■ General Description

The OCP9225 features a low-Ron internal FET and an operating range of $3V_{DC}$ to $28V_{DC}$. An internal clamp is capable of shunting surge voltages ±100V, protecting downstream components and enhancing system robustness. The OCP9225 features over-voltage protection that powers down the internal FET if the input voltage exceeds the OVP threshold. The OVP threshold is adjustable with optional external resistors. Over-temperature protection also powers down the device at 140 ℃(typical).

The OCP9225 is available in a fully "green" compliant 1.237mm * 1.912mm WLCSP-12B Package.

■ Features

- Surge Protection
  -IEC 61000-4-5: ±100V
- Over-Voltage Protection (OVP)
- Over-Temperature Protection (OTP)
- Absolute Maximum Input Voltage: 35V
- Low Ron Switch : 18mΩ
- Default OVP threshold
  - OCP9225A :6.8V
  - OCP9225B :10.2V
- External OVLO threshold : 1.2V

■ Applications

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

■ Pin Configuration

WLCSP-12B(Top View):

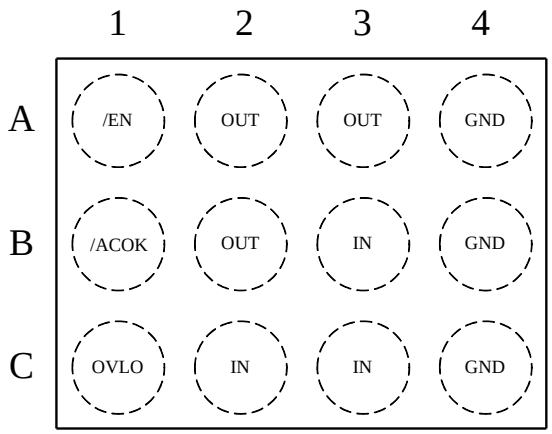


Figure 1, Pin Assignments of OCP9225

Pin Name	Pin No.	Pin Function
OUT	A2 A3 B2	Switch output to Load
IN	B3 C2 C3	Switch input and Device supply
OVLO	C1	Over-Voltage Lockout Adjustment Pin
GND	A4 B4 C4	Ground
/EN	A1	Enable pin, active low
/ACOK	B1	Power flag, active-low, open-drain output. When $V_{IN\_UVLO}<V_{IN}<V_{IN\_OVLO}$, /ACOK is pulled low, otherwise it's hi-Z state

