

4.0V to 20V Input, 3A COT Synchronous Step-Down Converter

Features

- COT Control Mode
- Ultra-Fast Transient Response
- Compatible with Low-ESR Ceramic Capacitors
- Low Output Ripple
- 0.8V Internal Reference Voltage
- Output Voltage Range: 0.8V to 6V
- 3A Output Current
- 600KHz Pseudo-Fixed Frequency (at 5V Output)
- Light-Load Mode Switching
- 4.0V-20V Input Voltage Range
- Internal Soft Start
- Cycle-by-Cycle Valley Current Limit
- Integrated Internal Compensation
- TSOT23-6 Package

APPLICATIONS

- Digital TVs
- Home Network Terminals
- Digital Set-Top Boxes
- DSL Modems

GENERAL DESCRIPTION

The EA9206A is a synchronous step-down converter adopting Constant On-Time (COT) control scheme.

The main control loop of EA9206A operates in COT mode. It supports low-ESR ceramic output capacitors and delivers fast transient response without external compensation components. For 1.2V output, the voltage deviation is only 50mV under 0~3A load step change. The constant on-time control enables seamless transition between heavy-load PWM operation and light-load operation, maintaining high efficiency under light load conditions.

The EA9206A accepts input voltage from 4.0V to 20V, and the output voltage can be programmed between 0.8V and 6V. In addition, the soft-start time is configurable. The device integrates

over-temperature protection, under-voltage lockout and cycle-by-cycle current limiting functions.

The EA9206A is supplied in a 6-pin TSOT23-6 package.

TYPICAL APPLICATION

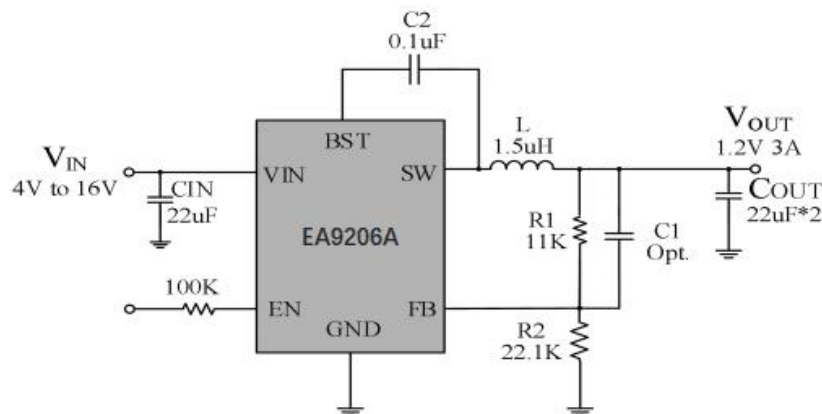


Figure 1. Basic Application Circuit

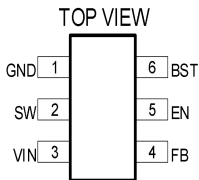
ABSOLUTE MAXIMUM RATINGS (Note 1,Note 2)

Parameter/Symbol		MIN	MAX	UNIT
Voltage range	VIN	-0.3	20	V
	VFB, VEN	-0.3	6	
	VSW	-0.3	20	
	VSW (10 ns transient)	-3	20	
	VBS vs VSW	-0.3	6	
ESD	Human Body Model(HBM)		2	kV
	Charged Device Model(CDM)		500	V
Thermal Resistance θ_{JC}			55	°C/W
Thermal Resistance θ_{JA}			100	°C/W
Junction Temperature, T_J		-40	150	°C
Storage Temperature, T_{stg}		-40	85	
Thermal Resistance θ_{JC}		-55	150	

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: T_J is calculated from the ambient temperature T_A and power dissipation P_D according to the following formula: $T_J = T_A + (P_D) \times (100^\circ\text{C/W})$.

PACKAGE/ORDER INFORMATION(Note 3,Note 4)

	Order Part Number	Package	Top Marking	Packaging
	EA9206A	TSOT23-6	X22xxx	3000pcs/reel

Note 3: Marking code definition::Y=Year, W=Week, N=Internal Trace Code.

