SGM25642
5.5V, 15A Peak Current Ability, Low R_{DSON} Load Switch with Programmable Soft-Start, Current Monitoring and Output Discharge Function

GENERAL DESCRIPTION

The SGM25642 is a single-channel load switch with controlled slew rate. The VOUT rise time can be programmed by setting an additional capacitor to the SS pin, which can minimize inrush current. The device contains a low R_{DSON} N-MOSFET that can operate over an input voltage range of 2.8V to 5.5V with high efficiency.

The SGM25642 supports 12A continuous current, which can be monitored through IMON pin. EN pin controls the state of the switch. The SGM25642 also features additional functions including programmable de-bounce time, over-voltage protection, power good indication and quick output discharge.

The SGM25642 is available in a Green UTDFN-2.2×2-12L package.

FEATURES

- **Input Voltage Range: 2.8V to 5.5V**
- **VIN Surge up to 12V**
- **Integrated 3.1mΩ Ultra-Low R_{DSON}**
- **12A Continuous Current**
- **Programmable De-bounce Time**
- **Adjustable Start-up Slew Rate**
- **Quick Output Discharge Function**
- **Current Monitor**
- **PG Indication**
- **Over-Voltage Protection**
- **Thermal Protection**
- **VIN Under-Voltage Protection:**
  - **SGM25642A: 2.76V (TYP)**
  - **SGM25642B: 2.66V (TYP)**
- **-40℃ to +125℃ Junction Temperature Range**
- **Available in a Green UTDFN-2.2×2-12L Package**

APPLICATIONS

Notebook and Tablet Computers
Portable Devices
Solid State Drivers
Handheld Devices

TYPICAL APPLICATION

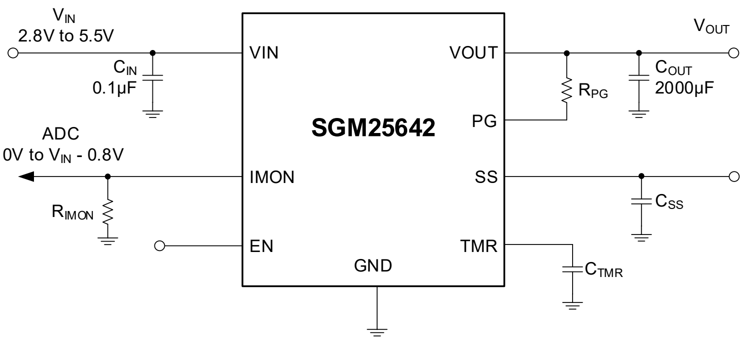


Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM25642A	UTDFN-2.2×2-12L	-40℃ to +125℃	SGM25642AXUHU12G/TR	1VK XXXX	Tape and Reel, 3000
SGM25642B	UTDFN-2.2×2-12L	-40℃ to +125℃	SGM25642BXUHU12G/TR	1VL XXXX	Tape and Reel, 3000

MARKING INFORMATION

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

YYY — Serial Number
XXXX
- Vendor Code
- Trace Code
- Date Code - Year

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

Supply Voltage, V_{IN} .... -0.3V to 6.5V
8/20μs Surge Generator, V_{IN} 12V
Output Voltage, V_{OUT} .... -0.3V to 6.5V
EN, SS, TMR, IMON, PG .... -0.3V to 6.5V
Package Thermal Resistance
UTDFN-2.2×2-12L, θ_{JA} .... 79.1℃/W
UTDFN-2.2×2-12L, θ_{JB} .... 11℃/W
UTDFN-2.2×2-12L, θ_{JC} .... 41.7℃/W
Junction Temperature .... +150℃
Storage Temperature Range .... -65℃ to +150℃
Lead Temperature (Soldering, 10s) .... +260℃
ESD Susceptibility (1) (2)
HBM .... ±4000V
CDM .... ±1000V

NOTES:

1. For human body model (HBM), all pins comply with ANSI/ESDA/JEDEC JS-001 specifications.
2. For charged device model (CDM), all pins comply with ANSI/ESDA/JEDEC JS-002 specifications.

RECOMMENDED OPERATING CONDITIONS

Supply Voltage, V_{IN} .... 2.8V to 5.5V
Enable Voltage, V_{EN} .... 0V to 5.5V
Monitor Resistance, R_{IMON} 1kΩ
Operating Junction Temperature, T_J .... -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

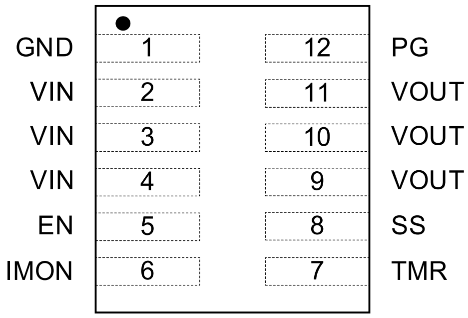
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance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

SGM25642 (TOP VIEW)



UTDFN-2.2×2-12L

PIN DESCRIPTION

PIN	NAME	FUNCTION
1	GND	Ground.
2, 3, 4	VIN	Input Power Supply.
5	EN	Enable Input for Setting Programmable Under-Voltage Lockout Threshold. This pin cannot be left floating.
6	IMON	This pin sources a scaled down ratio of current through the internal FET. A resistor (1kΩ is recommended) from this pin to GND converts current to proportional voltage, used as analog current monitor.
7	TMR	Time Control Pin. An external capacitor connected to this pin sets the de-bounce time before soft-start period.
8	SS	Soft-Start Pin. An external capacitor connected to this pin sets the slew rate of the output voltage soft-start period.
9, 10, 11	VOUT	Output to the Load.
12	PG	Power Good Indication. This is an open-drain pin, when the EN value is higher than the rising threshold and the soft-start period is finished, the pin is set to high level.

