JW5062T/JW5062TF

18V/4A

Sync. Step-Down Converter

Preliminary Specifications Subject to Change without Notice

DESCRIPTION

The JW®5062T and JW®5062TF are monolithic buck switching regulator based on I2™ architecture for fast transient response. Operating with an input range of 4V~18V, JW5062T and JW5062TF deliver 4A of continuous output current with two integrated N-Channel MOSFETs. The internal synchronous power switches provide high efficiency without the use of an external Schottky diode. At light loads, JW5062T operates in low frequency to maintain high efficiency, while JW5062TF operates in continuous current mode for frequency sensitive application.

JW5062T and JW5062TF guarantee robustness with output short protection, thermal protection, current run-away protection, input under voltage lockout.

JW5062T is available in TSOT23-6 and TSOT23-8 package, and JW5062TF is available in TSOT23-6 package, which both provide a compact solution with minimal external components.

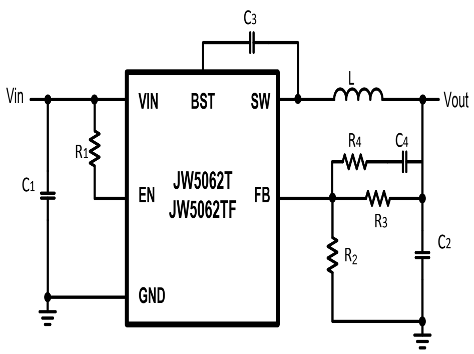
FEATURES

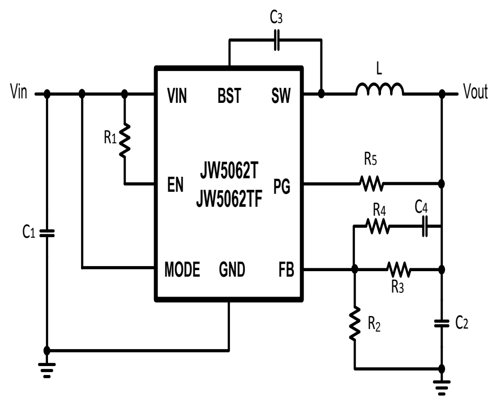
- 4V to 18V operating input range
  4A output current
- Up to 95% efficiency
- 600kHz switching frequency
- FCCM at light load (JW5062TF)
- PFM at light load (JW5062T)
- Internal soft-start
- Input under voltage lockout
- Current run-away protection
- Output short protection
- Thermal protection
- Available in TSOT23-6 and TSOT23-8 package

APPLICATIONS

- Distributed Power Systems
- Networking Systems
- FPGA, DSP, ASIC Power Supplies
- Green Electronics/ Appliances
- Notebook Computers

TYPICAL APPLICATION





ORDER INFORMATION

DEVICE[1]	PACKAGE	TOP MARKING[2]
JW5062TTSOTB#TRPBF	TSOT23-6	JW2C□ YW□□□
JW5062TTSOTC#TRPBF	TSOT23-8	JW2D□ YW□□□
JW5062TFTSOTB#TRPBF	TSOT23-6	JWDE□ YW□□□

Notes:

1) JW□ □# TRPBF
- PB Free
- Tape and Reel(If" TR" is not shown, it means tube)
- Package Code
- Part No.

2) Line1: JW□□□
- Internal control code
- Product code
- Joulwatt LOGO

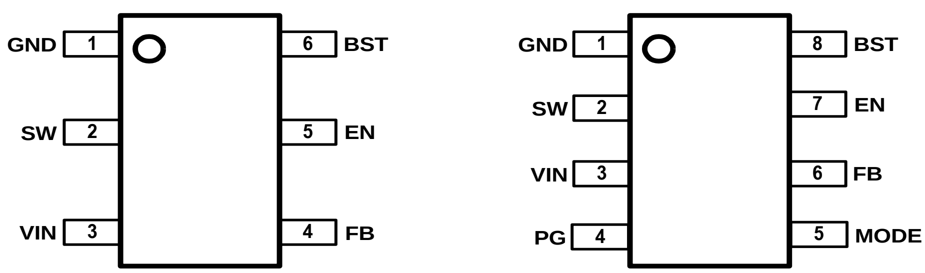
Line2: YW□□□
- Lot number
- Week code
- Year code

DEVICE INFORMATION

DEVICE[1]	Operation Mode at light load	Function	Package
JW5062TTSOTB#TRPBF	PFM	-	TSOT23-6
JW5062TTSOTC#TRPBF	PFM /FCCM Selectable	PG	TSOT23-8
JW5062TFTSOTB#TRPBF	FCCM	-	TSOT23-6

PIN CONFIGURATION

TOP VIEW



TSOT23-6 TSOT23-8

ABSOLUTE MAXIMUM RATING[1)]

VIN, EN, SW,MODE Pin …..-0.3V to 25V
BST Pin ....SW-0.3V to SW+5V
All other Pins ....-0.3V to 6V
Junction Temp. [2) 3)] 150ºC
Lead Temperature 260ºC
ESD Susceptibility (Human Body Model) 2kV

RECOMMENDED OPERATING CONDITIONS

Input Voltage VIN .... 4V to 18V
Output Voltage Vout ....0.765V to VIN-3V

THERMAL PERFORMANCE[4)] θ_{JA} θ_{Jc}

TSOT23-6...110....55ºC/W
TSOT23-8...110....55ºC/W

Note:

1) Exceeding these ratings may damage the device.

2) The JW5062T and JW5062TF guarantee robust performance from -40°C to 150°C junction temperature. The junction temperature range specification is assured by design, characterization and correlation with statistical process controls.

3) The JW5062T and JW5062TF includes thermal protection that is intended to protect the device in overload conditions. Thermal protection is active when junction temperature exceeds the maximum operating junction temperature. Continuous operation over the specified absolute maximum operating junction temperature may damage the device.

4) Measured on JESD51-7, 4-layer PCB.

