

SGM2039

Fast Transient Response, Low Voltage, 1A, Low Dropout Linear Regulator

GENERAL DESCRIPTION

The SGM2039 is a CMOS low dropout linear regulator featuring 1A output current. The input voltage is as low as 1.8V and the output voltage can be set from 0.8V.

The SGM2039 is available in a Green XTDFN-1.6×1.2-8L package. It operates over an operating temperature range of -40°C to +125°C.

APPLICATIONS

Battery Powered Equipment
Portable Communication Equipment
Cameras, Image Sensors and Camcorders

FEATURES

- Operating Input Voltage Range: 1.8V to 5.5V
- Output Voltage Range: 0.8V to 4.2V
- Fixed or Adjustable Output Voltage Applications
- Quiescent Current: 55μA (TYP)
- Low Dropout: 103mV (TYP) at 1A, $V_{OUT} = 3.3V$
- Stable with Small 1μF Ceramic Capacitors
- Over-Current Protection
- Built-in Soft-Start Circuit to Suppress Inrush Current
- Thermal Shutdown Protection
- SGM2039A: with Output Automatic Discharge
- SGM2039B: without Output Automatic Discharge
- -40°C to +125°C Operating Temperature Range
- Available in a Green XTDFN-1.6×1.2-8L Package

TYPICAL APPLICATION CIRCUITS

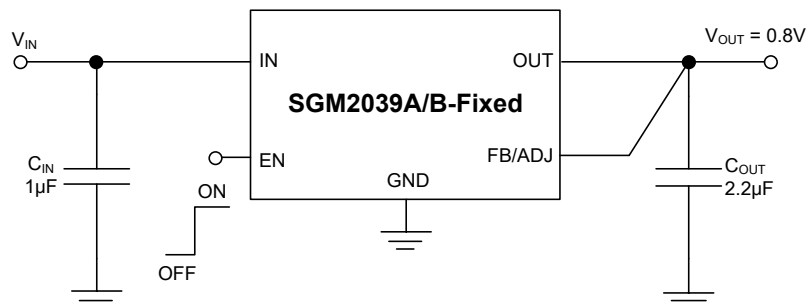


Figure 1. Typical Application Circuit for Fixed Output Voltage

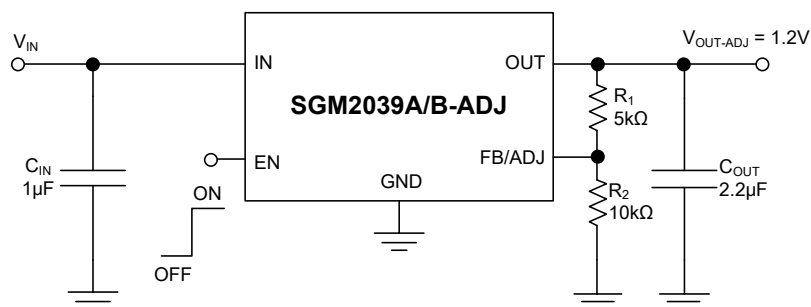


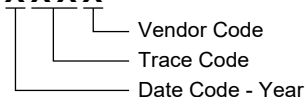
Figure 2. Typical Application Circuit for Adjustable Output Voltage

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2039A-0.8	XTDFN-1.6×1.2-8L	-40°C to +125°C	SGM2039A-0.8XXEV8G/TR	S008 XXXX	Tape and Reel, 5000
SGM2039A-0.9	XTDFN-1.6×1.2-8L	-40°C to +125°C	SGM2039A-0.9XXEV8G/TR	S009 XXXX	Tape and Reel, 5000
SGM2039A-1.0	XTDFN-1.6×1.2-8L	-40°C to +125°C	SGM2039A-1.0XXEV8G/TR	S00A XXXX	Tape and Reel, 5000
SGM2039A-1.05	XTDFN-1.6×1.2-8L	-40°C to +125°C	SGM2039A-1.05XXEV8G/TR	S00B XXXX	Tape and Reel, 5000
SGM2039A-1.1	XTDFN-1.6×1.2-8L	-40°C to +125°C	SGM2039A-1.1XXEV8G/TR	S00C XXXX	Tape and Reel, 5000
SGM2039A-1.2	XTDFN-1.6×1.2-8L	-40°C to +125°C	SGM2039A-1.2XXEV8G/TR	S00D XXXX	Tape and Reel, 5000
SGM2039A-1.8	XTDFN-1.6×1.2-8L	-40°C to +125°C	SGM2039A-1.8XXEV8G/TR	S00E XXXX	Tape and Reel, 5000
SGM2039A-2.5	XTDFN-1.6×1.2-8L	-40°C to +125°C	SGM2039A-2.5XXEV8G/TR	S00F XXXX	Tape and Reel, 5000
SGM2039A-2.8	XTDFN-1.6×1.2-8L	-40°C to +125°C	SGM2039A-2.8XXEV8G/TR	S00G XXXX	Tape and Reel, 5000
SGM2039A-3.0	XTDFN-1.6×1.2-8L	-40°C to +125°C	SGM2039A-3.0XXEV8G/TR	S00H XXXX	Tape and Reel, 5000
SGM2039A-3.3	XTDFN-1.6×1.2-8L	-40°C to +125°C	SGM2039A-3.3XXEV8G/TR	S00I XXXX	Tape and Reel, 5000
SGM2039A-4.2	XTDFN-1.6×1.2-8L	-40°C to +125°C	SGM2039A-4.2XXEV8G/TR	S00J XXXX	Tape and Reel, 5000
SGM2039A-ADJ	XTDFN-1.6×1.2-8L	-40°C to +125°C	SGM2039A-ADJXXEV8G/TR	S00K XXXX	Tape and Reel, 5000

