

GENERAL DESCRIPTION

The SGM2539 is a 5A unidirectional USB power delivery (PD) high-side switch with under-voltage lockout (UVLO), over-voltage lockout (OVLO), reverse current (RCP) and over-temperature (OTP) protections. The SGM2539 recommended operating voltage range is from 2.5V to 20V. It is typically used for controlling the power delivery from the sources connected to the USB ports of system with necessary protection features. For the USB PD applications such as cell phones, tablets or notebooks, the SGM2539 provides a reliable path to charge the internal battery from the power delivered to the USB ports.

This switch can tolerate up to 29V at VBUS pin (22V at VINT pin) when it is turned off. It can automatically turn off and disconnect the terminals under fault conditions. Two SGM2539 devices can be paralleled for connecting two USB power inputs for charging the device battery.

The SGM2539 has a default 22.75V over-voltage protection threshold and it can be changed by an external resistor divider connected to the OVLO pin. To limit the inrush current, a 15ms debounce time followed by a soft-start time is applied before turning the switch on.

The SGM2539 is available in a Green WLCSP-2.56×1.54-15B package and can operate over a temperature range of -40°C to +85°C.

FEATURES

- **Input Voltage Range: 2.5V to 20V**
- **5A Maximum Continuous Switch Current**
- **29V Tolerance at VBUS Pin**
- **Low On-Resistance: 30mΩ (TYP)**
- **Adjustable Over-Voltage Lockout (OVLO)**
- **Controlled Slew Rate for Inrush Current Limit**
- **Two-Level Reverse Current Protection (RCP)**
- **Full Set of Protections**
 - ◆ **Over-Temperature Protection**
 - ◆ **Over-Voltage Protection**
 - ◆ **Under-Voltage Lockout**
 - ◆ **Reverse Current Protection in All Conditions**
- **Available in a Green WLCSP-2.56×1.54-15B Package**

APPLICATIONS

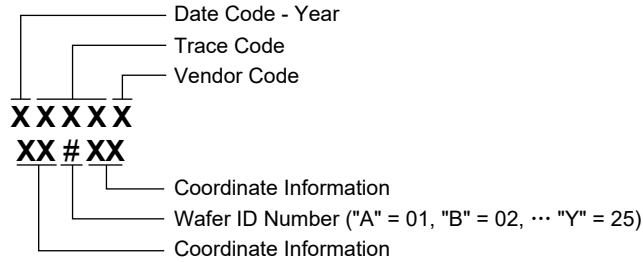
Notebooks
Feature Phones
Tablets, eBooks

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2539	WLCSP-2.56×1.54-15B	-40°C to +85°C	SGM2539YG/TR	SGM2539 XXXXX XX#XX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XXXXX = Date Code, Trace Code and Vendor Code. XX#XX = Coordinate Information and Wafer ID Number.



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

VBUS	-0.5V to 29V
VINT	-0.5V to 22V
OVLO	-0.5V to V _{VBUS}
nEN	-0.5V to 29V
ACK	-0.5V to 6V
Continuous Switch Current, I _{SW} , T _J = +25°C	5A
Peak Switch Current, I _{SW} , (100µs Pulse, 2% Duty Cycle)	10A
Package Thermal Resistance	
WLCSP-2.56×1.54-15B, θ _{JA}	97°C/W
WLCSP-2.56×1.54-15B, θ _{JC (top)}	24°C/W
Junction Temperature	+150°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10s)	+260°C
ESD Susceptibility	
HBM	4000V
CDM	1000V
IEC61000-4-2 Contact Discharge on VBUS	8000V

RECOMMENDED OPERATING CONDITIONS

VBUS	2.5V to 20V
VINT	2.5V to 20V
nEN	0V to 20V
ACK	0V to 5.5V
Operating Junction Temperature Range	-40°C to +125°C
Operating Ambient Temperature Range	-40°C to +85°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.