Note 4: Moisture Sensitivity Level MSL3.

PIN DESCRIPTION

Pin Name	Pin Number	Description
GND	1	Power Ground Pin.
SW	2	Switch Node Pin.
VIN	3	Power Input Pin.
FB	4	Feedback pin for output voltage setting via external resistor divider network.
EN	5	Enable pin. High level turns on the IC; low level puts the IC into shutdown mode. A resistor of $\geq 100\text{k}\Omega$ must be connected in series if EN pin is tied to VIN.
BST	6	Bootstrap Capacitor Pin.

ELECTRICAL CHARACTERISTICS (Note 5)

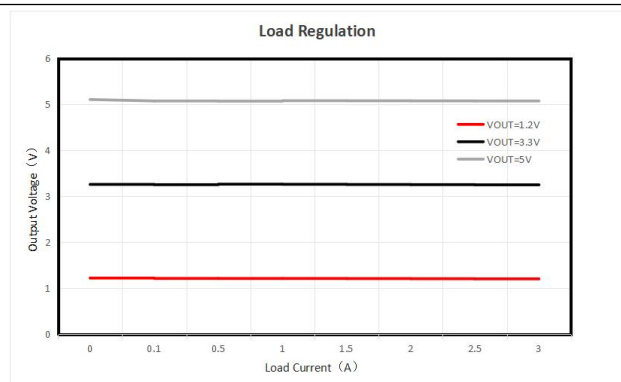
($V_{IN}=12V$, $T_A=25^{\circ}C$, unless otherwise noted.)

PARAMETER/SYMBOL		CONDITIONS	MIN	TYP	MAX	UNIT
V_{IN}	Recommended Input Voltage Range		4		18	V
I_{VIN}	Operation Quiescent Current	V_{IN} Current, $T_A = 25^{\circ}C$, $EN = 5V$, $V_{FB} = 0.9V$		340	580	μA
I_{VINSN}	Shutdown Supply Current	V_{IN} Current, $T_A = 25^{\circ}C$, $EN = 0V$		2.0	10	μA
UVLO	UVLO Rising Threshold	Input voltage rising turn-on threshold		3.9		V
		Hysteresis Voltage		0.2		
V_{EN}	EN Logic-High Voltage	EN	1.6			V
	EN Logic-Low Voltage	EN			0.6	V
V_{FB}	V_{FB} Voltage	$T_A = 25^{\circ}C$	785	800	815	mV
I_{VFB}	V_{FB} Leakage Current	$V_{FB}=0.9V, T_A=25^{\circ}C$		0	± 0.15	μA
$R_{DS(on)}$	High-Side Switch On-Resistance	$25^{\circ}C$, $V_{BST-SW}=5.5V$		80		$m\Omega$
	Low-Side Switch On-Resistance	$25^{\circ}C$		40		$m\Omega$
Tsoft	Soft-Start Time			1.0		mS
I_{ocl}	Valley Current Limit Threshold	$L=1.5\mu H$		3.5		A
t_{ON}	On-Time	$V_{IN} = 12V$, $V_O = 1.2V$		120		nS
$t_{OFF(MIN)}$	Minimum Off-Time	$T_A = 25^{\circ}C$, $V_{FB} = 0.7V$		260	330	
T_{SDN}	Thermal Shutdown Threshold	Input voltage rising turn-on threshold		170		$^{\circ}C$
		Hysteresis Voltage		30		

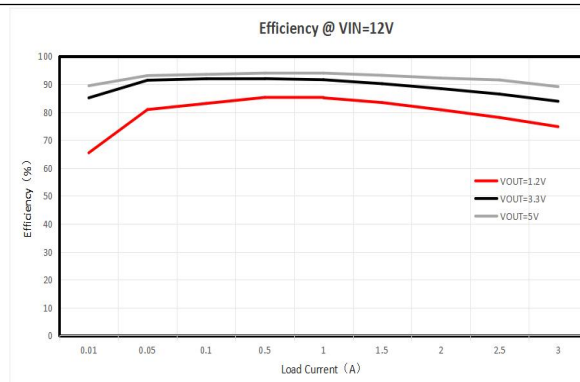
Note 5: 100% production test performed at $25^{\circ}C$. Specifications across full temperature range are guaranteed by design simulation and characterization.

