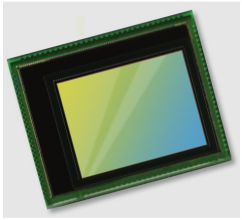
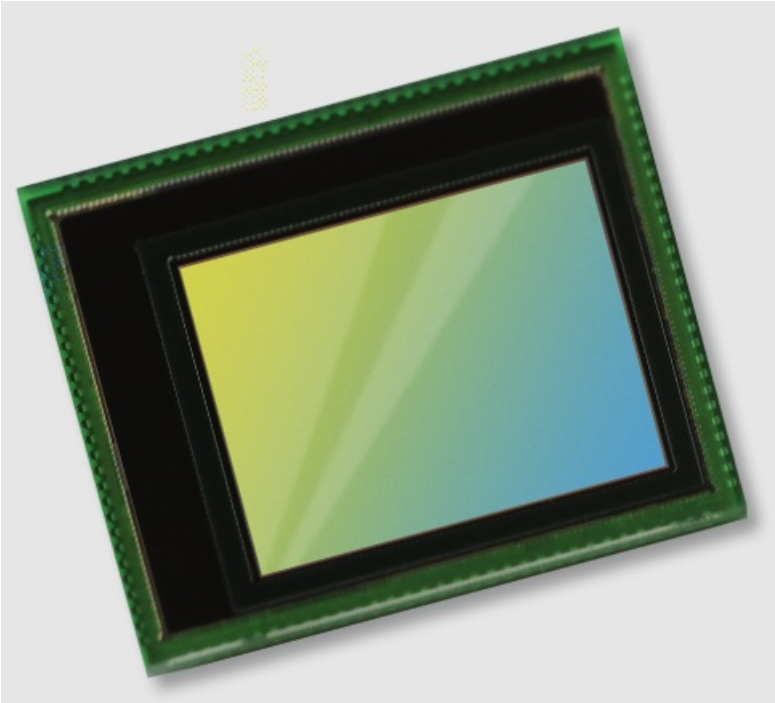


OMNIVISION WS4694C Image Sensor User Manual

Contents

OMNIVISION WS4694C Image Sensor



Descriptions

The WS4694C is a small, low RON, single channel load switch with controlled slew rate. The device operates over an input voltage range of 2.6 V to 5.5 V. The device supports current limit from 0.05 A to 2 A.

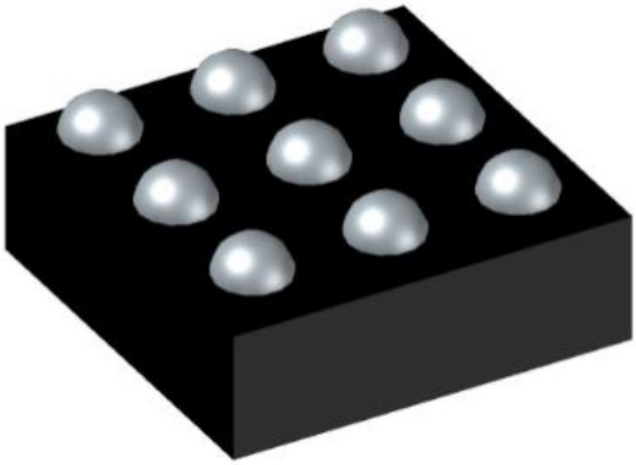


Figure 1 CSP-9L

The controlled rising time of the device greatly reduces inrush current caused by large bulk load capacitance, thereby reducing or eliminating power supply drop. The WS4694C has a True Reverse-Current Blocking (TRCB) function that obstructs unwanted reverse current from VOUT to VIN during ON and OFF states. The small size and low RON device is designed for space constrained battery powered applications. The wide input voltage range of the switch makes it a versatile solution for many different voltage rails.
The WS4694C are available in a CSP-9L package. Standard products are Pb-free and Halogen-free.

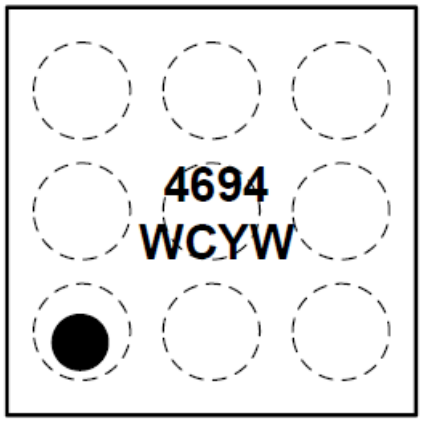


Figure 2 Marking (Top View)

4694 = Device Code

WC = Special Code

Y = Year Code

W = Week Code

Features

- Input Voltage Range: 2.6 V ~ 5.5 V
- Absolute Rating at VOUT: 28 V
- Maximum Output current: 2.0 A
- Adjustable Current Limit: 0.05 A ~ 2.0 A
  1 A ~2.0 A with 15% Accuracy
- True Reverse-Current Blocking (TRCB)
- Under-Voltage Lockout and Thermal Shutdown
- CSP-9L

