GENERAL DESCRIPTION

The SGM2541 bidirectional load switch is designed for systems or chargers with high voltage quick charging capability and wireless charging capability. The device supports up to 20V operating input voltage (28V withstand) at USBIN pins, and provides input voltage-clamped protection for input surge events up to 130V. The device can also provide 16V reverse voltage at the OUT pins.

The two OVP threshold voltages (17V/13V) can be programmed through VP pin. The over-voltage protection function can ensure the safe operation of surge events in any state.

The addition of a wireless Rx with an enable/disable pin allows the load switch to implement an equivalent 2:1 power multiplexer (PMUX).

The bidirectional device can detect and support USB-OTG applications. It also includes under-voltage lockout, over-voltage lockout and over-temperature protection circuits designed to automatically isolate the power switch terminals when a fault condition occurs.

The SGM2541 is available in a Green WLCSP-2.43× 1.75-20B package. It operates over an ambient temperature range of -40℃ to +85℃.

FEATURES

- **Bidirectional Switch for USBIN and OUT to Allow On-The-Go (OTG) Mode**
- **Input Voltage Range:**
  3V to 20V at USBIN and 3V to 16V at OUT
- **Programmable OVP Threshold Voltages**
- **28V Tolerance on USBIN Pin**
- **130V Surge Protection**
- **5A Continuous Current from USBIN to OUT**
- **5A Continuous Current from OUT to USBIN in OTG Mode**
- **Low On-Resistance: 29mΩ (TYP)**
- **1.4V Control Logic**
- **Soft-Start to Reduce Input Peak Current**
- **Available in a Green WLCSP-2.43×1.75-20B Package**
- **-40℃ to +85℃ Operating Temperature Range**

APPLICATIONS

Smart Phone
Tablet PC
Mobile Devices with Wireless Charging Options

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2541	WLCSP-2.43×1.75-20B	-40℃ to +85℃	SGM2541YG/TR	XXXXX 2541YG	Tape and Reel, 3000

MARKING INFORMATION

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

X X X X X
— Vendor Code
— Trace Code
— 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

V_{USBIN_ABSMAX} 28V
V_{USBIN} to V_{OUT} (Differential Input, Blocking)......................28V
V_{OUT} to V_{USBIN} (Differential Input, Blocking)......................16V
V_{OUT_MAX}, V_{USB_SNS} 20V
Control Pin Voltages 6V
Junction Temperature ....+150℃
Storage Temperature Range.........................-65℃ to +150℃
Lead Temperature (Soldering, 10s) ....+260℃
ESD Susceptibility
HBM...2000V
MM...400V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range ....3V to 20V
Operating Ambient Temperature Range..........-40℃ to +85℃