ELECTRICAL CHARACTERISTICS

VIN=12V, T_A=25℃, Unless otherwise stated.

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
V_{IN} Under Voltage Lock-out Threshold	V_{IN_MIN}	V_{IN} rising			3.8	V
V_{IN} Under Voltage Lock-out Threshold	V_{IN_L}	Vin falling	3			V
V_{IN} Under voltage Lockout Hysteresis[5)]	$V_{IN\_MIN\_HYST}$			200		mV
Shutdown Supply Current	I_{SD}	V_{EN}=0V			1	μA
Supply Current	I_Q	V_{EN}=5V, V_{FB}=1.2V		260	385	μA
Feedback Voltage	V_{FB}	4V<V_{VIN}<18V	750	765	780	mV
Top Switch Resistance[5)]	$R_{DS(ON)T}$			49		mΩ
Bottom Switch Resistance[5)]	$R_{DS(ON)B}$			20		mΩ
Top Switch Leakage Current	I_{LEAK_TOP}	V_{IN}=18V, V_{EN}=0V, V_{SW}=0V			1	μA
Bottom Switch Leakage Current	I_{LEAK_BOT}	V_{IN}=18, V_{EN}=0V, V_{SW}=18V			1	μA
Top Switch Current Limit	I_{LIM_TOP}			6.5		A
Bottom Switch Current Limit	I_{LIM_BOT}		4	4.5	5	A
Switch Frequency[5)]	F_{SW}		480	600	720	kHz
Minimum On Time[5)]	T_{ON_MIN}			120		ns
Minimum Off Time[5)]	T_{OFF_MIN}	V_{FB}=0.4V		100		ns
EN Rising threshold	V_{EN_H}	V_{EN} rising			2.2	V
EN Falling threshold	V_{EN_L}	V_{EN} falling	1.7			V
EN Hysteresis[5)]	V_{EN_HYS}	V_{EN} Hysteresis		150		mV
Soft-Start Period[5)]	t_{SS}			1.6		ms
Power good lower threshold	$PGD_{\_LTH}$	FB falling		88%		Vref
Power good upper threshold	$PGD_{\_UTH}$	FB rising		112%		Vref
Power good delay[5)]	$PGD_{\_DLY}$	PG from low to high		416		μs
Thermal Shutdown[5)]	T_{TSD}			170		°C
Thermal Shutdown hysteresis[5)]	T_{TSD_HYST}			20		°C

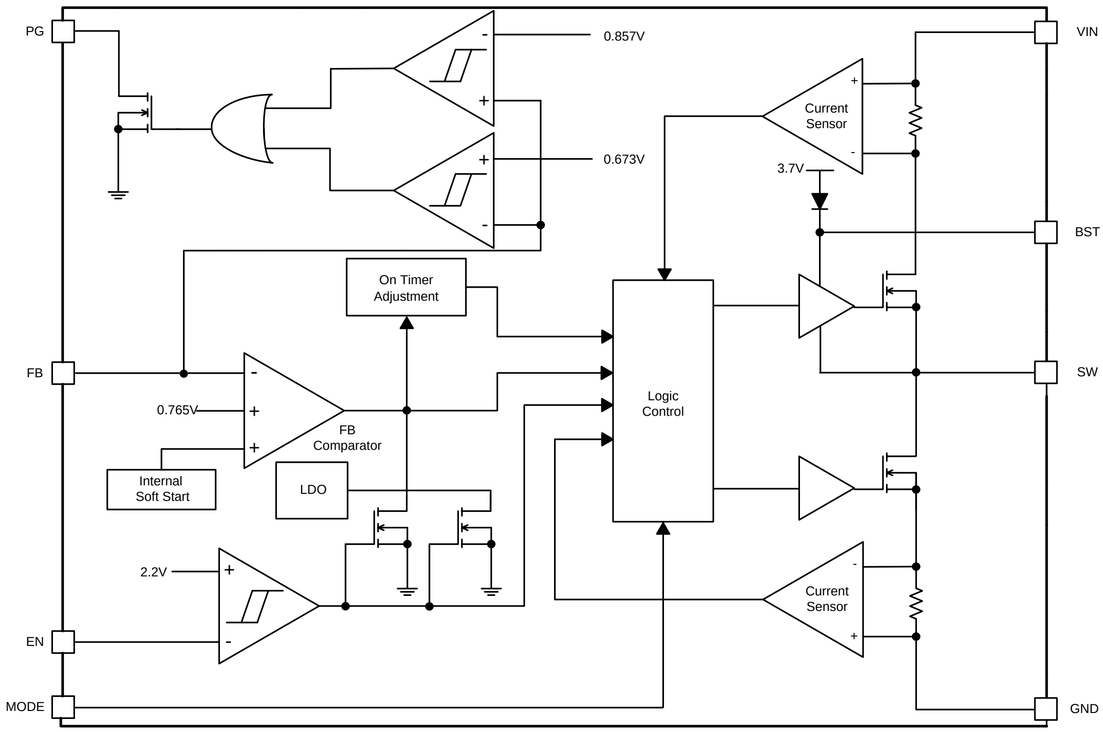
Note:

5) Guaranteed by design.

PIN DESCRIPTION

Pin		Name	Description
TSOT23-6	TSOT23-8		
1	1	GND	Ground pin.
2	2	SW	SW is the switching node that supplies power to the output. Connect the output LC filter from SW to the output load.
3	3	VIN	Input voltage pin. VIN supplies power to the IC. Connect a 4V to 18V supply to VIN and bypass VIN to GND with a suitably large capacitor to eliminate noise on the input to the IC.
4	6	FB	Output feedback pin. FB senses the output voltage and is regulated by the control loop to 0.765V. Connect a resistive divider at FB.
5	7	EN	Drive EN pin high to turn on the regulator and low to turn off the regulator.
6	8	BST	Connect a 0.1uF capacitor between BST and SW pin to supply current for the top switch driver.
	4	PG	Power good monitor output. This is an open-drain output so a 30kΩ to 100kΩ resistor should be connected at this pin to Vout.
	5	MODE	Pull MODE pin low to GND or floating to achieve FCC operation. Pull MODE up to VIN to achieve PFM operation.

