SGM790A/SGM790B/SGM790C
Dual Load Detectors with 300nA Operating Current

GENERAL DESCRIPTION

The SGM790A, SGM790B and SGM790C are low current, dual load sensing devices that can detect connection or removal of the loads on a supply bus. By using short pulse injections into the input capacitance and measuring the voltage change, load existence is periodically checked.

The SGM790A and SGM790C provide wake-up output pins, denoted by WKP and nWKP respectively. The logic levels of the SGM790C are completely the opposite of the SGM790A. When a load attachment or detachment is sensed, a pulse (1.3s, TYP) is generated on WKP (nWKP) pin to report the status change or to awaken the host. The bidirectional WKP (nWKP) pin is also used as a selection input pin to choose either SNS1 or SNS2 channel. The detection status of SNSx channel is reported on the FLG output pin during the 1.3s window. In the SGM790B, the most recent detection status of SNSx channel is reported on the corresponding FLGx channel output.

These devices are available in a Green UTDFN-1.2×1.2-6L package, and can operate in the ambient temperature range of -40℃ to +85℃.

FEATURES

- **2.5V to 5.5V Operating Voltage Range**
- **Very Low Operating Current: 300nA (TYP)**
- **Two Independent Detection Channels**
- **1.3s Wake-Up Output Signal (SGM790A/SGM790C)**
- **160ms Detection Period**
- **Available in a Green UTDFN-1.2×1.2-6L Package**

APPLICATIONS

Power Bank

Powered Storage Box

Low Standby Power Cord Supply

TYPICAL APPLICATION

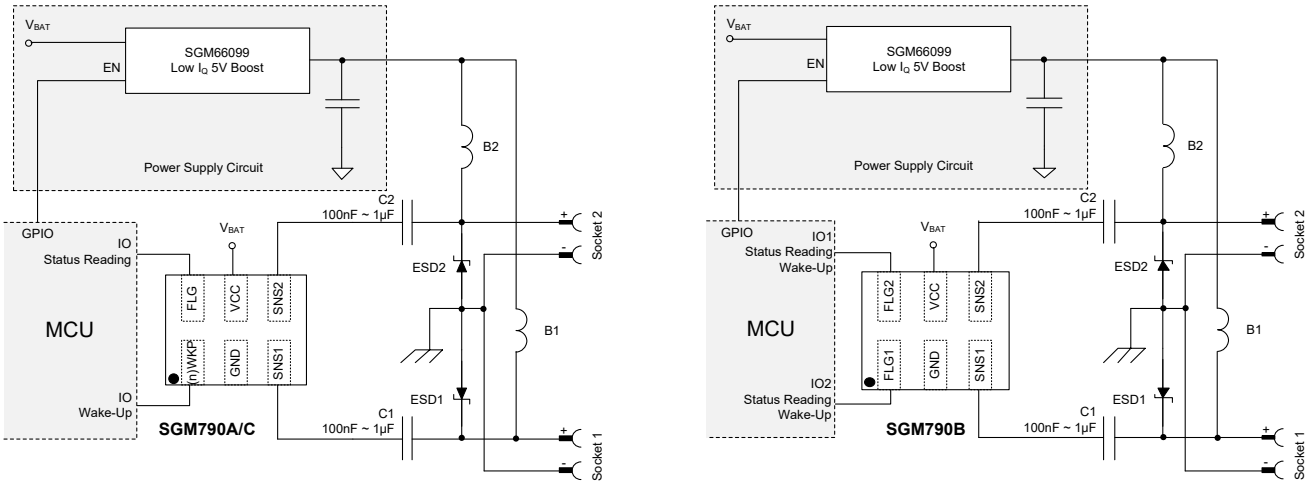


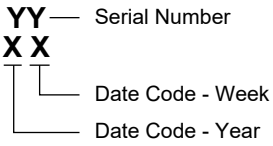
Figure 1. Typical Application Circuits

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM790A	UTDFN-1.2×1.2-6L	-40℃ to +85℃	SGM790AYUDX6G/TR	MD XX	Tape and Reel, 5000
SGM790B	UTDFN-1.2×1.2-6L	-40℃ to +85℃	SGM790BYUDX6G/TR	0A XX	Tape and Reel, 5000
SGM790C	UTDFN-1.2×1.2-6L	-40℃ to +85℃	SGM790CYUDX6G/TR	ME XX	Tape and Reel, 5000

