JWH5140/JWH5140F

100V/0.6A Synchronous Step-Down Converter

DESCRIPTION

The JWH5140 and JWH5140F is a monolithic buck switching regulator based on constant on-time control (COT) for fast transient response. Operating with a wide input voltage range of 6V~100V, the JWH5140 and JWH5140F delivers 0.6A of continuous output current with two integrated MOSFETs. Constant on-time control mode control provides tight load transient response and cycle-by-cycle current limit. At light loads, JWH5140 operates in low frequency to maintain high efficiency, while JWH5140F operates in continuous current mode for frequency sensitive application.

The JWH5140 and JWH5140F guarantees robustness with short-circuit protection, thermal protection, current run-away protection, and input under voltage lockout.

The JWH5140 and JWH5140F are available both in ESOP8 and DFN4X4-8 packages, which provides a compact solution with minimal external components.

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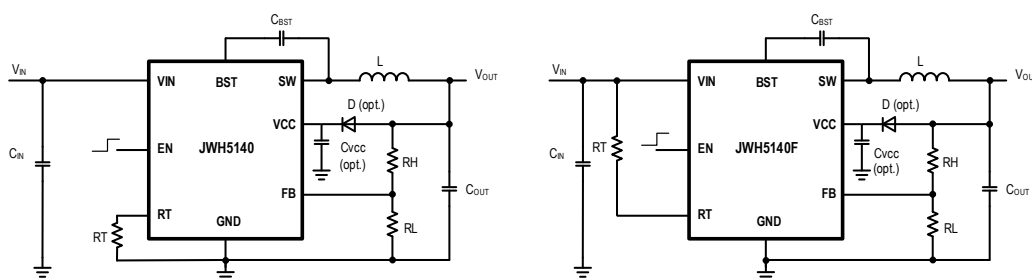
FEATURES

- 6V to 100V Operating Input Range 0.6A Output Current
- Internal Soft-start
- Adjustable Switch Frequency
- FCCM at Light Load (JWH5140F)
- PFM at Light Load (JWH5140)
- Input under Voltage Lockout
- Current Run-away Protection
- Short Circuit Protection
- Thermal Protection
- Available in ESOP8/DFN4X4-8 Package

APPLICATIONS

- Distributed Power Systems
- Smart Meter
- Automotive Systems
- High Voltage Power Conversion
- Industrial Power Systems
- Battery Powered Systems

TYPICAL APPLICATION

JWH5140/JWH5140F Rev.0.21
2022/09/07

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ORDER INFORMATION

DEVICE[1)	PACKAGE	TOP MARKING[2)	ENVIRONMENTAL[3)
JWH5140DFNI#TR	DFN4X4-8	JWH5140 YW□□□□□	Green
JWH5140FDFNI#TR	DFN4X4-8	JWH5140F YW□□□□□	Green
JWH5140ESOP#TR	ESOP8	JWH5140 YW□□□□□	Green
JWH5140FESOP#TR	ESOP8	JWH5140F YW□□□□□	Green

Notes：

1) JW□□ □□#TR
   - 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

3) All JoulWatt products are packaged with Pb-free and Halogen-free materials and compliant to RoHS standards.

DEVICE INFORMATION

DEVICE	OPERATION MODE AT LIGHT LOAD	PAKAGE	MSL	STATUS
JWH5140DFNI#TR	PFM	DFN4X4-8	MSL3	Available
JWH5140FDFNI#TR	FCCM	DFN4X4-8	MSL3	Available
JWH5140ESOP#TR	PFM	ESOP8	MSL3	Available
JWH5140FESOP#TR	FCCM	ESOP8	MSL3	Available

PIN CONFIGURATION

TOP VIEW

ESOP8

DFN4X4-8

ABSOLUTE MAXIMUM RATING[1]

VIN, EN, SW, RT Pin .... -0.3V to 110V

SW Pin………………………………………..……………………… -0.3V (-7V for 10ns) to 110V

BST Pin .... SW-0.3V to SW+6V

VCC Pin ....… -0.3V to 27V

FB Pin .... -0.3V to 6V

Junction Temperature[2] 150ºC

Lead Temperature 260ºC

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

ESD Susceptibility (Human Body Model) 2kV

ESD Susceptibility (Charged Device Model)..500V

RECOMMENDED OPERATING CONDITIONS[3]

Input Voltage V_{IN} ....6V to 100V

Output Voltage V_{OUT}..1.225V to Dmax x VIN (<30V)

Operating Junction Temperature ....-40ºC to125ºC

THERMAL PERFORMANCE[4] θ_{JA} θ_{Jc}

ESOP8.. 42...2.5ºC/W

DFN4X4-8...42...3.2ºC/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 OPERATING CONDITIONS.

2) The JWH5140 and JWH5140F 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 device is not guaranteed to function outside of its operating conditions.

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

ELECTRICAL CHARACTERISTICS

V_{IN} = 48V, T_J = -40ºC~125ºC, unless otherwise stated.

Item	Symbol	Condition	Min.	Typ.	Max.	Units
V_{IN} Under-voltage Lockout Threshold	V_{IN_MIN}	V_{IN} rising	5.3	5.6	5.9	V
V_{IN} Under-voltage Lockout Hysteresis	$V_{IN\_MIN\_HYST}$	V_{IN} falling		252		mV
Shutdown Supply Current	I_{SD}	V_{EN}=0V@25 ºC		3.3	5	µA
		-40~125ºC			6	µA
Supply Current	I_Q	No switching@25 ºC	105	145	180	µA
		-40~125ºC	80	145	250	µA
Feedback Voltage	V_{FB}	6V≤V_{VIN}≤100V	1.2	1.225	1.25	V
FB Over-voltage Threshold	V_{FB_OVP}	Trip Point for Switch OFF	1.57	1.65	1.73	V
High-side FET On Resistance	$R_{DS(ON)T}$	I_{SW}=-100mA		0.58		Ω
Low-side FET On Resistance	$R_{DS(ON)B}$	I_{SW}= 100mA		0.3		Ω
High-side FET Current Limit	I_{LIM_TOP}		0.9	1.2	1.5	A
Low-side FET Current Limit	I_{LIM_BOT}		0.57	0.64	0.685	A
Low-side FET Negative Current Limit	I_{LIM_Neg}	JWH5140F	0.75	0.9	1.05	A
Switch Frequency	f_{SW}	R_{RT}=200kohm,@ V_{IN}=48V, V_{OUT}=12V, I_{OUT}=0.3A, JWH5140		635		kHz
		R_{RT}=1.1Mohm,@V_{IN}=48V, V_{OUT} =12V, I_{OUT}=0.3A, JWH5140F		620		kHz
Switch Frequency Range			100		1000	kHz
Minimum On Time[5]	T_{ON_MIN}			90		ns
Minimum Off Time	T_{OFF_MIN}	V_{FB}=1V		150		ns
Soft-start Time	T_{SS}	0V <V_{FB}<1.2V		1.9		ms
EN Under-voltage Lockout Threshold	V_{EN_TH}	V_{EN} rising	1.19	1.225	1.26	V
EN Under-voltage Lockout Hysteresis Input Current	I_{EN_HYST}	V_{EN} =2.5V(JWH5140F)	12	21	30	µA
EN Shut-down Threshold	V_{EN_SD}	V_{EN} falling	0.8	1.09		V
VCC Power Supply Switch Voltage	V_{CC_TH}	V_{CC} rising		6.175		V
	V_{CC_TL}	Vcc falling		6		V
Thermal Shutdown[5]	T_{TSD}			165		°C
Thermal Shutdown Hysteresis[5]	T_{TSD_HYST}			20		°C

