XC9510 / 11 Series

LDO Regulator Built-In
Synchronous Step-Down DC/DC Converters

Preliminary

June 9, 2003 Ver. 3

- ◆ INPUT VOLTAGE RANGE : 2.4V ~ 6.0V
- ◆ OUTPUT VOLTAGE RANGE : DC/DC 0.9 ~ 4.0V (±2%)
  VR 0.9 ~ 4.0V (±2%)
  VD 0.9 ~ 5.0V (±2%)
- ◆ SWITCHING FREQUENCY : 300kHz, 600kHz, 1.2MHz
- ◆ OUTPUT CURRENT : DC/DC 800mA
  VR 400mA
- ◆ CERAMIC CAPACITOR COMPATIBLE

■ APPLICATIONS

- HDD
- CD-R / RW, DVD
- PDAs, portable communication modem
- Cellular phones
- Palmtop computers
- Cameras, video recorders

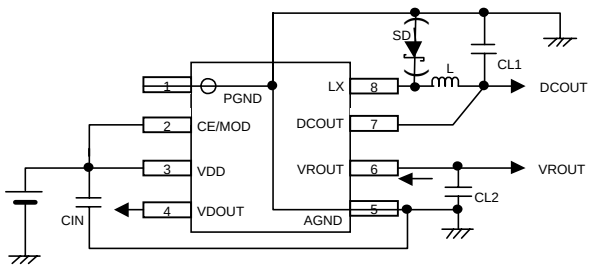
■ GENERAL DESCRIPTION

The XC9510/11 series consists of a DC/DC converter, a high-speed LDO regulator and a voltage detector. The XC9510 is powered by the DC/DC output, the regulator operates with high efficiency at output voltages down to 0.9V with low noise and very low output ripple.
The DC/DC converter block incorporates a P-Channel driver transistor and a N-Channel switching transistor. With an external coil and two capacitors, the XC9510/11 can deliver output currents up to 800mA at efficiencies over 90%. Designed for use with small ceramic capacitor and small inductors the XC9510/11 is ideal for applications where PCB area is at a premium.
A choice of three switching frequencies are available, 300 kHz, 600 kHz, and 1.2 MHz. The designer can select between, full synchronous PWM operation and PWM/PFM auto-switching using the CE/MODE pin.
Voltage settings for the DC/DC and VR are set-up internally in 0.1V steps in the ranges of 0.9V to 4.0V (± 2.0%) and for VD are set-up in the range of 0.9V to 5.0V (± 2.0%). The XC9510/11 includes a built-in current limit circuit, and the soft start time is internally set to 5ms.
With the built-in U.V.L.O. (Under Voltage Lock Out) function, the internal P-channel driver transistor is forced OFF when input voltage becomes 1.4 V or lower.
The XC9511 series is very similar to the XC9510, but the input for the Voltage Regulator block comes from the main power supply and the VR operates independently from the DC/DC.

■ FEATURES

Input Voltage Range :	2.4V ~ 6.0V
Load Capacitors :	Ceramic Capacitors Compatible (Low ESR Capacitors)
VD Function :	Nch Open Drain Output
<DC/DC Converter>	
Output Voltage Range :	0.9 ~ 4.0V (±2%)
Output Current :	800mA
Controls :	PWM Control (Synchronous) PWM, PWM / PFM Automatic Switching External (Non-Synchronous)
Oscillation Frequency :	300kHz, 600kHz, 1.2MHz
<Regulator>	
Output Voltage Range :	0.9 ~ 4.0V (±2%)
Current Limit:	600mA
Dropout Voltage :	240mV @ IOUT=300mA(VOUT=2.8V)
High Ripple Rejection :	60dB @ 1kHz (VOUT:2.8V)

■ TYPICAL APPLICATION CIRCUIT



SOP-8
(TOP VIEW)

■ PIN CONFIGURATION

PIN NUMBER	PIN NAME	FUNCTION
1	PGND	Power Ground
2	CE/MODE	Chip Enable / MODE
3	VDD	Power Supply
4	VDOUT	VD Output
5	AGND	Analog Ground
6	VROUT	VR Output
7	DCOUT	DC/DC Output
8	LX	Switching

TOREX

Preliminary

■ SELECTION GUIDE

- Ordering Information

XC9510 ①②③④⑤⑥ The input for the voltage regulator block comes from the DC/DC.

