SGM2075
500mA, 1.2V Logic, Low Noise, Low Dropout, Bias Rail CMOS Voltage Regulator

GENERAL DESCRIPTION

The SGM2075 is a low noise, low dropout, bias rail CMOS voltage regulator. It is capable of supplying 500mA output current with typical V_{IN} dropout voltage of only 125mV. The operating input voltage range is from 0.8V to 5.5V and bias supply voltage range is from 2.5V to 5.5V. The output voltage range is from 0.8V to 3.6V.

Other features include 1.2V logic-controlled shutdown mode, short-circuit current limit and thermal shutdown protection. The SGM2075 has automatic discharge function to quickly discharge V_{OUT} in the disabled status.

The SGM2075 is suitable for applications which need low noise, fast transient response and low I_Q consumption, such as battery-powered equipment and smartphones, etc.

The SGM2075 is available in a Green XTDFN-1.2×1.2-4L package. It operates over an operating temperature range of -40℃ to +125℃.

FEATURES

- **Input Supply Voltage Range: 0.8V to 5.5V**
- **Bias Supply Voltage Range: 2.5V to 5.5V**
- **Fixed Output from 0.8V to 3.6V**
- **Output Voltage Accuracy: ±1% at +25℃**
- **500mA Output Current**
- **Low Dropout Voltage: 125mV (TYP) at 500mA**
- **Low Noise: 31μV_{RMS} (TYP)**
- **Very Low BIAS Pin Operating Current: 120μA (MAX)**
- **Very Low BIAS Pin Disable Current: 0.5μA (MAX)**
- **Current Limiting and Thermal Protection**
- **Excellent Load and Line Transient Responses**
- **Supports 1.2V Logic Enable Input for ON/OFF Control**
- **With Output Automatic Discharge**
- **Stable with Small Case Size Ceramic Capacitors**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in a Green XTDFN-1.2×1.2-4L Package**

APPLICATIONS

Portable Equipment
Smartphone
Industrial and Medical Equipment

TYPICAL APPLICATION

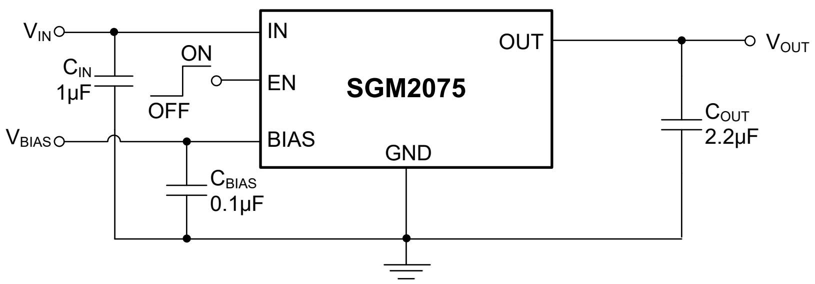


Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2075-0.8	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-0.8XXHO4G/TR	07 XX	Tape and Reel, 5000
SGM2075-0.9	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-0.9XXHO4G/TR	08 XX	Tape and Reel, 5000
SGM2075-1.0	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-1.0XXHO4G/TR	09 XX	Tape and Reel, 5000
SGM2075-1.05	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-1.05XXHO4G/TR	04 XX	Tape and Reel, 5000
SGM2075-1.1	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-1.1XXHO4G/TR	05 XX	Tape and Reel, 5000
SGM2075-1.15	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-1.15XXHO4G/TR	0A XX	Tape and Reel, 5000
SGM2075-1.2	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-1.2XXHO4G/TR	06 XX	Tape and Reel, 5000
SGM2075-1.25	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-1.25XXHO4G/TR	0B XX	Tape and Reel, 5000
SGM2075-1.3	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-1.3XXHO4G/TR	0C XX	Tape and Reel, 5000
SGM2075-1.5	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-1.5XXHO4G/TR	0D XX	Tape and Reel, 5000
SGM2075-1.8	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-1.8XXHO4G/TR	0E XX	Tape and Reel, 5000
SGM2075-2.5	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-2.5XXHO4G/TR	0F XX	Tape and Reel, 5000
SGM2075-2.8	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-2.8XXHO4G/TR	0G XX	Tape and Reel, 5000
SGM2075-3.0	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-3.0XXHO4G/TR	0H XX	Tape and Reel, 5000
SGM2075-3.3	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-3.3XXHO4G/TR	0I XX	Tape and Reel, 5000
SGM2075-3.6	XTDFN-1.2×1.2-4L	-40℃ to +125℃	SGM2075-3.6XXHO4G/TR	0J XX	Tape and Reel, 5000

MARKING INFORMATION

NOTE: XX = Date Code.

YY — Serial Number
X X
Date Code - Week
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

IN, BIAS, EN to GND .... -0.3V to 6V
OUT to GND ....-0.3V to MIN((V_{IN} + 0.3V), 6V)
Package Thermal Resistance
XTDFN-1.2×1.2-4L, θ_{JA}.. 160.2℃/W
XTDFN-1.2×1.2-4L, θ_{JB}... 105℃/W
XTDFN-1.2×1.2-4L, $\theta_{JC(TOP)}$..................................113.5℃/W
XTDFN-1.2×1.2-4L, $\theta_{JC(BOT)}$................................... 97.5℃/W
Junction Temperature ....+150℃
Storage Temperature Range........................-65℃ to +150℃
Lead Temperature (Soldering, 10s) ....+260℃
ESD Susceptibility
HBM...8000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Input Supply Voltage Range ....0.8V to 5.5V
Bias Supply Voltage Range ....2.5V to 5.5V
Enable Input Voltage Range ....0V to 5.5V
Bias Effective Capacitance, C_{BIAS} .... 0.1μF (MIN)
Input Effective Capacitance, C_{IN} .... 0.5μF (MIN)
Output Effective Capacitance, C_{OUT} .... 1μF to 100μF
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.