Order Information

Table 1

Device	Package	Shipping
WS4694C-9/TR	CSP-9L	3000/Reel&Tape

Applications

- Smart Phones, Tablet PCs
- Storage, DSLRs, and other portable devices

Pin Information

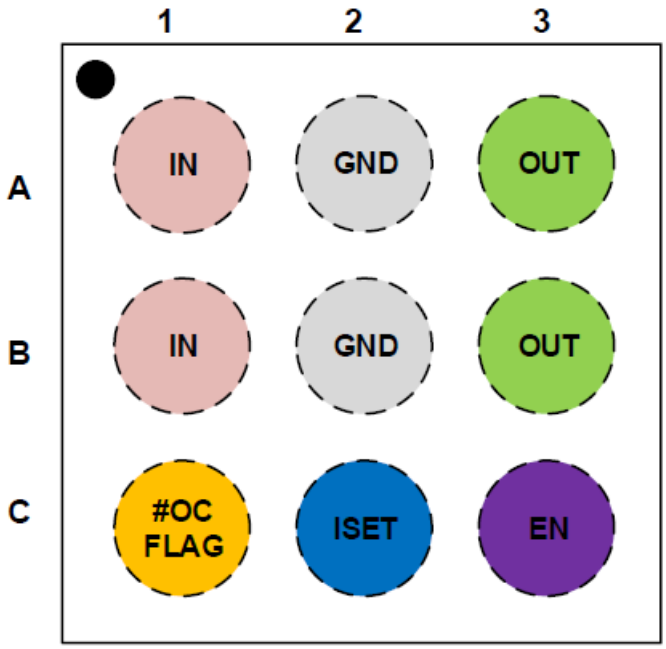


Figure 3 Pin Information (Top View)

Table 2

Pin	Symbol	Description
A3, B3	OUT	Output pin
A1, B1	IN	Input pin
A2, B2	GND	Ground
C3	EN	ON/OFF Control Input: Active HIGH
C2	ISET	Current Limit Set Input: A resistor from ISET to ground sets the current limit for the switch.
C1	#OCFLAG	Fault Output: Active LOW, open-drain output that indicates an input over current. An external pull-up resistor to VDD is required.

