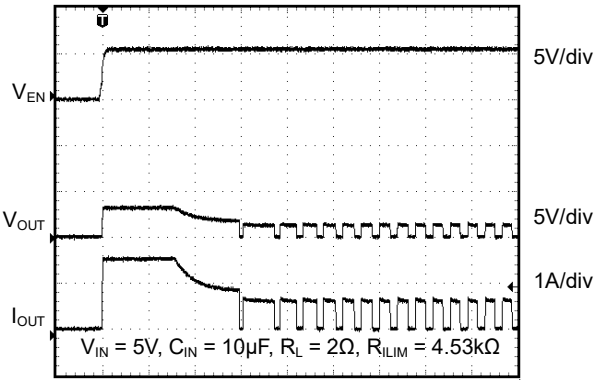
Time (400μs/div)

Inrush Current Response



Time (1ms/div)

Thermal Shutdown Response



Time (100ms/div)

FUNCTIONAL BLOCK DIAGRAMS

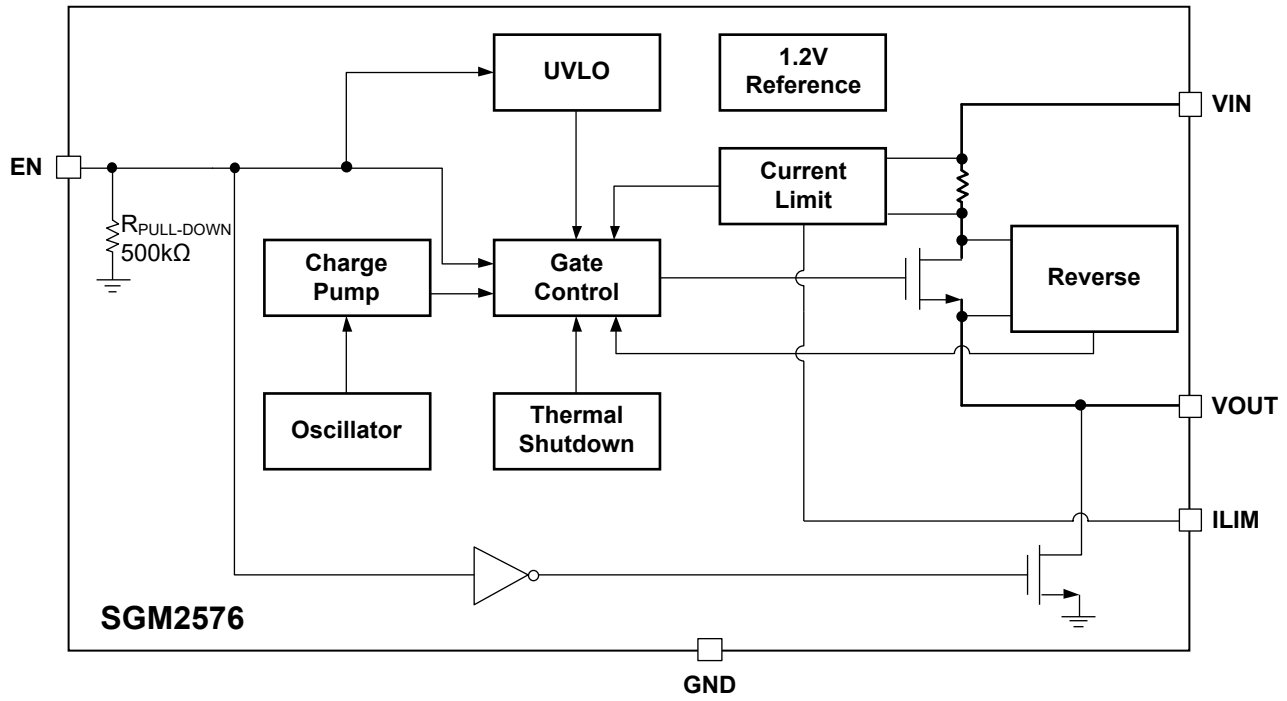


Figure 3. SGM2576 Block Diagram

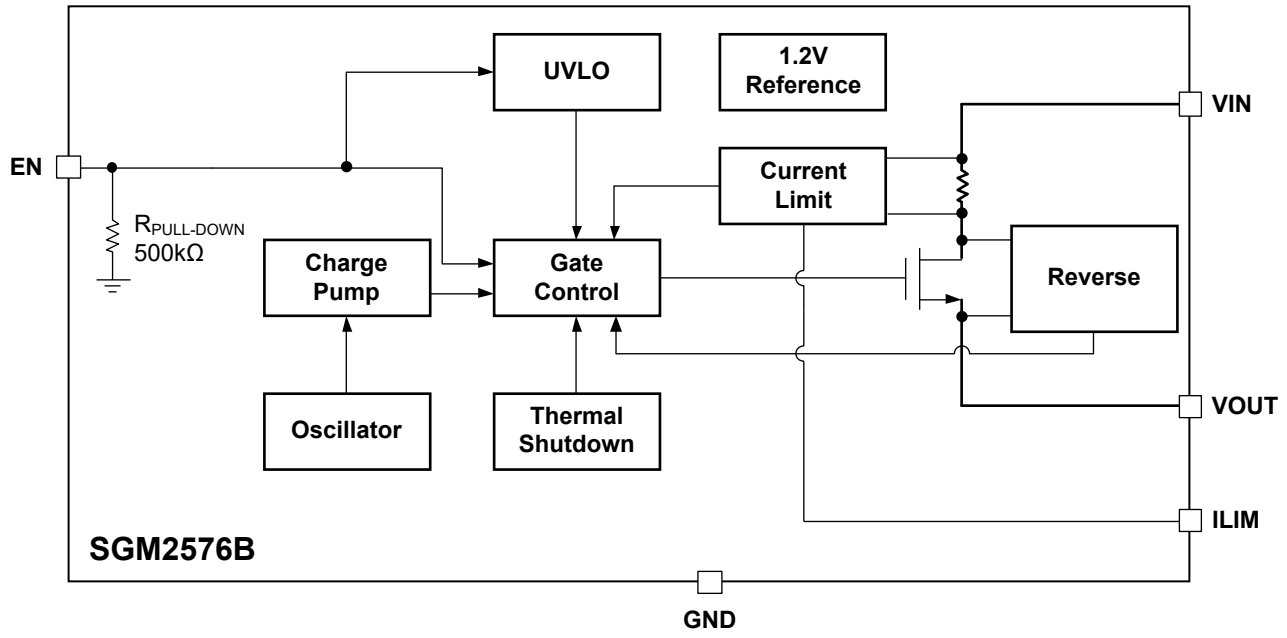


Figure 4. SGM2576B Block Diagram

TIMING DIAGRAM

Figure 5. Switch Turn-On and Turn-Off Delay Times

FUNCTIONAL DESCRIPTION

Input and Output

VIN is the power supply connection to the logic circuitry and the drain of the MOSFET. VOUT is the source of the output MOSFET. In a typical circuit, current flows from VIN to VOUT toward the load. The output MOSFET and driver circuit are also designed to allow the MOSFET source to be externally forced to a higher voltage than the drain (V_{OUT}>V_{IN}) when the switch is disabled.

Thermal Shutdown

Thermal shutdown shuts off the output MOSFET if the die temperature exceeds +150℃ until the die temperature drops to +130℃.

Soft-Start

In order to eliminate the upstream voltage sag caused by the large inrush current during hot-plug events, the ”soft-start” feature effectively isolates power supplies from such highly capacitive loads.

Under-Voltage Lockout (UVLO)

UVLO prevents the MOSFET switch from turning on until input voltage exceeds 2.15V (TYP). If input voltage drops below 2.05V (TYP), UVLO shuts off the MOSFET switch. Under-voltage detection functions only when the switch is enabled.

Current Limiting and Short Protection

The current limit circuit is designed to limit the output current to protect the upstream power supply. The typical current limit threshold is set through R_{ILIM}.

Under output short-circuit condition, the typical current limit folded back 75%.

If SGM2576 and SGM2576B keep at over-current condition for a long time, the junction temperature may exceed 150℃, and over-temperature protection will shut down the output until temperature drops 130℃ or limit (short) condition is removed.

Reverse-Voltage Protection

The reverse-voltage protection feature turns off the N-MOSFET switch whenever the output voltage exceeds the input voltage by 50mV (TYP). Its hysteresis voltage is 38mV (TYP).

