



CJ9460E DC/DC Switching Regulators

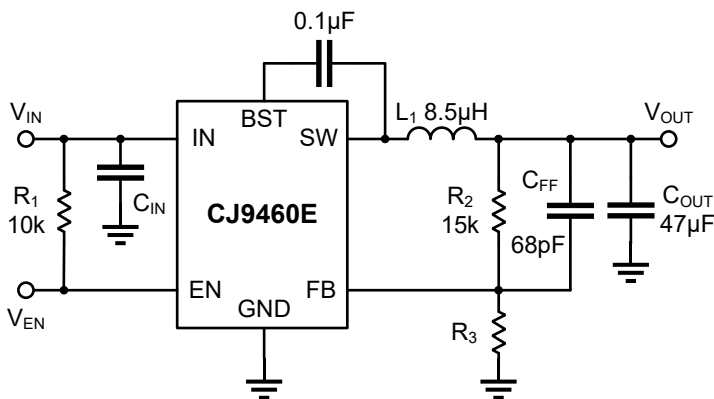
1 Introduction

The CJ9460E is an efficient synchronous rectification buck DC/DC converter. It adopts a constant conduction time control mode. The input voltage range is 4.5V to 18V, with a maximum output current of up to 2A and a constant operating frequency of 500kHz. Due to the internal integration of a main switch with low conduction resistance and a synchronous rectifier, this device can achieve efficient operation without the need for Schottky diodes.

The output voltage range of the CJ9460E is 0.6V to 6.0V, and it has protection functions such as overcurrent, over temperature, and short circuit. Therefore, the CJ9460E is an ideal choice for lithium-ion battery powered devices, helping to extend battery life in portable systems.

2 Available Package

PART NUMBER	PACKAGE
CJ9460E	SOT-23-6L



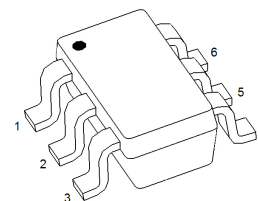
Typical Application Circuit

3 Features

- Input Voltage Range: 4.5V ~ 18V
- Feedback Reference Voltage:
FB Reference Voltage: 0.6V
FB Output Tolerance: $\pm 2\%$
- Adjustable Output Voltage Range:
0.6V ~ 6.0V
- Output Current: up to 2A
- 500kHz Constant Operating Frequency
- Typical 6.0µA Shutdown Current
- Fast Transient Response
- Stable Using Low ESR Ceramic Output Capacitors
- Multifunctional Comprehensive Protection:
 - Built-in HICCUP type Current Limiting
 - Output Short-circuit Protection
 - Input Undervoltage-lockout (UVLO)
 - Output Undervoltage Protection (UVP)
 - Output Overvoltage Protection (OVP)
 - Thermal Shutdown

4 Applications

- Distributed Power Systems
- Digital Set Top Boxes
- Flat Panel Television and Monitors
- Notebook Computer
- Wireless and DSL Modems



SOT-23-6L

5 Orderable Information

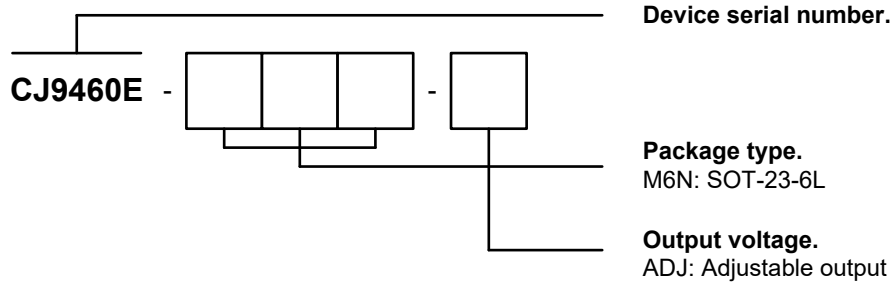


Figure 5-1. Naming Conventions

MODEL	DEVICE	PACKAGE	OP TEMP	ECO PLAN	MSL	PACKING OPTION	SORT
CJ9460E-ADJ	CJ9460E-M6N-ADJ	SOT-23-6L	-40 ~ 85°C	RoHS & Green	Level 3 168 HR	Tape and Reel 3000 Units / Reel	Active
Others	-	-	-	-	-	-	Customized

Note:

ECO PLAN: For the RoHS and Green certification standards of this product, please refer to the official report provided by JSCJ.

MSL: Moisture Sensitivity Level. Determined according to JEDEC industry standard classification.

SORT: Specifically defined as follows:

Active: Recommended for new products;

Customized: Products manufactured to meet the specific needs of customers;

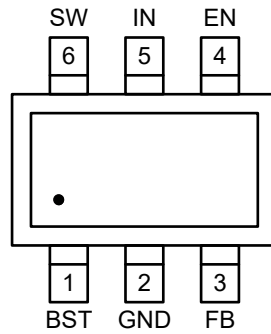
Preview: The device has been released and has not been fully mass produced. The sample may or may not be available;

NoRD: It is not recommended to use the device for new design. The device is only produced for the needs of existing customers;

Obsolete: The device has been discontinued.

6 Pin Configuration and Marking Information

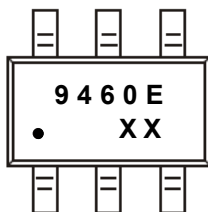
6.1 Pin Configuration and Function



CJ9460E-M6N-ADJ
SOT-23-6L

PIN NAME	I / O	CJ9460E Pin Function
		DESCRIPTION
BST	I	Bootstrap input to supply the high-side gate driver. A bootstrap capacitor 0.1μF is required between the BST and SW pins. The voltage on this capacitor supplies the gate driver of the high-side MOSFET.
GND	-	Ground pin.
FB	I	Feedback input. Inverting input of the transconductance error amplifier. Connect FB to the center point of the external resistor divider.
EN	I	Enable input pin. Drive this pin to a logic-high to enable the device, drive to a logic-low to disable the device and enter micropower shutdown mode. Don't float EN pin, if enable function is not used, connect EN to IN.
IN	I	Power supply. Use the recommended value of the input capacitor and place it as close to the IN and GND pins of the device as possible to help minimize the input impedance.
SW	O	Switching node output of the converter.

6.2 Marking Information



"CJ9460E": Device serial number.

"•" Solid dot: Anchor point.

"XX": Code, indicating weekly record information of production.

