

5.5V-36V 2A, Sync Step-Down Converter



XTP8421

36V 2A, Sync Step-Down Converter

XTX Technology Inc.

Tel: (+86 755) 28229862

Fax: (+86 755) 28229847

Web Site: <http://www.xtxtech.com/>

Technical Contact: fae@xtxtech.com

* Information furnished is believed to be accurate and reliable. However, XTX Technology Inc. assumes no responsibility for the consequences of use of such information or for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent rights of XTX Technology Inc. Specifications mentioned in this publication are subjected to change without notice. This publication supersedes and replaces all information previously supplied. XTX Technology Inc. products are not authorized for use as critical components in life support devices or systems without express written approval of XTX Technology Inc. The XTX logo is a registered trademark of XTX Technology Inc. All other names are the property of their respective own.

5.5V-36V 2A, Sync Step-Down Converter

General Description

XTP8421 is a synchronous step-down BUCK, which integrates high and low power field effect transistors.

XTP8421's continuous output current can reach 2A, and the ACOT control mode makes the load dynamic adjustment extremely excellent.

XTP8421 reduces switching frequency at light load to reduce switching losses and achieve high conversion efficiency within a wide load range. XTP8421 has built-in protection functions such as cycle current limiting, hiccup mode short circuit protection, and over-temperature protection. Built-in frequency dithering function easily passes EMI tests.

Features

- 5.5V to 36V Input Voltage Range
- Output current up to 2A
- ACOT control mode
- Voltage accuracy: $\pm 1\%$
- Operating frequency: 520kHz
- PFM at light load; built-in frequency jitter for easy

EMI compliance

- MOS on-resistance: 130m Ω / 80m Ω
- Internal soft start
- Adjustable output voltage from 1.16V
- Over-current protection, short-circuit hiccup mode,

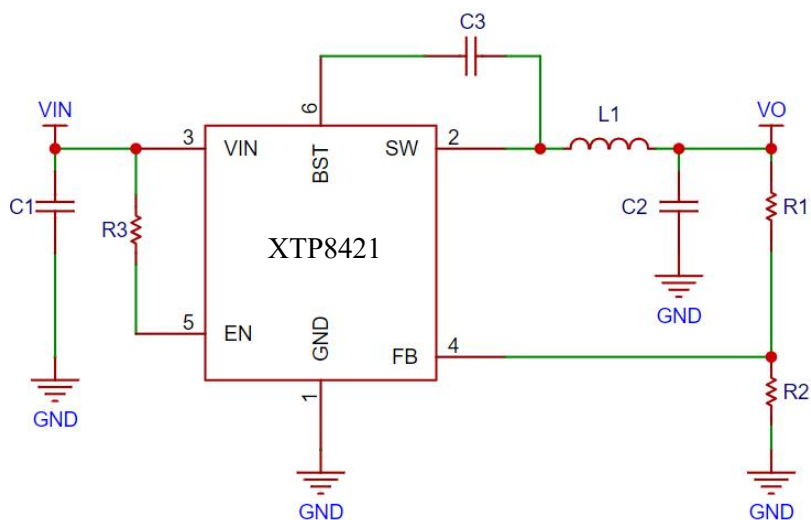
over-temperature protection

- Package: SOT23-6

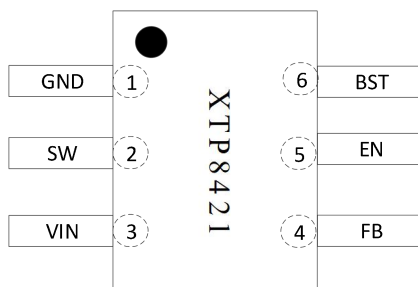
Application

- Surveillance cameras
- Home appliances
- Multi-function printers
- Automotive
- Industrial control

Typical Application Circuit



Function Order Information



SOT23-6

Pin No	Name	Description
1	GND	Ground
2	SW	Half-bridge connection node of internal high-side and low-side MOSFETs
3	VIN	The input power node
4	FB	Feedback node, with V_{FB} at 1.163V.
5	EN	Chip enable pin, pull high to turn on the chip
6	BST	Bootstrap capacitor

Order Information

Part No	Package	Top Marking	Tape & Reel
XTP8421AS3CT	SOT23-6	P8421 YWZZX	3000/Reel

MARKING INFORMATION

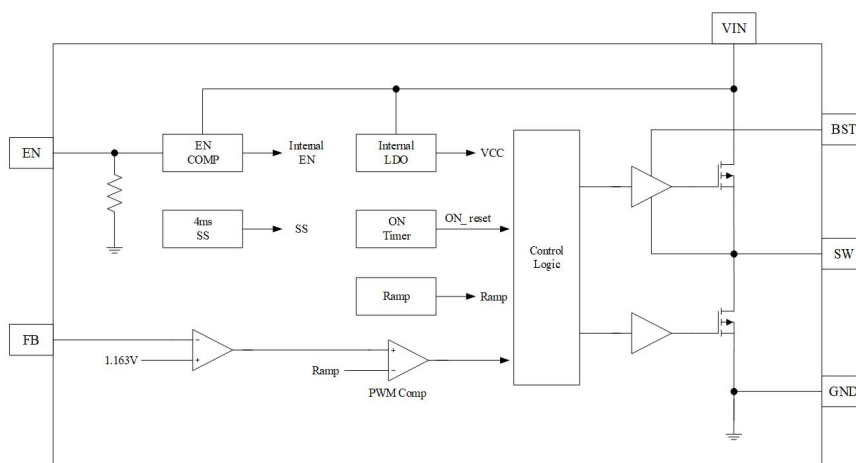
NOTE:

P8421: Device Code

YW: Date Code

ZZX: Inside Code

Function Block Diagram



Absolute Maximum Ratings

PARAMETER	Min	Typ	Max	Unit
V_{IN} to GND ₍₁₎	-0.3	-	40	V
SW Voltage	-0.7	-	$V_{IN}+0.7$	V
BST(BST TO SW)	-0.3	-	6	V
EN(Maximum input current)	-	-	100	uA
All Other Pins	-0.3	-	6	V
Junction Temperature	-40	-	150	°C
Storage Temperature	-55	-	150	°C
Thermal Resistance, θ_{JA}	-	100	-	°C/W
ESD(HBM)	2000	-	-	V

Notes: Exceeding these ratings may damage the device.

Electrical Characteristics

All typical values are at $T_J=25^{\circ}\text{C}$ (unless otherwise noted)

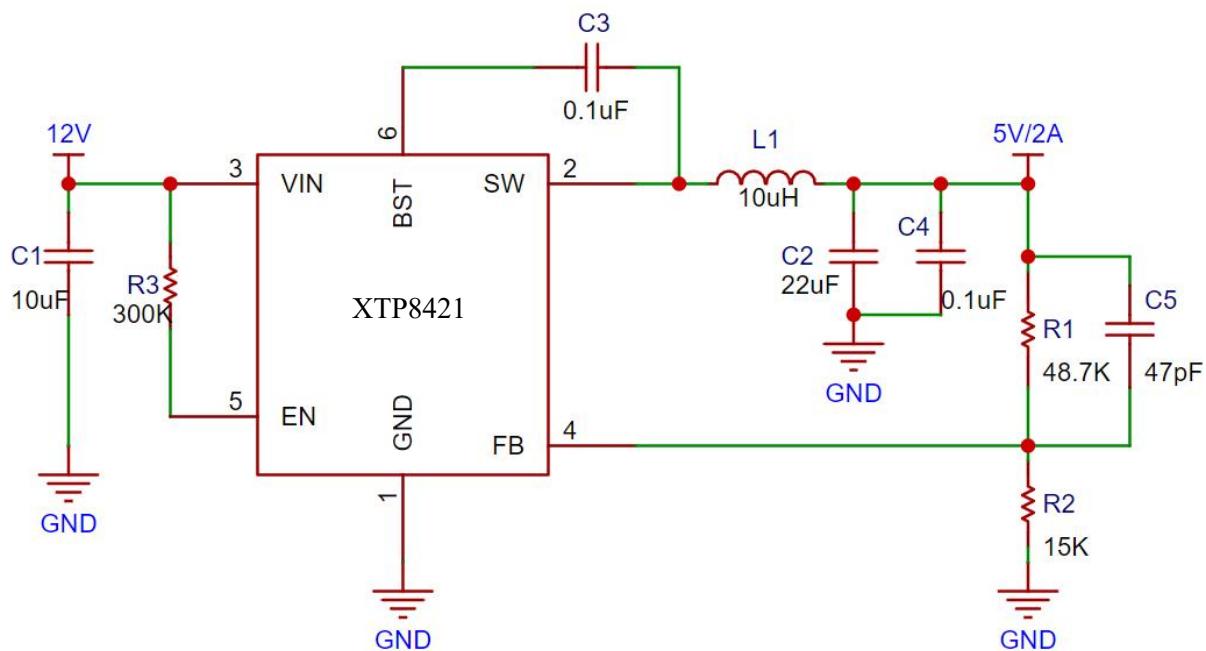
symbol	illustrate	Test conditions	scope			Unit
			Min	Typ	Max	
I_S	Shutdown Current, I_{OFF}	$V_{EN} < 0.3V$ $V_{IN}=12V$	-	0.1	0.5	μA
I_Q	Quiescent Current, I_Q	No load	-	400	-	μA
$V_{IN_{UVR}}$	V_{IN} undervoltage rising threshold		-	5.0	-	V
$V_{IN_{UVF}}$	V_{IN} undervoltage falling threshold		-	4.0	-	V
$V_{IN_{UV_hys}}$	Undervoltage lockout hysteresis voltage		-	1.0	-	V
V_{FB}	FB Voltage	$T_A = -40^{\circ}\text{C} \sim 125^{\circ}\text{C}$	1145	1163	1168	mV
		$T_A = 25^{\circ}\text{C}$	1151	1163	1174	mV
V_{EN_R}	EN Input Threshold ON		-	2.0	-	V
V_{EN_F}	EN Input Threshold OFF		-	0.8	-	V
V_{EN_Hys}	Enable hysteresis threshold		-	0.2	-	V
	EN Input Pull Down Resistor		-	-	-	$\text{K}\Omega$
F_{SW}	Switching Frequency		440	520	600	KHz
D_{MAX}	Maximum duty cycle		-	-	90	%
R_{ON-HS}	High-Side Switch On-Resistance	$V_{BST} - V_{SW} = 5V$	-	130	-	$\text{m}\Omega$
R_{ON-LS}	Low-side Switch on-resistance	$V_{BST} - V_{SW} = 5V$	-	80	-	$\text{m}\Omega$
T_{OTP_R}	OTP	output off	-	140	-	$^{\circ}\text{C}$
T_{OTP_Hys}	OTP hysteresis		-	20	-	$^{\circ}\text{C}$

