Low On-Resistance Load Switch With Reverse Current Blocking

■ General Description

The OCP9212 features a low-Ron internal FET and an operating range of 1.2 V to 5.5 V. The switch is controlled by an on/off input which is compatible with standard CMOS GPIO. The low shut-off current allows power designs to meet standby and off-power drain specifications. On-chip discharge resistance is integrated for quick output discharge when switch is turned off. Slew-rate control prevents inrush current during switch turn-on.

OCP9212 provides reverse current protection both ON and OFF states. Additionally, under voltage lockout protection turns switch off if the input voltage is too low.

The OCP9212 is available in a fully “green” compliant 0.77mm * 0.77mm WLCSP-4B Package.

■ Features

- Input Voltage Range: 1.2 V to 5.5 V
- Typical Ron
  - Ron=30 mΩ at VIN=5V
  - Ron=40 mΩ at VIN=3.3V
  - Ron=75 mΩ at VIN=1.8V
  - Ron=100 mΩ at VIN=1.5V
  - Ron=190 mΩ at VIN=1.2V-
- Slew Rate Control
- IOUT Max 2A(VIN=1.5V~5.5V)
- Low Quiescent Current
- Full-Time Reverse Current Protection
- Integrated Discharge Function
- 4-Bump, WLCSP 0.77 mm x 0.77 mm, 0.4mm Pitch

■ Applications

- Portable Media Players
- Cell Phones or Smart Phones
- PDAs
- Mobile Handsets
- Tablet PCs and Laptops/Net books

■ Pin Configuration

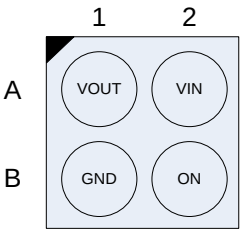


Figure 1, Pin Assignments of OCP9212 (Top View)

Pin Name	Pin No.	Pin Function
VOUT	A1	Switch output
VIN	A2	Switch input
GND	B1	Ground
ON	B2	ON/OFF Control, active HIGH