MARKING INFORMATION

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

XXXX

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 to GND	-0.3V to 6V
OUT to GND	-0.3V to ($V_{IN} + 0.3V$)
EN to GND.....	-0.3V to 6V
Junction Temperature	+150°C
Storage Temperature Range.....	-65°C to +150°C
Lead Temperature (Soldering, 10s)	+260°C

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range	1.8V to 5.5V
Input Effective Capacitance, C_{IN}	0.5 μ F (MIN)
Output Effective Capacitance, C_{OUT}	0.8 μ F to 10 μ F
Operating Junction Temperature Range.....	-40°C to +125°C

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.

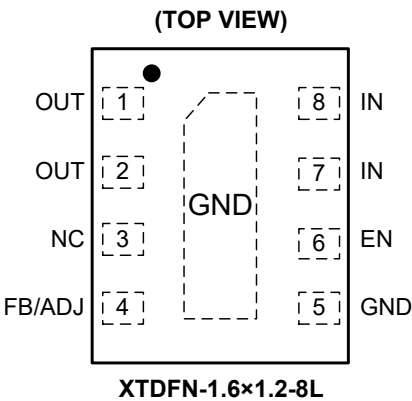
ESD SENSITIVITY CAUTION

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	
1, 2	OUT	Regulated Output Voltage Pin. It is recommended to use an output capacitor with effective capacitance in the range of 0.8μF to 10μF. The capacitor should be located very close to this pin.
3	NC	Tune the space here, this line is not horizontally aligned with others. Not internally connected. This pin can be tied to the ground plane to improve thermal dissipation.
4	FB/ADJ	Feedback/Adjustable Input Pin (connect this pin directly to the OUT pin or to the resistor divider).
5	GND	
6	EN	Enable Pin. Driving EN high to turn on the regulator. Driving EN low to turn off the regulator.
7, 8	IN	Input Voltage Supply Pin. Bypass with a 1μF capacitor to GND.
Exposed Pad	GND	Exposed Pad. Exposed pad is internally connected to GND. Connect it to a large ground plane to maximize thermal performance; not intended as an electrical connection point.