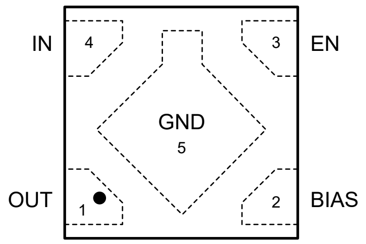
ESD SENSITIVITY CAUTION

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



XTDFN-1.2×1.2-4L

PIN DESCRIPTION

PIN	NAME	FUNCTION
1	OUT	Regulated Output Voltage Pin. It is recommended to use a ceramic capacitor with effective capacitance in the range of 1μF to 100μF to ensure stability. This ceramic capacitor should be placed as close as possible to OUT pin.
2	BIAS	Bias Voltage Supply Pin for Internal Control Circuits. It is recommended to use a 0.1μF or larger ceramic capacitor from BIAS pin to ground and this ceramic capacitor should be placed as close as possible to BIAS pin.
3	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 resistance.
4	IN	Input Supply Voltage Pin. It is recommended to use a 1μF 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.
5	GND	Ground.

FUNCTIONAL BLOCK DIAGRAM

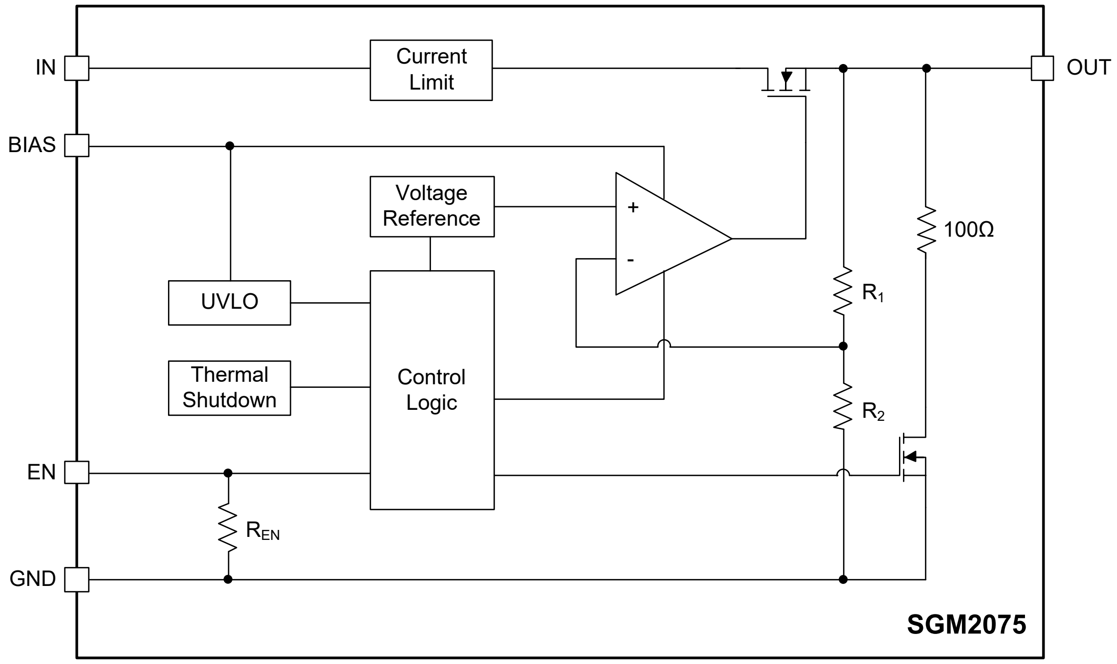


Figure 2. Block Diagram

ELECTRICAL CHARACTERISTICS

(V_{IN} = $V_{OUT(NOM)}$ + 0.3V, V_{BIAS} = 2.7V or ($V_{OUT(NOM)}$ + 1.6V) whichever is greater, V_{EN} = V_{BIAS}, I_{OUT} = 1mA, C_{IN} = 1μF, C_{BIAS} = 0.1μF, C_{OUT} = 2.2μF, T_J = -40℃ to +125℃, typical values are at T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Input Supply Voltage Range	V_{IN}			$V_{OUT(NOM)}$ + V_{DROP_IN}		5.5	V
Bias Supply Voltage Range	V_{BIAS}			($V_{OUT(NOM)}$ + 1.6) ≥ 2.5		5.5	V
Output Voltage Accuracy	V_{OUT}	V_{BIAS} = 2.5V or ($V_{OUT(NOM)}$ + 1.6V) to 5.5V, I_{OUT} = 1mA to 500mA	T_J = +25℃	-1		1	%
			T_J = -40℃ to +125℃	-1.5		1.2	
Under-Voltage Lockout Thresholds	V_{UVLO}	V_{BIAS} rising			1.58	1.7	V
		Hysteresis			0.2		
V_{IN} Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	V_{IN} = ($V_{OUT(NOM)}$ + 0.3V) to 5.5V			0.002	0.03	%/V
V_{BIAS} Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{BIAS} \times V_{OUT}}$	V_{BIAS} = 2.5V or ($V_{OUT(NOM)}$ + 1.6V) to 5.5V, $V_{OUT(NOM)}$ = 0.8V to 1.8V			0.002	0.03	%/V
		V_{BIAS} = ($V_{OUT(NOM)}$ + 1.6V) to 5.5V, $V_{OUT(NOM)}$ = 1.8V to 3.6V			0.01	0.1	
Load Regulation	ΔV_{OUT}	I_{OUT} = 1mA to 500mA	$V_{OUT(NOM)}$ = 0.8V to 1.8V		0.8	3	mV
			$V_{OUT(NOM)}$ = 1.8V to 3.6V		1.5	5	
V_{IN} Dropout Voltage	V_{DROP_IN}	V_{OUT} = 95% × $V_{OUT(NOM)}$	I_{OUT} = 150mA		35	65	mV
			I_{OUT} = 500mA		125	220	
V_{BIAS} Dropout Voltage (1)	V_{DROP_BIAS}	V_{OUT} = 95% × $V_{OUT(NOM)}$, I_{OUT} = 500mA			1.25	1.5	V
Output Current Limit	I_{LIMIT}	V_{OUT} forced at 90% × $V_{OUT(NOM)}$		520	780	1100	mA
Short-Circuit Current Limit	I_{SHORT}	V_{OUT} = 0V			400		mA
BIAS Pin Operating Current	I_{BIAS}	V_{BIAS} = 5.5V			88	120	μA
BIAS Pin Disable Current	I_{DIS_BIAS}	V_{EN} = 0V			0.01	0.5	μA
IN Pin Disable Current	I_{DIS_IN}	V_{EN} = 0V			0.1	2	μA
EN Pin Threshold Voltage	V_{IH}	EN input voltage high		0.71		5.5	V
	V_{IL}	EN input voltage low		0		0.46	V
EN Pin Pull-Down Resistance	R_{EN}			350	580	800	kΩ
Output Discharge Resistance	R_{DIS}	V_{EN} = 0V, V_{OUT} = 0.5V, V_{BIAS} = 5.5V		60	100	140	Ω
Turn-On Time	t_{ON}	From assertion of V_{EN} to V_{OUT} = 90% × $V_{OUT(NOM)}$			90		μs
V_{IN} Power Supply Rejection Ratio	PSRR	V_{IN} to V_{OUT}, f = 1kHz, $V_{OUT(NOM)}$ = 1.2V, I_{OUT} = 150mA, V_{IN} ≥ 1.7V			80		dB
V_{BIAS} Power Supply Rejection Ratio		V_{BIAS} to V_{OUT}, f = 1kHz, $V_{OUT(NOM)}$ = 1.2V, I_{OUT} = 150mA, V_{IN} ≥ 1.7V			73		
Output Voltage Noise	e_n	V_{IN} = $V_{OUT(NOM)}$ + 0.5V, $V_{OUT(NOM)}$ = 1.2V, f = 10Hz to 100kHz			31		$μV_{RMS}$
Thermal Shutdown Temperature	T_{SHDN}				155		℃
Thermal Shutdown Hysteresis	ΔT_{SHDN}				20		℃