Block Diagram

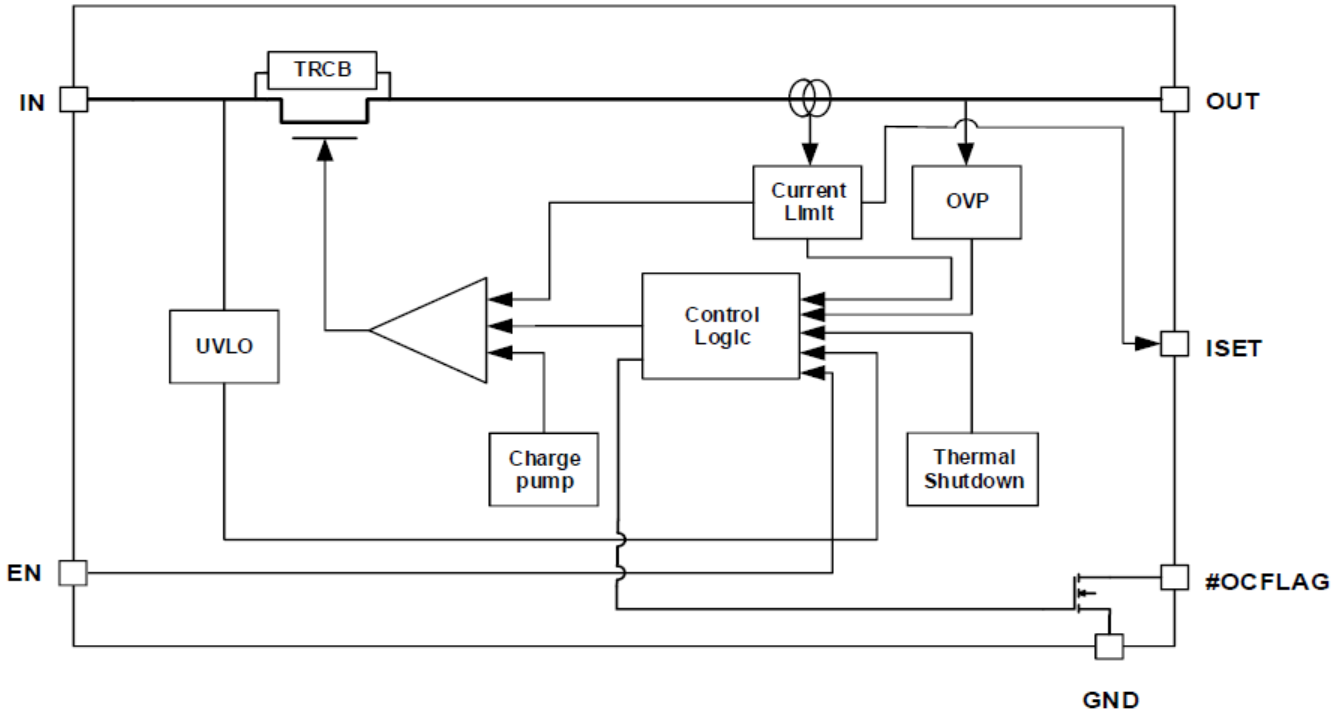


Figure 4 Block Diagram

Typical Application

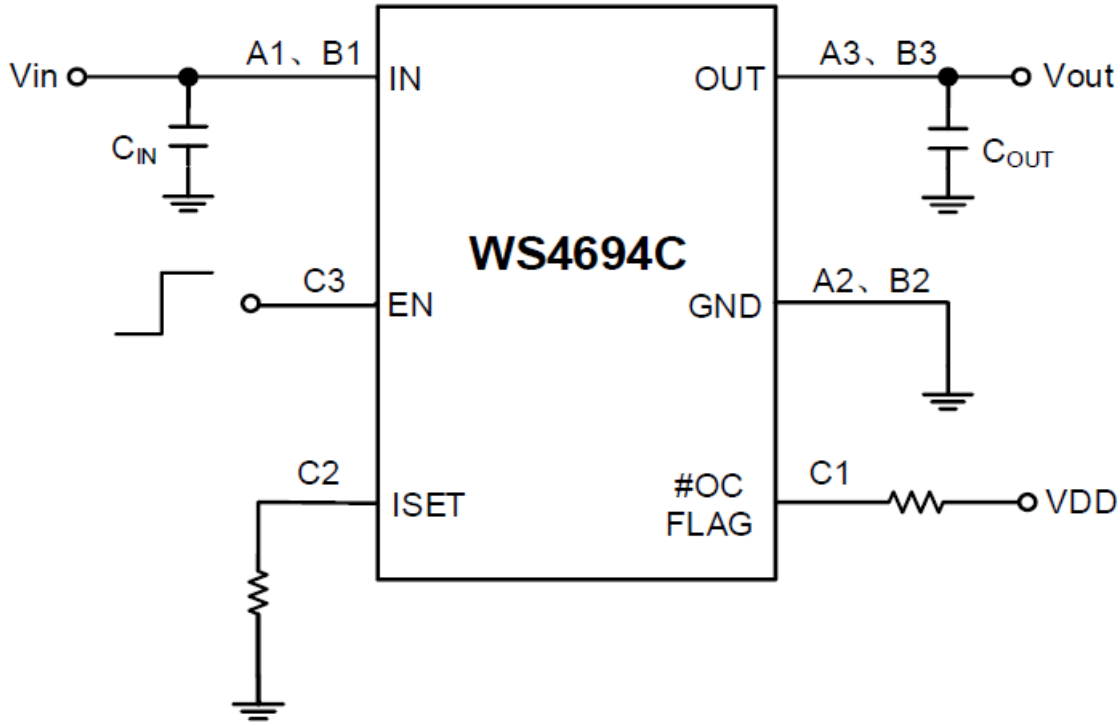


Figure 5 Typical Application

Absolute Maximum Ratings

These are stress ratings only. Stresses exceeding the range specified in Table 3 might cause substantial damage to the device. Functional operation of the device at other conditions beyond those listed in the specification is not implied. Prolonged exposure to extreme conditions might affect device reliability.

Table 3

Parameter	Symbol	Min.	Max.	Unit
VOUT to GND, VOUT to VIN	OUT	-0.3	28	V
Other Pins to GND	IN, EN, ISET, #OCFLAG	-0.3	6	V
Maximum Continuous Switch Current **1**	ISW	2.3		A
Operating Junction Temperature	TJ	-40	150	oC
Storage Temperature Range	TSTG	-65	150	oC
Lead Temperature	TL	260		oC
ESD Ratings	HBM	5		kV
	CDM	2		kV
	Air Discharge (VIN, VOUT to GND)	15		kV
	Contact Discharge (VIN, VOUT to GND)	8		kV

Maximum Junction Temperature = 85°C

Recommend Operation Ratings

The following table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications.

Table 4

Parameter	Symbol	Min.	Max.	Unit
Supply Voltage	VIN	2.6	5.5	V
Other Pins	EN, ISET, #OCFLAG	2.5	5.5	V
Operating Ambient Temperature	TA	-40	85	oC
Thermal Resistance, RθJA (CSP-9L) **2**	RθJA	110		oC/W

Surface mounted on FR-4 Board using 2 oz, 1 square inch Cu area, PCB board size 1.5*1.5 square inches.

Electrical Characteristics

TA = -40 to +85°C, VIN = 2.6 to 5.5 V, Typical values are at VIN = 5 V and TA = 25oC, unless otherwise noted.

Table 5

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Basic Operation						
Input Voltage	VIN		2.6		5.5	V
Quiescent Current	IQ	VIN= VEN, VOUT=Open, TA=25°C		80	150	μA
Shutdown Current	ISD	VIN=5.5 V, VOUT=0 V, VEN=GND		0.1		μA
Off Supply Current	IQ(OFF)	VEN=GND, VOUT=Open		1		μA
On Resistance	RON	VIN=VEN=5 V, IOUT=1 A, TA=25°C		75	100	mΩ
		VIN=VEN=3.7 V, IOUT=1 A, TA=25°C		85	105	
EN Logic High Voltage	VIH	VIN=5 V, IOUT=0.1 A	1.1			V
EN Logic Low Voltage	VIL	VIN=5 V, IOUT=0.1 A			0.4	V

#OCFLAG Output Logic Low Voltage	VIL_FLAG	VIN=5 V, ISINK=10 mA		0.1	0.2	V
		VIN=2.6 V, ISINK=10 mA		0.15	0.3	V
#OCFLAG Output Logic High Leakage Current	IFLAG_LK	VIN=5 V, Switch on		0.1	1	µA
EN Input Leakage	ION	VEN=0 V to VIN			1	µA
Pull-Down Resistance at EN Pin	REN_PD	VIN=2.6~5.5 V, VEN=High TA= –40 to 85oC		14		MΩ
Over-Voltage Protection						
Output OVP Lockout	VOV_TRIP	VOUT Rising Threshold	5.5	5.8	6	V
		VOUT Falling Threshold		5.5		
Output OVP Hysteresis	OUTHYS			0.3		V
OVP Response Time[3]	tOVP	IOUT=0.5 A, CL=1 µF, TA=25ºC, VOUT from 5.5 V to 6.0 V	1		4	µs