ELECTRICAL CHARACTERISTICS

(Over operating free-air temperature range, typical values are at V_{IN} = 3.3V, T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Input Voltage							
Input Voltage	V_{IN}			2.8		5.5	V
OVLO Rising Threshold	V_{OVR}	T_J = +25℃		3.64	3.7	3.76	V
		T_J = -40℃ to +85℃		3.62		3.78	
		T_J = -40℃ to +125℃		3.62		3.78	
OVLO Hysteresis	V_{OVHYS}				0.112		V
UVP Threshold Voltage	V_{UVP}	SGM25642A	T_J = +25℃	2.74	2.76	2.78	V
			T_J = -40℃ to +85℃	2.73		2.8	
			T_J = -40℃ to +125℃	2.73		2.8	
		SGM25642B	T_J = +25℃	2.64	2.66	2.68	V
			T_J = -40℃ to +85℃	2.63		2.7	
			T_J = -40℃ to +125℃	2.63		2.7	
Supply Current							
Supply Current, Enabled	I_{Q_ON}	EN = high, V_{OUT} = floating	T_J = +25℃		80	120	μA
			T_J = -40℃ to +85℃			130	
			T_J = -40℃ to +125℃			150	
Supply Current, Disabled	I_{Q_OFF}	EN = low, V_{OUT} = floating	T_J = +25℃		50	75	μA
			T_J = -40℃ to +85℃			80	
			T_J = -40℃ to +125℃			120	
Off-State Leakage Current	$I_{LEAKAGE}$	EN = low, V_{OUT} = 0V	T_J = +25℃		0.01	1	μA
			T_J = -40℃ to +85℃			4	
			T_J = -40℃ to +125℃			30	
Power FET							
On-Resistance	R_{DSON}	T_J = +25℃			3.1	3.9	mΩ
		T_J = -40℃ to +85℃				4.8	
		T_J = -40℃ to +125℃				5.4	
Thermal Shutdown and Recovery							
Shutdown Temperature	T_{SD}				150		℃
Hysteresis	T_{HYS}				30		℃
Soft-Start							
SS Pull-Up Current	I_{SS}	EN = high, V_{SS} = 0.5V		9	10	11	μA
SS Discharging Resistance	R_{SS}	EN = low, I_{SS} = 10mA sinking			16		Ω
Power Good							
PG Leakage Current	I_{PG}	EN = high, V_{PG} = 3.3V	T_J = +25℃		0.01	0.5	μA
			T_J = -40℃ to +85℃			1	
			T_J = -40℃ to +125℃			1	
PG Pull-Down Resistance	R_{PG}	EN = low, I_{PG} = 10mA sinking			18		Ω

ELECTRICAL CHARACTERISTICS (continued)

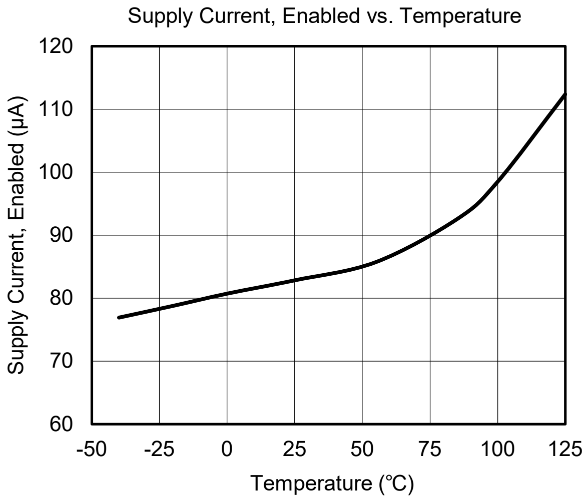
(Over operating free-air temperature range, typical values are at V_{IN} = 3.3V, T_J = +25℃, unless otherwise noted.)

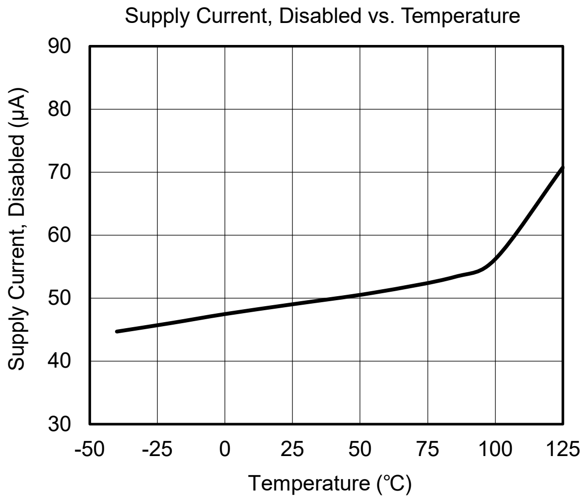
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
TMR Time						
TMR Pull-Up Current	I_{TMR}	EN = high, V_{TMR} = 0V		6.5		μA
TMR Discharging Resistance	R_{TMR}	EN = low, I_{TMR} = 10mA sinking		16		Ω
TMR Voltage Threshold	V_{TMR}	T_J = +25℃	1.1	1.12	1.14	V
		T_J = -40℃ to +85℃	1.095		1.145	
		T_J = -40℃ to +125℃	1.095		1.145	
EN						
EN Rising Threshold	V_{ENR}	T_J = +25℃	0.77	0.796	0.82	V
		T_J = -40℃ to +85℃	0.765		0.825	
		T_J = -40℃ to +125℃	0.765		0.825	
EN Hysteresis	V_{EN_HYS}			100		mV
IMON						
GAIN (IMON)	I_{MON}/I_{OUT}	I_{OUT} = 1A	95	100	105	μA/A
		I_{OUT} = 5A	95	100	104	
		I_{OUT} = 10A	97.5	100	102.5	
		I_{OUT} = 12A	97.5	100	103.5	
Discharge Resistance						
Discharge Resistance	R_{DIS}	EN = low, I_{OUT} = 10mA sinking		26		Ω
Inrush Control						
Inrush Current Slew Rate (1)	I_{INRUSH_SR}	C_{SS} = 220nF, C_{OUT} = 2000μF, 10% ~ 90% current slew rate		34		A/s
VOUT Low Voltage Power on Protection Threshold						
V_{OUT} Falling Threshold to Power-On	$V_{OUT\_FALLING}$	T_J = +25℃	0.29	0.31	0.35	V
		T_J = -40℃ to +85℃	0.28		0.36	
		T_J = -40℃ to +125℃	0.28		0.36	
Parasitic Capacitance						
Input Effective Capacitance (1)	C_{IN}			1		nF