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

(TOP VIEW)
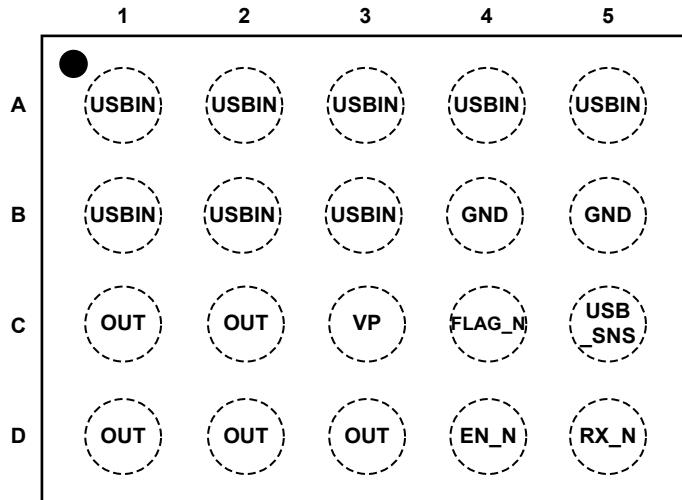
WLCSP-2.43×1.75-20B

PIN DESCRIPTION

PIN	NAME	FUNCTION
A1 - A5, B1 - B3	USBIN	Switch Input Pin. A capacitor needs to be added between USBIN pin and GND.
B4, B5	GND	Ground.
C1, C2, D1 - D3	OUT	Switch Output Pin. Connect this pin to the charger input pins, output capacitors, and wireless Rx output node for dual input configurations.
C3	VP	Programmable OVP Voltage Pin. The two OVP threshold voltages can be programmed through VP pin. Connect the pin to GND to select 17V (TYP). Float the pin to select 13V (TYP).
C4	FLAG_N	Flag Pin.
C5	USB_SNS	USB_SNS is a Clamped USBIN Sense Pin. In slave mode, connect this pin to the input sense pin of the system that can respond to a valid USBIN voltage. This pin is optional in autonomous mode for system diagnostic purposes. An optional ceramic capacitor may be added from this pin to GND, sized as needed.
D4	EN_N	Active Low Enable Pin. In slave mode, connect this pin to the system's enable logic pin. In autonomous mode, pull this pin logic low, or tie it to the external GND plane.
D5	RX_N	Active Low Wireless Rx Enable Pin. In slave mode, pull this pin logic low, or tie to an external GND plane. In autonomous mode, connect this pin to the wireless Rx active low enable pin if a system output control pin is not available.

ELECTRICAL CHARACTERISTICS

(V_{USBIN} = 5V, V_{OUT} = 5V, C_{USBIN} = 1µF, C_{OUT} = 10µF, C_{USB_SNS} = 1µF, Full = -40℃ to +85℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Input Voltage Range	V_{USBIN}		Full	3		20	V
Output Voltage Range	V_{OUT}		Full	3		V_{OVP}	V
Input/Output Under-Voltage Lockout	V_{UVLO_USBIN}	Rising	+25℃		2.84	2.97	V
	V_{UVLO_OUT}	Rising	+25℃		2.65	2.78	V
UVLO Hysteresis	V_{UVLO_HYS}		+25℃		0.52		V
Input Over-Voltage Protection Threshold	V_{OVP}	V_{USBIN} > V_{OVP} enters fault state; the VP pin is tied to ground.	Full	16.38	17	17.62	V
		V_{USBIN} > V_{OVP} enters fault state; the VP pin is floating.	Full	12.52	13	13.46	V
V_{OVP} Hysteresis	V_{OVP_HYS}		+25℃		0.43		V
Maximum USB_SNS Pin Clamping Voltage	V_{USB_SNS}	I_{USB_SNS} = 0, the VP pin is tied to ground.	Full	16.61	17.3	18	V
		I_{USB_SNS} = 0, the VP pin is floating.	Full	12.75	13.3	13.76	V
Sense Pin Voltage Drop When Loaded	ΔV_{USB_SNS}	I_{USB_SNS} = 20mA	+25℃		30	50	mV
Input Quiescent Current in Operating State	$I_{Q\_USBIN\_OP}$	Switch conducting, USBIN = 5V.	Full		123	190	µA
	$I_{Q\_OUT\_OP}$	Switch conducting, OUT = 5V.	Full		125	190	
Input Quiescent Current in Clamping State	$I_{Q\_USBIN\_CLAMP}$	USBIN-GND current (clamping).	+25℃			5	mA
OUT Float Voltage	$V_{USBIN-OUT(FLOAT)}$	Switch not conducting, V_{USBIN} = 4.5V to 20V. 4MΩ resistor is always connected between OUT and GND.	+25℃			2	V
USBIN Float Voltage	$V_{OUT-USBIN(FLOAT)}$	Switch not conducting, V_{OUT} = 4.5V to V_{OUT_MAX}. 2MΩ resistor is always connected between USBIN and GND.	+25℃			2	V
On-Resistance	R_{ON}	Measured between USBIN and OUT when the switch is conducting, EN_N = low.	+25℃		29	39	mΩ
Continuous Output Current	I_{OUT}, I_{OTG}		+25℃		±5.0		A
OUT Discharge Resistance	R_{DIS_USBIN}	Measured from the USBIN to GND during the discharge event.	+25℃		1200		Ω
	R_{DIS_OUT}	Measured from the OUT to GND during the discharge event.	+25℃		500		
Input Debounce Time	t_{DEB}	V_{UVLO} < V_{USBIN} < V_{OVP}, soft-start starts after the debounce time (rising UVLO, falling OVP); EN_N = low.	+25℃		50		ms
Discharge Time	t_{DIS_OUT}	Discharge of OUT	+25℃		50		ms
	t_{DIS_USBIN}	Discharge of USBIN	+25℃			25	
Input Rising Disable Delay	$t_{OVP-DLY}$	Valid V_{USBIN} which transitions to V_{USBIN} > OVP fast event.	+25℃		80		ns
Initialization Time of Power	t_{INIT}	Upon USBIN or OUT crossing UVLO	+25℃		150		µs
Logic Pin Turn-On/Off Delay: EN_N, FLAG_N	t_{LDELAY}	Time delay from EN_N/FLAG_N enable/disable load switch, excluding a soft-start.	+25℃		100		µs
Input Capacitance	C_{USBIN}	Actual capacitance.	+25℃			10	µF
OTG Hot Swap Capacitance	C_{OTG}	Actual capacitance.	+25℃			200	µF
Output Capacitance	C_{OUT}	Actual capacitance.	+25℃			20	µF
Input Leakage Current: EN_N, FLAG_N	I_{LEAK}	V_{USBIN}/V_{OUT} = 5V.	+25℃			1	µA