Over-Current Protection						
Current Limit	ILIM	VIN=VEN=5 V, RSET=1000 Ω	850	1000	1150	mA
		VIN=VEN=5 V, RSET=500 Ω	1700	2000	2300	
Under-Voltage Lockout	VUVLO	VIN Increasing		2.4		V
		VIN Decreasing		2.2		
UVLO Hysteresis	VUVLO_HYS			200		mV
RCB Protection Trip Point	VT_RCB	VOUT – VIN		50		mV

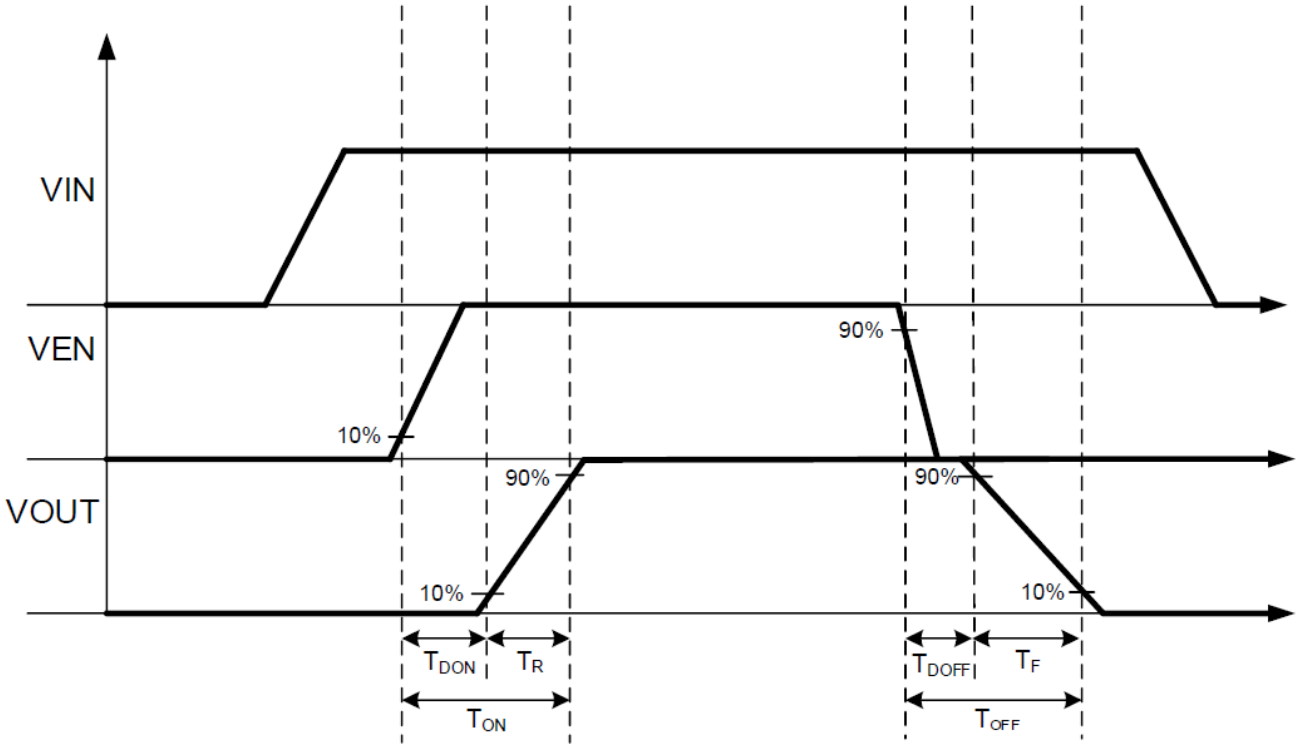
Parameter	**Symbol**	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
RCB Protection Release Trip Point	VR_RCB	VIN – VOUT		50		mV
RCB Hysteresis	VRCB_HYS			100		mV
Default RCB Response Time[(3)]	tRCB	VIN=5 V, VEN=High/Low		2		µs

RCB Current	IRCB	VEN=0 V, VOUT=5.5 V		7		µA
Hard Over-Current Response Time[3]	tHOCP	Moderate Over-Current Condition, IOUT ≥ ILIM, VOUT =0 V		2		µs
Over-Current Response Time[3]	tOCP	Moderate Over-Current Condition, IOUT ≥ ILIM, VOUT ≤ VIN		25		µs
Over-Current Flag Response Time	tOC_FLAG	When Over-Current Occurs to Flag Pulling LOW		8		ms
Thermal Shutdown	TSD	Shutdown Threshold		150		oC
		Return from Shutdown		130		
		Hysteresis		20		
Turn-On Delay	TDON	VIN=5 V, RL=100 Ω, CL=1 uF RSET=2000 Ω, TA=25ºC		0.8		ms
VOUT Rise Time	TR			0.3		
Turn-On Time	TON			1.1		
Turn-Off Delay	TDOFF			10		µs
VOUT Fall Time	TF			270		

Turn-Off Time	TOFF			280		
Turn-On Delay	TDON	VIN=5 V, RL=3.8 Ω, CL=10 uF RSET=600 Ω, TA=-40 to 85ºC		0.8		ms
VOUT Rise Time	TR			0.5		
Turn-On Time	TON			1.3		
Turn-Off Delay	TDOFF			10		µs
VOUT Fall Time	TF			230		
Turn-Off Time	TOFF			240		

This parameter is guaranteed by design.

