SGM2525/SGM2526
Programmable Current Limit Switches with Over-Voltage Protection

GENERAL DESCRIPTION

SGM2525/6 are programmable current limit switches with input voltage range selection and output voltage clamping. Extremely low $R_{DS(ON)}$ of the integrated protection N-channel FET helps to reduce power loss during the normal operation. Programmable soft-start time controls the slew rate of the output voltage during the start-up time. Independent enable control allows the complicated system sequencing control. They integrate the over-temperature protection shutdown and auto-recovery with hysteresis.

The SGM2525/6 are available in Green TDFN-3×3-10L package and operate over a temperature range of -40℃ to +85℃.

FEATURES

- **Wide Input Voltage Range from 4.5V to 24V with Surge up to 30V**
- **Extremely Low $R_{DS(ON)}$ for the Integrated Protection Switch: 23mΩ**
- **Programmable Soft-Start Time**
- **Programmable Current Limit 5A MAX**
- **Thermal Shutdown Protection**
  SGM2525: Latched-Off
  SGM2526: Auto-Recovery
- **Selectable Input Range and Clamping Output Voltage Threshold**
- **Enable Interface Pin**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in the Green TDFN-3×3-10L Package**

APPLICATIONS

Notebook PC
iPad Mini
Server
Service PC

TYPICAL APPLICATION

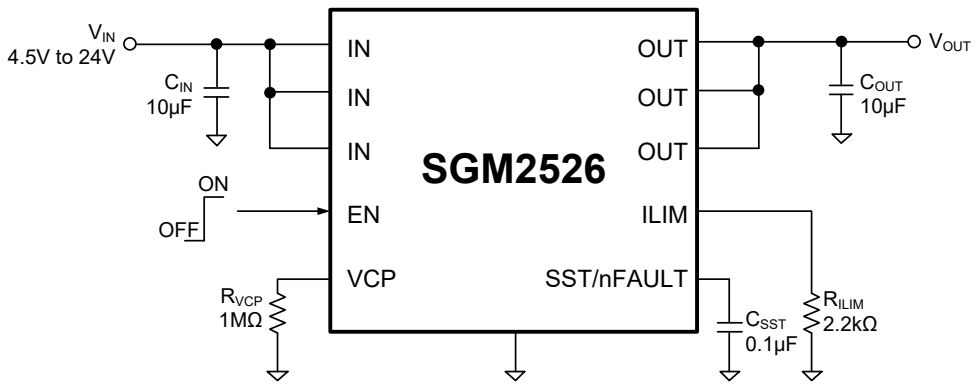


Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2525	TDFN-3×3-10L	-40℃ to +85℃	SGM2525YTD10G/TR	SGM 2525D XXXXX	Tape and Reel, 4000
SGM2526	TDFN-3×3-10L	-40℃ to +85℃	SGM2526YTD10G/TR	SGM 2526D XXXXX	Tape and Reel, 4000

NOTE: XXXXX = Date 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

Supply Input Voltage 30V
EN Pin, VCP Pin 30V
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃

RECOMMENDED OPERATING CONDITIONS

Supply Input Voltage ..... 4.5V to 24V
Operating Temperature Range ..... -40℃ to +85℃
Operating Junction Temperature Range ..... -40℃ to +125℃

OVERSTRESS CAUTION

Stresses beyond those listed may cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational section of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

ESD SENSITIVITY CAUTION

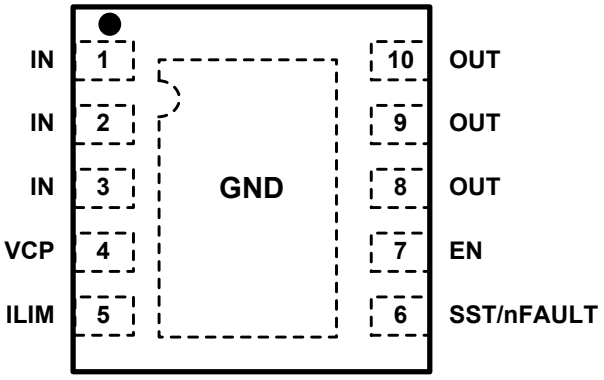
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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, specification or other related things if necessary without notice at any time.