■ Typical Application Circuit

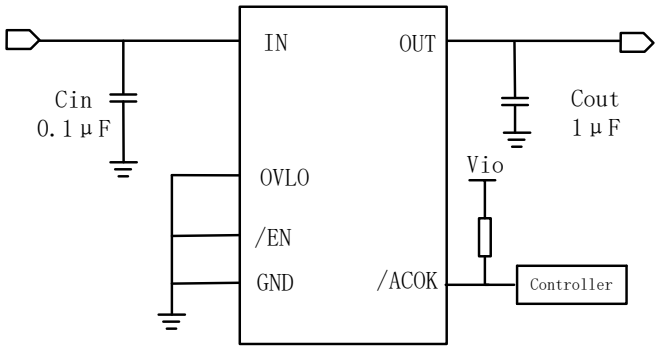


Figure 2-1, using default OVP threshold

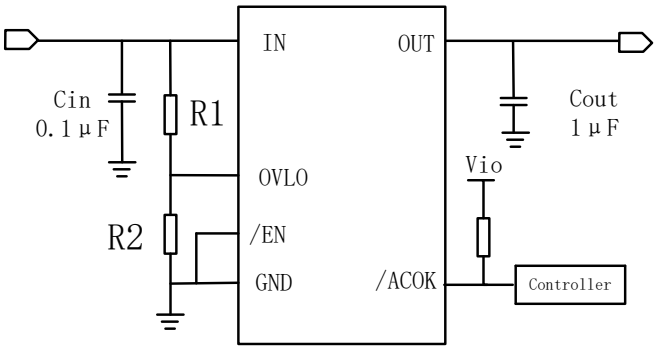


Figure 2-2, using external OVP threshold

1. If V_{IN} is required to pass surge voltage greater than 100V, external TVS is needed, the maximum clamping voltage of the TVS should be below 35V.
2. When the default OVP threshold is used, connect OVLO pin to GND directly or through a 0Ω resistor. OVLO pin cannot be left floating.
3. If R1 and R2 are used to adjust the OVP threshold, it is better to use 1% precision resistors to improve the OVP threshold precision.
4. If /ACOK is not used, it can be left floating, or short to GND.
5. C_{IN}=0.1μF is recommended for typical application, larger C_{IN} is also acceptable. The rate voltage of C_{IN} should be larger than the TVS maximum clamping voltage, if no TVS is applied and only OCP9225 is used, the rated voltage of C_{IN} should be 50V.
6. C_{OUT}=1μF is recommended for typical application, larger C_{OUT} is also acceptable. The rated voltage of C_{OUT} should be larger than the OVP threshold. For example, if the OVP threshold is 6.8V, the rated voltage of C_{OUT} should be 10V or higher, if the OVP threshold is 10.2V, the rated voltage of C_{OUT} should be 16V or higher.

■ Block Diagram

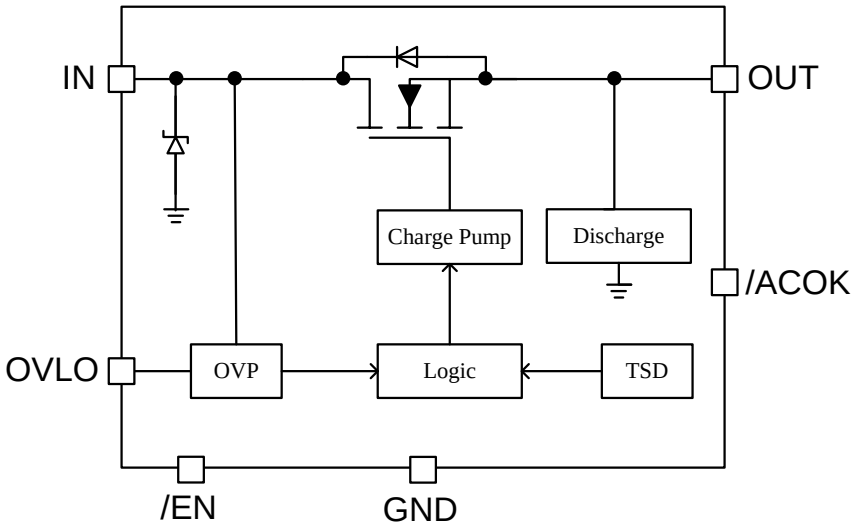


Figure 3, Block Diagram of OCP9225

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

Parameter	Symbol	Rating	Unit
V_{IN} Pin to GND	V_{IN}	-0.3 to +35	V
V_{OUT} Pins to GND	V_{OUT}	-0.3 to V_{IN}+ 0.3	V
V_{OVLO} Pins to GND	V_{OVLO}	-0.3 to 6	V
$V_{/ACOK}$ Pins to GND	$V_{/ACOK}$	-0.3 to 6	V
$V_{/EN}$ Pins to GND	$V_{/EN}$	-0.3 to 6	V
Maximum Continuous Current of Switch IN-OUT[2]	I_{SW}	6	A
Maximum Peak Current[3]	I_{PEAK}	9	A
Storage Temperature Range	T_S	-55 to +150	℃
Operating Junction Temperature Range	T_J	-40 to +150	℃
Maximum Soldering Temperature (at leads, 10 sec)	T_{LEAD}	260	℃

Note 1: 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.
Note 2: Limited by thermal design.
Note 3: Maximum 10ms pulse width.