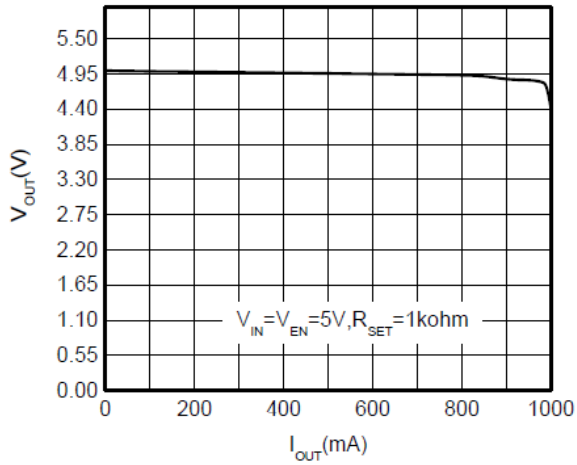
Timing Diagram



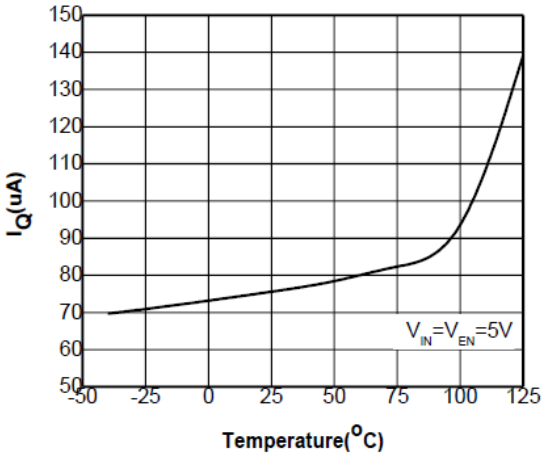
Note: $T_{ON}=T_{DON}+T_R$, $T_{OFF}=T_{DOFF}+T_F$.

Typical characteristics

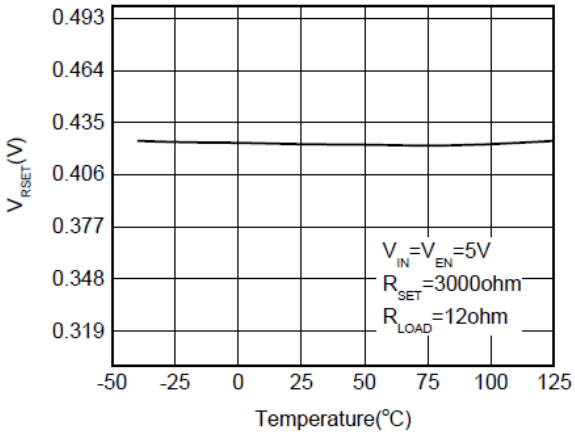
TA = 25oC, VIN = VEN = 5 V, CIN = 1 µF, COUT = 1 µF, unless otherwise noted.