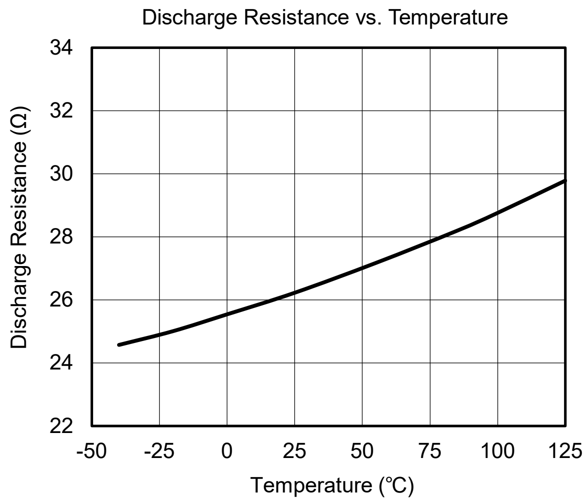
NOTE: 1. Design guaranteed.

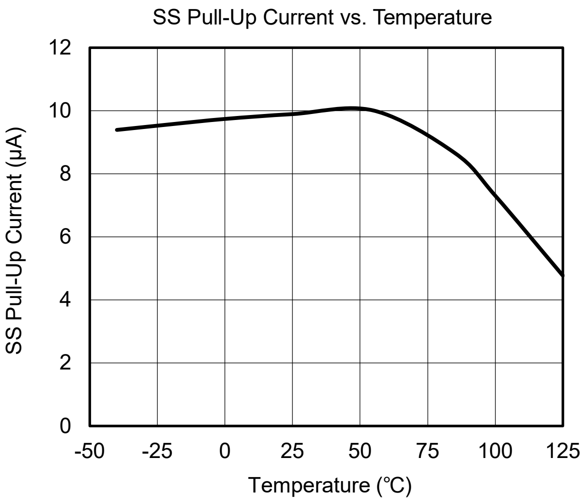
TYPICAL PERFORMANCE CHARACTERISTICS

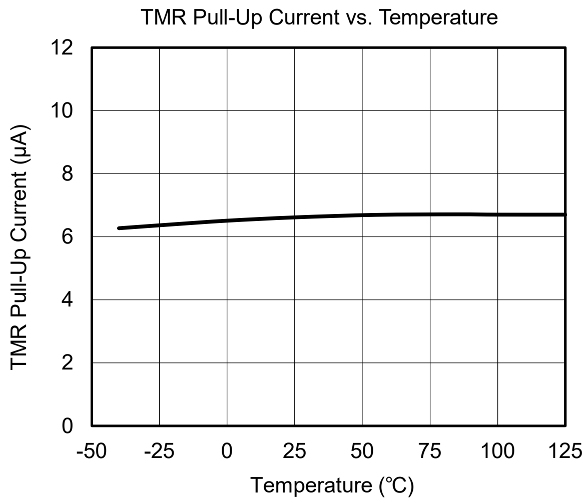
T_J = +25℃, unless otherwise noted.