Note：

5) Guaranteed by design.

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PIN DESCRIPTION

Pin ESOP8	Pin DFN4X4-8	Name	Description
1	1	GND	Ground.
2	2	VIN	Input voltage pin. VIN supplies power to the IC. Connect a 6V to 100V supply to VIN and bypass VIN to GND with a suitably large capacitor to eliminate noise on the input to the IC.
3	3	EN	Drive EN pin high to turn on the regulator and low to turn off the regulator.
4	4	RT	Switching Frequency Program Input. Connect a resistor from this pin to VIN (JWH5140F) or GND (JWH5140) to set the switching frequency.
5	5	FB	Output feedback pin. FB senses the output voltage and is regulated by the control loop to 1.225V. Connect a resistive divider at FB.
6	6	VCC	Supply input of the internal LDO
7	7	BST	An external capacitor is required between the BST and SW pins (0.1-µF ceramic). The BST pin capacitor is charged by the internal regulator when the SW pin is low.
8	8	SW	SW is the switching node that supplies power to the output. Connect the output LC filter from SW to the output load.
		Exposed-pad GND	Exposed pad must be connected to the GND pin. Solder to the system ground plane on application board for reduced thermal resistance.

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BLOCK DIAGRAM

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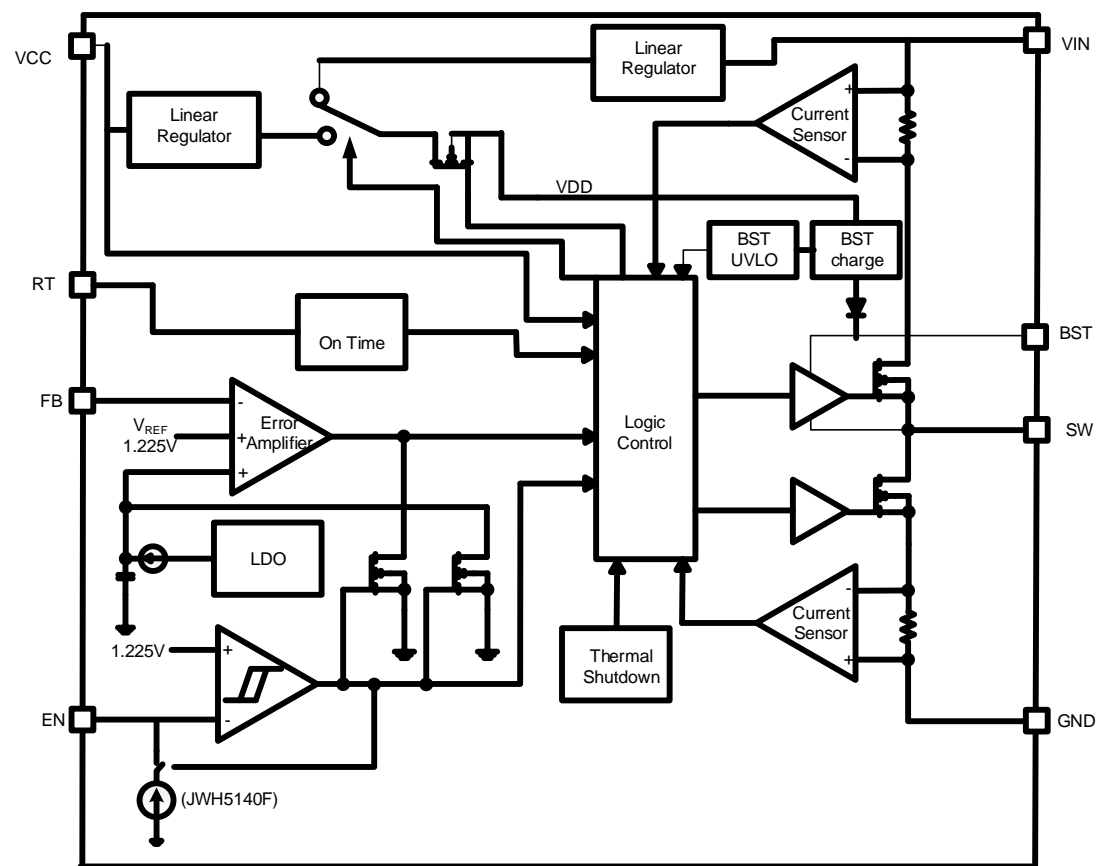
TYPICAL PERFORMANCE CHARACTERISTICS (JWH5140)

V_{IN} =48V, V_{OUT}= 12V, L = 47µH, C_{OUT} = 10µF, R_T = 200kΩ, T_A = +25°C, unless otherwise noted

Steady State Test
V_{IN}=48V, V_{OUT}=12V
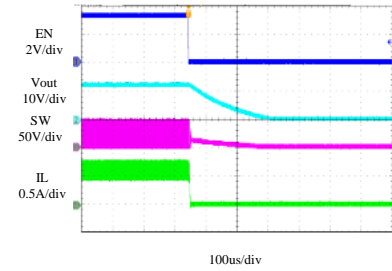I_{OUT}=0.6A

