XC9252 Series

Low Power Consumption Step-down DC/DC Controller IC

■GENERAL DESCRIPTION

The XC9252 series is a 30V operation step-down DC/DC controller IC. The external P-ch driver transistor is used to achieve a stable operation under low input voltage. Low ESR capacitors such as ceramic capacitors can be used for the load capacitor (C_L).

A 0.8V reference voltage source is incorporated, and the output voltage can be set freely from 1.5V using external resistors (R_{FB1}, R_{FB2}).

280kHz to 550kHz can be selected for the switching frequency by connecting an external resistor to the R_{OSC} pin. The generation of unneeded noise can be reduced by this synchronization with an external CLK within ±25% of the internal clock using the MODE/SYNC pin. In automatic PWM/PFM control, the IC operates by PFM control when the load is light to achieve high efficiency over the full load range from light to heavy.

The soft start time can be set as desired by adding an external capacitance to the SS pin.

With the built-in UVLO function, the driver transistor is forced OFF when input voltage becomes 2.5V or lower.

Internal protection circuits include over current protection, short-circuit protection, and thermal shutdown circuits to enable safe use.

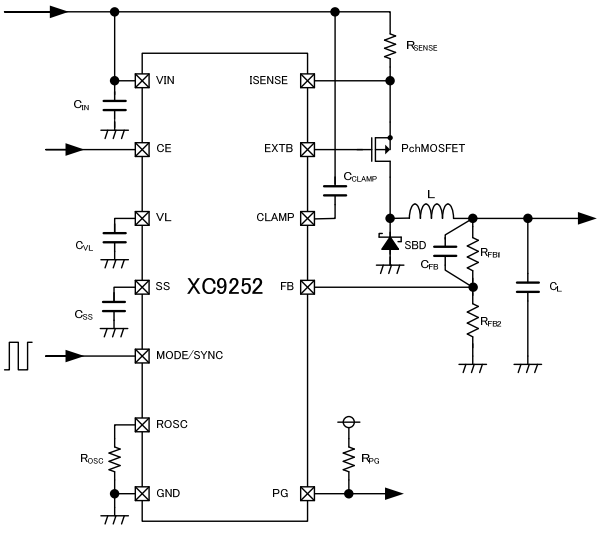
■APPLICATIONS

- Car navigation systems
- Car audios
- ETC automotives

■FEATURES

Input Voltage Range	: 3.0V～30V (Absolute MAX. Rating: 36V)
FB Voltage	: 0.8V (±2%)
Supply Current	: 30μA (@300kHz)
Oscillation Frequency	: 280kHz～550kHz (External Resistor)
External Clocking Synchronous	:±25% of the internal clock
Control Method	: PWM control (MODE:H) PWM/PFM (MODE:L)
Soft-Start	: External set (External C)
Protection Circuits	: Over current limit (External Resistor) Automatic Return (XC9252A/B) Integral latch protection (XC9252C) Thermal shutdown
Output Capacitor	: Low ESR Capacitor
Operating Ambient Temperature	: -40℃～+105℃
Packages	: TSSOP-16 (XC9252A/C) USP-10B (XC9252B)
Environmentally Friendly	: EU RoHS Compliant, Pb Free

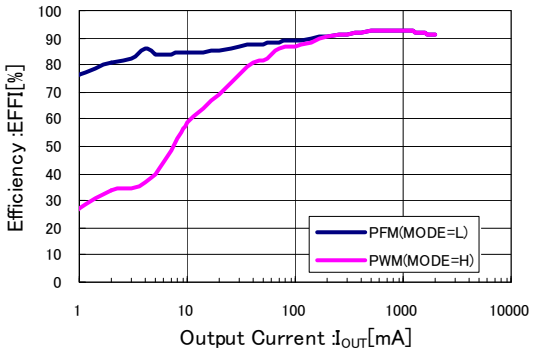
■TYPICAL APPLICATION CIRCUIT



■TYPICAL PERFORMANCE CHARACTARISTICS

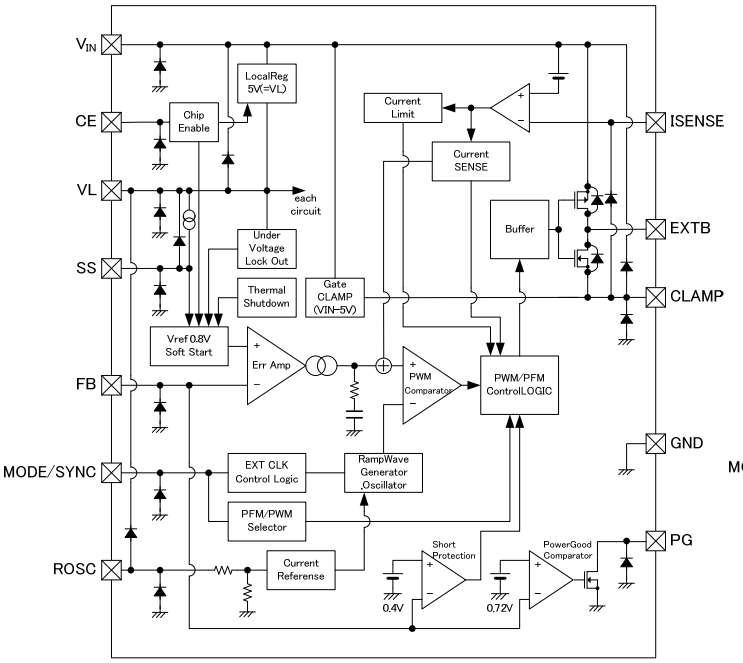
XC9252x08A(V_{IN}=12V, V_{OUT}=5.7V, f_{OSC}=280kHz)

L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=300kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



