

- ◆ Synchronous, Bootstrap Nch-Nch Drive
- ◆ Input Voltage Range : 2.5V ~ 25.0V
- ◆ Switching Frequency : 300kHz (±15%)
- ◆ PWM/PFM Manual Switching Control
- ◆ Overcurrent Protection Circuit Built-In
- ◆ High Efficiency : 93% (TYP.)
- ◆ TSSOP-16 Package
- ◆ Ceramic Capacitor Compatible

■ APPLICATIONS

- PDAs
- Mobile Phones
- Note book computers
- Portable Audio Systems
- Various Multi-function Power Supplies

■ GENERAL DESCRIPTION

XC9213 series is Nch-Nch drive, synchronous, step-down DC/DC controller ICs with a built-in bootstrap driver circuit. Output will be stable no matter which load capacitors, including a low ESR capacitor, are used.

Resistance (RSENSE) of about 100mΩ will be required as a current sense. The phase compensation is also run when a low ESR capacitor is used. In addition, the circuit is double protected by the ways of limiting the current while detecting overshoot current and making output shutdown at any given timing by a protection time setting capacitor (CPRO).

The output voltage can be set freely within a range of 1.5V~15.0V with 1.0V (accuracy ±1.5%) of internal reference voltage by using externally connected resistors (RFB1, 2). Synchronous rectification PWM control can be switched to non-synchronous 30mV current limit PFM/PWM automatic switchable control (= voltage between RSENSE pins) by using the MODE pin.

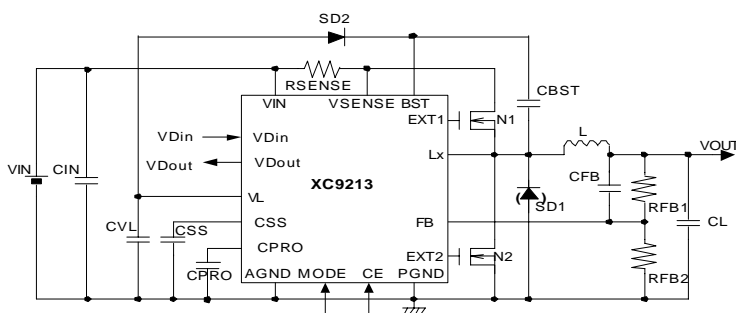
The series has a built-in voltage detector for monitoring a selected voltage by external resistors.

During stand-by (CE pin = low) all circuits are shutdown to reduce current consumption to as low as 3.0μA or less.

■ FEATURES

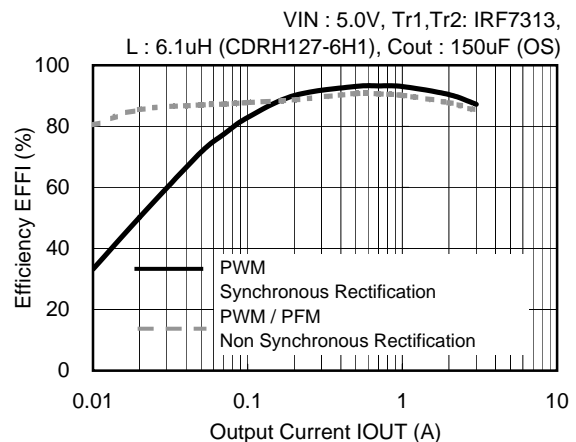
Input Voltage Range	: 2.5V ~ 25.0V
Output Voltage Range	: 1.5V ~ 15.0V externally set Reference voltage : 1.0V (±1.5%)
Oscillation Frequency	: 300kHz (±15%)
Output Current	: More than 5A (VIN=5.0V, VOUT=3.3V)
Control	: PWM/PFM manual-switching control.
Current Limiter, Protection	: Current limit operates at voltage sense 150mV. Shutdown time can be adjusted by CPRO.
High Efficiency	: 93% (TYP., PWM mode @ VIN=5.0V, VOUT = 3.3V, 1A)
Detect Voltage Function	: Detects 0.9V / Open-drain output
Stand-by Current	: ISTB = 3.0μA (MAX.)
Load Capacitor	: Low ESR (ceramic, etc.) capacitor compatible
Package	: TSSOP-16