Figure 6-1. CJ9460E Marking Information

7 Specifications

7.1 Absolute Maximum Ratings

($T_A = 25^\circ\text{C}$, unless otherwise specified)⁽¹⁾

CHARACTERISTIC			SYMBOL	VALUE	UNIT
Input voltage range ⁽²⁾			V_{IN}	-0.3 ~ 20	V
Enable input voltage range ⁽²⁾			V_{EN}	-0.3 ~ 20	
SW voltage range ⁽²⁾			V_{SW}	-0.6 ~ ($V_{IN} + 0.3$)	
FB voltage range ⁽²⁾			V_{FB}	-0.3 ~ 4.0	
BS voltage range ⁽²⁾			V_{BS}	($V_{SW} - 0.3$) ~ ($V_{SW} + 4.0$)	
Maximum power dissipation	CJ9460E	SOT-23-6L	$P_{D\ Max}$	Internally Limited ⁽³⁾	W
Maximum junction temperature			$T_{J\ Max}$	150	$^\circ\text{C}$
Storage temperature			T_{stg}	-65 ~ 150	$^\circ\text{C}$
Soldering temperature & time			T_{solder}	260 $^\circ\text{C}$, 10s	-

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum rated conditions for extended periods may affect device reliability.

(2) All voltages are with respect to network ground terminal.

(3) Refer to *Thermal Information* for details.

7.2 Recommend Operating Conditions

PARAMETER	SYMBOL	MIN.	NOM.	MAX.	UNIT
Input voltage	V_{IN}	4.5	-	18	V
Operating junction temperature	T_J	-40	-	125	$^\circ\text{C}$
Operating ambient temperature ⁽⁴⁾	T_A	-40	-	85	$^\circ\text{C}$

(4) It is necessary to ensure that the operating junction temperature of the device does not exceed the rated value of the recommended operating conditions when using the device for design.

7 Specifications

7.3 ESD Ratings

ESD RATINGS		SYMBOL	VALUE	UNIT
Electrostatic discharge ⁽⁵⁾	Human body model	$V_{\text{ESD-HBM}}$	2000	V

(5) ESD testing is conducted in accordance with the relevant specifications formulated by the Joint Electronic Equipment Engineering Commission (JEDEC). The human body model (HBM) electrostatic discharge test is based on the JESD22-114D test standard, using a 100pF capacitor and discharging to each pin of the device through a resistance of 1.5kΩ.

7.4 Thermal Information

THERMAL METRIC ⁽⁶⁾		SYMBOL	CJ9460E	UNIT
			SOT-23-6L	
Thermal resistance	Junction-to-ambient	$R_{\theta\text{JA}}$	240.5	°C/W
	Junction-to-case	$R_{\theta\text{JC}}$	65.1	
Reference maximum power dissipation for continuous operation		$P_{\text{D Ref}}$	0.42	W

(6) Thermal metric is measured in still air with $T_A = 25^\circ\text{C}$ and installed on a 1 in² FR-4 board covered with 2 ounces of copper.

7 Specifications

7.5 Electrical Characteristics

CJ9460E ($V_{IN} = 12V$, $V_{OUT} = 3.3V$, $I_{LOAD} = 0mA$, $C_{IN} = 22\mu F$, $C_{BST} = 0.1\mu F$, $T_A = 25^\circ C$, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply Voltage (IN Pin)						
Input voltage	V_{IN}	-	4.5	-	18	V
Internal UVLO threshold	$V_{IN\ UVLO}$	V_{IN} rising	-	4.1	4.5	V
Internal UVLO hysteresis	$V_{IN\ UVLO\ HYS}$	-	-	0.35	-	V
Non-switching supply current	I_{OFF}	$V_{FB} = 1.5V$	-	200	320	μA
Shutdown supply current	I_{SHDN}	$EN = 0V$	-	6.0	10	μA
Enable (EN Pin)						
Enable rising threshold	$V_{EN\ High}$	-	1.50	1.53	-	V
Enable falling threshold	$V_{EN\ Low}$	-	-	1.37	1.45	V
Enable hysteresis	$V_{EN\ HYS}$	-	80	150	250	mV
Feedback Voltage (FB Pin)						
Regulated feedback voltage	V_{FB}	$T_A = -20$ to $85^\circ C$	0.588	0.600	0.612	V
Feedback supply current	I_{FB}	$V_{FB} = 0.7V$	-150	-	150	nA
Power MOSFETs						
High-side switch resistance ⁽⁷⁾	$R_{DS\ ON\ HS}$	-	-	140	-	m Ω
Low-side switch resistance ⁽⁷⁾	$R_{DS\ ON\ LS}$	-	-	90	-	m Ω
Switching (SW Pin)						
Switching frequency	F_{SW}	$I_{OUT} = 2A$	-	500	-	kHz
Zero crossing detection threshold	I_{ZCD}	$L = 4.7\mu H$	-	50	-	mA
Minimum on-time ⁽⁷⁾	T_{ON}	-	-	50	-	ns
Minimum off-time ⁽⁷⁾	T_{OFF}	-	-	180	-	ns
Current Limit						
Output current	I_{OUT}	$T_J = 25^\circ C$	2.0	-	-	A
Output current limit	$I_{OUT\ Limit}$	-	2.5	3.0	4.0	A
Hiccup wait time	-	-	-	31	-	Cycles
Hiccup time before restart	-	-	-	16	-	ms
Thermal Shutdown						
Thermal shutdown	T_{SD}	-	-	155	-	$^\circ C$
Thermal shutdown hysteresis	$T_{SD\ HYS}$	-	-	30	-	$^\circ C$
Soft Start						
Soft start time ⁽⁷⁾	t_{SS}	-	-	1.8	-	ms

Note:

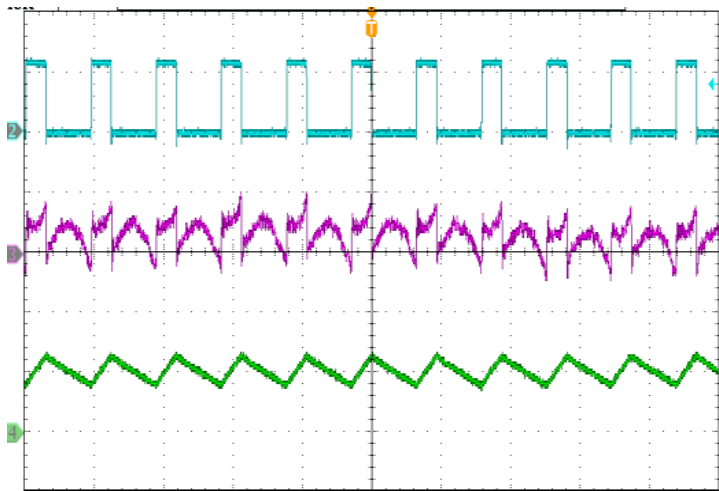
(7) Guaranteed by design, not subject to production.