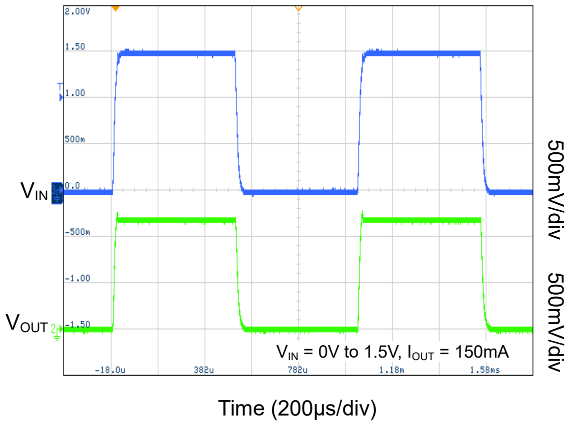
NOTE:

1. The V_{BIAS} dropout voltage is not suitable for output voltages below 1.5V because the minimum bias operating voltage is 2.5V.

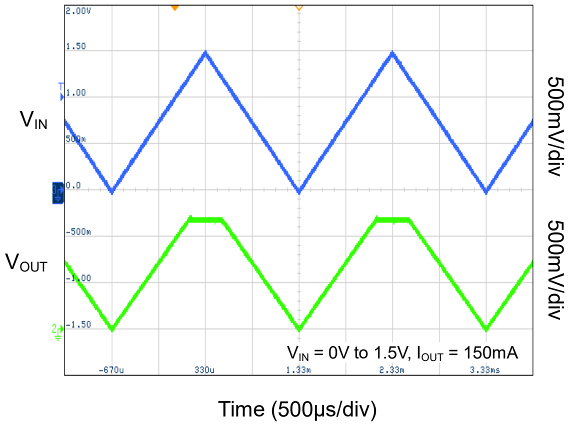
TYPICAL PERFORMANCE CHARACTERISTICS

T_J = +25℃, V_{IN} = 1.5V, $V_{OUT(NOM)}$ = 1.2V, V_{EN} = V_{BIAS} = 2.8V, C_{IN} = 1μF, C_{BIAS} = 0.1μF, C_{OUT} = 2.2μF, unless otherwise noted.

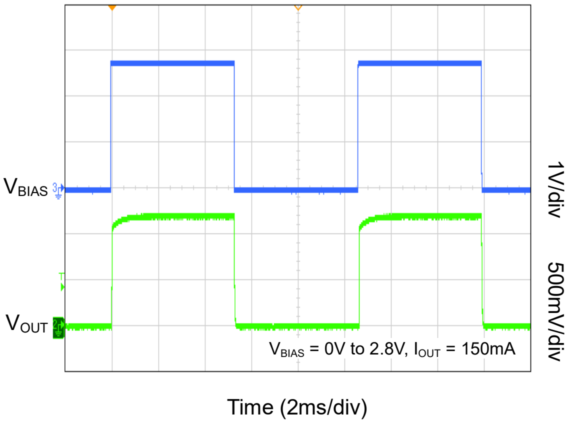
V_{IN} Power-Up/Power-Down Output Waveform



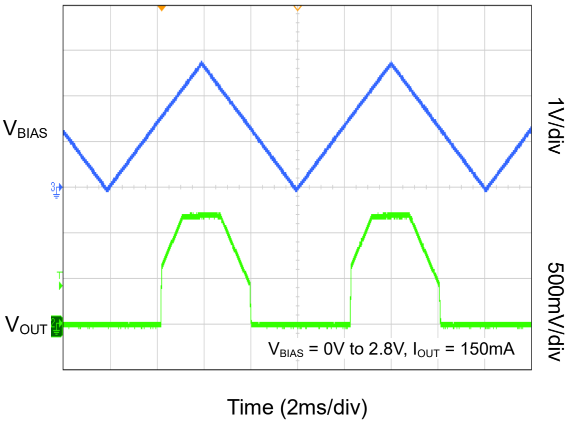
V_{IN} Power Ramp-Up/Ramp-Down Output Waveform