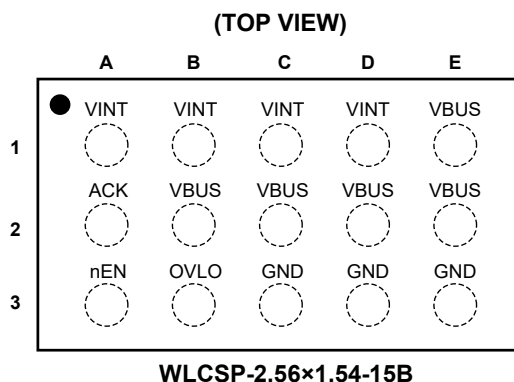
ESD SENSITIVITY CAUTION

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	FUNCTION
A1, B1, C1, D1	VINT	Power Output. Switch terminals for current output to the load.
A2	ACK	Open-Drain Power Good Acknowledge Output. It is pulled low if the switch is turned on. The ACK will be released (Hi-Z) to go high (external pull-up) when the switch is turned off. Pull this pin up to a logic voltage less than 5.5V with a resistor (R_{PU}) range from 10k Ω to 100k Ω .
A3	nEN	Active Low Enable Input for the Device. Pull this pin low (< 0.4V) to enable the internal circuits and turn on the switch (if other conditions are valid). A 15ms debounce time will apply before turning the switch on. Pull this pin high above 1.2V (up to 20V) to turn off the switch and disable the internal circuits and enter into low power mode. The nEN is weakly pulled low by an internal 1M Ω resistor to assure switch operation with a dead battery.
B2, C2, D2, E1, E2	VBUS	Power Input Supply. Input supply and switch terminal for current input. Recommended operating voltage range is from 2.5V to 20V.
B3	OVLO	V_{OVLO} Threshold Input. Connect this pin to ground (or less than 0.1V) to set the V_{OVLO} threshold to the default 22.75V threshold. A resistor divider can be connected from VBUS to OVLO to reduce and adjust the V_{OVLO} level (between 4V and 22.75V).
C3, D3, E3	GND	Ground.

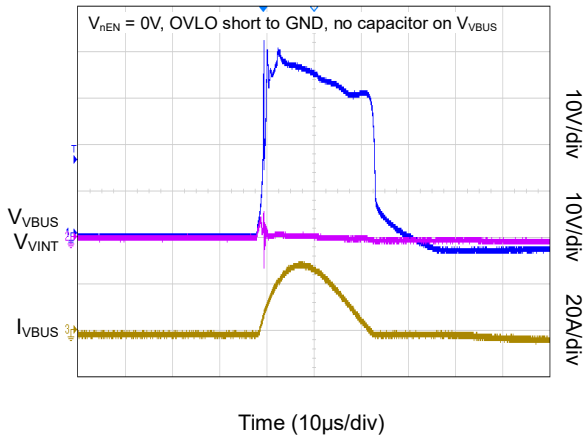
ELECTRICAL CHARACTERISTICS

(T_J = -40°C to +85°C, typical values are at T_J = +25°C, unless otherwise noted.)

