JW5513

20V, 15A, High Efficiency Synchronous Step-up Regulator

Parameters Subject to Change Without Notice

DESCRIPTION

The JW®5513 is a synchronous high-efficiency, step-up boost converter. The device adopts constant-off-time (COT) control topology. The integrated low $R_{DS(ON)}$ switches minimize the conduction loss.

The JW5513 provides selectable PFM/PWM light load operation mode. The device features cycle by cycle peak current limit up to 15A. The low output voltage ripple, the small external inductor and the capacitor size are achieved at programmable pseudo-constant frequency.

JW5513 guarantees robustness with over voltage protection and over temperature protection.

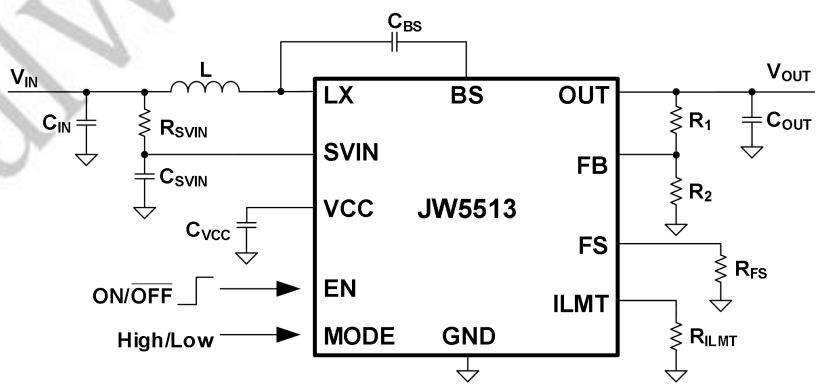
FEATURES

- Input Voltage Range: 2.6V to 20V
- Output Voltage Range: up to 20V
- Programmable Switch Peak Current: up to 15A
- Low $R_{DS(ON)}$ for FETs Integrated: Low-Side FET: 10mΩ, High-Side FET: 20mΩ
- Adjustable Switching Frequency: up to 2MHz
- PFM/PWM Selectable Light Load Operation Mode
- Internal Loop Compensation
- Internal Soft-start Limit the Inrush Current
- Over Temperature Protection
- Over Voltage Protection
- RoHS Compliant and Halogen Free
- Compact Package: QFN3x3-20

APPLICATIONS

- High Power AP
- Bluetooth Speaker
- Power Banks
- E-cigarette

TYPICAL APPLICATION



User Guide: For the application of Vo>16V and I_{PEAK}>10A, please connect a snubber circuit(4.7Ω+2.2nF) from LX pin to GND

ORDER INFORMATION

DEVICE[1)]	PACKAGE	TOP MARKING[2)]
JW5513QFNAV#TRPBF	QFN3x3-20	JW5513 YW□□□□□

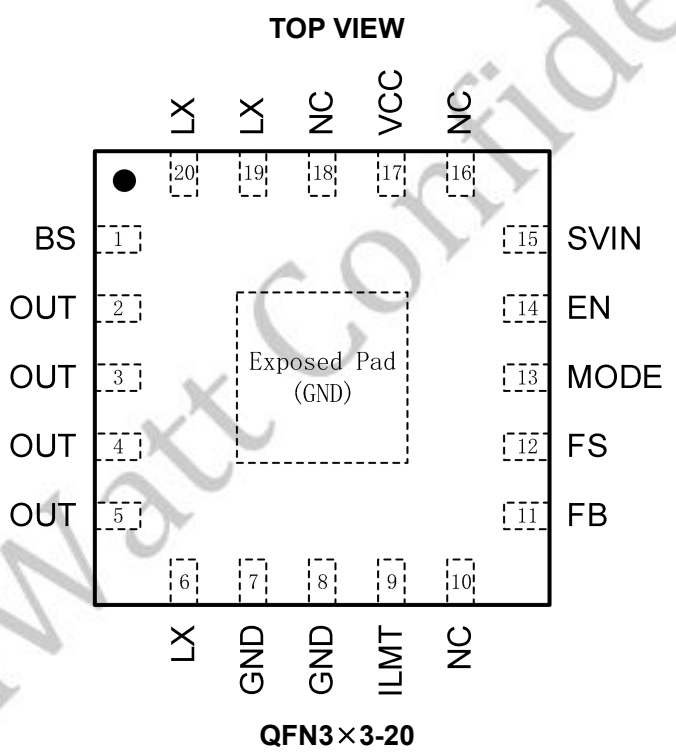
Notes:

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

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

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

PIN CONFIGURATION



QFN3×3-20

ABSOLUTE MAXIMUM RATING[1)]

