ELM621LA High efficiency 30V step up DC/DC converter

■General description

ELM621LA is a high efficiency step-up DC/DC converter using a constant frequency, current mode architecture. Featuring current-mode and fixed frequency operation, this device incorporates an integrated main switch and the switching frequency is internally set at 1.3MHz, allowing the use of small surface mount inductors and capacitor. As for the output voltage, it can be regulated ranging from 2.7V to 30V.

ELM621LA is available in a low profile TSOT-25 package.

■Features

- Current mode operation
- Thermal shutdown protection
- Undervoltage-lockout (UVLO)
- Input voltage range : 2.5V to 5.5V
- Internal current limit : 1.45A
- Shutdown current : < 0.1μA
- Constant frequency operation : Typ.1.3MHz
- High efficiency : 90%
- Package : TSOT-25

■Application

- Cellular telephones
- PDAs and smart phones
- MP3 players
- Wireless and DSL card
- Digital still cameras
- Slim-type DVD
- Portable instruments

■Maximum absolute ratings

Parameter	Symbol	Limit	Unit
VIN power supply voltage	Vin	GND-0.3 to +6.5	V
Apply voltage to EN	Ven	GND-0.3 to +6.5	V
Apply voltage to FB	Vfb	GND-0.3 to +6.5	V
Apply voltage to SW	Vsw	GND-0.3 to +43	V
SW peak current	Isw	2	A
Power dissipation	Pd	200	mW
Operating temperature range	Top	-20 to +85	°C
Storage temperature range	Tstg	-65 to +150	°C

Caution:Permanent damage to the device may occur when ratings above maximum absolute ones are used.

■Selection guide

ELM621LA-S

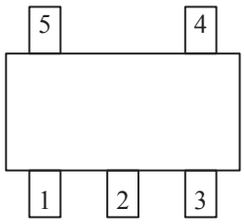
Symbol		
a	Package	L: TSOT-25
b	Product version	A
c	Taping direction	S: Refer to PKG file

ELM621LA - S
↑↑ ↑
a b c

∗ Taping direction is one way.