ELECTRICAL CHARACTERISTICS (continued)

(V_{USBIN} = 5V, V_{OUT} = 5V, C_{USBIN} = 1µF, C_{OUT} = 10µF, C_{USB_SNS} = 1µF, Full = -40℃ to +85℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
ENABLE, START-UP, CLAMP FEATURES							
Logic Input Threshold High Level	V_{IH}	EN_N, FLAG_N	Full	1.2			V
Logic Input Threshold Low Level	V_{IL}	EN_N, FLAG_N	Full			0.4	V
Logic Output Threshold High Level	V_{OH}	RX_N, FLAG_N	Full	1.6			V
Logic Output Threshold Low Level	V_{OL}	FLAG_N	Full			0.6	V
Open Drain Internal Pull-Up Resistance: FLAG_N/RX_N	$R_{PULL-UP}$		+25℃		500		kΩ
Open Drain Internal Pull-Down Resistance: RX_N	$R_{PULL-DOWN}$		+25℃		4.5		kΩ
Internal Pull-Up Current: VP	$I_{PULL-UP}$		+25℃		8.5		µA
Soft-Start Time	t_{SS_USBIN}	USBIN = 5V, OUT from 10% to 90% of USBIN	+25℃		0.35		ms
	t_{SS_OUT}	OUT = 5V, USBIN from 10% to 90% of OUT	+25℃		0.64		
	$t_{SS\_USB\_SNS}$	USBIN = 5V, USB_SNS from 0.5V to 4.5V, not loaded	+25℃		0.23		ms
THERMAL							
Over-Temperature Shutdown Threshold	t_{SD}	Temperature Rising.			157		℃
Over-Temperature Shutdown Hysteresis	t_{HYS}				21		℃

FUNCTIONAL BLOCK DIAGRAM
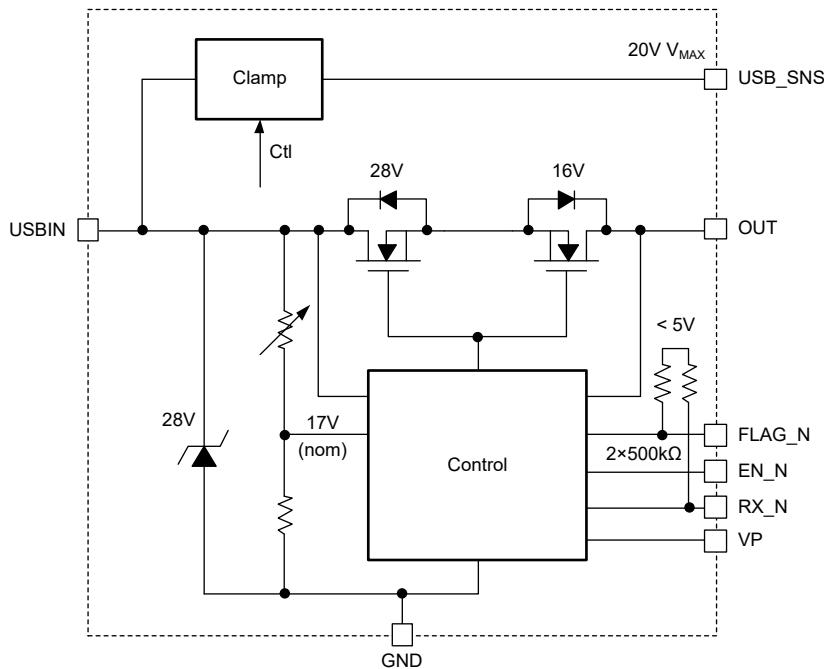
Figure 1. Block Diagram

TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, C_{USBIN} = 1µF, C_{OUT} = 10µF, C_{USB_SNS} = 1µF, unless otherwise noted.