2us/div

Startup through Enable
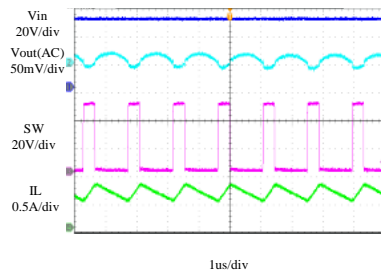V_{IN}=48V, V_{OUT}=12V
I_{OUT}=0.6A (Resistive load)

2ms/div

Shutdown through Enable
V_{IN}=48V, V_{OUT}=12V
I_{OUT}=0.6A (Resistive load)

100us/div

Heavy Load Operation
0.6A LOAD

2us/div

Light Load Operation
0.16A LOAD

2us/div

No Load Operation
0 A LOAD

800us/div

Short Circuit Protection
V_{IN}=48V, V_{OUT}=12V
I_{OUT}=0.6A-Short

10ms/div

Short Circuit Recovery
V_{IN}=48V, V_{OUT}=12V
I_{OUT}= Short-0.6A

10ms/div

Load Transient
0.1A LOAD->0.6A LOAD->0.1A LOAD

800us/div

TYPICAL PERFORMANCE CHARACTERISTICS (JWH5140F)

V_{IN} =48V, V_{OUT}= 12V, L = 47µH, C_{OUT} = 10µF, R_T = 1MΩ, T_A = +25°C, unless otherwise noted

Steady State Test
V_{IN}=48V, V_{OUT}=12V
I_{OUT}=0.6A
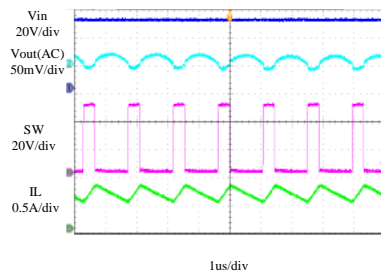
Startup through Enable
V_{IN}=48V, V_{OUT}=12V
I_{OUT}=0.6A (Resistive load)
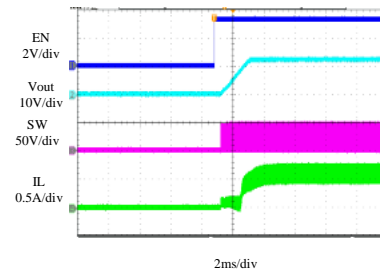
Shutdown through Enable
V_{IN}=48V, V_{OUT}=12V
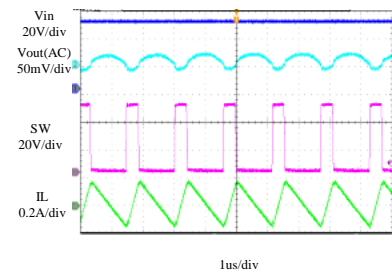I_{OUT}=0.6A (Resistive load)

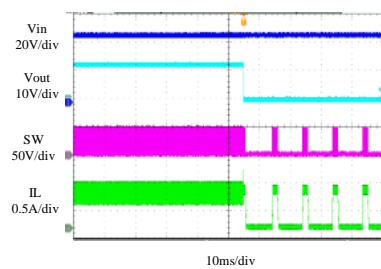### Heavy Load Operation
0.6A LOAD

Light Load Operation
0.15A LOAD
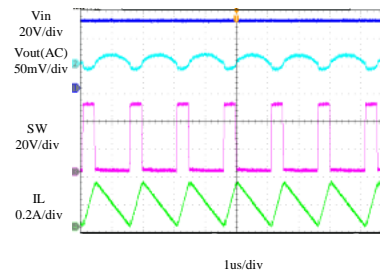
No Load Operation
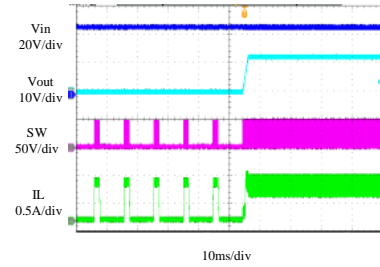0 A LOAD

Short Circuit Protection
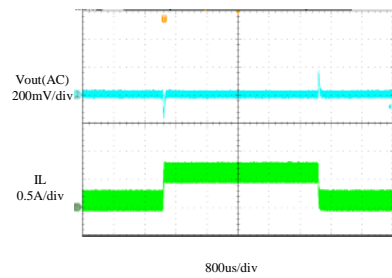V_{IN}=48V, V_{OUT}=12V
I_{OUT}=0.6A-Short

Short Circuit Recovery
V_{IN}=48V, V_{OUT}=12V
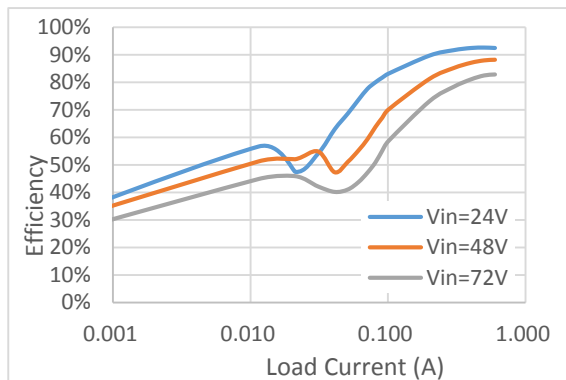I_{OUT}= Short-0.6A

Load Transient
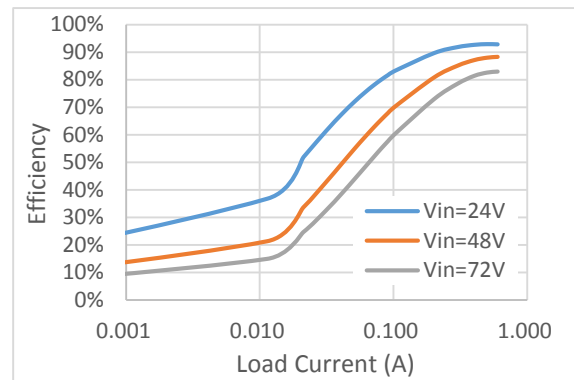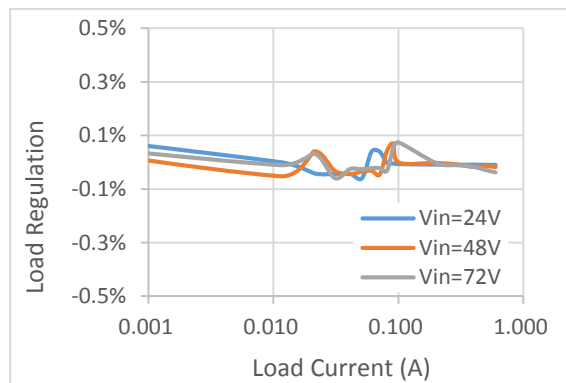0.1A LOAD->0.6A LOAD->0.1A LOAD