ELECTRICAL CHARACTERISTICS

($V_{IN} = (V_{OUT(NOM)} + 0.5V)$ or 1.8V (whichever is greater), $I_{OUT} = 1mA$, $C_{IN} = 1\mu F$, $C_{OUT} = 2.2\mu F$, $V_{EN} = V_{IN}$, $T_J = -40^{\circ}C$ to $+125^{\circ}C$, typical values are at $T_J = +25^{\circ}C$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Input Voltage	V_{IN}		1.8		5.5	V
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	$V_{IN} = (V_{OUT(NOM)} + 0.5V)$ to 5.5V, $I_{OUT} = 1mA$		0.006		%/V
Load Regulation	ΔV_{OUT}	$I_{OUT} = 1mA$ to 1A		4		mV
Dropout Voltage	V_{DROP}	$I_{OUT} = 1A$, when V_{OUT} falls to $(V_{OUT(NOM)} - 100mV)$	$V_{OUT(NOM)} = 1.8V$	175		mV
			$V_{OUT(NOM)} = 2.5V$	126		
			$V_{OUT(NOM)} = 3.3V$	103		
Quiescent Current	I_Q	$I_{OUT} = 0mA$		55		μA
Shutdown Current	I_{SHDN}	$V_{EN} = 0V$		100		nA
FB/ADJ Pin Input Current	$I_{FB/ADJ}$			10		nA
Reference Voltage	V_{REF}	SGM2039A-ADJ, SGM2039B-ADJ		0.8		V
Output Current Limit	I_{LIMIT}	$V_{OUT} = 90\%$ of $V_{OUT(NOM)}$		1.3		A
Output Short Circuit Current	I_{SHORT}	$V_{OUT} = 0V$		1.3		A
Enable Input Current	I_{EN}			120		nA
Enable Threshold Voltage	V_{IH}	EN input voltage high	1.2			V
	V_{IL}	EN input voltage low			0.3	
Power Supply Rejection Ratio	PSRR	$V_{IN} = V_{OUT(NOM)} + 1V$, $\Delta V_{RIPPLE} = 0.2V_{P-P}$, $I_{OUT} = 30mA$	$f = 1kHz$	88		dB
			$f = 1MHz$	35		dB
Output Noise	e_n	$f = 10Hz$ to $100kHz$, $I_{OUT} = 50mA$		10		μV_{RMS}
Output Discharge Resistance (SGM2039A option only)	R_{DIS}	$V_{IN} = 5.5V$, $V_{EN} = 0V$, $V_{OUT} = 1.8V$		43		Ω
Thermal Shutdown Temperature	T_{SHDN}	Temperature rising from $T_J = +25^{\circ}C$		165		$^{\circ}C$
Thermal Shutdown Hysteresis	ΔT_{SHDN}	Temperature falling from T_{SHDN}		20		$^{\circ}C$

FUNCTIONAL BLOCK DIAGRAM

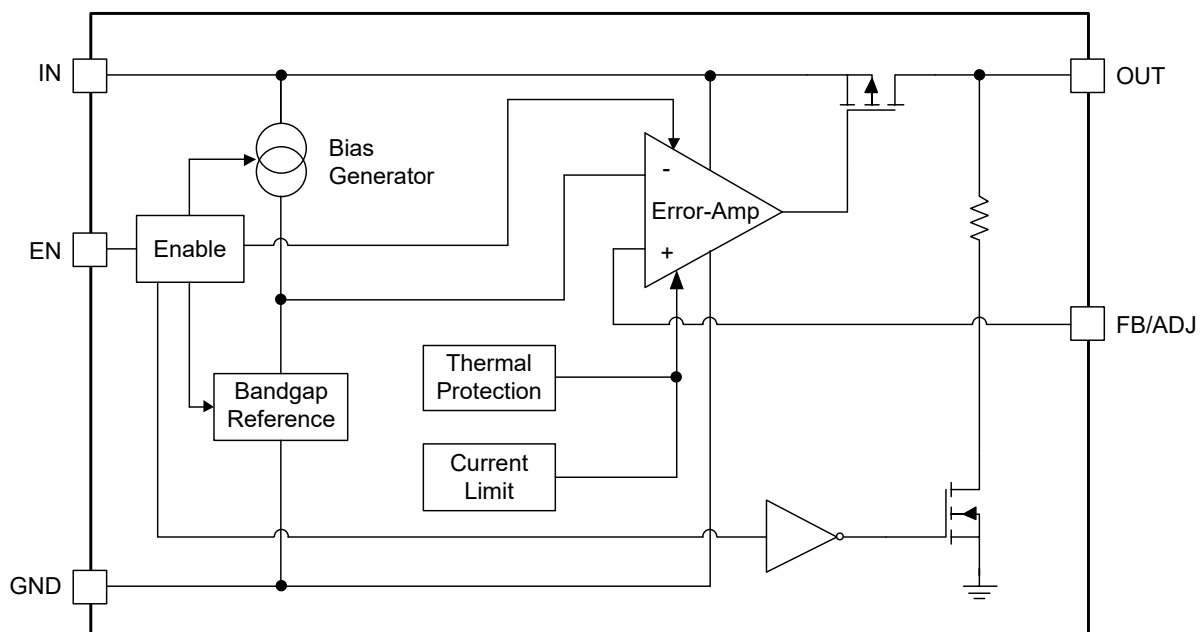


Figure 3. SGM2039A Block Diagram (with Output Automatic Discharge)