7 Specifications

7.6 Typical Characteristics

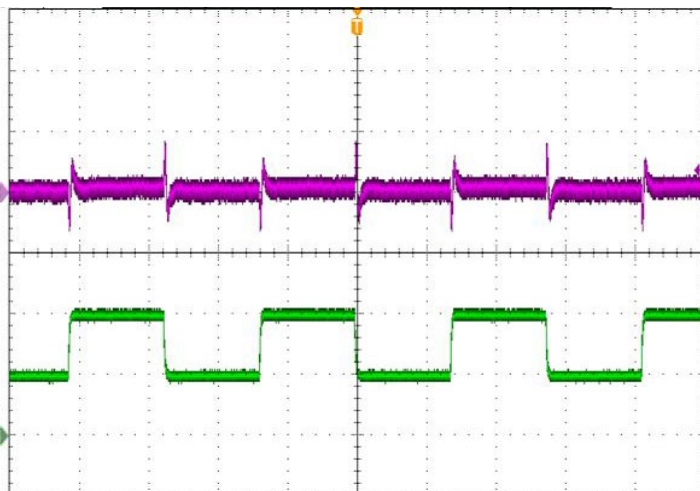
CJ9460E ($V_{IN} = 12V$, $V_{OUT} = 3.3V$, $L = 4.7\mu H$, $T_A = 25^\circ C$, unless otherwise specified)

Ripple ($I_{OUT} = 2A$)



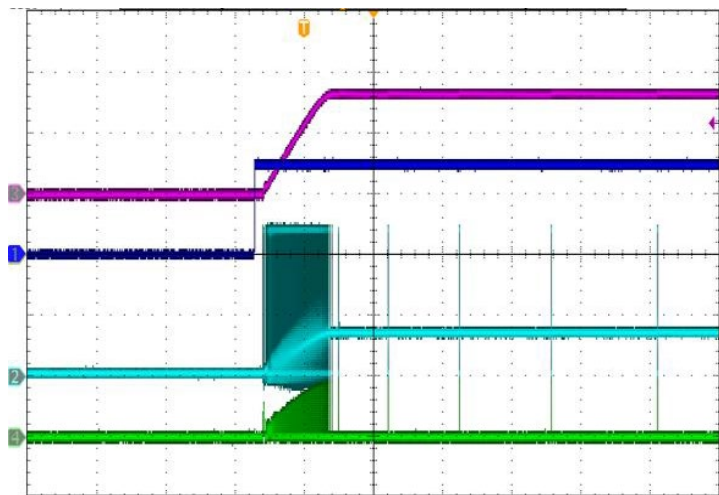
CH2: SW 10V/div, CH3: VOUT 10mV/div, CH4: ILOAD 2A/div

Load Transient ($I_{OUT} = 1 \sim 2A$)



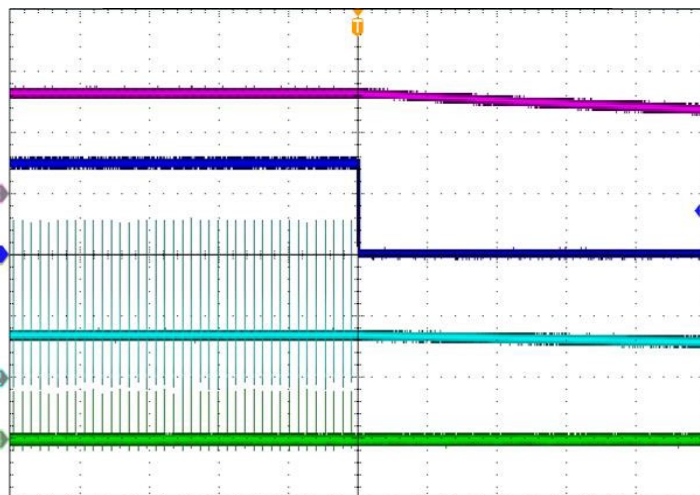
CH3: VOUT 10mV/div, CH4: ILOAD 2A/div

EN High ($I_{OUT} = 0mA$)

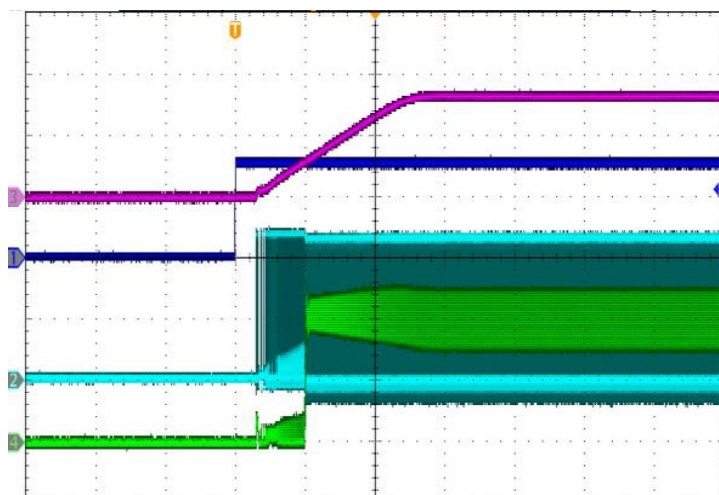


CH1: EN 2V/div, CH2: SW 10V/div, CH3: VOUT 2V/div, CH4: ILOAD 1A/div

EN Low ($I_{OUT} = 0mA$)

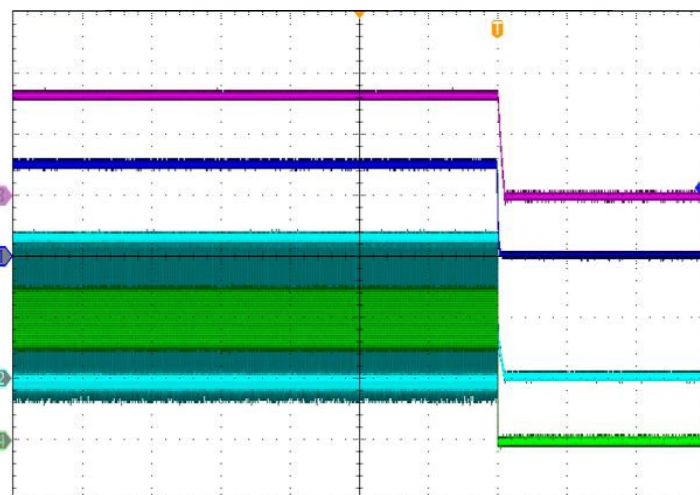


EN High ($I_{OUT} = 2A$)