PIN CONFIGURATION

SGM2525/26 (TOP VIEW)



TDFN-3×3-10L

PIN DESCRIPTION

PIN	NAME	FUNCTION
1, 2, 3	IN	Power Input Pin. Decouple high frequency noise by connecting at least 0.1μF MLCC to ground.
4	VCP (1)	Output Clamp Voltage Selection Based on the Input Voltage. Pull VCP pin to high by connecting a resistor to IN, or pull VCP pin to low by connecting a resistor to ground, or float VCP pin to select different output clamping thresholds. Recommend to decoupling this pin with 0.1μF capacitor.
5	ILIM	Current Limit Program Pin. Program the current limit by connecting a resister to ground.
6	SST/nFAULT	Soft-Start Time Program and Fault Event Indicator Pin. Connect a capacitor to ground to program the soft-start time. nFAULT event indicator, goes low to indicate fault condition due to under-voltage or thermal shutdown event.
7	EN	Enable Interface Pin. Pull it high to enable the IC.
8, 9, 10	OUT	Power Output Pin.
Exposed Pad	GND	Ground Pin.

NOTE 1:

VCP	V_{IN} (V)		Clamping Threshold (V)
			TYP
Low	20	Over 22	22
High	5	Over 6	5.7
Floating	12	14	13.3

ELECTRICAL CHARACTERISTICS

(T_A = +25℃, V_{IN} = 5V, R_{LIM} = 10kΩ, C_{SST} = 105nF, C_{IN} = 10μF, C_{OUT} = 10μF, unless otherwise specified.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range	V_{IN}		4.5		24	V
Input UVLO Threshold	V_{UVLO}	VCP = Low		13		V
		VCP = High		8.5		V
		VCP = Open		3.6		V
UVLO Hysteresis	V_{HYS}	VCP = Low		0.3		V
		VCP = High		0.080		
		VCP = Open		0.190		
Bias Current	I_{BIAS}			160		μA
Shutdown Current	I_{SHDN}	EN = 0		0.7		μA
Protection FET R_{ON}	$R_{DS(ON)}$			23		mΩ
Current Limit Accuracy		10% I_{LIM}		±10		%
Current Limit Program Range (3)	I_{LIM}		1		5	A
Clamping Output Voltage	V_{CLP}	VCP = Low		22		V
		VCP = High		5.7		V
		VCP = Open		13.3		V
Soft-Start Time (2)	t_{SST}	C_{SST} = 0F		1.4		ms
		C_{SST} = 105nF		29.4		ms
Soft-Start Time Accuracy (2)		C_{SST} = 105nF		±30% t_{SST}		
EN Turn-On Threshold	V_{EN_ON}		1.3			V
EN Turn-Off Threshold	V_{EN_OFF}				0.3	V
Thermal Shutdown Temperature	T_{SD}			150		℃
Thermal Shutdown Hysteresis	T_{HYS}			20		℃

NOTE 2:

Recommended Soft-Start Time Program Table:

C_{SST} (nF)	None	10	55	105
Rise Time (ms)	1.4	2.8	15.4	29.4

Recommended Formula for C_{SST} & Soft-Start Time Calculation:

T_{SS} =	T_{SS_DLT}, No External C_{SST}
	C_{SST}/I_{INT}×1.2V, $T_{SS} > T_{SS\_DLT}$

Where, T_{SS_DLT} is the internally fixed default soft-start time, about 1.4ms, which means there's no any external C_{SST}; I_{INT} is the internal Current source, about 4.3μA.