Remarks:

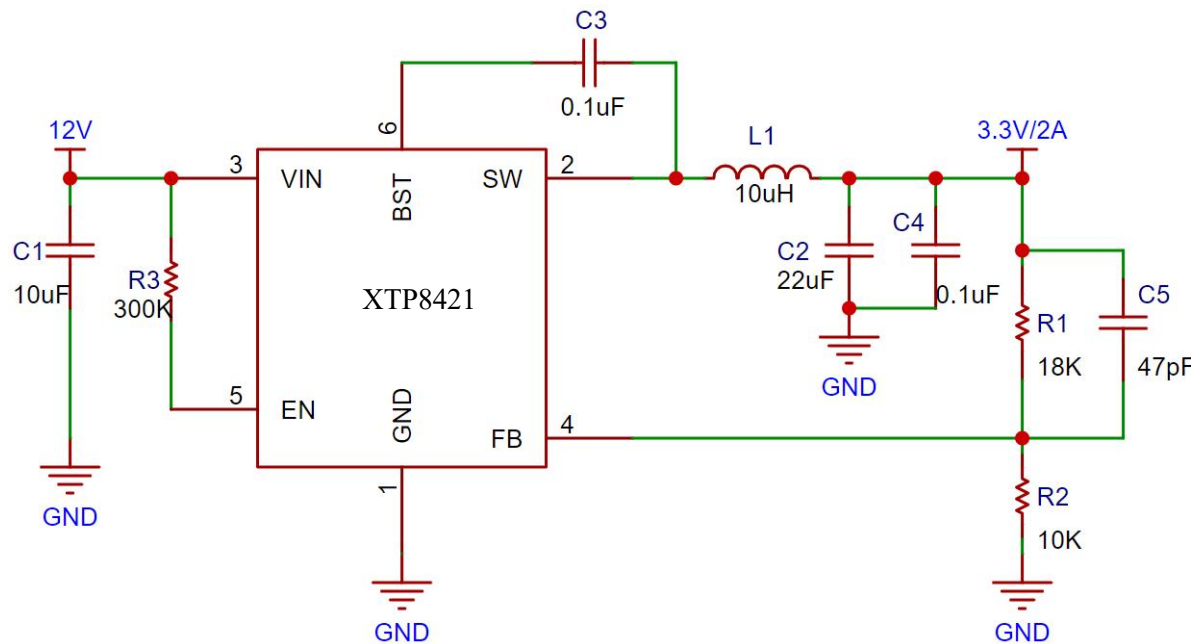
The minimum and maximum parameter ranges in the specification are guaranteed by testing, and the typical values are guaranteed by design, testing or statistical analysis.

Application Circuits

Typical application circuits



VIN=12V VOUT=5V/2A



VIN=12V VOUT=3.3V/2A

Functional Description

Pulse Width Modulation (PWM) Control

XTP8421 is a synchronous step-down switching mode converter. It adopts ACOT control mode to achieve fast transient response and stable loop operation. The duty cycle is determined by both output voltage and input voltage.

At the end of the TON period, the HS-FET turns off. When VFB falls below VREF, the HS-FET turns on again. The output voltage is regulated through this repetitive operation. With ACOT control, stable voltage is achieved even with ceramic output capacitors. Internal compensation ensures stable output under no-load conditions.

Enable Control

The enable (EN) pin is a digital control pin. The chip is enabled and starts normal operation when $EN > 2V$, and shuts down when $EN < 0.8V$. The EN pin is internally clamped to a maximum of 6V.

Under-Voltage Lockout

Under-voltage lockout (UVLO) protects the chip from insufficient supply voltage. XTP8421 monitors the input voltage via an internal UVLO comparator. The UVLO rising threshold is approximately 5.1V, and the falling threshold is approximately 4V.

Internal Soft Start

Soft start (SS) prevents output voltage overshoot during startup. When the chip starts, an internal circuit generates a soft-start voltage (VSS) rising from 0V to 1V. When VSS is lower than the REF voltage, VSS is used as the reference for the error amplifier. When VSS exceeds REF, the error amplifier uses REF as the reference. The internal VSS rise time is set to 4ms.

Over-Current Protection (OCP) and Short-Circuit Protection (SCP)

XTP8421 features valley current limiting control. The inductor current is monitored during the low-side LS-FET on-period. When the inductor current reaches the valley current limit, the LS-FET triggers the current limit comparator, and the system enters OCP mode. The HS-FET restarts only after the valley current limit condition clears.

