JW7808

300mA, Low-Dropout High-PSRR, Low-Noise LDO

DESCRIPTION

The JW7808 is a high PSRR and low noise low-dropout (LDO) voltage regulator with enable function that operates from 2.2V to 5.5V. It provides up to 300mA of output current. The feature of low noise and high PSRR makes this device ideal for RF and analog systems.

JW7808 guarantees robustness with output short-circuit protection, input under voltage lockout protection and over temperature protection.

JW7808 is available in 5-pin SOT23-5 and X2DFN1×1-4 packages.

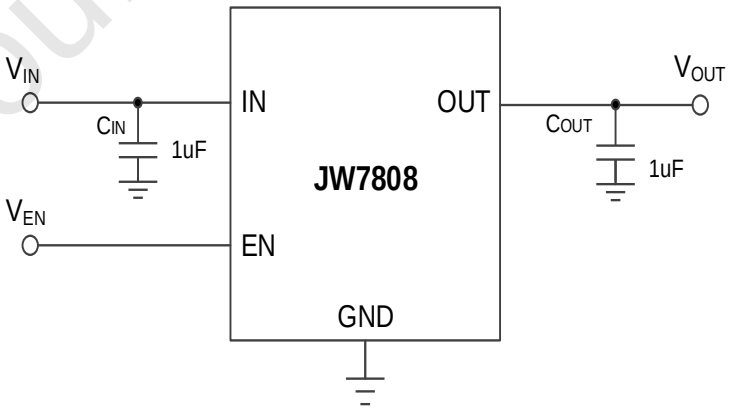
FEATURES

- Input Voltage Range:2.2V to 5.5V
- Output Voltage Range:1.2V to 4.5V
- Output Voltage Accuracy:±2%
- Output Current:300mA
- Low I_Q(Enabled): 12μA
- Low Dropout:300mV(Max.) @250mA
- High PSRR: 40dB @ 1MHz
- Low Output Voltage Noise: 40μV_{RMS}
- Stable with 1μF Ceramic Input and Output Capacitors
- Current Limit Protection and Over Temperature Protection
- Available in SOT23-5, X2DFN1x1-4 Packages

APPLICATIONS

- Mobile Phones, Tablets
- Digital Cameras and Audio Devices
- Portable, Battery Powered Equipment
- Ultra Low Power Micro-controllers
- Notebook Computers

TYPICAL APPLICATION



ORDER INFORMATION

DEVICE[1)]	PACKAGE	TOP MARKING[2)]	ENVIRONMENTAL[3)]
JW7808-1.2X2DHAB#TR	X2DFN1x1-4	H□	Green
JW7808-1.5X2DHAB#TR	X2DFN1x1-4	J□	Green
JW7808-1.8X2DHAB#TR	X2DFN1x1-4	G□	Green
JW7808-1.9X2DHAB#TR	X2DFN1x1-4	K□	Green
JW7808-2.2X2DHAB#TR	X2DFN1x1-4	L□	Green
JW7808-2.5X2DHAB#TR	X2DFN1x1-4	M□	Green
JW7808-2.7X2DHAB#TR	X2DFN1x1-4	N□	Green
JW7808-2.75X2DHAB#TR	X2DFN1x1-4	P□	Green
JW7808-2.8X2DHAB#TR	X2DFN1x1-4	Q□	Green
JW7808-2.85X2DHAB#TR	X2DFN1x1-4	R□	Green
JW7808-2.9X2DHAB#TR	X2DFN1x1-4	S□	Green
JW7808-3.0X2DHAB#TR	X2DFN1x1-4	T□	Green
JW7808-3.1X2DHAB#TR	X2DFN1x1-4	U□	Green
JW7808-3.2X2DHAB#TR	X2DFN1x1-4	V□	Green
JW7808-3.3X2DHAB#TR	X2DFN1x1-4	X□	Green
JW7808-4.0X2DHAB#TR	X2DFN1x1-4	Y□	Green
JW7808-4.5X2DHAB#TR	X2DFN1x1-4	Z□	Green
JW7808-1.2SOTA#TR	SOT23-5	JWY9□ YW□□□	Green
JW7808-1.5SOTA#TR	SOT23-5	JWYC□ YW□□□	Green
JW7808-1.8SOTA#TR	SOT23-5	JWYD□ YW□□□	Green
JW7808-2.5SOTA#TR	SOT23-5	JWYE□ YW□□□	Green
JW7808-2.8SOTA#TR	SOT23-5	JWYF□ YW□□□	Green
JW7808-2.85SOTA#TR	SOT23-5	JWYG□ YW□□□	Green
JW7808-2.9SOTA#TR	SOT23-5	JWYH□ YW□□□	Green
JW7808-3.0SOTA#TR	SOT23-5	JWYJ□ YW□□□	Green
JW7808-3.1SOTA#TR	SOT23-5	JWYK□ YW□□□	Green
JW7808-3.2SOTA#TR	SOT23-5	JWYL□ YW□□□	Green
JW7808-3.3SOTA#TR	SOT23-5	JWYM□	Green

		YW□□□	
JW7808-4.5SOTA#TR	SOT23-5	JWYN□ YW□□□	Green

Notes:

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

2) SOT23-5: Line1: JW□□□
- Internal control code
- Product code
- Joulwatt LOGO

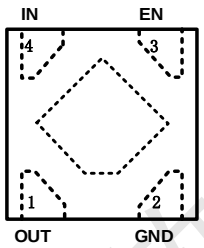
Line2: YW□□□
- Lot number
- Week code
- Year code

X2DFN1X1-4: Line1: □□
- Lot number
- Product code

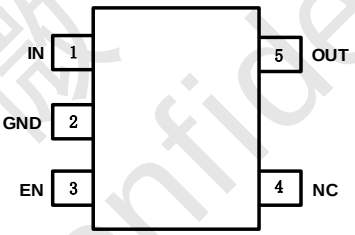
3) All JoulWatt products are packaged with Pb-free and Halogen-free materials and compliant to RoHS standards.