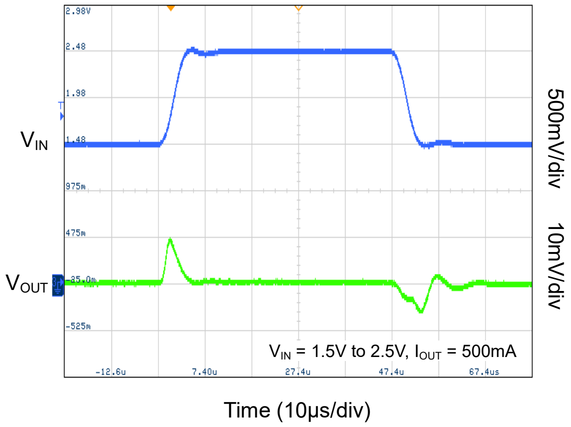
V_{BIAS} Power-Up/Power-Down Output Waveform



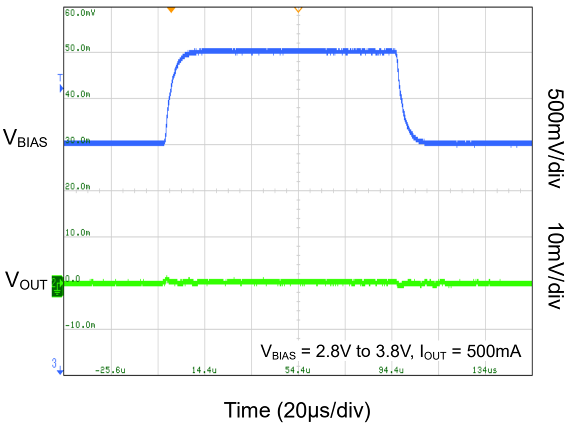
V_{BIAS} Power Ramp-Up/Ramp-Down Output Waveform



V_{IN} Line Transient Response



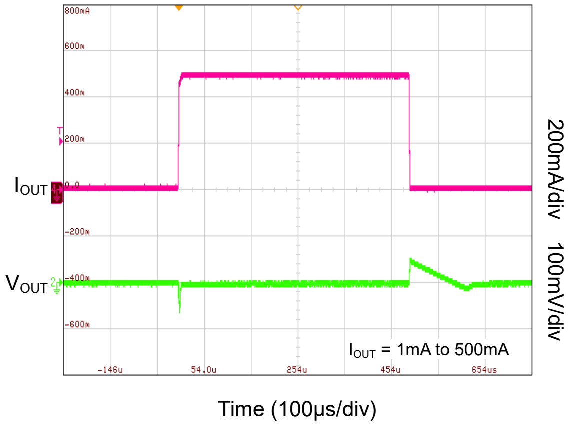
V_{BIAS} Line Transient Response



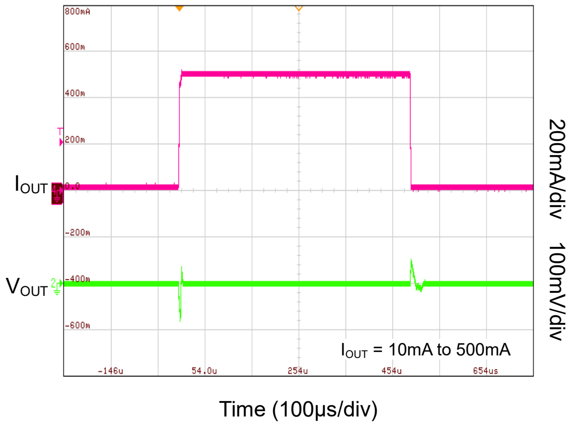
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_J = +25℃, V_{IN} = 1.5V, $V_{OUT(NOM)}$ = 1.2V, V_{EN} = V_{BIAS} = 2.8V, C_{IN} = 1μF, C_{BIAS} = 0.1μF, C_{OUT} = 2.2μF, unless otherwise noted.