Charging Power-Up and Power-Off in Autonomous Mode

Time (50ms/div)

OTG Activate and Deactivate in Autonomous Mode

Time (10ms/div)

Charging Activate and Deactivate in Slave Mode

Time (50ms/div)

OTG Activate and Deactivate in Slave Mode

Time (20ms/div)

IN-GND 130V Off-State Surge Discharge Waveform

C_{USB_SNS} = 0.1µF

Time (10µs/div)

IN-GND 130V On-State Surge Discharge Waveform

C_{USB_SNS} = 0.1µF

Time (10µs/div)
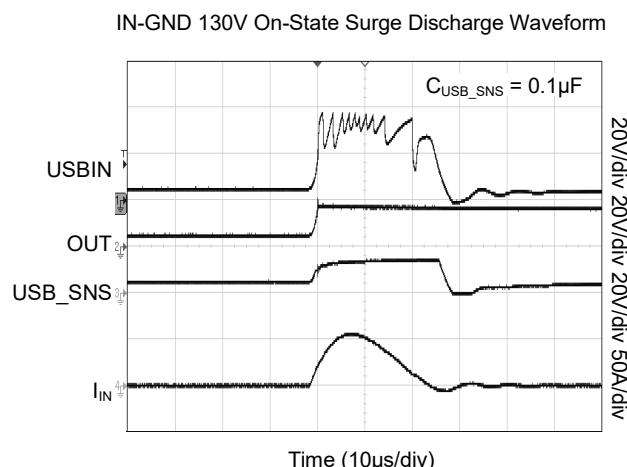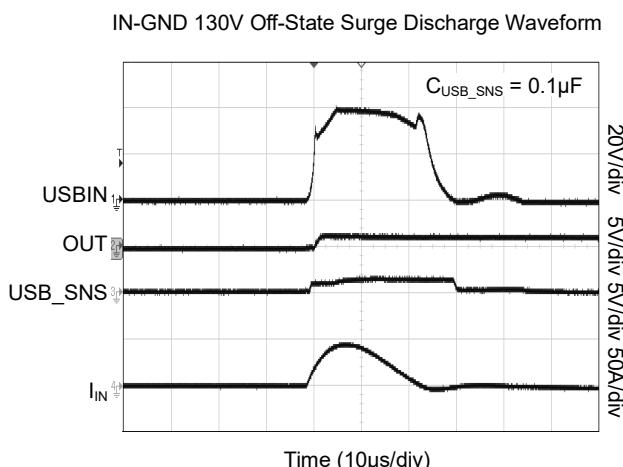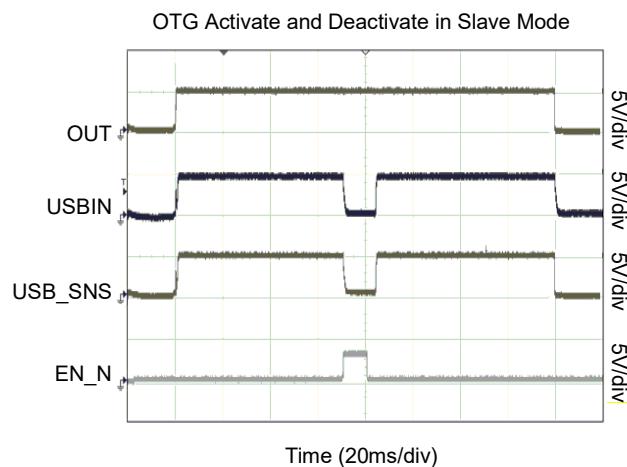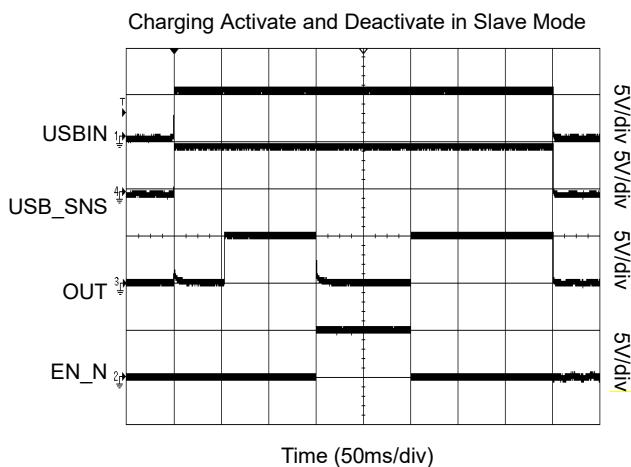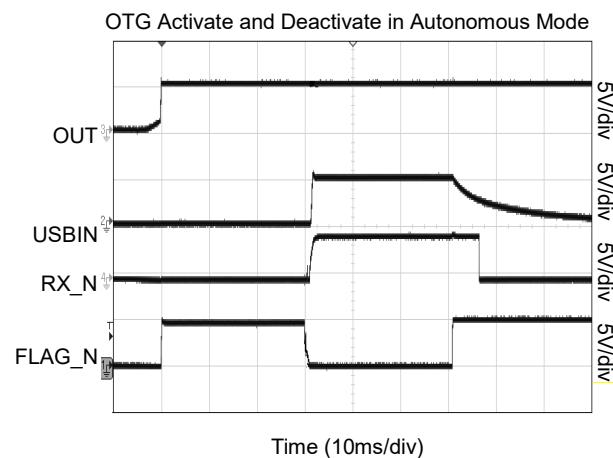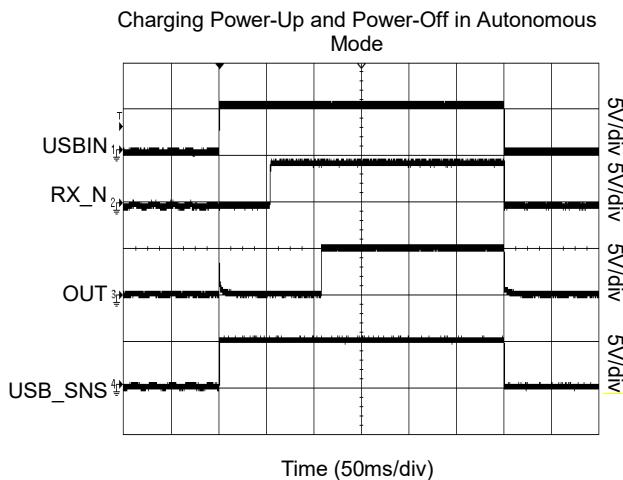
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, C_{USBIN} = 1µF, C_{OUT} = 10µF, C_{USB_SNS} = 1µF, unless otherwise noted.