■BLOCK DIAGRAM

1) XC9252 Series, Type A



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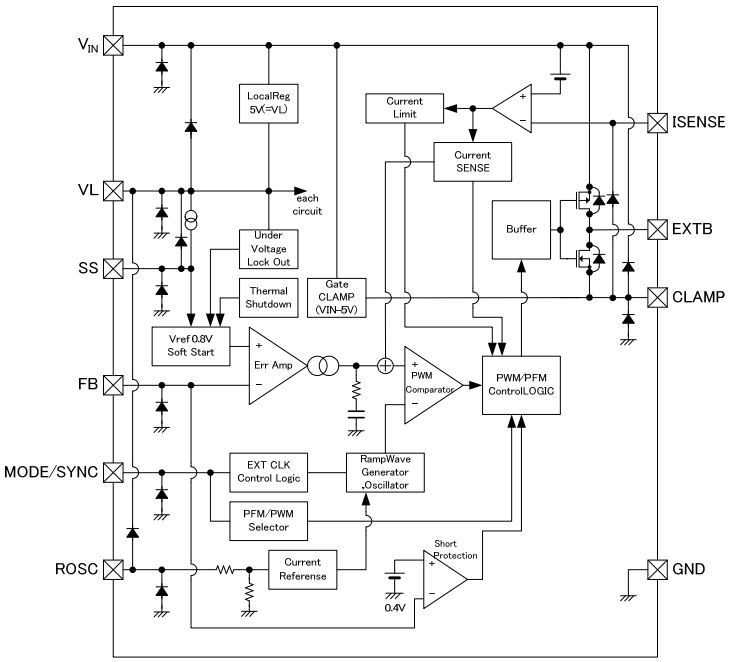
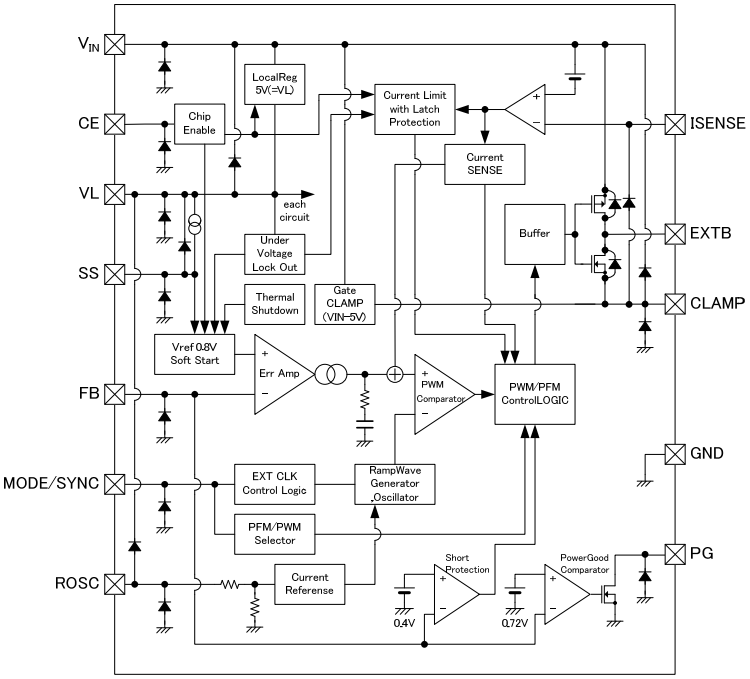


3) XC9252 Series, Type C



* Diodes inside the circuit are an ESD protection diode and a parasitic diode.

■PRODUCT CLASSIFICATION

●Ordering Information

XC9252①②③④⑤⑥-⑦

DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
①	TYPE	A	Refer to Selection Guide
		B	
		C	
②③	Adjustable Output Voltage	08	Reference voltage is fixed in 0.8V
④	Oscillation Frequency	A	Adjustable
⑤⑥-⑦ (*1)	Packages (Order Unit)	VR-G	TSSOP-16 (3,000pcs/Reel) *Only Type A,C
		DR-G	USP-10B (3,000pcs/Reel) (*2) *Only Type B

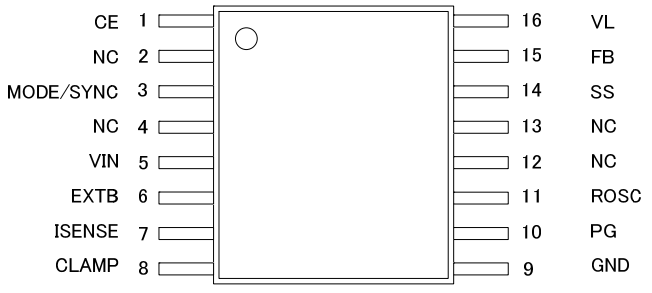
(*1) The "-G" suffix denotes Halogen and Antimony free as well as being fully EU RoHS compliant.
(*2) The USP-10B reels are shipped in a moisture-proof packing.

●Selection Guide

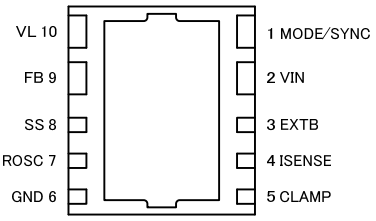
TYPE	CHIP ENABLE	SOFT-START	CURRENT LIMITER	LATCH PROTECTION	THERMAL SHUTDOWN	UVLO
A	Yes	Yes	Yes	No	Yes	Yes
B	No	Yes	Yes	No	Yes	Yes
C	Yes	Yes	Yes	Yes	Yes	Yes

TYPE	SYNCHRONIZED WITH EXTERNAL CLOCK	POWER-GOOD
A	Yes	Yes
B	Yes	No
C	Yes	Yes

■PIN CONFIGURATION



TSSOP-16
(TOP VIEW)



USP-10B
(BOTTOM VIEW)

* The dissipation pad for this IC should be solder-plated for mounting strength and heat dissipation. Please refer to the reference mount pattern and metal masking. The dissipation pad should be connected to the GND (No. 6) pin.

■PIN ASSIGNMENT

PIN NUMBER		PIN NAME	FUNCTIONS
TSSOP-16	USP-10B		
5	2	VIN	Power Input
1	-	CE	Chip Enable
16	10	VL	Local Power Supply
10	-	PG	Power-good Output
14	8	SS	Soft-start Adjustment
15	9	FB	Output Voltage Sense
3	1	MODE/SYNC	Mode Control/External CLK Sync Pin
11	7	ROSC	Frequency Adjustment
9	6	GND	Ground
8	5	CLAMP	High Side Gate Clamp
7	4	ISENSE	Current Sense Pin
6	3	EXTB	External Transistor Drive Pin
2, 4, 12, 13	-	NC	No Connection

■FUNCTION

XC9252 Series, Type A and Type C

PIN NAME	SIGNAL	STATUS
CE	L	Stand-by
	H	Active
	OPEN	Undefined State (*1)

XC9252 Series

PIN NAME	SIGNAL	STATUS
MODE /SYNC	L	PWM/PFM Automatic Control
	H	PWM control
	CLK	Synchronized with External Clock Signal (PWM control)
	OPEN	Undefined State(*1)

(*1) Please do not leave the CE and MODE/SYNC pin open.

■ABSOLUTE MAXIMUM RATINGS

Ta=25℃

PARAMETER		SYMBOL	RATINGS	UNITS
V_{IN} Pin Voltage		V_{IN}	-0.3 ～ +36	V
CE Pin Voltage		V_{CE}	-0.3 ～ +36	V
FB Pin Voltage		V_{FB}	-0.3 ～ +6.5	V
VL Pin Voltage		V_{VL}	-0.3 ～ V_{IN}+0.3 or +6.5 (*1)	V
VL Pin Current		I_{VL}	10	mA
SS Pin Voltage		V_{SS}	-0.3 ～ V_{VL}+0.3 or +6.5 (*2)	V
ROSC Pin Voltage		V_{ROSC}	-0.3 ～ V_{VL}+0.3 or +6.5 (*2)	V
MODE/SYNC Pin Voltage		V_{MODE}	-0.3 ～ +6.5	V
PG Pin Voltage (*6)		V_{PG}	-0.3 ～ +6.5	V
PG Pin Current (*6)		I_{PG}	5	mA
CLAMP Pin Voltage		V_{CLAMP}	-0.3 or V_{IN}-6.5 (*4) ～ V_{IN}+0.3 or +36 (*3)	V
CLAMP Pin Current		I_{CLAMP}	10	mA
ISENSE Pin Voltage		V_{ISENSE}	-0.3 or V_{IN}-6.5 or V_{CLAMP}-0.3 (*5) ～ V_{IN}+0.3 or +36 (*3)	V
EXTB Pin Voltage		V_{EXT}	-0.3 or V_{IN}-6.5 or V_{CLAMP}-0.3 (*5) ～ V_{IN}+0.3 or +36 (*3)	V
EXTB Pin Current		I_{EXT}	100	mA
Power Dissipation	TSSOP-16	Pd	350	mW
	USP-10B		150	
Surge Voltage		V_{SURGE}	46 (*7)	–
Operating Ambient Temperature		Topr	-40～+105	℃
Storage Temperature		Tstg	-55～+125	℃

* All voltages are described based on the GND pin.