CH1: EN 2V/div, CH2: SW 10V/div, CH3: VOUT 2V/div, CH4: ILOAD 1A/div

EN Low ($I_{OUT} = 2A$)

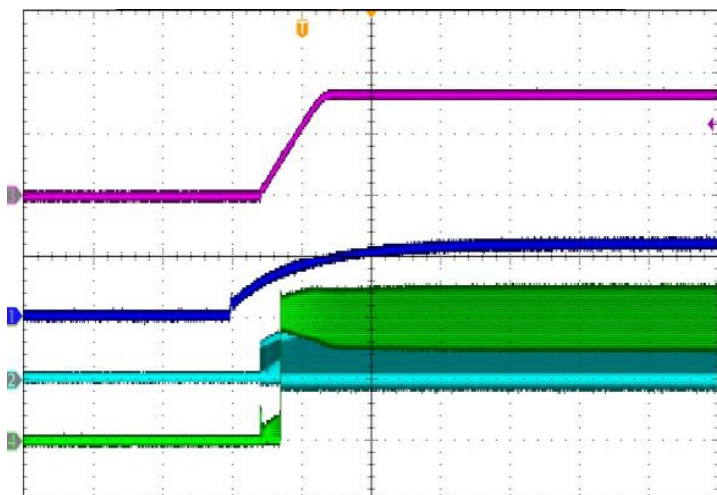


7 Specifications

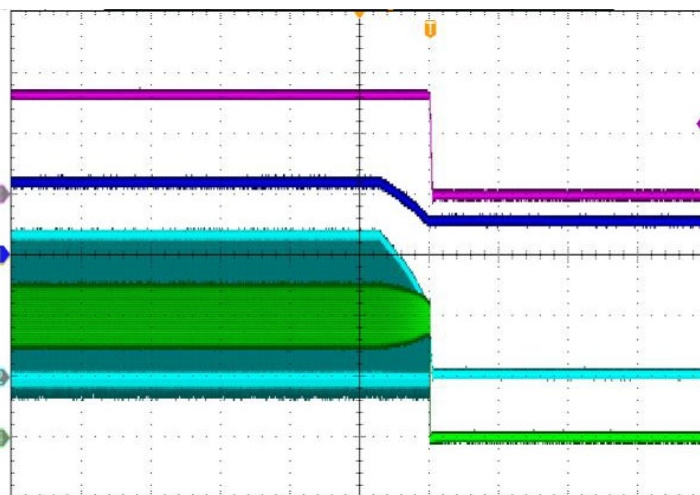
7.6 Typical Characteristics (continued)

CJ9460E ($V_{IN} = 12V$, $V_{OUT} = 3.3V$, $L = 4.7\mu H$, $T_A = 25^\circ C$, unless otherwise specified)

Start-up ($I_{OUT} = 2A$)

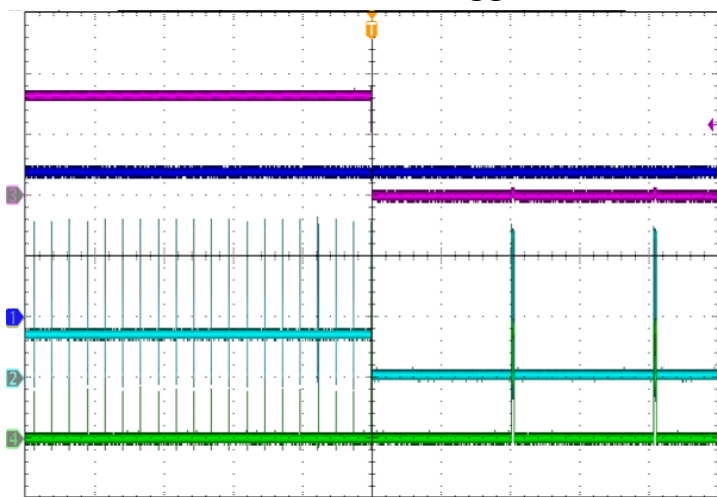


Shutdown ($I_{OUT} = 2A$)

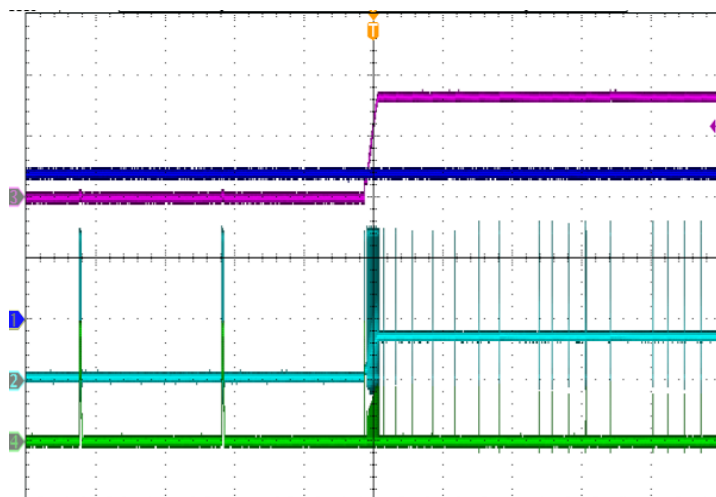


CH1: V_{IN} 10V/div, CH2: SW 10V/div, CH3: V_{OUT} 2V/div, CH4: I_{LOAD} 1A/div

Short Circuit Protection Triggered ($I_{OUT} = 0mA$)



Short Circuit Protection Released ($I_{OUT} = 0mA$)



CH1: V_{IN} 5V/div, CH2: SW 5V/div, CH3: V_{OUT} 2V/div, CH4: I_{LOAD} 1A/div

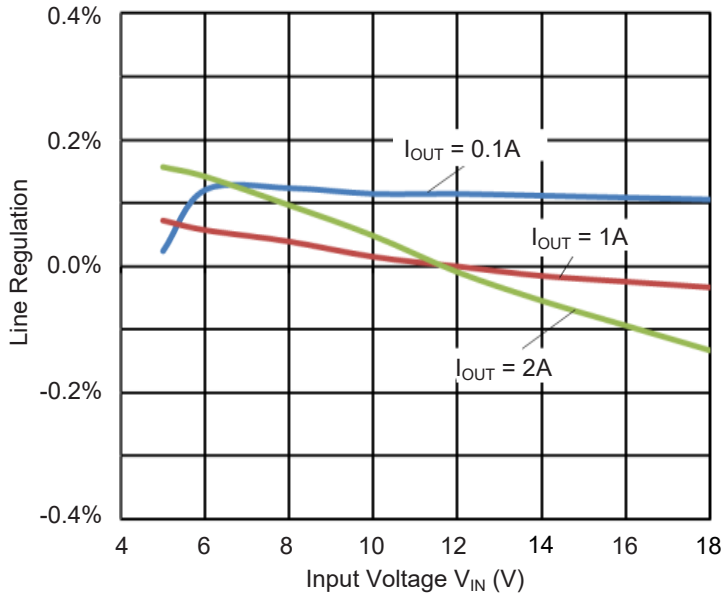
7 Specifications

7.6 Typical Characteristics (continued)

CJ9460E ($V_{IN} = 12V$, $V_{OUT} = 3.3V$, $L = 4.7\mu H$, $T_A = 25^\circ C$, unless otherwise specified)

