General Description

The EC9215 is a single PWM, step- up DC- DC controller with low operating voltage application integrating softstart and short circuit detection function. The oscillator switching frequency on chip can be operated by terminating OSC pin to connect capacitor and resistor for adjustable operating frequency. Soft- start is adjusted with the external capacitor, which sets the input current ramp. Besides, the external compensation FB pin will apply the flexibility in the dynamic loop status, which allows using small and low equivalent series resistance (ESR) ceramic output capacitors.
The EC9215 is available in a Pb- free, SOP- 8L and TSSOP-8L package.

Features

- 2.5 to 5.5V Input Voltage Range
- Adjustable Frequency: Maximum 1MHZ
- Incorporates Soft- Start Function
- Built- in Short- Circuit Detection Circuit (SCP)
- Low Operating Current: Maximum to 1mA
- Low Shutdown Current: Maximum to 1μA
- Under- Voltage Lockout
- Package: SOP- 8 and TSSOP- 8
- Lead Free and Green Devices Available (RoHS Compliant)

Applications

- LCD Display Power Source
- PDA, PMP, MP3
- Digital Camera

Pin Assignments

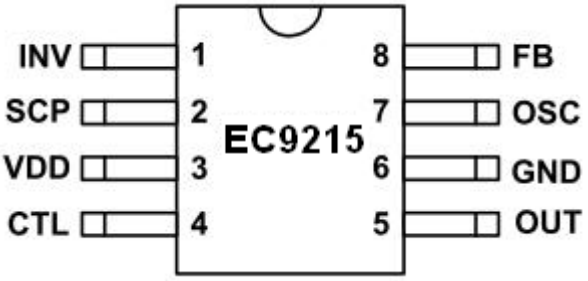
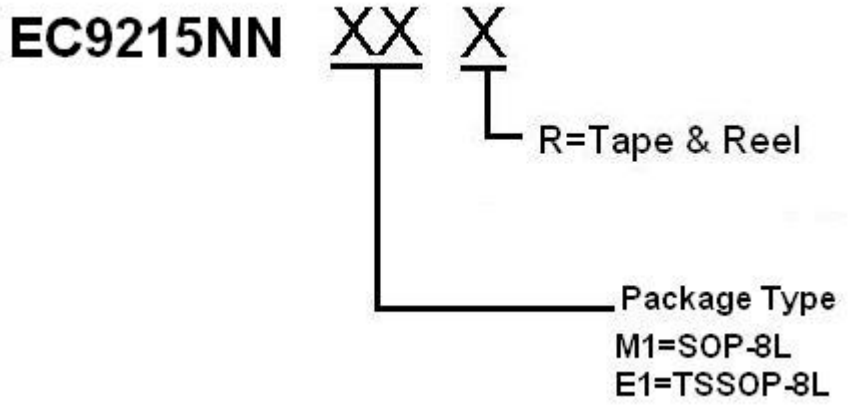


Figure1 Pin Configuration of EC9215(Top View)

Pin Description

Pin Number	Pin Name	Description
1	INV	Internal 0.5V reference voltage. Use a resistor divider to set the output voltage
2	SCP	Soft- start and short- circuit detection, connects a capacitor from the pin to ground.
3	VDD	Power supply input pin for IC voltage
4	CTL	Output control pin. Low = operating mode; High = shutdown mode.
5	OUT	External MOSFET driving pin.
6	GND	GND
7	OSC	Setting capacitor and resister to provide oscillation switching frequency adjustment.
8	FB	Error amplifier output pin. Setting circuit for IC compensation.

Ordering Information



Part Number	Package	Marking	Marking Information
EC9215NNM1R	SOP-8L	EC9215 LLLLL YYWWT	1. LLLL：Last four number of Lot No 2. YYWW：Date Code 3. T：Internal Tracking Code
EC9215NNE1R	TSSOP-8L		

Function Block

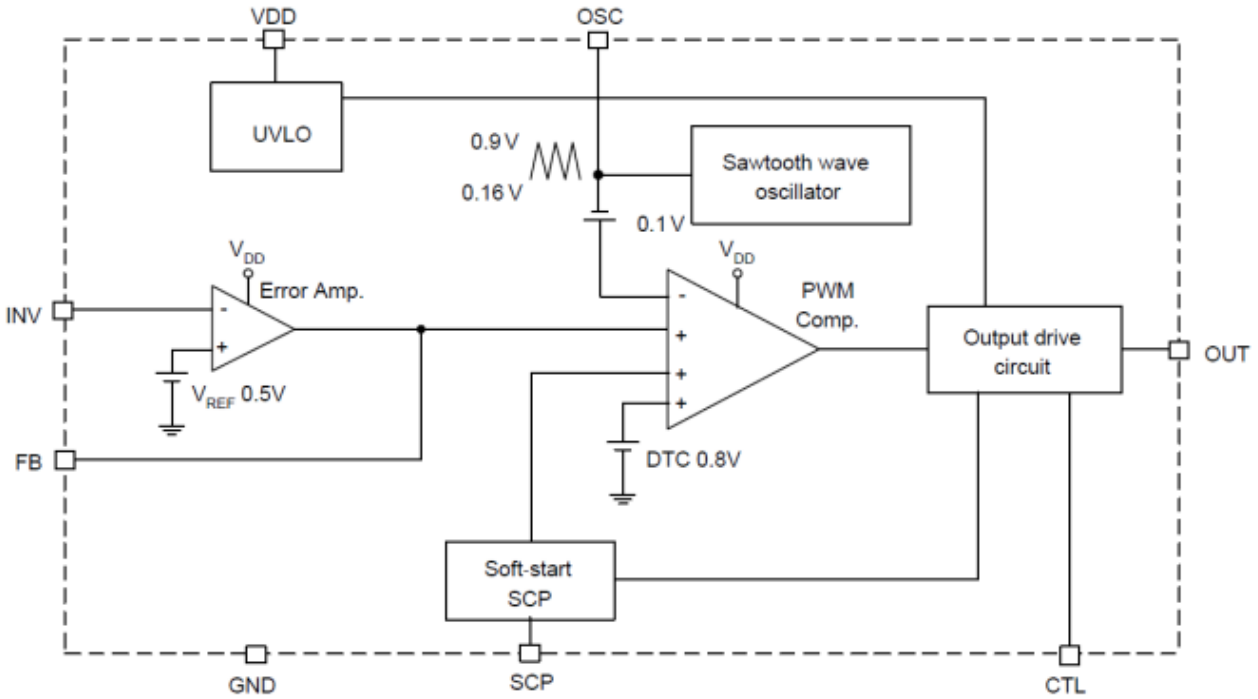


Figure 2 Function Block Diagram of EC9215

Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
V_{DD}	Supply Voltage	- 0.3 to 7	V
V_{IO}	Input/Output Pins	- 0.3 to 7	V
T_A	Operating Ambient Temperature Range	- 40 to 85	℃
T_J	Junction Temperature Range	- 40 to 150	℃
T_{STG}	Storage Temperature Range	- 60 to 150	℃
T_{SDR}	Maximum Lead Soldering Temperature, 10 Seconds	260	℃