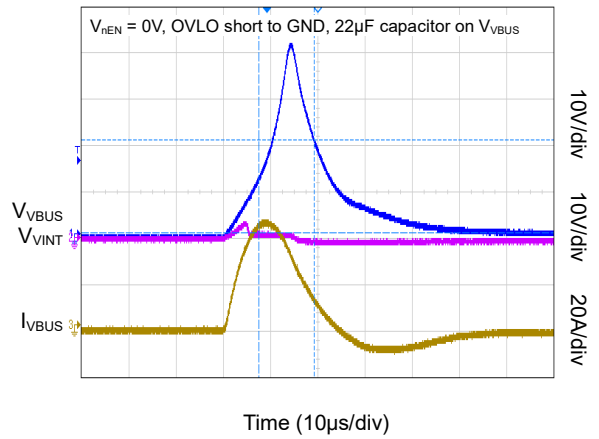
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Static Characteristics						
Under-Voltage Lockout Release Voltage	V _{UVLO}	V _{REN} = 0V, OVLO short to GND, V _{VBUS} rising, until V _{VINT} rising		2.34	2.46	V
Under-Voltage Lockout Hysteresis Voltage	V _{UVLO_HYS}	V _{VBUS} Falling		60		mV
nEN High-Level Input Voltage	V _{IH}	V _{VBUS} = 2.5V to 20V	1.2			V
nEN Low-Level Input Voltage	V _{IL}	V _{VBUS} = 2.5V to 20V			0.4	V
Low-Level Output Voltage	V _{OL_ACK}	I _{LOAD} = 6mA, V _{VBUS} = 2.5V to 20V			0.5	V
nEN Pin Internal Pull-Down Resistance	R _{PD}			1		MΩ
VBUS On-State Quiescent Current	I _Q	V _{REN} = 0V, V _{VBUS} = 5V, I _{LOAD} = 0A		75	97	μA
		V _{REN} = 0V, V _{VBUS} = 20V, I _{LOAD} = 0A		115	155	
VBUS Off-State Quiescent Current	I _{SD}	V _{REN} = 5V, V _{VBUS} = 5V, I _{LOAD} = 0A		0.5	2	μA
		V _{REN} = 5V, V _{VBUS} = 20V, I _{LOAD} = 0A		3	8	
VBUS Off-State Leakage Current	I _{LEAK_VBUS}	V _{REN} = 5V, V _{VBUS} = 5V, V _{VINT} = 0V		0.4	2	μA
		V _{REN} = 5V, V _{VBUS} = 20V, V _{VINT} = 0V		3	8	
VINT Off-State Leakage Current	I _{LEAK_VINT}	V _{REN} = 5V, V _{VINT} = 5V, V _{VBUS} = 0V		0.41	2	μA
		V _{REN} = 5V, V _{VINT} = 20V, V _{VBUS} = 0V		3	8	
RCP Leakage Current	I _{LEAK_RCP}	V _{REN} = 0V, V _{VINT} = 5V, V _{VBUS} = 0V		0.4	2	μA
OVLO Input Leakage Current	I _{LEAK_OVLO}	V _{OVLO} = V _{TH_OVLO}			50	nA
Default Over-Voltage Lockout Voltage	V _{OVLO}	V _{VBUS} Rising, V _{REN} = 0V, OVLO short to GND	21.85	22.75	23.80	V
		V _{VBUS} Falling, V _{REN} = 0V, OVLO short to GND		22.4		V
External OVLO Set Threshold Voltage	V _{TH_OVLO}	V _{VBUS} = 2.5V to 20V, nEN = 0V	1.141	1.190	1.240	V
RCP Trigger Voltage	V _{TRIG}	V _{TRIG} = V _{VINT} - V _{VBUS} , V _{VBUS} = 5V	30	55	85	mV
		V _{TRIG} = V _{VINT} - V _{VBUS} , V _{VBUS} = 20V	10	49	110	
On-Resistance	R _{ON}	I _{LOAD} = 0.2A, V _{VBUS} = 5V to 20V, see Figure 2		30	47	mΩ
Thermal Shutdown Temperature	T _{TSD}			156		°C
Thermal Shutdown Hysteresis	T _{HYS}			26		°C
Dynamic Characteristics (See Figure 3 and Figure 4)						
Enable Time	t _{REN}	From nEN to V _{VINT} = 10% V _{VBUS} , (including 15ms debounce time), V _{VBUS} = 5V, C _{LOAD} = 100μF, R _{LOAD} = 100Ω		20		ms
VINT Rise Time	t _{RISE}	V _{VINT} from 10% to 90% V _{VBUS} , C _{LOAD} = 100μF, R _{LOAD} = 100Ω	V _{VBUS} = 5V	2.9		ms
			V _{VBUS} = 20V	2.5		
OVP Turn-Off Time	t _{OFF_OVP}	From V _{VBUS} > V _{OVLO} to V _{VINT} = 80% V _{VBUS} , R _{LOAD} = 100Ω, C _{LOAD} = 0μF, V _{VBUS} = 20V, OVLO pin short to GND		80		ns
RCP Deglitch Time	t _{DEG}	From V _{VINT} > V _{VBUS} + 55mV to switch off	3	4.5	6	ms
RCP Turn-Off Time	t _{OFF_RCP}	From V _{VINT} > V _{VBUS} + 120mV to switch off		10		μs
Turn-On Time	t _{ON}	nEN to V _{VINT} = 90% V _{VBUS} , C _{LOAD} = 100μF, R _{LOAD} = 100Ω	V _{VBUS} = 5V	23		ms
			V _{VBUS} = 20V	23		
Turn-Off Time	t _{OFF}	nEN to V _{VINT} = 10% V _{VBUS} , C _{LOAD} = 100μF, R _{LOAD} = 100Ω	V _{VBUS} = 5V	22.5		ms
			V _{VBUS} = 20V	23.5		