■ Recommended Operating Conditions[4]

Parameter	Symbol	Rating	Unit
V_{IN} Pin Voltage to GND	V_{IN}	+3 to +28	V
Thermal Resistance	$R_{\theta JA}$	88	℃/W
Operating Temperature Range	T_{OP}	-40 to +85	℃

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

■ Electrical Characteristics

(unless otherwise noted, Typical values are at T_A= 25℃,V_{IN}=5.0V，C_{IN}=0.1μF，C_{OUT}=1μF)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Basic Operation						
I_Q	Input Quienscent Current	OCP9225A：V_{IN} = 5V，V_{OVLO}=0V，I_{OUT}=0A	-	110		μA
		OCP9225B：V_{IN} =9V，V_{OVLO}=0V，I_{OUT}=0A		180		
$I_{IN\ OVP}$	Input current at over-votage condition	OCP9225A：V_{IN} = 5V，V_{OVLO}=3V，I_{OUT}=0A		50	70	μA
		OCP9225B：V_{IN} = 9V，V_{OVLO}=3V，I_{OUT}=0A		80	100	
R_{on}	Switch On Resistance	V_{IN} = 5V，I_{OUT} =1A，T_A=25℃	-	18	25	mΩ
V_{IN_OVP}	VIN OVP Trip Level	OCP9225A V_{IN} Rising	6.66	6.8	6.94	V
		OCP9225B V_{IN} Rising	9.99	10.2	10.4	V
$V_{IN\_OVP\_HYS}$	VIN OVP Hysteresis	V_{IN} Falling Hysteresis	-	0.3	-	V
V_{IN_UVLO}	UVLO Trip Level	V_{IN} Rising	-	2.7	-	V
		V_{IN} Falling Hysteresis	-	0.1	-	V
V_{OVLO_TH}	OVLO set threshold	V_{OVLO} Rising	1.16	1.2	1.24	V
	Hys			0.05	-	V

V_{OVLO_SEL}	External OVLO select threshold	V_{OVLO} Rising	0.19	0.27	0.33	V
	Hys		-	0.1	-	V
I_{OVLO}	OVLO pin leakage current	$V_{OVLO}=V_{OVLO\ TH}$	-0.2	-	0.2	μA
$I_{LEAK\ /ACOK}$	/ACOK leakage current	Vio=5V	-0.5	-	0.5	μA
V_{OL}	/ACOK output low voltage	I_{SINK}=1mA	-	-	0.4	V
V_{IH}	/EN input high level	/EN Rising	1.2	-	-	V
V_{IL}	/EN input low level	/EN Falling	-	-	0.5	V
Timing Characteristics						
T_{DEB}	Debounce Time	Time from Vin> V_{IN_UVLO} to OUT = 0.1*V_{OUT}	-	13	-	ms
T_{ON}	Switch Turn-on Time	OUT from 0.1 * V_{IN} to 0.9 * V_{IN} C_{LOAD} = 1μF	-	900	-	μs
T_{OFF}	Switch Turn-off Time	C_{LOAD} = 1μF , V_{IN} > $V_{IN\ OVLO}$ to V_{OUT} stop rising	-	50	-	ns
T_{START}	Start time	From V_{IN}>$V_{IN\ UVLO}$ to /ACOK low		25		ms
Thermal Shutdown						
T_{SDN}	Thermal Shutdown			140		℃
T_{SDN_HYS}	Thermal Shutdown Hysteresis			35		℃