■ TYPICAL APPLICATION CIRCUIT

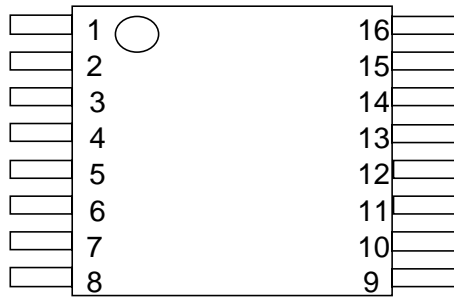


■ TYPICAL PERFORMANCE CHARACTERISTICS

XC9213B103V (FOSC:300kHz,3.0V)



■ PIN CONFIGURATION



TSSOP-16
(TOP VIEW)

■ PIN ASSIGNMENT

PIN NUMBER	PIN NAME	FUNCTION
1	VIN	Input Voltage
2	VSENSE	Current Detection
3	VL	Local Power Supply
4	CE	Chip Enable
5	AGND	Analog Ground
6	MODE	PWM / PFM Switch
7	CPRO	Protection Time Setting Capacitor Connection <Set shutdown time of VOUT when detecting overcurrent>
8	CSS	Soft-start Capacitor Connection <Set soft-start time>
9	VDIN	Voltage Detector Input (0.9V)
10	FB	Output Voltage Setting Resistor Connection < Set output voltage freely by split resistors >
11	VDOUT	Voltage Detector Output (Open-Drain)
12	PGND	Power Ground
13	EXT2	Low Side Nch Driver Transistor <Connect to Gate of Low Side Nch MOSFET >
14	LX	Coil Connection
15	EXT1	High Side Nch Driver Transistor <Connect to Gate of High Side Nch MOSFET >
16	BST	Bootstrap

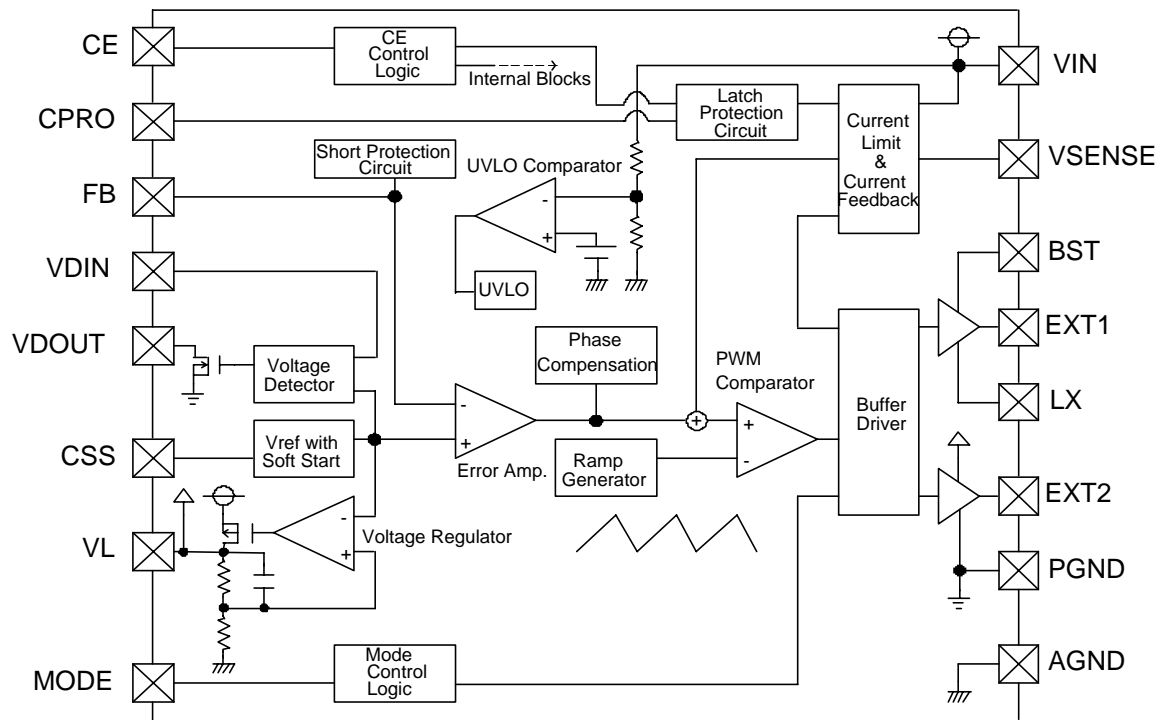
■ SELECTION GUIDE

● ORDERING INFORMATION

XC9213B ① ② ③ ④ ⑤

SYMBOL	PART NO.	DESCRIPTION
①, ②	10	Reference Voltage Fixed
③	3	Oscillation Frequency : 300kHz
④	V	Package Types : TSSOP-16
⑤	R	Device Orientation : Embossed Tape, Standard Feed
	L	Device Orientation : Embossed Tape, Reverse Feed