■ Typical Application Circuit

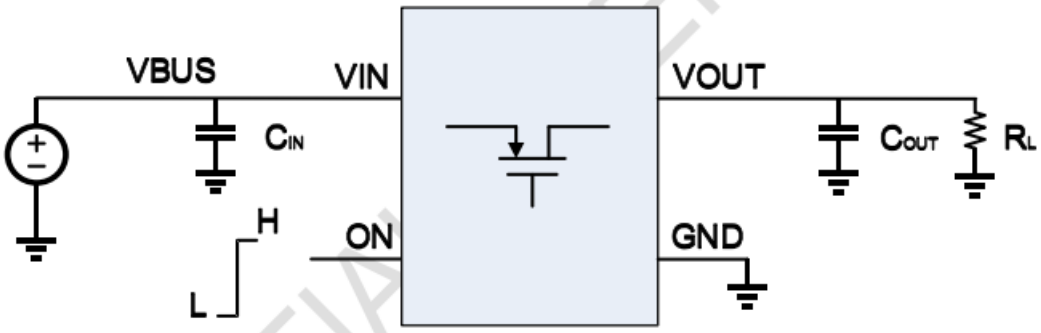


Figure 2 Typical Application

■ Block Diagram

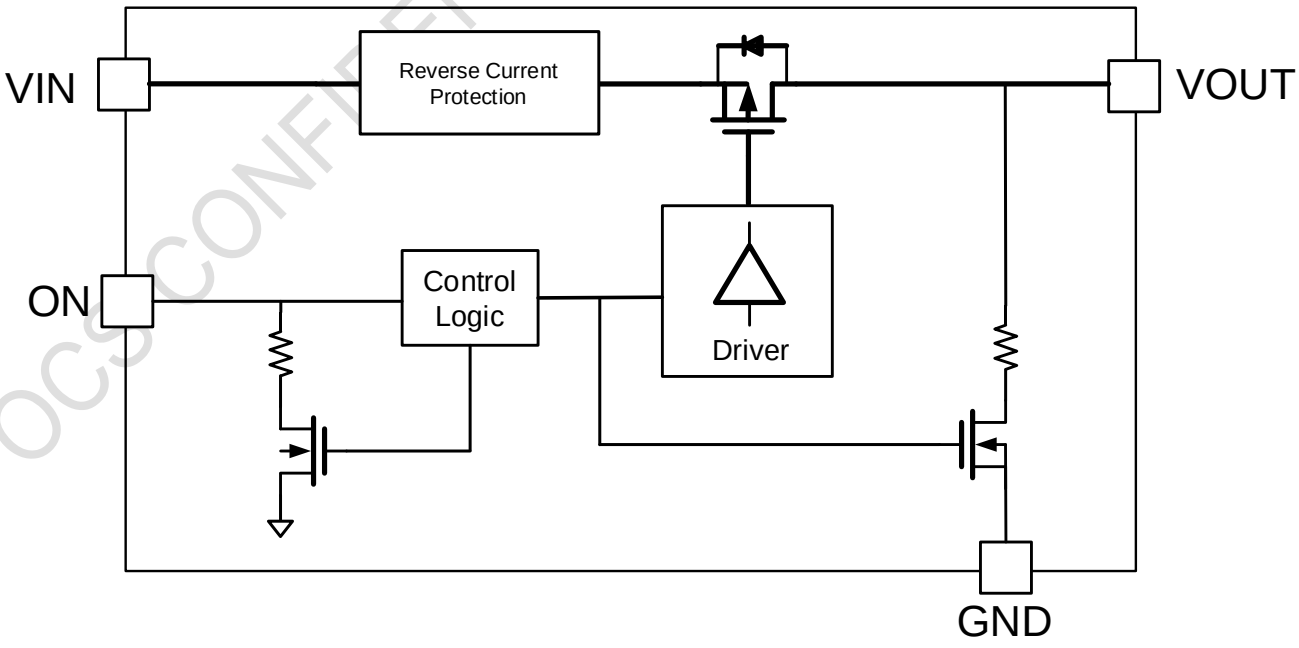


Figure 3 Block Diagram of OCP9212

■ Ordering Information

Part Number	Marking	Package Type	Package Qty	Temperature	Eco Plan	Lead/Ball Finish
OCP9212WPAD	J	WLCSP-4B	7-in reel 3000pcs/reel	-40～85℃	Green	Cu/Ag/Sn

■ Absolute Maximum Ratings[1] (TA=25°C, unless otherwise noted)

Parameter	Symbol	Rating	Unit
VIN Pin to GND	V_{IN}	-0.3 to +6	V
VOUT Pin to GND	V_{OUT}	-0.3 to +6	V
ON Pin to GND	V_{ON}	-0.3 to +6	V
Maximum Continuous Switch Current at Ambient Operating Temperature[2]	I_{SW}	2	A
Human Body Model (HBM)	ESD	4	kV
Charged Device Model (CDM)		2	
Storage Temperature Range	T_S	-55 to +150	℃
Operating Junction Temperature Range	T_J	-40 to +150	℃

Note1: Stresses above those listed in absolute maximum ratings may cause permanent damage to the device. Functional operation at conditions other than the operating conditions specified is not implied. Only one absolute maximum rating should be applied at any one time.

2：The continuous current 2A is only when VIN=1.5V-5.5V, when VIN is lower than 1.5V, only 1A can be guaranteed.

3: When using continuous high currents, thermal design needs to be considered.

■ Recommended Operating Conditions[4]

Parameter	Symbol	Rating	Unit
V_{IN} Pin Voltage to GND	V_{IN}	+1.2 to +5.5	V
Thermal Resistance	$R_{\theta JA}$	110	℃/W
Operating Temperature Range	T_{OP}	-40 to +85	℃

4: The device is not guaranteed to function outside of its operating conditions.