MARKING INFORMATION

NOTE: XX = Date 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 Voltage Range, V_{CC} ..... -0.3V to 6V
WKP, nWKP, SNS1, SNS2, FLG, FLG1, FLG2 Voltage Ranges ..... -0.3V to V_{CC} + 0.3V
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM (SNS1 and SNS2 Pins) 8000V
HBM (Other Pins) 3000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range, V_{CC} ..... 2.5V to 5.5V
Operating Temperature Range ..... -40℃ to +85℃
Load Capacitor ..... 100nF (MIN)

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

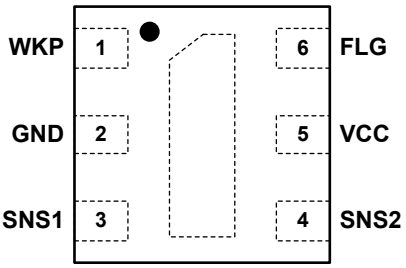
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance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

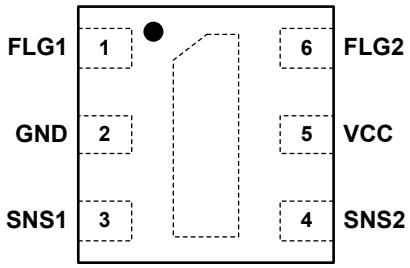
PIN CONFIGURATION

SGM790A (TOP VIEW)



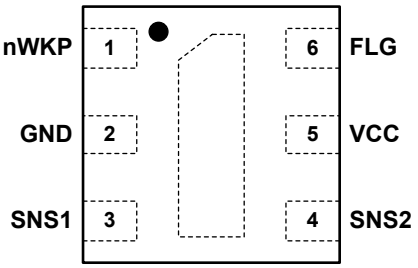
UTDFN-1.2×1.2-6L

SGM790B (TOP VIEW)



UTDFN-1.2×1.2-6L

SGM790C (TOP VIEW)



UTDFN-1.2×1.2-6L

PIN DESCRIPTION

PIN			NAME	TYPE	FUNCTION
SGM790A	SGM790B	SGM790C			
1	—	—	WKP	IO	Wake-Up Output or Channel Selection Input. When a load attachment or detachment is sensed by SNS1 or SNS2, the WKP (nWKP) pin outputs an up-going (a down-going) pulse with a duration of 1.3s to report the status change or to awaken the host. The WKP (nWKP) pin can be forced low while it is high or forced high while it is low. The 1.3s output pulse will also appear on this pin if it is forced high (low). During the 1.3s window, forcing this pin low or high can choose the status of which channel is reported on the FLG output. The logic levels of the SGM790C are completely the opposite of the SGM790A.
—	—	1	nWKP	IO	
—	1	—	FLG1	O	Open-Drain PFET Flag Output for the Load Status Sensed by SNS1. It is in high-impedance (Hi-Z) state if the load is detached. It is pulled high when a load is connected.
2	2	2	GND	G	Ground.
3	3	3	SNS1	IO	Channel 1 Load Sensing Pin.
4	4	4	SNS2	IO	Channel 2 Load Sensing Pin.
5	5	5	VCC	P	Power Supply Input.
6	—	6	FLG	O	Shared Flag Output for the Load Status Sensed by SNS1 and SNS2. During the 1.3s high (low) pulse on the WKP (nWKP) pin, the FLG pin is high if a load is sensed connected and low if it is disconnected. After the WKP (nWKP) pulse period, the FLG pin is in high-impedance (Hi-Z) state. In the SGM790A, the FLG pin reports the SNS1 status if WKP is forced low, and reports the SNS2 status if WKP is high or forced high, during the high pulse window of WKP. In the SGM790C, the FLG pin reports the SNS2 status if nWKP is low or forced low, and reports the SNS1 status if nWKP is high, during the low pulse window of nWKP.
—	6	—	FLG2	O	Open-Drain PFET Flag Output for the Load Status Sensed by SNS2. It is in high-impedance (Hi-Z) state if the load is detached. It is pulled high when a load is connected.
Exposed Pad	Exposed Pad	Exposed Pad	—	—	The exposed pad should be connected to a large ground plane to maximize thermal performance.