(*1) The maximum value should be either V_{IN}+0.3 or +6.5 in the lowest.

(*2) The maximum value should be either V_{VL}+0.3 or +6.5 in the lowest.

(*3) The maximum value should be either V_{IN}+0.3 or +36 in the lowest.

(*4) The minimum value should be either -0.3 or V_{IN}-6.5 in the highest.

(*5) The minimum value should be either -0.3 or V_{IN}-6.5 or V_{CLAMP}-0.3 in the highest.

(*6) For the XC9252 Type A and C only.

(*7) Applied Time≦400ms

■ELECTRICAL CHARACTERISTICS

XC9252 Series

Ta=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	CIRCUIT
FB Voltage	V_{FB}	-	0.784	0.800	0.816	V	②
Output Voltage Setting Range	V_{OUTSET}	-	1.5 (*1)	-	V_{IN}	V	③
Operating Voltage Range	V_{IN}	-	3	-	30	V	-
Local Regulator Output Voltage	V_{VL}	I_{VL}=0.1mA	4.75	5.00	5.25	V	②
Gate Clamp Voltage	V_{CLAMP}	I_{CLAMP}=0.1mA, V_{CLAMP}=V_{IN}-CLAMP	4.75	5.00	5.25	V	②
UVLO Detect Voltage	V_{UVLO1}	V_{IN}: 2.8V→2.3V, V_{CE}=12V, V_{FB}=0.72V V_{IN} Voltage when EXTB pin voltage changes from "L" level to "H" level	2.375	2.500	2.625	V	②
UVLO Release Voltage	V_{UVLO2}	V_{IN}: 2.3V→2.8V, V_{CE}=12V, V_{FB}=0.72V V_{IN} Voltage which EXTB pin voltage changes from "H" level to "L" level	2.470	2.600	2.730	V	②
UVLO Detect Time	t_{UVLO}	V_{IN}: 2.8V→2.3V, V_{CE}=12V, V_{FB}=0.72V V_{IN} Voltage when EXTB pin voltage changes from "L" level to "H" level	0.20	0.35	0.60	ms	②
Supply Current	I_{DD}	V_{IN}=V_{CE}=30V, V_{MODE}=5V, V_{FB}=0.95V(PWM)	70	95	120	μA	①
Quiescent Current 1	I_{q1}	V_{IN}=V_{CE}=30V, V_{MODE}=0V, V_{FB}=0.95V (PWM/PFM) R_{OSC}=270kΩ	18	30	46	μA	①
Quiescent Current 2	I_{q2}	V_{IN}=V_{CE}=30V, V_{MODE}=0V, V_{FB}=0.95V (PWM/PFM)	25	36	55	μA	①
Stand-by Current	I_{STB}	V_{IN}=30V, V_{CE}=0V		0	1	μA	①
Operating Oscillation Frequency Setting Range	f_{OSCSET}	-	280	-	550	kHz	③
Oscillation Frequency 1	f_{OSC1}	Connected to external components, I_{OUT}=100mA, R_{OSC}: 270kΩ, L=22μH	270	300	330	kHz	③
Oscillation Frequency 2	f_{OSC2}	Connected to external components, I_{OUT}=100mA	414	460	506	kHz	③
External Clock Signal Synchronized Frequency	SYNCOSC	Connected to external components, V_{IN}=V_{CE}=12V, I_{OUT}=100mA	f_{OSC}x0.75	f_{OSC}	f_{OSC}x1.25	kHz	③
External Clock Signal Duty Cycle	D_{SYNC}	Connected to external components	25	-	75	%	③
Maximum Duty Cycle	D_{MAX}	V_{FB}=0.65V	100	-	-	%	②
Minimum Duty Cycle	D_{MIN}	V_{FB}=0.95V	-	-	0	%	②
EXTB"H" SW On Resistance	R_{EXTH}	V_{IN}=V_{CE}=5V, V_{CLAMP}=0V, V_{FB}=0.95V, I_{EXT}=50mA	2.0	3.5	6.0	Ω	②
EXTB"L" SW On Resistance	R_{EXTL}	V_{IN}=V_{CE}=5V, V_{CLAMP}=0V, V_{FB}=0.65V, I_{EXT}=-50mA	1.4	2.5	6.0	Ω	②
Current Limit Voltage 1 (*2)	$V_{ISENSE1}$	V_{ISENSE}=V_{IN}→V_{IN}-0.20V, V_{FB}=0.65V, R_{OSC}: 270kΩ V_{ISENSE} Voltage when EXTB pin voltage changes from "L" level to "H" level	127.5	150	172.5	mV	②
Current Limit Voltage 2 (*2)	$V_{ISENSE2}$	V_{ISENSE}=V_{IN}→V_{IN}-0.15V, V_{FB}=0.65V V_{ISENSE} Voltage when EXTB pin voltage changes from "L" level to "H" level	85	100	115	mV	②
Latch Time1 (*4)	t_{LAT1}	V_{ISENSE}=V_{IN}→V_{IN}-0.2V, V_{FB}=0.65V, R_{OSC}: 270kΩ V_{ISENSE} Voltage when EXTB pin voltage changes from "L" level to "H" level	1.2	1.9	2.3	ms	③
Latch Time2 (*4)	t_{LAT2}	V_{ISENSE}=V_{IN}→V_{IN}-0.2V, V_{FB}=0.65V V_{ISENSE} Voltage when EXTB pin voltage changes from "L" level to "H" level	0.8	1.2	1.5	ms	③
Short Protection Threshold Voltage (*5)	V_{SHORT}	V_{FB}=0.5V→0.3V, V_{FB} Voltage when Oscillation Frequency is decreased	0.35	0.40	0.45	V	③
Internal Soft-start Time	t_{SS1}	V_{CE}=0→12V, V_{SS}=5V, V_{FB}=V_{FB}×0.9V Time until EXTB pin oscillates	0.5	0.8	1.2	ms	②
External Soft-start Time	t_{SS2}	V_{CE}=0→12V, V_{FB}=V_{FB}×0.9V, C_{SS}=4700pF Time until EXTB pin oscillates	4.0	5.6	7.0	ms	②

NOTE:

Unless otherwise stated, V_{IN}=V_{CE}=12V, SS:OPEN, R_{OSC}:160kΩ, C_{VL}=1μF, C_{CLAMP}=1μF

External Components: L=10μH, C_{IN}=10μF, C_L=22μF, R_{SENSE}=33mΩ, R_{FB1}=220kΩ, R_{FB2}=36kΩ, C_{FB}=33pF（V_{OUTSET}=5.7V）

(*1) Please use within the range of $V_{OUT}/V_{IN} \geqq 0.15$

(*2) Current limit denotes the level of detection at peak of coil current.