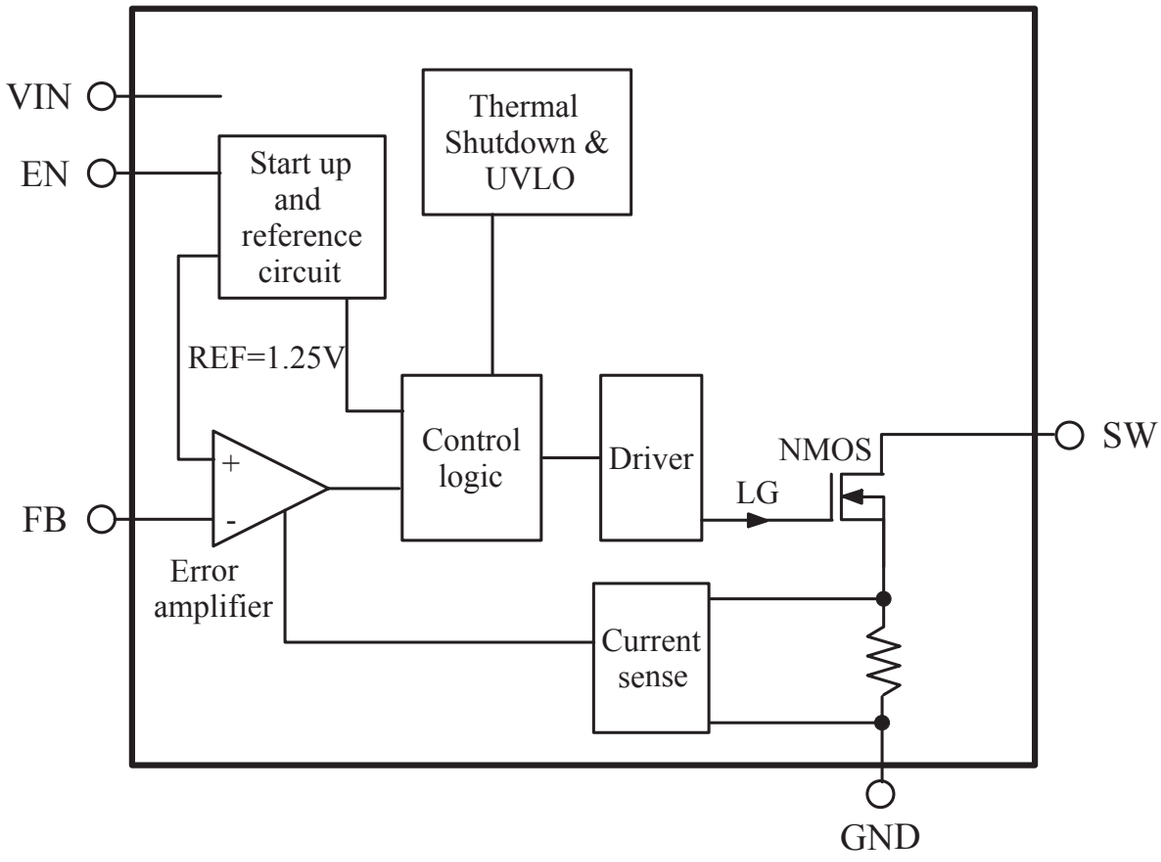
■Pin configuration

TSOT-25(TOP VIEW)

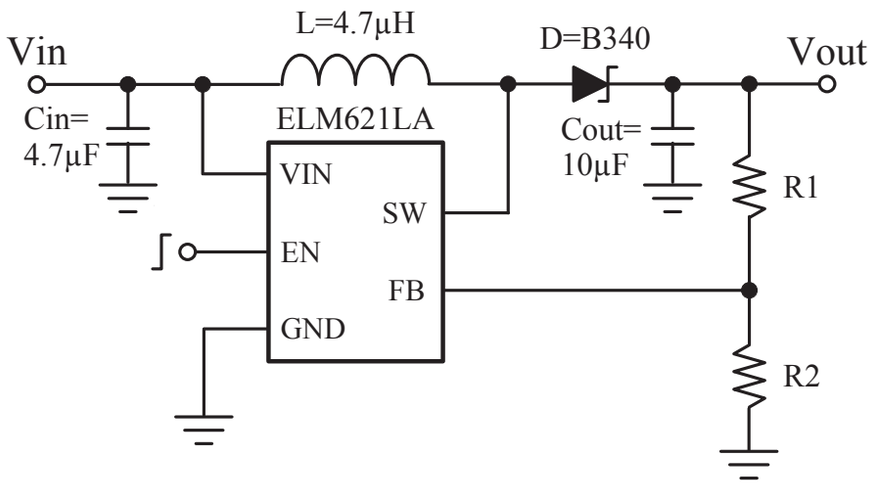


Pin No.	Pin name	Pin description
1	SW	Power switch output
2	GND	Ground
3	FB	Output voltage feedback
4	EN	Regulator enable control Input
5	VIN	Power input

■Block diagram



■Standard circuit



■DC electrical characteristics

Vin= 5V, Vout=12V, Top=25°C, unless otherwise noted

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input voltaqe	Vin		2.5		5.5	V
Output voltage	Vout		2.7		30.0	V
Feedback current	Ifb		-30.0	0.5	30.0	nA
Feedback voltage	Vfb	-20°C ≤Ta≤85°C		1.25		V
Shutdown current into VIN	Is	Ven=0V		0.01	1.00	μA
Quiescent current	Iq	Vfb=1.5V, No switching		250		μA
SW leakage current	Ileak	Ven=0V, Vout=5.5V Vlx=0V or 5.5V	-1		1	μA
SW on resistance	Rdson	lsw =-100mA		0.25		Ω
SW current limit	Ilim_sw			1.45		A
Oscillator frequency	Fosc		1.04	1.30	1.56	MHz
Thermal shutdown temperature	Ts			145		°C
EN high level input voltage	Venh	-20°C ≤Ta≤85°C	0.6			V
EN low level input voltage	Venl	-20°C ≤Ta≤85°C			0.3	V
EN input current	Ien	Ven=0V to Vin	-1		1	μA
Under voltaqe lockout	UVLO	Vin rising		2.35	2.45	V
Under voltage lockout hvsteresis	ULVOH			230		mV

■Functional description

ELM621LA is a step-up converter with the constant frequency and current-mode PWM. It provides the function to set the output voltage ranging from 2.7V to 30V by an external resistor divider. The output voltage (Vout) can be obtained by the following formula:

$$Vout = 1.25 * (1+ R1 / R2)$$

The duty cycle D of a step-up converter is defined as the following:

$$D = Ton * Fosc * 100\% \approx (1-Vin / Vout) * 100\%$$

where Ton is the main switch on time, and Fosc is the oscillator frequency.