■ Electrical Characteristics

(Unless otherwise noted, T_A = -40 to +85℃ and V_{IN}=1.2V to 5.5V. Typical values are at T_A= 25℃,V_{IN}=3.3V)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Basic Operation						
I_Q	Quiescent Current	V_{ON} = V_{IN}=1.8V，I_{OUT}=0 mA	-			μA
		V_{ON} = V_{IN}=3.3V，I_{OUT}=0 mA	-	0.15		μA
		V_{ON} = V_{IN}=5.5V，I_{OUT}=0 mA	-	0.3	1	μA
I_{SD}	Shutdown Current	V_{ON} = 0V, V_{IN}=1.8V, V_{OUT}=GND				nA
		V_{ON} = 0V, V_{IN}=3.3V, V_{OUT}=GND		8		nA
		V_{ON} = 0V, V_{IN}=5.5V, V_{OUT}=GND	-	50	250	nA

$I_{Q(OFF)}$	Off Supply Current	V_{ON}= 0V, V_{OUT}=OPEN		10	100	nA
I_{ON}	On Input Leakage Current	Enable	-10		10	nA
R_{PD}	Smart Pull Down Resistance	Disable		850		kΩ
R_{on}	Switch On Resistance	V_{IN} = 5.5V，I_{OUT} =200 mA，T_A=25℃	-	30		mΩ
		V_{IN} = 3.3V，I_{OUT} =200 mA，T_A=25℃		40	65[5]	
		V_{IN} = 1.8V，I_{OUT} =200 mA，T_A=25℃		75	100[5]	
		V_{IN} = 1.5V，I_{OUT} =200 mA，T_A=25℃		100	150[5]	
		V_{IN} = 1.2V，I_{OUT} =200 mA，T_A=25℃		190	220[5]	
R_{PD}	Output Discharge Resistance[6]	V_{IN} = 3.3V，I_{OUT} =20 mA，V_{OUT} = OFF, T_A=25℃		75		Ω
V_{IH}	ON input high level	ON Rising	0.825	-	-	V
V_{IL}	ON input low level	ON Falling	-	-	0.4	V
VRCP_TH	RCB Protection Threshold Voltage	VOUT – VIN		25		mV
VRCB_RL	RCB Protection Release Voltage	VIN - VOUT		30		
IRCP	Reverse current protection leakage after reverse current event	Enabled, VOUT > VIN		0.2		μA
Timing Characteristics						
T_{DON}	Switch Turn-on DelayTime	RL=150Ω, COUT=0.1 μF	-	164	-	μs
T_R	V_{OUT} Rise Time		-	200	-	μs
T_{ON}	Switch Turn-on Time		-	364	-	μs
T_{DOFF}	Switch Turn-off DelayTime[5]			2.8		μs
T_F	V_{OUT} Fall Time[5]			14		μs
T_{OFF}	Switch Turn-off Time[5]			16.8		μs

Note 5: This parameter is guaranteed by design and characterization; not production tested.
6: Output discharge enable during off-state.

■ Typical Characteristics

(Unless otherwise noted, T_A = -40 to +85℃ and V_{IN}=1.2V to 5.5V. Typical values are at T_A= 25℃,V_{IN}=3.3V)