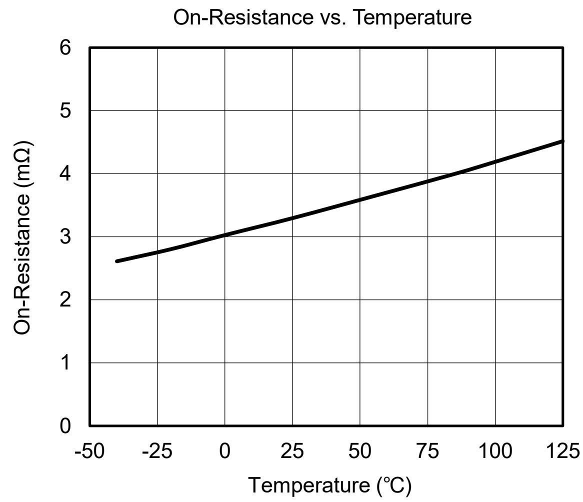






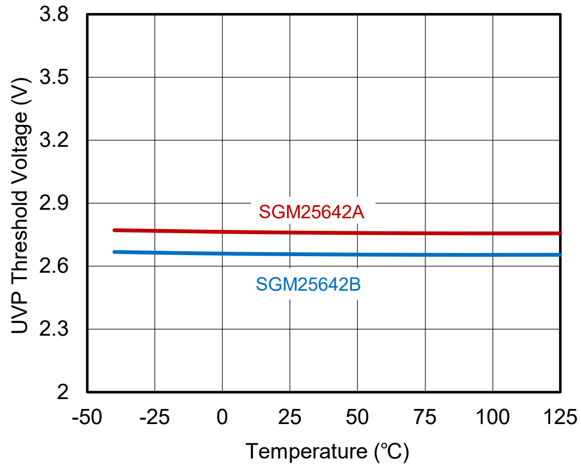




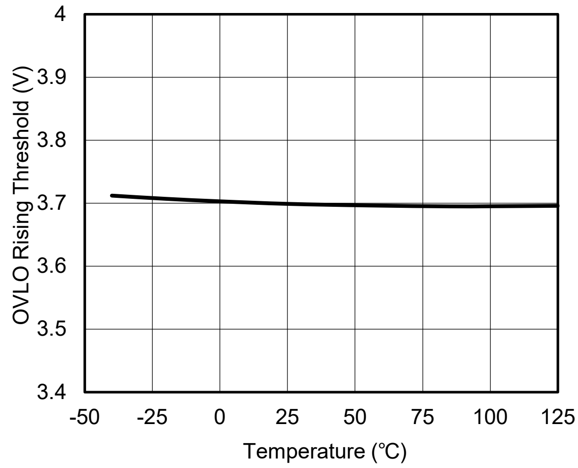


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

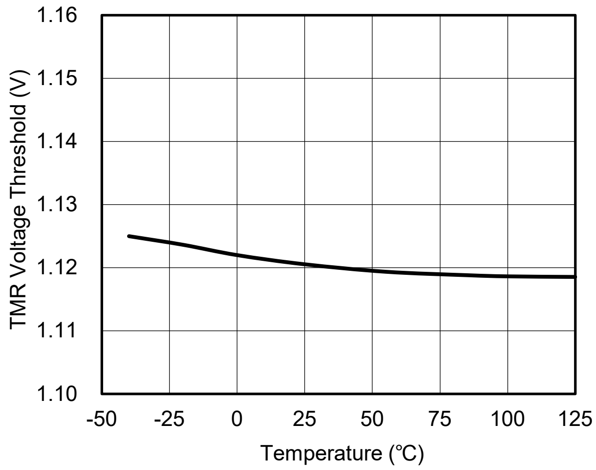
T_J = +25℃, unless otherwise noted.



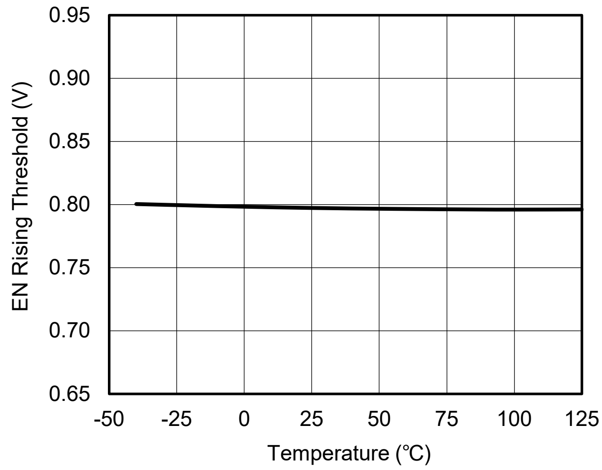
UVP Threshold Voltage vs. Temperature



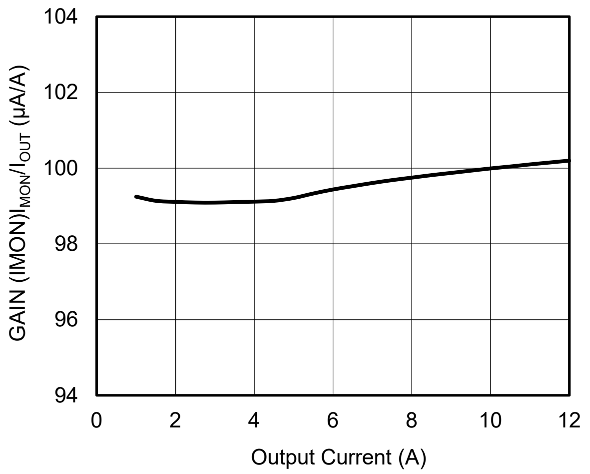
OVLO Rising Threshold vs. Temperature



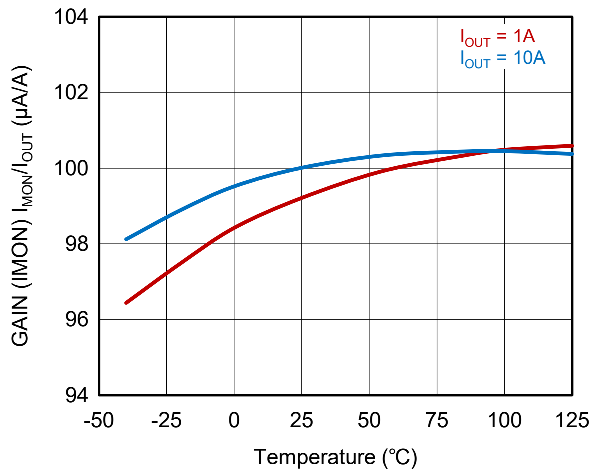
TMR Voltage Threshold vs. Temperature



EN Rising Threshold vs. Temperature



GAIN (IMON) I_{MON}/I_{OUT} vs. Output Current

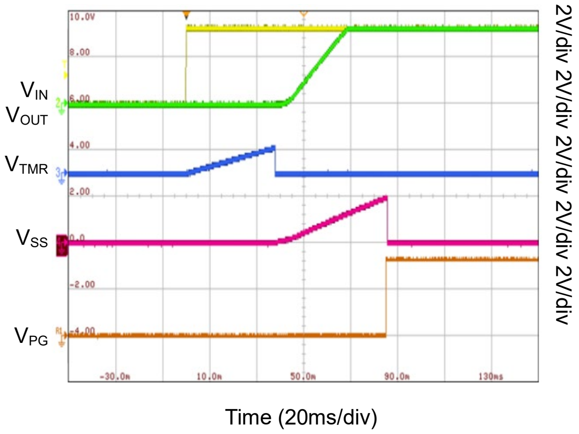


GAIN (IMON) I_{MON}/I_{OUT} vs. Temperature

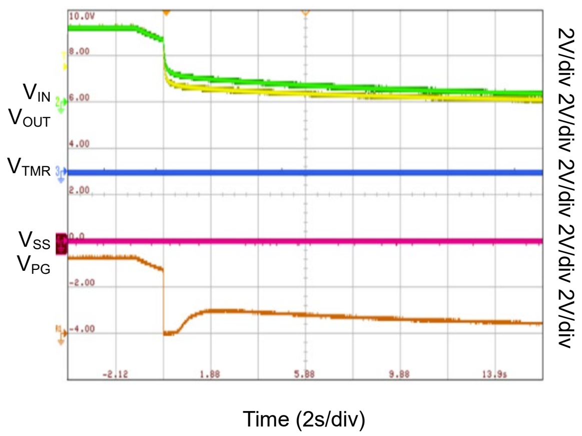
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_J = +25℃, V_{IN} = 3.3V, R_{EN_UP} = 2.7kΩ, R_{EN_DOWN} = 1kΩ, C_{OUT} = 2000μF, C_{SS} = C_{TMR} = 220nF, R_{IMON} = 1kΩ, V_{PG} = V_{OUT}, unless otherwise noted.