1) Current mode PWM control

Slope compensated current mode PWM control provides stable switching and cycle-by-cycle current limit for superior load and line response and protection of the internal main switch. ELM621LA switches at a constant frequency (1.3MHz) and regulates the output voltage. The PWM comparator modulates the power transferred to the load by changing the inductor peak current based on the feedback error voltage during each cycle.The main switch is turned on for a certain time to ramp the inductor current at each rising edge of the internal oscillator under normal operation whereas off when the peak inductor current is above the error voltage.

2) Soft-start

ELM621LA features an internal soft-start function, which reduces inrush current and overshoot of the output voltage. Soft-start can be achieved by ramping up the reference voltage (Vref), which is applied to the input of the error amplifier.

3) Thermal shutdown

As soon as the junction temperature exceeds the typical 145°C, the device goes into thermal shutdown and the main switch is latched off in this mode.

4) Undervoltage-lockout (UVLO)

The undervoltage-Iockout (UVLO) circuit prevents mal-operation of the device at low input voltage. It prevents the converter from turning on the main switch under undefined conditions.

5) Shutdown

Driving the EN pin low can make the device enter the shutdown mode, during which the supply current drops to 0.01μA. The capacitance and load at the output determine the rate at which Vout decays. The Vout is connected to the input through the inductor and output rectifier, holding the output voltage to one diode drop below Vin when the converter is shut down.

6) Output voltage

The output voltage is set using the FB pin and a resistor divider connected to the output as shown in standard circuit. Schematic below. The output voltage (Vout) can be calculated according to the voltage of the FB pin (Vfb) and ratio of the feedback resistors by the following equation, where (Vfb) is 1.25V:

$$Vfb=Vout \times R_2 / (R_1 + R_2)$$

Thus the output voltage is:

$$Vout = 1.25 \times (R_1 + R_2) / R_2$$

■Application notes

1. Input and output capacitor selection

For the most optimized application of ELM621LA, 4.7μF of the input ceramic capacitor and 10μF of output ceramic capacitor are recommended. Additionally, ceramic capacitors with low ESR are recommended for better voltage filtering. Regarding the ceramic type, multi-layer ceramic (MLC) type such as X5R or X7R is recommended to ensure good capacitance stability over the full operating temperature range.

An output capacitor is required to filter the output and supply the load transient current. The high capacitor value and low ESR will reduce the output ripple and the load transient drop. These requirements can be met by a mix of capacitors and careful layout. Assuming a capacitor with zero ESR, the minimum capacitance needed for a given ripple can be obtained by the following formula:

$$Cout = (Vout - Vin) \times Iout / (Vout \times Fs \times Vripple)$$

Vripple = Peak to peak output ripple

The additional output ripple component caused by ESR is calculated using:

$$Vripple\_ESR = Iout \times Resr$$

High frequency decoupling capacitors should be placed as close to the power pins of the load as physically possible. For the decoupling requirements, please consult the capacitor manufacturers for confirmation.

2. Inductor selection

For the value of the inductor to achieve the most optimized application, it is recommended to select that ranging from 4.7μH to 15μH. The small size as well as better efficiency are the main concern for portable devices such as mobile phones. Therefore low core loss at 1.3MHz and low DCR are required for the inductor to have better efficiency. Besides, the inductor saturation current rating should be considered to cover the inductor peak current.

3. Diode selection

To get better efficiency, Schottky diode is a good choice for ELM621LA because of its low forward voltage drop and fast reverse recovery. The high speed rectification is also a good characteristic of it for the high switching frequency. The current rating of the diode must meet the root mean square of the peak current and output average current multiplication as the following: $Id(RMS) \approx (Iout \times Ipeak)$

The diode's reverse breakdown voltage should be larger than the output voltage. 40V rated Schottky diodes are recommended for outputs less than 30V, while 60V rated Schottky diodes are recommended for outputs greater than 35V.