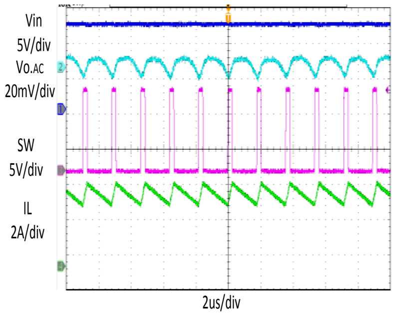
BLOCK DIAGRAM



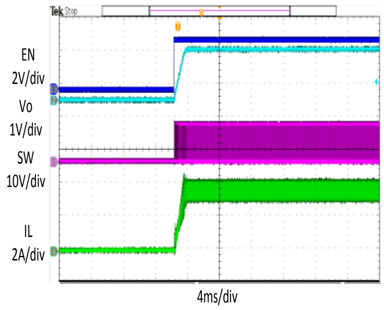
TYPICAL PERFORMANCE CHARACTERISTICS

Vin =12V, Vout = 1.5V, L = 2.2μH, Cout = 44μF, TA = +25°C, unless otherwise noted

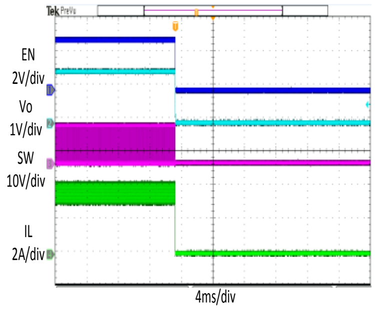
Steady State Test
VIN=12V, Vout=1.5V
Iout=4A



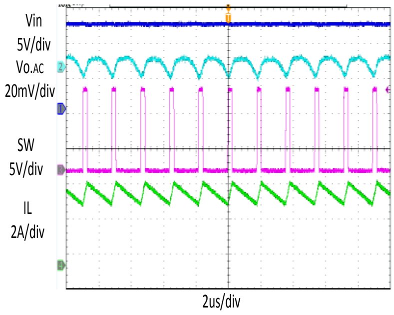
Startup through Enable
VIN=12V, Vout=1.5V
Iout=4A(Resistive load)



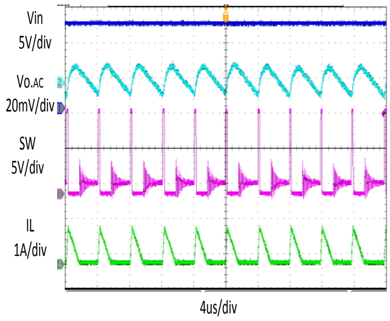
Shutdown through Enable
VIN=12V, Vout=1.5V
Iout=4A (Resistive load)



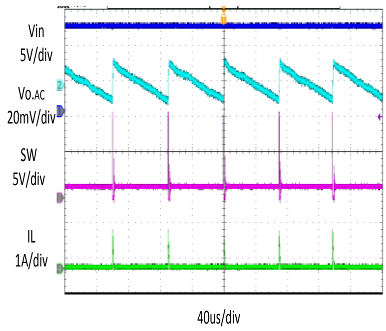
Heavy Load Operation
4A LOAD



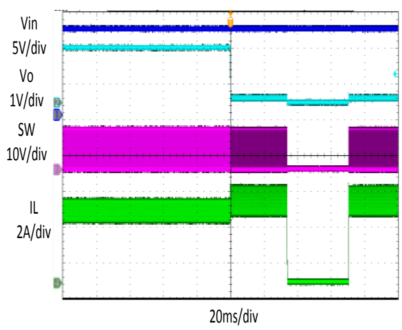
Medium Load Operation
0.2A LOAD



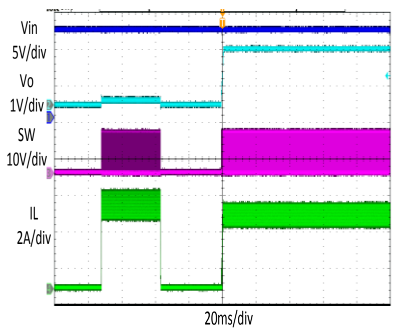
Light Load Operation
0 A LOAD



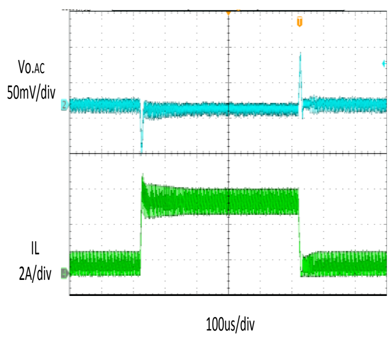
Short Circuit Protection
VIN=12V, Vout=1.5V
Iout=4A- Short



Short Circuit Recovery
VIN=12V, Vout=1.5V
Iout= Short-4A



Load Transient
0.4A LOAD → 4A LOAD → 0.4A LOAD



TYPICAL PERFORMANCE CHARACTERISTICS

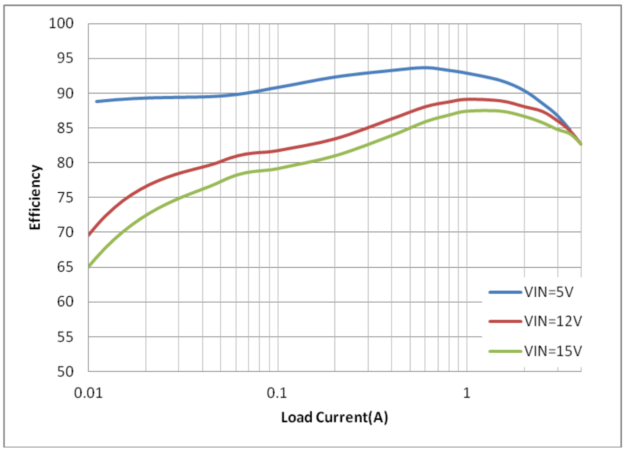


Figure 1. Efficiency vs. Load Current

(Vout=1.5V, L=2.2uH)