Recommended Operating Conditions

Symbol	Parameter	Rating			Unit
		Min.	Typ.	Max.	
V_{DD}	Supply Voltage	2.5	-	5.5	V
V_{INV}	Error Amplifier Invert Input Voltage	-0.2		1	V
V_{CTL}	Control Pin Input Voltage	-0.2		V_{DD}	V
C_{SCP}	SCP Pin Capacitor		0.1		uF
R_T	Timing Resistance	1.0	3.3	10	KΩ
C_T	Timing Capacitor	100		270	pF
F_{SW}	Oscillator Frequency	200	600	1000	KHz

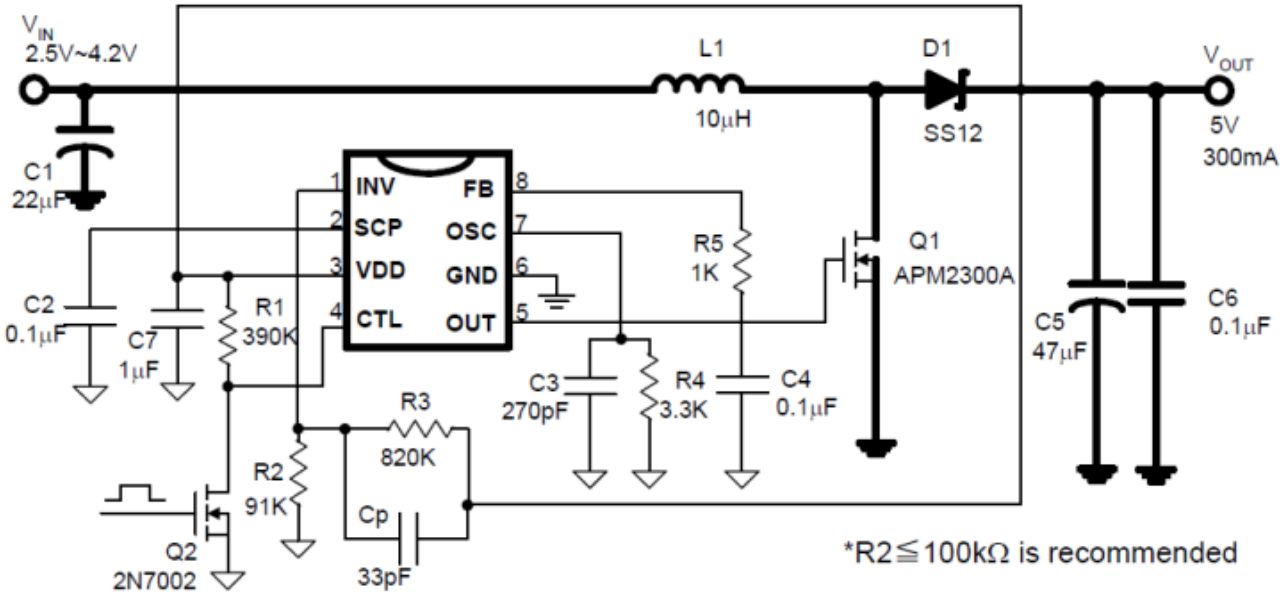
Electrical Characteristics

(VDD = 3.3V, TA = 25°C unless otherwise specified)