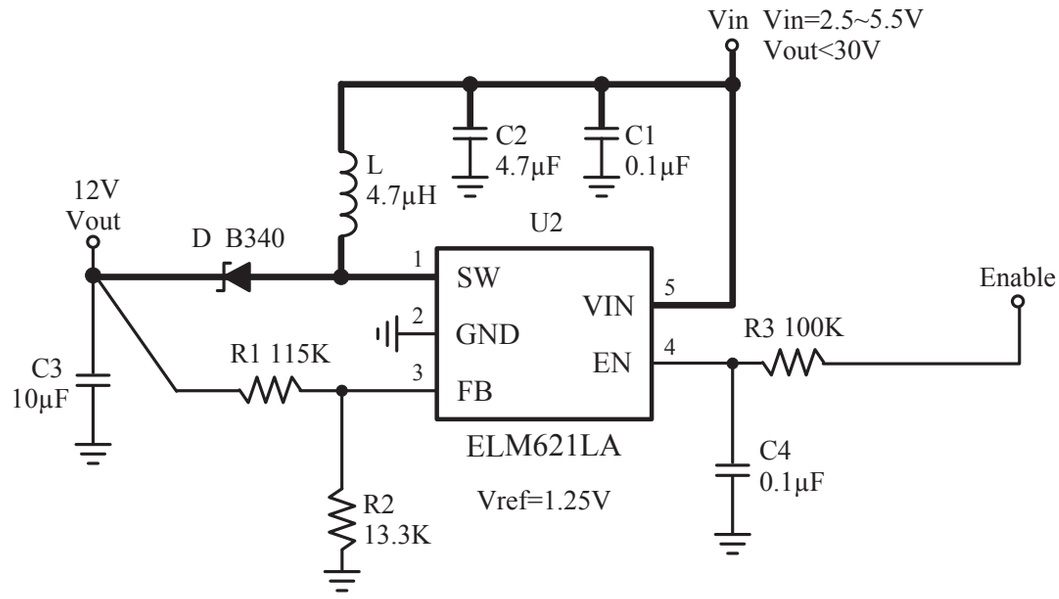
4. Layout consideration

The physical design of the PCB is the final stage in the design of power converter. If designed improperly, the PCB could radiate excessive EMI and contribute instability to the power converter. Therefore, following the PCB layout guidelines below can ensure better performance of ELM621LA.

1) The bold lines of AP Circuit1 below show the main power current paths. Keep the traces short and wide.
2) To reduce resistive voltage drops and the number of via, ELM621LA and power components (Cin. Cout and L) should be placed on the component side of the board and power current traces routed on its component layer.
3) SW node supports high frequency voltage swing (dv/dt). It should be routed small area.
4) Place input capacitor CIN as close as possible to the IC pins (VIN and GND).
5) When laying out a board, minimize trace lengths between the IC and inductor, diode, input capacitor, and out capacitor.
6) To minimize parasitical capacitor couplings and magnetic field-to-loop couplings, the power converter should be located away from other circuitry, especially from sensitive analog circuitry.