(*3) EFFI = { (output voltage × output current) ／ (input voltage × input current) } × 100

(*4) For the XC9252 Type C only

(*5) For the XC9252 Type A and B only

(*6) For the XC9252 Type A and C only

■ ELECTRICAL CHARACTERISTICS (Continued)

XC9252 Series

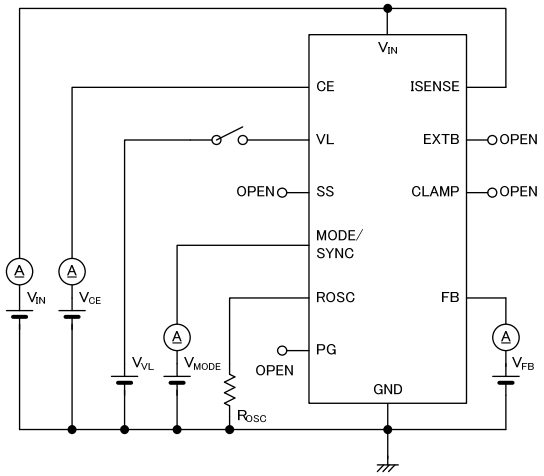
Ta=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	CIRCUIT
SS Pin Current 1	I_{SS1}	V_{FB}=0.95V, V_{SS}=0V, R_{OSC}: 270kΩ	0.6	0.8	1.2	μA	②
SS Pin Current 2	I_{SS2}	V_{FB}=0.95V, V_{SS}=0V	1.4	1.7	2.0	μA	②
Efficiency (*3)	EFFI	Connected to external components, V_{OUT}=5.7V, I_{OUT}=1A	-	90	-	%	③
FB Voltage Temperature Characteristics	ΔV_{FB}/ (ΔTopr･V_{FB})	I_{OUT}=100mA, -40℃≦Topr≦105℃	-	±50	-	ppm/℃	②
PG detect voltage (*6)	V_{PG}	V_{FB}=0.76V→0.65V, R_{PG}: 200kΩ pull-up to VL Voltage when PG pin voltage changes from "H" level to "L" level	0.691	0.720	0.749	V	②
PG Output Current (*6)	I_{PG}	V_{FB}=0.65V, V_{PG}=0.5V	1	-	-	mA	②
MODE/SYNC 'H' Voltage	V_{MODEH}	−	1.2	-	6.0	V	③
MODE/SYNC 'L' Voltage	V_{MODEL}	−	GND	-	0.45	V	③
MODE/SYNC 'H' Current	I_{MODEH}	V_L=V_{MODE}=6V	-0.1	0	0.1	μA	①
MODE/SYNC 'L' Current	I_{MODEL}	V_L=6V, V_{MODE}=0V	-0.1	0	0.1	μA	①
FB 'H' Current	I_{FBH}	V_{SYNC}=0V, V_{FB}=6V	-0.1	0	0.1	μA	①
FB 'L' Current	I_{FBL}	V_{SYNC}=0V, V_{FB}=0V	-0.1	0	0.1	μA	①
CE 'H' Voltage (*6)	V_{CEH}	V_{CE}=0.7→2.8V, V_{IN}=30V, V_{MODE}=0V, V_{FB}=0.65V Voltage when EXTB pin voltage changes from "H" level to "L" level	2.8	-	30	V	②
CE 'L' Voltage (*6)	V_{CEL}	V_{CE}=2.8→0.7V, V_{IN}=30V, V_{MODE}=0V, V_{FB}=0.65V Voltage when EXTB pin voltage changes from "L" level to "H" level	GND	-	0.7	V	②
CE 'H' Current (*6)	I_{CEH}	V_{IN}=V_{CE}=30V, V_{MODE}=0V	-0.1	0	0.1	μA	①
CE 'L' Current (*6)	I_{CEL}	V_{IN}=30V, V_{CE}=V_{MODE}=0V	-0.1	0	0.1	μA	①
Thermal Shutdown Temperature	T_{TSD}	Junction Temperature	-	150	-	℃	②
Hysteresis Width	T_{HYS}	Junction Temperature	-	25	-	℃	②

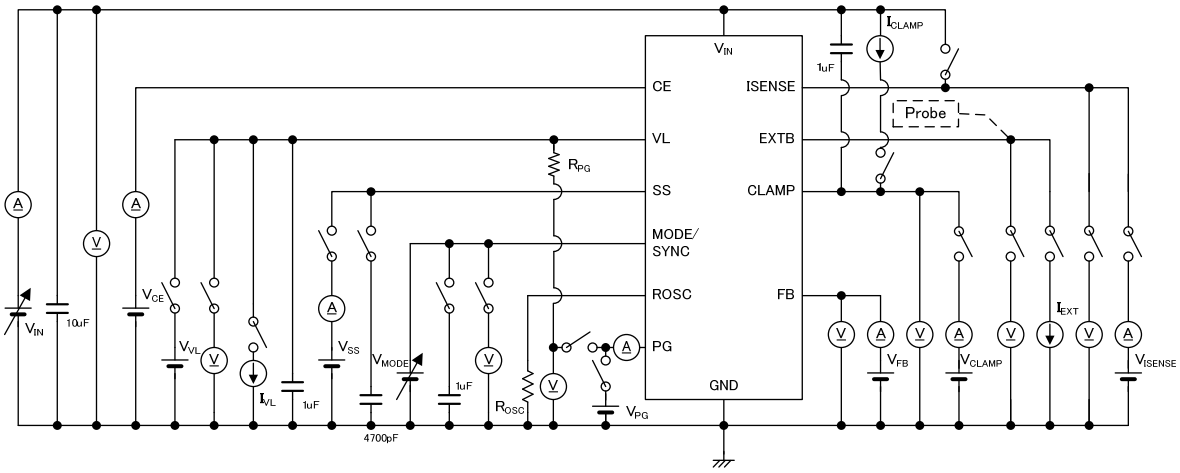
NOTE:
Unless otherwise stated, V_{IN}=V_{CE}=12V, SS:OPEN, R_{OSC}:160kΩ, C_{VL}=1μF, C_{CLAMP}=1μF
External Components: L=10μH, C_{IN}=10μF, C_L=22μF, R_{SENSE}=33mΩ, R_{FB1}=220kΩ, R_{FB2}=36kΩ, C_{FB}=33pF（V_{OUTSET}=5.7V）
(*3) EFFI = { (output voltage × output current) ／ (input voltage × input current) } × 100
(*4) For the XC9252 Type C only
(*5) For the XC9252 Type A and B only
(*6) For the XC9252 Type A and C only