TYPICAL PERFORMANCE CHARACTERISTICS

Efficiency vs Load Current

(JWH5140, V_{OUT}=12V, L=47μH)

Efficiency vs Load Current

(JWH5140F, V_{OUT}=12V, L=47μH)

Load Regulation vs Load Current

(JWH5140, V_{OUT}=12V, L=47μH)
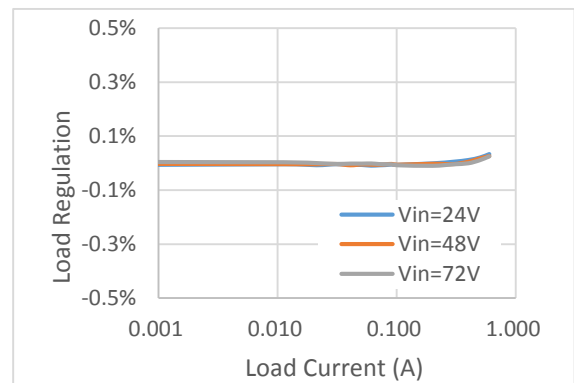
Load Regulation vs Load Current

(JWH5140F, V_{OUT}=12V, L=47μH)
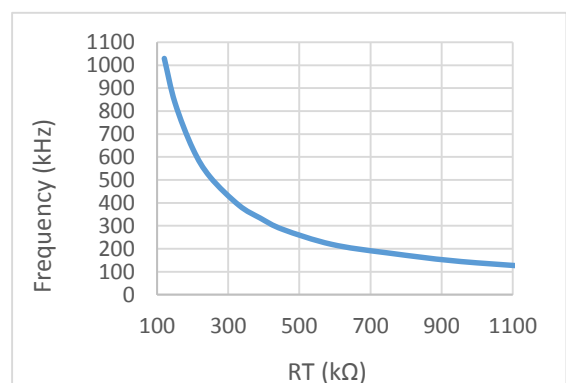
Switch Frequency vs RT

(JWH5140, V_{OUT}=12V, I_{OUT}=0.3A)
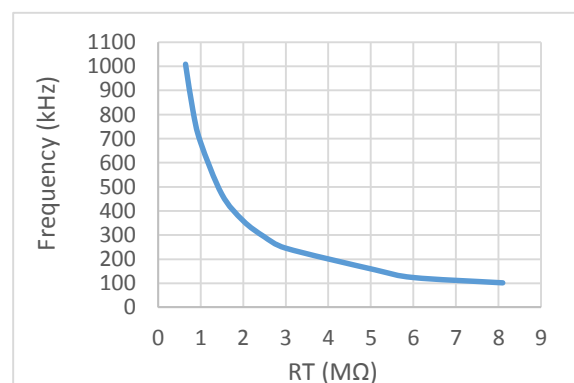
Switch Frequency vs RT

(JWH5140F, V_{OUT}=12V, I_{OUT}=0.3A)

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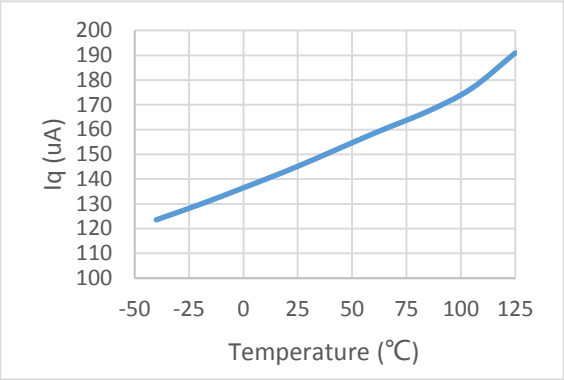
Supply Current vs Junction Temperature
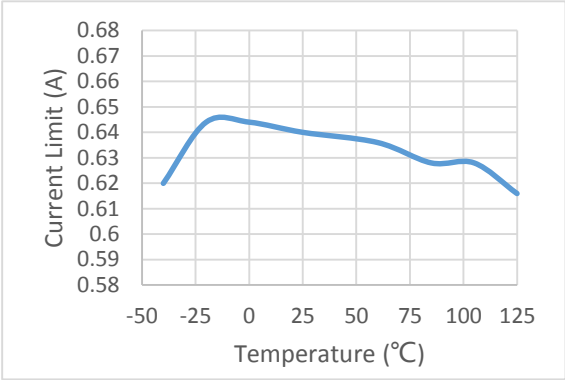
Current Limit vs Junction Temperature
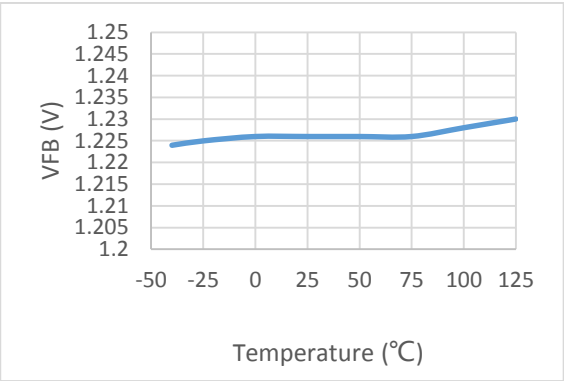
FB Voltage Regulaion vs Junction Temperature

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FUNCTIONAL DESCRIPTION

The JWH5140 and JWH5140F is a synchronous, COT, step-down regulator. It regulates input voltages from 6V to 100V down to an output voltage as low as 1.225V, and is capable of supplying up to 0.6A of load current.

Shut-Down Mode

The JWH5140 and JWH5140F shut down when voltage at EN pin is below 0.4V. The entire regulator is off and the supply current consumed by the JWH5140 and JWH5140F drops below 5uA.