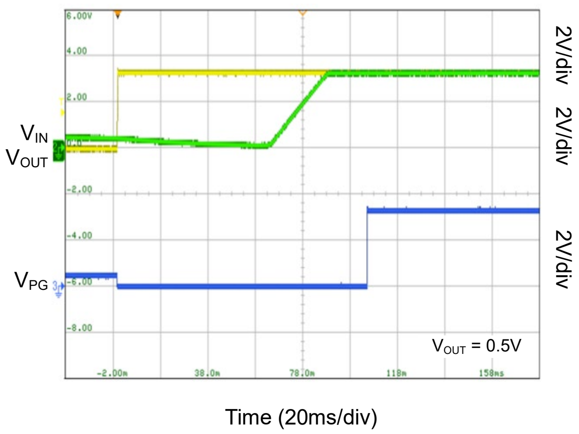
Hot-Swap Power-On



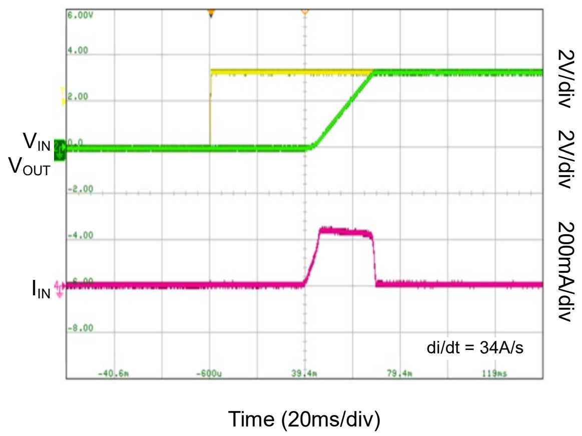
Hot-Swap Power-Off



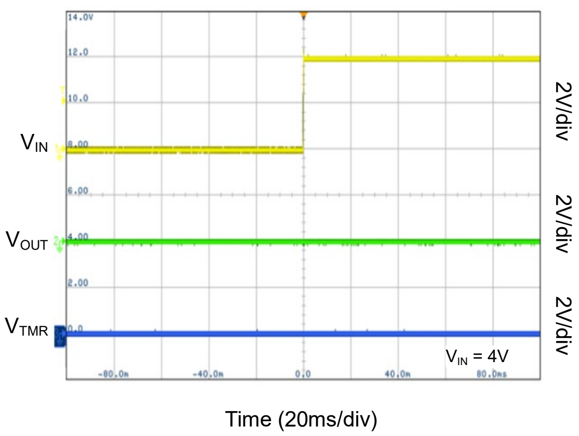
OUT Bias Power-On



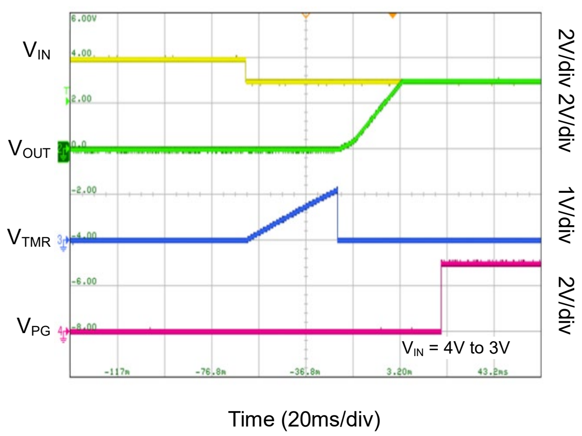
Input Current Slew Rate



Over-Voltage Power-On



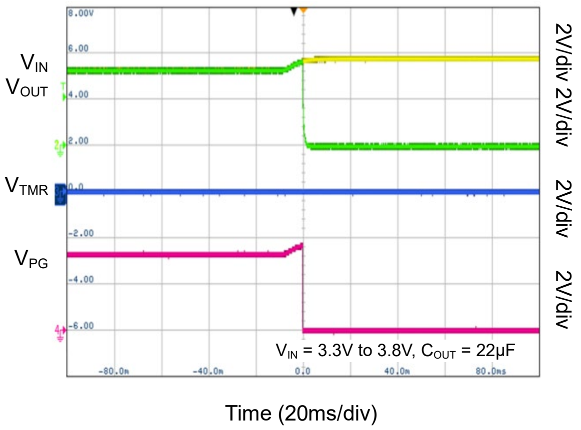
Over-Voltage Recovery



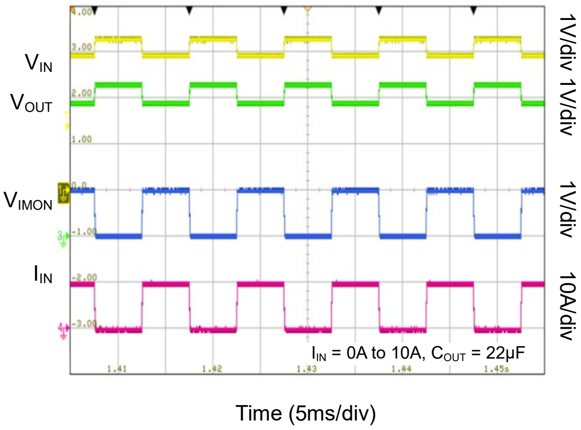
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_J = +25℃, V_{IN} = 3.3V, R_{EN_UP} = 2.7kΩ, R_{EN_DOWN} = 1kΩ, C_{OUT} = 2000μF, C_{SS} = C_{TMR} = 220nF, R_{IMON} = 1kΩ, V_{PG} = V_{OUT}, unless otherwise noted.