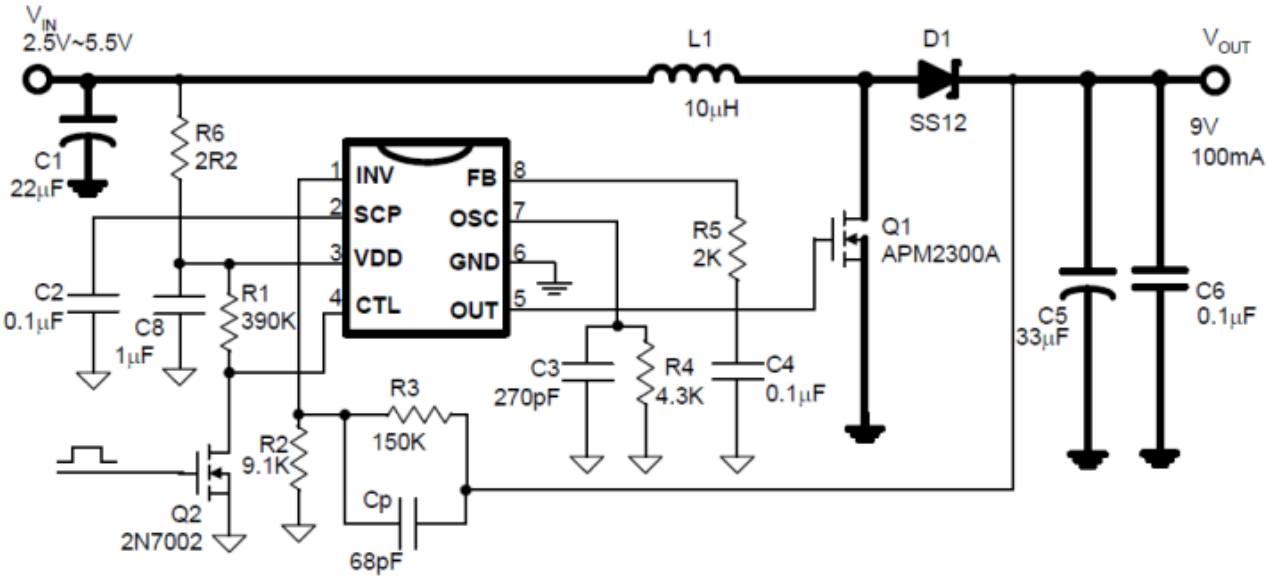
Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
ENTIRE DEVICE						
Supply Voltage	V_{DD}		2.5	-	5.5	V
Supply Current	I_{DD}	V_{DD}=2.5V to 5.5V	-	0.7	1	mA
Shutdown Current	I_{SD}	CTL pin open or VDD	-	0.1	1	μA
Maximum Duty Cycle	D_{MAX}	R_T =3.3K, C_T =270pF	80	85	92	%
UNDER- VOLTAGE LOCKOUT PROTECTION						
VDD Startup Threshold Voltage	V_{TH}	-	2.0	-	2.4	V
Hysteresis voltage	V_R	-	-	150	-	mV
SOFT- START						
Voltage at Soft- Start Completion	V_{SS}	-	0.7	0.8	0.9	V
Soft- Start Charge Current	I_{CS}	V_{SCP} =0V	- 0.7	- 1.0	- 1.5	μA
Voltage at Soft- Start Completion	V_{SS}	-	0.7	0.8	0.9	V
Soft- Start Charge Current	I_{CS}	V_{SCP} =0V	- 0.7	- 1.0	- 1.5	μA
SHORT CIRCUIT PROTECTION (SCP)						
Threshold Voltage	V_{SCP}		0.7	0.8	0.9	V
Charge Current	I_{SCP}	V_{SCP} =0V	- 0.7	- 1.0	- 1.5	μA
SAWTOOTH WAVEFORM OSCILLATOR (OSC)						
Oscillator Frequency	F_{OSC}	RT =3.3k, CT =270pF	500	600	700	kHz
Frequency Stability for Voltage	F_{DV}	V_{DD}=2.5V to 5.5V	-	2	5	%
Frequency Stability for Temperature	F_{DT}	T_A=- 40°C to 85°C	-	5	-	%
ERROR AMPLIFIER						
Reference Voltage	V_{REF}	V_{FB}=INV	0.490	0.5	0.510	V
VREF Stability		V_{DD}= 2.5V to 5.5V		5	20	mV
VREF Variation with Temperature		TA=-40℃ to 85℃		1		%
Transconductance	gm		1000	1300	1600	uA/V
Input Bias Current	I_B	INV=0V			1	uA
Output Voltage Range	V_{OH}		1.6	1.8		V
	V_{OL}				0.01	V

Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Output Source Current		INV=0V,FB=0.5V	-150	-180	-210	uA
Output Sink Current		INV=1V,FB=0.5V	140	170	200	uA
PWM CONTROLLER DRIVER						
Output Source Current	I_{SOURCE}	Duty<5%,OUT=0V	-150	-200		mA
Output Sink Current	I_{SINK}	Duty>5%,OUT=5V	150	200		mA
CONTROL BLOCK						
Control Voltage	V_{IL}	Active mode			$0.2V_{DD}$	
	V_{IH}	Switch-off mode	$0.8V_{DD}$			