TYPICAL PERFORMANCE CHARACTERISTICS

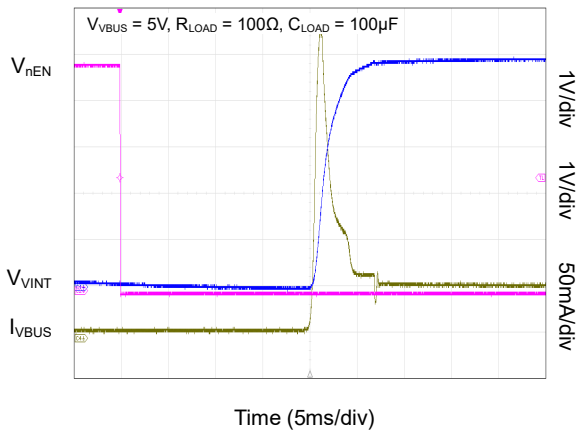
90V Surge Voltage with Device



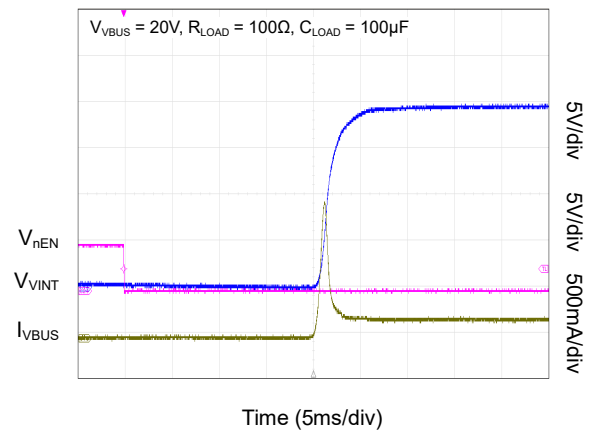
100V Surge Voltage with Device



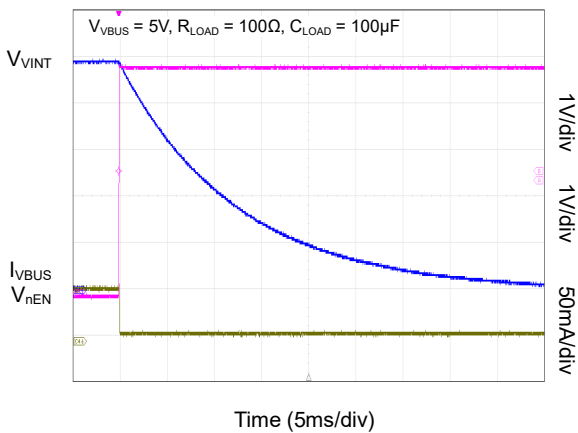
Turn-On Time and Inrush Current at 5V



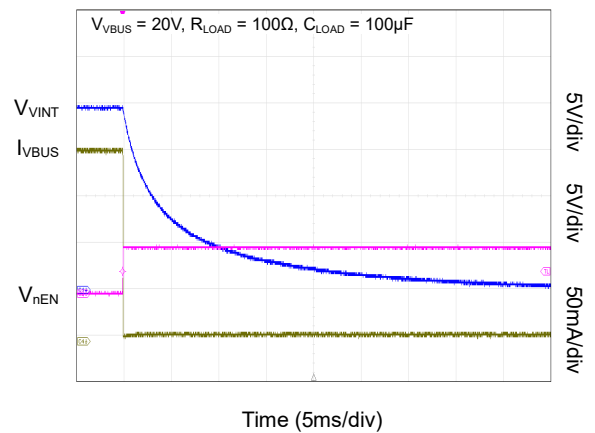