■ Timing Diagrams

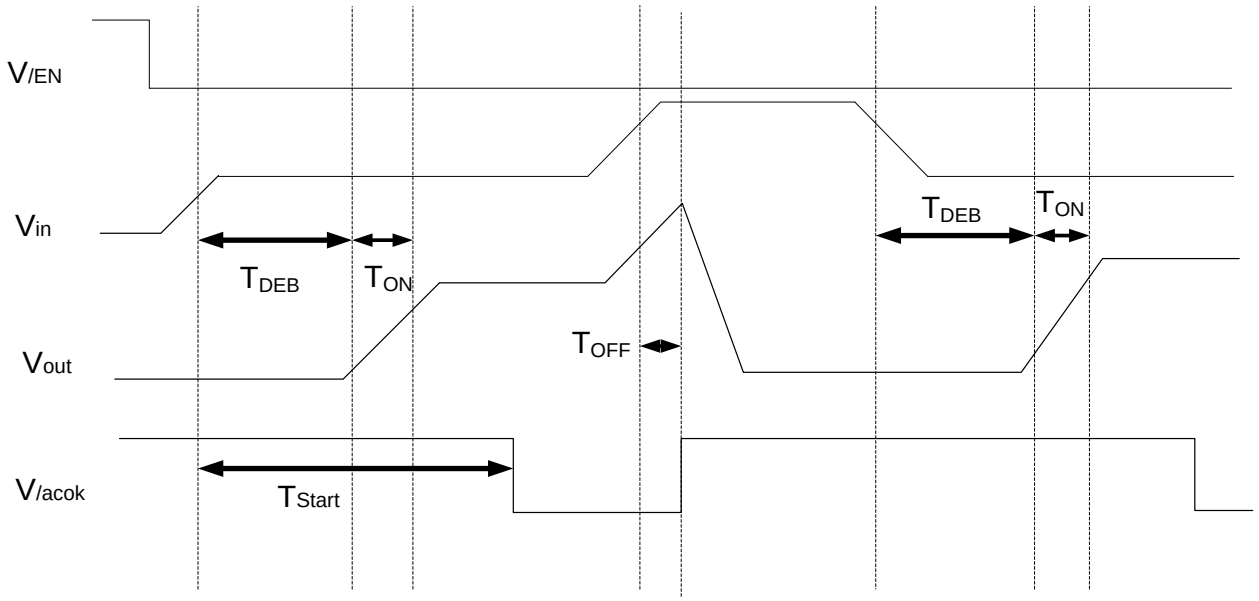


Figure 4, Timing Diagram

Detailed Functional Description

Device Operation

If the OCP9225 is enabled and the input voltage is between UVLO and OVP threshold, the internal charge pump begins to work after 13ms debounce time, the gate of the nFET switch will be slowly charged high till the switch is fully on. The OVP switch features an ultra-low 18mΩ (typ.) on-resistance MOSFET and protects low-voltage system against voltage faults up to 35VDC. If the input voltage exceeds the OVP trip level, the switch will be turned off in about 50ns.

Surge Protection

The OCP9225 integrates a clamp circuit to suppress input surge voltage. For surge voltages between VIN_OVLO and VIN_CLAMP, the switch will be turned off but the clamp circuit will not work. For surge voltages greater than VIN_CLAMP, the internal clamp circuit will detect surge voltage level and discharge the surge energy to ground. The device can suppress surge voltages up to ±100V.

Over-Voltage Protection

If the input voltage exceeds the OVP rising trip level, the switch will be turned off in about 50ns. The switch will remain off until VIN falls below the OVP falling trip level.

OVP Threshold Adjustment

If the default OVP threshold is used, OVLO pin must be grounded. If OVLO pin is not grounded, and by connecting external resistor divider to OVLO pin as shown in the typical application circuit, between IN and GND, the OVP threshold can be adjusted as following:

$$VIN\_OVLO = VOVLO\_TH \times (R1+R2)/R2$$

For example, if we select R1 = 510kΩ and R2 = 51kΩ, then the new OVP threshold calculated from the above formula is 13.2V. The OVP threshold adjustment range is 4V to 20V. When the OVLO pin voltage VOVLO exceeds VOVLO_SEL (0.27V typical), VOVLO is compared with the reference voltage VOVLO_TH (1.2V typical) to judge whether input supply is over-voltage.