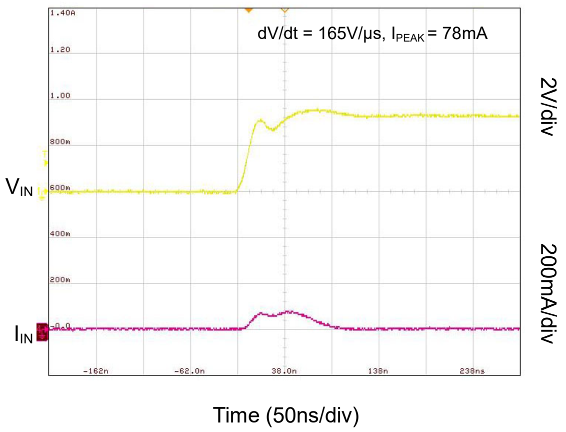
Over-Voltage Protection



Load Regulation



Hot-Swap Input Leakage Current



FUNCTIONAL BLOCK DIAGRAM

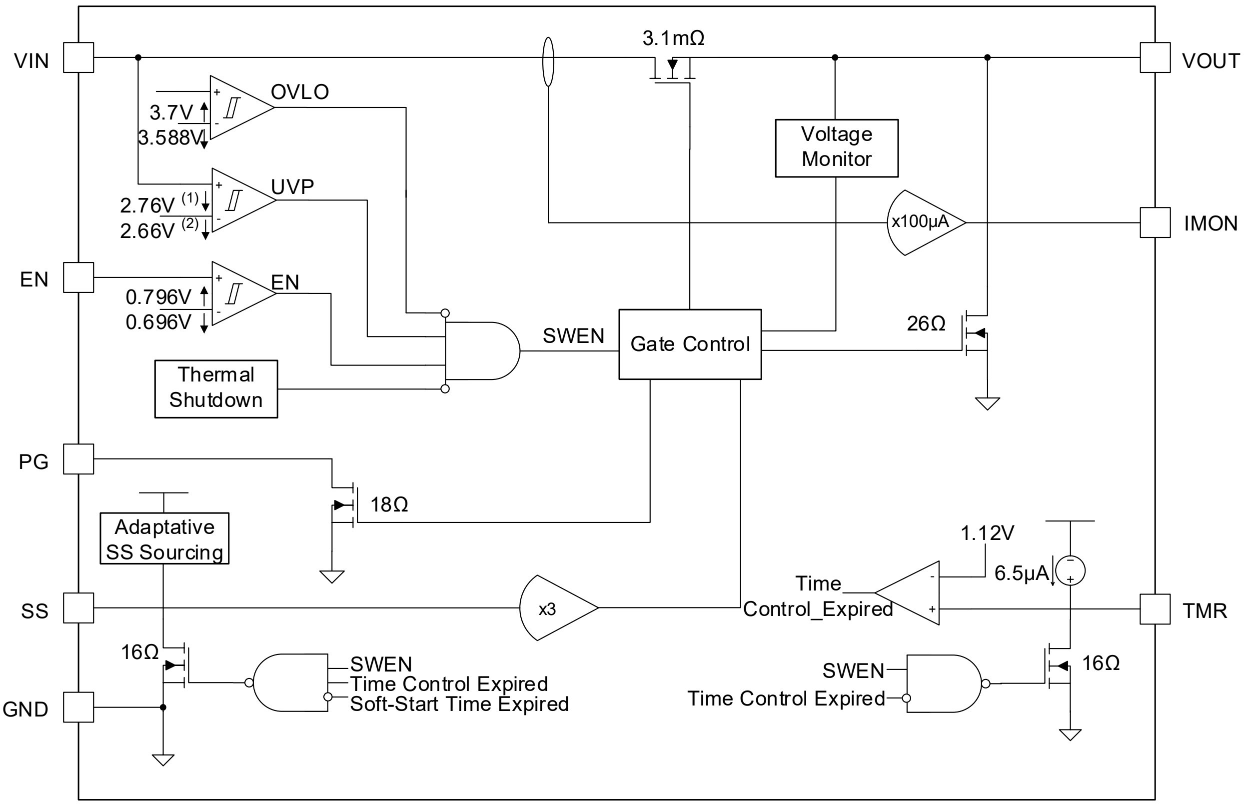


Figure 2. Block Diagram

NOTES:
1. SGM25642A only.
2. SGM25642B only.

APPLICATION INFORMATION

Overview

The SGM25642 is a load switch with integrated power path that is used to ensure safe power delivery customized for optical module devices. The device starts its operation by monitoring the IN bus. When the input supply voltage (V_{IN}) exceeds the under-voltage protection threshold (V_{UVP}), the device samples the EN pin. A high level (> V_{ENR}) on this pin enables the internal power path to start conducting. When the IN supply voltage is insufficient (< V_{UVP}) or the EN is held low (< V_{ENF}), the internal power path is turned off.

Time Control

When the VIN and EN are both exceed their respective rising threshold voltages, the device starts charging the TMR pin capacitor using an internal 6.5μA pull-up current. If the VIN or EN voltage drops below the respective falling threshold before the TMR capacitor (C_{TMR}) charges to V_{TMR}, the TMR is reset by pulling it down to GND. This avoids supply pulses to pass through the device and to affect optical module devices. If the supply is in steady state, the C_{TMR} continues to charge and once it charges to V_{TMR}, the soft-start starts operating. At the same time, the C_{TMR} is discharged down to GND again so that it is at its default state before the next power-on. Equation 1 can be used to calculate the C_{TMR} value for a desired de-bounce time.

$$t_{TMR} = V_{TMR} \times C_{TMR} / I_{TMR}$$
$$C_{TMR}(nF) = 5.8(\mu A/V) \times t_{TMR}(ms) \quad (1)$$

V_{TMR} is TMR threshold voltage (1.12V TYP).
C_{TMR} is capacitance value on the TMR pin (in nF).
I_{TMR} is TMR internal current source (6.5μA).
t_{TMR} is TMR time (in ms).