Typical Application Circuit

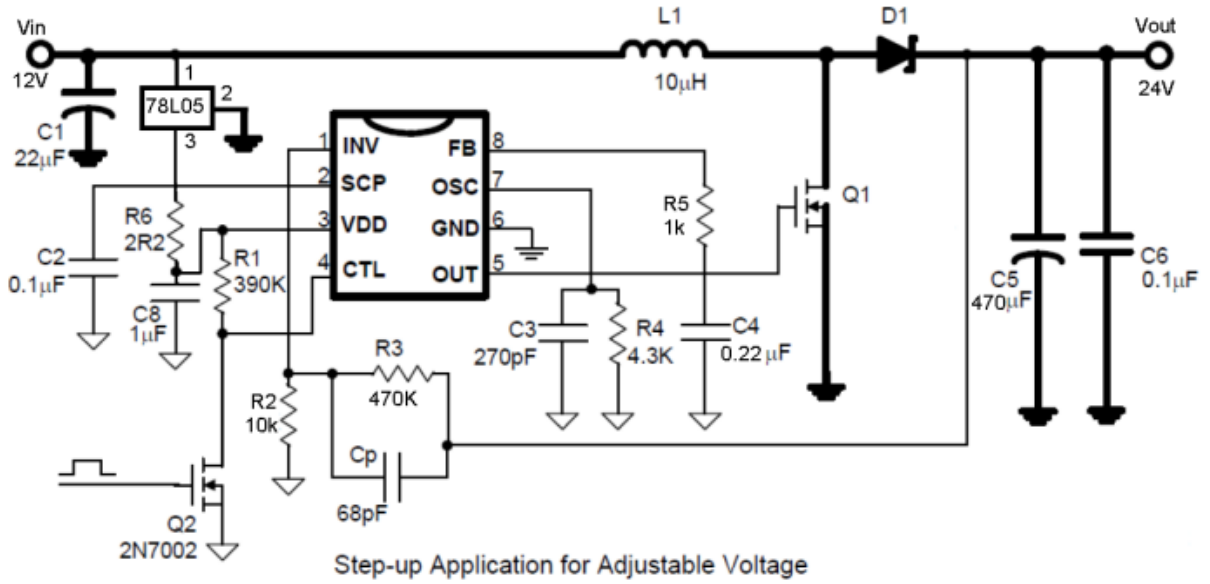


Step-up Application for Adjustable Voltage

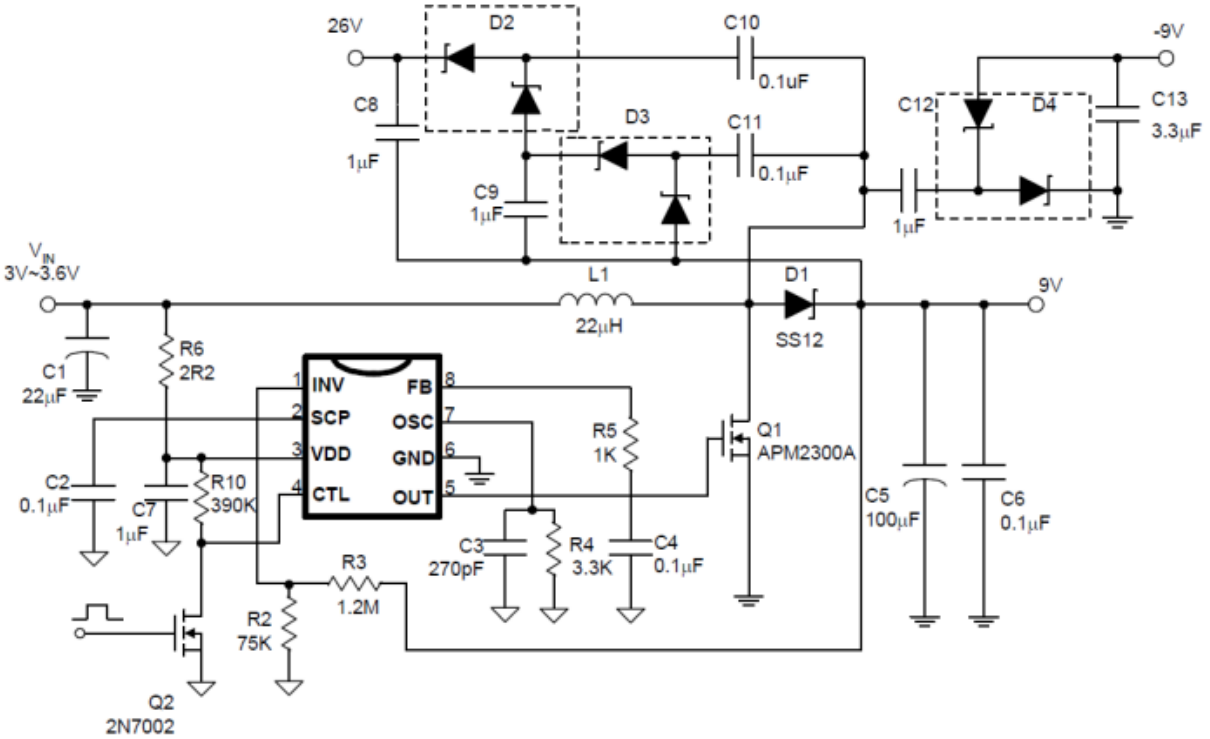


Step-up Application for Adjustable Voltage

Typical Application Circuit

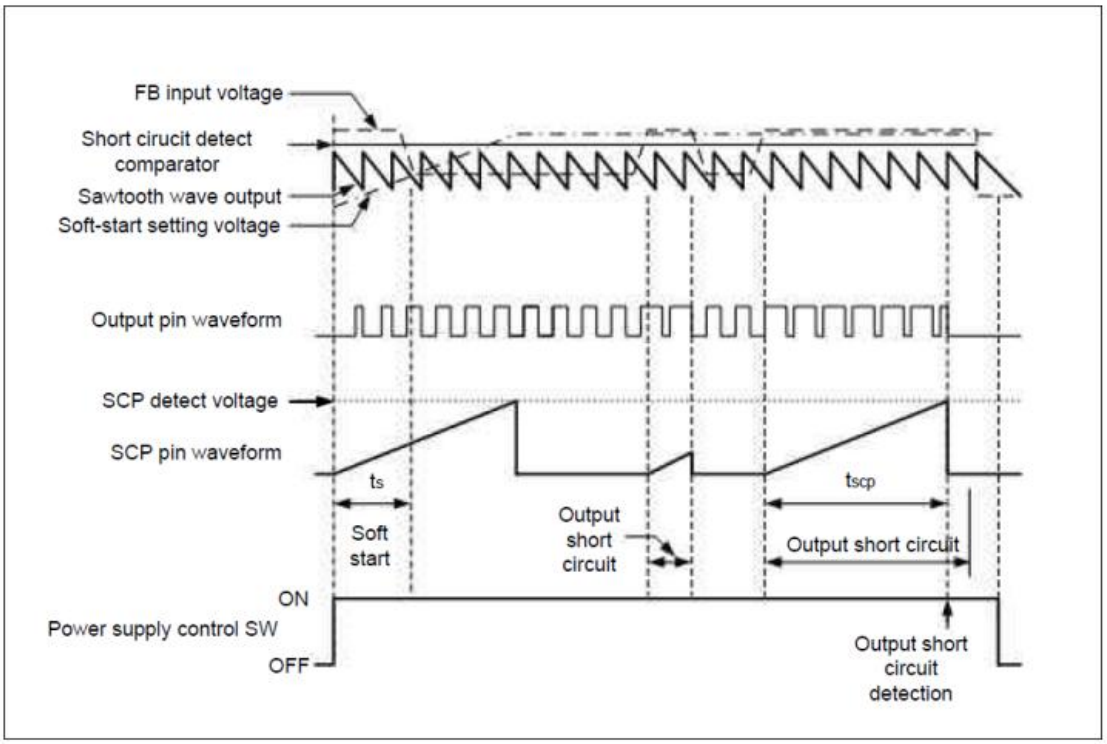


Step-up Application for Adjustable Voltage



Multiple-output for TFT LCD Panel Power

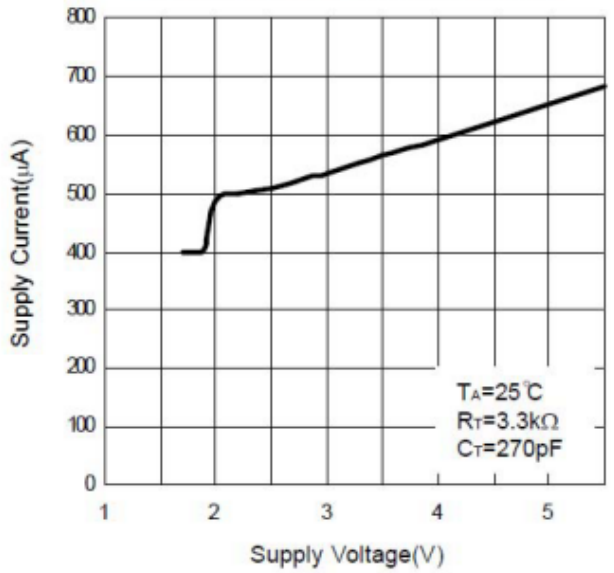
Timing Diagram



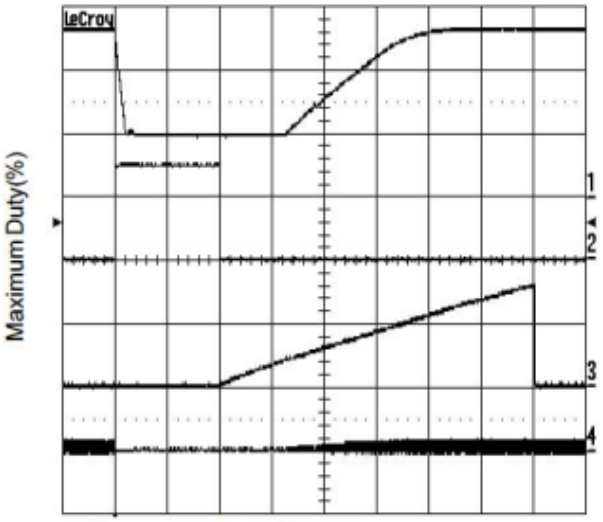
Typical Performance Characteristics