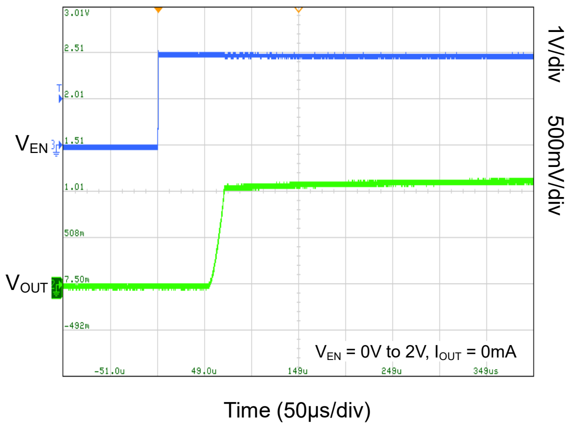
Load Transient Response



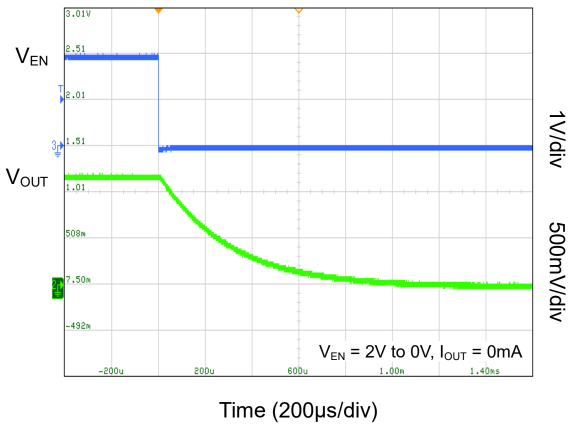
Load Transient Response



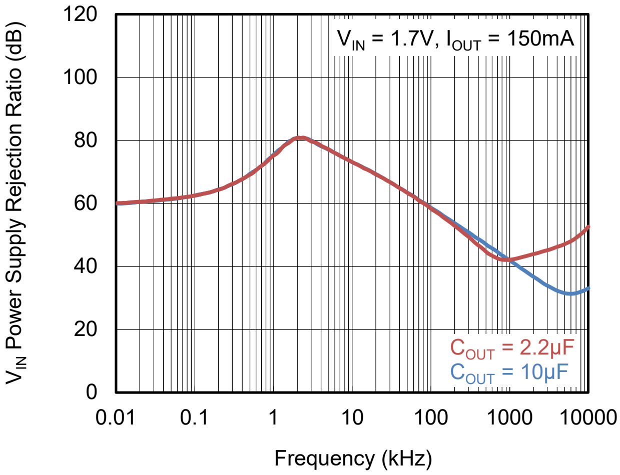
Turn-On Speed with EN Pin



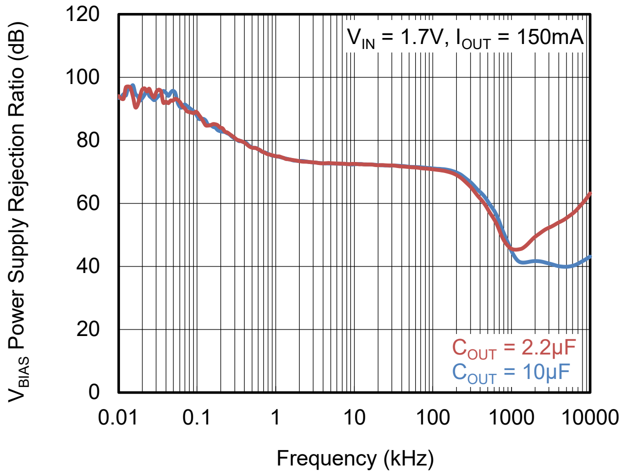
Turn-Off Speed with EN Pin



V_{IN} Power Supply Rejection Ratio vs. Frequency

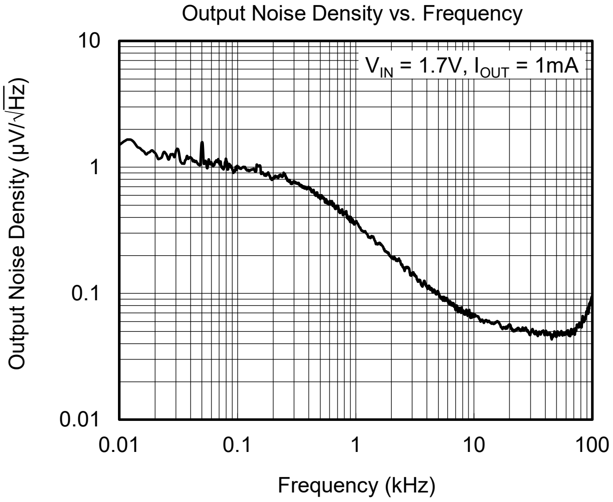


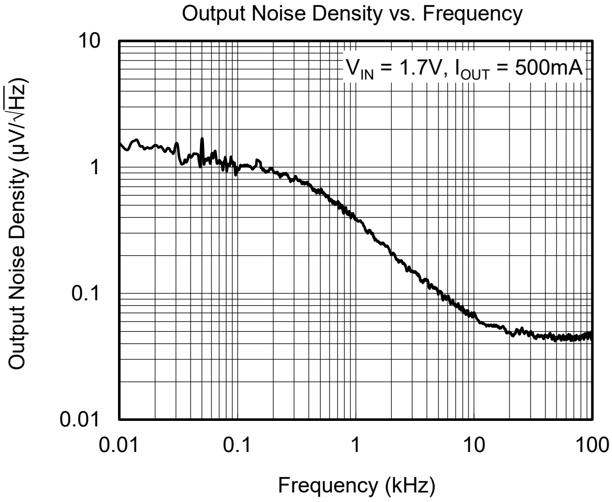
V_{BIAS} Power Supply Rejection Ratio vs. Frequency

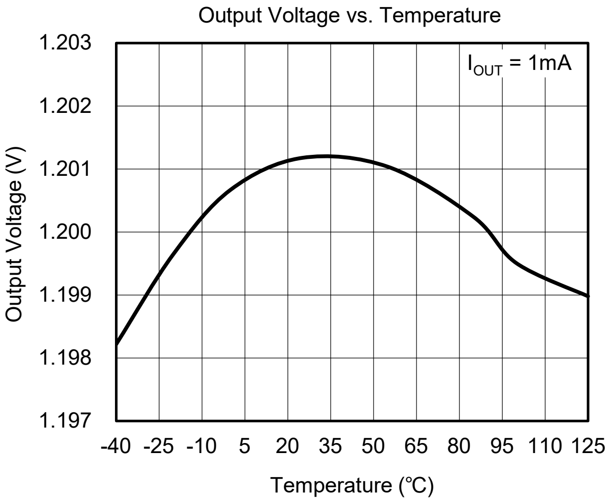


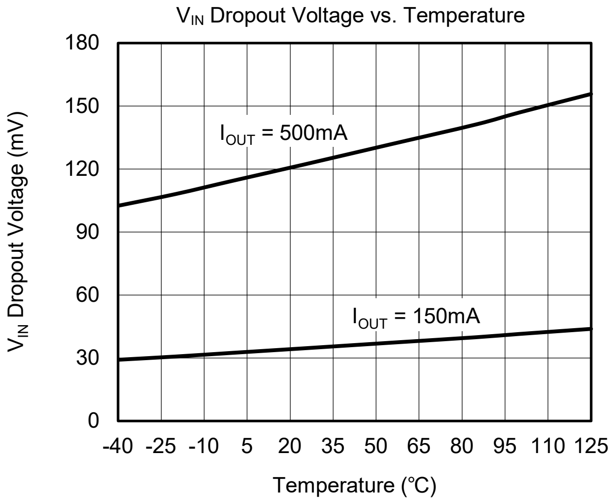
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