■TEST CIRCUITS

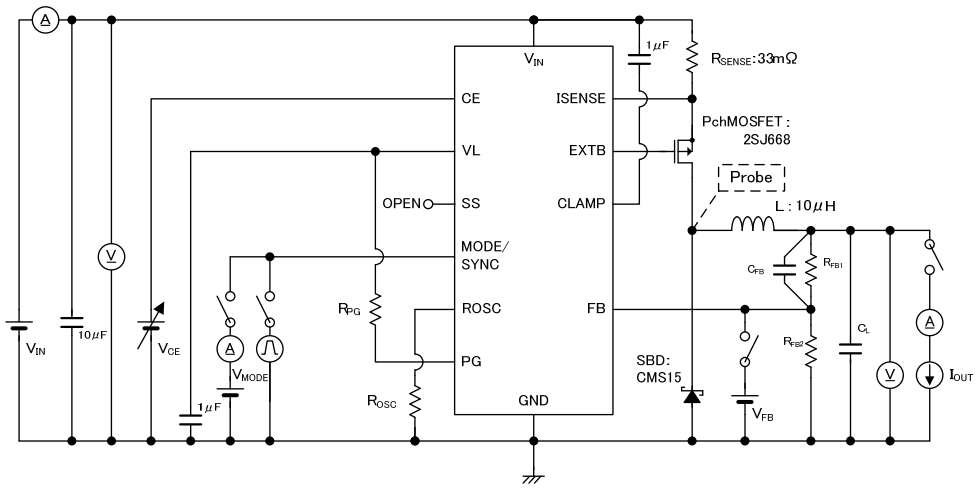
CIRCUIT①



CIRCUIT②

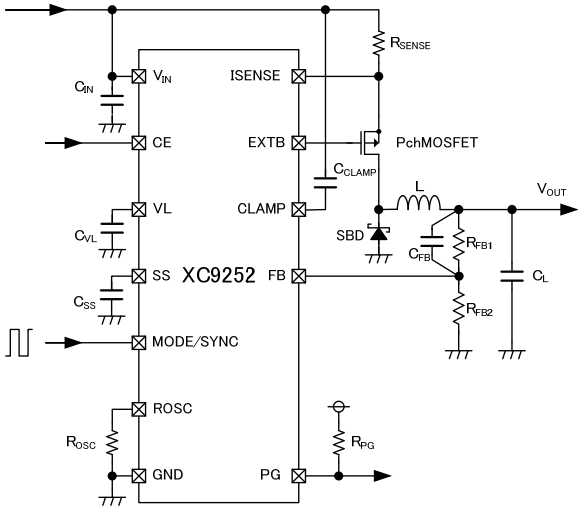


CIRCUIT③



(*1) The Type B does not have the CE and PG pin.

■TYPICAL APPLICATION CIRCUIT



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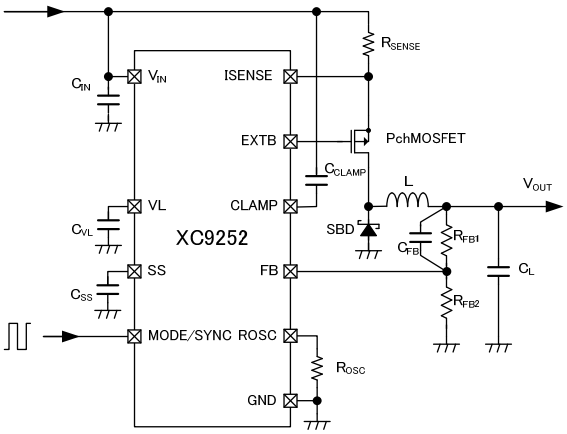


<USP-10B>

【Typical Examples】

	MANUFACTURER	PRODUCT NUMBER	VALUE
L	TDK	CLF10040T-4R7M	4.7 μH
		CLF10040T-100M	10 μH
		CLF12555T-220M	22 μH
Pch MOSFET	TOSHIBA	2SJ668	V_{DS}=60V/I_{DS}=5A/R_{ON}=250mΩ
	SANYO	CPH3351	V_{DS}=60V/I_{DS}=1.8A/R_{ON}=330mΩ
SBD	TOSHIBA	CMS15	V_F=0.58V(3A)
		CLS03	V_F=0.58V(10A)
C_{IN}	Murata	GRM32ER71H106K	10 μF/50V
C_L	Murata	GRM32ER71E226K	22 μF/25V
	Panasonic	20SVP22M	22 μF/20V/ESR=60mΩ
	Panasonic	20SVP47M	47 μF/20V/ESR=45mΩ
C_{VL}, C_{CLAMP}	Murata	GRM188R71A105K	1 μF/10V

<Output voltage setting>

The output voltage can be set by adding an external dividing resistor. The output voltage is determined by the equation below based on the values of R_{FB1} and R_{FB2}.

$V_{OUT}=0.8\times(R_{FB1}+R_{FB2})/R_{FB2}$
with $R_{FB1}+R_{FB2} \leqq 1M\Omega$

Adjust the value of the phase compensation speed-up capacitor C_{FB} using the equation below.

$$C_{FB}=\frac{1}{2\pi\times fzfb\times RFB1}$$

A target value for fzfb of about $\frac{2}{2\pi\sqrt{CL\times L}}$ is optimum.

【Setting Example】

When R_{FB1}=220kΩ, R_{FB2}=36kΩ, V_{OUT}=0.8×(220kΩ+36kΩ) / 36kΩ=5.69V
When C_L=22 μF, L=10 μH, and fzfb is set to a target of 21.46kHz using the above equation,
C_{FB}=1/(2×π×21.46kHz×220kΩ)=33pF

* The setting range for the output voltage is 1.5V to V_{IN}. The condition $V_{OUT}/V_{IN} \geqq 0.15$ must be satisfied.

■TYPICAL APPLICATION CIRCUIT (Continued)

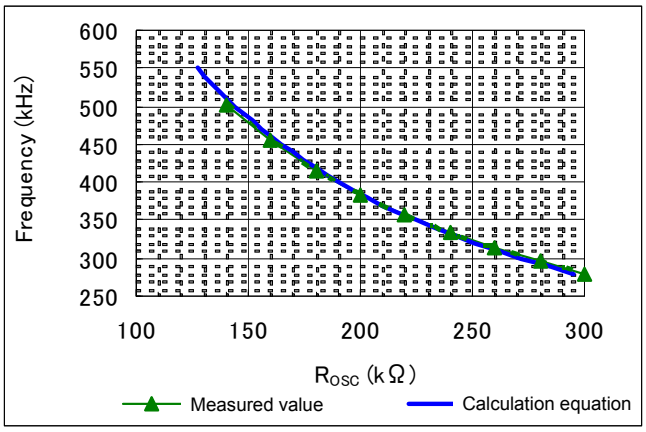
<Switching frequency setting>

In the XC9252 series, the switching frequency can be set to any value in the range 280kHz to 550kHz by connecting a resistance (R_{OSC}) between the R_{OSC} pin and GND. R_{OSC} is determined by the equation below.

$$R_{OSC}=(30\times f_{OSCSET}-83016)/(27.4-f_{OSCSET})$$

R_{OSC}: Switching frequency setting resistance [kΩ]

f_{OSCSET}: Set frequency [kHz]



【Setting Example】

Switching Frequency	R_{OSC}
300kHz	270kΩ
460kHz	160kΩ

<Inductance value setting>

In the XC9252 series, it is optimum to set an inductance value within the range below based on the switching frequency.