(T_A=25,V_{DD}=3.3V,unless otherwise specified)

Supply Current vs. Supply Voltage

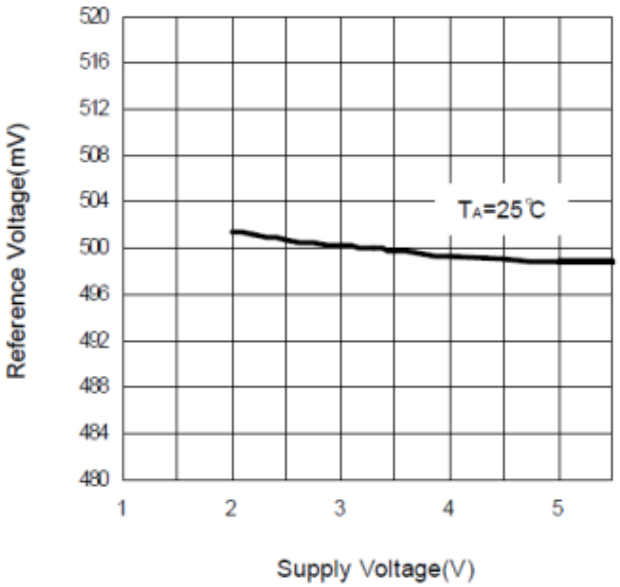


SHDN and Release

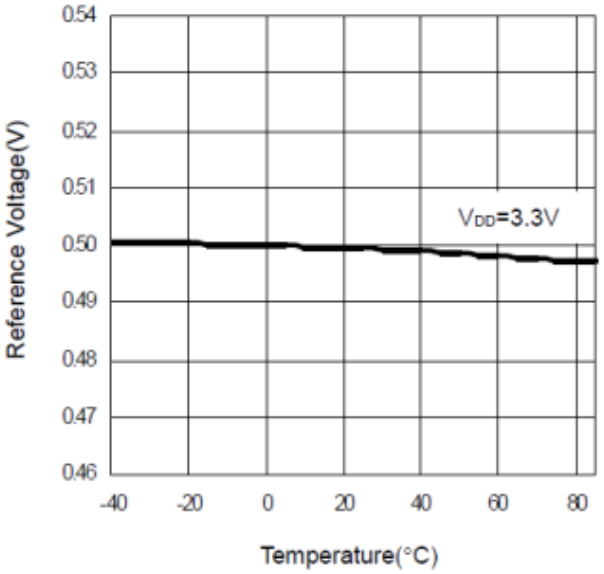


CH1=V_{OUT} 2V/DIV TIME=20ms/DIV
CH2=V_{CTL} 2V/DIV
CH3=V_{SS} 0.5V/DIV
CH4=I_L 1A/DIV

Reference Voltage vs. Supply Voltage



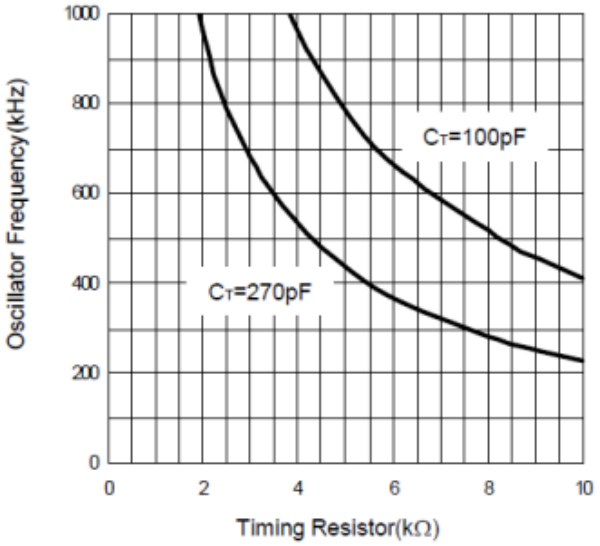
Reference Voltage vs. Temperature



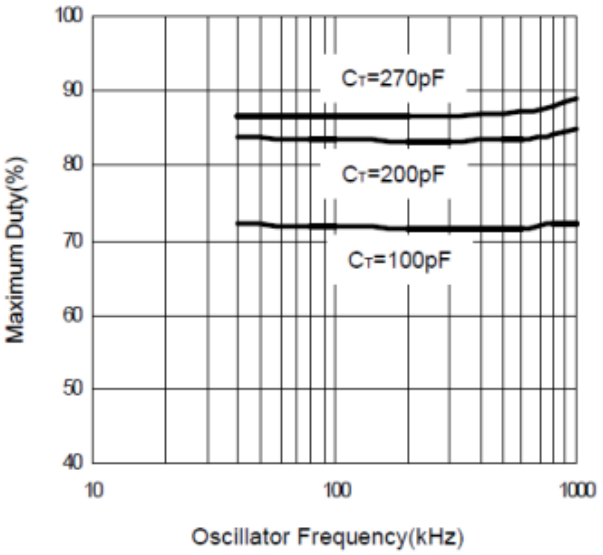
Typical Performance Characteristics(Cont.)