Turn-On Time and Inrush Current at 20V



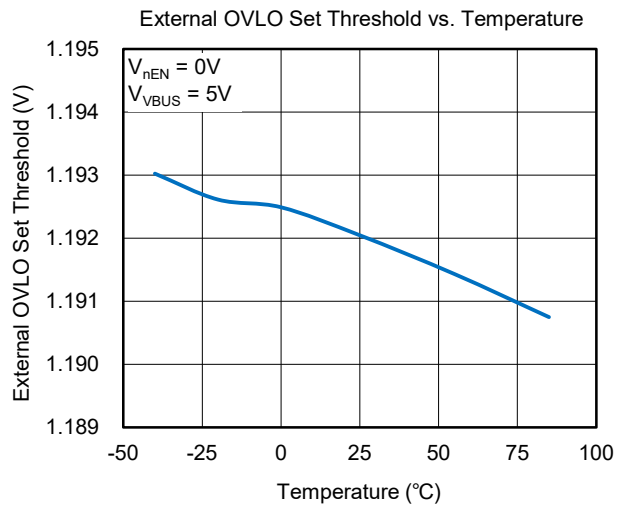
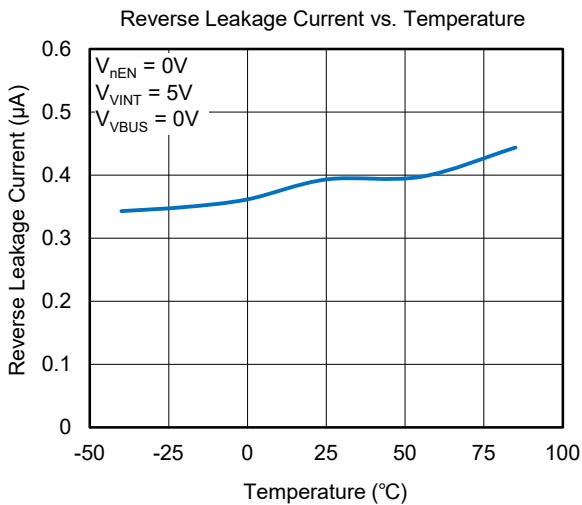
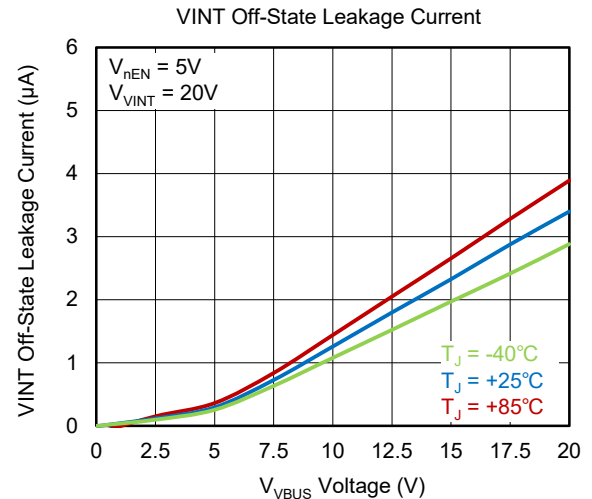
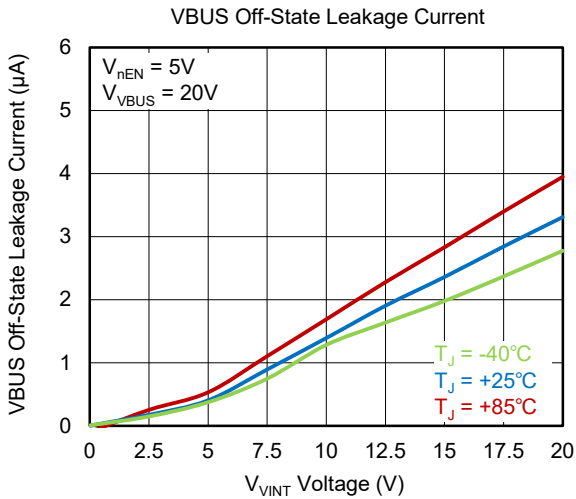
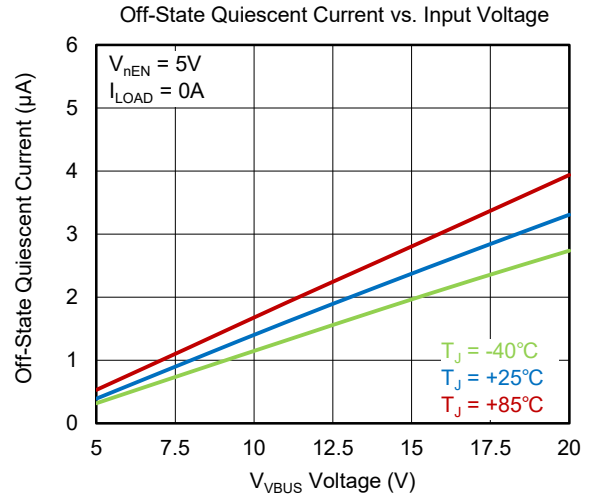
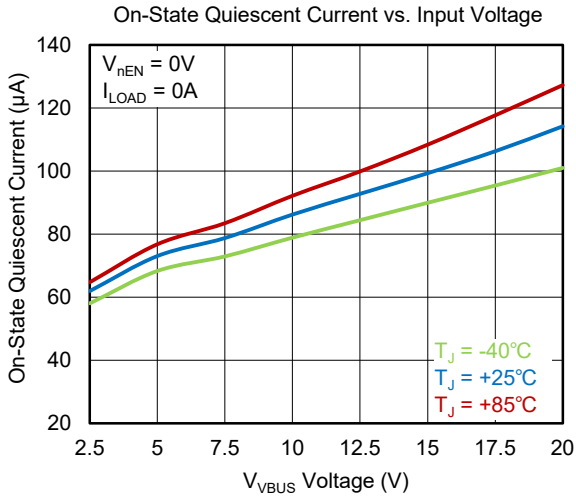
Turn-Off Time at 5V