NOTE: IO: input or output pin; O: output pin; P: power pin; G: ground of the internal circuit.

ELECTRICAL CHARACTERISTICS

(At T_A = +25℃, V_{CC} = 3.7V, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage Range	V_{CC}		2.5		5.5	V
Under-Voltage Lockout Threshold	V_{UVLO}	V_{CC} rising		2.1		V
		V_{CC} falling		2.0		V
Operating Current	I_{CC}	V_{CC} = 5.0V		300	500	nA
SNS1 and SNS2						
Test Pulse Width	t_{TEST}	V_{CC} = 2.5V		30		ns
		V_{CC} = 5.5V		45		
Detection Repeat Period	t_{DET}	V_{CC} = 2.5V	100	175	250	ms
		V_{CC} = 5.5V	80	150	220	
Pull-Up Resistance	R_{UP_SNS}	V_{CC} = 2.5V, V_{SNSx} = 1.25V		42		Ω
		V_{CC} = 5.5V, V_{SNSx} = 2.0V		25		Ω
Pull-Down Resistance	R_{DOWN_SNS}	I_{OUT} = 1mA		400		Ω
WKP/nWKP and FLG (SGM790A/C)						
Output Pulse Duration	t_{WKP_OUT}	V_{CC} = 2.5V	0.7	1.4	2.2	s
		V_{CC} = 5.5V	0.6	1.2	2.0	
Pull-Up Resistance	R_{UP_WKP}	I_{OUT} = -50μA	10	14	18	kΩ
Pull-Down Resistance	R_{DOWN_WKP}	I_{OUT} = 50μA	10	14	18	kΩ
Pull-Up Resistance	R_{UP_FLG}	I_{OUT} = -50μA	10	14	18	kΩ
Pull-Down Resistance	R_{DOWN_FLG}	I_{OUT} = 50μA	10	14	18	kΩ
Leakage Current when High-Impedance	I_{L_FLG}	V_{FLG} = 0V or V_{CC}		±0.01	±1	μA
High-Level Input Voltage	V_{IH_WKP}		1.0			V
Low-Level Input Voltage	V_{IL_WKP}				0.4	V
WKP/nWKP Change to FLG Output Setup Time	$t_{WKP2FLG}$			5		μs
FLG1 and FLG2 (SGM790B)						
Pull-Up Resistance	R_{UP_FLG}	I_{OUT} = -50μA	10	14	18	kΩ
Leakage Current when High-Impedance	I_{L_LKG}	V_{FLGx} = 0V or V_{CC}		±0.01	±1	μA