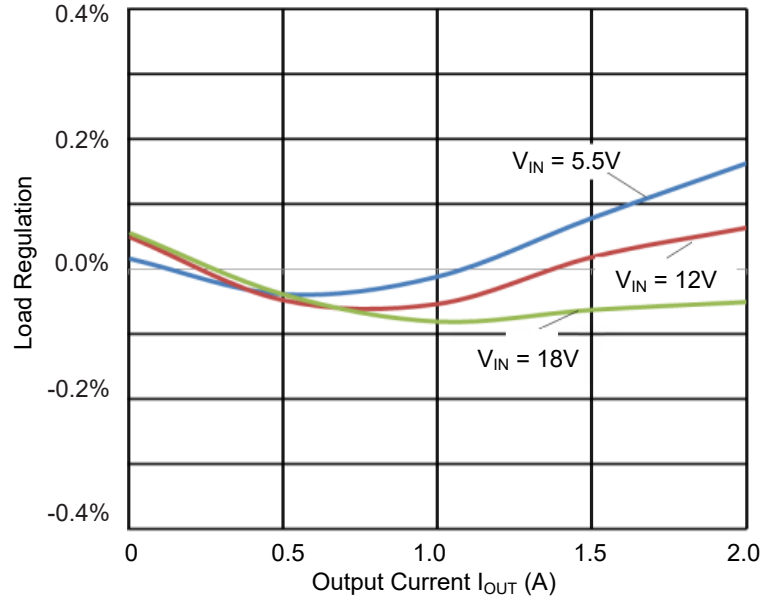
Line Regulation

($I_{OUT} = 0.1A, 1A, 2A$)



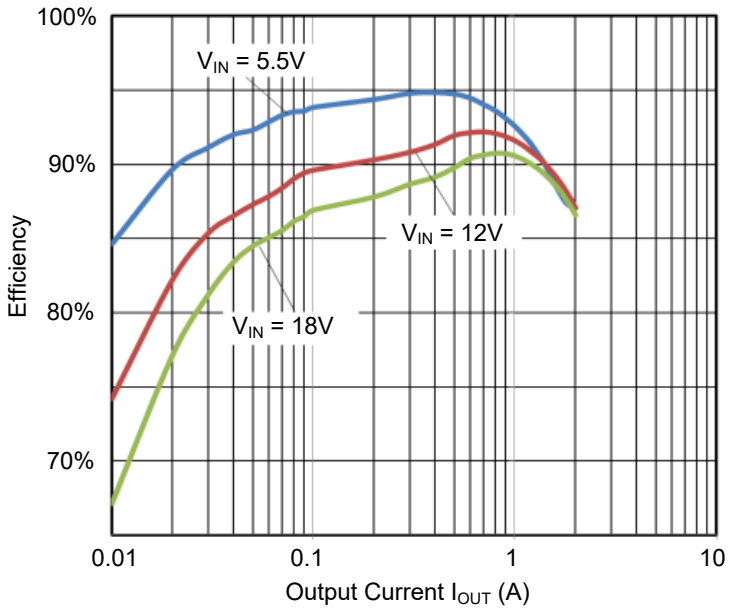
Load Regulation

($V_{IN} = 5.5V, 12V, 18V$)



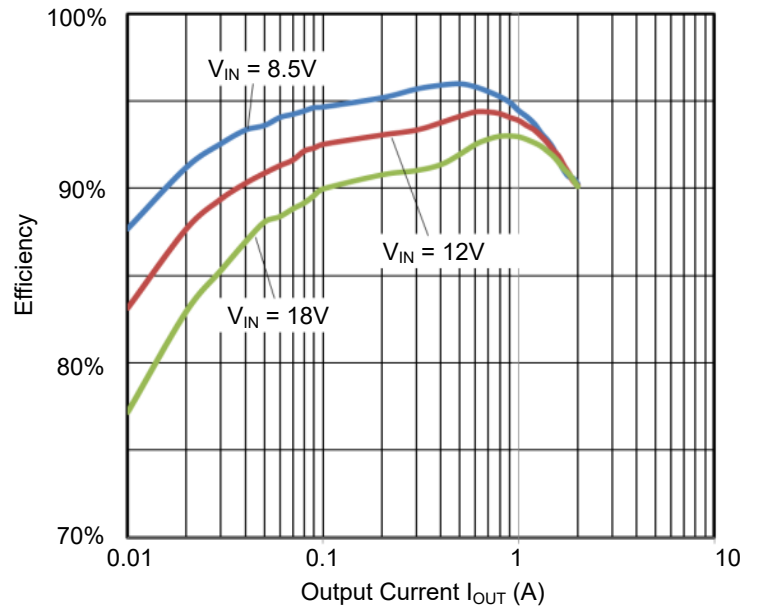
Efficiency

($V_{OUT} = 3.3V, L = 4.7\mu H$)



Efficiency

($V_{OUT} = 5.0V, L = 8.5\mu H$)