PIN CONFIGURATION

TOP VIEW



X2DFN1×1-4



SOT23-5

ABSOLUTE MAXIMUM RATING[1)]

IN, EN Pin ..... -0.3V to 7V
OUT Pin..... -0.3V to V_{IN}+0.3V
Junction Temperature[2)] 150ºC
Lead Temperature 260ºC
Storage Temperature ..... -65ºC to +150ºC
ESD Susceptibility (Human Body Model) .....±2kV
ESD Susceptibility (Charged Device Model) .....±500V
MSL (SOT23-5)..... MSL1
MSL (X2DFN1×1-4)..... MSL1
Continuous Power Dissipation(T_A=+25ºC)SOT23-5 ..... 0.66W
Continuous Power Dissipation(T_A=+25ºC)X2DFN1×1-4 ..... 0.68W

RECOMMENDED OPERATING CONDITIONS[3)]

Input Voltage V_{IN} ..... 2.2V to 5.5V
Output Current I_{OUT} ..... 0A to 0.3A
Operating Junction Temperature ..... -40ºC to 125ºC

THERMAL PERFORMANCE[4)]

	θ_{JA}	θ_{JB}	$\theta_{Jc(top)}$	$\theta_{Jc(bot)}$	
SOT23-5	151.7	100.1	103.7	n/a	ºC/W
X2DFN1×1-4	146	104.6	204.2	25.8	ºC/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 JW7808 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}=$V_{OUT(NOM)}$+1V, V_{EN}=1.0V, I_{OUT}=1mA, C_{IN}=1μF, C_{OUT}=1μF, T_J=-40°C~125°C, unless otherwise stated.						
Item	**Symbol**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
Input Voltage	V_{IN}	T_A=25°C	2.2		5.5	V
Input Supply UVLO	V_{UVLO}	V_{IN} rising		2	2.18	V
Input Supply UVLO Hysteresis	V_{HYS}			110		mV
Output Voltage Accuracy	△V_{OUT}	V_{IN}=($V_{OUT(NOM)}$+1V) to 5.5V I_{OUT}=1mA to 250mA	-2%		2%	V_{OUT}
Line Regulation	△V_{OUT}/△V_{IN}	V_{IN}=($V_{OUT(NOM)}$+1V) to 5.5V I_{OUT}=1mA		0.2		mV/V
Load Regulation	△V_{OUT}/△I_{OUT}	I_{OUT}=1mA to 250mA		0.05		mV/mA
Quiescent Current	I_Q	V_{EN}=1.2V, I_{OUT}=0mA		12	25	μA
		V_{EN}=0.3V		0.2	1	μA
Dropout Voltage	V_{DO}	I_{OUT}=100mA		50		mV
		I_{OUT}=250mA			300	
Output Current Limit	I_{CL}		305	370		mA
Short-Circuit Current Limit	I_{SC}	T_A=25°C		100		mA
Power-Supply Rejection Ratio[5)]	PSRR	f=1kHz, I_{OUT}=20mA		75		dB
		f=1MHz, I_{OUT}=20mA		40		
Output Noise Voltage[5)]	V_N	BW=10Hz to 100kHz I_{OUT}=1mA		40		μV_{RMS}
Output Discharge Resistance	R_{PD}	V_{EN}=0V(Disabled)		300		Ω
High Input Threshold	V_{ENH}	EN rising	1.0			V
Low Input Threshold	V_{ENL}	EN falling			0.4	V
EN Leakage Current	I_{EN_LKG}	V_{EN}=5.5V, V_{IN}=5.5V			1	μA
Turn On Time	t_{ON}	V_{EN}>V_{ENH} to V_{OUT}=95%$V_{OUT(NOM)}$, V_{OUT}=3.3V		700		μs
Thermal Shutdown[5)]	T_{TSD}			160		°C
Thermal Shutdown Hysteresis[5)]	T_{TSD_HYST}			15		°C