Normalized On-Resistance vs. Output Current

Normalized On-Resistance vs. Temperature

Input Supply Current vs. Input Voltage
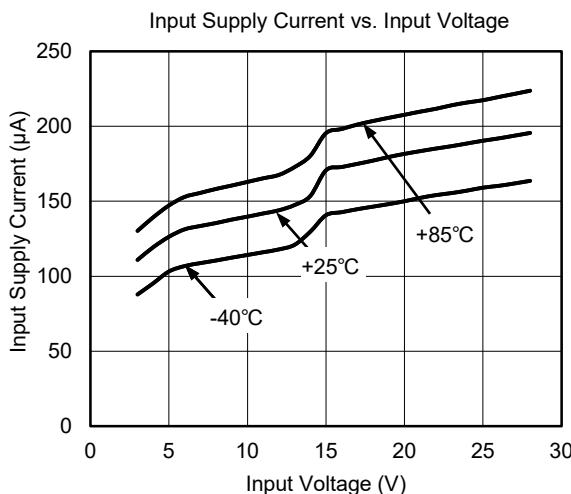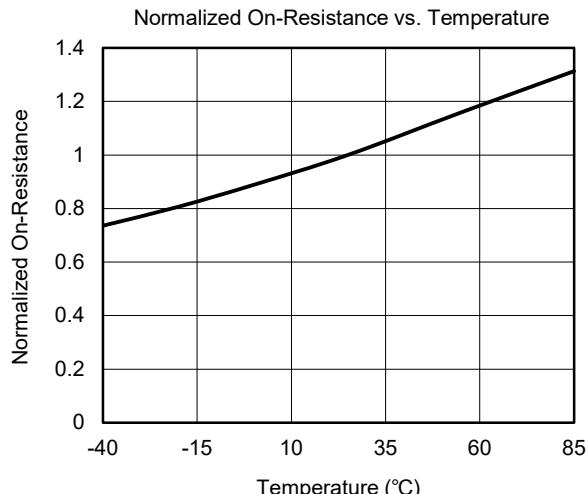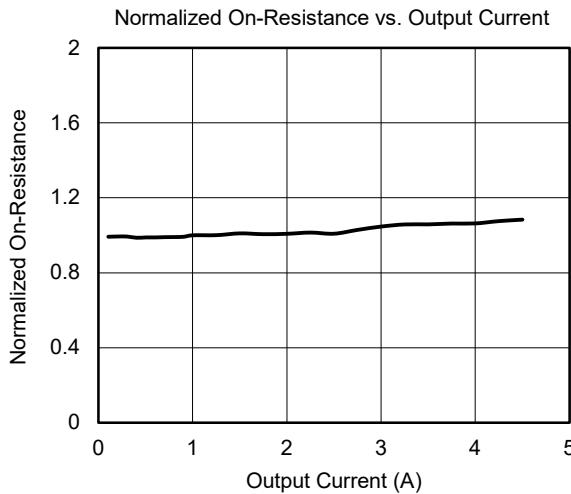
REVISION HISTORY