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNITS
VIN pin voltage	VIN	- 0.3 ~ 30.0	V
VSENSE pin voltage	VSENSE	- 0.3 ~ 30.0	V
VL pin voltage	VL	- 0.3 ~ 6.0	V
CE pin voltage	CE	- 0.3 ~ 30.0	V
MODE pin voltage	MODE	- 0.3 ~ 30.0	V
CPRO pin voltage	CPRO	- 0.3 ~ 6.0	V
CSS pin voltage	CSS	- 0.3 ~ 6.0	V
VDIN pin voltage	VDIN	- 0.3 ~ 6.0	V
FB pin voltage	FB	- 0.3 ~ 6.0	V
VDOUT pin voltage	VDOUT	- 0.3 ~ 30.0	V
EXT2 pin voltage	EXT2	- 0.3 ~ 6.0	V
Lx pin voltage	Lx	- 0.3 ~ 30.0	V
EXT1 pin voltage	EXT1	- 0.3 ~ 30.0	V
BST pin voltage	BST	- 0.3 ~ 30.0	V
Power Dissipation	Pd	350	mW
Operational Ambient Temperature	Topr	- 40 ~ + 85	°C
Storage Temperature	Tstg	- 55 ~ + 125	°C

ELECTRICAL CHARACTERISTICS

XC9213B103

(FOSC = 300kHz)

Ta=25°C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Input Voltage	VIN		2.5	-	25.0	V
Output Voltage Setting Range	VOUTSET		1.5	-	15.0	V
FB Control Voltage	VFB		-	1.0	-	V
UVLO Voltage	UVLO	Voltage which EXT1 pin starts oscillation	-	1.5	-	V
Supply Current 1	IDD1	No external components, CE=VIN, FB=0.9V	-	550	-	μA
Supply Current 2	IDD2	No external components, CE=VIN, FB=1.1V	-	450	-	μA
Stand-by Current	ISTB	No external components, CE=FB=0V	-	-	3.0	μA
Oscillation Frequency	FOSC	Same as IDD1	255	300	345	kHz
Max. Duty Ratio 1	MAXDTY1	Same as IDD1	-	95	-	%
Max. Duty Ratio 2	MAXDTY2	Same as IDD2	-	98	-	%
PFM Duty Ratio	PFMDTY	MODE=0V, IOUT=1mA, No RSENSE	-	2	-	μS
SENSE Voltage	VSENSE		-	150	-	mV
CPRO time	TPRO	CPRO=100pF	-	100	-	μS
Soft-Start Time	TSS	CSS=100pF, VOUT x 0.95, CE=0V ⇒ 3V	-	300	-	μS
Efficiency	EFFI	IOUT=1A	-	93	-	%
CE "H" Voltage	VCEH	No external components, FB=0V, Voltage which EXT pin starts oscillation	1.4	-	-	V
CE "L" Voltage	VCEL	No external components, FB=0V, Voltage which EXT pin voltage holding "L" level	-	-	0.5	V
MODE "H" Voltage	VPWMH	No load	1.4	-	-	V
MODE "L" Voltage	VPWML	No load	-	-	0.5	V
EXT1 "H" Resistance	REXT1H	FB=0.9V, EXT1=3.6V	-	18	-	Ω
EXT1 "L" ON Resistance	REXT1L	FB=1.1V, EXT2=0.4V	-	10	-	Ω
EXT2 "H" ON Resistance	REXT2H	FB=1.1V, EXT1=3.6V	-	18	-	Ω
EXT2 "L" ON Resistance	REXT2L	FB=0.9V, EXT2=0.4V	-	3	-	Ω
CE "H" Current	ICEH	CE=5.0V	-	-	0.1	μA
CE "L" Current	ICEL	CE=0V	-	-	-0.1	μA
MODE "H" Current	IMODEH	MODE=5.0V	-	-	0.1	μA
MODE "L" Current	IMODEL	MODE=0V	-	-	-0.1	μA
CSS "H" Current	ICSSH	CSS=3.8V	-	-0.7	-	μA
CSS "L" Current	ICSSL	CSS=0V	-	-2.0	-	μA
FB "H" Current	IFBH	FB=5.0V	-	-	0.1	μA
FB "L" Current	IFBL	FB=1.1V	-	-	-0.1	μA