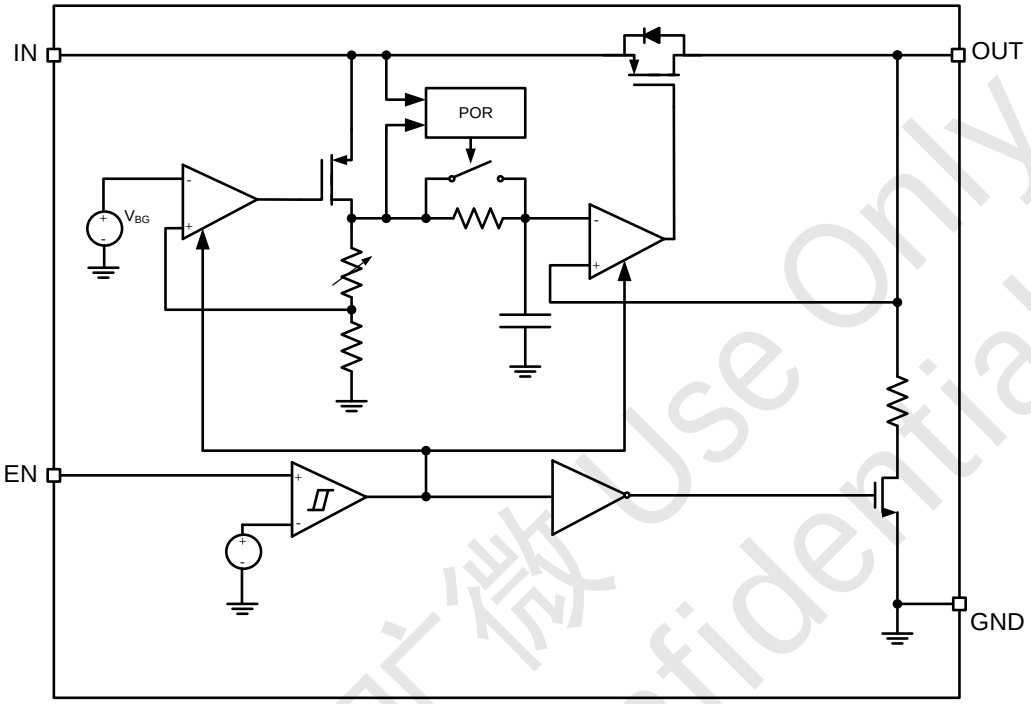
Note：

5) Guaranteed by design.

PIN DESCRIPTION

Pin		Name	Description
X2DFN1x1-4	SOT23-5		
1	5	OUT	Output of the regulator. A 1μF or larger output capacitor is recommended.
2	2	GND	Ground.
3	3	EN	Enable input.
4	1	IN	Supply voltage input. A 1μF or larger input capacitor is recommended.
	4	NC	Not connected.
Exposed Pad	-	-	The exposed pad should be connected to a large ground plane to maximize thermal performance.

BLOCK DIAGRAM

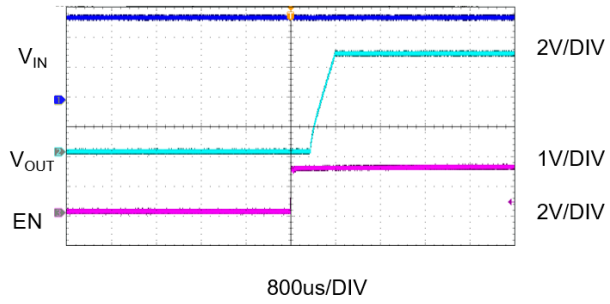


TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN} = $V_{OUT(NOM)}$ + 1V (whichever is greater), $V_{OUT(NOM)}$ = 3.3V, V_{EN} = 1.2V,C_{IN} = 1μF, C_{OUT} = 1μF , I_{OUT}= 1mA,and T_A = 25°C, unless otherwise noted.