NOTE 3:

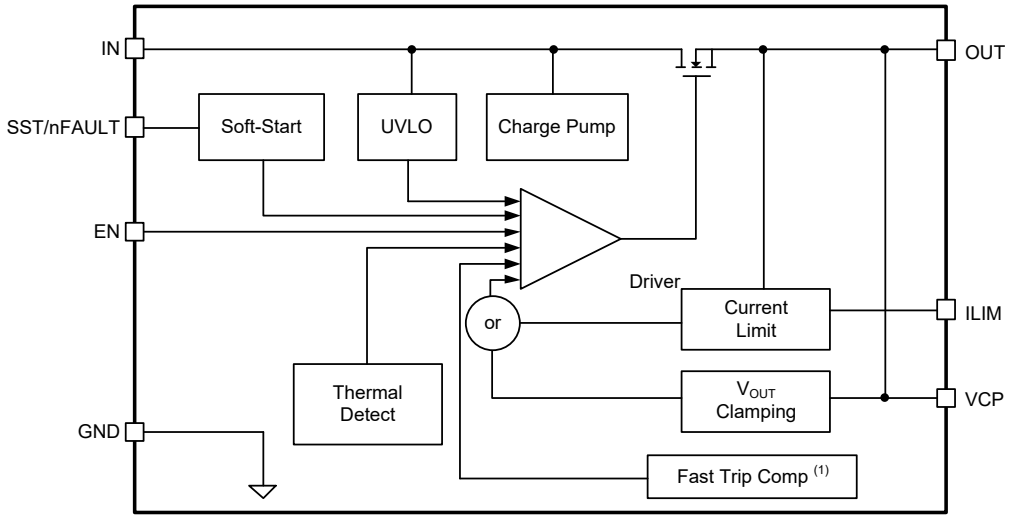
Recommended Current Limit Program Table

Current Limit Resistance (kΩ)	16.5	8.25	6.6	5.55	4.65	4.2	3.6	3.3
Current Limit (A)	1.0	2.0	2.5	3.0	3.5	4.0	4.5	5.0

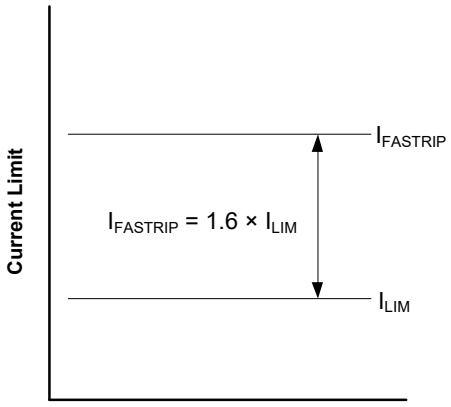
Recommended Formula for R_{LIM} & Current Limit Calculation:

$$R_{LIM} = \frac{16.5k}{I_{LIM}}(\Omega)$$

FUNCTIONAL BLOCK DIAGRAM



NOTE 1: During a transient short circuit event, the current through the device increases very rapidly. The current-limit amplifier cannot respond very quickly to this event due to its limited bandwidth. Therefore, the SGM2525/6 incorporates a fast trip comparator, which shuts down the pass device very quickly when $I_{OUT} > I_{FASTRIP}$ ($I_{FASTRIP} = 1.6 \times I_{LIM}$), and terminates the rapid short-circuit peak current. After the transient short-circuit peak current has been terminated by the fast-trip comparator, the current limit amplifier smoothly regulates the output current to I_{LIM}.



APPLICATION EXAMPLES

The SGM2525/6 provide simple solution for current limiting, inrush current control and supervision of power rails for wide range of applications operating at 4.5V to 24V and delivering up to 5A.

Protection and Current Limiting for Primary-side Regulated Power Supplies

Primary side regulated power supplies and adapters are dominant today in many of the applications such as LCD-TV, Fast Charger, Set-Top-Box and Gaming consoles.

- No secondary side protection for immediate termination of critical faults such as short-circuit and over-voltage.
- Do not provide precise current limiting for over-load transients.
- Have poor output voltage regulation for sudden change in AC-input voltages-triggering output over-voltage condition.

Many of the above applications require precise output current limiting and secondary side protection, driving the need for current sensing in the secondary side. This needs additional circuit implementation using precision operational amplifiers. This increases the complexity of the solution and also results in sensing losses the SGM2525/6 with its integrated low-ohmic N-channel FET provides a simple and efficient solution.