FUNCTIONAL BLOCK DIAGRAM

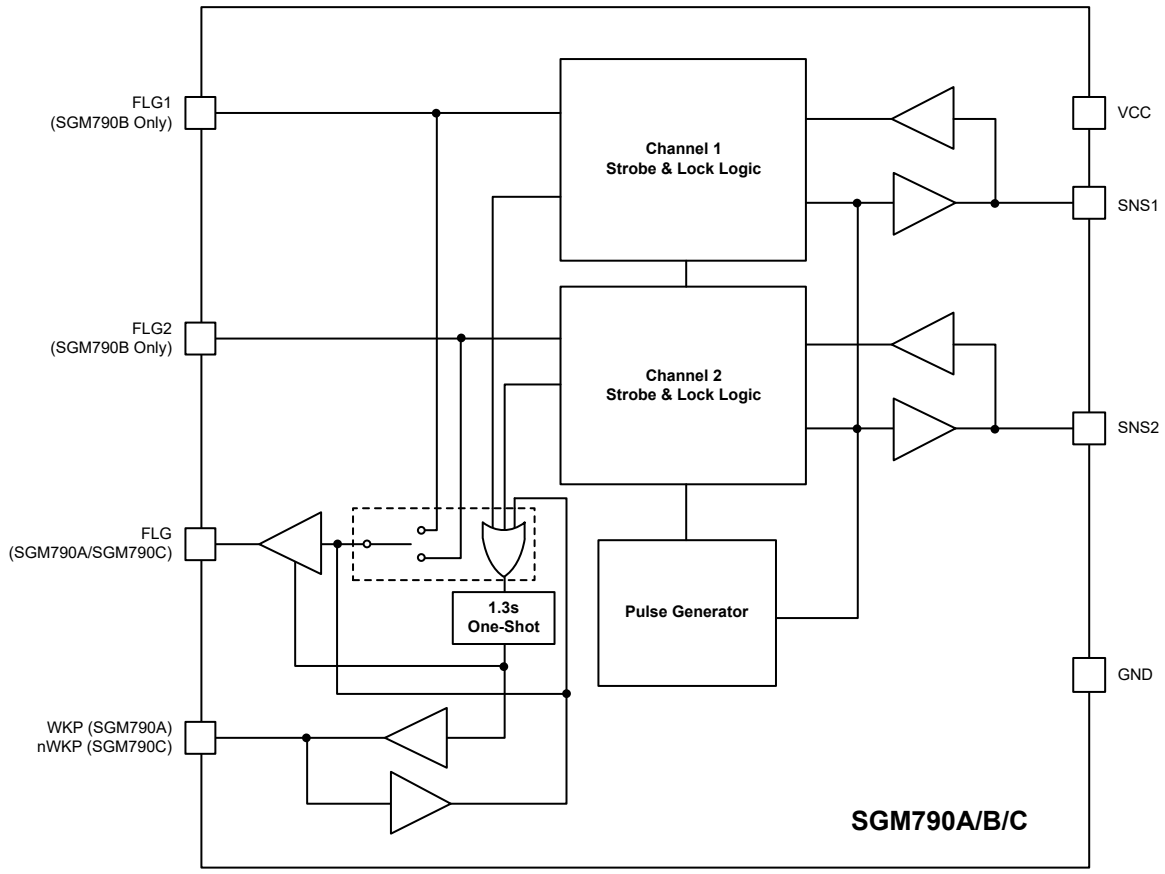


Figure 2. Block Diagram

DETAILED DESCRIPTION

In many applications, detection of the load existence is necessary for system operation. For example, a power bank can detect the connection or removal of the loads to power up or power down the power circuits. The SGM790A, SGM790B and SGM790C provide a simple load detection solution for these applications by checking the load capacitance as indicator. The SNS1 and SNS2 pins act as pulse sources with relatively large internal resistances. Short pulses of t_{TEST} (35ns, TYP) time are periodically injected by the SNS1 and SNS2 pins to the power bus(es) every t_{DET} (160ms, TYP) period (5 ~ 7 times per second).

Each SNSx pin couples to the bus by a capacitor. With ferrite beads used on the bus, the permanent capacitances of the power bus are isolated and the load capacitance can be detected directly by injecting signals. High-impedance ferrite beads block the pulses from injecting into the bus capacitors. The SNS1 and SNS2 pins send the pulses periodically and check the resulting voltage changes. When a load capacitance is attached to a SNSx pin, the pulse voltage will drop, and when the load is removed, the pulse voltage will rise.

SGM790A WKP and FLG Pins

The FLG output of the SGM790A reflects the status of SNS1 and SNS2 depending on the WKP state. If the WKP is high or pulled high, the FLG reports the status sensed by SNS2, and if it is pulled low while it is already high, the FLG will report SNS1 status.

The key timing diagram of the SGM790A is shown in Figure 3. Upon detection of a change on a SNSx input or by forcing the WKP from low to high, a one-shot that generates a time frame with a period of t_{WKP_OUT} (1.3s, TYP) is triggered. During this period, the WKP can be pulled low or high to select which channel is reported on the FLG output.