Power Dissipation

The device’s junction temperature depends on several factors such as the load, PCB layout, ambient temperature, and package type. Equations that can be used to calculate power dissipation and junction temperature are found below:

$$P_D = R_{DS(ON)} \times I_{OUT}^2$$

To relate this to junction temperature, the following equation can be used:

$$T_J = P_D \times \theta_{JA} + T_A$$

where:
T_J = junction temperature
T_A = ambient temperature
θ_{JA} = the thermal resistance of the package

APPLICATION INFORMATION

Supply Filter Capacitor

In order to prevent the input voltage drooping during hot-plug events, connect a 10μF ceramic capacitor (C_{IN}) from VIN to GND. The C_{IN} is positioned close to VIN and GND of the device. However, higher capacitor values could reduce the voltage sag on the input further. Furthermore, an output short will cause ringing on the input without the input capacitor. It could destroy the internal circuitry when the input transient exceeds 6V which is the absolute maximum supply voltage even for a short duration. Therefore 47μF C_{IN} capacitor is recommended for SGM2576/SGM2576B when programmable current limit threshold exceeds 1.5A.

Output Filter Capacitor

Between VOUT and GND, connect a low-ESR 10μF ceramic capacitor to meet the 330mV maximum drop requirement. Standard bypass methods should be used to minimize inductance and resistance between the bypass capacitor and the down-steam connector. This will reduce EMI and improve the transient performance. If long cables are connected to the output terminals, an anti-parallel schottky diode such as BAT54 is suggested to be placed in parallel with the output terminals to absorb the negative ringing due to the cable inductance.

PCB Layout Guide

For best performance of the SGM2576/SGM2576B, the following guidelines must be strictly followed:

- Keep all V_{BUS} traces as short and wide as possible and use at least 2 ounce copper for all V_{BUS} traces.
- Place a ground plane under all circuitry to lower both resistance and inductance and improve DC and transient performance.
- Dual low-ESR 10μF ceramic capacitors between VOUT and GND, VIN and GND.
- Locate the output capacitor as close to the connectors as possible to lower impedance (mainly inductance) between the port and the capacitor and improve transient performance.
- Input and output capacitors should be placed closed to the IC and connected to ground plane to reduce noise coupling.
- Locate the ceramic bypass capacitors as close as possible to the VIN pin and VOUT pin of SGM2576/SGM2576B.

REVISION HISTORY

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

MARCH 2018 – REV.A.2 to REV.A.3

Added SGM2576B Version	All

DECEMBER 2017 – REV.A.1 to REV.A.2

Update Feature section	1

APRIL 2016 – REV.A to REV.A.1

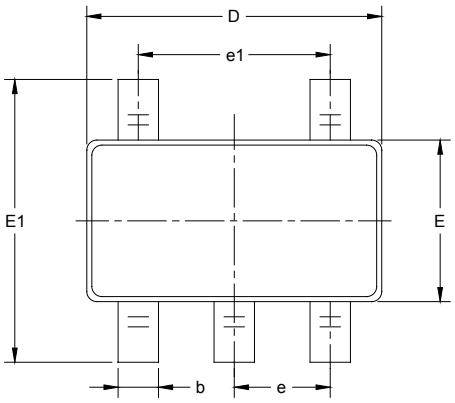
Changed Reverse-Voltage Protection section	10

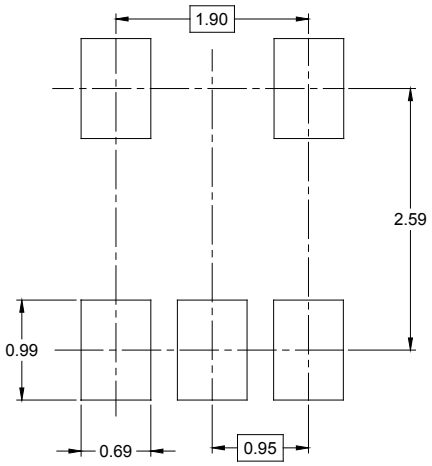
Changes from Original (OCTOMBER 2015) to REV.A