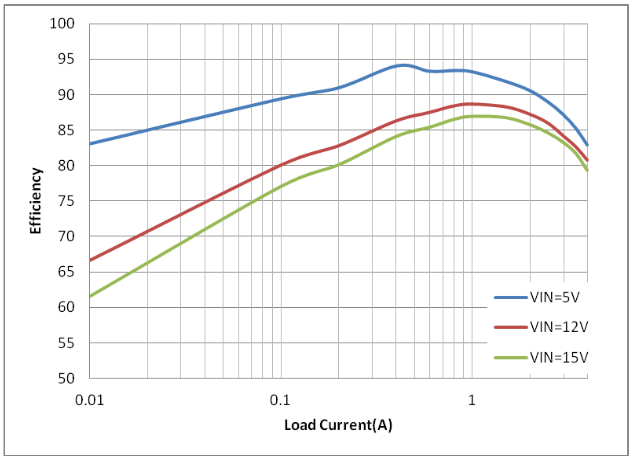


Figure 2. Efficiency vs. Load Current

(Vout=1.8V, L=2.2uH)

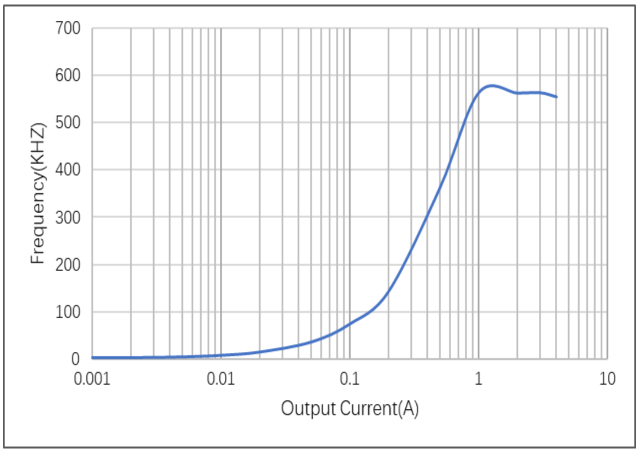


Figure 3. Frequency vs. Output Current

(Vin=12V, Vo=3.3V, L=2.2uH)

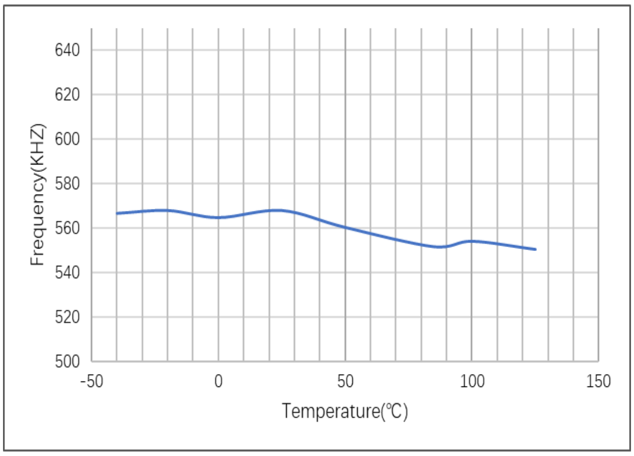


Figure 4. Frequency VS Temperature

(Vin=12V, Vo=3.3V, L=2.2uH)

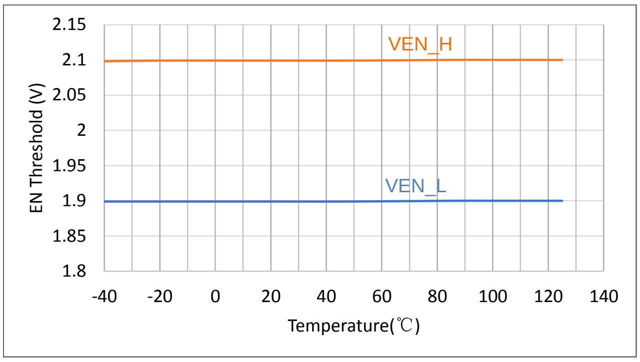


Figure 5. EN Threshold vs. Temperature

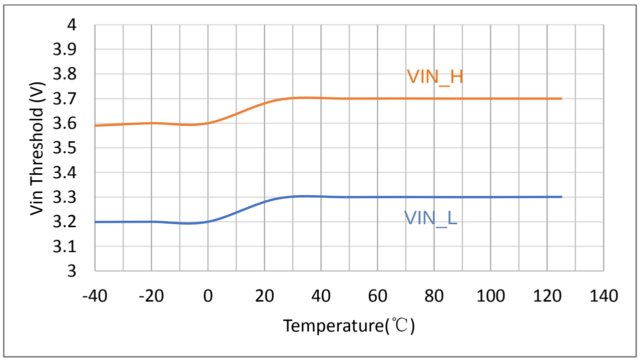


Figure 6. Vin Threshold vs. Temperature

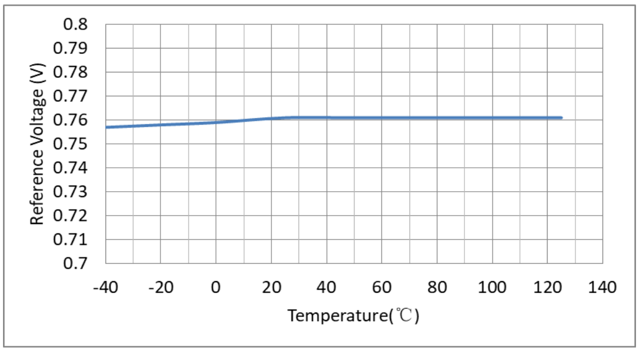


Figure 7. Reference Voltage vs. Temperature

FUNCTIONAL DESCRIPTION

JW5062T and JW5062TF are synchronous step-down regulators based on I2™ control architecture. It regulates input voltages from 4V to 18V down to an output voltage as low as 0.765V, and is capable of supplying up to 4A of load current.