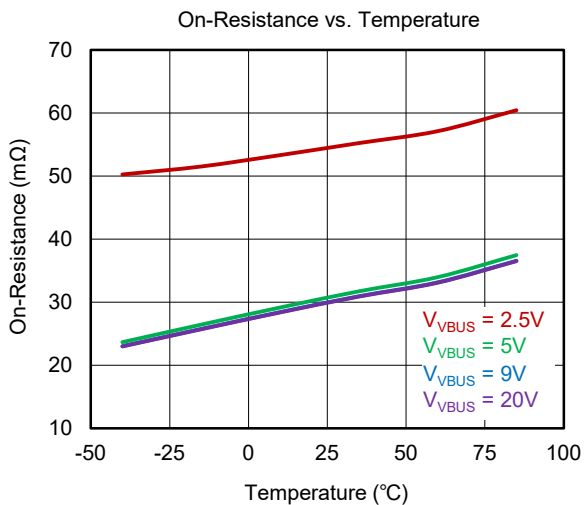
Turn-Off Time at 20V



TYPICAL PERFORMANCE CHARACTERISTICS (continued)



TYPICAL PERFORMANCE CHARACTERISTICS (continued)



REVISION HISTORY

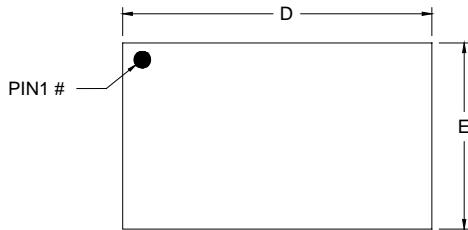
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (NOVEMBER 2021) to REV.A	Page
Changed from product preview to production data.....	All

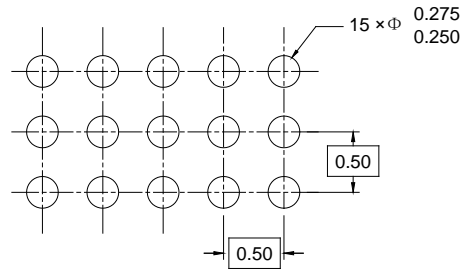
PACKAGE INFORMATION

PACKAGE OUTLINE DIMENSIONS

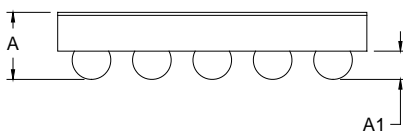
WLCSP-2.56x1.54-15B



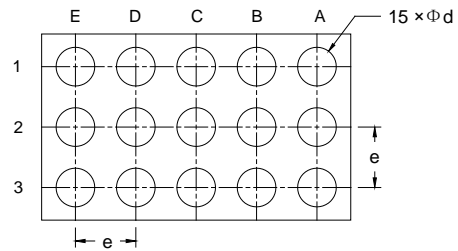
TOP VIEW



RECOMMENDED LAND PATTERN (Unit: mm)



SIDE VIEW



BOTTOM VIEW

Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	0.515	0.555	0.595
A1	0.214	0.234	0.254
D	2.530	2.560	2.590
E	1.510	1.540	1.570
d	0.300	0.320	0.340
e	0.500 BSC		

NOTE: This drawing is subject to change without notice.

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
WLCSP-2.56×1.54-15B	7"	12.4	1.72	2.74	0.70	4.0	4.0	2.0	12.0	Q2

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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