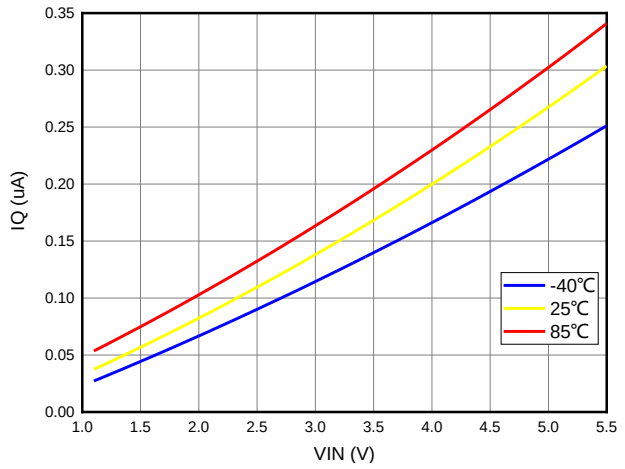


Figure 4-1. Quiescent Current（VIN=ON）

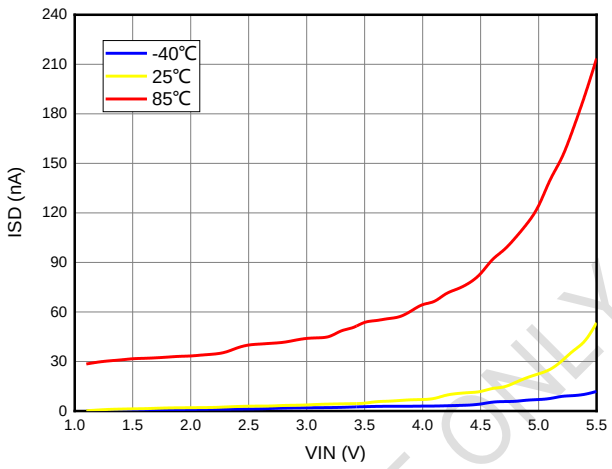


Figure 4-2. Shutdown Current

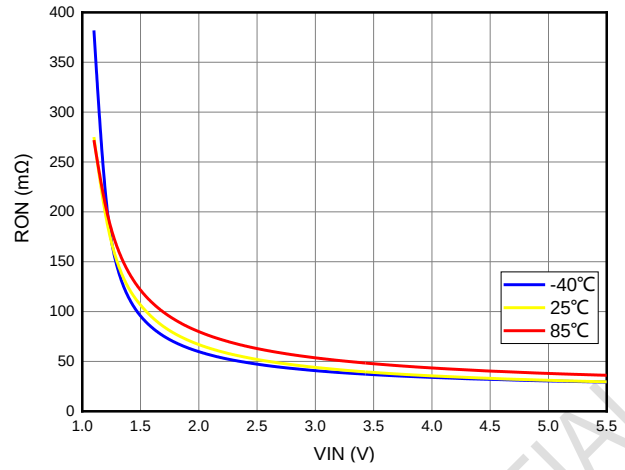


Figure 4-3 On-Resistance（I_{OUT}=200mA）

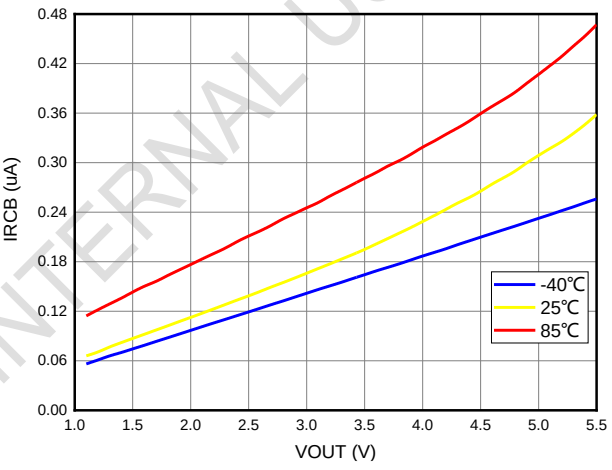


Figure 4-4 IRCB(Enable,VOUT>VIN)