During the HS-FET on-period, the inductor current is compared with the peak current limit. If the peak current limit is triggered, the Ton pulse terminates immediately. The output voltage drops until VFB falls below the under-voltage (UV) threshold (typically 20% below the reference). Once UV is triggered, XTP8421 enters hiccup mode and restarts periodically. In hiccup mode, the chip turns off the output and attempts soft start after a delay. If the over-current condition persists after soft start, the cycle repeats until the fault is removed and the output recovers. OCP is a non-latching protection.

Over-Temperature Protection

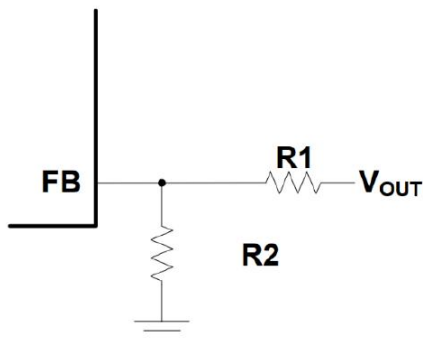
Thermal shutdown prevents operation at excessively high temperatures. The entire chip shuts down when the junction temperature exceeds the upper threshold, and restarts when the temperature drops below the lower threshold.

Application Information

Output Voltage Setting

The output voltage of XTP8421 is set by an external resistor divider. The reference voltage is fixed at 1.163V.

Formula:



$$V_{OUT} = V_{FB} \times (R1 + R2) / R2$$

Inductor Selection

For most applications, use a 3.3μH ~ 47μH inductor with a DC current rating at least 25% higher than the maximum load current. For optimal efficiency, select an inductor with low DC resistance.

Inductor value formula:

$$L = \frac{V_{OUT} * (V_{IN} - V_{OUT})}{V_{IN} * \Delta I_L * F_{OSC}}$$

ΔIL: inductor ripple current.

recommended 30% of maximum load current. Maximum inductor peak current:

$$I_{L(MAX)} = I_{LOAD} + \frac{\Delta I_L}{2}$$

Table 1. Key Component Reference Values for Common Output Voltages.

V _{OUT} (V)	R1(kΩ)	R2(kΩ)	L(μH)	C _{OUT} (μF)
5	48.7	15	10	22
3.3	18	10	10	22

Output Capacitor Selection

Output capacitors (C2, C3) suppress output voltage ripple. Ceramic, tantalum, or low-ESR electrolytic capacitors are recommended. Low ESR helps minimize ripple. Estimated output voltage ripple:

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

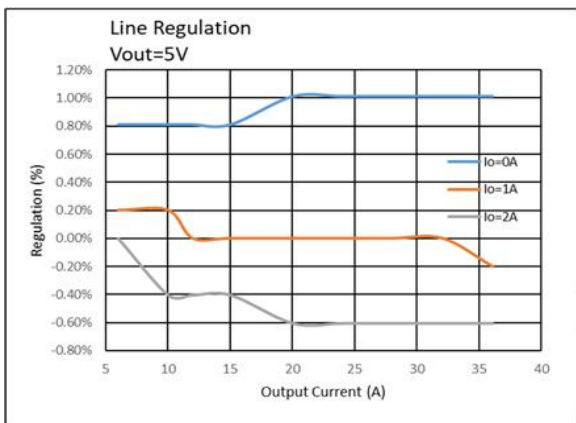
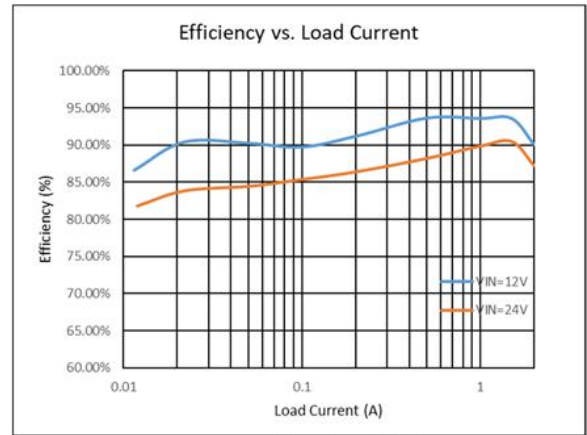
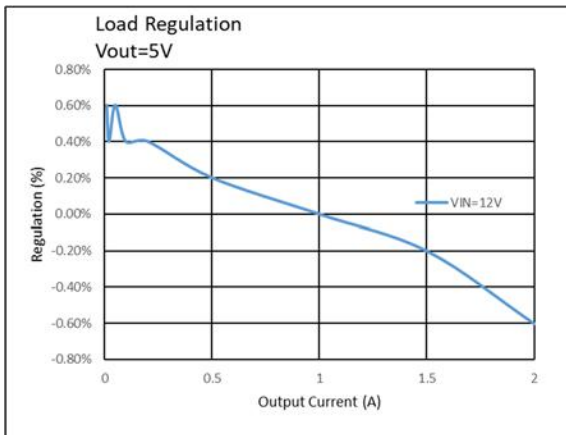
Where L is the inductance value and RESR is the equivalent series resistance (ESR) value of the output capacitor.

