SGM2079xQ
1A, Low Noise, Wide Bandwidth, High PSRR, Low Dropout Linear Regulator

GENERAL DESCRIPTION

The SGM2079xQ is a low noise, high PSRR, low dropout voltage linear regulator. It is capable of supplying 1A output current with typical dropout voltage of only 140mV. The operating input voltage range is from 2.2V to 5.5V and output voltage range is from 0.8V to 5.0V.

Other features include logic-controlled shutdown mode, short-circuit current limit and thermal shutdown protection. The SGM2079xQ has automatic discharge function to quickly discharge V_{OUT} in the disabled status.

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

The SGM2079xQ is available in a Green TDFN-3×3-8JL package. It operates over an operating temperature range of -40℃ to +125℃.

FEATURES

- **AEC-Q100 Qualified for Automotive Applications**
  Device Temperature Grade 1
  T_A = -40℃ to +125℃
- **Operating Input Voltage: 2.2V to 5.5V**
- **Adjustable Output Voltage: 0.8V to 5.0V**
- **Low Dropout Voltage: 140mV (TYP) at 1A**
- **Low Noise:**
  13μV_{RMS} (TYP) at $V_{OUT(NOM)}$ = 1.1V (10Hz to 100kHz)
- **Power Supply Rejection Ratio at $V_{OUT(NOM)}$ = 1.1V:**
  - **74dB (TYP) at 1kHz**
  - **66dB (TYP) at 10kHz**
  - **48dB (TYP) at 1MHz**
- **Current Limiting and Thermal Protection**
- **Excellent Load and Line Transient Responses**
- **With Output Automatic Discharge**
- **Stable with Small Case Size Ceramic Capacitors**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in a Green TDFN-3×3-8JL Package**

APPLICATIONS

Automotive Applications
PLL/VCO/RF Circuit
Audio Equipment

TYPICAL APPLICATION

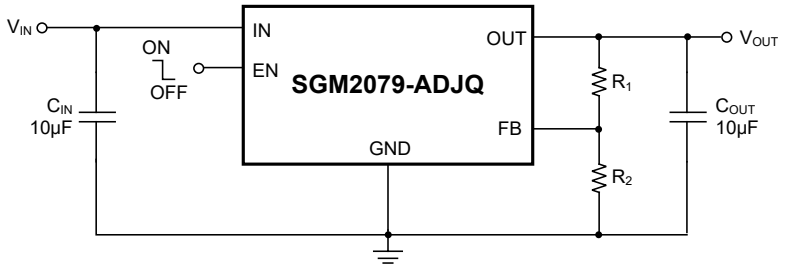


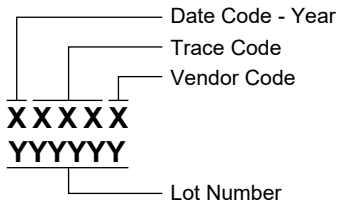
Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2079-ADJQ	TDFN-3×3-8JL	-40℃ to +125℃	SGM2079-ADJQTHI8G/TR	0NFTHI XXXXX YYYYYY	Tape and Reel, 4000

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

IN, OUT to GND ..... -0.3V to 6V
FB to GND ..... -0.3V to 6V
EN to GND ..... -0.3V to 6V
Package Thermal Resistance
TDFN-3×3-8JL, θ_{JA} ..... 51℃/W
TDFN-3×3-8JL, θ_{JB} ..... 23℃/W
TDFN-3×3-8JL, θ_{JC} ..... 50℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃

RECOMMENDED OPERATING CONDITIONS

Operating Input Voltage Range, V_{IN} ..... 2.2V to 5.5V
Adjustable Output Voltage Range ..... 0.8V to 5.0V
Enable Voltage Range ..... 0V to 5.5V
Input Effective Capacitance, C_{IN} ..... 2.2μF (MIN)
Output Effective Capacitance, C_{OUT} ..... 4.7μF to 220μF
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.