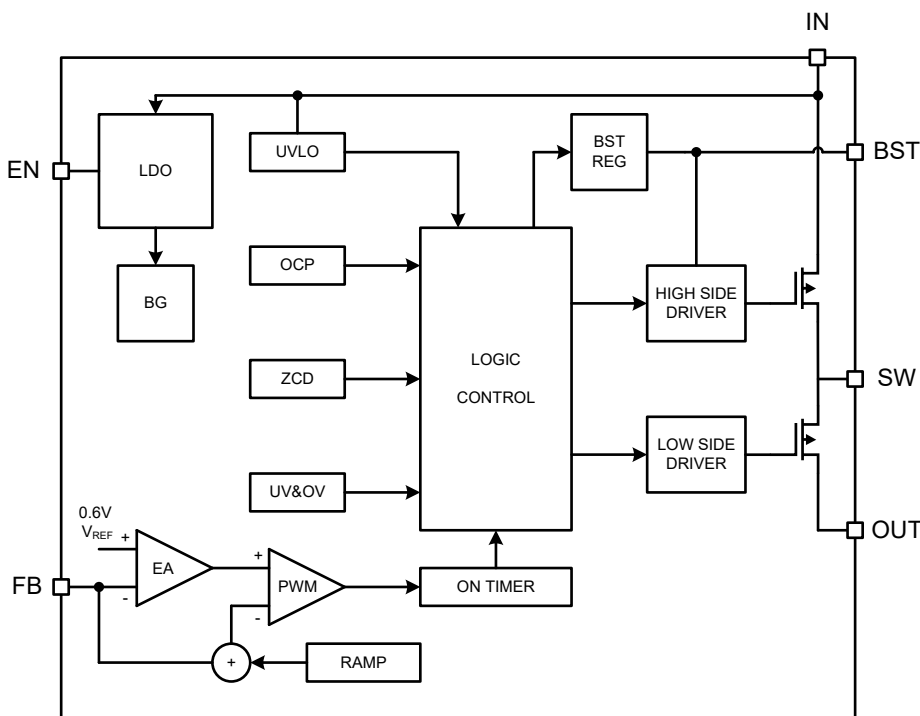
8 Detailed Description

8.1 Description

The CJ9460E is a synchronous rectification buck DC/DC converter with 4.5V to 18V input. The low conduction resistance power MOSFETs integrated internally reduce the energy loss generated during conversion, and the constant time conduction control mode can enable the device to have fast transient response.

The CJ9460E adopts an internal compensation circuit to simplify the peripheral application environment requirements, enabling the output capacitor with low ESR resistance to meet the peripheral application requirements of the device. The built-in current limiting protection, short circuit protection, and thermal shutdown protection of the device prevent damage caused by accidental increase in output current. In addition, the CJ9460E can operate in DCM mode, resulting in high conversion efficiency for device operation under both light and heavy load conditions.

8.2 Functional Block Diagram



8.3 Feature Description

Power Supply and Undervoltage Protection (IN Pin)

The power input pin IN of the CJ9460E is internally connected to the built-in linear voltage regulator (LDO) to supply power to the internal logic control circuit of the device and provide input voltage to the power MOSFETs circuit. The operating input voltage range is 4.5V to 18V. It is recommended to place an input capacitor C_{IN} between IN and GND and ensure that the position of the C_{IN} is as close as possible to the IN and GND pins.

When the input voltage on the IN pin drops below the threshold of $V_{IN\ UVLO}$, the device will be disabled until the input voltage rises again. The typical threshold value for initiating internal input undervoltage protection is 4.1V, and the hysteresis voltage is 350mV.

8 Detailed Description

8.3 Feature Description (continued)

Enable Control (EN Pin)

The CJ9460E has the enable control function, which can control the device on/off through the EN pin. When the input voltage of the EN pin is lower than the EN drop threshold $V_{EN\ Low}$, the device will be disabled and the power supply current of the device will be reduced to a very low level; When the input voltage of the EN pin is higher than the EN rise threshold $V_{EN\ High}$, the device will be enabled and operate normally. $V_{EN\ High}$ and $V_{EN\ Low}$ can be found in *Electrical Characteristics*. Don't float the EN pin. If the enable function is not needed, connect the EN to the IN.

Feedback and Output Voltage Setting (FB Pin)

The FB pin of CJ9460E is the input for feedback and differential remote detection amplifiers, used for output voltage regulation. The reference voltage V_{REF} is typically 0.6V, with an output tolerance range of $\pm 2\%$. During the startup or tracking process, the actual reference voltage set for the output may change.

Connecting the FB pin to the midpoint of the resistance divider can set the output voltage (as shown in the *Typical Application Circuit*). After determining the expected output voltage V_{OUT} , the values of R_2 (top resistance) and R_3 (bottom resistance) can be calculated using the following formula:

$$R_{TOP} = \left(\frac{V_{OUT}}{V_{REF}} - 1 \right) \times R_{BOTTOM}$$

When calculating the resistance value, the designer can first determine the resistance value of R_3 (bottom resistance), such as a 10k Ω resistor, and then determine the resistance value of R_2 (top resistance). R_2 should not choose a resistor that is too large (not exceeding 30k Ω , recommended to use a 15k Ω) because this may cause output errors due to FB bias current, making the device susceptible to noise coupling to FB input, causing adverse effects on the load adjustment rate and stability of the device.

The output voltage can be set within the range of 0.6V to 6.0V. It is recommended to use resistors with a tolerance of 1% or higher to achieve good output accuracy.

Conduction Mode (CCM & DCM)

The operating modes of CJ9460E include continuous conduction mode (CCM) and discontinuous conduction mode (DCM). In most load conditions, the device will operate in CCM. When under light load conditions, the device will switch to DCM, which can reduce energy loss and improve the efficiency of device operation under light load conditions.

The typical value of the zero crossing detection threshold I_{ZCD} for the CJ9460E is 50mA.

Output Overvoltage Protection (OVP)

The CJ9460E has an output overvoltage protection (OVP) function to avoid high overshoot of the output voltage during operation. Usually, the OVP occurs after the overload condition is eliminated. When the output voltage drops due to continuous overload, the error amplifier output reaches its maximum value and forces the converter to provide the maximum output current. After the overload condition is eliminated, the output of the regulator rises rapidly, because high inductor current will quickly charge the output capacitor, especially when the C_{OUT} is small. The error amplifier will respond and readjust itself, but it is not as fast as the output filter (LC) and may experience overshoot.

To minimize overshoot, the device monitors the FB pin voltage and compares it with the internal OVP threshold. If the threshold is exceeded, the high side MOSFET is turned off to stop feeding current to the output. When the FB voltage drops below the OVP threshold, the high side MOSFET can conduct again in the next cycle. The threshold voltage when CJ9460E enters in OVP mode is 120% of V_{REF} , and CJ9460E return to normal operation until the FB drop lower than 120% of V_{REF} .

8 Detailed Description

8.3 Feature Description (continued)

Output Undervoltage Protection (UVP)

The CJ9460E has an output undervoltage protection function to avoid damage to the equipment caused by the output voltage being lower than the rated working voltage during operation. Due to excessive current or power supply interruption, the device may experience output undervoltage. When the voltage at the FB end is detected to be lower than 80% of V_{REF} , the undervoltage protection circuit begins to operate, and the internal high and low sides will be simultaneously turned off. The output of the device will gradually decrease to 0V and enter the HICCUP mode. After an internal delay of 20ms, the device will release UVP and restart into normal working mode. At this point, if the output is still in an undervoltage state, the device will re-enter UVP.