SVIN, LX, OUT, ILMT, FS, MODE, EN ..... -0.3V to 20V
FB, VCC ..... -0.3V to 4V
BS-LX ..... -0.3V to 4V
Dynamic LX Voltage in 10ns Duration ..... -3.5V to 24V
Junction Temperature Range[2)] ..... -40ºC to +150ºC
Power Dissipation, P_D @ (T_A = 25ºC)[3)] QFN3×3-20 ..... 3.1W
Lead Temperature (Soldering, 10 sec.) 260ºC

Storage Temperature Range ..... -65ºC to +150ºC

RECOMMENDED OPERATING CONDITIONS[4)]

SVIN ..... 2.6V to 20V
Junction Temperature Range ..... -40ºC to +125ºC
Ambient Temperature Range ..... -40ºC to +85ºC

THERMAL PERFORMANCE[5)]

	θ_{JA}	θ_{JC}
QFN3×3-20	32	4ºC/W

Note:

1) Exceeding these ratings may damage the device. These stress ratings do not imply function operation of the device at any other conditions beyond those indicated under RECOMMENDED OPERATIONF CONDITIONS

2) The JW5513 includes thermal protection that is intended to protect the device in overload conditions. Continuous operation over the specified absolute maximum operating junction temperature may damage the device.

3) The maximum allowable continuous power dissipation at any ambient temperature is calculated by PD (MAX) = $(T_J(MAX)-T_A)/\theta_{JA}$.

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

5) Measured in the natural convection at T_A = 25℃ on a four-layer JoulWatt Evaluation Board.

ELECTRICAL CHARACTERISTICS

VIN=5V, V_{OUT}=12V, I_{OUT}=100mA, T_A=25°C, unless otherwise specified

Item	Symbol	Condition	Min.	Typ.	Max.	Units
POWER SUPPLY						
Input voltage range	V_{SVIN}		2.6		20	V
Input voltage under voltage lockout (UVLO) threshold	V_{SVIN_UVLO}	V_{SVIN} rising		2.4	2.6	V
		V_{SVIN} falling		2.0		V
VIN UVLO hysteresis	V_{SVIN_HYS}			200		mV
Quiescent current	I_Q			260	300	uA
Quiescent current in sleep mode	I_{Q_SLP}	V_{FB} =1.1V		100	130	uA
Shutdown current	I_{SHDN}	EN=0		1.5	3.5	uA
POWER SWITCHES						
Low side N-FET(LS-FET) R_{ON}	$R_{DS(ON)\_L}$			10		mΩ
High side N-FET(HS-FET) R_{ON}	$R_{DS(ON)\_H}$			20		mΩ
VOLTAGE REFRENCE						
Feedback reference voltage	V_{REF}		0.99	1	1.01	V
FB leakage current	I_{FB}	V_{FB}=3.3V	-50		50	nA
CURRENT LIMIT						
LS-FET current limit	I_{LMT}	R_{ILMT}=100kΩ	13	15	17	A
LS-FET current limit program range	I_{LMT_RNG}		3		15	A
ILMT reference voltage	V_{ILMT}			0.6		V
ENABLE AND MODE						
EN/MODE input voltage high	$V_{EN/MODE\_H}$		1.6			V
EN/MODE input voltage low	$V_{EN/MODE\_L}$				0.4	V
SWITCHING CHARACTERISTICS						
Switching frequency program range	f_{SW_RNG}		300		2000	kHz
Switching frequency accuracy	f_{SW}	R_{FS}=360kΩ	400	500	600	kHz
Minimum ON time	T_{ON_MIN}			120		ns
Minimum OFF time	T_{OFF_MIN}			110		ns
SOFT START						
Soft start time	T_{SS}			3		ms
PROTECTION						
Output OVP threshold	V_{OUT_OVP}			23.5		V
Feedback overvoltage with respect to reference voltage	V_{FB_OVP}	V_{FB} rising		120		%
		V_{FB} falling		110		%

Thermal shutdown temperature(6)	T_{SD}			150		ºC
Thermal shutdown hysteresis(6)	T_{HYS}			15		ºC