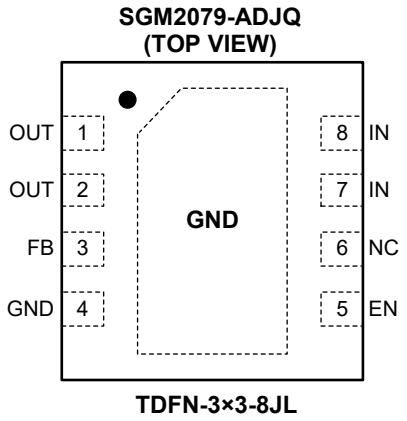
ESD SENSITIVITY CAUTION

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



PIN DESCRIPTION

PIN	NAME	FUNCTION
1, 2	OUT	Regulator Output Pin. It is recommended to use a ceramic capacitor with effective capacitance in the range of 4.7μF to 220μF to ensure stability. This ceramic capacitor should be placed as close as possible to OUT pin.
3	FB	Feedback Voltage Input Pin. Connect this pin to the midpoint of an external resistor divider to adjust the output voltage. Place the resistors as close as possible to this pin.
4	GND	Ground.
5	EN	Enable Pin. Drive EN high to turn on the regulator. Drive EN low to turn off the regulator. The EN pin has an internal pull-down current source.
6	NC	No Connection.
7, 8	IN	Input Supply Voltage Pin. It is recommended to use a 4.7μF or larger ceramic capacitor from IN pin to ground to get good power supply decoupling. This ceramic capacitor should be placed as close as possible to IN pin.
Exposed Pad	–	Exposed Pad. Connect it to a large ground plane to maximize thermal performance. This pad is not an electrical connection point.