Switching Frequency	L
280kHz≦f_{oscset}＜400kHz	10μH ～ 22μH
400kHz≦f_{oscset}≦550kHz	4.7μH ～ 10μH

<C_L setting >

In the XC9252 series, a low ESR capacitor can be used for the load capacitance C_L; however, if a ceramic capacitor is used, the set voltage is restricted to 2.5V or higher. If less than 2.5V, an OS-CON (conductive polymer aluminum solid electrolytic capacitor) is recommended. Select according to the set voltage and switching frequency as shown in the table below. Select a capacitor with good temperature characteristics and bias dependence characteristics.

Switching Frequency	V_{OUTSET}＜2.5V	V_{OUTSET}≧2.5V
	OS-CON	Ceramic
280kHz≦f_{oscset}＜400kHz	47μF	22μF×2
400kHz≦f_{oscset}≦550kHz	22μF	22μF

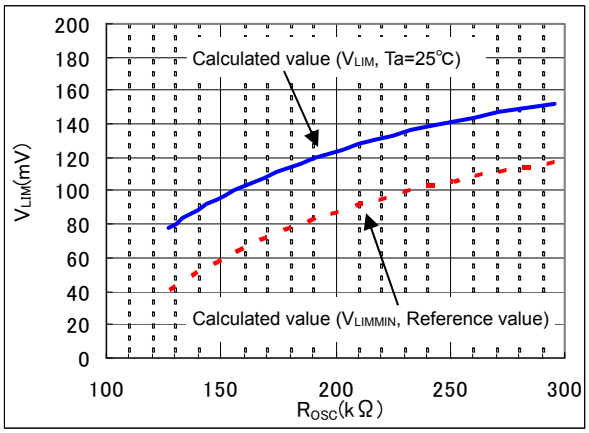
■TYPICAL APPLICATION CIRCUIT (Continued)

<Limit current setting>

In the XC9252 series, a resistance can be connected between the V_{IN} pin and I_{SENSE} pin to set a limit current. The sense resistance (R_{SENSE}) is determined by the equation below.

$R_{SENSE} = V_{LIM} / I_{LIM}$

I_{LIM}: Limit current (peak current) [A]
R_{SENSE}: Sense resistance [mΩ]
V_{LIM}= (230-(0.2765×f_{OSCSET})): Limit current detection voltage [mV]
f_{OSCSET}: Set frequency [kHz]



* The limit current detection voltage V_{LIM} varies depending on the temperature. Set the limit current (reference value) using the lower limit value given by the equation below.

V_{LIMMIN}=(230-(0.33×f_{OSCSET})) x 0.85
V_{LIMMIN}: Lower limit value within operating temperature range (-40 to 105℃)

$I_{LIMMIN}=V_{LIMMIN} / R_{SENSE}$ [A]

【Calculation Example】

To set I_{LIM} to 3A with f_{OSCSET}=460kHz

R_{SENSE}=(230-(0.2765×460)) / 3 ≒ 34 [mΩ]

In this case, the lower limit value of the limit current is I_{LIMMIN} = (230-(0.33×460)) x 0.85 / 34=1.95 [A]

<Soft-start function>

The soft-start time of the XC9252 series can be adjusted externally (SS pin). The soft-start time is the time from the start of V_{CE} until the output voltage reaches 90% of the set voltage. The soft-start time depends on the external capacitance C_{SS}, and is determined by the equation below.

t_{SS2}=0.002 x C_{SS} / I_{SS} [ms]
C_{SS}: External capacitance [pF]
I_{SS}=f_{OSCSET} / 300 [μA , TYP.]
f_{OSCSET}: Set frequency [kHz]

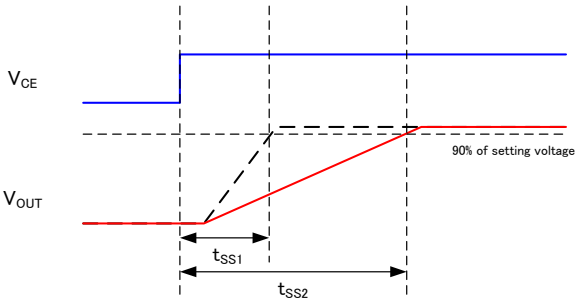
* Note that the value of the soft-start time t_{SS2} varies depending on the effective capacitance value of the delay capacitance C_{SS}.

【Calculation Example】

When f_{OSCSET}=460kHz, C_{SS}=4700pF
t_{SS2}=0.002×4700/(460/300)=6.13ms

The minimum value t_{SS1} of the soft-start time is set internally to about 0.8ms @460kHz (TYP.). The internal soft-start time is determined by the equation below.

t_{SS1}=368 / f_{OSCSET} [ms]
f_{OSCSET}: Set frequency [kHz]

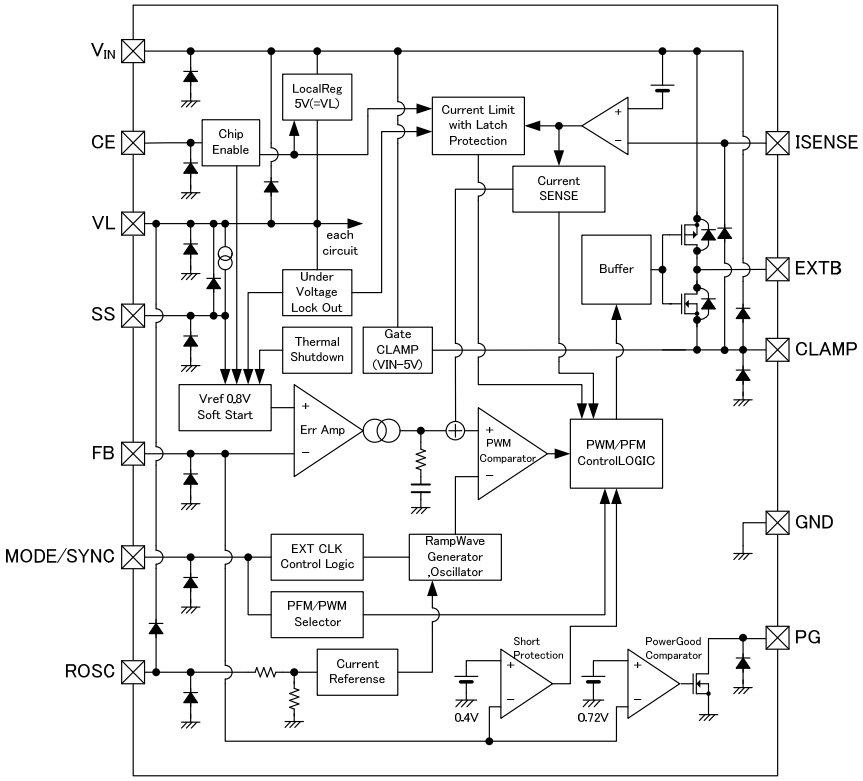


■OPERATIONAL EXPLANATION

The XC9252 series consists internally of a reference voltage supply, ramp wave circuit, error amp, PWM comparator, phase compensation circuit, current limiting circuit, under-voltage lockout (UVLO) circuit, internal power supply (VL) circuit, gate clamp (CLAMP) circuit, thermal shutdown (TSD) circuit, oscillator (OSC) circuit, soft-start circuit, control block and other elements.