Changed from product preview to production data	All

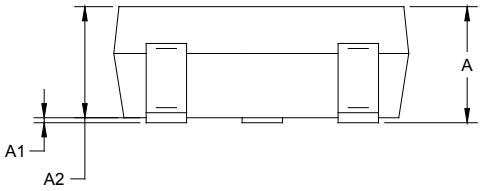
PACKAGE OUTLINE DIMENSIONS

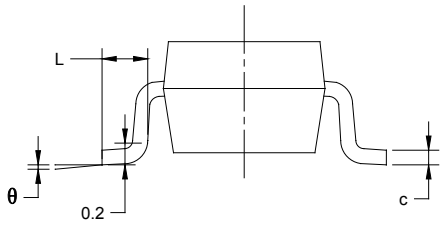
SOT-23-5





RECOMMENDED LAND PATTERN (Unit: mm)

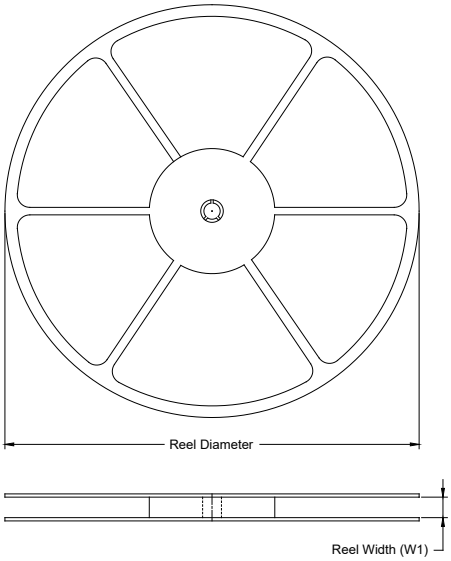




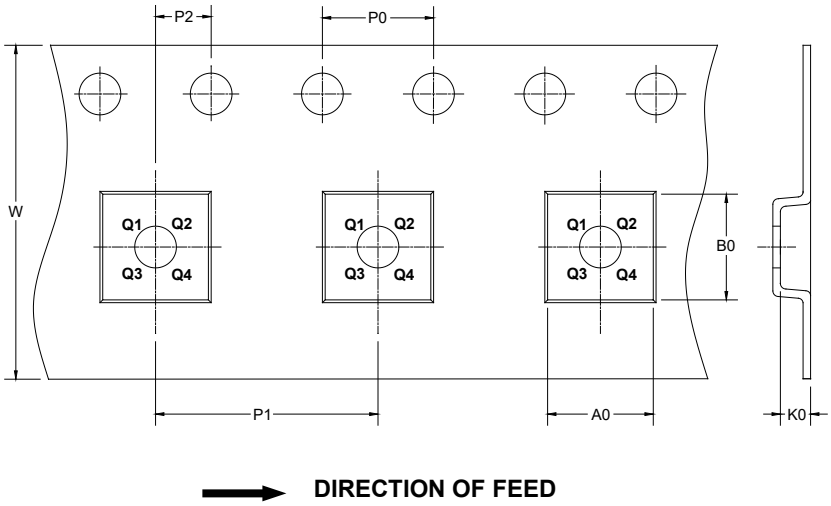
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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



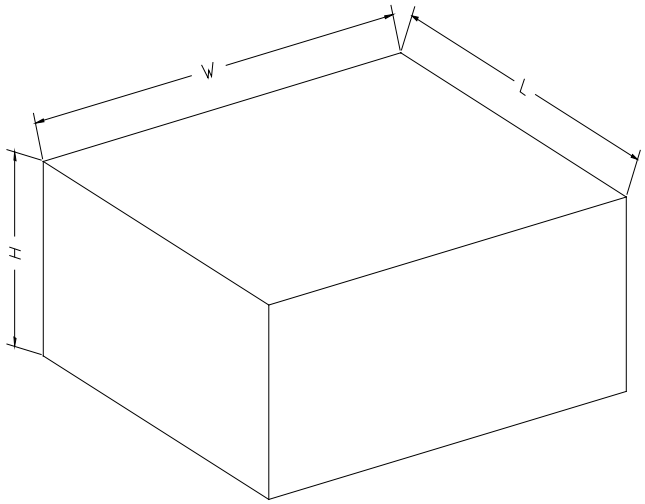
NOTE: The picture is only for reference. Please make the object as the standard.

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-23-5	7″	9.5	3.20	3.20	1.40	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