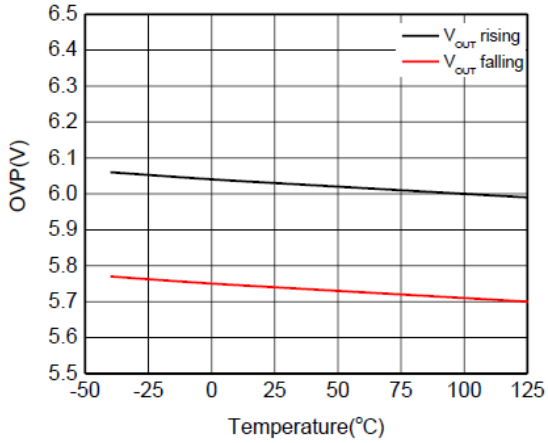
V_{OUT} VS. I_{OUT}



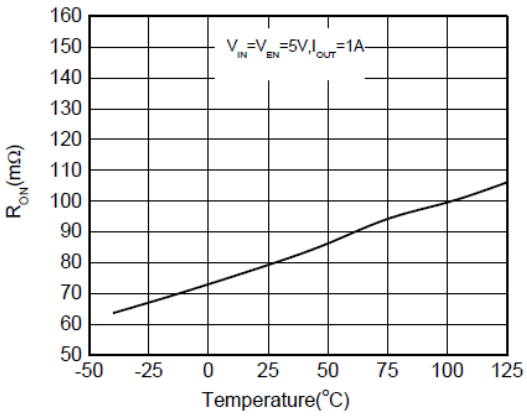
I_Q VS. Temperature



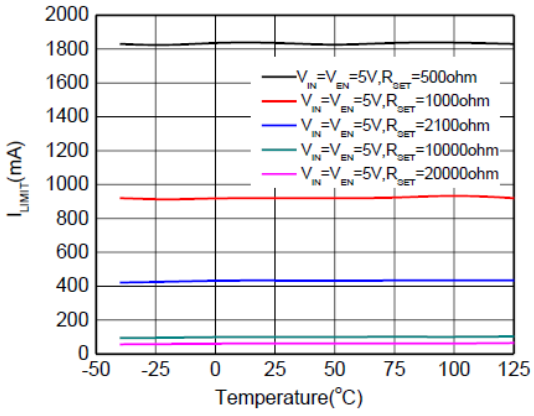
V_{RSET} VS. Temperature



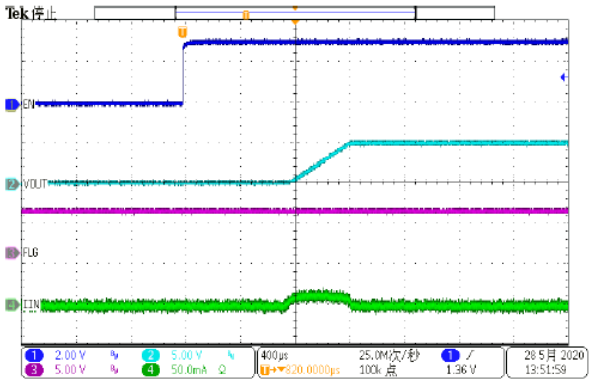
OVP VS. Temperature



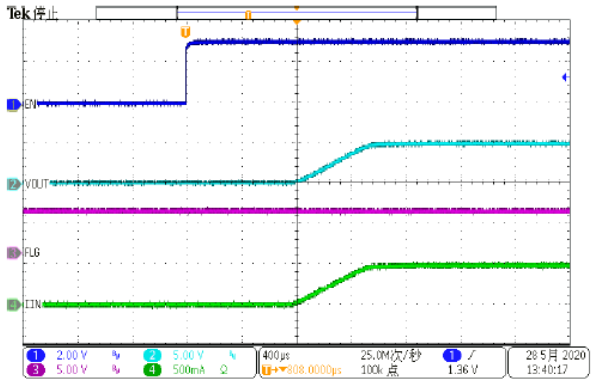
R_{ON} VS. Temperature



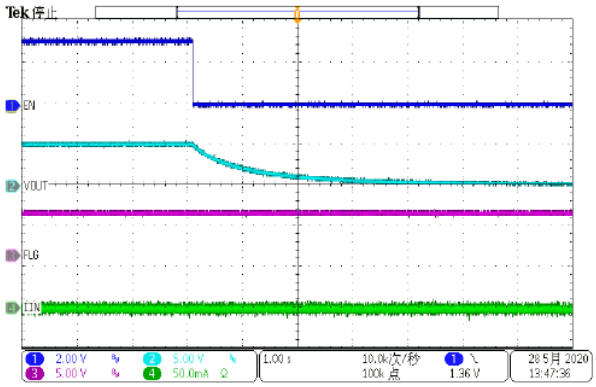
I_{LIMIT} VS. Temperature



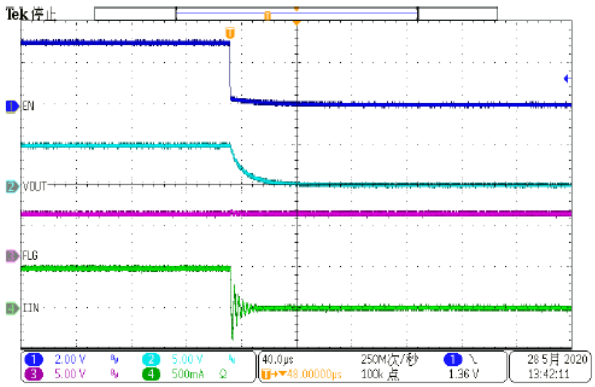
Start up by EN, C_{IN}=C_{OUT}=1 uF, V_{IN}=V_{EN}=5 V, R_{SET}=1 K, I_{OUT}=0 mA



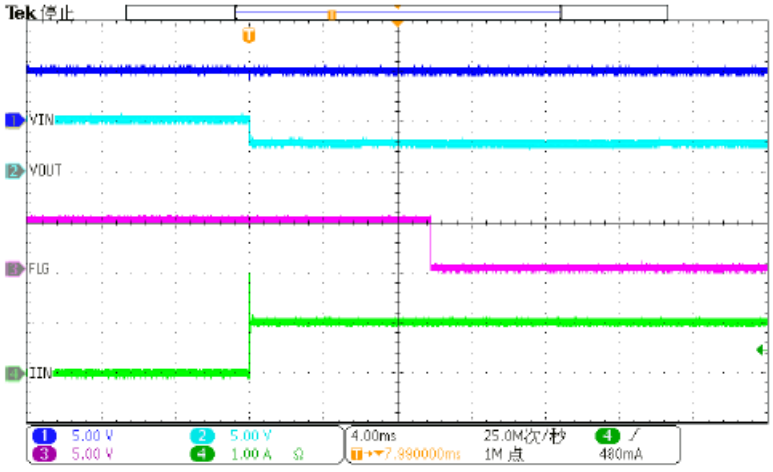
Start up by EN, C_{IN}=C_{OUT}=1 uF, V_{IN}=V_{EN}=5 V, R_{SET}=1 K, I_{OUT}=500 mA



Shut down by EN, C_{IN}=C_{OUT}=1 uF, V_{IN}=V_{EN}=5 V, R_{SET}=1 K, I_{OUT}=0 mA



Shut down by EN, C_{IN}=C_{OUT}=1 uF, V_{IN}=V_{EN}=5 V, R_{SET}=1 K, I_{OUT}=500 mA



Current limit, C_{IN}=C_{OUT}=1 uF, V_{IN}=V_{EN}=5 V, R_{SET}=1 K, R_{LOAD}=2.5 Ω

Application Information

Input Capacitor

To limit the voltage drop on the input supply caused by transient in-rush currents when the switch turns on, a capacitor needs to be placed between the VIN and the GND. Higher values of CIN can be used to further reduce the voltage drop in high-current applications.

Output capacitor

An output capacitor needs to be placed between the VOUT and the GND pin. The capacitor prevents parasitic

board inductance from forcing VOUT below GND when the switch is on. The capacitor also prevents reverse inrush current from a voltage spike that could damage the device in the case of a VOUT short.

Fault Reporting
Upon the detection of an over-current, #OC_FLAG signals the fault by activating LOW.