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

PACKAGE OUTLINE DIMENSIONS

WLCSP-2.43×1.75-20B

A1 CORNER

20 × Φ 0.24 / 0.20

0.4

0.4

TOP VIEW

RECOMMENDED LAND PATTERN

0.195± 0.020

0.040± 0.005

0.345± 0.013

0.580± 0.038

SIDE VIEW

2.430± 0.025

5 4 3 2 1

20 × Φ 0.260± 0.020

A B C D

0.4

1.750± 0.025

0.4

BOTTOM VIEW
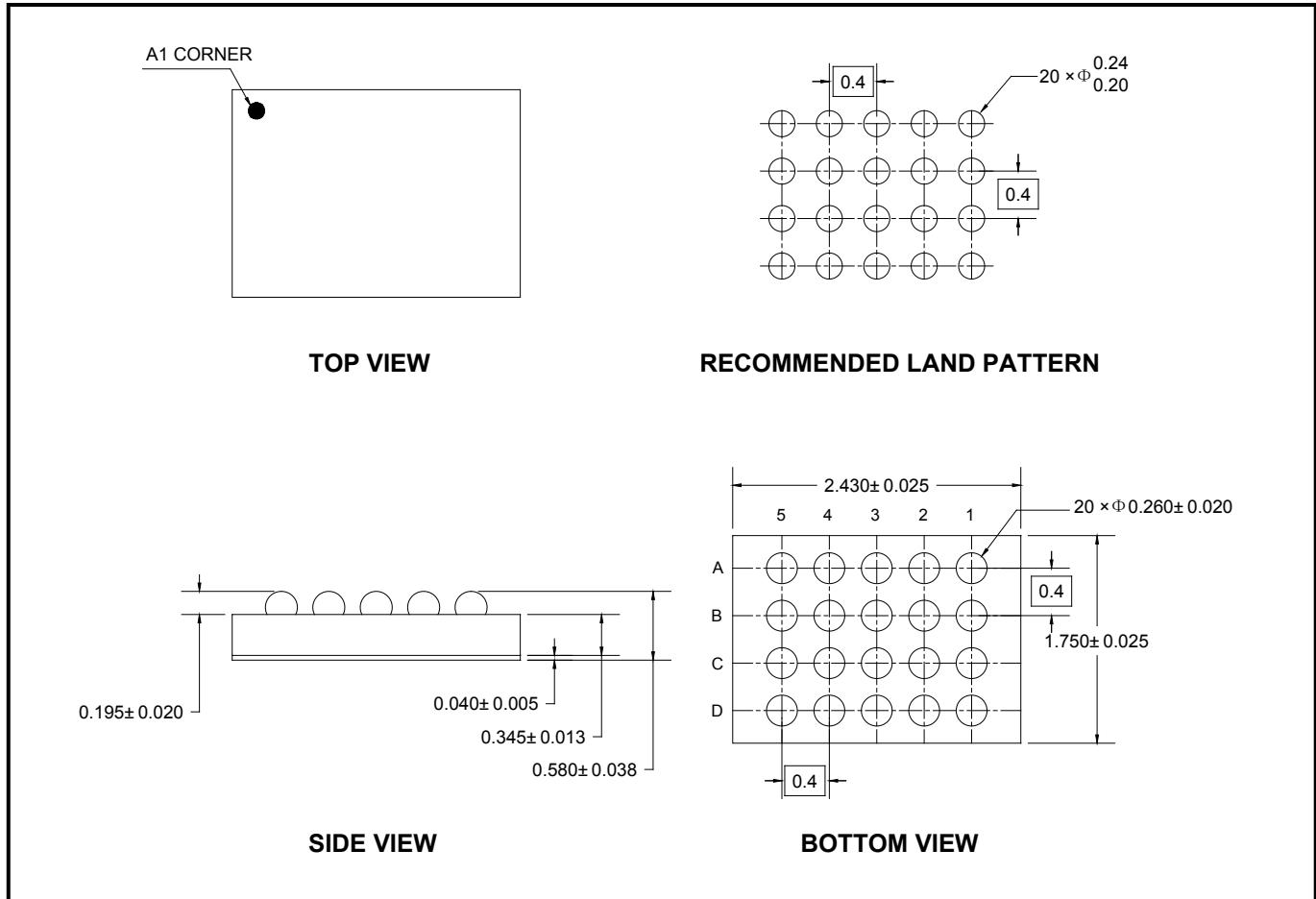
NOTE: All linear dimensions are in millimeters.