Shut-Down Mode

The regulator shuts down when voltage at EN pin is driven below 0.3V. The entire regulator is off and the supply current consumed by JW5062T or JW5062TF drop below 1uA.

Power Switch

N-Channel MOSFET switches are integrated on the JW5062T and JW5062TF to down convert the input voltage to the regulated output voltage. Since the top MOSFET needs a gate voltage greater than the input voltage, a boost capacitor connected between BST and SW pins is required to drive the gate of the top switch. The boost capacitor is charged by the internal 3.7V rail when SW is low.

Vin Under-Voltage Protection

A resistive divider can be connected between Vin and ground, with the central tap connected to EN, so that when Vin drops to the pre-set value, EN drops below 1.7V to trigger input under voltage lockout protection.

Output Current Run-Away Protection

At start-up, due to the high voltage at input and low voltage at output, current inertia of the output inductor can be easily built up, resulting in a large start-up output current. A valley current limit is designed in JW5062T and JW5062TF so that only when output current drops below the valley current limit can the top power switch be turned on. By such control mechanism, the output current at start-up is well controlled.

Output Short Protection

When the output is shorted to ground, the regulator is allowed to switch for 1024 cycles. If the short condition is cleared within this period, then the regulator resumes normal operation. If the short condition is still present after 1024 switching cycles, then no switching is allowed and the regulator enters hiccup mode for 2048 cycles. After the 2048 hiccup cycles, the regulator will try to start-up again. If the short condition still exists after 1024 cycles of switching, the regulator enters hiccup mode. This process of start-up and hiccup iterate itself until the short condition is removed.

Thermal Protection

When the temperature of the device rises above 170°C, it is forced into thermal shut-down. Only when core temperature drops below 150°C can the regulator becomes active again.

Power Good

The JW5062T has power-good (PG) output. The PG pin is the open drain of a MOSFET. Connect to a voltage source (such as Vout) through a resistor. When the output voltage becomes within +-12% of the target value, internal comparators detect power good state and the power good signal becomes high. If the feedback voltage goes under or higher 12% of the target value, the power good signal becomes low.

APPLICATION INFORMATION

Output Voltage Set

The output voltage is determined by the resistor divider connected at the FB pin, and the voltage ratio is:

$$V_{FB} = V_{out} \cdot \frac{R_2}{R_2+R_3}$$

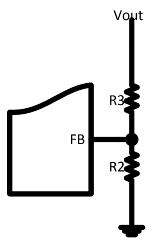
where V_{FB} is the feedback voltage and V_{OUT} is the output voltage.

Choose R_2 around 16kΩ, and then R_3 can be calculated by:

$$R_3 = R_2 \cdot \left(\frac{V_{out}}{0.765} - 1\right)$$

Too large resistance and the following table lists the recommended values.

VOUT(V)	R2(kΩ)	R3(kΩ)
1	13.3	4.02
1.2	28	16
1.5	16	15.4
2.5	20.5	46.4
3.3	16	53.1
5	16	88.7



Input Capacitor

The input capacitor is used to supply the AC input current to the step-down converter and maintaining the DC input voltage. The ripple current through the input capacitor can be calculated by:

$$I_{C1} = I_{LOAD} \cdot \sqrt{\frac{V_{OUT}}{V_{IN}} \cdot \left(1 - \frac{V_{OUT}}{V_{IN}}\right)}$$

where I_{LOAD} is the load current, V_{OUT} is the output voltage, V_{IN} is the input voltage.

Thus the input capacitor can be calculated by the following equation when the input ripple voltage is determined.

$$C_1 = \frac{I_{LOAD}}{f_S \cdot \Delta V_{IN}} \cdot \frac{V_{OUT}}{V_{IN}} \cdot \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

where C_1 is the input capacitance value, f_S is the switching frequency, $\triangle V_{IN}$ is the input ripple voltage.

The input capacitor can be electrolytic, tantalum or ceramic. To minimizing the potential noise, a small X5R or X7R ceramic capacitor, i.e. 0.1uF, should be placed as close to the IC as possible when using electrolytic capacitors.

A 22uF~44uF/25V ceramic capacitor is recommended in typical application.

Output Capacitor

The output capacitor is required to maintain the DC output voltage, and the capacitance value determines the output ripple voltage. The output voltage ripple can be calculated by:

$$\Delta V_{OUT} = \frac{V_{OUT}}{f_S \cdot L} \cdot \left(1 - \frac{V_{OUT}}{V_{IN}}\right) \cdot \left(R_{ESR} + \frac{1}{8 \cdot f_S \cdot C_2}\right)$$

where C_2 is the output capacitance value and R_{ESR} is the equivalent series resistance value of the output capacitor.

The output capacitor can be low ESR electrolytic, tantalum or ceramic, which lower ESR capacitors get lower output ripple voltage.

The output capacitors also affect the system stability and transient response, and a

44uF~66uF ceramic capacitor is recommended in typical application.

Inductor

The inductor is used to supply constant current to the output load, and the value determines the ripple current which affect the efficiency and the output voltage ripple. The ripple current is typically allowed to be 40% of the maximum switch current limit, thus the inductance value can be calculated by:

$$L = \frac{V_{OUT}}{f_S \cdot \Delta I_L} \cdot \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

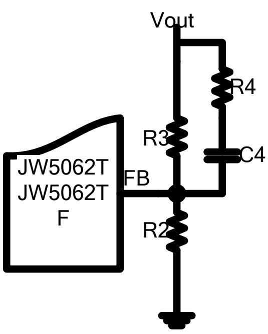
where V_{IN} is the input voltage, V_{OUT} is the output voltage, f_S is the switching frequency, and $\triangle I_L$ is the peak-to-peak inductor ripple current.