Current Limiting
The current limit ensures that the current through the switch does not exceed the maximum set value, while not limiting the minimum value. The current at which the part's limit is adjustable through the selection of the external resistor connected to the ISET pin. Information for selecting the resistor is found in the section below. The device acts as a constant-current source when the load draws more than the maximum value set by the device until thermal shutdown occurs. The device recovers if the die temperature drops below the threshold.

Under-Voltage Lockout
The Under-Voltage Lockout (UVLO) turns off the switch if the input voltage drops below the lockout threshold. With the EN pin activated, the input voltage rising above the UVLO threshold releases the lockout and enables the switch.

True Reverse-Current Blocking
The true reverse-current blocking feature protects the input source against current flow from output to input regardless of whether the load switch is on or not.

Thermal Shutdown
The thermal shutdown protects the die from internally or externally generated excessive temperature. During an over-temperature condition, the switch is turned off. The switch automatically turns on again if the temperature of the die drops below the threshold temperature.

Setting Current Limit
The current limit is set with an external resistor connected between the ISET and GND pins.
The current limit is calculated as the following:

$$I_{LIMIT}(A) = \frac{1000}{Rset(\Omega)}$$

The resistor tolerance of 1% or less is recommended

Table 6 Current Limit Settings by RSET

RSETΩ	Min. Current Limit (mA)	Typ. Current Limit (mA)	Max. Current Limit (mA)
500	1700	2000	2300
571	1490	1750	2010
667	1275	1500	1725
800	1065	1250	1435
1000	850	1000	1150
1111	750	900	1050
1250	650	800	950
1429	550	700	850
1667	450	600	750
2000	350	500	650

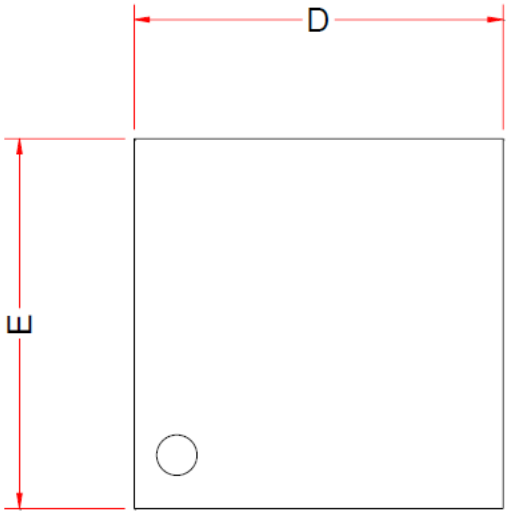
Note: Table values are based on 1% tolerance resistors.

Layout Guide

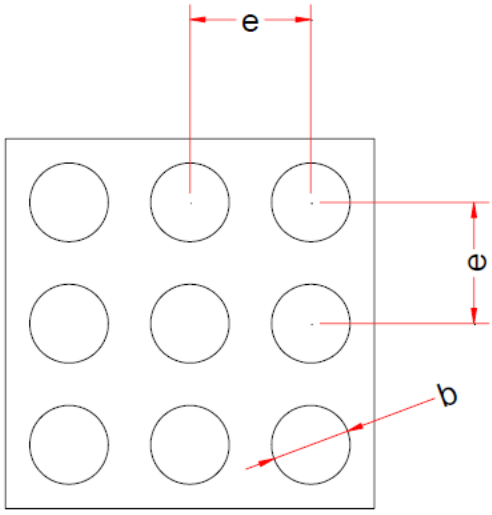
For best performance, all traces need to be as short as possible. To be the most effective, the input and output capacitors need to be placed close to the device to minimize the effect that parasitic trace inductance might have on normal and short-circuit operation. Using wide traces for VIN, VOUT, GND helps minimize parasitic electrical effects along with the case-to-ambient thermal impedance.

Package Outline Dimensions

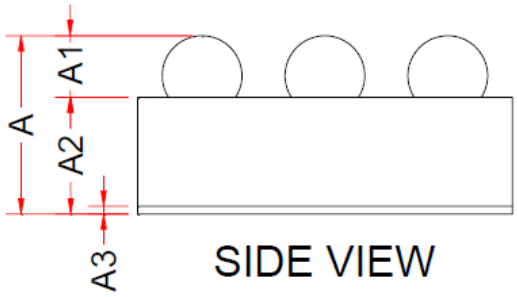
CSP-9L



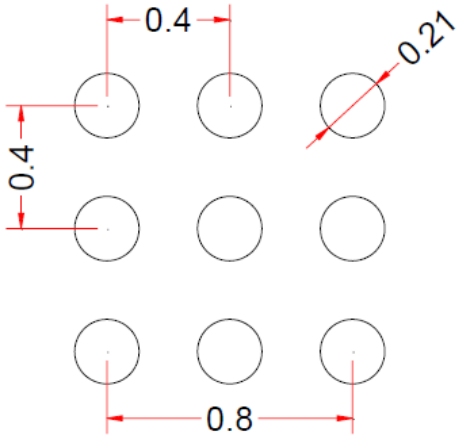
TOP VIEW



BOTTOM VIEW



SIDE VIEW

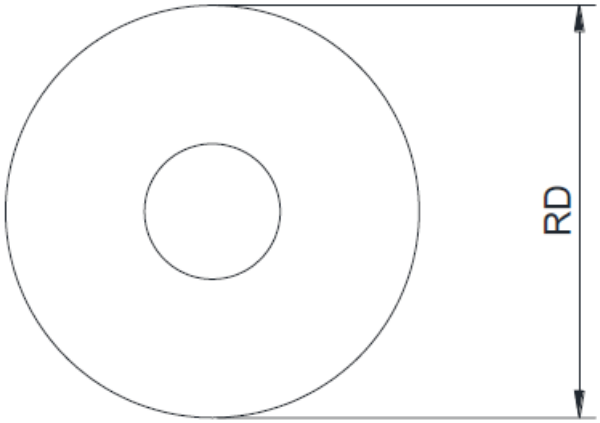


RECOMMENDED LAND PATTERN(unit:mm)