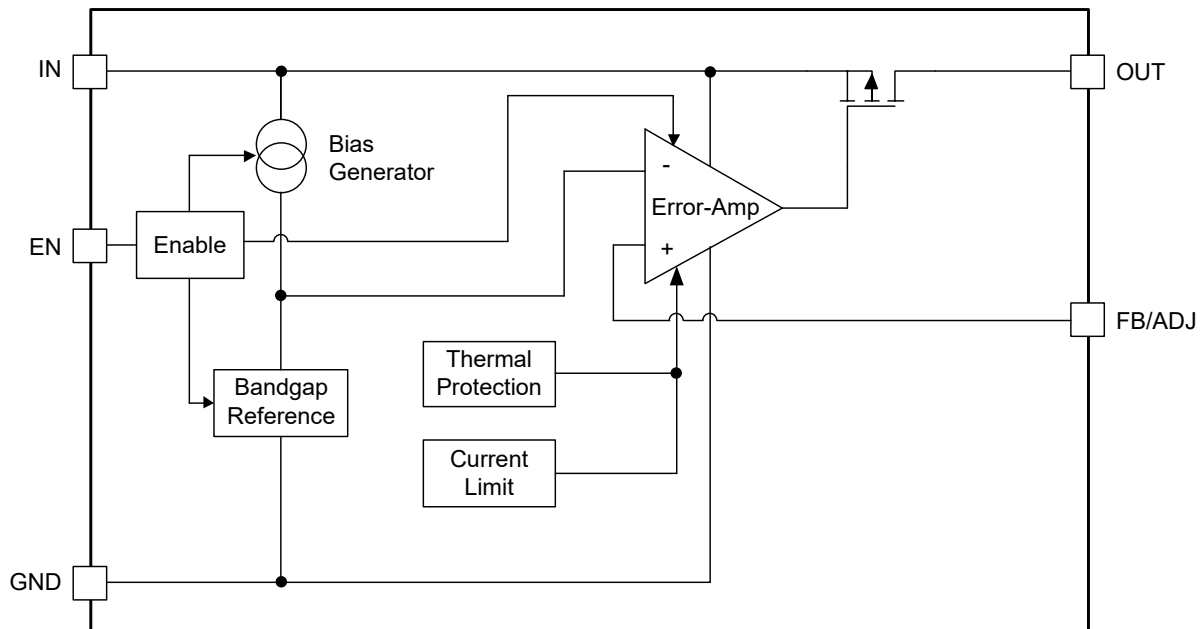


Figure 4. SGM2039B Block Diagram (without Output Automatic Discharge)

APPLICATION INFORMATION

The SGM2039 is a high performance 1A low dropout linear regulator (LDO) delivering excellent noise and dynamic performance. Thanks to its adaptive ground current behavior, the device consumes only 55μA (TYP) of quiescent current (no load condition).

The regulator features low noise of 10μVRMS, PSRR of 88dB at 1kHz and very good line/load transient performance. Such excellent dynamic parameters, small dropout voltage and small package size make the device an ideal choice for powering the precision noise sensitive circuitry in portable applications.

A logic EN input provides ON/OFF control of the output voltage. When the EN is low the device consumes as low as 100nA (TYP) from the IN pin.

The device is fully protected in case of output overload, output short circuit condition or overheating, ensuring a very robust design.

Input Capacitor Selection (C_{IN})

It is necessary to connect the input capacitor as close as possible to ensure the device stability. The X7R or X5R capacitor should be used for reliable performance over temperature range.

The value of the input capacitor should be 1μF or greater for the best dynamic performance. This capacitor will provide a low impedance path for unwanted AC signals or noise modulated onto the input voltage.

There is no requirement for the ESR of the input capacitor but it is recommended to use ceramic capacitor for its low ESR and ESL. A good input capacitor will limit the influence of input trace inductance and source resistance during load current changes.

Output Capacitor Selection (C_{OUT})

The LDO requires an output capacitor connected as close as possible to the output and ground pins. The recommended capacitor value is 1μF, ceramic X7R or X5R type due to its low capacitance variations over the specified temperature range. The LDO is designed to remain stable with minimum effective capacitance of 0.8μF. When selecting the capacitor the changes with temperature, DC bias and package size needs to be taken into account. Especially for small package size capacitors such as 0201 the effective capacitance drops rapidly with the applied DC bias voltage (refer to the capacitor's datasheet for details).

There is no requirement for the minimum value of equivalent series resistance (ESR) for the C_{OUT} but the maximum value of ESR should be less than 0.2Ω. Larger capacitance and lower ESR improves the load transient response and high frequency PSRR. Only ceramic capacitors are recommended, the other types like tantalum capacitors not due to their large ESR.