External Bootstrap Capacitor

A bootstrap capacitor is required to supply voltage to the top switch driver. A 0.1uF low ESR ceramic capacitor is recommended to connected to the BST pin and SW pin.

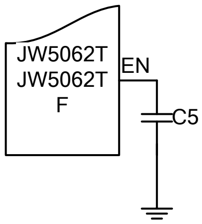
Feedforward Capacitor

In order to minimize the ripple of output voltage at light load, a feedforward capacitor in series with a resistor should be in parallel to the upper divider resistor. Choose R4 around 1kΩ and C4 around 180pF.



Start up through EN

If JW5062T start up through EN, a 10nF or larger capacitor is recommended to be connected between EN pin and GND to eliminate noise.



PCB Layout Note

For minimum noise problem and best operating performance, the PCB is preferred to following the guidelines as reference.

1. Place the input decoupling capacitor as close to JW5062T (VIN pin and PGND) as possible to eliminate noise at the input pin. The loop area formed by input capacitor and GND must be minimized.
2. Put the feedback trace as far away from the inductor and noisy power traces as possible.
3. The ground plane on the PCB should be as large as possible for better heat dissipation.

TSOT23-6:

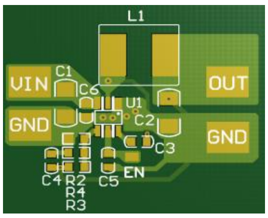


Figure1. TSOT23-6 PCB Layout Recommendation

TSOT23-8

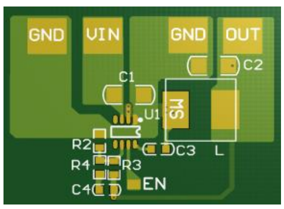
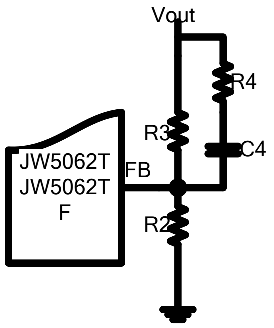


Figure2. TSOT23-8 PCB Layout Recommendation

External Components Suggestion:

VOUT(V)	R2 (kΩ)	R3 (kΩ)	R4 (kΩ)	C4 (pF)	L (uH)	Cout (uF)
1	13.3	4.02	1	51	1.5~2.2	54~66
1.2	28	16	1	51	1.5~2.2	54~66
1.5	12	11.2	1	51	2.2~3.3	44~66
2.5	20.5	46.4	1	51	2.2~3.3	44~66
3.3	16	53.1	1	51	2.2~4.7	44~66
5	16	88.7	1	51	3.3~4.7	44~66



REFERENCE DESIGN

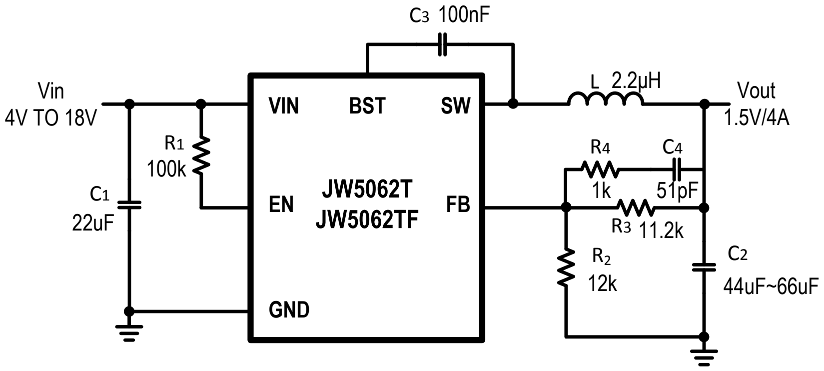
Reference 1:

Vin : 4V~18V

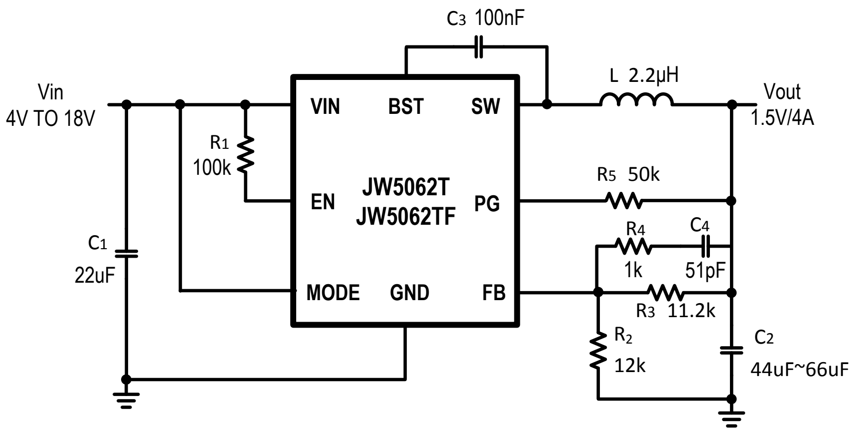
Vout: 1.5V

Iout : 0~4A

TSOT23-6:



TSOT23-8:



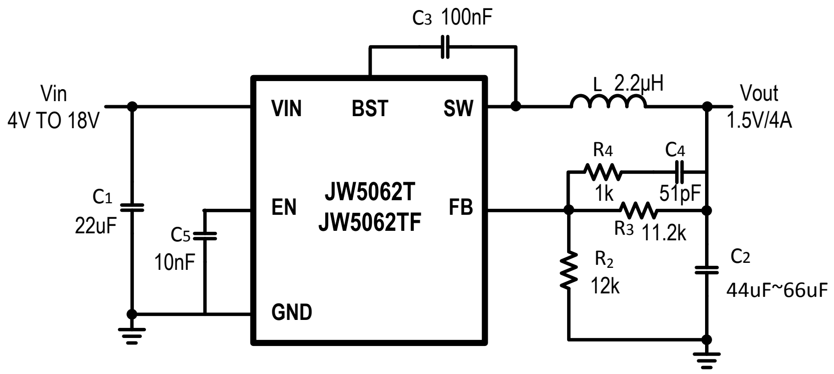
Start up Through EN

Vin : 4V~18V

Vout: 1.5V

Iout : 0~4A

TSOT23-6:



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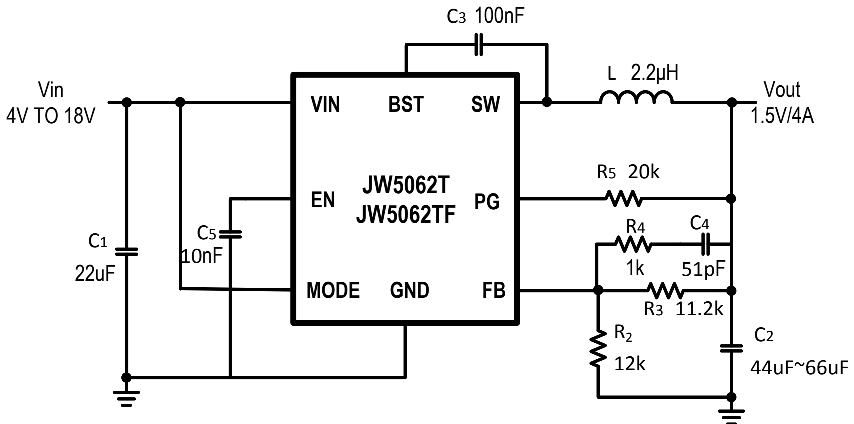
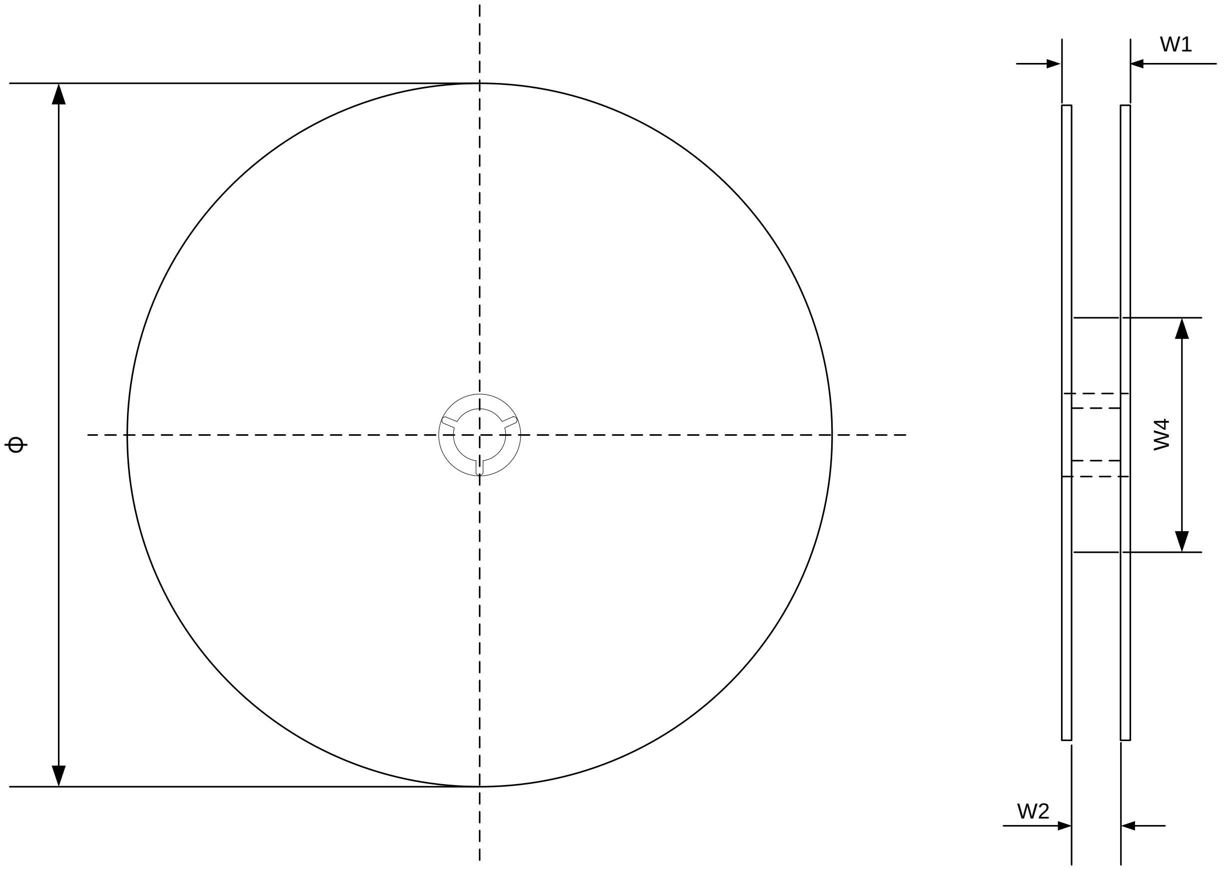