Each rising edge of the WKP, which can be caused by change detection or forcing high from low or releasing from forcing low during t_{WKP_OUT} time, triggers a new period of t_{WKP_OUT}.

The FLG output returns to Hi-Z state when the WKP goes low after the t_{WKP_OUT} period. If the WKP remains high during the t_{WKP_OUT} timeout, the FLG output will keep indicating the SNS2 status. And then FLG output changes to Hi-Z if the WKP is forced low or released from forcing high.

When the FLG output is in Hi-Z state, pulling WKP high will trigger an approximately 1.3s pulse in which the latest status of the loads can be read on the FLG output. Table 1 summarizes the FLG output in different conditions.

The SGM790A checks the loads in every t_{DET} period, and WKP reports the change with the t_{WKP_OUT} window.

Table 1. SGM790A/SGM790C FLG Output During t_{WKP_OUT}

SNS1/SNS2	FLG	
	WKP = 1 (nWKP = 0), for SNS2	WKP = 0 (nWKP = 1), for SNS1
With Load Capacitance	High	High
Without Load Capacitance	Low	Low

SGM790C nWKP and FLG Pins

The timing logic of the SGM790C is completely the opposite of the SGM790A. An nWKP falling edge triggers a new period of t_{WKP_OUT}. The FLG output indicates SNS1 or SNS2 status when the nWKP is low or high. Please refer to the Table 1 and Figure 4.

SGM790B FLG1 and FLG2 Pins

Right after each detection (t_{DET}) period of the SGM790B, the status of the loads connected to SNS1 and SNS2 are updated on the FLG1 and FLG2 outputs respectively. The FLGx state remains unchanged until the next test.

Table 2 summarizes how FLG1 and FLG2 are updated depending on the load sense inputs.

Table 2. SGM790B Detection Logic

SNS1/SNS2	FLG1/FLG2
With Load Capacitance	High
Without Load Capacitance	Hi-Z

DETAILED DESCRIPTION (continued)