Capacitor characteristics affect loop stability. XTP8421 is optimized for a wide range of capacitor and ESR values.

Typical Performance Characteristics

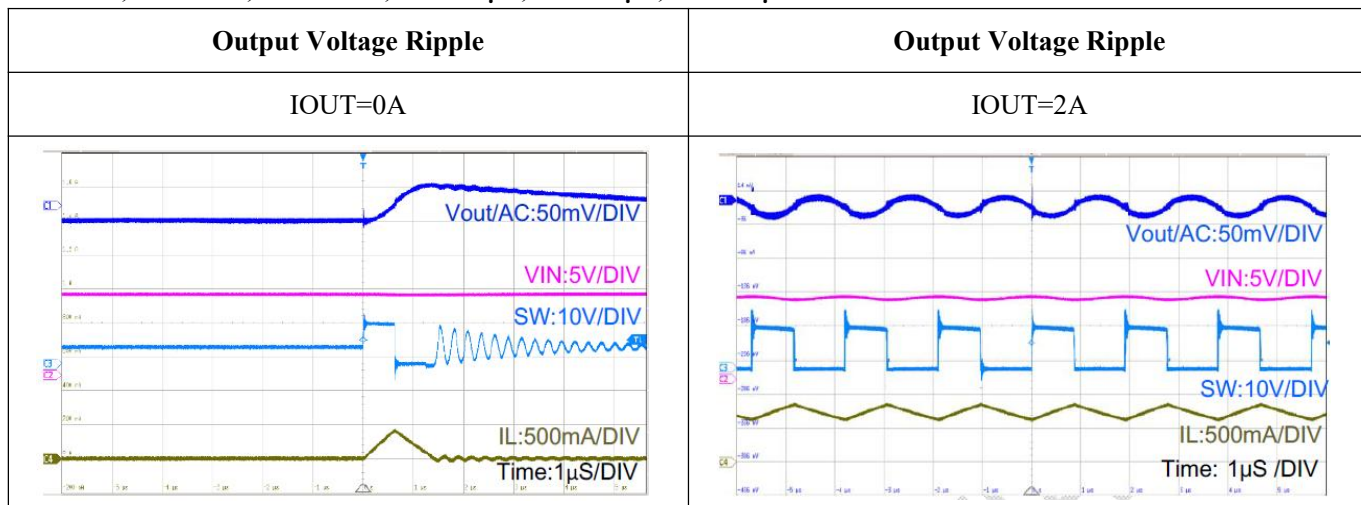
Test conditions: TA=25°C, VIN=12V, VOUT=5V, C1=10μF, C2=22μF, L1=10μH