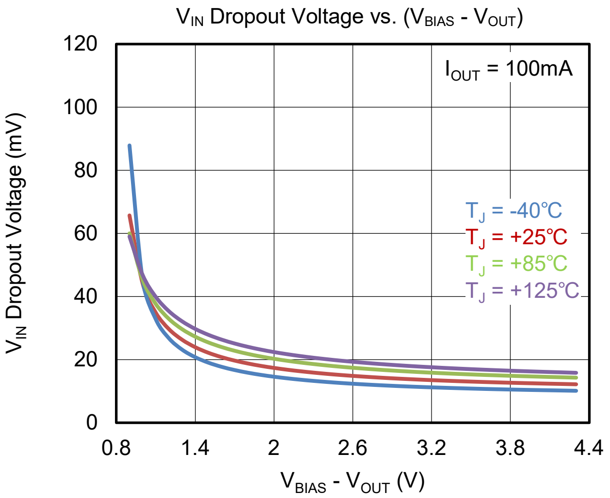
T_J = +25℃, V_{IN} = 1.5V, $V_{OUT(NOM)}$ = 1.2V, V_{EN} = V_{BIAS} = 2.8V, C_{IN} = 1μF, C_{BIAS} = 0.1μF, C_{OUT} = 2.2μF, unless otherwise noted.

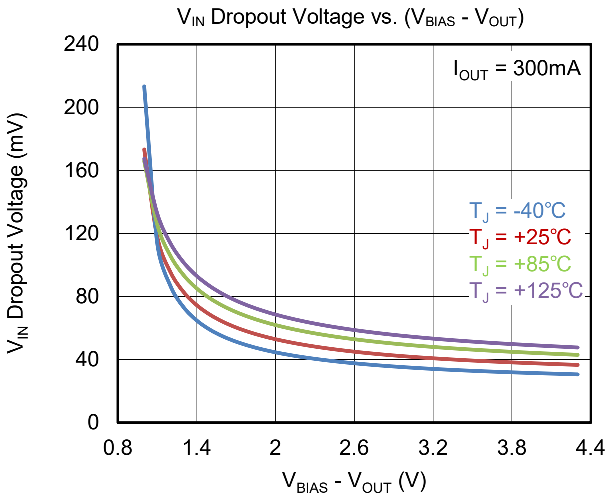






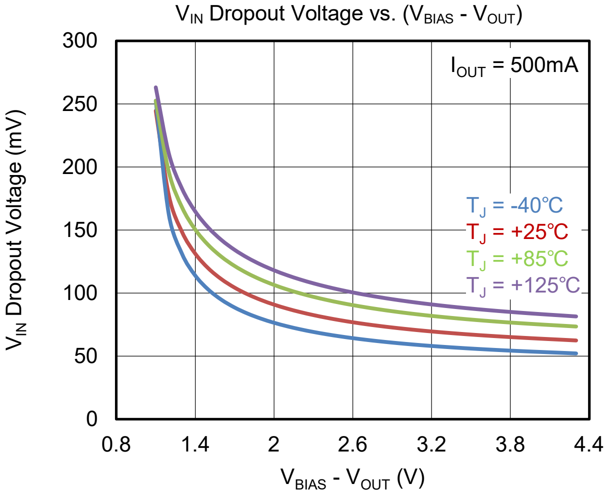


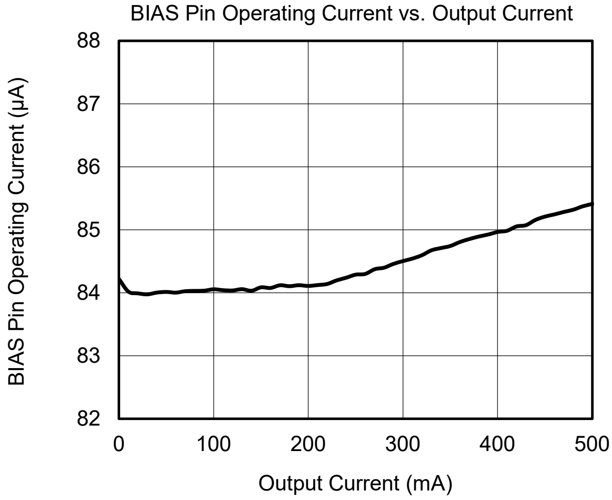


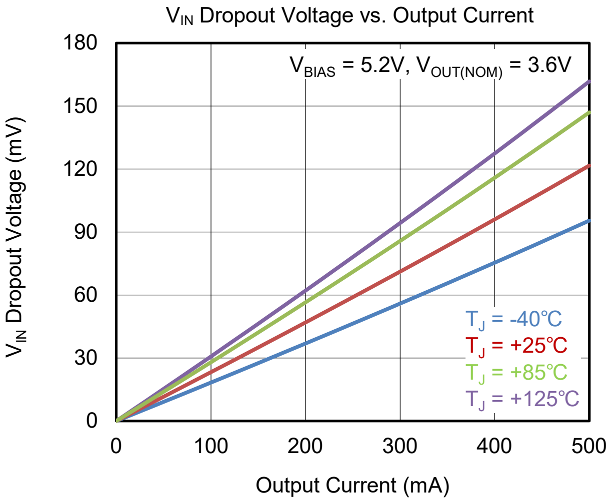


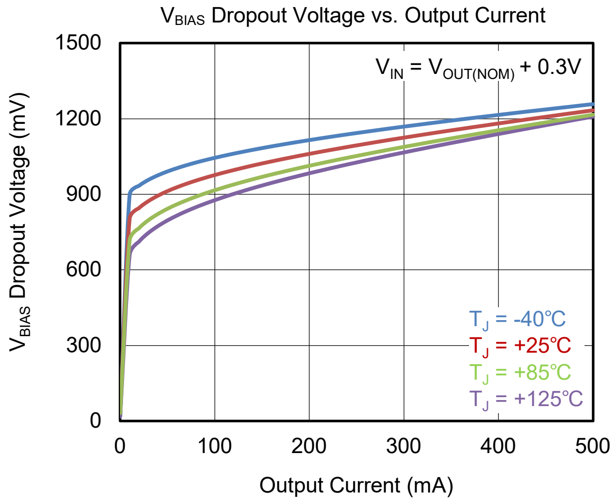
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