The voltage feed back from the FB pin is compared to the internal reference voltage by the error amp, the output from the error amp is phase compensated, and the signal is input to the PWM comparator to determine the ON time of switching during PWM operation. The output signal from the error amp is compared to the ramp wave by the PWM comparator, and the output is sent to the buffer drive circuit and output from the EXTB pin as the duty width of switching. This operation is performed continuously to stabilize the output voltage.

The driver transistor current is monitored at each switching by the ISENSE pin, and the output signal from the error amp is modulated as a multi-feedback signal. This allows a stable feedback system to be obtained even when a low ESR capacitor such as a ceramic capacitor is used, and this stabilizes the output voltage .



XC9252 Series, Type A

<Reference voltage source>

The reference voltage source provides the reference voltage to ensure stable output voltage of the DC/DC converter.

<Oscillator circuit>

The ramp wave circuit determines switching frequency. By connecting an external resistance R_{OSC}, operation at any switching frequency from 280kHz to 550kHz is possible.

Clock pulses generated in this circuit are used to produce ramp waveforms needed for PWM operation.

<Error amplifier>

The error amplifier is designed to monitor output voltage. The amplifier compares the reference voltage with the feedback voltage divided by the internal split resistors, R_{FB1} and R_{FB2}. When a voltage is lower than the reference voltage, then the voltage is fed back, the output voltage of the error amplifier increases. The error amplifier output is fixed internally to deliver an optimized signal to the mixer.

<Chip enable>

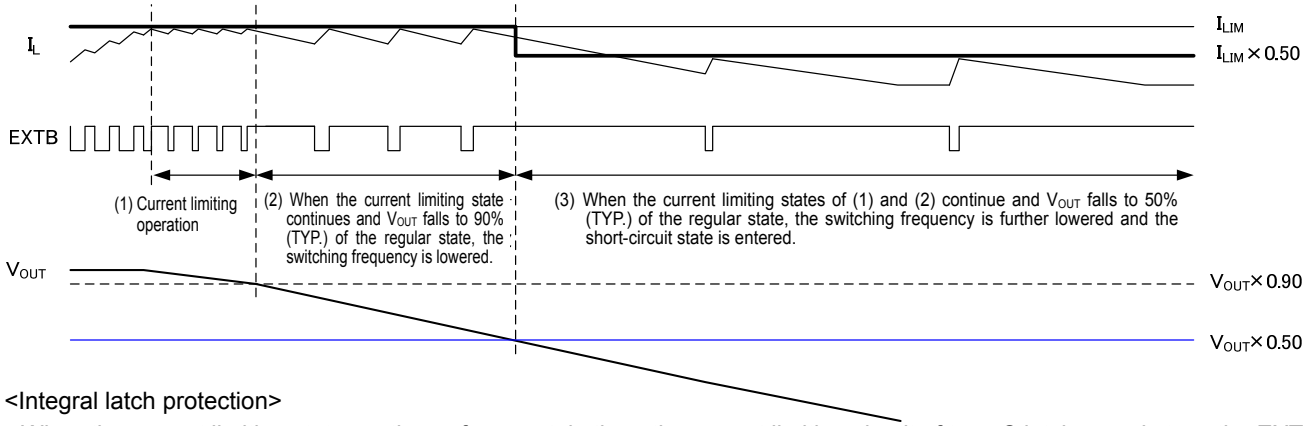
Types A and C can be put in the standby state by inputting L level into the CE pin. In the standby state, the quiescent current of the IC is 0 μA (TYP.). When H level is input into CE pin, operation starts. The input of the CE pin is CMOS input and the sink current is 0 μA (TYP.).

■OPERATIONAL EXPLANATION (Continued)

<Current limiting, short-circuit protection>

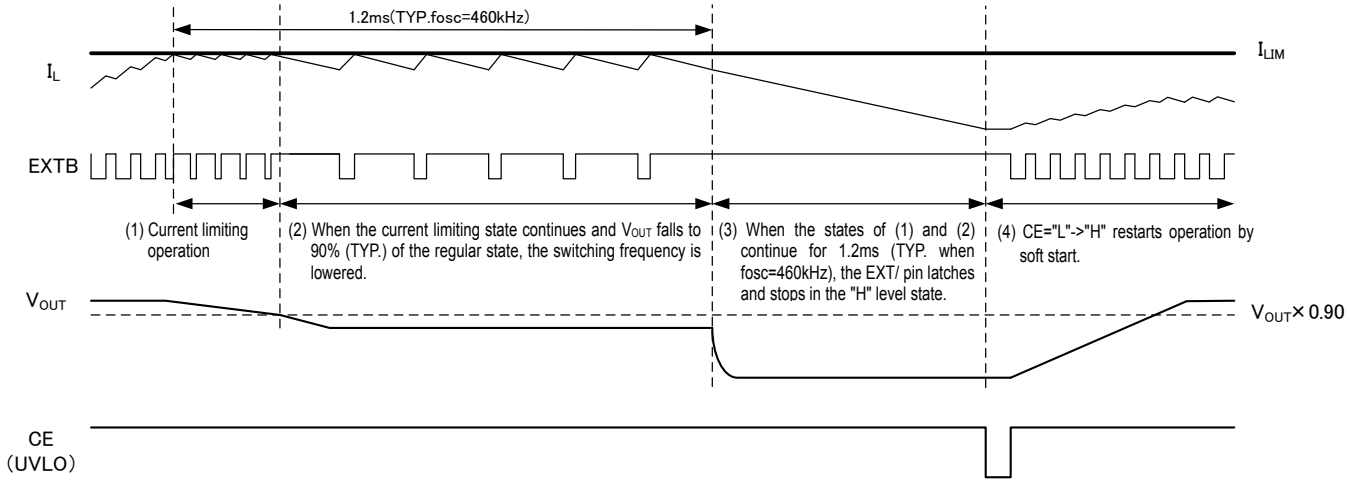
The current limiting circuits of types A and B combine both current limiting and short-circuit protection.

(1) The current in the sense resistance (R_{SENSE}) connected to the V_{IN} pin -I_{SENSE} pin is monitored, and when the load current attains the limiting current, the current limiting circuit activates and the output voltage drops.
(2) The output voltage drops to about 90% of the regular state, and this causes the switching frequency to drop and prevent coil current (I_L) overlay. When the limiter state is released and the output voltage returns to the regular state, the switching frequency returns to the frequency set by R_{OSC}.
(3) If the output voltage drops further from states (2), the output current is limited, the switching frequency is lowered further, and the short-circuit state is entered. When the load becomes lighter than the short-circuit state, restart takes place automatically. To prevent overshoot during restart, restart takes place by soft-start.



<Integral latch protection>

When the current limiting state continues for a certain time, the correct limiting circuit of type C latches and stops the EXT/ pin in the "H" level state (turning off the driver Tr). To restart operation by soft-start once in the latch stop state, "L" level must be input into the CE pin followed by "H" level, or restart of the V_{IN} pin (briefly lowering the V_{IN} voltage below the UVLO detection voltage) must be performed.



<Thermal shutdown>

The thermal shutdown (TSD) as an over current limit is built in the XC9252 series.
When the junction temperature of the IC reaches the detection temperature, EXTB becomes "H" level and forcibly stops output. When the junction temperature falls to the release temperature while in the output stop state, restart takes place by soft-start.