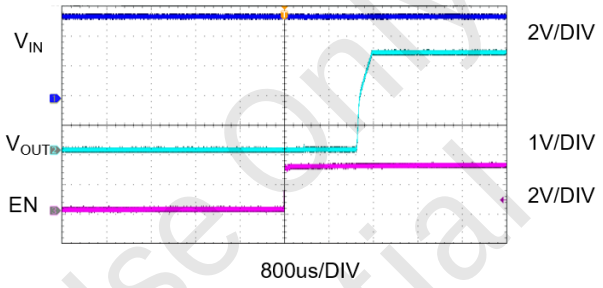
Start-Up

V_{IN}=5.5V,V_{OUT}=3.3V, I_{OUT} =0mA



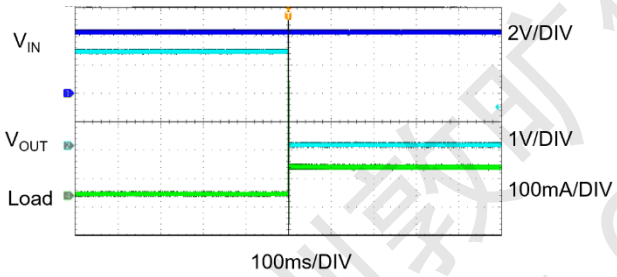
Start-Up

V_{IN}=5.5V,V_{OUT}=3.3V, I_{OUT} =50mA



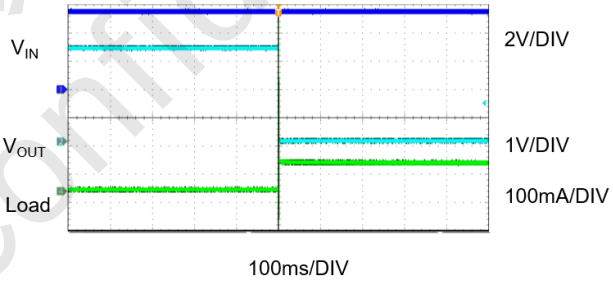
Short Circuit Protection

V_{IN}=4.3V,V_{OUT}=3.3V, I_{OUT} =0A to short



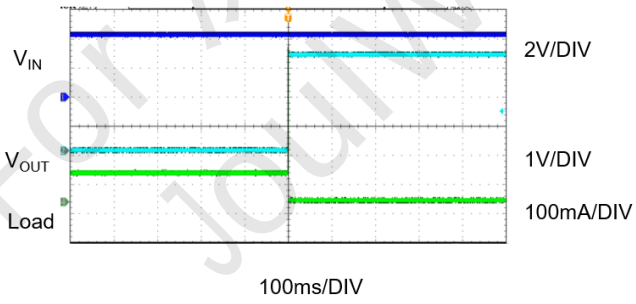
Short Circuit Protection

V_{IN}=5.5V,V_{OUT}=3.3V, I_{OUT} =0A to short



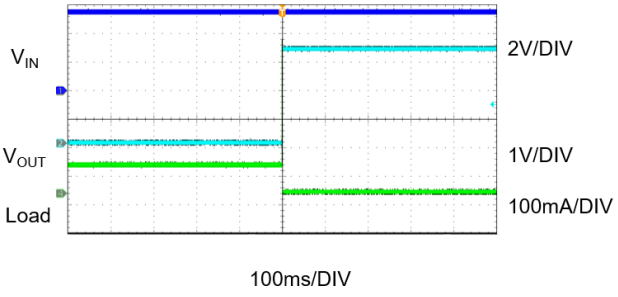
Short Circuit Recovery

V_{IN}=4.3V,V_{OUT}=3.3V



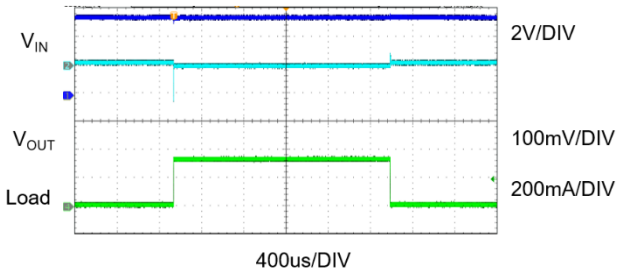
Short Circuit Recovery

V_{IN}=5.5V,V_{OUT}=3.3V



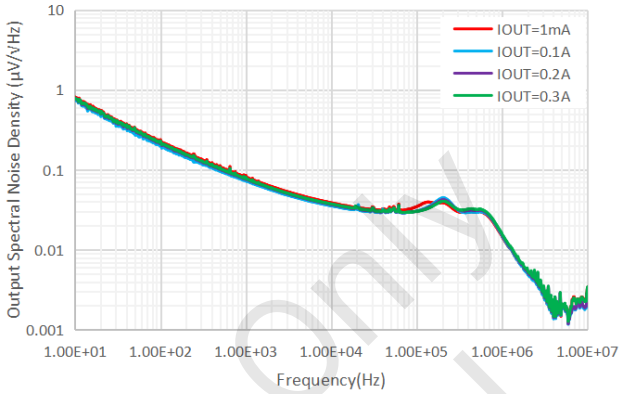
Load Transient

V_{IN}=5.5V,V_{EN}=3V,V_{OUT}=3.3V,Load=0.01mA to 300mA to 0.01mA



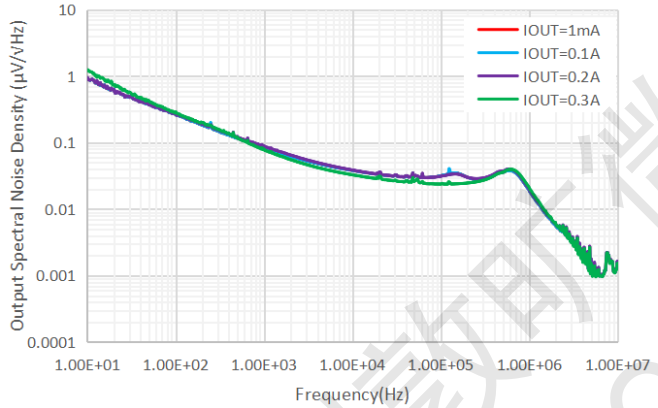
Output Spectral Noise Density vs Frequency

V_{IN} =2.2V, V_{OUT}=1.2V



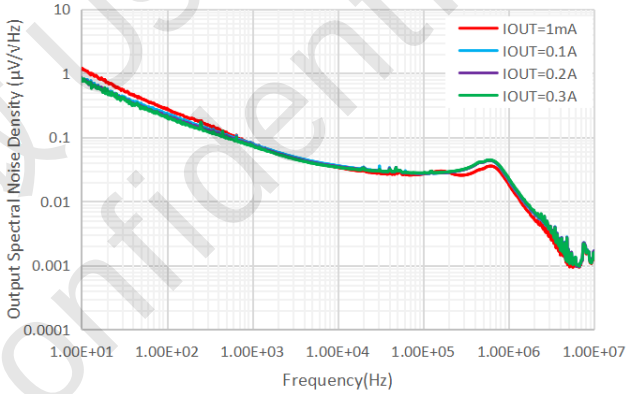
Output Spectral Noise Density vs Frequency

V_{IN} =3.8V, V_{OUT}=2.8V



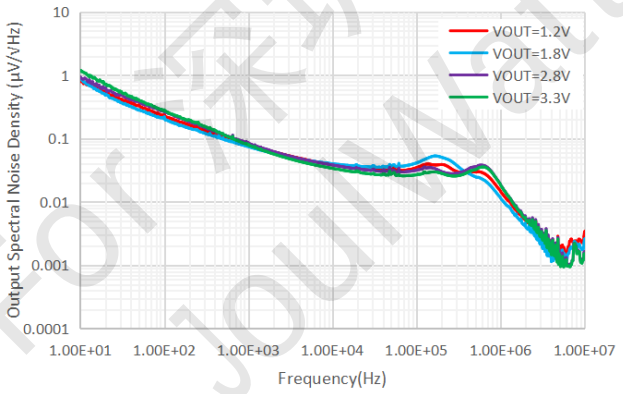
Output Spectral Noise Density vs Frequency