(T_A=25,V_{DD}=3.3V,unless otherwise specified)

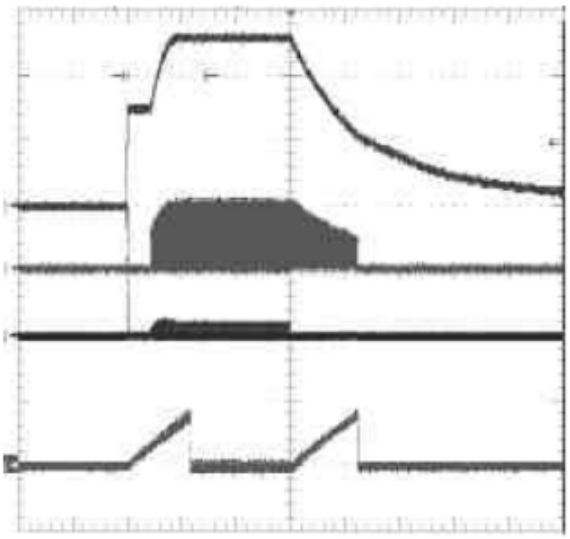
Oscillator Frequency vs. Timing Resistor



Maximum Duty vs. Oscillator Frequency

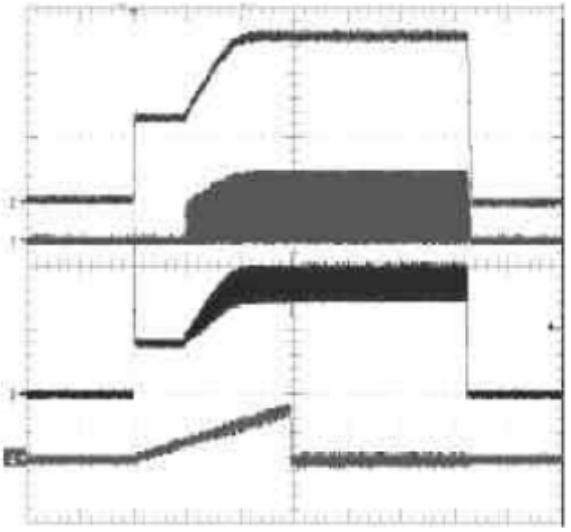


Power on and off under light load



I_{OUT}= 5mA, TIME=40ms/DIV
CH1=V_{OUT} 5V/DIV
CH2=V_{OUT}=V_{DD} 2V/DIV
CH3=I_L 0.5A/DIV
CH4=V_{SS} 1V/DIV

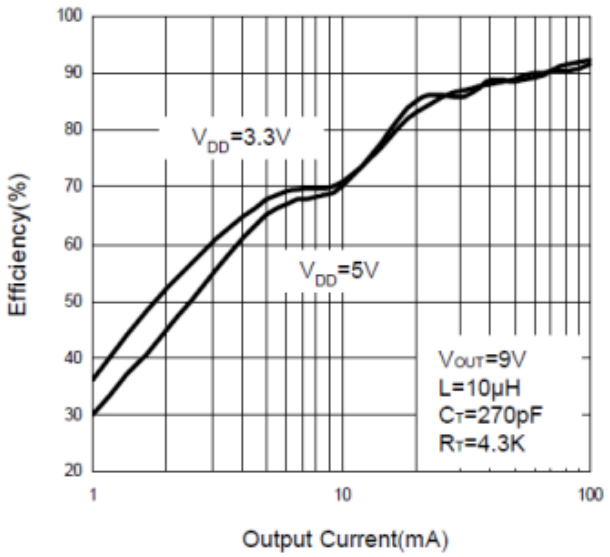
Power on and off under heavy load



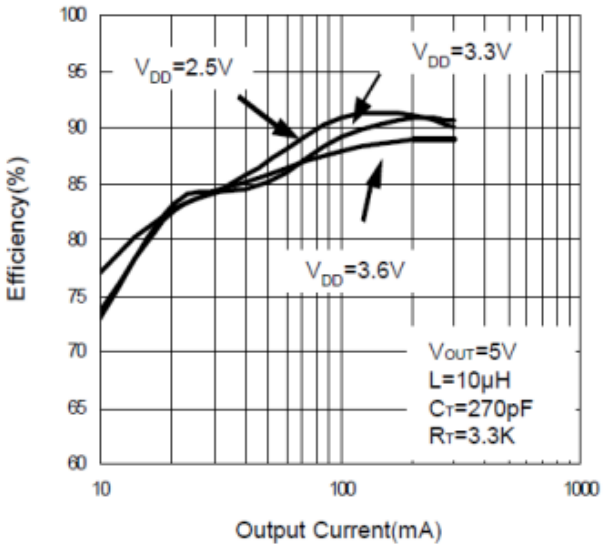
I_{OUT}= 400mA, TIME=40ms/DIV
CH1=V_{OUT} 5V/DIV
CH2=V_{OUT}=V_{DD} 2V/DIV
CH3=I_L 0.5A/DIV
CH4=V_{SS} 1V/DIV

Typical Performance Characteristics(Cont.)