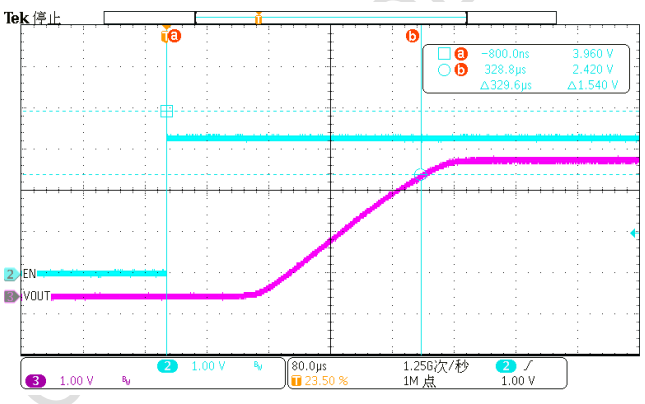


Figure 4-5 Turn-On Response
VIN=3.3V, CIN=1uF, COUT=0.1uF, RL=150Ω

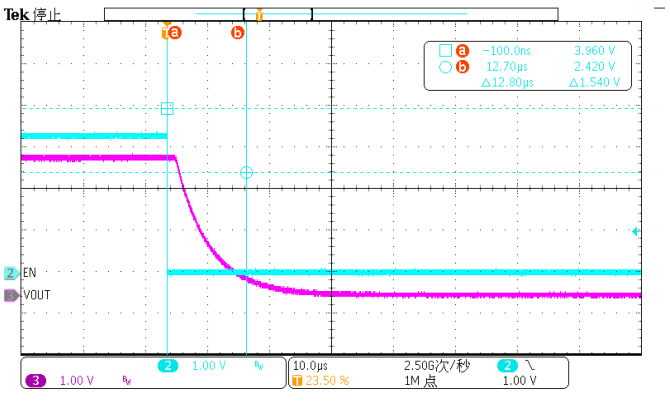


Figure 4-6 Turn-Off Response
VIN=3.3V, CIN=1uF, COUT=0.1uF, RL=150Ω

■ Timing Diagrams

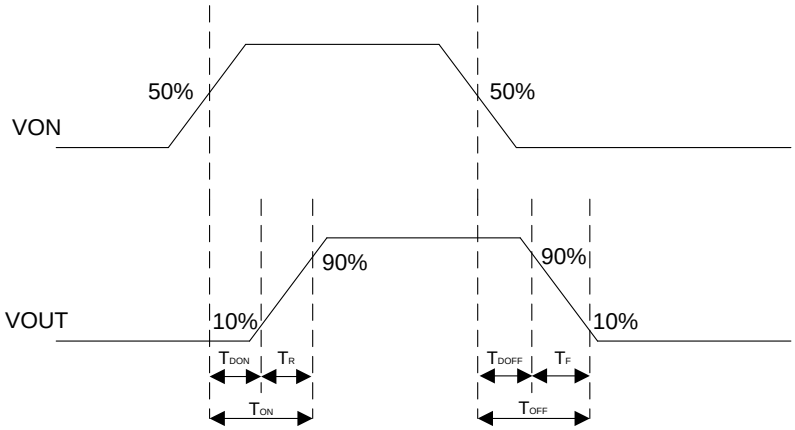


Figure 4, Timing Diagram

■ Detailed Functional Description

Device Operation

The OCP9212 is low-R_{ON} P-channel load switch in 4-pin WLCSP package. The slew urn-on control is integrated to limited inrush current. The device is designed to have very low leakage current during off state for low power-saving system.

Full-Time Reverse Current Protection

In a scenario where V_{OUT} is greater than V_{IN}, there is potential for reverse current to flow through the pass FET or the body diode. The devices monitor V_{IN} and V_{OUT} voltage levels. When the reverse current voltage threshold (V_{RCP}) is exceeded, the switch is disabled (within 10μs typ). The pass FET, and the output voltage (V_{OUT}), will resume normal operation when the reverse voltage scenario is no longer present.