V_{IN} =4.3V, V_{OUT}=3.3V



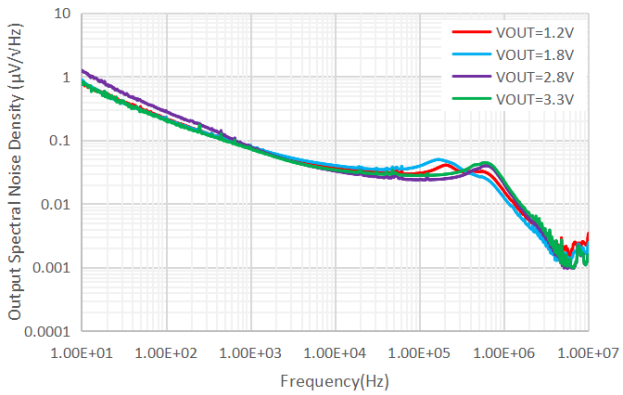
Output Spectral Noise Density vs Frequency

V_{IN} =V_{OUT}+1V,I_{OUT}=1mA



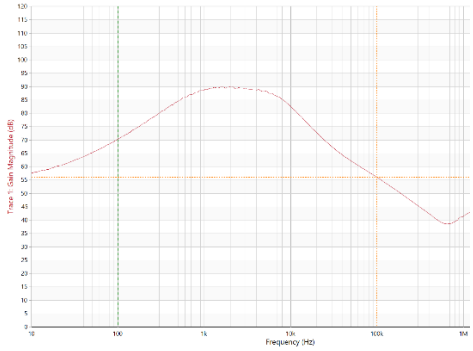
Output Spectral Noise Density vs Frequency

V_{IN} =V_{OUT}+1V,I_{OUT}=300mA



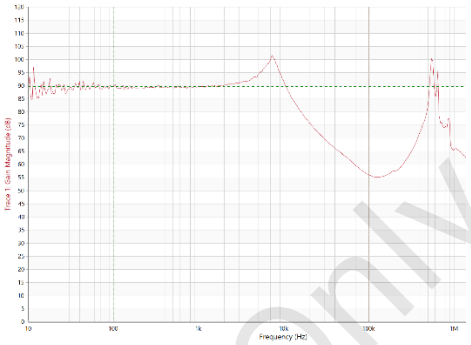
PSRR vs Frequency

V_{OUT}=3.3V, I_{OUT}=250mA, C_{IN}=1μF, C_{OUT}=1μF



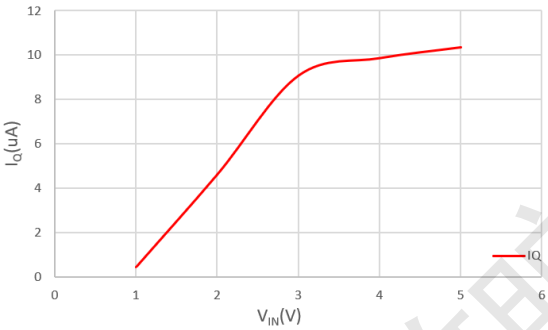
PSRR vs Frequency

V_{OUT}=3.3V, I_{OUT}=1mA, C_{IN}=1μF, C_{OUT}=1μF



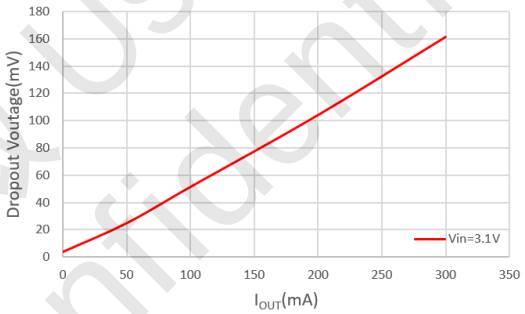
Quiescent Current vs Input Voltage

V_{OUT}=3.3V, V_{EN}=1.2V, Load=0mA



Dropout Voltage vs Load Current

V_{IN}=3.3V,V_{EN}=1.2V



FUNCTIONAL DESCRIPTION

The JW7808 is a low noise, low quiescent current linear regulator. The input voltage range is from 2.2V to 5.5V, and the output current is up to 300mA. The minimum required output capacitance for stable operation is 1μF effective capacitance after consideration of the temperature and voltage coefficient of the capacitor.

Output Transistor

The JW7808 builds in a P-MOSFET which provides a low switch-on resistance for low dropout voltage applications.

Error Amplifier

The Error Amplifier (EA) compares the internal reference voltage V_{REF} with the output feedback voltage V_{FB} through the internal divider. Output of the error amplifier (EA) is used to control the gate voltage of P-MOSFET and ensures that the device provides good line and load regulation at output voltage.

Enable

The device is active when EN pin is set to high. For proper operation, this pin must be terminated and must not be left floating. With EN pin set to low, the device enters shutdown mode with less than 1μA current consumption.

Current Limit and Short Circuit Protection

JW7808 provides current limit function to prevent the device from damages during the over load or shorted-circuit condition. The current is detected by a sensing transistor, which monitors and controls the pass transistor's gate voltage, limiting the output current to I_{CL}. When a short circuit happens, the output current limit decreases to I_{SC} to prevent the device from over-heating. The PMOS pass transistor dissipates $(V_{IN} - V_{OUT}) \times I_{CL}$ until thermal shutdown is triggered and the device turns off. When the device cools, the internal thermal shutdown circuit turns the device back on. If the fault condition continues, the device cycles between current limit and thermal shutdown.