Power Switch

Two N-Channel MOSFET switches are integrated on the JWH5140 and JWH5140F to down convert the input voltage to the regulated output voltage.

Precision Enable and Adjustable UVLO Protection

The JWH5140 and JWH5140F support adjustable input under-voltage lockout (UVLO) with hysteresis programmed by the resistor values for application specific power-up and power-down requirements and a resistive divider connected between VIN and ground with the central tap connected to EN can be used to adjust the input voltage UVLO. (Shown in Figure 1). Once the EN pin voltage exceeds 1.225 V, an additional 21µA of hysteresis is added. This additional current facilitates input voltage hysteresis. Use below Equation to set the input startup voltage and external hysteresis for the input voltage.

$$V_{inUVLO} = \left(1 + \frac{R_{EN\_H}}{R_{EN_L}}\right) * V_{EN\_TH}$$

$$V_{UVLO_{HYS}} = \left(1 + \frac{R_{EN_H}}{R_{EN_L}}\right) * \left(V_{EN\_HYS} + I_{ENHYS} * \frac{R_{EN\_H} * R_{EN\_L}}{R_{EN\_H} + R_{EN\_L}}\right)$$

Where JWH5140F i_{HYS}=21uA, JWH5140

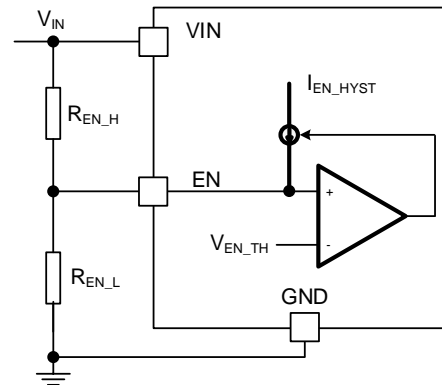i_{HYS}=0uA, V_{EN_TH} =1.225V

Figure 1. UVLO Setting

In applications, R_{EN_H} should be at least 7 times R_{EN_L}.

Internal Soft-start

Soft-start is designed in JWH5140 and JWH5140F to prevent the converter output voltage from overshooting during startup and short-circuit recovery. When the chip starts, the internal circuit generates a soft-start voltage (SS) ramping up from 0V to 3V. When it is less than the V_{REF}, SS overrides V_{REF} and the error amplifier uses SS as the reference. When SS exceeds V_{REF}, V_{REF} regains control.

Internal LDO Regulator

The JWH5140 and JWH5140F consists of two internal LDOs for VDD from the VIN pin and the VCC pin. When the voltage of VCC is lower than 6V, the LDO regulator current from VIN sources will into the capacitor on internal VDD. When the voltage on the VDD reaches the under voltage lockout threshold voltage, the Buck switch is enabled. When the voltage of VCC pin voltage is higher than 6.175V, the VCC side LDO is enabled and the VIN side LDO is disabled. A 0.1µF ceramic capacitor is recommended for CVCC for most applications.

In order to reduce internal power dissipation, an

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auxiliary voltage can be connected to the VCC pin via a diode. Setting the auxiliary voltage to 6.5 -25V will shut off the internal regulator from VIN.
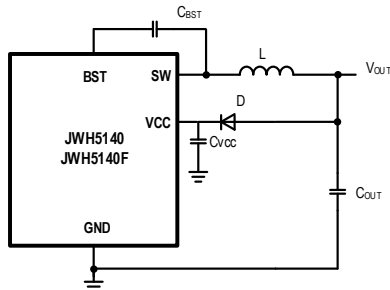

Figure 2. VCC Setting

Switching Frequency

The switching frequency of JWH5140 and JWH5140F can be set by the resistor RT connecting the RT pin to VIN pin (JWH5140F) or GND pin (JWH5140). In a typical application scenario with an input voltage of 48V and an output voltage of 12V with a load of 0.3A,The frequency of JWH5140 can be calculated by the following equation：

$$R_T(\text{k}\Omega) = 164930 \cdot f_{sw}(\text{kHz})^{-1.041}$$

where the unit of R_{RT} is kΩ.

In the above application，The frequency of JWH5140F can be calculated by the following equation:

$$R_T(\text{M}\Omega) = 1188 \cdot \ (f_{sw}(\text{kHz}) - 2）^{-1.084}$$

where the unit of R_{RT} is MΩ.

To reduce the solution size one would typically set the switching frequency as high as possible, but tradeoffs of the conversion efficiency, maximum input voltage and minimum controllable on time should be considered. The minimum controllable on time is typically 90 ns which limit the maximum operating frequency in applications with high input to output step down ratios.

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 inductance can be easily built up, resulting in a large start-up output current. A valley current limit is designed in the JWH5140 and JWH5140F 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

The current limit of JWH5140 and JWH5140F is a cycle-by-cycle "valley" mechanism, measuring the inductor current through the synchronous rectifier during the off-time while the inductor current ramps down. The current is determined by measuring the voltage between source and drain of the synchronous rectifier. If the current exceeds the current limit, the turn-on signal of top MOSFET is inhibited until the inductor current ramps down below the current limit. Thus, only when the inductor current is well below the current limit, another on-time is permitted. If the output current exceeds the available inductor current (controlled by the current limit mechanism), the output voltage will drop. When the output is shorted to ground, the regulator is allowed to switch for 128 cycles. If the short condition is cleared within this period, then the regulator resumes normal operation. If the short condition is still present after 8ms, then no switching is allowed and the regulator enters hiccup mode for 8ms. After the 8ms, the regulator will try to start-up again. If the short condition still exists after 128 cycles of switching, the regulator enters hiccup mode. This process of start-up and hiccup iterate itself until the short condition is removed.

Over Voltage Protection

Output overvoltage protection (OVP) is

designed in JWH5140 and JWH5140F to minimize voltage overshoot when recovering from output fault conditions or strong unload transients in designs with low output capacitance and the power supply output voltage increase faster than the response of the error amplifier output resulting in an output overshoot.

The OVP feature minimizes output overshoot when using a low value output capacitor by comparing the FB pin voltage to the rising OVP threshold which is nominally 1.65V. If the FB pin voltage is greater than the rising OVP threshold,

the high side MOSFET is immediately disabled to minimize output overshoot. When the FB voltage drops below the falling OVP threshold which is nominally 1.225V, the high side MOSFET resumes normal operation.