Typical curve



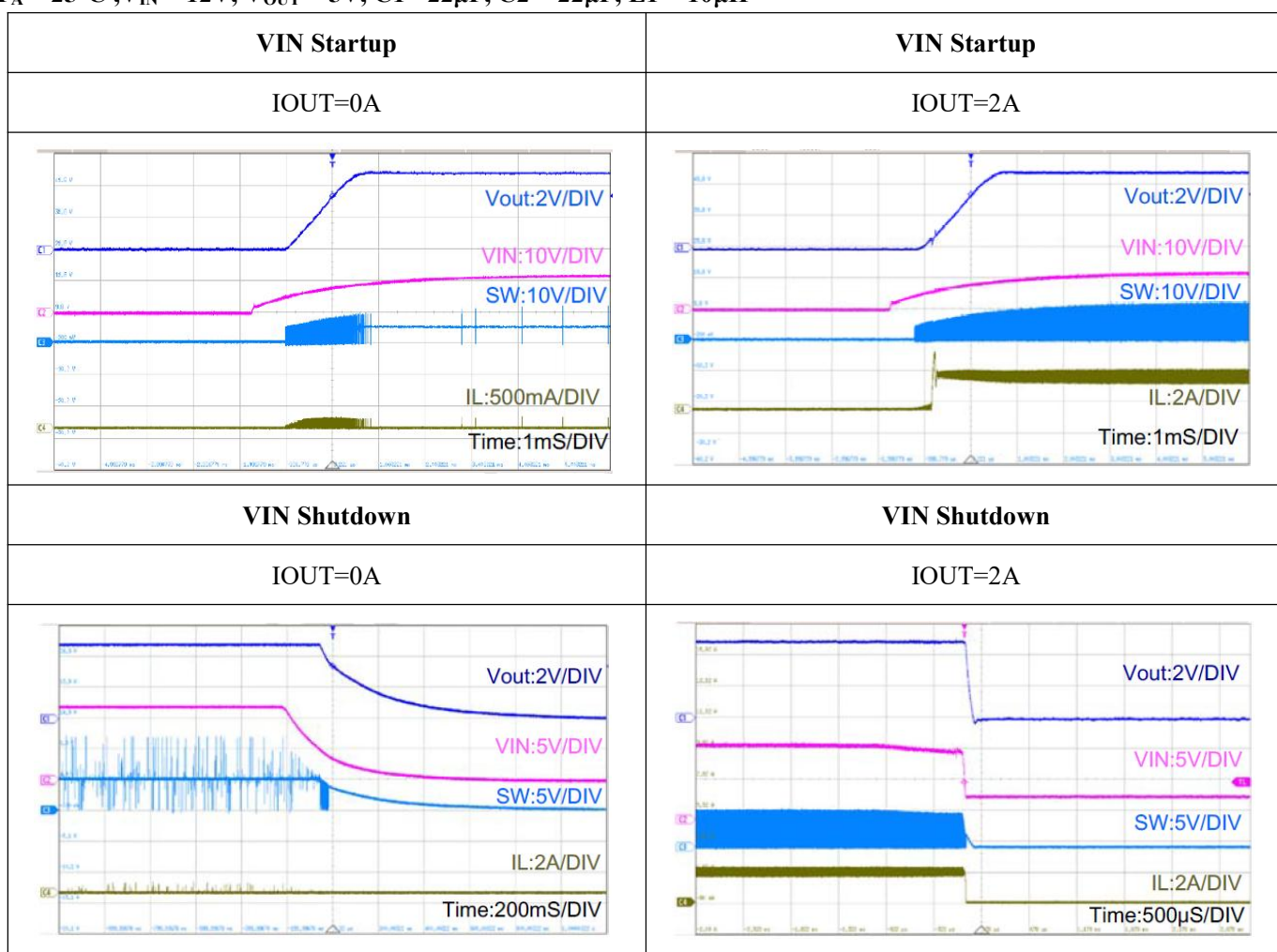
Steady-State Waveforms

$T_A = 25^\circ\text{C}$, $V_{IN} = 12\text{V}$, $V_{OUT} = 5\text{V}$, $C1 = 10\mu\text{F}$, $C2 = 22\mu\text{F}$, $L1 = 10\mu\text{H}$