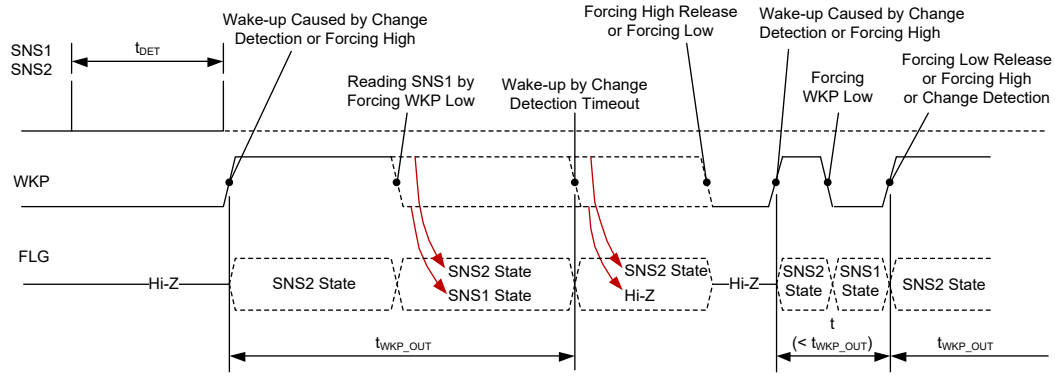


Figure 3. SGM790A Timing Diagram

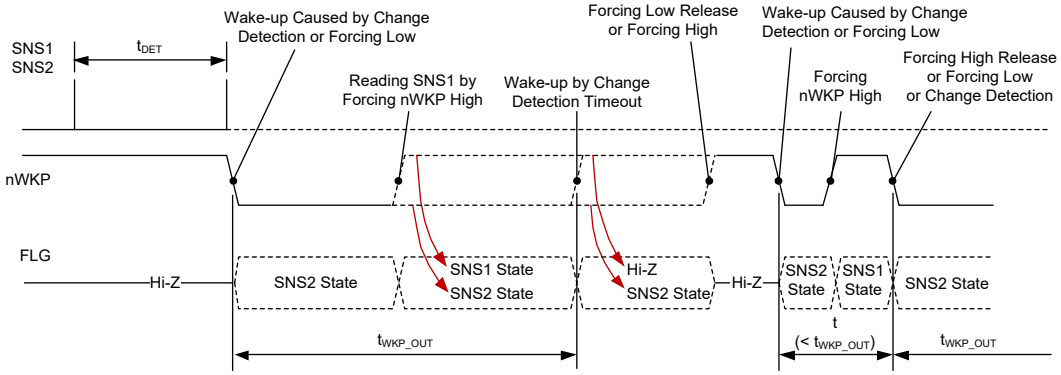


Figure 4. SGM790C Timing Diagram

Components Selection

Referring to Figure 1 and Figure 5, a few external components are needed to complete the load detection circuit. It is important that the ferrite beads B1 and B2 should have enough current rating to carry the load current and high enough impedance at high frequency to isolate the test pulses from the permanent bus capacitors. FBSWB0402-102-201R is recommended. Coupling capacitors C1 and C2 can be chosen in a range from 100nF to 1μF.

If the load connection point is close to the sense pins, the SGM790A, SGM790B and SGM790C can easily detect connection or removal of the loads with minimum 100nF input capacitance. If the load is away from the device, the load capacitance must be increased to ensure detection.

Application Example

Figure 5 shows how the SGM790B can be used in an application with no host to turn on or off (enable/disable) a power supply when a load is connected or disconnected. The power supply is enabled if a load is connected to either of the load ports (SNS1 or SNS2).

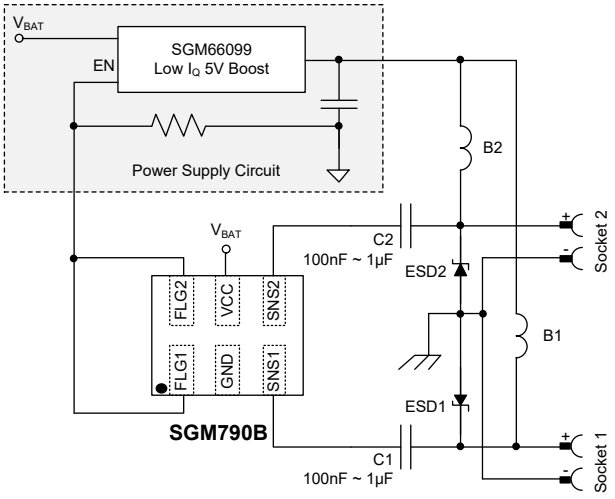


Figure 5. Control of a Power Supply with FLG1 and FLG2

REVISION HISTORY

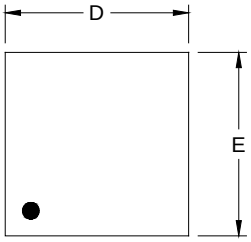
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (DECEMBER 2020) to REV.A

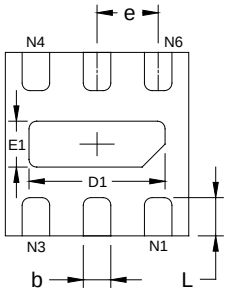
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