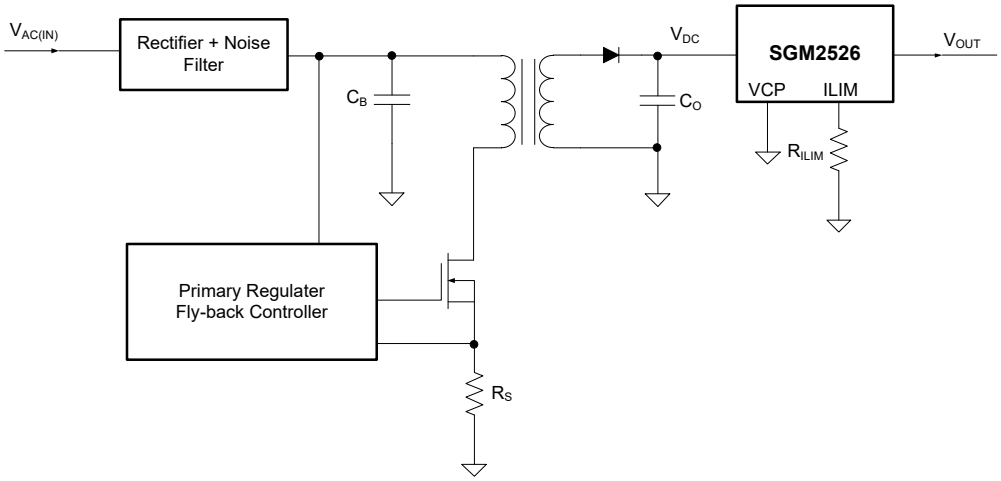


Figure 2. Current Limiting and Protection for AC-DC Power Supplies

APPLICATION EXAMPLES (continued)

Precision Current Limiting in Intrinsic Safety Applications

Intrinsic Safety (IS) is becoming prominent need for safe operation of electrical and electronic equipment in hazardous areas. Intrinsic Safety requires that equipment is designed such that the total amount of energy available in the apparatus is simply not enough to ignite an explosive atmosphere. The energy can be electrical, in the form of a spark, or thermal, in the form of a hot surface.

This calls for precise current limiting and precision shutdown of the circuit for over voltage conditions ensuring that set voltage and current limits are not exceeded for wide operating temperature range and variable environmental conditions. Applications such as Gas Analyzers, Medical equipment (such as electrocardiographs), Portal Industrial Equipment, Cabled Power distribution systems and hand-held motor operated tools need to meet these critical safety standards.

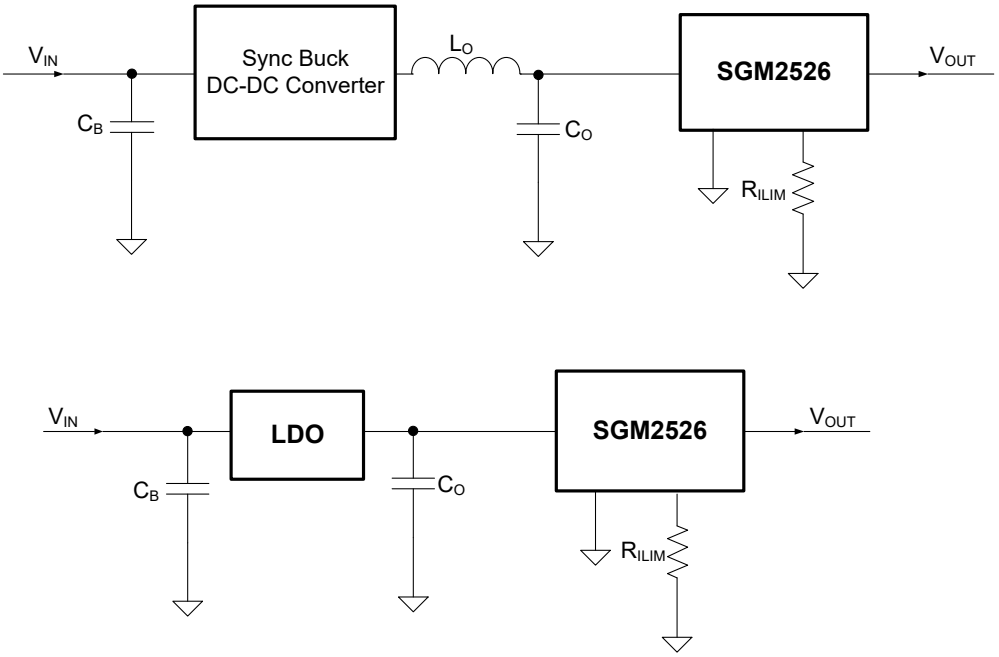


Figure 3. Precision Current Limit and Protection of Internal Rails

APPLICATION EXAMPLES (continued)

Smart Load Switch

A smart load switch is a series FET used for switching of the load (resistive or inductive). It also provides protection during fault conditions. Typical discrete implementation is shown in Figure 4. Discrete solutions have higher component count and require complex circuitry to implement each of the protection fault needs.