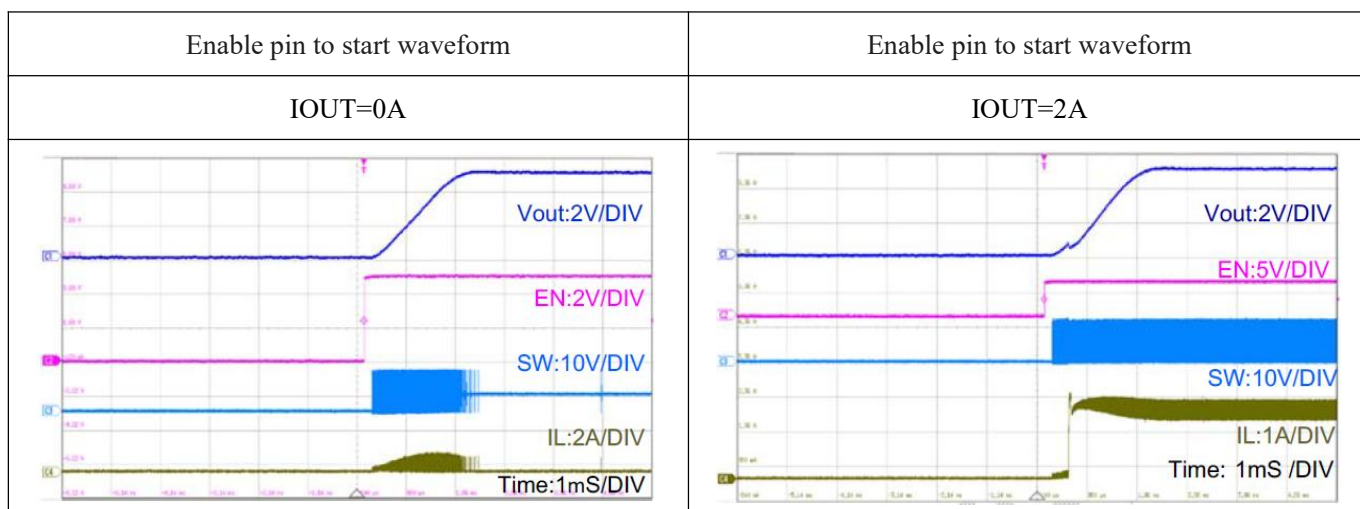


Power On/Off Waveforms

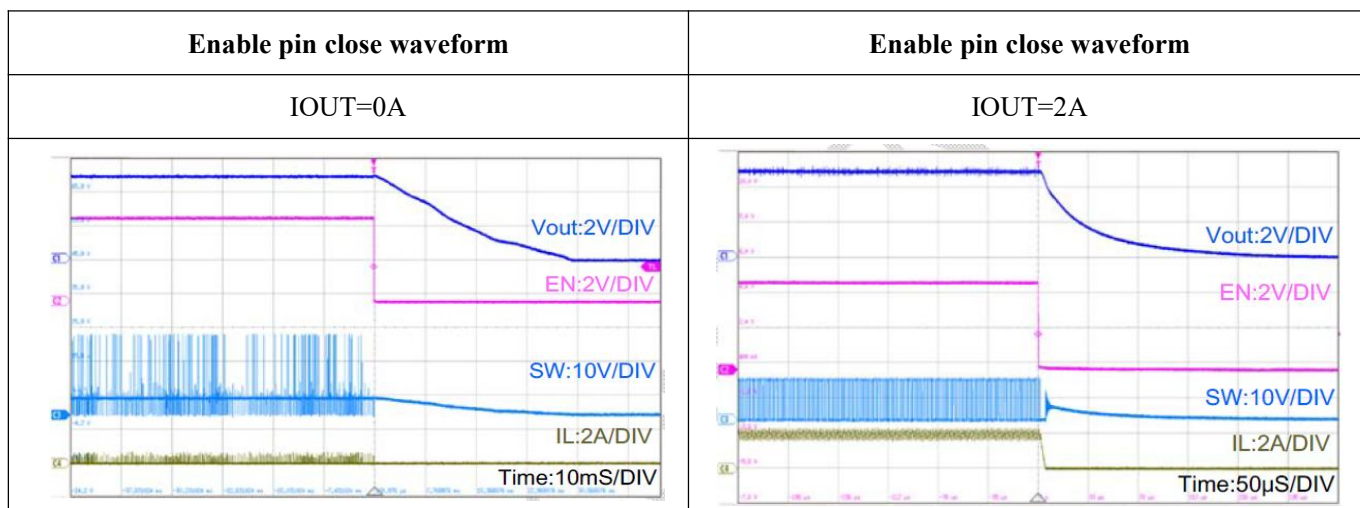
$T_A = 25^\circ\text{C}$, $V_{IN} = 12\text{V}$, $V_{OUT} = 5\text{V}$, $C1 = 22\mu\text{F}$, $C2 = 22\mu\text{F}$, $L1 = 10\mu\text{H}$



Enable Startup Waveforms

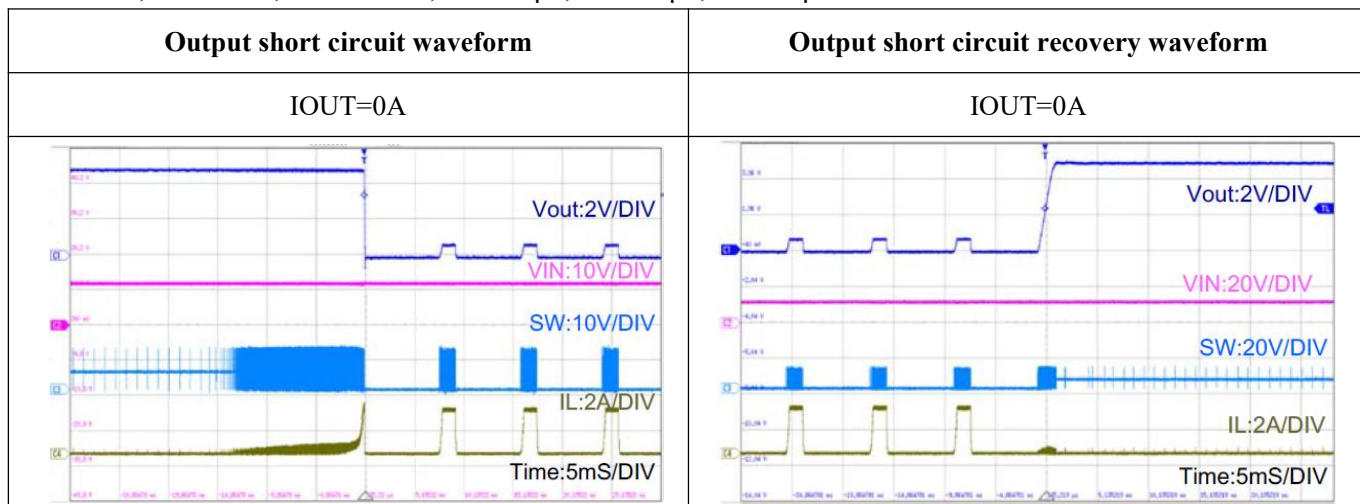


Enable Shutdown Waveforms



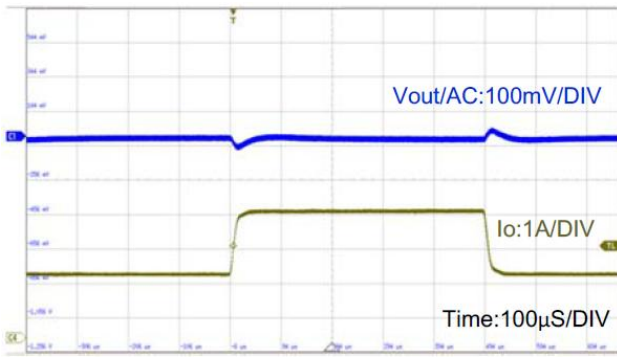
Output Short-Circuit & Recovery Waveforms

$T_A = 25^{\circ}\text{C}$, $V_{IN} = 12\text{V}$, $V_{OUT} = 5\text{V}$, $C_1 = 10\mu\text{F}$, $C_2 = 22\mu\text{F}$, $L_1 = 10\mu\text{H}$