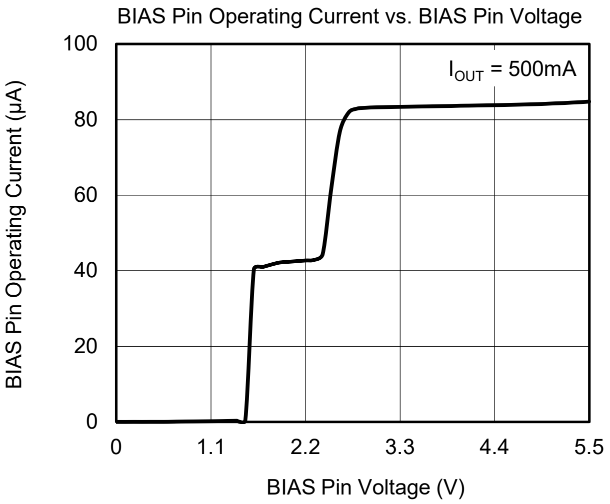
T_J = +25℃, V_{IN} = 1.5V, $V_{OUT(NOM)}$ = 1.2V, V_{EN} = V_{BIAS} = 2.8V, C_{IN} = 1μF, C_{BIAS} = 0.1μF, C_{OUT} = 2.2μF, unless otherwise noted.











APPLICATION INFORMATION

The SGM2075 is a low noise and low dropout LDO with fast transient response and provides 500mA 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 SGM2075 useful in a variety of applications. The SGM2075 provides protection functions for output overload, output short-circuit condition and overheating.

The SGM2075 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 0.01μA (TYP).

Input Capacitor Selection (C_{IN} and C_{BIAS})

The input decoupling capacitors should be placed as close as possible to the IN pin and BIAS pin to ensure the device stability. C_{IN} = 1μF and C_{BIAS} = 0.1μF or larger X7R or X5R ceramic capacitors are 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 to keep it below the device absolute maximum ratings. For C_{OUT} with larger capacitance, it is recommended to choose the larger capacitance C_{IN}.

Output Capacitor Selection (C_{OUT})

The output capacitor should be placed as close as possible to the OUT pin. 1μF or larger X7R or X5R ceramic capacitor is selected to get good dynamic performance. The minimum effective capacitance of C_{OUT} that SGM2075 can remain stable is 1μF. For ceramic capacitor, temperature, DC bias and package size will change the effective capacitance, so 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

The SGM2075 specifies two dropout voltages because there are two power supplies V_{IN} and V_{BIAS} and one V_{OUT} regulator output. V_{IN} dropout voltage is defined as the difference between V_{IN} and V_{OUT} when V_{OUT} falls 5% below $V_{OUT(NOM)}$. When the output voltage is lower than 1.5V, V_{BIAS} dropout voltage is not applicable because the minimum bias operating voltage is 2.5V.

When V_{OUT} begins to decrease and V_{BIAS} is high enough, the V_{IN} dropout voltage equals to V_{IN} - V_{OUT}. V_{BIAS} dropout voltage refers to V_{BIAS} - V_{OUT} when the IN and BIAS pins are connected together and V_{OUT} begins to decrease.

Enable Operation

The SGM2075 uses the EN pin to enable/disable the device and to deactivate/activate the output automatic discharge function.

When the EN pin voltage is lower than 0.46V, the device is in shutdown state. There is no current flowing from IN pin to OUT pin. In this state, the automatic discharge transistor is active to discharge the output voltage through a 100Ω (TYP) resistor.

When the EN pin voltage is higher than 0.71V, the device is in active state. The output voltage is regulated to the expected value and the automatic discharge transistor is turned off.

Reverse Current Protection

The NMOS power transistor has an inherent body diode, this body diode will be forward biased when $V_{OUT} > V_{IN}$. When $V_{OUT} > V_{IN}$, the reverse current flowing from the OUT pin to the IN pin will damage the SGM2075. If $V_{OUT} > (V_{IN} + 0.3V)$ is expected in the application, one external Schottky diode will be added between the OUT pin and IN pin to protect the SGM2075.

APPLICATION INFORMATION (continued)

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 780mA (TYP). When the OUT pin is shorted to ground, the short-circuit protection will limit the output current to 400mA (TYP).

Thermal Shutdown

When the die temperature exceeds the threshold value of thermal shutdown, the SGM2075 will be in shutdown state and it will remain in this state until the die temperature decreases to +135℃.

Power Dissipation (P_D)

Power dissipation (P_D) of the SGM2075 can be calculated by the equation $P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$. The maximum allowable power dissipation ($P_{D(MAX)}$) of the SGM2075 is affected by many factors, including the difference between junction temperature and ambient temperature ($T_{J(MAX)} - T_A$), package thermal resistance from the junction to the ambient environment (θ_{JA}), the rate of ambient airflow and PCB layout. $P_{D(MAX)}$ can be approximated by the following equation:

$$P_{D(MAX)} = (T_{J(MAX)} - T_A)/\theta_{JA} \quad (1)$$

The power dissipation must be less than 1.6W for the device protection. For example, when output is short to GND, the short current is about 0.4A and the input voltage must be less than 4V, otherwise the SGM2075 may be damaged.