SGM2525/6 can be used as a smart power switch for applications ranging from 4.5V to 24V. SGM2525/6 provide programmable soft-start, programmable current limits, over-temperature protection, a fault flag and under-voltage lockout.

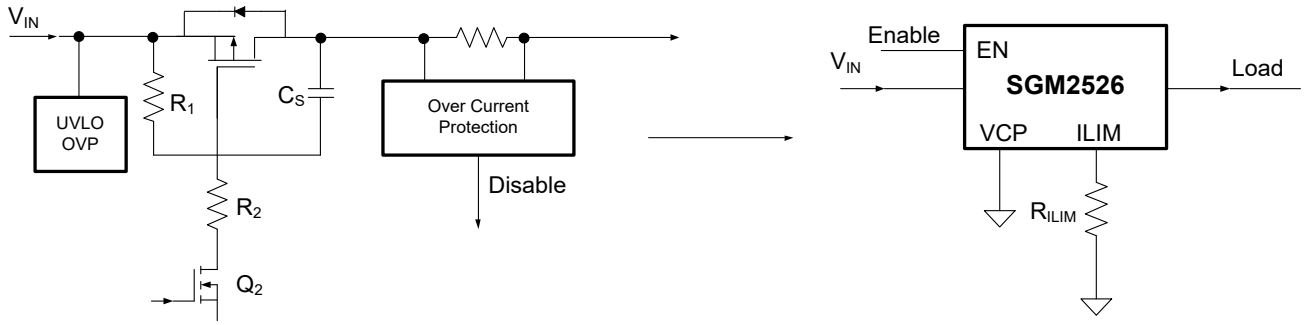
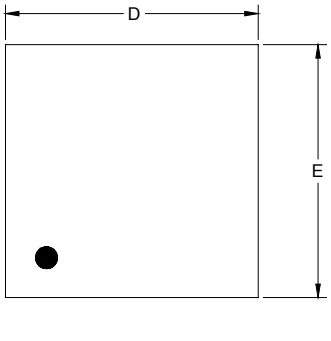


Figure 4. Smart Load Switch Implementation

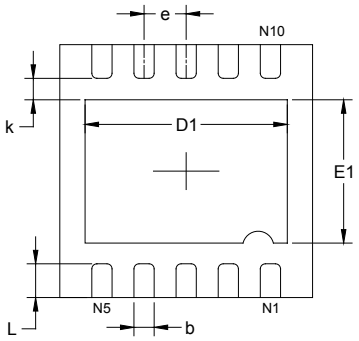
Figure 4 shows typical implementation and usage as load switch. This configuration can be used for driving a solenoid and FAN control. It is recommended to use a freewheeling diode across the load when load is highly inductive.