Dynamic response

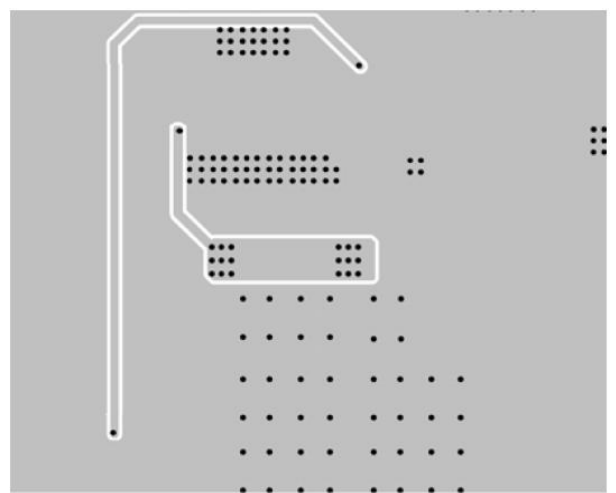
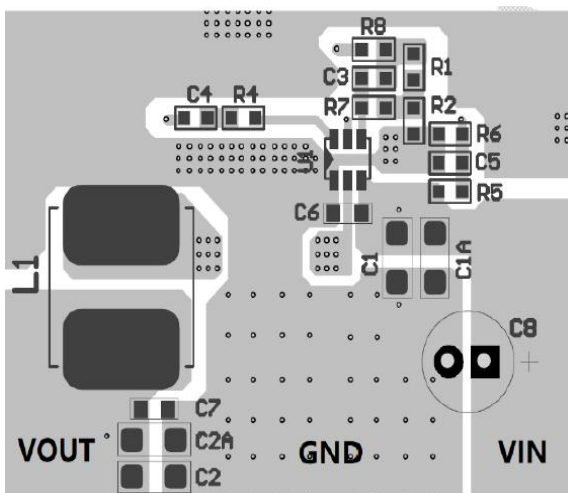
$I_{OUT} = 1A \text{ to } 2A, C_{OUT}: 2 \times 22\mu F, 2.5A/\mu s$



PCB Layout Guidelines

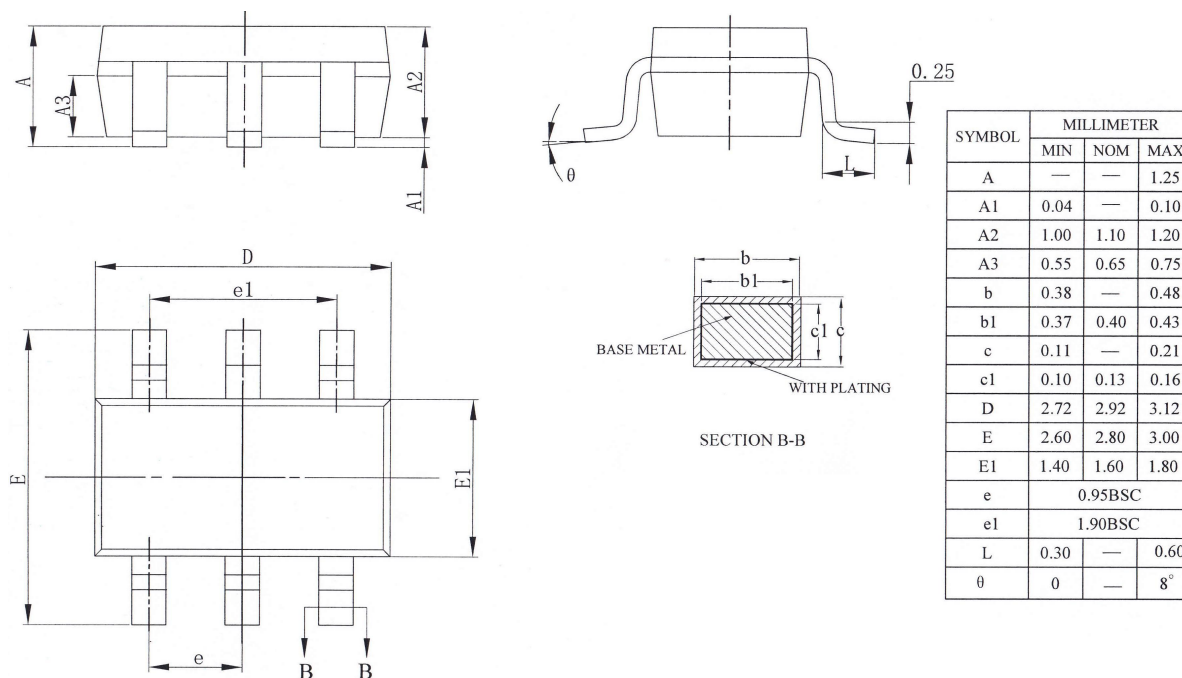
The reasonable layout of the switching power supply is crucial to the stable operation of the switching power supply. For high-frequency switching converters, poor layout design can lead to poor line or load regulation and stability problems. For best results, refer to the image below and follow the guidelines below.

1. Place input capacitor as close as possible to VIN and GND.
2. Place feedback resistors close to the FB pin.
3. Keep switching nodes (SW, BST) away from the feedback network.
4. Add thermal vias on exposed copper to improve heat dissipation.



Package Information

SOT23-6



REVISION HISTORY

Number	Date	Description
Rev 1.0	2026/04/09	XTP8421 datasheet release