Thermal Protection

When the temperature of the JWH5140 and JWH5140F rises above 165°C, it is forced into thermal shut-down.

Only when core temperature drops below 145°C can the regulator becomes active again.

APPLICATION INFORMATION

Output Voltage Set

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

$$V_{FB} = V_{OUT} * \frac{R_L}{R_H + R_L}$$

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

Choose R_L around 1 kΩ~20kΩ, and then R_H can be calculated by:

$$R_H = R_L * \left(\frac{V_{OUT}}{1.225} - 1\right)$$

Input Capacitor

The input capacitor is used to supply the AC input current to the step-down converter and maintaining the DC input voltage. Estimate the RMS current in the input capacitor with:

$$I_{CIN} = I_{OUT} * \sqrt{\frac{V_{OUT}}{V_{IN}} * \left(1 - \frac{V_{OUT}}{V_{IN}}\right)}$$

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

When using ceramic capacitors, make sure that they have enough capacitance to provide sufficient charge to prevent excessive voltage ripple at the input. Thus the input capacitor can be calculated by the following equation when the input ripple voltage is determined.

$$C_{IN} = \frac{I_{OUT}}{f_S * \Delta V_{IN}} * \frac{V_{OUT}}{V_{IN}} * \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

where C_{IN} 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 22μF/200V electrolytic 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:

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

where C_{OUT} 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 10uF 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 30% to 50% of the maximum switch current limit, thus the inductance value can be calculated by:

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

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

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ESR ceramic capacitor is recommended to connected to the BST pin and SW pin.

Load Transient Consideration

The JWH5140 and JW5140F regulator adopts the instant PWM architecture to achieve good stability and fast transient responses. Adding a ceramic capacitor C_{FF} in parallel with RH is recommended.
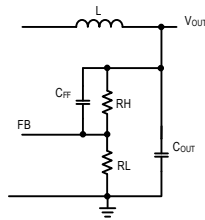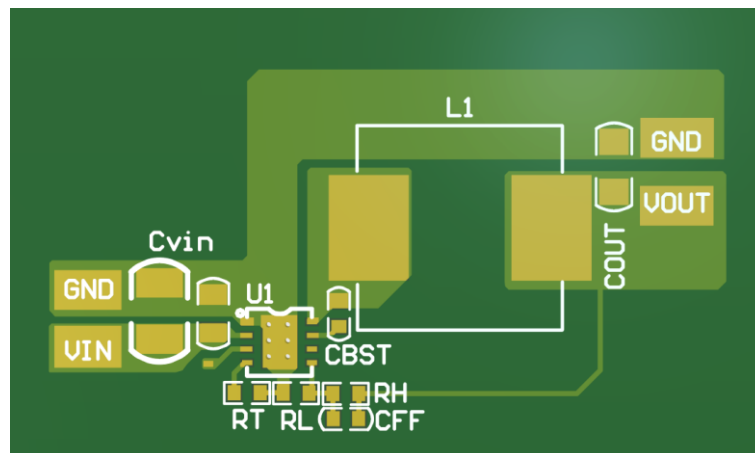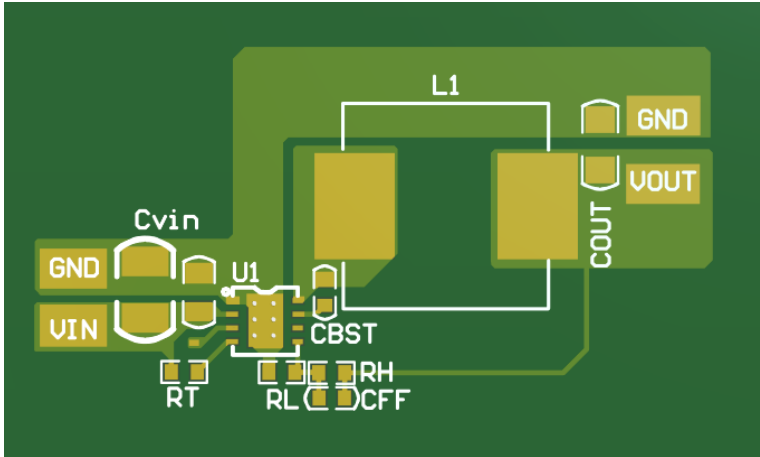

PCB Layout Note

For minimum noise problem and best operating performance, the PCB is preferred to following DFN4x4-8:

the guidelines as reference.

1. Place the input decoupling capacitor as close to JWH5140/F (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 short as possible, and far away from the inductor and noisy power traces like SW node.

3. The ground plane on the PCB should be as large as possible for better heat dissipation.

4. Keep the switching node SW short to prevent excessive capacitive coupling

5. Make V_{IN}, V_{OUT} and ground bus connections as wide as possible. This reduces any voltage drops on the input or output paths of the converter and maximizes efficiency.

PCB Layout Recommendation for JWH5140

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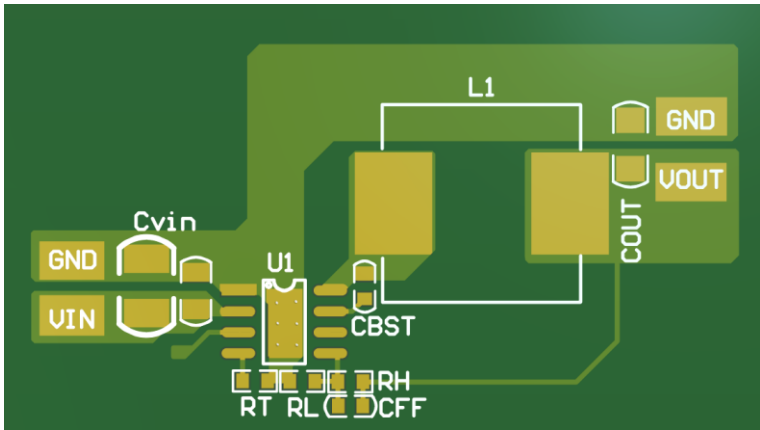
PCB Layout Recommendation for JWH5140F

ESOP8:

PCB Layout Recommendation for JWH5140

PCB Layout Recommendation for JWH5140F

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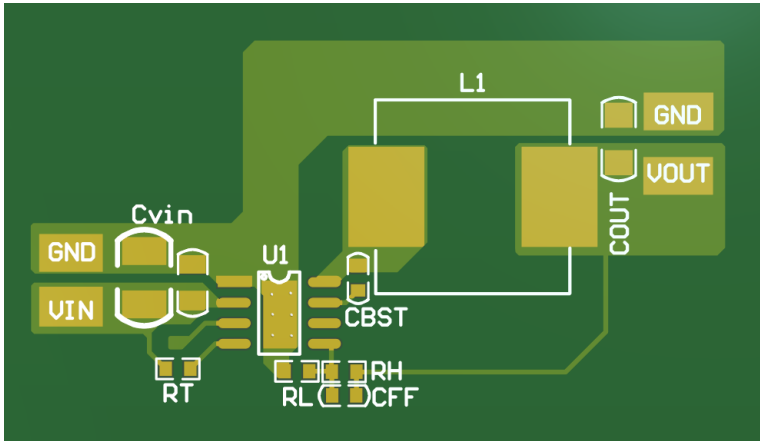
REFERENCE DESIGN

Note: Information in the following reference design sections is not part of JoulWatt component specification. Customers are responsible for determining suitability of components chosen for their purposes and should validate their design implementation to make sure the proper system functionality.

Reference 1:

V_{IN}:   15V~100V

V_{OUT}:   12V
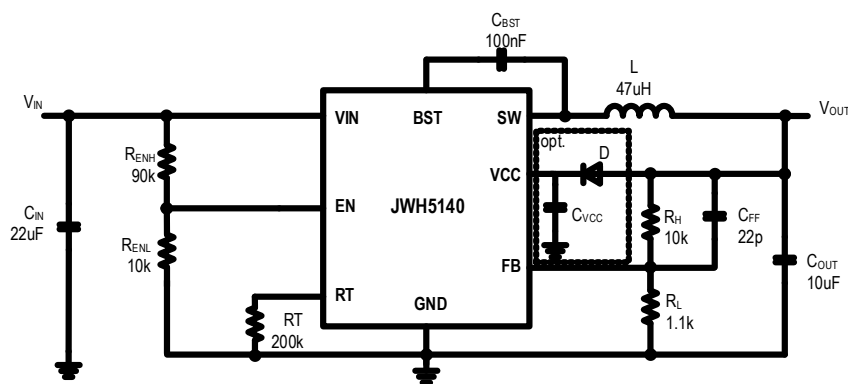
I_{OUT}:   0~0.6A

Reference 2:

V_{IN}:   15V~100V

V_{OUT}:   12V

I_{OUT}:   0~0.6A

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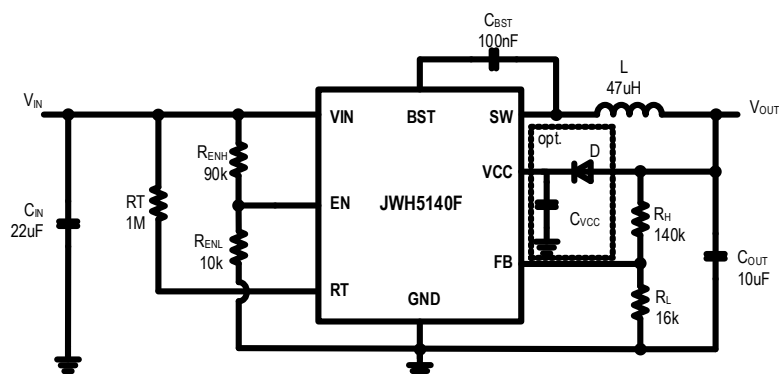
External Components Suggestion (V$_{IN}$=48V):

	V$_{OUT}$ (V)	R$_L$ (kΩ)	R$_H$ (kΩ)	C$_{FF}$ (pF)	RT (MΩ)	L (µH)	C$_{OUT\_NOM}$ (µF)	C$_{OUT\_EFF}$ (µF)
JWH5140	12	1.1	10	22	0.2	47	10	6
JWH5140F	12	16	140	NC	1	47	10	6

Notes:

1) In order to improve dynamic performance, a feedforward capacitor (C$_{FF}$) can be considered to be in parallel with R$_H$.

2) Capacitor tolerance and bias voltage de-rating should be considered. The effective capacitance can vary by +20% and -80%. Please refer to the datasheet of the capacitor.

3) C$_{OUT\_NOM}$ is the minimum nominal capacitance value of C$_{OUT}$(output capacitance). C$_{OUT\_EFF}$ is the minimum effective capacitance value of C$_{OUT}$.

TAPE AND REEL INFORMATION

Reel   UNIT: mm

Package	Diameter Φ	Thickness W1	Width W2	W4
DFN4x4-8	330±2	17.6±2	12.4±2	100±2
ESOP8	330±2	17.6±2	12.4±2	100±2