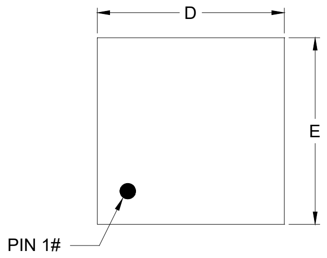
REVISION HISTORY

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

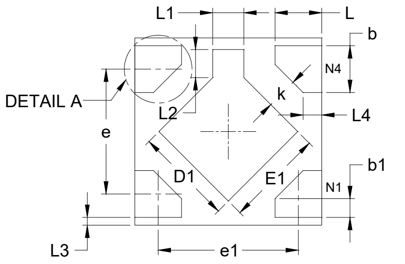
Changes from Original (MAY 2024) to REV.A	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

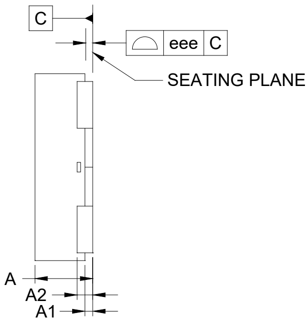
XTDFN-1.2×1.2-4L



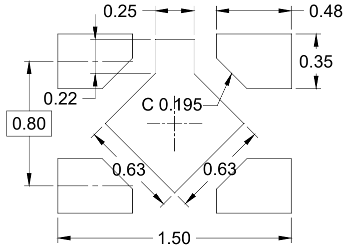
TOP VIEW



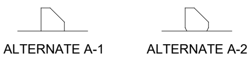
BOTTOM VIEW



SIDE VIEW



RECOMMENDED LAND PATTERN (Unit: mm)



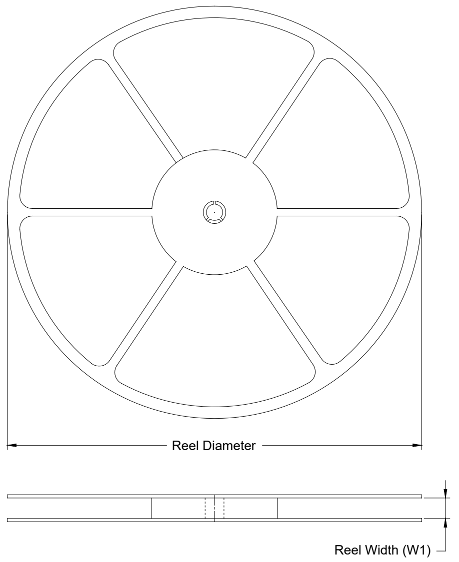
DETAIL A
ALTERNATE TERMINAL
CONSTRUCTION

Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	0.340	-	0.400
A1	0.000	-	0.005
A2	0.100 REF		
b	0.250	-	0.350
b1	0.120 REF		
D	1.100	-	1.300
D1	0.530	-	0.730
E	1.100	-	1.300
E1	0.530	-	0.730
e	0.800 BSC		
e1	0.900 BSC		
k	0.150	-	-
L	0.200	-	0.400
L1	0.150	-	0.250
L2	0.130	-	0.230
L3	0.000	-	0.100
L4	0.120 REF		
eee	0.050		

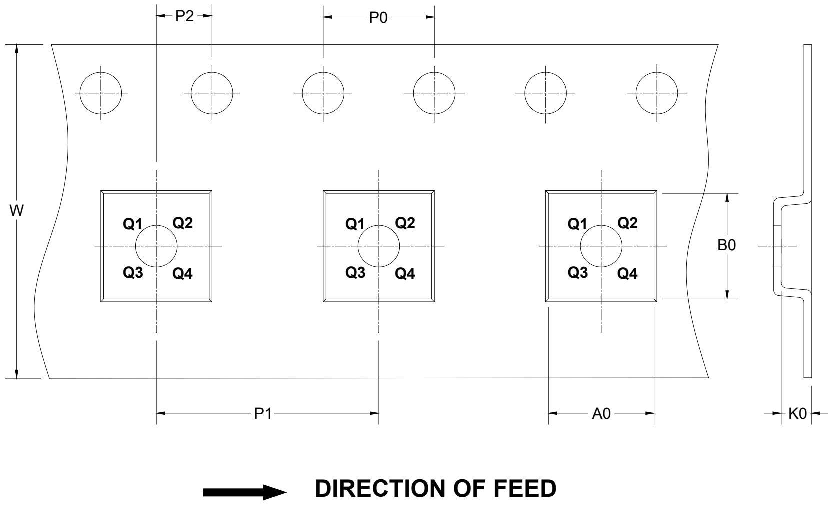
NOTE: This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



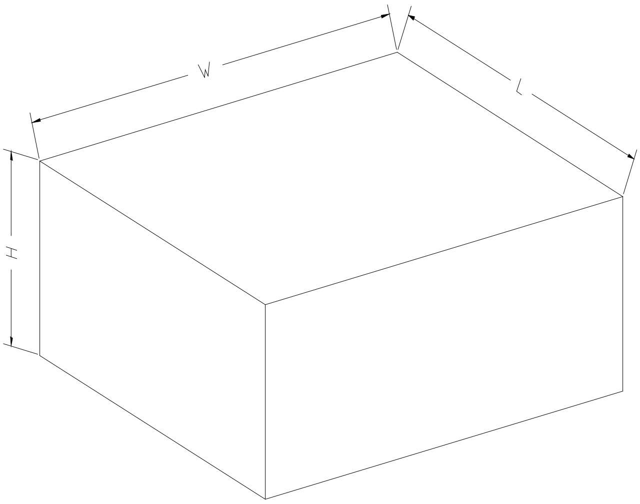
NOTE: The picture is only for reference. Please make the object as the standard.

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-1.2×1.2-4L	7"	9.5	1.37	1.37	0.55	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