Output Discharge

The device provides automatic output voltage discharge once it is disabled. This feature prevents residual charge voltage on the output capacitor, which may impact proper power up of the system connected to the converter. The discharge circuit at OUT pin becomes active once the EN pin is pulled low or the input voltage drops below UVLO comparator threshold.

Low Output Noise

Any internal noise at the JW7808 reference voltage is reduced by a first order low-pass RC filter before it is passed to the output buffer stage.

Thermal Protection

When the temperature of the JW7808 rises above 160°C, it is forced into thermal shutdown. Only when core temperature drops below 145°C can the device becomes active again.

APPLICATION INFORMATION

CIN and COUT Selection

The JW7808 is design to support low ESR (Equivalent Series Resistance) ceramic capacitors. It is recommended to use ceramic capacitors (dielectric types X5R, X7R or COG) to obtain good stability across different temperatures. A better choice for temperature coefficient in a ceramic capacitor is X7R. this type of capacitor is the most stable and holds the capacitance within ±15% over the temperature range.

A typically 1μF or greater output ceramic capacitor is suggested. The output capacitor must meet the requirement for the minimum value of capacitance and have an ESR value that is within the range 5mΩ to 100mΩ for stability. The initial tolerance, applied voltage de-rating, and temperature coefficient must all be considered when selecting the output capacitor to ensure the actual capacitance is never less than 0.7μF over the entire operating range.

Input capacitance is select to minimize transient input drop during load current steps. For general applications, an input capacitor, typically 1μF, is highly recommended to minimize input impedance. If the trace parasitic inductance between the JW7808 input pin and power supply is high, a fast load transient can cause V_{IN} voltage level ringing above the absolute maximum voltage rating which damages the device. Adding more input capacitors is available to restrict the ringing and keep it below the device absolute maximum ratings. Like the output capacitor, the initial tolerance, applied voltage de-rating, and temperature coefficient must all be considered when selecting the input capacitor to ensure the actual capacitance is never less than 0.7μF over the entire operating range.

Dropout Voltage

The JW7808 uses a PMOS to achieve low dropout. When (V_{IN} – V_{OUT}) is less than the dropout voltage (V_{DO}), the PMOS pass device is in its linear region of operation and the input-to-output resistance is the $R_{DS(ON)}$ of the PMOS. V_{DO} scales approximately with output current because the PMOS device in dropout behaves the same way as a resistor.

Power Dissipation and Device Operation

The permissible power dissipation for any package depends on the capability of the device passing heat from the power source, the junctions of the IC, to the ultimate heat sink, the ambient environment.

The maximum permissible power dissipation for the device in a given package can be calculate using Equation:

$$P_{D-MAX} = (T_{J-MAX} - T_A)/R_{\theta JA}$$

Where the $T_{J-MAX} = 125^{\circ}C$

Power dissipation in the regulator depends on the input-to-output voltage difference and load conditions. PD can be calculate by the following equation.

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$$

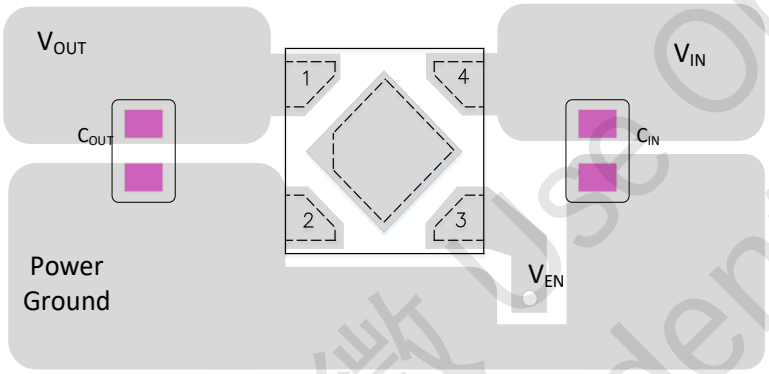
The maximum power dissipation determines the maximum allowable junction temperature (T_J) for the device. Power dissipation and junction temperature are related by the junction-to-ambient thermal resistance(θJA) of the combined PCB and device package and the temperature of the ambient air (T_A), according to

$$T_J = T_A + (\theta_{JA} \times P_D)$$

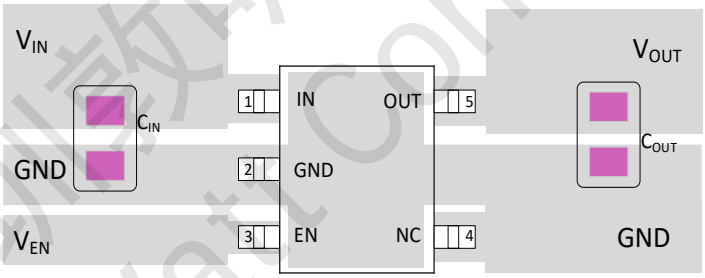
Layout Guidelines

Place all circuit components on the same side of the circuit board and as close to the respective LDO pin as possible. Place ground return connections to the input and output capacitor. Connect the ground plane with a wide copper surface for good thermal dissipation. Using vias and long power traces for the input and output capacitors connections is not recommend and negatively effects system performance.