Enable Operation

The LDO uses the EN pin to enable/disable its operation and to deactivate/activate the output discharge function (A version only).

If the EN pin voltage is < 0.3V, the device is disabled and the pass transistor is turned off so there is no current flow between the IN and OUT pins. On A version, the automatic discharge transistor is active so the output voltage is pulled to GND through 43Ω (TYP) resistor.

If the EN pin voltage is > 1.2V, the device is enabled and regulates the output voltage. The automatic discharge transistor is turned off.

The EN pin has internal pull-down current source with value of 120nA (TYP) which ensures the device is turned off when the EN pin is unconnected. In case when the EN function isn't required, the EN pin should be tied directly to IN pin.

Output Voltage

FB/ADJ pin could be connected to the output pin directly to compensate voltage drop across the internal bond wiring and PCB traces or to the middle point of the output resistor divider to adjust the output voltage.

When connected to the output pin, the output voltage of the circuit is simply the same as the nominal output voltage of the LDO.

When connected to the resistor divider, the output voltage is the nominal output voltage multiplied by the resistors divider ratio, see following equation. Corresponding schematic is shown at Figure 1.

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

where:

V_{OUT-ADJ} is output voltage of the circuit with resistor divider, V_{OUT(NOM)} is the LDO's nominal output voltage.

APPLICATION INFORMATION (continued)

For good stability and fast transient response, choose the R_1 and R_2 values to have their currents I_{R1} and I_{R2} in range from $10\mu\text{A}$ to $100\mu\text{A}$. If a bypass capacitor (C_{BYPASS}) across the high-side feedback resistor (R_1) is used, it will help provide better PSRR, improve load transient response and the output noise performance.

Output Current Limit

Output current is internally limited to a 1.3A (TYP). The LDO will source this current when the output voltage drops down from the nominal output voltage (test condition is $V_{\text{OUT(NOM)}} - 100\text{mV}$). If the output voltage is shorted to ground, the short circuit protection will limit the output current to 1.3A (TYP). The current limit and short circuit protection will work properly over the whole temperature and input voltage ranges. There is no limitation for the short circuit duration.

Thermal Shutdown

When the LDO's die temperature exceeds the thermal shutdown threshold value, the device is internally disabled.

The IC will remain in this state until the die temperature decreases by value called thermal shutdown hysteresis.

Once the IC temperature falls this way, the LDO is back enabled. The thermal shutdown feature provides the protection against overheating due to some application

failure and it is not intended to be used as a normal working function.

Reverse Current

The PMOS pass transistor has an inherent body diode which will be forward biased in the case when $V_{\text{OUT}} > V_{\text{IN}}$.

Due to this fact in cases, where the extended reverse current condition can be anticipated the device may require additional external protection.

Power Supply Rejection Ratio

The LDO features very high power supply rejection ratio.

The PSRR at higher frequencies (in the range above 100kHz) can be tuned by the selection of C_{OUT} capacitor and proper PCB layout. A simple LC filter could be added to the LDO's IN pin for further PSRR improvement.

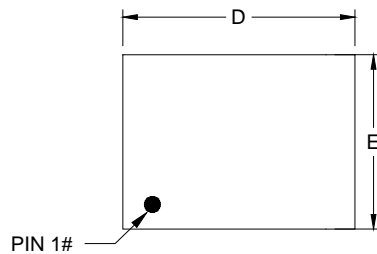
Enable Turn-On Time

The enable turn-on time is defined as the time from EN assertion to the point in which V_{OUT} will reach 98% of its nominal value. This time is dependent on various application conditions such as $V_{\text{OUT(NOM)}}$, C_{OUT} and T_J .