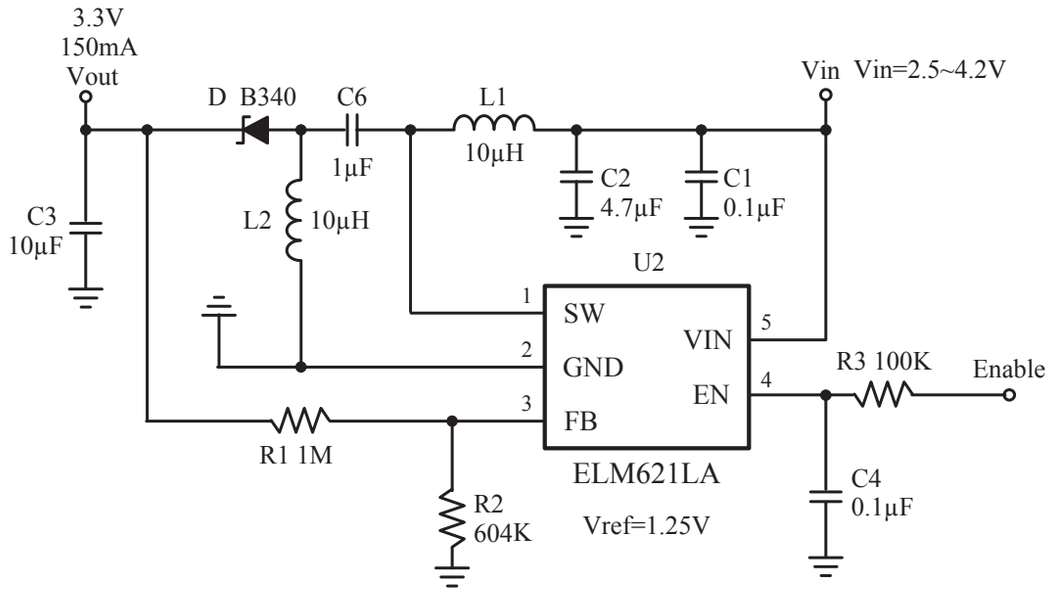
■AP circuit1 12V Step up converter

Vin 2.5V~5.5V to Vout 12V



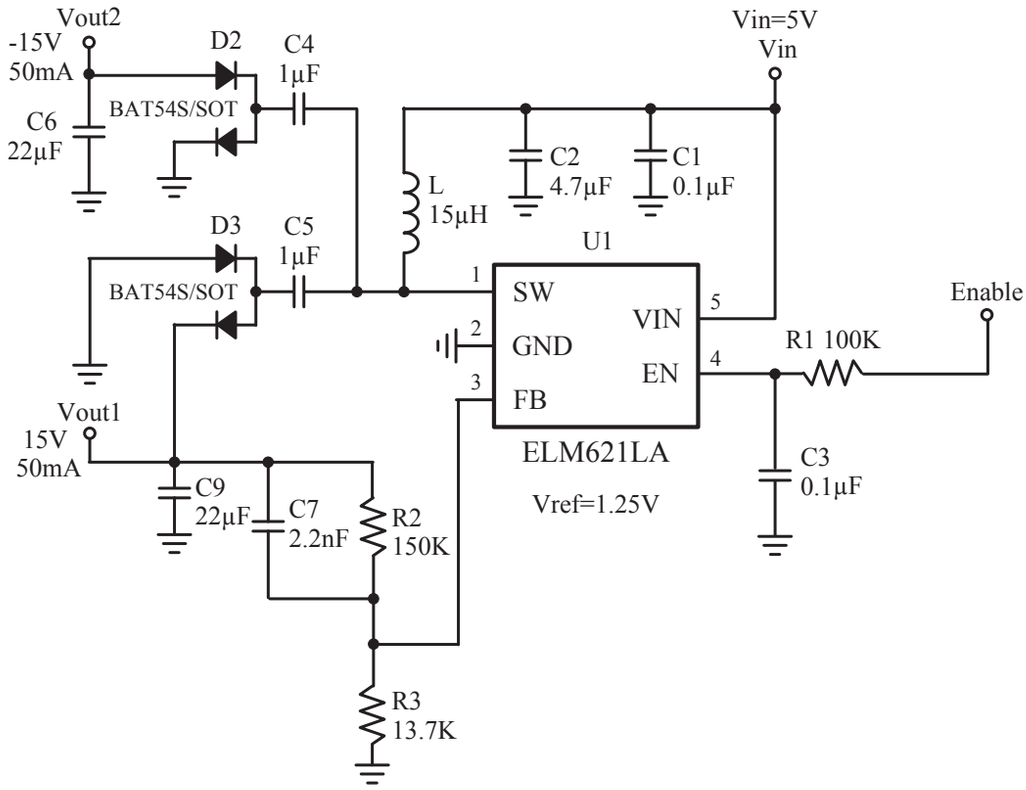
■AP circuit2 SEPIC Converter(Step up/Step down)

Step up/Step down converter is realized by ELM621LA and SEPIC topology. Vin2.5V~4.2V to Vout 3.3V.