Equation 2 shows discharge time of TMR pin:

$$t_{TMR\_dis}(\mu s) = 3 \times \tau(\mu s)$$
$$\tau(\mu s) = R_{TMR}(\Omega) \times C_{TMR}(\mu F) \quad (2)$$

R_{TMR} is discharge resistance on the TMR pin (16Ω TYP).
C_{TMR} is capacitance value on the TMR pin (in μF).
t_{TMR_DIS} is TMR discharge time (in μs).

The fastest de-bounce time is achieved by leaving the TMR pin open. To ensure fully discharge of TMR, a built-in delay is applied when power is turned on.

Soft-Start

During hot-plug events or while trying to charge a large output capacitance at start-up, there can be a large inrush current. If the inrush current is not managed properly, it can cause the system power supply to droop leading to unexpected restarts or damage to optical module devices. The inrush current during turn-on is directly proportional to the load capacitance and rising slew rate. Equation 3 can be used to find the slew rate (SR) requirement to limit the inrush current (I_{INRUSH}) for a given load capacitance (C_{OUT}):

$$SR(V/ms) = \frac{I_{INRUSH}(mA)}{C_{OUT}(\mu F)} \quad (3)$$

Same with the TMR pin, if the VIN or EN drops below the respective falling threshold during soft-start state, the SS is reset by pulling it down to GND. In order to decrease inrush current for optical module devices, the device integrates adjustable output soft-start slew rate function. Equation 4 can be used to calculate the C_{SS} value for a desired soft-start time.

$$t_{SS} = C_{SS} \times V_{OUT} / I_{SS} / 2.4$$
$$C_{SS}(nF) = 24\mu A \times t_{SS}(ms) / V_{OUT}(V) \quad (4)$$

V_{OUT} is output voltage (in V).
C_{SS} is capacitance value on the SS pin (in nF).
I_{SS} is soft-start internal current source (10μA).
t_{SS} is soft-start time (in ms).

Equation 5 shows discharge time of SS pin:

$$t_{SS\_DIS}(\mu s) = 3 \times \tau(\mu s)$$
$$\tau(\mu s) = R_{SS}(\Omega) \times C_{SS}(\mu F) \quad (5)$$

R_{SS} is discharge resistance on the SS pin (16Ω TYP).
C_{SS} is capacitance value on the SS pin (in μF).
t_{SS_DIS} is soft-start discharge time (in μs).

The fastest soft-start time is achieved by leaving the SS pin open.

APPLICATION INFORMATION (continued)

Power-On Sequencing

The recommended power sequences are as follows:

1. VIN → EN
2. VIN & EN at the same time

After the VIN and EN are powered on, the TMR capacitor will be charged to V_{TMR}, then V_{OUT} begins to soft-start, the PG pin is set to high level after soft-start period is finished. Refer to Figure 3.

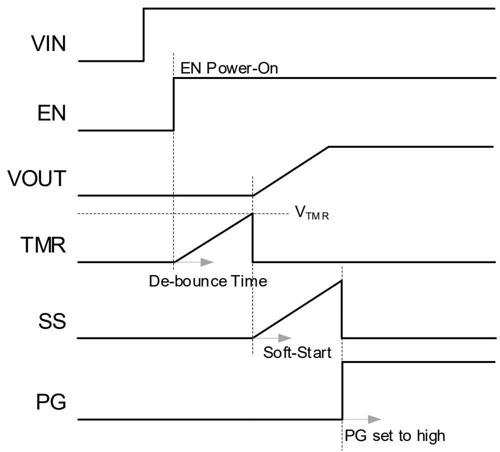


Figure 3. Power-On Sequencing

EN Control

The device has an enable pin which is used to enable or disable the device. Pulling EN low will turn off the internal pass FET, while pulling high will turn on the FET, and the device enters the start-up routine.

Current Monitor

The SGM25642 allows the system to accurately monitor the load current by providing an analog current sense output on the IMON pin which is proportional to the current through the FET from IN to OUT. The user can sense the voltage (V_{IMON}) across the R_{IMON} to get a measure of the output load current. The maximum V_{IMON} should not exceed V_{IN} - 0.8V. 1kΩ R_{IMON} is recommended.

Over-Voltage Protection

The SGM25642 integrates over-voltage protection function. When the input supply voltage (V_{IN}) exceeds the over-voltage protection threshold (V_{OVR}), the device will be shut down, once input supply voltage falls below V_{OVF}, the device will recycle power-on process.

Output Voltage Monitor

To avoid inrush current caused by repeatedly power-on conditions and to ensure fully reset of downstream equipment, SGM25642 integrates output voltage monitor function. The device will only power on until output voltage drops to 0.31V (TYP).

Quick Output Discharge

The SGM25642 integrates the output discharge feature. When the EN pin is pulled low (below V_{ENF}), a discharge resistance with a typical value of 26Ω is connected between the VOUT and GND. This resistance pulls down the output and prevents it from floating when the device is disabled. For a new round of start-up process, the discharge function continues until the end of TMR.

Thermal Shutdown

The SGM25642 features thermal shutdown circuitry. If the junction temperature exceeds +150℃ (TYP), the internal FET will be turned off. And the devices exit thermal shutdown if the junction temperature cools down sufficiently. After that, it will retry to turn on automatically after about 420ms delay time if the device is still enabled.