Soft Start

The CJ9460E is designed with a soft start function. During the sudden turning on of the power supply, there may be significant surge currents and voltages, and soft starting can help mitigate their impact on the device. The soft start time is set to 1.8ms.

Bootstrap Voltage (BST Pin)

The CJ9460E has an integrated bootstrap voltage regulator, and needs to connect a 0.1 μ F ceramic capacitor between the BST and SW pins to provide gate drive voltage for the high side MOSFET. It is recommended to use ceramic capacitor with dielectric grade of X7R or X5R to ensure stable characteristics within the temperature and voltage range.

Current Limit and Short-circuit Protection

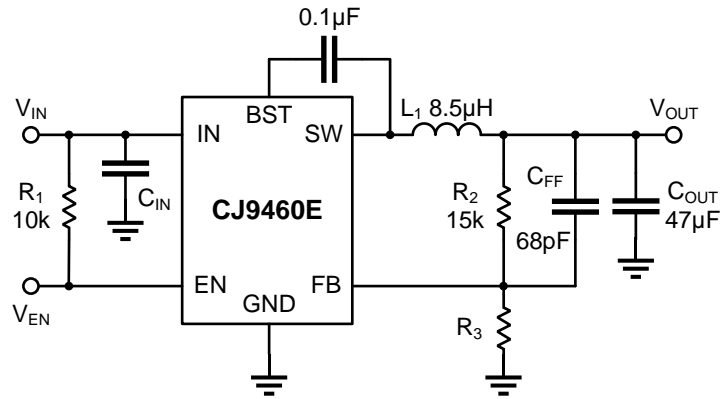
The CJ9460E has a current limiting function, which can put the device into an current limit protection state during accidental overload or short circuit to prevent device damage. When the output current exceeds the current limit threshold I_{Limit} for a period of time (typically 31 operating cycles), the internal current limiting circuit will simultaneously turn off both the high and low side of the power MOSFETs and enter the HICCUP mode. After a typical delay of 16ms, the current limiting state will be lifted and the device will resume normal operation. At this point, if the output current still exceeds I_{Limit} , the device will re-enter the current limiting state after the 31 operating cycles waiting time.

Thermal Shutdown

The CJ9460E has a thermal shutdown protection function. When the junction temperature T_J exceeds the thermal shutdown threshold temperature (T_{SD}), it will trigger the thermal shutdown protection. At this point, the output will be turned off to prevent catastrophic damage to the chip due to accidental heating. When T_J drops to a certain range of thermal shutdown threshold temperature ($T_{SD HYS}$), the thermal shutdown will be released and the device will return to normal operation. T_{SD} and $T_{SD HYS}$ can be found in *Electrical Characteristics*.

Although the internal protection circuit of the device is designed to prevent overall thermal conditions, it is not intended to replace appropriate power consumption. To ensure reliable operation, please limit the junction temperature to the specified range of *Recommended Operating Conditions* in the data sheet. Applications exceeding the recommended temperature range may result in device exceeding its operating specifications. Continuous operation of device until thermal shutdown or above the recommended operating T_J will reduce long-term reliability.

9 Typical Application Circuit



Typical Application Circuit

Recommended Design Parameters

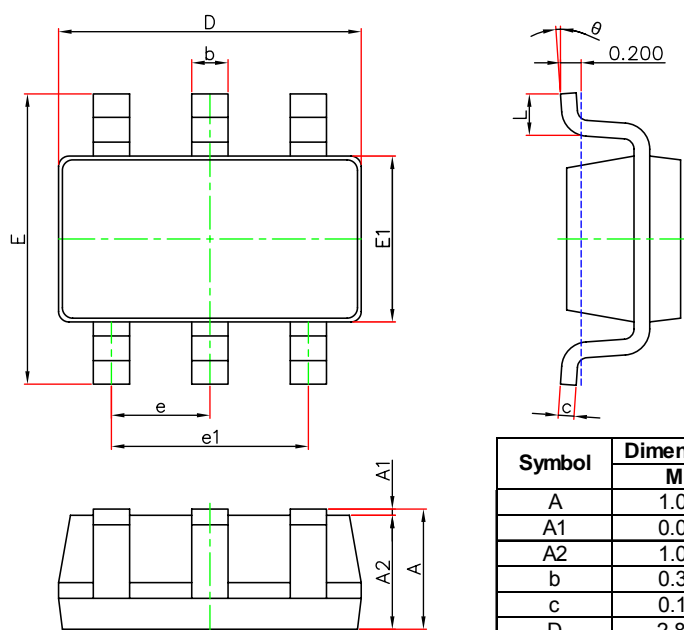
V _{OUT}	R ₂	R ₃	C _{FF}	L	C _{OUT}
1.2V	15kΩ	15kΩ	68pF	1.5µH	66µF
				2.2µH	47µF
2.5V	15kΩ	4.73kΩ	68pF	2.2µH	66µF
				3.3µH	47µF
3.3V	15kΩ	3.33kΩ	68pF	3.3µH	66µF
				4.7µH	47µF
5V	15kΩ	2.05kΩ	68pF	4.7µH	66µF
				8.5µH	47µF

NOTE

The application information in this section is not part of the data sheet component specification, and JSCJ makes no commitment or statement to guarantee its accuracy or completeness. Customers are responsible for determining the rationality of corresponding components in their circuit design and making tests and verifications to ensure the normal realization of their circuit design.

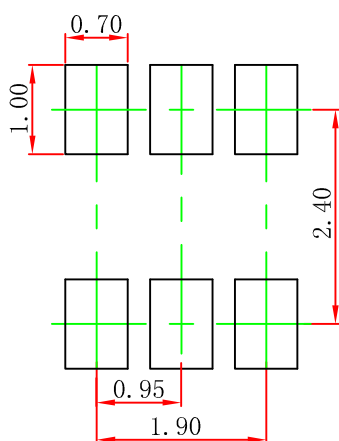
10 Mechanical Information

SOT-23-6L Package Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E1	1.500	1.700	0.059	0.067
E	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