TYPICAL PERFORMANCE CHARACTERISTICS

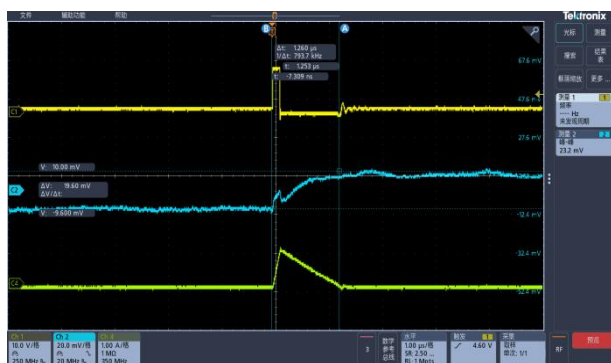
$V_{IN} = 12V$, $V_{OUT} = 1.2V$, $L = 1.5\mu H$, $T_A = +25^\circ C$, unless otherwise noted.



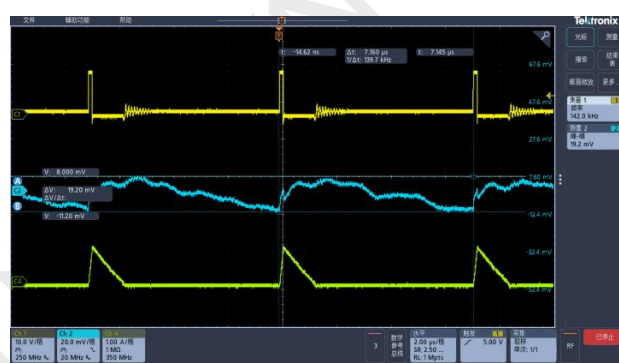
Load Regulation



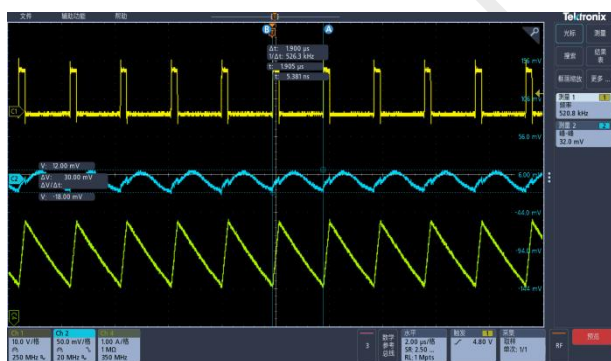
Efficiency



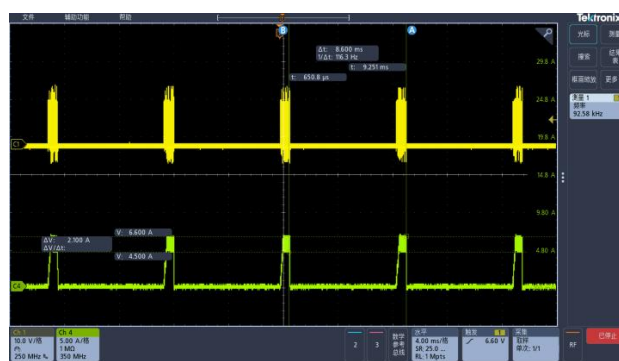
Operating Waveform @ $I_{LOAD}=0mA$



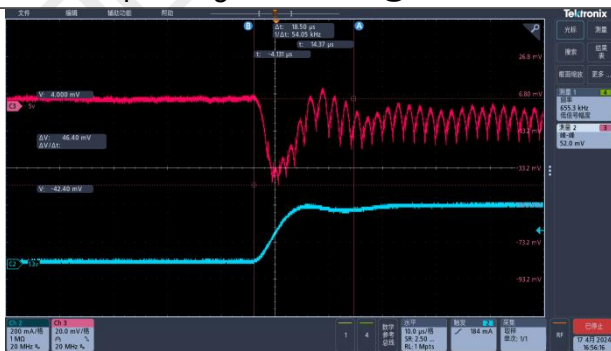
Operating Waveform @ $I_{LOAD}=100mA$



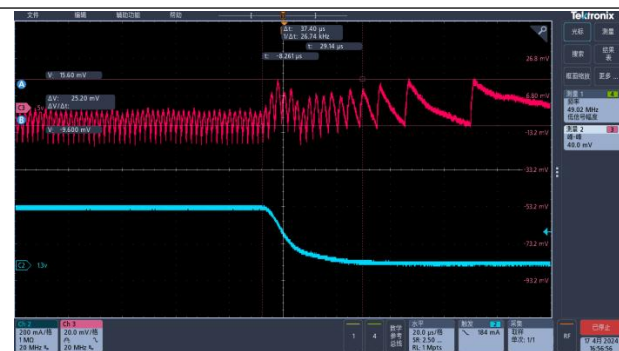
Operating Waveform @ $I_{LOAD}=3A$



Short-Circuit Protection Waveform



Load Step Transient @ $I_{LOAD}=0A$ to $3A$