FUNCTIONAL BLOCK DIAGRAM

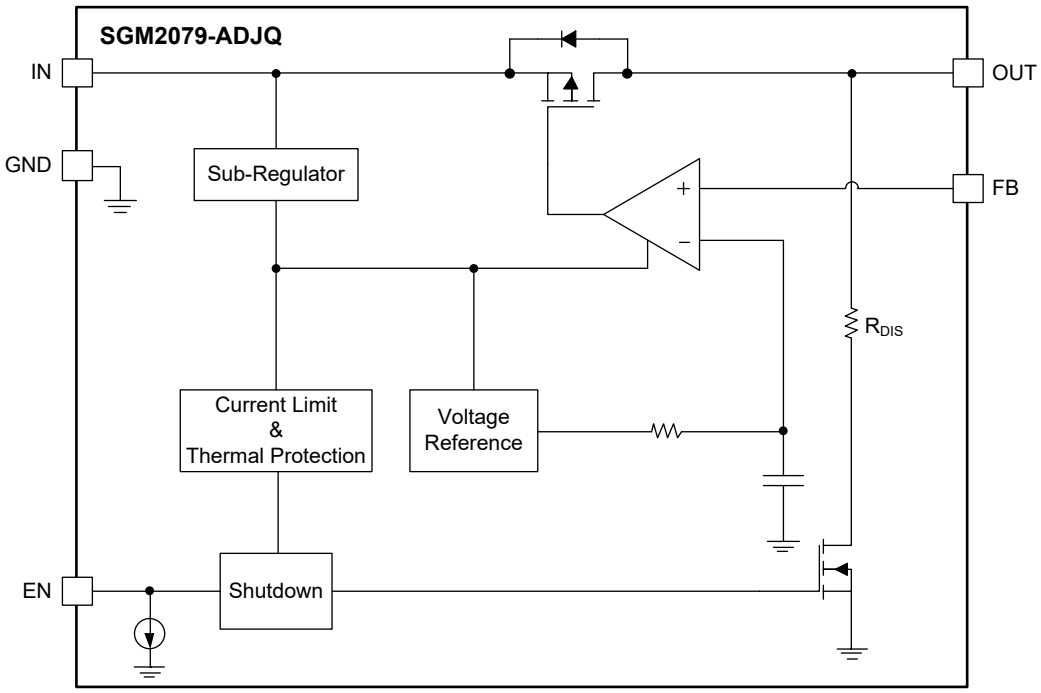


Figure 2. Adjustable Output Voltage Internal Block Diagram

ELECTRICAL CHARACTERISTICS

(V_{IN} = ($V_{OUT(NOM)}$ + 0.5V) or 2.2V (whichever is greater), V_{EN} = 2.2V, I_{OUT} = 1mA, C_{IN} = C_{OUT} = 4.7μF. For SGM2079-ADJQ, tested at V_{OUT} = 0.8V, T_J = -40℃ to +125℃, typical values are at T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Output Voltage Range	V_{OUT}			0.8		5.0	V
Reference Voltage	V_{ADJ}				0.8		V
Feedback Pin Current	I_{ADJ}	V_{IN} = 5.5V, V_{ADJ} = 0.9V			0.001		μA
Under-Voltage Lockout Thresholds	V_{UVLO}	V_{IN} rising			1.80		V
		Hysteresis			210		mV
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	V_{IN} = ($V_{OUT(NOM)}$ + 0.5V) to 5.5V, V_{IN} ≥ 2.2V, I_{OUT} = 1mA			0.007		%/V
Load Regulation	$\Delta V_{OUT}/\Delta I_{OUT}$	I_{OUT} = 1mA to 1A			0.22		μV/mA
Dropout Voltage	V_{DROP}	V_{FB} = GND, I_{OUT} = 1A, V_{IN} = 2.5V			140		mV
Output Current Limit	I_{LIMIT}	V_{OUT} = 90% × $V_{OUT(NOM)}$, V_{IN} = ($V_{OUT(NOM)}$ + 1V)			1.86		A
Short Current Limit	I_{SHORT}	V_{OUT} = 0V			1.70		A
Ground Pin Current	I_{GND}	No load, V_{IN} = 5.5V			84		μA
		I_{OUT} = 1A			676		
Shutdown Current	I_{SHDN}	V_{EN} ≤ 0.4V, V_{IN} ≥ 2.2V			0.03		μA
EN Pin High-Level Input Voltage	$V_{EN(H)}$	2.2V ≤ V_{IN} ≤ 5.5V		1.2			V
EN Pin Low-Level Input Voltage	$V_{EN(L)}$					0.4	V
EN Pin Current	I_{EN}	V_{IN} = 5.5V, V_{EN} = 0V			0.001		μA
		V_{IN} = 5.5V, V_{EN} = 5.5V			0.110		
Start-up Time	t_{STR}	from assertion of V_{EN} to 90% × $V_{OUT(NOM)}$			140		μs
Rising Time	t_R	V_{OUT} = 10% to 90% × $V_{OUT(NOM)}$			80		μs
Power Supply Rejection Ratio	PSRR	V_{IN} = 2.5V, $V_{OUT(NOM)}$ = 1.1V, I_{OUT} = 1A	f = 1kHz		74		dB
			f = 10kHz		66		
			f = 1MHz		48		
Output Voltage Noise	e_n	I_{OUT} = 100mA, f = 10Hz to 100kHz	$V_{OUT(NOM)}$ = 1.1V		13		$μV_{RMS}$
			$V_{OUT(NOM)}$ = 3.3V		38		
			$V_{OUT(NOM)}$ = 5.0V		49		
Output Discharge Resistance	R_{DIS}	V_{IN} = 2.2V			105		Ω
Thermal Shutdown Temperature	T_{SHDN}				168		℃
Thermal Shutdown Hysteresis	ΔT_{SHDN}				30		℃

APPLICATION INFORMATION

The SGM2079xQ is a low noise, high PSRR and fast transient response LDO and provides 1A output current. These features make the device a reliable solution to solve many challenging problems in the generation of clean and accurate power supply. The high performance also makes the SGM2079xQ useful in a variety of applications. The SGM2079xQ provides the protection function for output overload, output short-circuit condition and overheating.

The SGM2079xQ provides an EN pin as an external chip enable control to enable/disable the device. When the regulator is in shutdown state, the shutdown current consumes as low as 0.03μA (TYP).

Input Capacitor Selection (C_{IN})

The input decoupling capacitor should be placed as close as possible to the IN pin to ensure the device stability. 4.7μF or larger X7R or X5R ceramic capacitor is selected to get good dynamic performance.

When V_{IN} is required to provide large current instantaneously, a large effective input capacitor is required. Multiple input capacitors can limit the input tracking inductance. Adding more input capacitors is available to restrict the ringing and keep it below the device absolute maximum ratings.

Output Capacitor Selection (C_{OUT})

The output capacitor should be placed as close as possible to the OUT pin. 10μF or larger X7R or X5R ceramic capacitor is selected to get good dynamic performance. The minimum effective capacitance of C_{OUT} that SGM2079xQ can remain stable is 4.7μF. For ceramic capacitor, temperature, DC bias and package size will change the effective capacitance, thus, enough margin of C_{OUT} must be considered in design. Additionally, C_{OUT} with larger capacitance and lower ESR will help increase the high frequency PSRR and improve the load transient response.

Dropout Voltage and V_{IN}

The SGM2079xQ features low dropout voltage due to low $R_{DS(ON)}$ PMOSFET power transistor. For Linear regulator, when (V_{IN} - V_{OUT}) < dropout voltage (V_{DROP}), the PMOSFET power transistor will be turned on like a switch, the parameter of linear regulator, such as PSRR, load and input transient responses, will be degraded so much. To get good performance in application, the V_{IN} must be larger than (V_{OUT} + V_{DROP}).

Adjustable Regulator

The output voltage of the SGM2079-ADJQ can be adjusted from 0.8V to 5.0V. The FB pin will be connected to two external resistors as shown in Figure 4. The output voltage is determined by the following equation:

$$V_{OUT} = V_{ADJ} \times \left(1 + \frac{R_1}{R_2}\right) \quad (1)$$

where:

V_{OUT} is output voltage and V_{ADJ} is the internal voltage reference, V_{ADJ} = 0.8V.