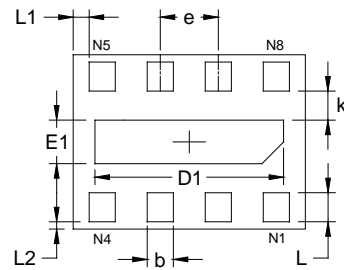
PACKAGE INFORMATION

PACKAGE OUTLINE DIMENSIONS

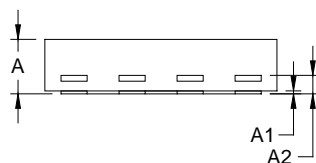
XTDFN-1.6×1.2-8L



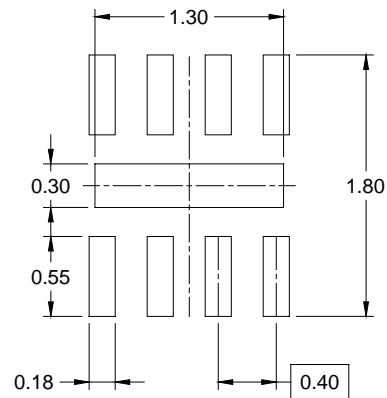
TOP VIEW



BOTTOM VIEW



SIDE VIEW



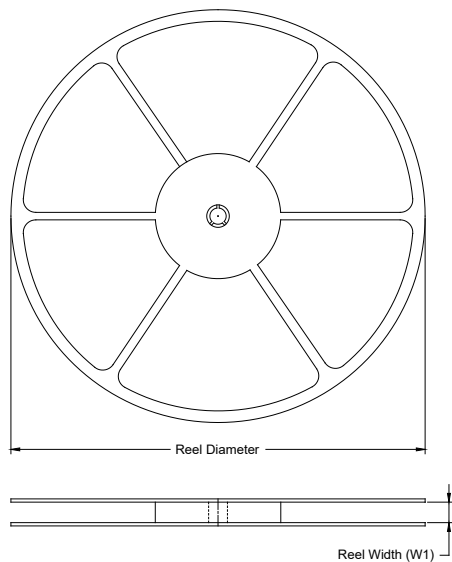
RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	0.340	-	0.400
A1	0.000	-	0.050
A2	0.127 REF		
D	1.500	1.600	1.700
E	1.100	1.200	1.300
D1	1.250	1.300	1.350
E1	0.250	0.300	0.350
b	0.130	0.180	0.230
e	0.400 BSC		
L	0.150	0.200	0.250
L1	0.110 REF		
L2	0.050 REF		
k	0.150	0.200	0.250

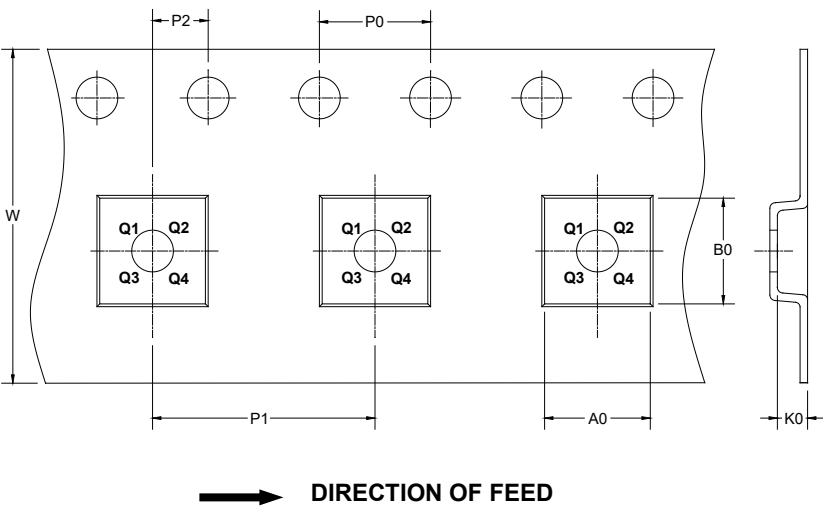
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

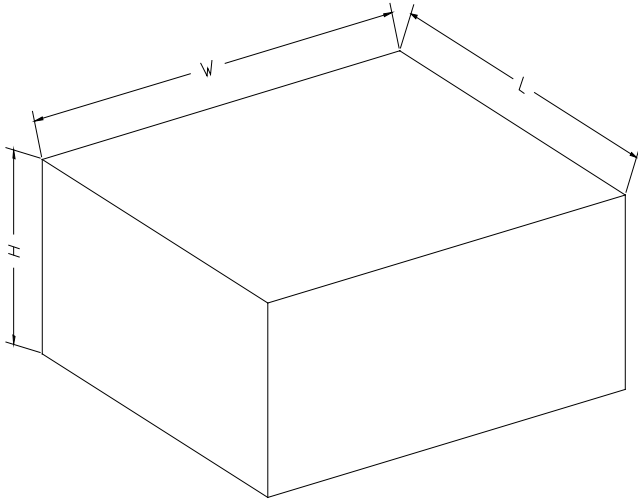
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
XTDFN-1.6×1.2-8L	7"	9.5	1.37	1.77	0.55	4.0	4.0	2.0	8.0	Q1

DD00001

PACKAGE INFORMATION

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