XC9511 ①②③④⑤⑥ The input for the voltage regulator block comes from the main power supply and the VR operates independently from the DC/DC.

DESIGNATOR	SYMBOL	DESCRIPTION
①		Control Methods, MODE, VD Sense pins (See the chart below)
②③		Setting voltage and specifications of each DC/DC, VR, and VD (See the chart below)
④		Oscillation Frequency of DCDC :
	3	300kHz
	6	600kHz
	C	1.2MHz
⑤	S	Package Type : SOP-8
⑥	R	Device Orientation : Embossed Tape : Standard Feed
	L	Embossed Tape : Reverse Feed

① Control Methods, MODE pins, VD Sense pins

SERIES	①	DCDC CONTROL METHODS	MODE PINS	VD SENSE PINS
XC9508	A	PWM Control	None	VDD
	B			DCOUT
	C			VROUT
	D		EN (VR)	VDD
	E			DCOUT
	F			VROUT
	M	PWM, PFM/PWM Manual Switch *	PWM, PFM/PWM Switch	VDD
	N			DCOUT
	P			VROUT
XC9509	A	PWM Control	None	VDD
	B			DCOUT
	C			VROUT
	D		EN (VR)	VDD
	E			DCOUT
	F			VROUT
	H		EN (DC/DC)	VDD
	K			DCOUT
	L			VROUT
	M	PWM, PFM/PWM Manual Switch *	PWM, PFM/PWM Switch	VDD
	N			DCOUT
	P			VROUT

* When PWM control, Sychronous. When PFM/PWM Automatic control, Non-Sychronous.

- Ordering Information (Continued)

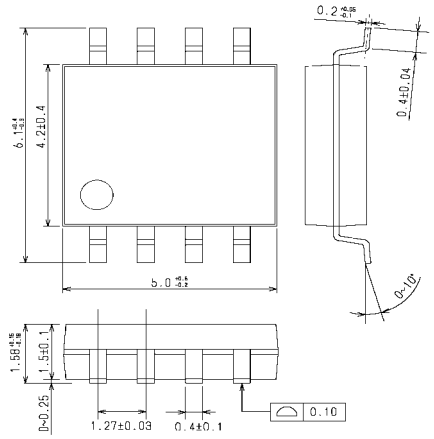
②③ Setting Voltage and Specifications (Serial number 80 to 99 are standard voltage products.)

②③	Setting Voltage (V)			②③	Setting Voltage (V)		
	DCDC	VR	VD		DCDC	VR	VD
80				90			
81				91			
82				92			
83				93			
84				94			
85				95			
86				96			
87				97			
88				98			
89				99			

* Order quantity of the series other than the standard voltage products must be more than 15K pcs.