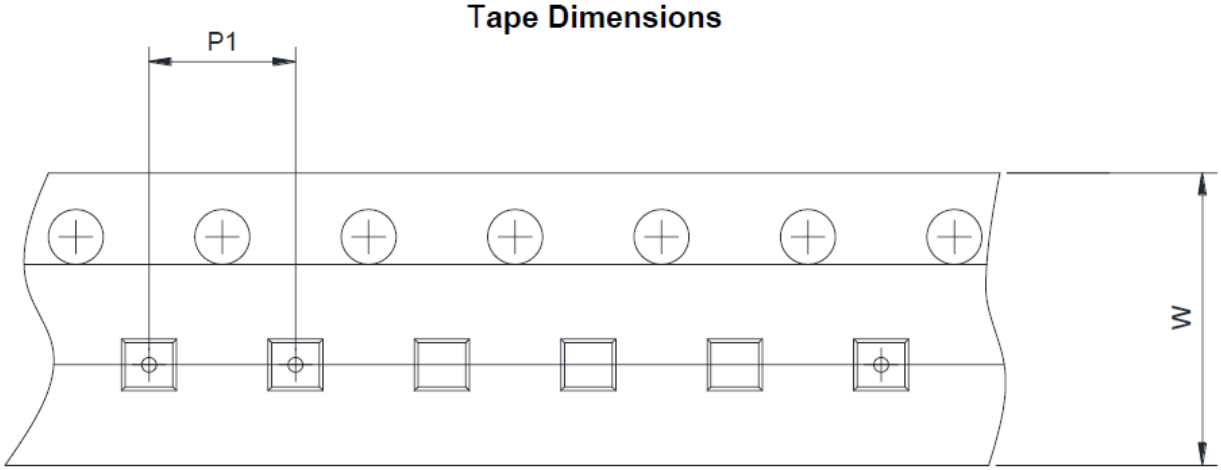
Symbol	Dimensions in Millimeters		
	Min.	**Typ.**	**Max.**
A	0.54	0.58	0.63
A1	0.18	0.20	0.22
A2	0.36	0.38	0.41
A3	0.025 Ref.		
D	1.19	1.22	1.25
E	1.19	1.22	1.25
b	0.24	0.26	0.28
e	0.40 BSC		

Tape And Reel Information

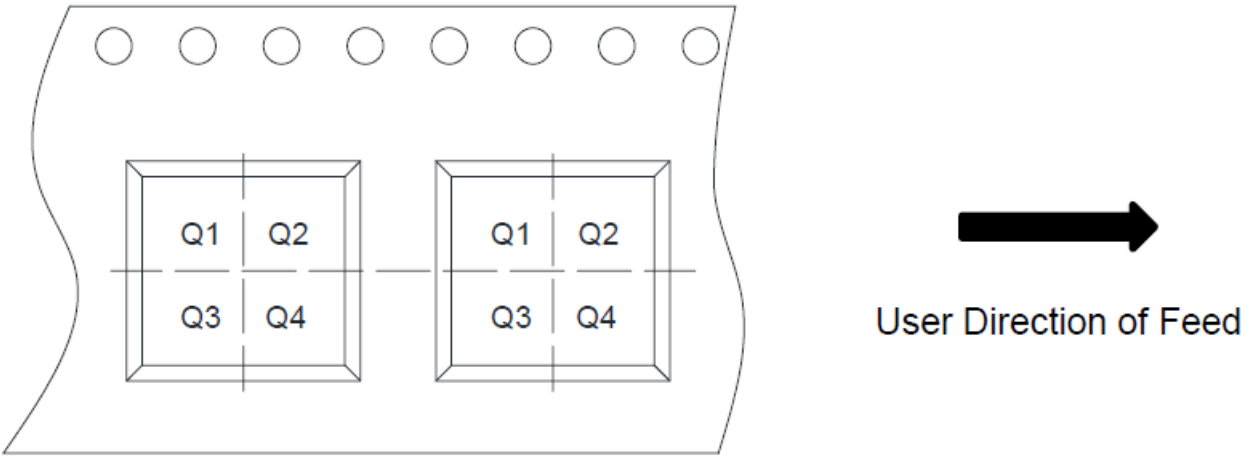
Reel Dimensions



Tape Dimensions



Quadrant Assignments for PIN1 Orientation in the Tape



RD	Reel dimension	☑ 7inch	☐ 13inch		
W	Overall width of the carrier tape	☑ 8mm	☐ 12mm		
P1	Pitch between successive cavity centers	☐ 2mm	☑ 4mm	☐ 8mm	
Pin1	Pin1 quadrant	☑ Q1	☐ Q2	☐ Q3	☐ Q4

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Documents / Resources

	OMNIVISION WS4694C Image Sensor [pdf] User Manual Image Sensor, Image, Sensor, WS4694C

References

- OMNIVISION | Semiconductor Manufacturer of Sensing, Analog and Touch & Display Solutions.