Load Step Transient @ $I_{LOAD}=3A$ to $0A$



FUNCTIONAL BLOCK DIAGRAM

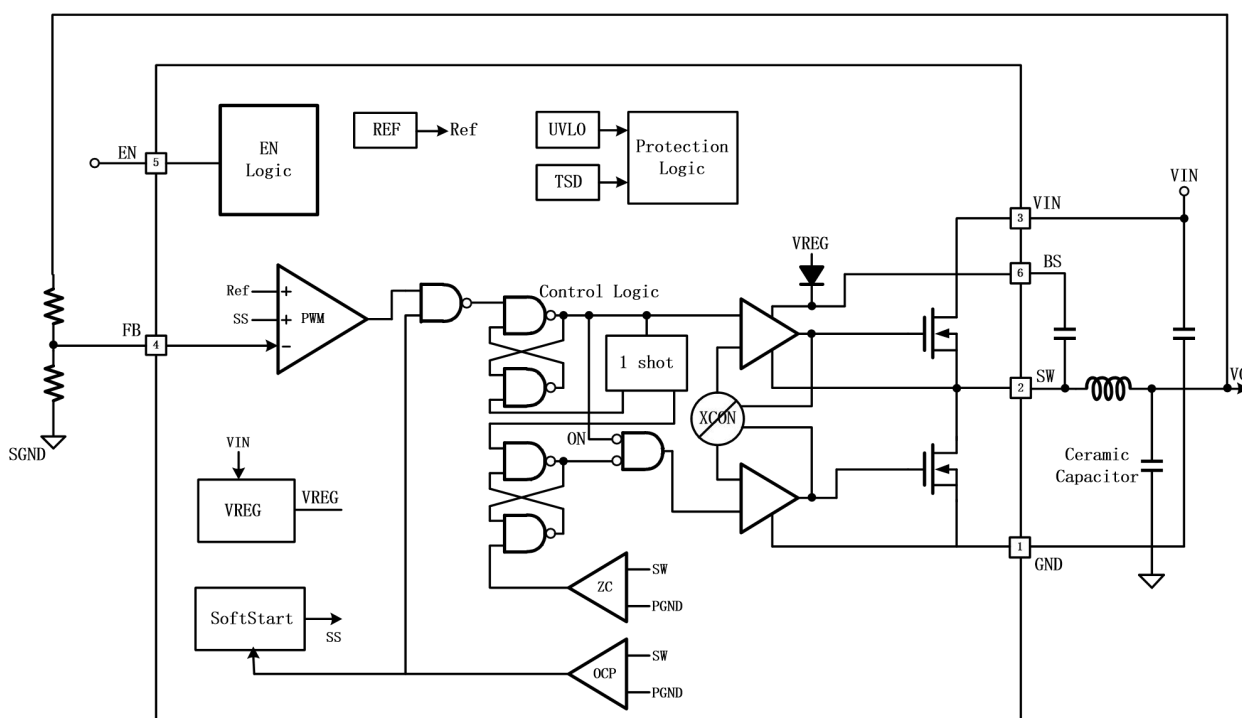


Figure 2. EA9206A Block Diagram

APPLICATIONS INFORMATION

The EA9206A is a 3A synchronous step-down converter with COT control scheme, integrating two internal N-channel MOSFETs. The COT control loop delivers outstanding transient response and eliminates the need for external compensation components. Dedicated internal circuit design allows low-ESR ceramic capacitors to be used on the output rail. The pseudo-constant frequency control architecture yields a nominal switching frequency of 600kHz.