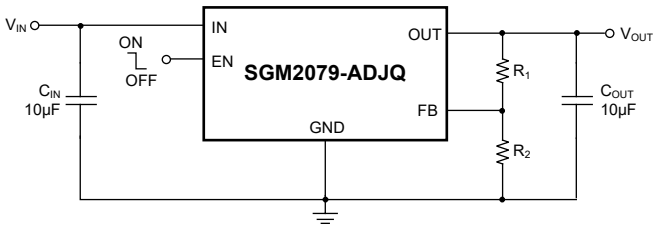


Figure 3. Adjustable Output Voltage Application

R_1 and R_2 can be calculated for any output voltage range using Equation 1. Choose R_2 = 80kΩ to maintain a 10μA minimum load.

Enable Control

The EN pin of the SGM2079xQ is used to enable/disable the device and to deactivate/activate the output automatic discharge function.

When the EN pin voltage is lower than $V_{EN(L)}$, the device is in shutdown state. There is no current flowing from IN to OUT pins. In this state, the automatic discharge transistor is active to discharge the output voltage through a 105Ω (TYP) resistor.

When the EN pin voltage is higher than $V_{EN(H)}$, the device is in active state. The output voltage is regulated to the expected value and the automatic discharge transistor is turned off.

APPLICATION INFORMATION (continued)

Under-Voltage Lockout (UVLO)

The UVLO circuit monitors the input voltage to prevent the device from turning on before V_{IN} rises above the V_{UVLO} threshold. The UVLO circuit responds quickly to glitches on the IN pin and attempts to disable the output of the device if any of these rails collapses. The local input capacitance prevents severe brownouts in most applications.

Reverse Current Protection

The pass transistor has an inherent body diode which will be forward biased in the case when $V_{OUT} > (V_{IN} + 0.3V)$. If extended reverse voltage operation is anticipated, external limiting might be appropriate.

Negatively Biased Output

When the output voltage is negative, the chip may not start up due to parasitic effects. Ensure that the output is greater than -0.3V under all conditions. If negatively biased output is excessive and expected in the application, a Schottky diode can be added between the OUT pin and GND pin.

Output Current Limit and Short-Circuit Protection

When overload events happen, the output current is internally limited to 1.86A (TYP). When the OUT pin is shorted to ground, the short-circuit protection will limit the output current to 1.70A (TYP).

Thermal Shutdown

When the die temperature exceeds the threshold value of thermal shutdown, the SGM2079xQ will be in shutdown state and remain in this state until the die temperature decreases to +138℃.

Power Dissipation (P_D)

Thermal protection limits power dissipation in the SGM2079xQ. When power dissipation on pass element ($P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$) is too much and the operating junction temperature exceeds +168℃, the OTP circuit starts the thermal shutdown function and turns the pass element off.

The maximum allowable power dissipation depends on the thermal resistance of the IC package, the PCB layout, the rate of surrounding airflow, and the difference between the junction temperature and ambient temperature. The maximum power dissipation can be approximated using the following equation:

$$P_{D(MAX)} = (T_{J(MAX)} - T_A)/\theta_{JA} \quad (2)$$

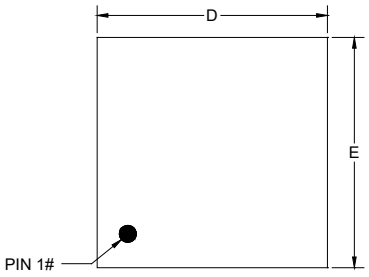
where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction-to-ambient thermal resistance.

Layout Guidelines

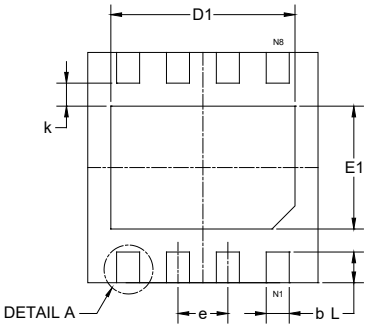
To get good PSRR, low output noise and high transient response performance, the input and output bypass capacitors must be placed as close as possible to the IN pin and OUT pin separately. V_{IN} and V_{OUT} had better use separate ground planes and these ground planes are single point connected to the GND pin.