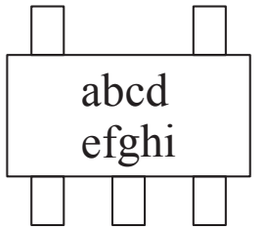
■AP circuit3 ±15V voltage converter(Charge pump circuit)

+15V and -5V are regulated from One VIn 5V by ELM621LA and charge pump circuit.



■Marking

TSOT-25

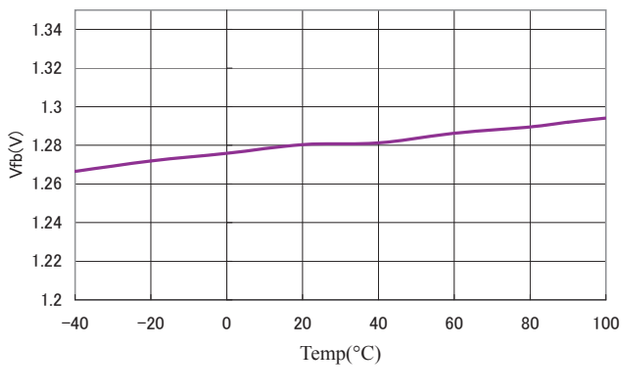


a to i : Assembly lot No. ——
A to Z (I, O, X excepted) and 0 to 9

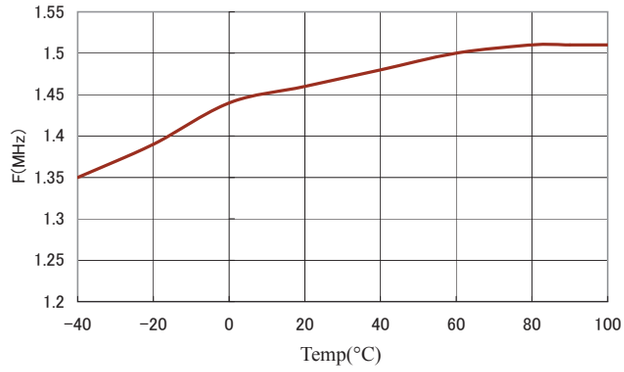
■Typical characteristics

- L=4.7µH, Cin=4.7µF, Cout=10µF, Top=25°C

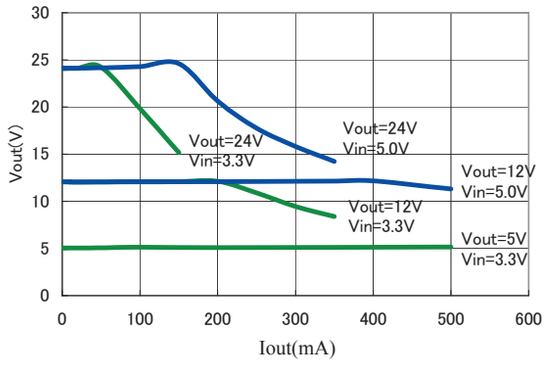
Temp-Vfb



Temp-F

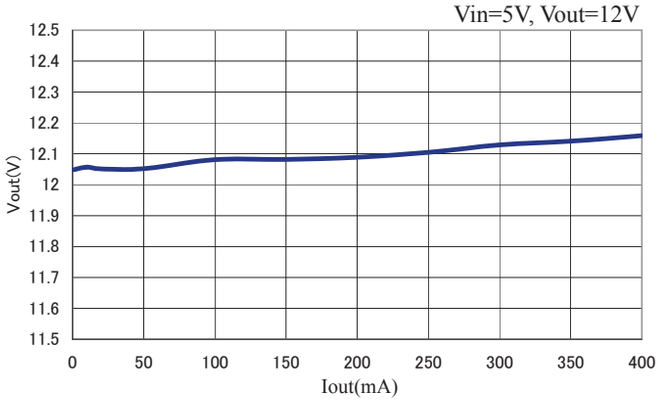