PACKAGE OUTLINE DIMENSIONS

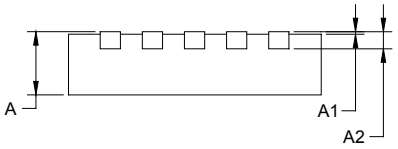
TDFN-3×3-10L



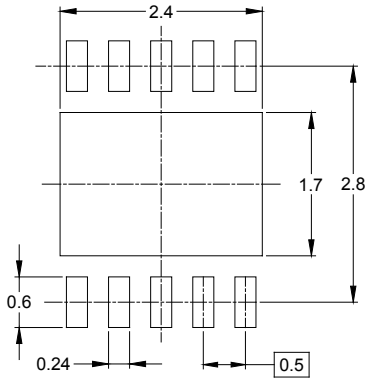
TOP VIEW



BOTTOM VIEW



SIDE VIEW

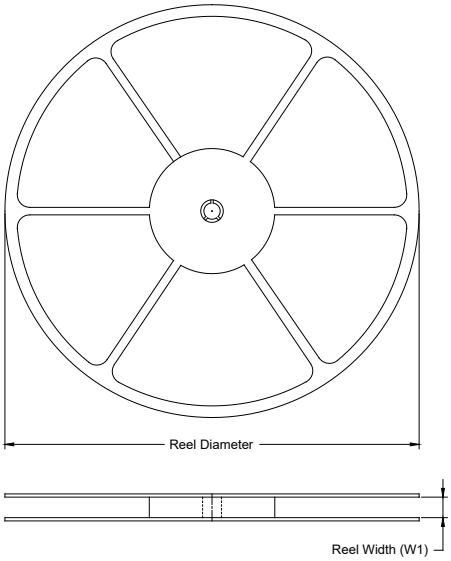


RECOMMENDED LAND PATTERN (Unit: mm)

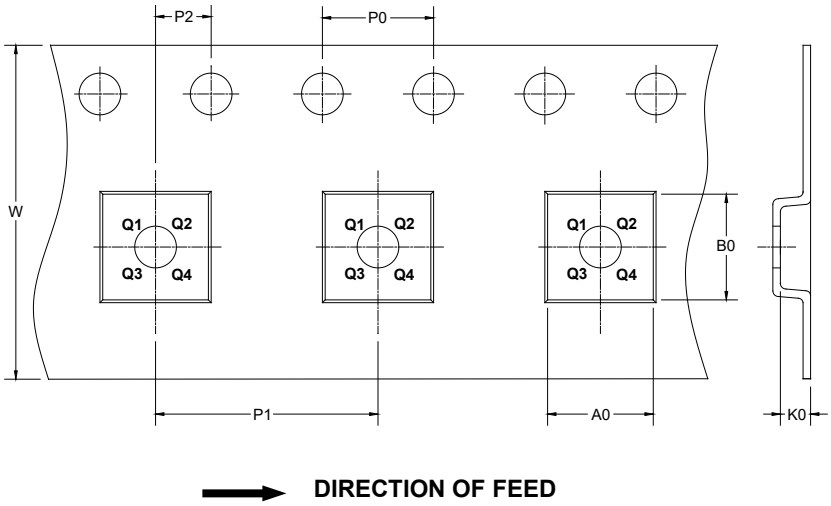
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	2.900	3.100	0.114	0.122
D1	2.300	2.600	0.091	0.103
E	2.900	3.100	0.114	0.122
E1	1.500	1.800	0.059	0.071
k	0.200 MIN		0.008 MIN	
b	0.180	0.300	0.007	0.012
e	0.500 TYP		0.020 TYP	
L	0.300	0.500	0.012	0.020

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



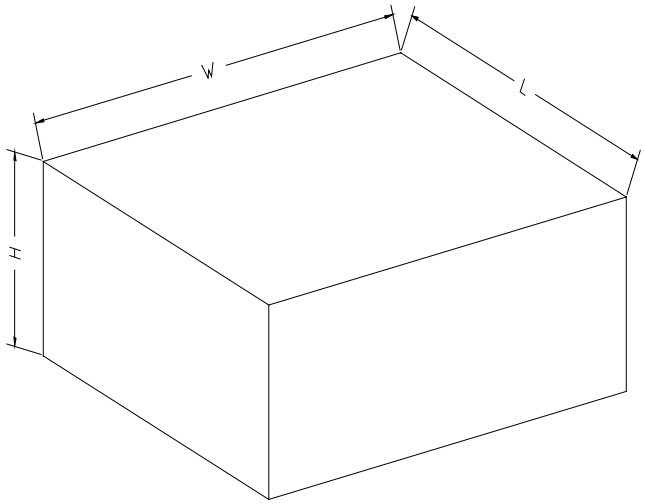
NOTE: The picture is only for reference. Please make the object as the standard.

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
TDFN-3×3-10L	13″	12.4	3.35	3.35	1.13	4.0	8.0	2.0	12.0	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
13″	386	280	370	5

DD0002