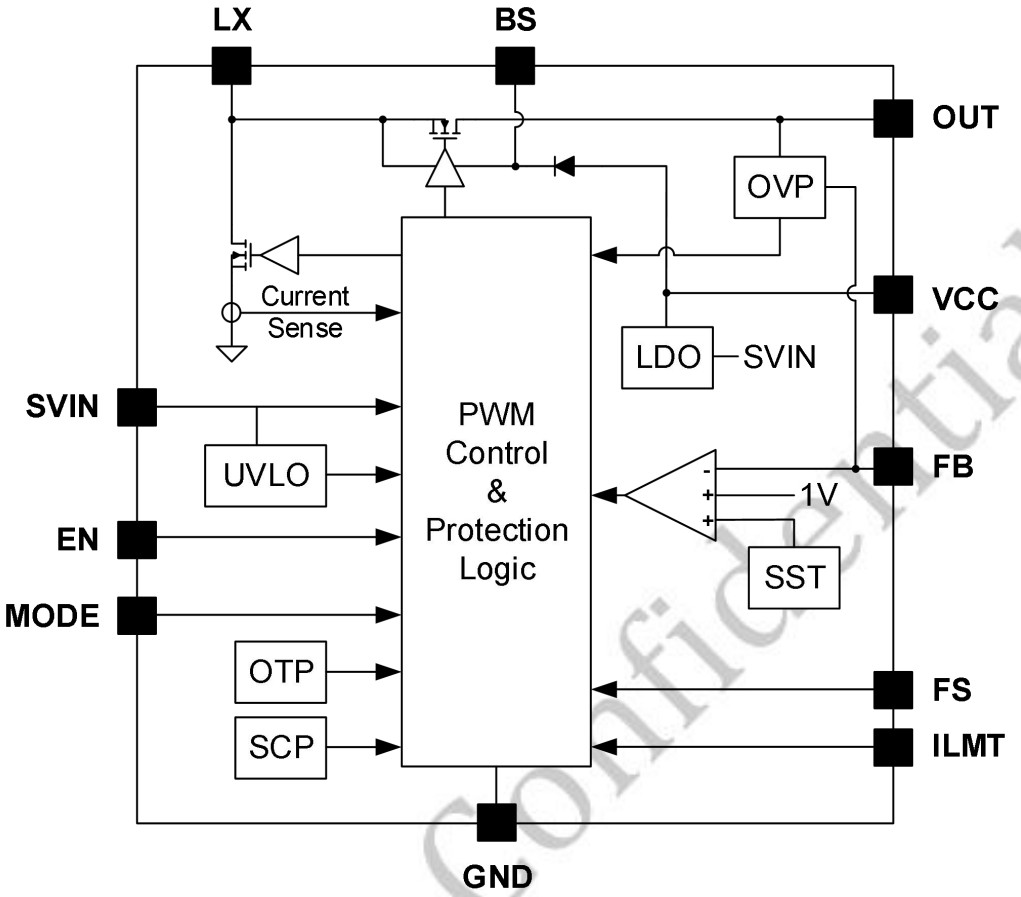
Notes:

6) Guaranteed by design.

PIN DESCRIPTION

Pin No.	Name	Description
1	BS	Boot-strap pin. Supply rectifier FET's gate driver. Connect a 0.1μF ceramic capacitor between BS and LX.
2,3,4,5	OUT	The Boost converter output pin.
6,19,20	LX	Inductor node. Connect an inductor from power input to the LX pin.
7,8,EP	GND	Ground pin of IC.
9	ILMT	Switch peak current limit setting. Connect a resistor from this pin to GND.
10,16,18	NC	Not connected.
11	FB	Feedback pin. Connected to the center of the resistor voltage divider to program the output voltage: $V_{OUT}=1V\times(R_1/R_2+1)$
12	FS	Switching frequency setting pin. Connect a resistor from this pin to ground to program the switching frequency.
13	MODE	Operating mode selection under light load. Pull this pin low for PFM operation, and pull this pin high or leave it floating for PWM operation.
14	EN	Enable control. Pull high to turn on the IC. Do not leave it floating.
15	SVIN	IC power supply input pin. Decouple this pin to the GND pin with a 1μF ceramic capacitor at least.
17	VCC	Output of the internal LDO regulator. Decouple this pin to the GND pin with a 1μF ceramic capacitor at least.

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

The JW5513 is a synchronous, high-efficiency, step-up boost converter. It is designed to operate from an input voltage range between 2.6V and 20V with up to peak switch current limit.

The device adopts adaptive constant off time and current mode control. The pseudo-constant switching frequency in in CCM can be programmed. PFM or PWM light load operation is selected by the MODE pin.

The JW5513 guarantees robustness with over voltage protection and over temperature protection.

Start-Up

When EN is high logic, the JW5513 can start up from a voltage as low as 2.4V typical. If the input voltage rises above $V_{SVIN,UVLO}$, the chip begins to operate and starts in PFM mode. The internal soft-start time can limit the inrush current during start-up. When the input voltage drops below 2.0V typical, the chip stops working.

Device Enable

The JW5513 starts operation when EN pin is pulled high and starts up with a soft-start process. Pulling EN pin low can force the device into shutdown mode. In shutdown mode, the chip stops switching and all the internal control circuit is off.