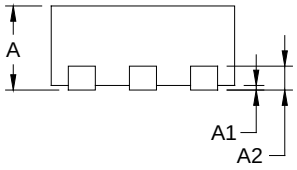
UTDFN-1.2×1.2-6L



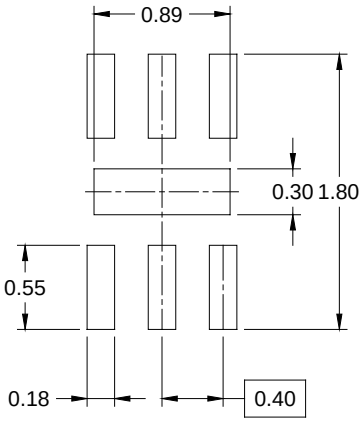
TOP VIEW



BOTTOM VIEW



SIDE VIEW

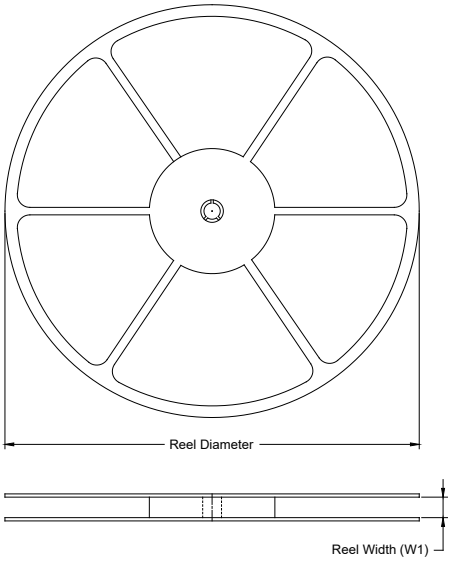


RECOMMENDED LAND PATTERN (Unit: mm)

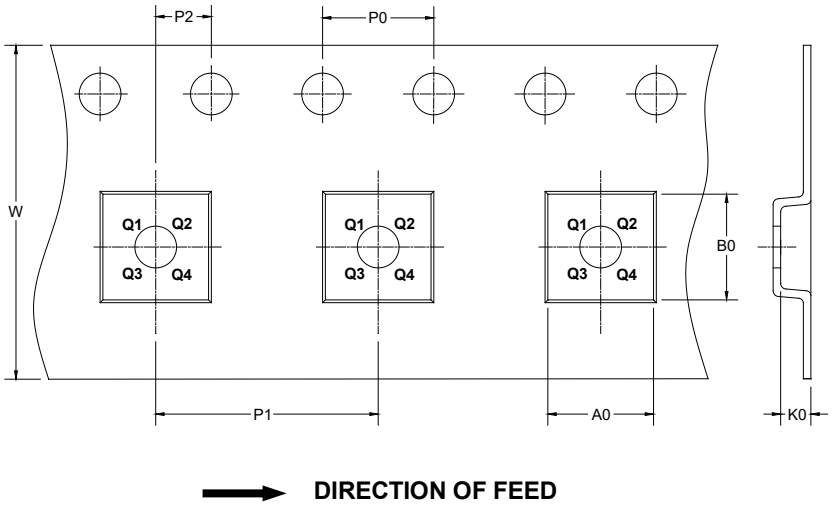
Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	0.500	0.550	0.600
A1			0.050
A2	0.152 REF		
e	0.400 BSC		
D	1.150	1.200	1.250
E	1.150	1.200	1.250
D1	0.840	0.890	0.940
E1	0.250	0.300	0.350
b	0.130	0.180	0.230
L	0.200	0.250	0.300

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



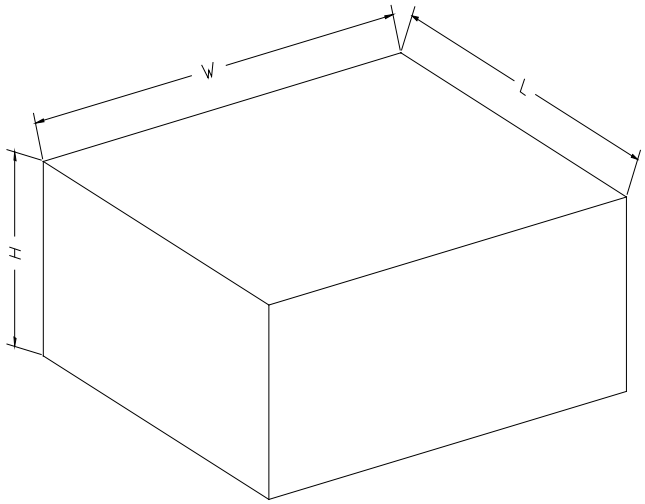
NOTE: The picture is only for reference. Please make the object as the standard.

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
UTDFN-1.2×1.2-6L	7″	9.0	1.35	1.35	0.73	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