X2DFN1x1-4:



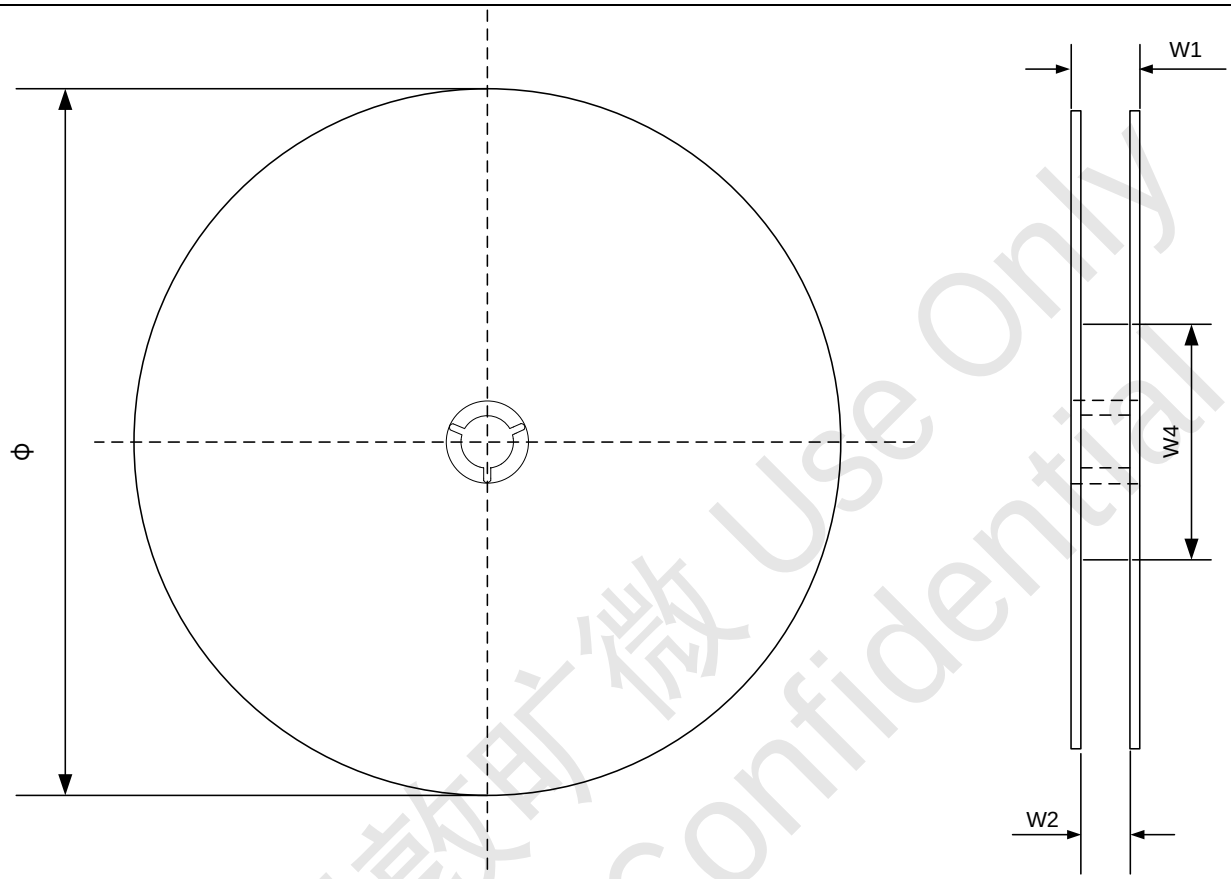
SOT23-5:



PCB Layout Recommendation

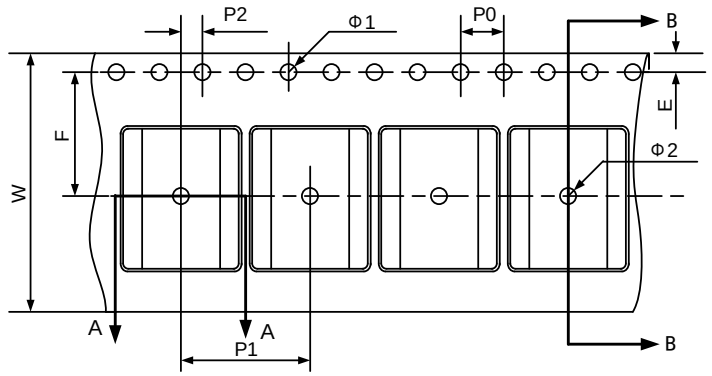
TAPE AND REEL INFORMATION

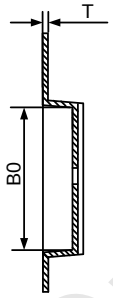
Reel UNIT: mm



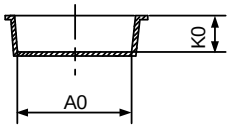
Package	Diameter Φ	Thickness W1	Width W2	W4
SOT23-5	178±2	12.30±2	9.5±2	58±4
X2DFN1×1-4	178±2	12.30±2	9.5±2	58±4

Carrier Tape UNIT: mm





SECTION B-B



SECTION A-A

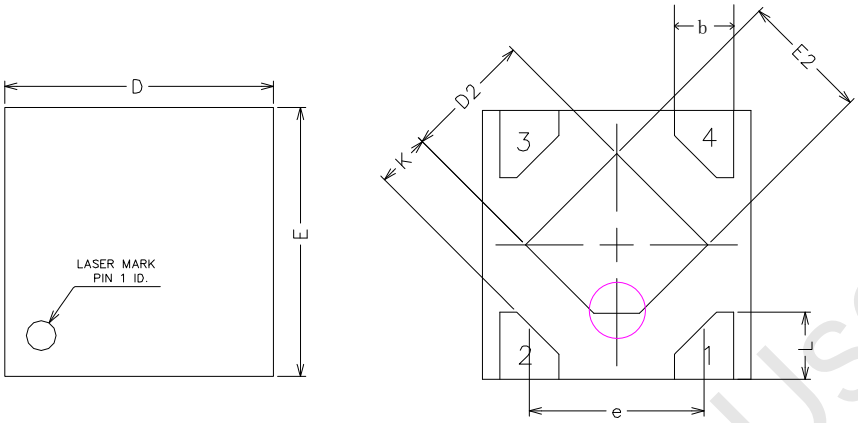
Note :

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.