Input Capacitor

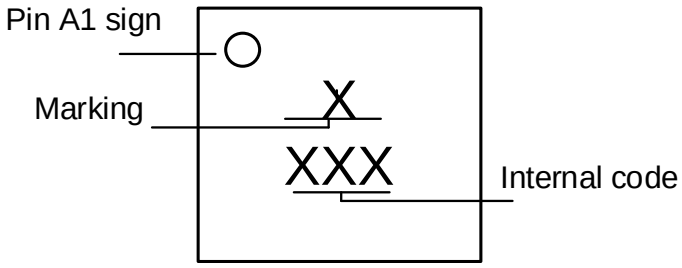
To limit the voltage drop on the input supply caused by transient inrush currents when the switch turns on into a discharged load capacitor or short-circuit, a capacitor needs to be placed between V_{IN} and GND. A 1-μF ceramic capacitor, C_{IN}, placed close to the pins, is usually sufficient. Higher values of C_{IN} can be used to further reduce the voltage drop during high current applications. When switching heavy loads, it is recommended to have an input capacitor about 10 times higher than the output capacitor to avoid excessive voltage drop.

Output Capacitor

Due to the integrated body diode in the PMOS switch, a C_{IN} greater than C_L is highly recommended. A C_L greater than C_{IN} can cause V_{OUT} to exceed V_{IN} when the system supply is removed. This could result in current flow through the body diode from V_{OUT} to V_{IN}.