Output Voltage

The output voltage is set by an external feedback resistive divider. The feedback signal is compared with internal precision 1V voltage reference by an error amplifier. The output voltage can be given by the equation:

$$V_o(V) = \frac{1V \times (R_1 + R_2)}{R_2}$$

Where R_1 and R_2 are defined in the typical application figure.

Adjustable Switch Peak Current Limit

To prevent the device from being damaged by a large input peak current, a cycle-by-cycle current limit is adopted in JW5513. The low side switch is turned off immediately, as soon as the switch current touches the setting limit, which is programmed by a resistor from the ILIM pin to ground. The peak current limit can be given by the formula below:

$$I_{LMT}(A) = \frac{1700}{R_{ILMT}(k\Omega)} - 2$$

where I_{LMT} is the switch peak current limit, R_{ILMT} is the resistor between ILMT pin and ground.

Adjustable Switching Frequency

The switching frequency of the JW5513 in CCM can be programmed by adjusting the external resistor R_{FS} connected between FS pin and ground.

$$F_{SW}(kHz) = \frac{73565}{R_{FS}(k\Omega)} + 300$$

Light Load Operation Mode Selection

During light load operation, PFM or PWM can be selected by the MODE pin. When the MODE pin is pulled logic high (>1.6V), the JW5513 operates in PWM. When the MODE pin is pulled logic low (<0.4V), the device operates in PFM.

PFM is engaged to maintain high efficiency at light load when Mode pin is pulled low. In PFM mode, switching frequency is continuously controlled in proportion to the load current, i.e.

switch frequency decreases when load current drops to increase power efficiency at light load by reducing switching loss and minimizing the circuit power dissipation.

Protection

Over Voltage Protection

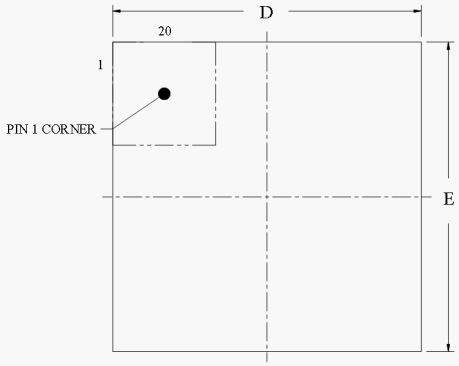
If output voltage is higher than V_{OUT_OVP} (Typ. 23.5V) or V_{FB} exceed 1.2V typical, the device stops switching immediately. Until the output voltage drops below 23.5V typical and V_{FB} drops below 1.1V typical, the device resumes switching automatically.

Over Temperature Protection

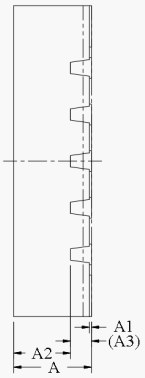
When the junction temperature of the device rises above T_{SD}, the device is forced into shut down mode. When the temperature drops by T_{HYS}, the device can be resumed with soft start.

PACKAGE OUTLINE

QFN3x3-20 UNIT: mm

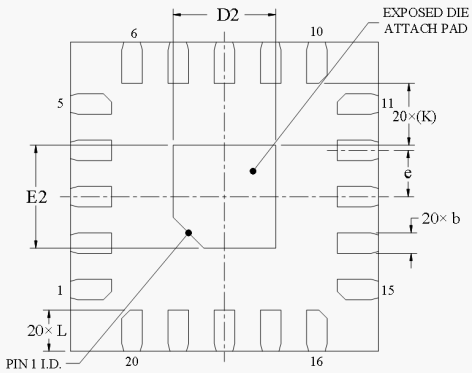


TOP VIEW

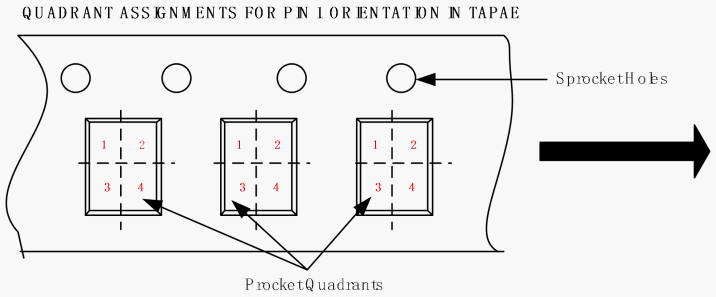


SIDE VIEW

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A2	—	0.55	—
A3		0.203 REF	
b	0.15	0.20	0.25
D	2.90	3.00	3.10
E	2.90	3.00	3.10
e		0.45 BSC	
D2	0.90	1.00	1.10
E2	0.90	1.00	1.10
L	0.30	0.40	0.50
K		0.60 REF	



BOTTOM VIEW



Package Type	Pin1 Quadrant
QFN3x3-20	1

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