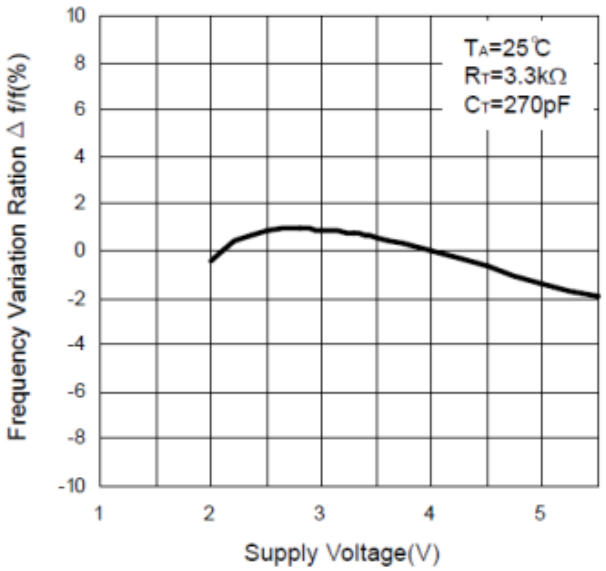
Efficiency



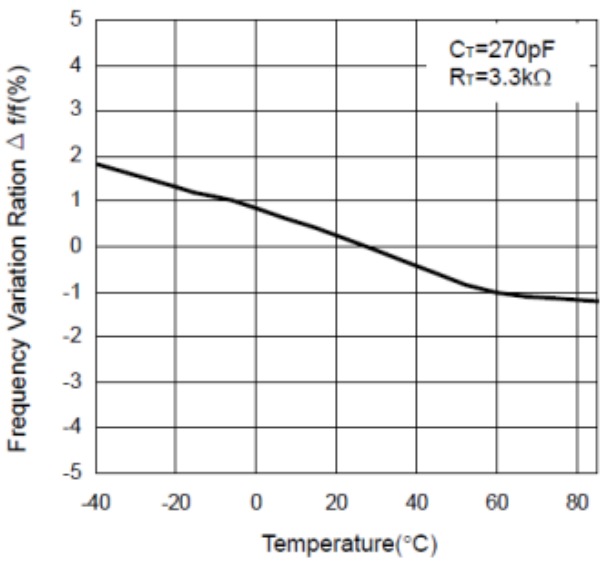
Efficiency



Frequency Variation Ratio vs. Supply Voltage



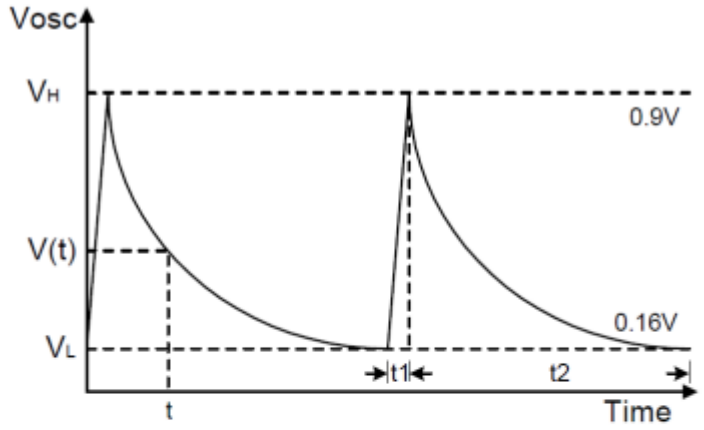
Frequency Variation Ratio vs. Temperature



Function Description

Setting Oscillating Frequency

The oscillator circuit generates a triangular saw tooth wave with a peak of 0.9V and through 0.16V using the timing capacitor (CT) and the timing resistor (RT) that are connected to OSC pin. This oscillator can provide oscillating frequency up to 1MHz



$$i=c\frac{\Delta V}{\Delta t}$$

$$t_1 = C_T \times \frac{0.9V - 0.16V}{2mA} = 370C_T$$

$$V(t) = V_H \times e^{\frac{1}{R_T C_T}}$$

$$t_2 = R_T C_T \ln(\frac{V_H}{V_L}) = 1.72R_T C_T$$

$$T = t_1 + t_2 = C_T(370 + 1.72R_T)$$

Setting Output Voltage

The output voltage is set using the INV pin and a resistor divider connected to the output is shown in the Typical Operating Circuit. The internal reference voltage is 0.5V with 2% variation, so the ratio of the feedback resistors sets the output voltage according to the following equation:

$$V_{OUT} = (1 + \frac{R3}{R2}) \times 0.5V$$

To avoid the thermal noise from feedback resistor, the resistance R2 is smaller than 100kW and 1% variation is recommended.

Error Amplifier

The error amplifier detects the output voltage of the switching regulator and outputs the PWM control signal. The voltage gain is fixed, and connecting a phase compensation resistor and capacitor to the FB pin (pin 8) provides stable phase compensation for the system.

PWM Comparator

The voltage comparator has one inverting and three non-inverting inputs. The comparator is a voltage/pulse width converter that controls the ON time of the output pulse depending on the input voltage. The output level is high (H) when the saw-tooth wave is lower than the error amplifier output voltage, soft- start setting voltage, and idle period setting voltage

Output Circuit

The output circuit is a typical push- pull configuration to drive an external NMOS transistor directly. It can provide a 200mA source/sink to/from OUT (pin 5).

Soft-Start and Short Circuit Detection

Soft-start operation is set by connecting capacitor CSCP to the SCP pin (pin 2).Soft-start prevents a current spike on start-up. On completion of the soft- start operation, the SCP pin (pin 2) stays low and enters the short circuit detection wait state. When an output short circuit occurs, the error amplifier output is fixed at 1.8V and capacitor CSCP starts charging.
After charging to approximately 0.8 V, the output pin (pin5) is set low and the SCP pin stays low. Once the protection circuit operates, the circuit can be restored by resetting the power supply. Short circuit detection time can be calculate as below:

$$t_{SCP} = 0.8 \times C_{SCP}(uF)$$

Under-Voltage Lock Out (UVLO)

Transients during powering on or instantaneous glitches in the supply voltage can cause system damage or failure. The circuit prevents malfunction at low input voltage detects a low input voltage by comparing the supply voltage with the internal reference voltage. On detection, the circuit fixes the output pin to low. The system recovers when the supply voltage rises back above the threshold voltage of thermal function prevention circuit.

Layout Consideration

Switching Noise Decoupling Capacitor

A 0.1uF ceramic capacitor should be placed close to the VOUT pin and the GND pin of the chip to filter the switching spikes in the output voltage monitored by the VOUT pin.