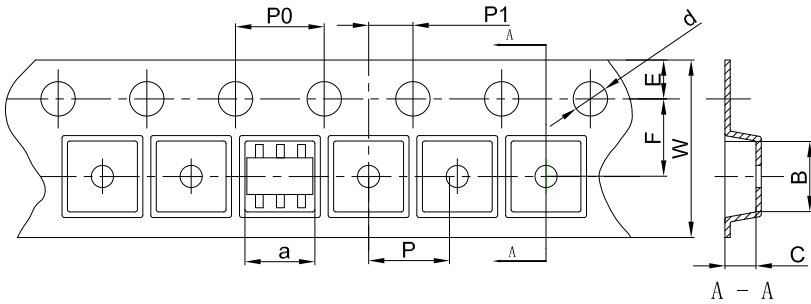
SOT-23-6L Suggested Pad Layout



11 Packaging Information

SOT-23-6L Tape and Reel Information

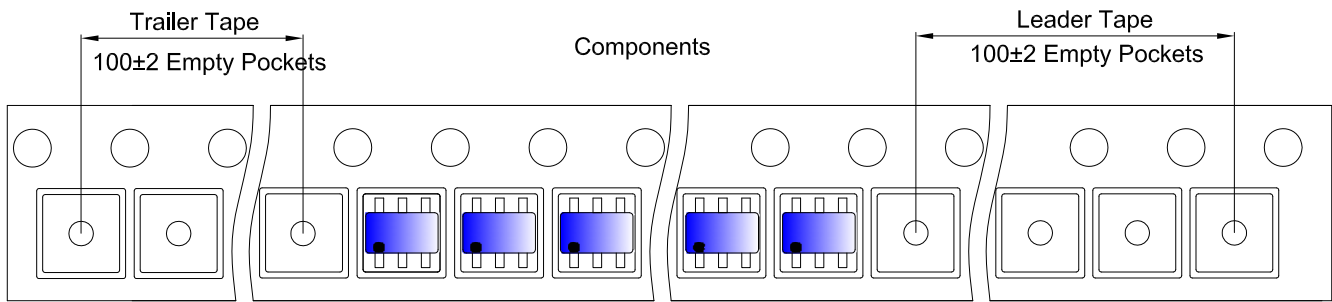
SOT-23-6L Embossed Carrier Tape



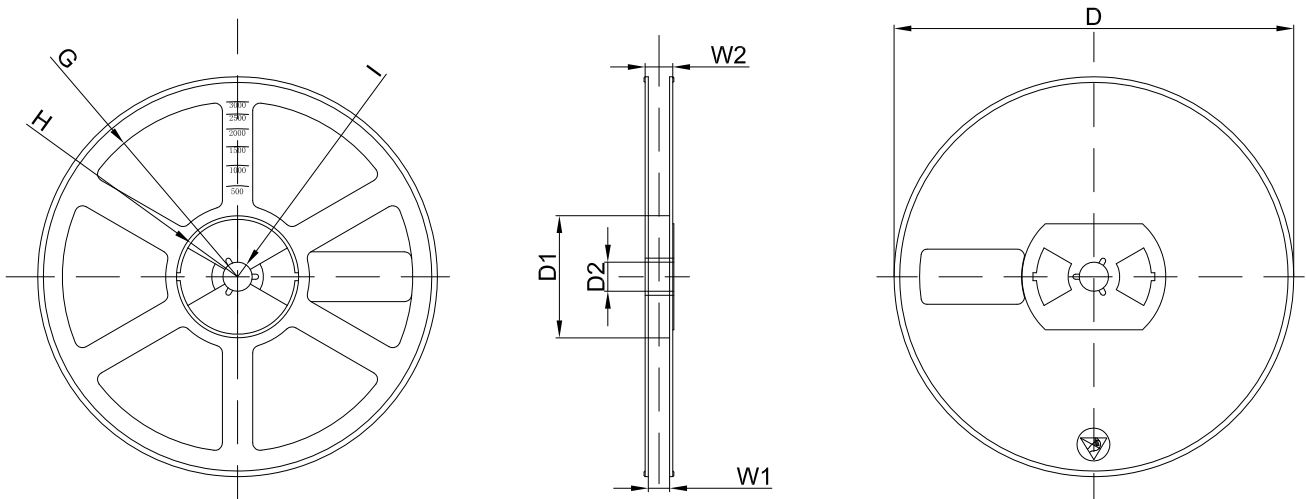
Packaging Description:
 SOT-23-6L parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 3,000 units per 7" or 18.0cm diameter reel. The reels are clear in color and is made of polystyrene plastic (anti-static coated).

Dimensions are in millimeter										
Pkg type	a	B	C	d	E	F	P0	P	P1	W
SOT-23-6L	3.23	3.17	1.37	Ø1.55	1.75	3.50	4.00	4.00	2.00	8.00

SOT-23-6L Tape Leader and Trailer



SOT-23-6L Reel



Dimensions are in millimeter								
Reel Option	D	D1	D2	G	H	I	W1	W2
7" Dia	Ø180.00	60.00	13.00	R78.00	R25.60	R6.50	9.50	13.10

REEL	Reel Size	Box	Box Size(mm)	Carton	Carton Size(mm)	G.W.(kg)
3000 pcs	7 inch	30,000 pcs	203×203×195	120,000 pcs	438×438×220	

12 Notes and Revision History

12.1 Associated Product Family and Others

To view other products of the same type or IC products of other types, click the official website of JSCJ -- <https://www.jscj-elec.com> for more details.

12.2 Notes

Electrostatic Discharge Caution



This IC may be damaged by ESD. Relevant personnel shall comply with correct installation and use specifications to avoid ESD damage to the IC. If appropriate measures are not taken to prevent ESD damage, the hazards caused by ESD include but are not limited to degradation of integrated circuit performance or complete damage of integrated circuit. For some precision integrated circuits, a very small parameter change may cause the whole device to be inconsistent with its published specifications.

12.3 Revision History

July, 2023: released CJ9460E rev - 1.0.

DISCLAIMER

IMPORTANT NOTICE, PLEASE READ CAREFULLY

The information in this data sheet is intended to describe the operation and characteristics of our products. JSCJ has the right to make any modification, enhancement, improvement, correction or other changes to any content in this data sheet, including but not limited to specification parameters, circuit design and application information, without prior notice.

Any person who purchases or uses JSCJ products for design shall: 1. Select products suitable for circuit application and design; 2. Design, verify and test the rationality of circuit design; 3. Procedures to ensure that the design complies with relevant laws and regulations and the requirements of such laws and regulations. JSCJ makes no warranty or representation as to the accuracy or completeness of the information contained in this data sheet and assumes no responsibility for the application or use of any of the products described in this data sheet.

Without the written consent of JSCJ, this product shall not be used in occasions requiring high quality or high reliability, including but not limited to the following occasions: medical equipment, military facilities and aerospace. JSCJ shall not be responsible for casualties or property losses caused by abnormal use or application of this product.

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