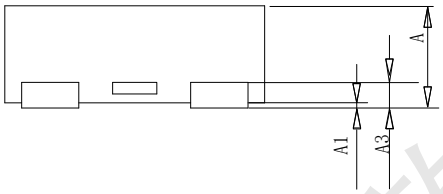
Package	Tape dimensions (mm）											
	P0	P2	P1	A0	B0	W	T	K0	Φ1	Φ2	E	F
SOT23-5	4.0±0.1	2.0±0.1	4.0±0.1	3.23±0.2	3.13±0.3	8.0±0.3	0.25±0.2	1.37±0.2	1.55±0.15	1.00min	1.75±0.1	3.50±0.1
X2DFN1×1-4	4.0±0.1	2.0±0.1	2.0±0.1	1.16±0.1	1.16±0.1	8.0±0.3	0.2±0.1	0.5±0.1	1.5±0.1	0.5±0.1	1.75±0.1	3.50±0.1

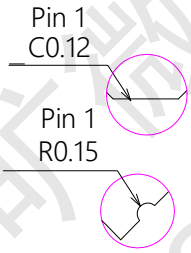
PACKAGE OUTLINE

X2DFN1x1-4 UNIT: mm

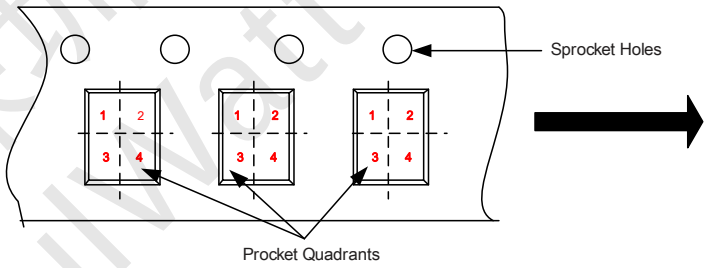


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	---	---	0.40
A1	0.00	0.02	0.05
A3	0.10	---	0.15
D	0.90	1.00	1.10
E	0.90	1.00	1.10
D2	0.38	0.48	0.58
E2	0.38	0.48	0.58
b	0.17	0.22	0.27
e	0.65BSC		
L	0.15	0.25	0.35



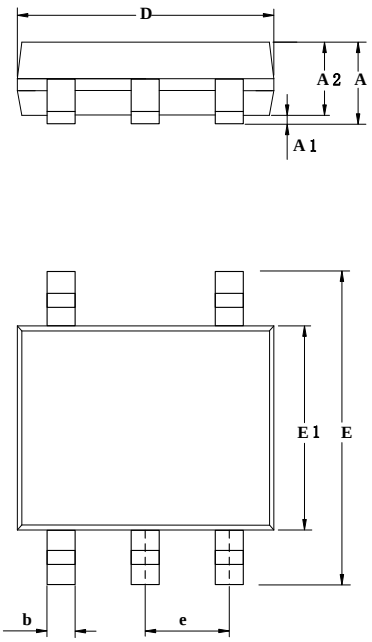


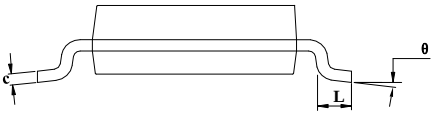
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPAE



Package Type	Pin1 Quadrant
X2DFN1×1-4	1

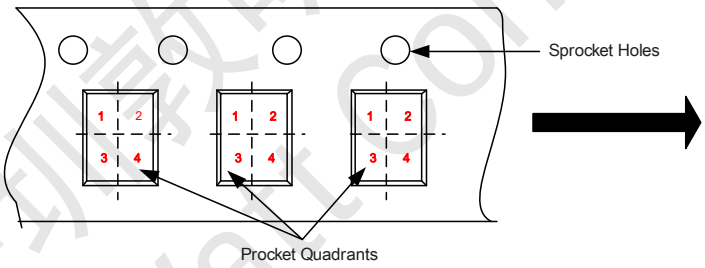
SOT23-5 UNIT: mm





SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	1.05	1.15	1.25
A1	0	0.05	0.15
A2	0.95	1.10	1.20
b	0.20	0.40	0.60
c	0.05	—	0.21
D	2.72	2.92	3.12
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
e	0.95（BSC）		
L	0.30	0.45	0.60
θ	0°	—	8°

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPAE



Package Type	Pin1 Quadrant
SOT23-5	3

IMPORTANT NOTICE

- **Joulwatt Technology Co.,Ltd reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein.**
- **Any unauthorized redistribution or copy of this document for any purpose is strictly forbidden.**
- **Joulwatt Technology Co.,Ltd does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.**
- **JOULWATT TECHNOLOGY CO.,LTD PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, SAFETY INFORMATION AND OTHER RESOURCES, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.**