PACKAGE OUTLINE DIMENSIONS

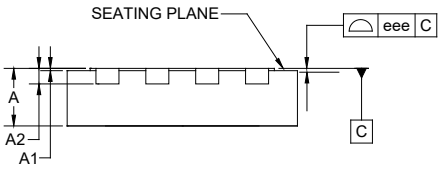
TDFN-3×3-8JL



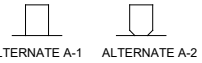
TOP VIEW



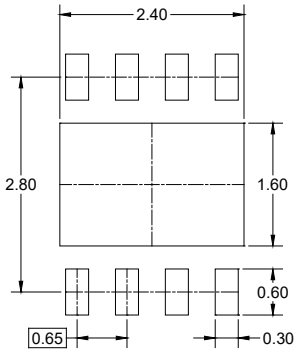
BOTTOM VIEW



SIDE VIEW



DETAIL A
ALTERNATE TERMINAL CONSTRUCTION



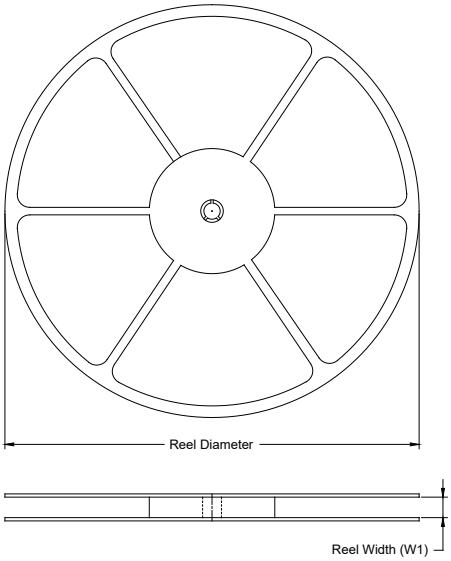
RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	0.700	-	0.800
A1	0.000	-	0.050
A2	0.203 REF		
b	0.250	-	0.350
D	2.900	-	3.100
D1	2.300	-	2.500
E	2.900	-	3.100
E1	1.500	-	1.700
e	0.650 BSC		
k	0.300 REF		
L	0.300	-	0.500
eee	0.080		

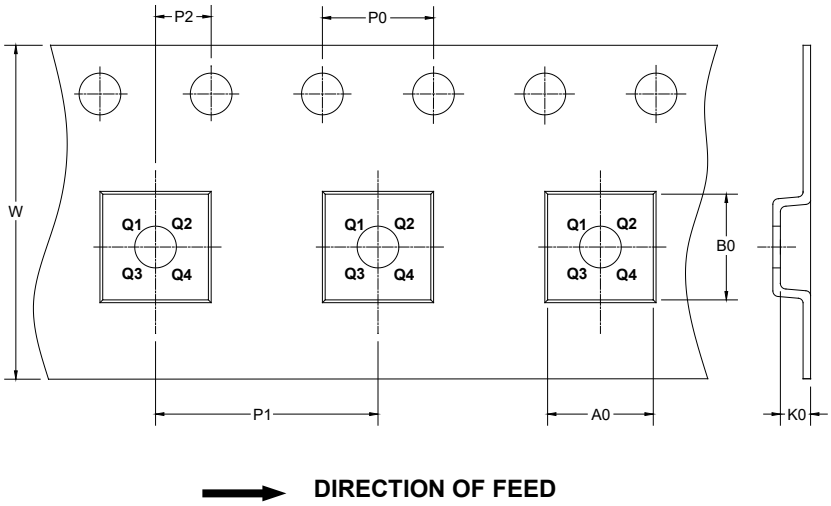
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TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



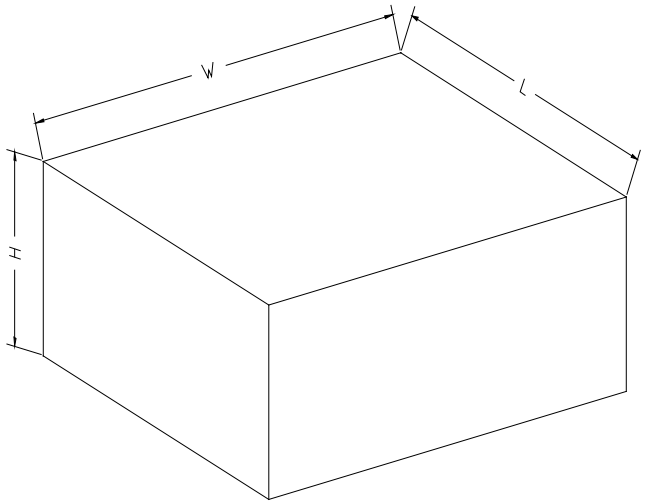
NOTE: The picture is only for reference. Please make the object as the standard.

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-3×3-8JL	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