Enable Control

EN is a digital logic pin. A high voltage level enables the converter; a low level forces the device into full shutdown mode. The EN pin is a low-voltage node clamped by an internal Zener diode. If EN needs to be tied to VIN, a series resistor of at least 100kΩ is mandatory.

Overcurrent & Short-Circuit Protection

The EA9206A implements valley current limiting for over-current and short-circuit protection. The inductor current is sensed while the low-side LS MOSFET is conducting. When the inductor valley current hits the limit threshold, the device enters over-current protection. If the output voltage collapses such that VFB falls below 75% of the internal reference, the IC triggers short-circuit protection with hiccup mode operation: the power stage is disabled, and soft-start restarts periodically.

Output Voltage Setting

The output voltage is set via an external resistor divider using Equation (1). 1% precision resistors are recommended to guarantee tight output accuracy.

$$V_{OUT} = 0.8 \times \left(1 + \frac{R1}{R2}\right) \quad (1)$$

Recommended External Component Values

The EA9206A output stage forms an LC low-pass filter. The COT control loop exhibits a double pole at the LC resonant frequency:

$$F_P = \frac{1}{2\pi\sqrt{L_{out} \cdot C_{out}}} \quad (2)$$

At the double pole frequency, loop gain rolls off at -40dB/decade with rapid phase drop. To ensure loop stability and sufficient phase margin, the component values in Table 1 are recommended.

Table 1. Recommended External Component Values

V _{OUT} (V)	R1 (kΩ)	R2 (kΩ)	C1(pF)	L(μH)	C _{OUT} (μF)
1	5.5	22.1		1.0 - 1.5	22 - 68
1.05	6.9	22.1		1.0 - 1.5	22 - 68
1.2	11	22.1		1.0 - 1.5	22 - 68
1.5	19.3	22.1		1.5	22 - 68
1.8	27.6	22.1	22 (Opt.)	1.5	22 - 68
2.5	46.9	22.1	22 (Opt.)	2.2	22 - 68
3.3	69	22.1	22 (Opt.)	2.2	22 - 68
5	116	22.1	22 (Opt.)	3.3	22 - 68

Bootstrap Capacitor Selection

A 0.1μF ceramic capacitor must be connected between BST and SW pins for proper operation.

PCB Layout Recommendations

1. The ground terminals of input and output capacitors must be placed close to the IC GND pin to minimize current loop area.
2. VIN, SW and VOUT traces carry large AC currents and shall be routed short and wide.
3. Minimize the copper area at the SW node to reduce EMI, as this node swings with high-frequency alternating voltage.
4. The FB pin is a high-impedance node; its trace must be kept as short as possible to avoid noise coupling and output voltage fluctuation. Place feedback resistors as close to the IC as possible. The GND terminal of R2 shall be routed adjacent to the IC GND pin. The trace from VOUT to R1 shall be kept away from the power inductor and SW switching node.

PACKAGE DESCRIPTION

TSOT23-6

尺寸/ 标注/ SYMBOL	尺寸/ SIZE	最小/MIN(mm)	最大/MAX(mm)	尺寸/ 标注/ SYMBOL	尺寸/ SIZE	最小/MIN(mm)	最大/MAX(mm)
A		2.820	3.020	C1		0.000	0.100
A1		0.950 (BSC)		C2		0.378	0.438
A2		0.350	0.500	D		0.300	0.600
B		1.600	1.700	θ		9° TYP4	
B1		2.650	2.950	$\theta 1$		10° TYP4	
B2		0.080	0.200	$\theta 2$		0~8°	
C		0.700	0.800				