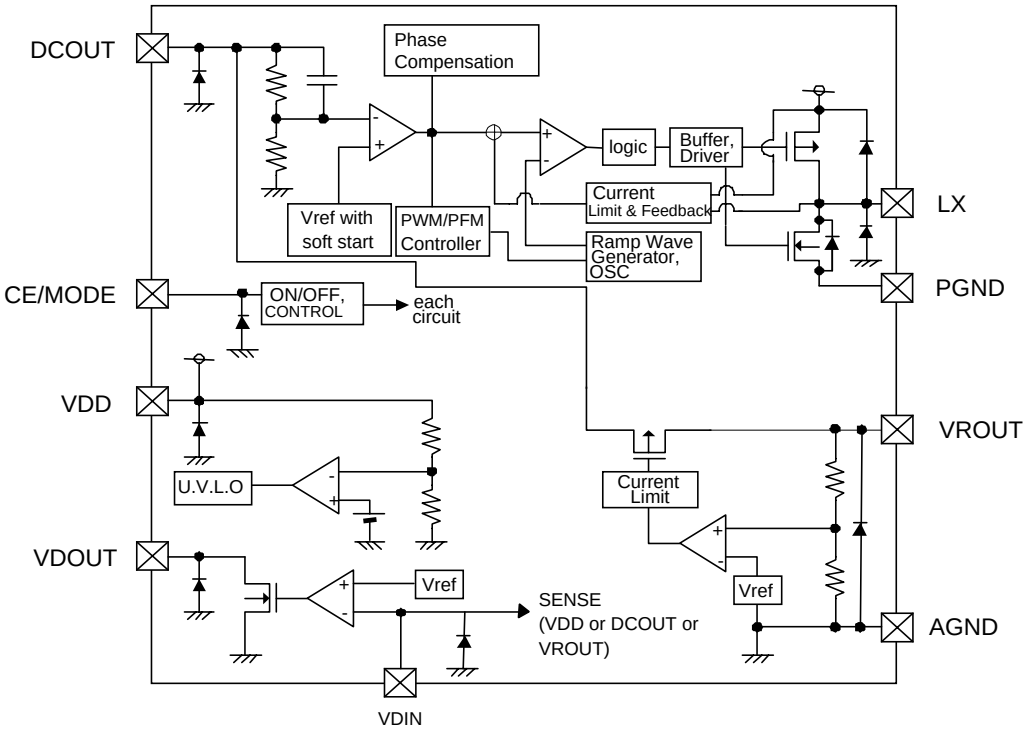
■ PACKAGING INFORMATION

❍ SOP-8

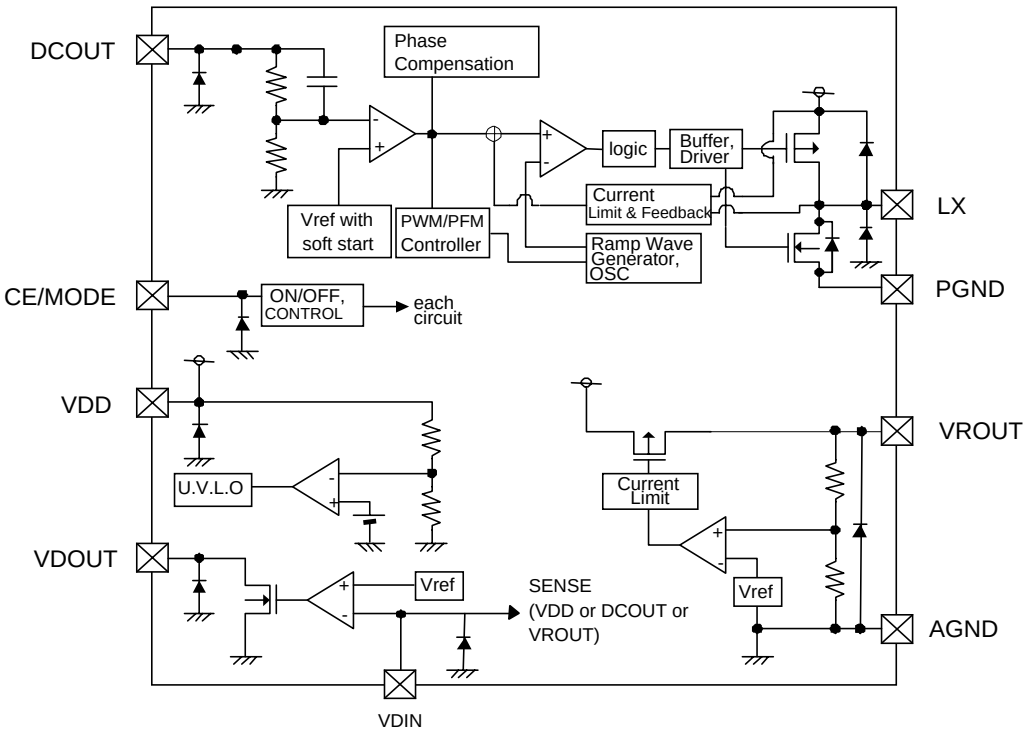


■ BLOCK DIAGRAM

- VR Input : DC/DC output type (XC9510)



- VR Input : VDD input type (XC9511)



* Diode shown in the above circuits are protective diodes.