Iout-Vout

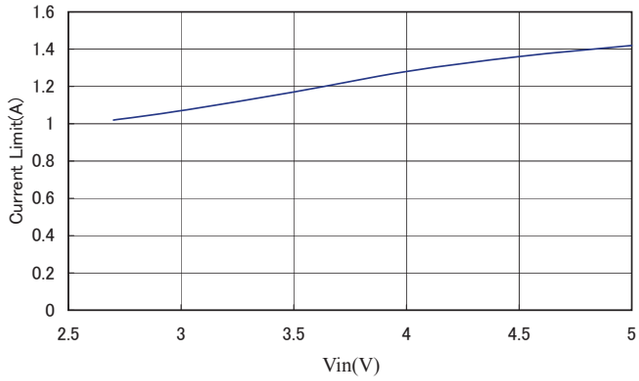


Iout-Vout

Vin=5V, Vout=12V

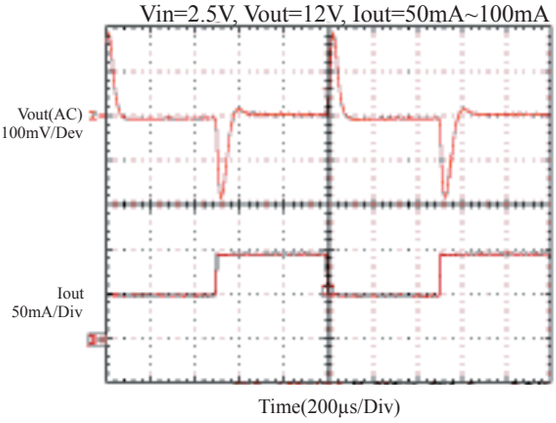


Vin-Current Limit



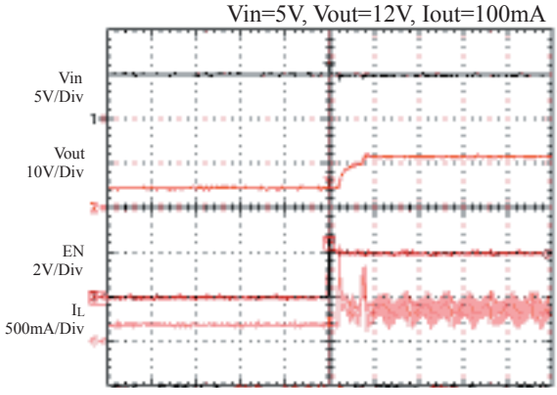
Load Transient Response

Vin=2.5V, Vout=12V, Iout=50mA~100mA



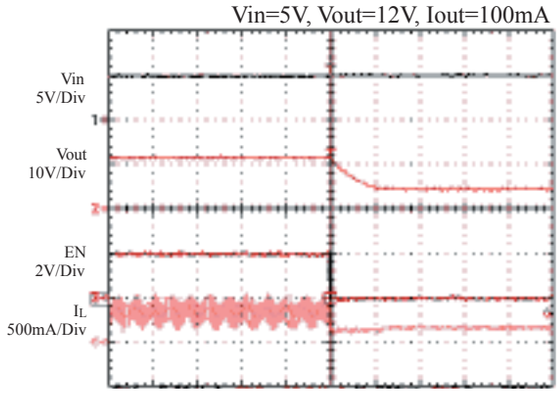
Enable On

Vin=5V, Vout=12V, Iout=100mA



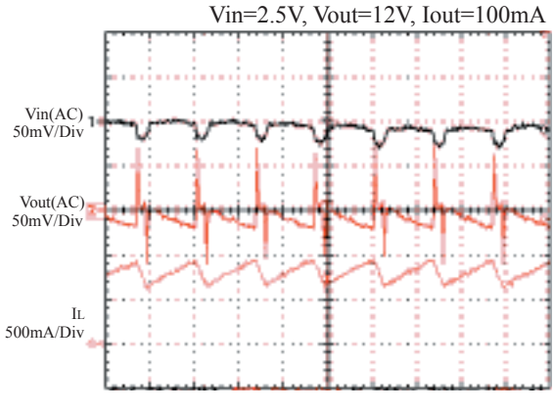
Enable Off

Vin=5V, Vout=12V, Iout=100mA



Ripple

Vin=2.5V, Vout=12V, Iout=100mA



Ripple

Vin=5.0V, Vout=12V, Iout=100mA