/ACOK Output

The device features an open-drain output /ACOK, it should be connected to the system I/O rail through a pull-up resistor. If the device is enabled and $V_{IN\_UVLO} < V_{IN} < V_{IN\_OVLO}$, /ACOK will be driven low indicating the switch is on with a good power input. If OVP, UVLO, or OT occurs, or EN is pulled high, the switch will be turned off and /ACOK will be pulled high.

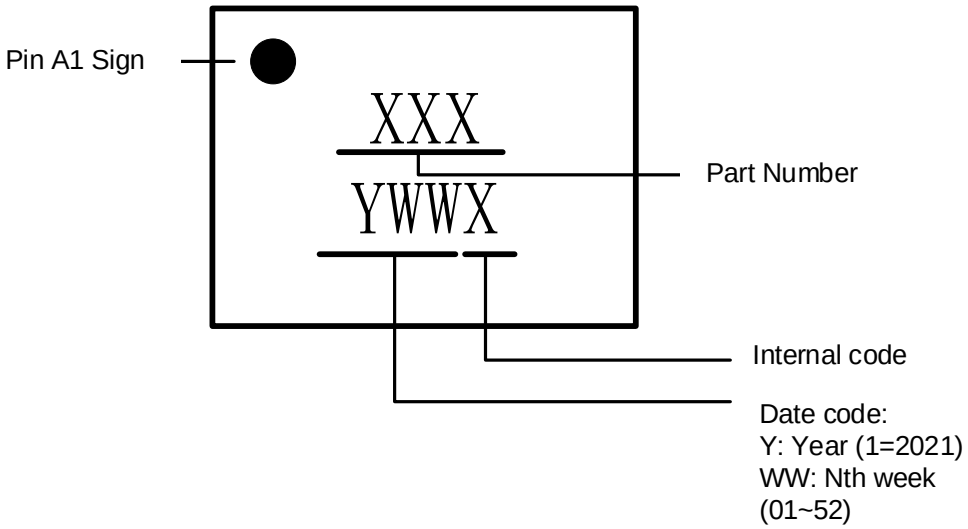
USB On-The-Go (OTG) Operation

If V_{IN} = 0V and OUT is supplied by OTG voltage, the body diode of the load switch conducts current from OUT to IN and the voltage drop from OUT to IN is approximately 0.7V. It is recommended to pull Pin /EN low in OTG mode, When $V_{IN} > V_{IN\_UVLO}$, internal charge pump begins to open the load switch after debounce time. After switch is fully on, current is supplied through switch channel and the voltage drop from OUT to IN is minimum.

■ Ordering Information

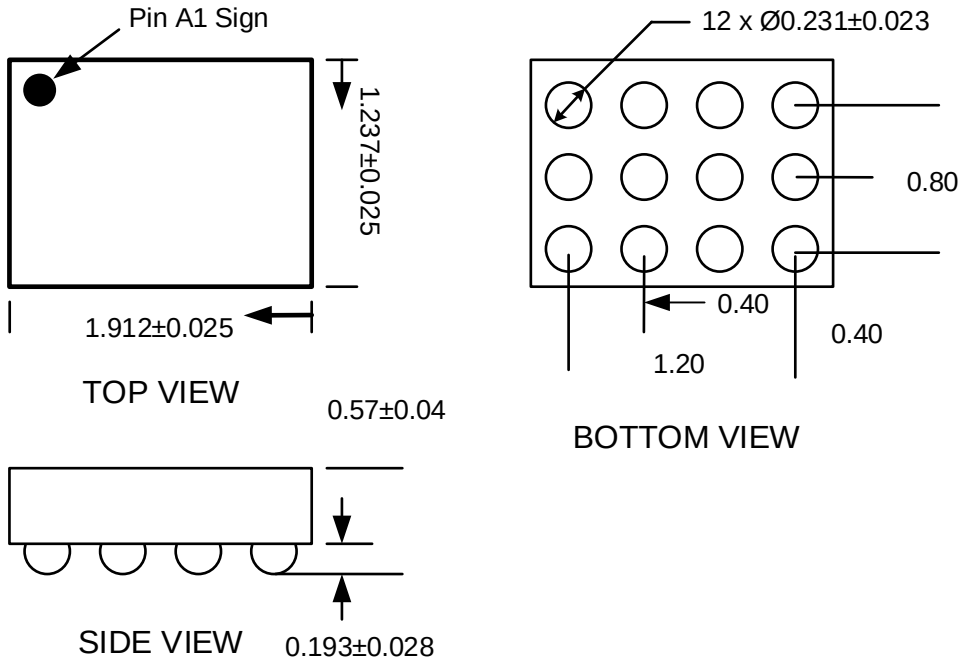
Part Number	OVP Voltage	Marking	Package Type	Package Qty	Temperature	Eco Plan
OCP9225AWPAD	6.8V	VLB	WLCSP-12B	7-in reel 3000pcs/reel	-40～85℃	Green
OCP9225BWPAD	10.2V	VMB	WLCSP-12B	7-in reel 3000pcs/reel	-40～85℃	Green