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNITS
VIN Pin Voltage	VIN	- 0.3 ~ 6.5	V
VOUTDC Pin Voltage	VOUTDC	- 0.3 ~ 6.5	V
VOUTVR Pin Voltage	VOUTVR	- 0.3 ~ 6.5	V
VDIN Pin Voltage	VDIN	- 0.3 ~ 6.5	V
VDOUT Pin Voltage	VDOUT	- 0.3 ~ 6.5	V
LX Pin Voltage	LX	- 0.3 ~ VDD + 0.5	V
CE Pin Voltage	CE/MODE	- 0.3 ~ 6.5	V
VSS Pin Voltage	VSS	- 0.3 ~ 6.5	V
Power Dissipation	Pd	650	mW
Operating Ambient Temperature	Topr	- 40 ~ + 85	°C
Storage Temperature	Tstg	- 55 ~ + 125	°C

* IOUT = Pd / (VIN - VOUT)

■ ELECTRICAL CHARACTERISTICS

XC9510 / 11 xxx6Sx DC/DC Controller Ta=25°C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	TEST CIRCUIT
Output Voltage	VOUTDC	IOUT = 30mA	x 0.98	-	x 1.02	V	
Oscillation Frequency	FOSC		-	600	-	kHz	
Maximum Duty Ratio	MAXDUTY		100	-	-	%	
PFM Duty Ratio	PFMDUTY	No Load	-	30	-	%	
LX SW 'High' On Resistance	RLXH		-	0.4	-	Ω	
LX SW 'Low' On Resistance	RLXL		-	0.4	-	Ω	
Maximum Output Current 1	IMAX1		800	-	-	mA	
Efficiency	EFFI		-	-	-	%	
Soft Start Time	TSS		-	5	-	mS	

XC9510 / 11 xxx6Sx Voltage Regulator Ta=25°C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	TEST CIRCUIT
Output Voltage	VOUTVR	IOUT = 30mA	x 0.98	-	x 1.02	V	
Maximum Output Current 2	IMAX2		400	-	-	mA	
Load Regulation	△ VOUT	1mA ≤ IOUT ≤ 200mA	-	50	-	mV	
Dropout Voltage	Vdif	IOUT = 100mA	-	80	-	mV	
Line Regulation	△ VOUT / △ VIN • VOUT	IOUT = 30mA VOUT (T) + 1V ≤ VIN ≤ 6V	-	0.2	-	%/V	
Current Limit	ILIM	VOUT = VOUT x 0.9V	-	600	-	mA	
Short-Circuit Current	ISHORT	VOUT = VSS	-	30	-	mA	

XC9510 / 11 xxx6Sx Voltage Detector Ta=25°C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	TEST CIRCUIT
Detect Voltage	VDF		x 0.98	-	x 1.02	V	
Hysterisis Range	VHYS		-	5	-	%	

■ ELECTRICAL CHARACTERISTICS (Continued)

XC9510 / 11 xxx6Sx

Ta=25°C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	TEST CIRCUIT
Input Voltage Range	VIN		2.4	-	6.0	V	
UVLO Voltage	VUVLO		-	1.4	-	V	
Supply Current 1	IDD1		-	-	-	μA	
Supply Current 2	IDD2		-	-	-	μA	
Stand-by Current (note 3)	ISTB		-	2	-	μA	
Output Voltage Temperature Characteristics	$\frac{\triangle VOUT}{\triangle Topr \cdot VOUT}$		-	±100	-	ppm /°C	
CE 'H' Level Voltage	VCEH		0.6	-	VDD	V	
CE 'M' Level Voltage	VCEM		-	-	VDD-1.0	V	
CE 'L' Level Voltage	VCEL		VSS	-	0.25	V	
CE 'H' Level Current	ICEH		- 0.1	-	0.1	μA	
CE 'L' Level Current	ICEL		- 0.1	-	0.1	μA	

Note 1 : Unless otherwise stated, VIN=VOUT+1.0(V)

Note 2 : EFFI = [(Output Voltage x Output Current) / (Input Voltage x Input Current)] x 100

Note 3 : VD operates when in stand-by mode.