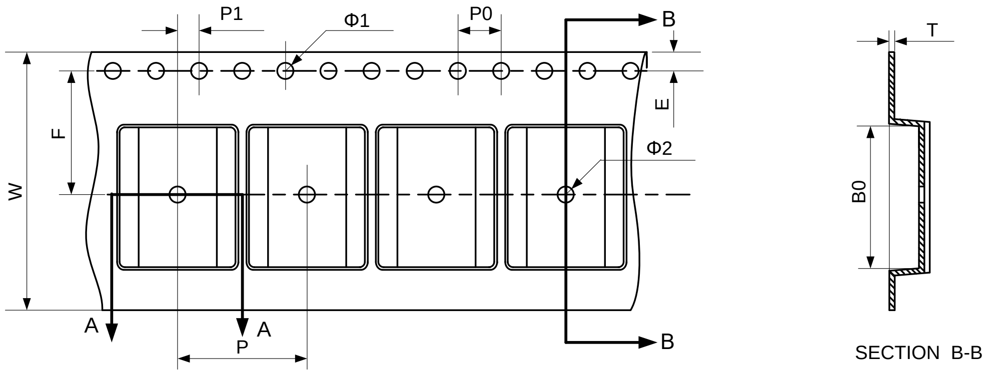
TAPE AND REEL INFORMATION

Reel UNIT: mm

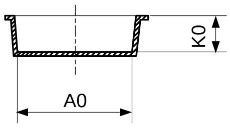


Package	Diameter Φ	Thickness W1	Width W2	W4
TSOT23-6(8)	178±2	12.30±2	9.5±2	60±2

Carrier Tape



SECTION B-B



SECTION A-A

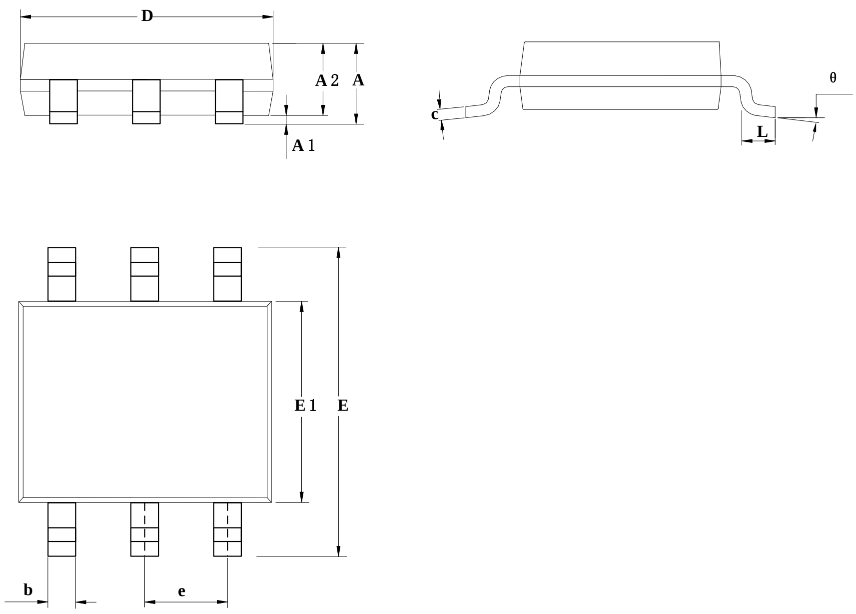
Note :

1) The carrier type is black, and colorless transparent.
2) Carrier camber is within 1mm in 100mm.
3) 10 pocket hole pitch cumulative tolerance:±0.20.
4) All dimensions are in mm.

Package	P0	P1	P	A0	B0	W	T	K0	Φ1	Φ2	E	F
TSOT23-6(8)	4.0±0.1	2.0±0.1	4.0±0.1	3.17±0.20	3.10±0.2	8.0±0.3	0.25±0.2	1.10±0.20	1.50min	1.00min	1.75±0.1	3.50±0.1

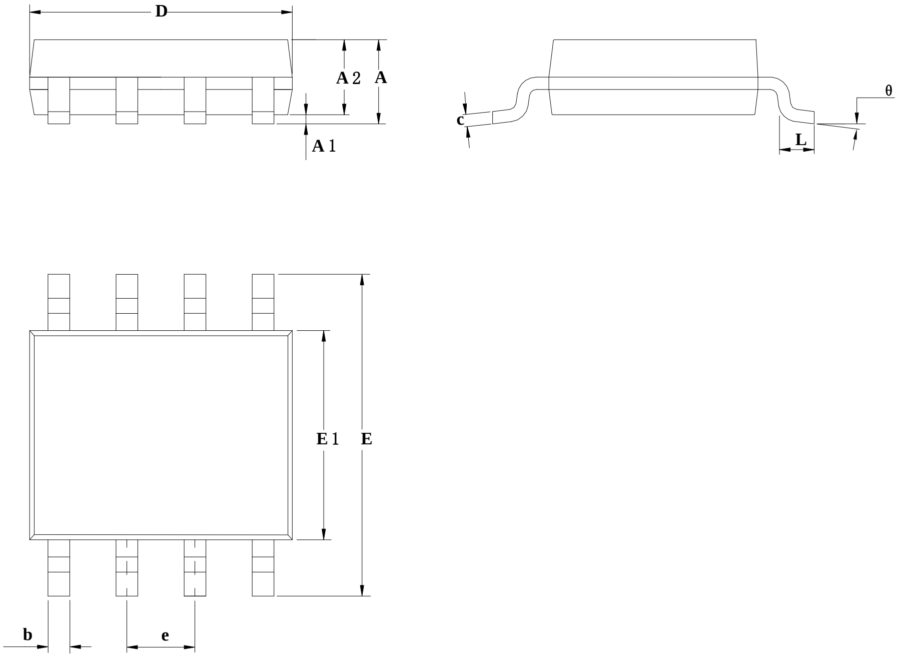
PACKAGE OUTLINE

TSOT23-6 UNIT: mm



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.10
A1	0	—	0.15
A2	0.55		1.00
b	0.30	0.40	0.50
c	0.08	0.15	0.30
D	2.70	2.90	3.10
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e	0.95（BSC)		
L	0.30	0.45	0.60
θ	0°	—	10°

TSOT23-8 UNIT: mm



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.10
A1	0	—	0.15
A2	0.55	0.65	1.00
b	0.20	0.40	0.50
c	0.08	0.15	0.30
D	2.70	2.90	3.10
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e	0.65（BSC)		
L	0.30	0.45	0.60
θ	0°	—	10°

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