○ Regulator

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	VLOUT	IOUT=10mA	-	4.0	-	V
Load Stability	Δ VOUT	1mA ≤ IOUT ≤ 30mA	-	100	-	mV
Input Stability	Δ VOUT Δ VIN x VOUT	IOUT=10mA VOUTVL + 1.0V ≤ VIN ≤ 25.0V	-	0.2	-	%/V

○ Detector

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Detect Voltage	VDF		-	0.9	-	V
Hysteresis Range	VHYS		-	6	-	%
VD Input Current	VDIOUT	VDOUT=0.5V	-	15	-	mV
Delay Time	tDLY	VDR ⇒ VOUT inversion	-	-	0.1	mS
VDIN "H" Current	IVDINH	VDIN=5.0V	-	-	0.1	μA
VDIN "L" Current	IVDINL	VDIN=0V	-	-	-0.1	μA
VDOUT "H" Current	IVDOUTH	VDOUT=5.0V	-	-	-0.1	μA
VDOUT "L" Current	IVDOUTL	VDOUT=0V	-	-	-0.1	μA

Test conditions : Unless otherwise stated, VOUT = 3.0V, VIN = 5.0V, CE = 5.0V, MODE = 5.0V

Test circuits :

Tr 1 :	2SK2857 (NEC)	CFB :	68pF
Tr 2 :	2SK2857 (NEC)	RSENSE :	0Ω
CL :	22μF (OS-CON)	CPRO :	0F
CIN :	22μF (OS-CON)	CSS :	100pF
SD 1 :	CRS02 (Schottky barrier diode)	CVL :	1μF
RFB 1 :	200kΩ	CBST :	0.1μF
RFB 2 :	110kΩ		

EXTERNAL COMPONENTS

<Setting of Output Voltage>

Output voltage can be set by adding external split resistors. Output voltage is determined by the following equation, based on the values of RFB1 and RFB2. The sum of RFB1 and RFB2 should normally be 2 MΩ or less.

$$V_{OUT} = R_{FB1} / R_{FB2} + 1$$

The value of CFB1, speed-up capacitor for phase compensation, should be $f_{zfb} = 1 / (2 \times \pi \times C_{FB} \times R_{FB1})$ which is equal to 10kHz. Adjustments are required from 1kHz to 50kHz depending on the application, value of inductance (L), and value of load capacity (CL).

[Example of Equation]

$$V_{OUT} = 3.0V$$

$$R_{FB1} = 200k\Omega, R_{FB2} = 110k\Omega, C_{FB} = 68pF$$

$$V_{OUT} = 220k / 110k + 1 = 3.0V$$

$$f_{zfb} = 1 / (2 \times \pi \times 68p \times 220k) = 10.64kHz$$

<External Components>

Tr 1, Tr 2

○ IOU1 = 2 ~ 3A

IRF7313 (Nch x 2) (IR, SO-8)

○ IOU2 = ~10A

SUP70N03-09 (Vishay, TO-220AB)

SUB70N03-09 (Vishay, TO-263)

L: 6.8μF (CDH127-6H1, SUMIDA)

SD 1 : CMS02 (Schottky barrier diode, TOSHIBA)

SD 2 : CRS02 (Schottky barrier diode, TOSHIBA)

* Please select SD2 with low reverse current.

RSENSE : Current Limit Value = 150mV / RSENSE

ex.) When RSENSE = 30mΩ,

Current Limit = 150mV / 30mΩ = about 5A

CPRO : TPRO = CPRO x 1e6

ex.) When CPRO = 100pF

TPRO = 100e-12 x 1e6 = 100μS

CSS= TSS = CSS x 3e6

ex.) When CSS = 3300pF,

TPRO = 3300e-12 x 3e6 = 9.9mS

CBST : 0.1μF ~ 1μF

* Please adjust according to

reverse current characteristics of SD2.

CVL : 1μF

CIN : 22μF

(OS-CON, SANYO)

CL : 150μF

(OS-CON, SANYO)