TAPE AND REEL INFORMATION

REEL DIMENSIONS
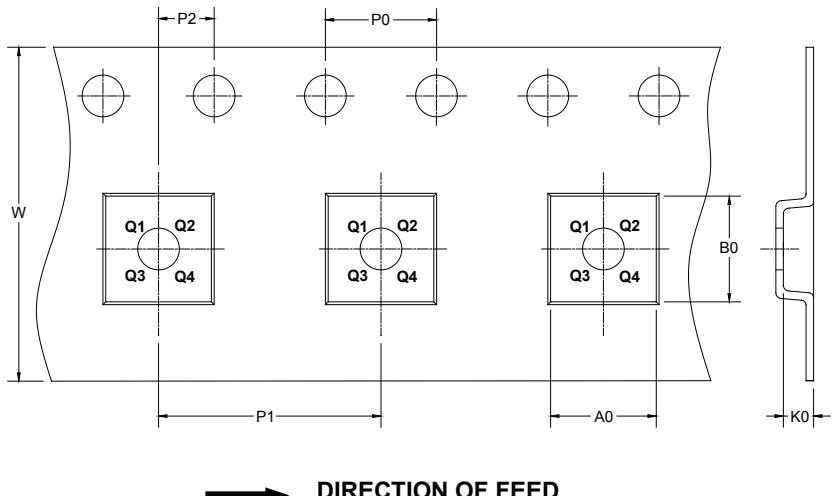
Reel Diameter

Reel Width (W1)

TAPE DIMENSIONS

DIRECTION OF FEED

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
WLCSP-2.43×1.75-20B	7″	9.2	1.90	2.71	0.81	4.0	4.0	2.0	8.0	Q2

DD0001

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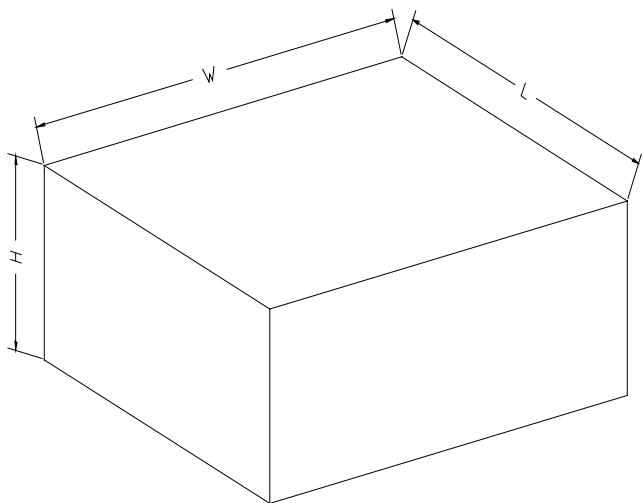
NOTE: The picture is only for reference. Please make the object as the standard.

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