Power Good

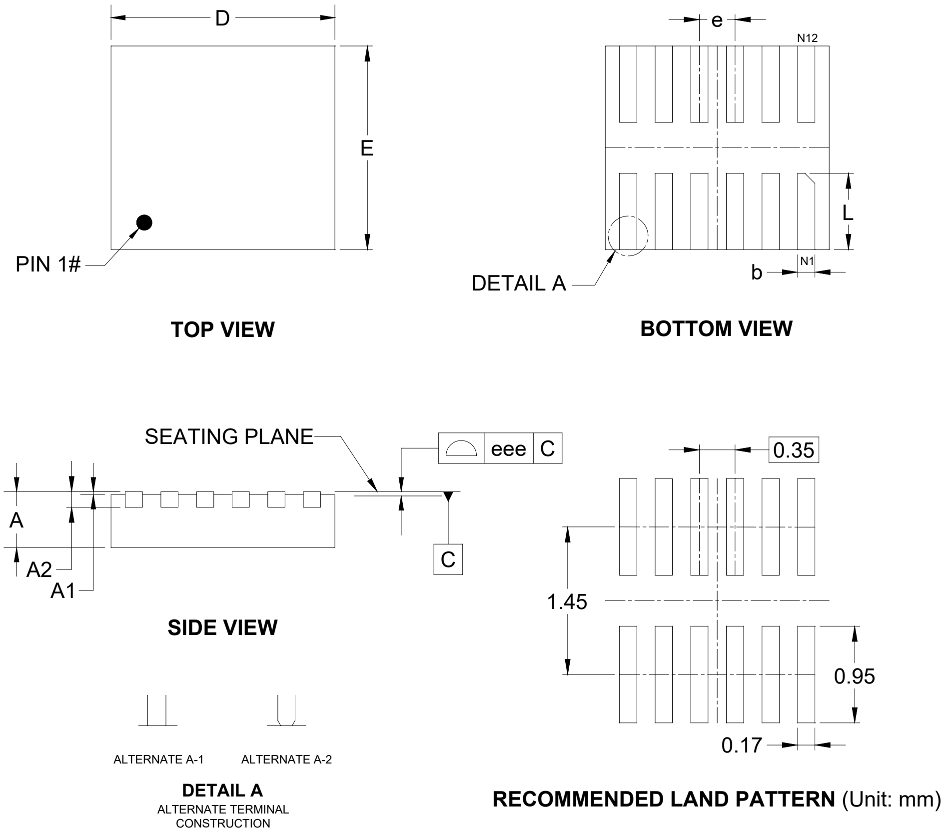
This is an open-drain pin. When the EN value is higher than the rising threshold and soft-start period is finished, the pin is set to high level. When V_{IN} is lower than the UVP threshold, EN is lower than the falling threshold or V_{IN} is higher than the OVLO rising threshold, the pin is set to low level.

REVISION HISTORY

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

Changes from Original to REV.A (JUNE 2025)	**Page**
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS
UTDFN-2.2×2-12L

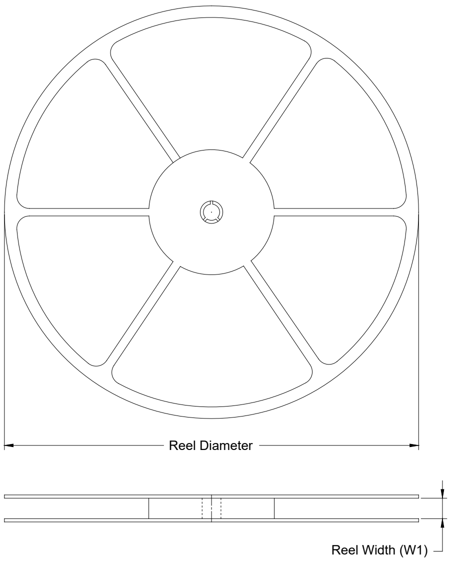


Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	0.500	-	0.600
A1	0.000	-	0.050
A2	0.152 REF		
b	0.140	-	0.200
D	2.100	-	2.300
E	1.900	-	2.100
e	0.350 BSC		
L	0.650	-	0.850
eee	0.080		

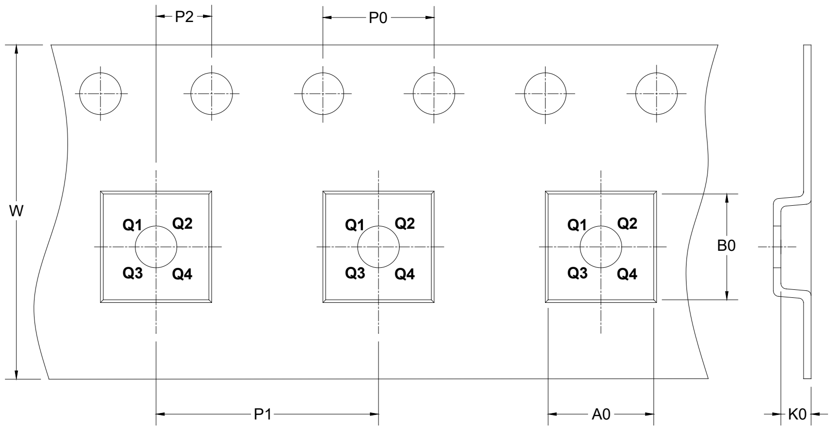
NOTE: This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



DIRECTION OF FEED

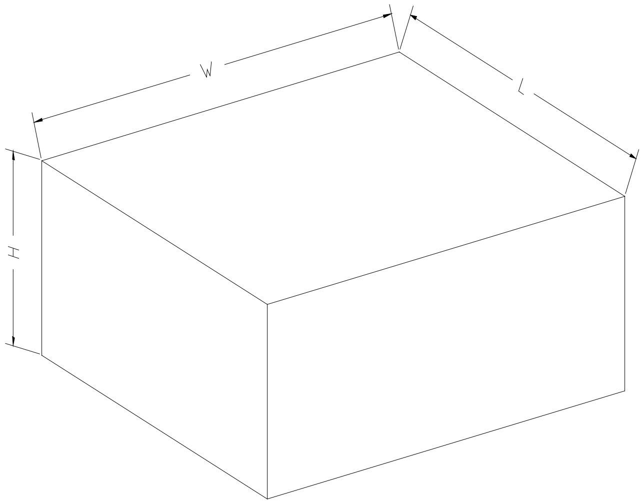
NOTE: The picture is only for reference. Please make the object as the standard.

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
UTDFN-2.2×2-12L	7"	9.5	2.25	2.45	0.75	4.0	4.0	2.0	8.0	Q1

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