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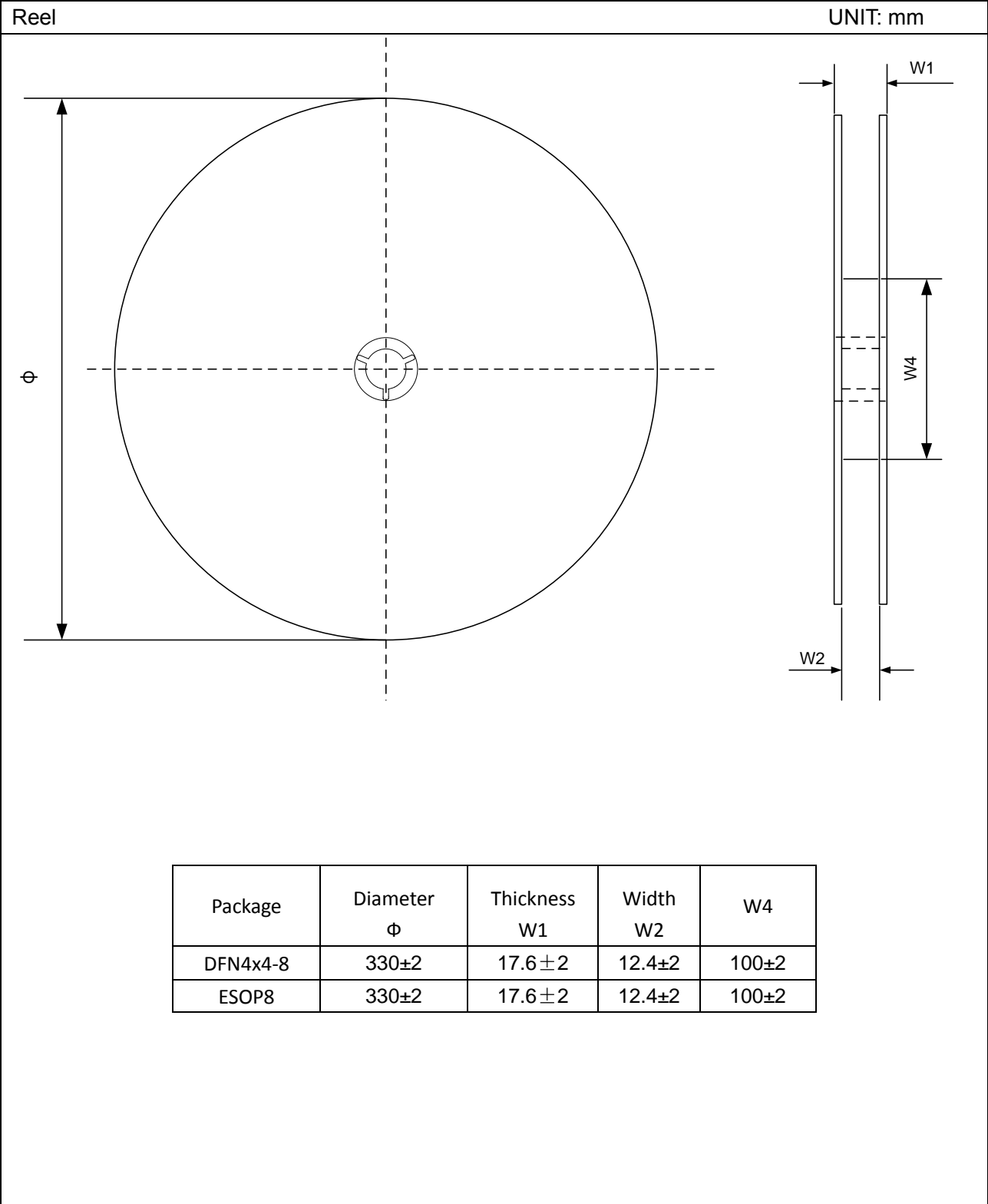
Carrier Tape   UNIT: mm
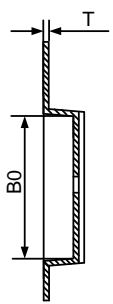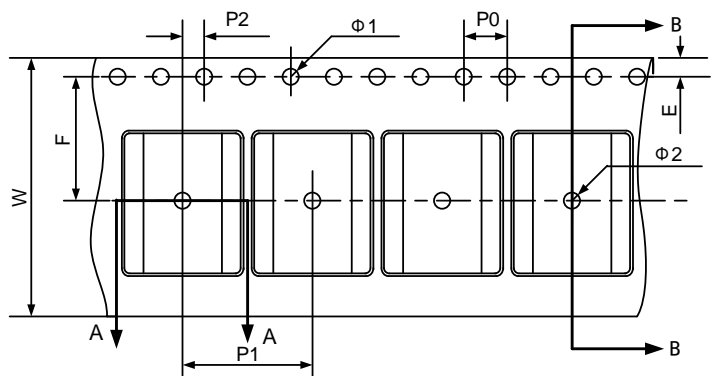
SECTION B-B

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.

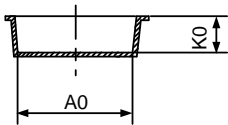| Package	Tape dimensions (mm)											
	P0	P1	P	A0	B0	W	T	K0	Φ1	Φ2	E	F
DFN4x4-8	4.0±0.10	2.0±0.10	8.0±0.2	4.30±0.2	4.30±0.2	12.0±0.3	0.25±0.10	1.10±0.2	1.50±0.10	1.50±0.25	1.75±0.1	5.50±0.10
ESOP8	4.0±0.1	2.0±0.1	8.0±0.1	6.40±0.3	5.35±0.3	12.0±0.3	0.25±0.2	2.00±0.2	1.50min	1.50min	1.75±0.1	5.50±0.10

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PACKAGE OUTLINE

ESOP8				UNIT: mm

Symbol	MILLIMETER		
	MIN	NOM	MAX
A	1.30	—	1.70
A1	0.00	—	0.10
A2	1.35	—	1.60
b	0.33	—	0.51
c	0.17	—	0.25
D	4.70	—	5.10
E	5.80	6.00	6.20
E1	3.75	3.90	4.15
D1	3.05	—	3.40
E2	2.16	—	2.50
e	1.27BSC		
L	0.40	—	1.27
θ	0°	—	8°

3.505

PIN#1

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPAE

Sprocket Holes

Procket Quadrants

Package Type	Pin1 Quadrant
ESOP8	1

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DFN4X4-8   UNIT: mm

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3	0.203 REF		
b	0.25	0.30	0.35
D	4 BSC		
E	4 BSC		
e	0.8 BSC		
D2	1.88	1.98	2.08
E2	2.9	3.0	3.1
L	0.30	0.40	0.50
K	0.61 REF		

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPAE

Sprocket Holes

Procket Quadrants
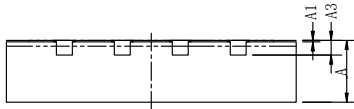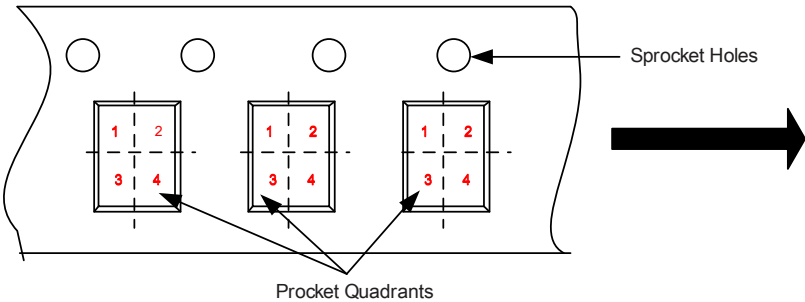
Package Type	Pin1 Quadrant
DFN4X4-8	1

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