Feedback Network

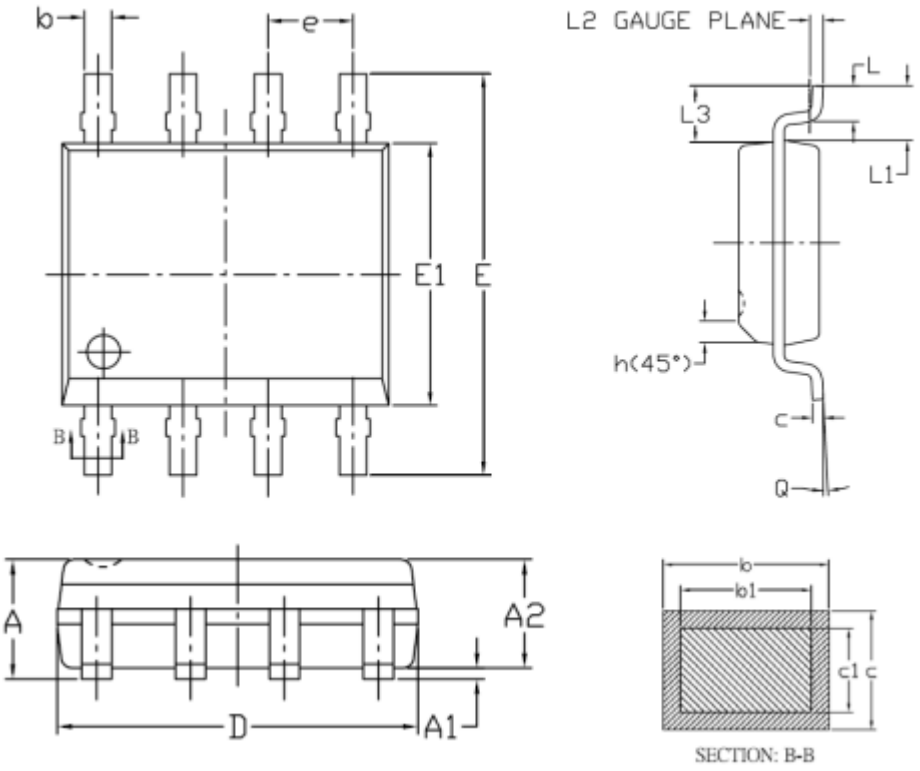
The feedback networks should be connected directly to a dedicated analog ground plane and this ground plane must connect to the GND pin. If no analog ground plane is available, and then this ground must tie directly to the GND pin. The feedback network, resistors R2 and R3, should be kept close to the FB pin, and away from the inductor.

Input Capacitor

The input capacitor CIN in VIN must be placed close to the IC. This will reduce copper trace resistance which effects input voltage ripple of the IC. For additional input voltage filtering, a 1uF capacitor can be placed in parallel with $C_{IN,}$ close to the VDD pin, to shunt any high frequency noise to the ground.

Package Information

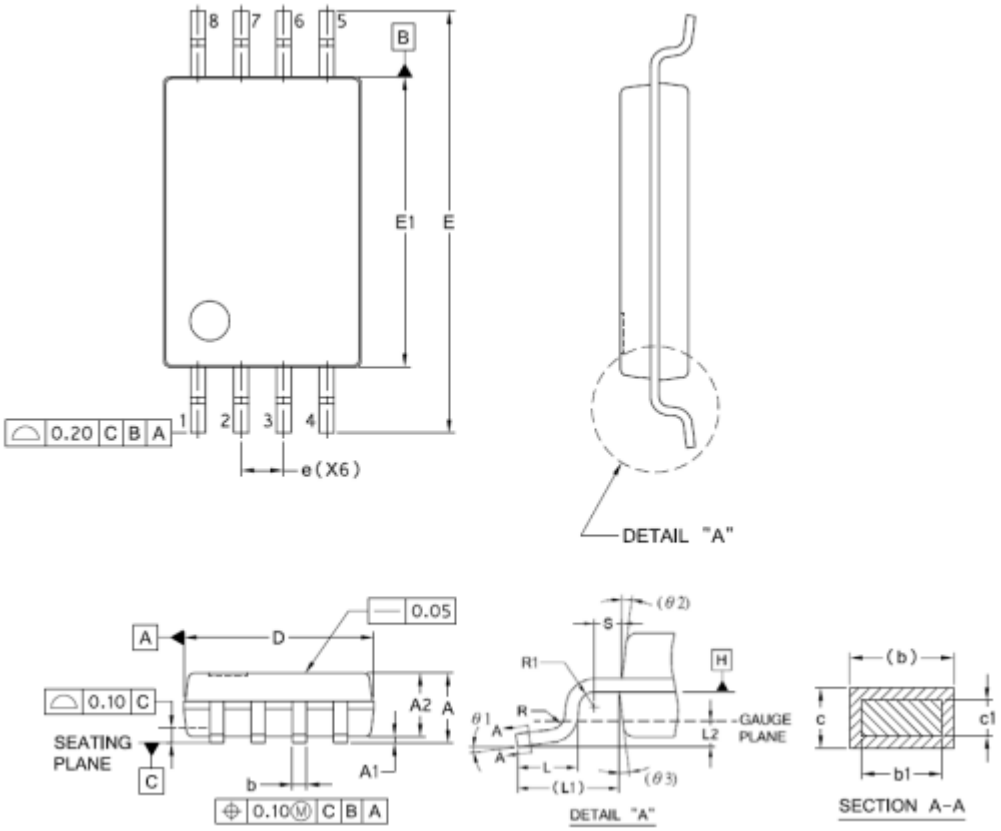
SOP-8L Package Outline Dimensions



SYMBOLS	DIMENSIONS			
	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A	—	1.75	—	0.069
A1	0.10	0.25	0.004	0.010
A2	1.25	—	0.049	—
b	0.31	0.51	0.012	0.020
b1	0.31	0.48	0.012	0.019
c	0.17	0.25	0.007	0.010
c1	0.17	0.23	0.007	0.009
D	4.90BSC		0.193BSC	
E	6.00BSC		0.236BSC	
E1	3.90BSC		0.154BSC	
e	1.27BSC		0.050BSC	
h	0.25	0.50	0.010	0.020
L	0.40	1.27	0.016	0.050
L1	1.04REF		0.041REF	
L2	0.25BSC		0.010BSC	
L3	1.04REF		0.041REF	
θ	0°	8°	0°	8°

Package Information

TSSOP-8L Package Outline Dimensions



SYMBOL	INCHES		MM	
	MIN.	MAX.	MIN.	MAX.
A	–	0.047	–	1.200
A1	0.002	0.006	0.050	0.150
A2	0.030	0.040	0.800	1.050
b	0.007	–	0.190	–
b1	0.007	0.010	0.190	0.250
c	–	0.008	–	0.200
c1	0.004	0.006	0.090	0.160
D	0.114	0.122	2.900	3.100
E	0.252 BSC		6.400 BSC	
E1	0.169	0.177	4.300	4.500
e	0.026 BSC		0.650 BSC	
L	0.018	0.030	0.450	0.750
L1	0.040 REF		1.00 REF	
L2	0.010		0.250	
R	0.004	–	0.090	–
R1	0.004	–	0.090	–
S	0.008	–	0.200	–
θ1	0°	8°	0°	8°
θ2	12° REF		12° REF	
θ3	12° REF		12° REF	