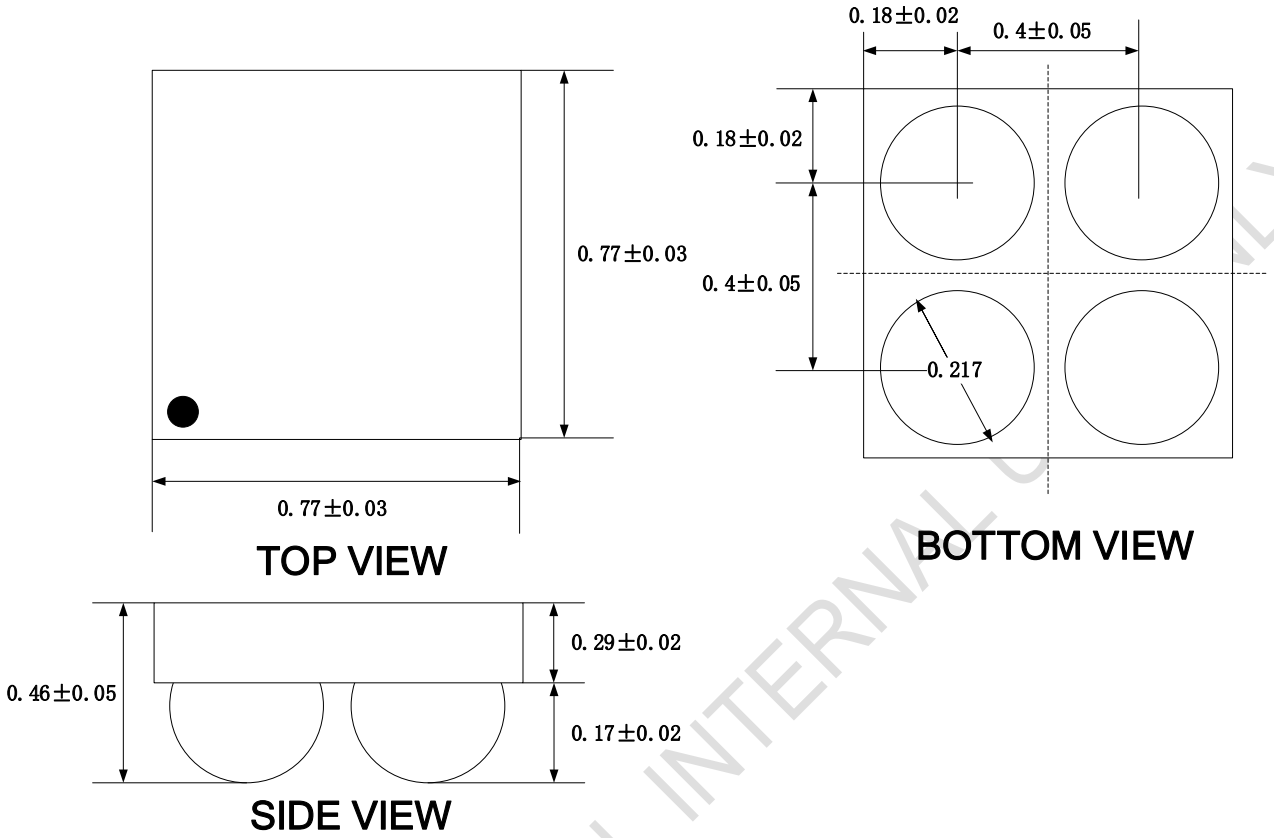
■ Marking Information

WLCSP-4B:



■ Package Information

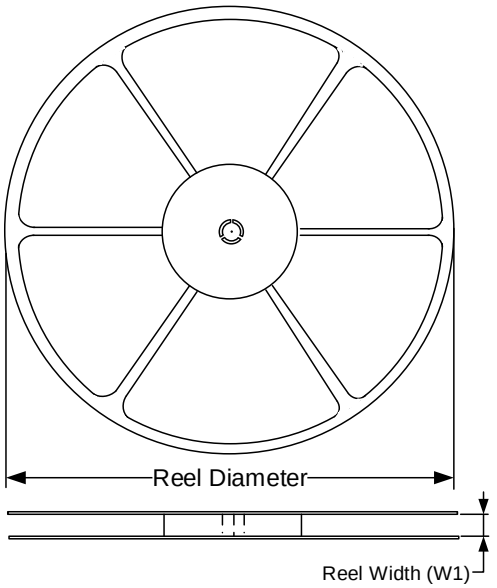
WLCSP-4B



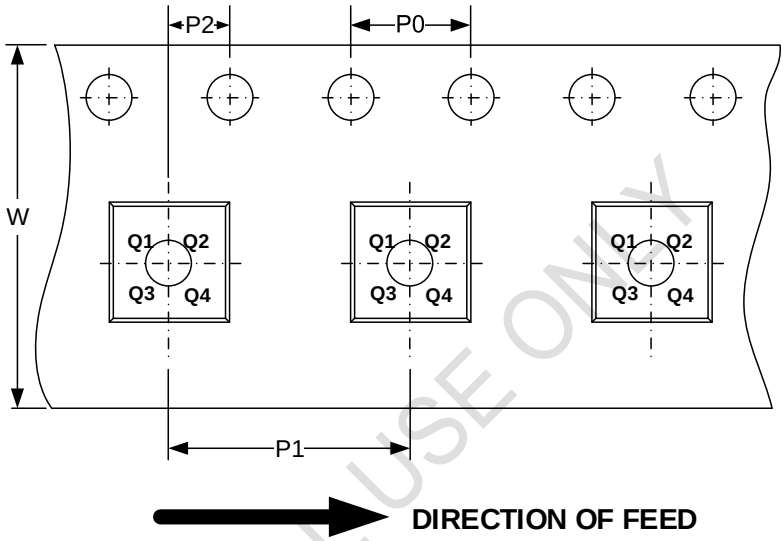
NOTE： ALL dimensions are in millimeters

■ Packing Information

REEL DIMENSIONS



TAPE DIMENSIONS



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Package type	SPQ (PCS)	Reel Diameter (mm)	Reel Width W1(mm)	W (mm)	P0 (mm)	P1 (mm)	P2 (mm)	MSL	PIN A1 Quadrant
4-Ball WLCSP (WLCSP-4B)	3000	180	8.6	8.0	4.0	4.0	2.0	Level-1-260℃	Q1

■ Note: Carrier Tape Dimension, Reel Size and Packing Minimum.

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