■ Marking Information



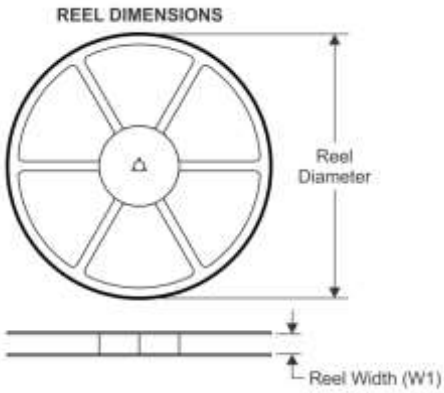
■ Package Information

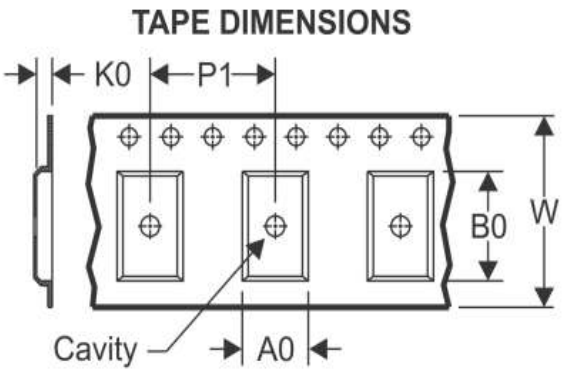
WLCSP-12B:



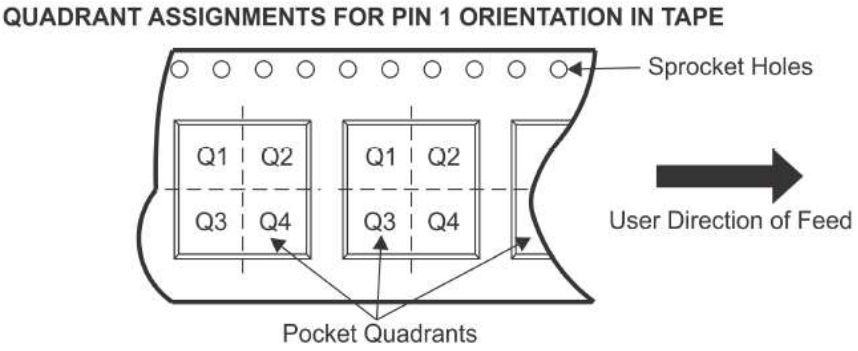
Note: All dimensions are in millimeters.

■ Packing Information





A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers



Package tape	Package Drawing	MSL	SPQ	Reel Diameter (inch)	Reel Width W1(mm)
12-Ball WLCSP (WLCSP-12B)	VLB/VMB	Level-1-260C	3000PCS	7	8.4
A0 (mm)	**B0 (mm)**	**K0 (mm)**	**P1 (mm)**	**W (mm)**	**PIN A1 Quadrant**
1.4	2.2	0.77	4.0	8.0	Q2

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