<UVLO>

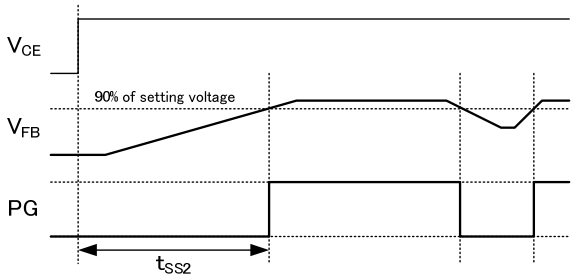
When the V_{IN} pin voltage falls below 2.5V (TYP.), EXTB becomes "H" level and forcibly stops output to prevent false pulse output due to instable operation of the internal circuits. When the V_{IN} pin voltage rises above 2.6V (TYP.), the UVLO function is released, the soft-start function activates, and output start operation begins. Stopping by UVLO is not shutdown; only pulse output is stopped and the internal circuits continue to operate.

■OPERATIONAL EXPLANATION (Continued)

<Power good>

On types A and C, the output state can be monitored using the power good function. When the FB voltage drops below 90% (TYP.), the PG pin outputs an "L" signal.

The PG pin is an Nch open drain output, therefore a pull-up resistance must be connected to the PG pin.

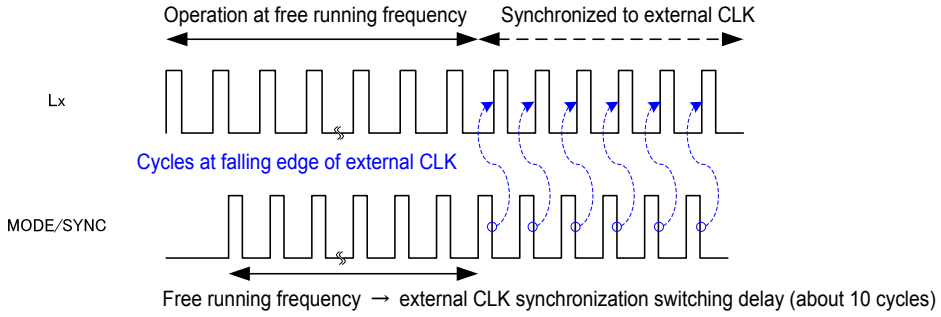


<SYNC/MODE function>

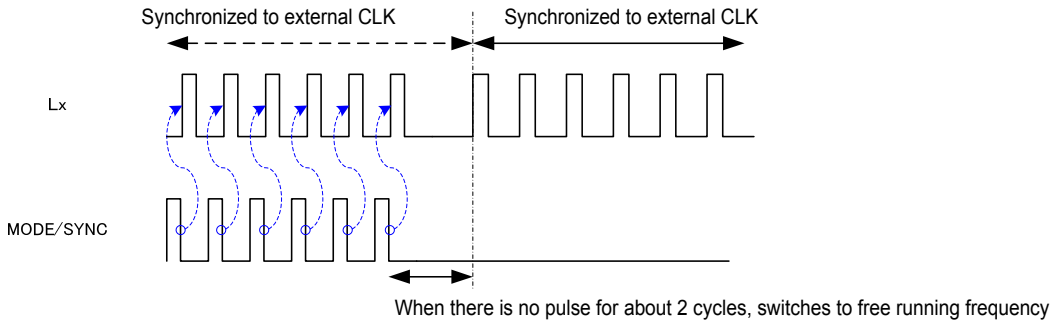
The MODE/SYNC pin has the two functions of a control MODE selector pin and an external CLK input pin. When "H" voltage is input, the mode becomes fixed PWM control, and when "L" voltage is input, the mode becomes PWM/PFM auto switching control.

When an external CLK (±25% of free running frequency, on duty 25% to 75%) is input into the MODE/SYNC pin, operation is synchronized to the falling edge of the external CLK (external CLK synchronization function). When synchronized to the external CLK, the control mode is automatically PWM control. When the external CLK is fixed at "H" voltage or "L" voltage for about 2 cycles of the free running frequency, external CLK synchronization stops and operation at the free running frequency takes place.

(1) Switching from free running frequency => external CLK synchronization



(2) Switching from external CLK synchronization => free running frequency



■NOTE ON USE

1. For the phenomenon of temporal and transitional voltage decrease or voltage increase, the IC may be damaged or deteriorated if IC is used beyond the absolute MAX. specifications.

2. Make sure that the absolute maximum ratings of the external components and of this IC are not exceeded.

3. The DC/DC converter characteristics depend greatly on the externally connected components as well as on the characteristics of this IC, so refer to the specifications and standard circuit examples of each component when carefully considering which components to select. Be especially careful of the capacitor characteristics and use B characteristics (JIS standard) or X7R, X5R (EIA standard) ceramic capacitors.

4. If there is a large dropout voltage, then there might be pulse-skip during light loads even with PWM control.

5. The DC/DC converter of this IC uses a current-limiting circuit to monitor the coil peak current. If the potential dropout voltage is large or the load current is large, the peak current will increase, which makes it easier for current limitation to be applied which in turn could cause the operation to become unstable. When the peak current becomes large, adjust the coil inductance and sufficiently check the operation. The following formula is used to show the peak current.

$$\text{Peak Current: } Ipk = (V_{IN} - V_{OUT}) \times \text{OnDuty} / (2 \times L \times f_{OSC}) + I_{OUT}$$

L: Coil Inductance [H]
f_{OSC}: Oscillation Frequency [Hz]
I_{OUT}: Load Current [A]

6. If there is a large dropout voltage, a circuit delay could create the ramp-up of coil current with staircase waveform exceeding the current limit.

7. The ripple voltage could be increased when switching from discontinuous conduction mode to Continuous conduction mode. Please apply the ICs only after careful examination by the customer.

8. When operation changes from free running frequency to external CLK synchronization, the output voltage may fluctuate. Please apply the ICs only after careful examination by the customer.

9. The internal power supply VL and gate clamp CLAMP are optimized as a local power supply for the DC/DC control block of the IC. Do not use the VL pin output and the CLAMP pin output.

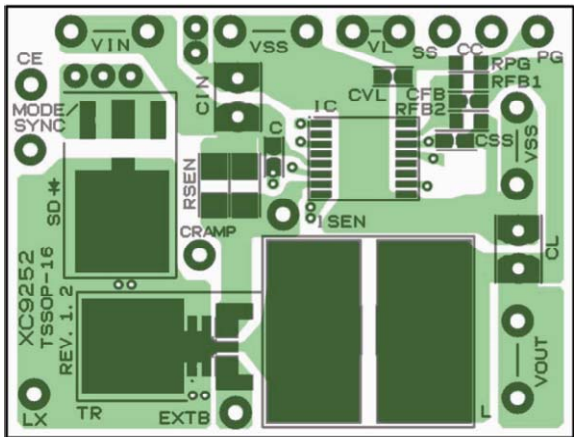
10. Instructions of pattern layouts
The operation may become unstable due to noise and/or phase lag from the output current when the wire impedance is high, please place the input capacitor(C_{IN}) and the output capacitor (C_L,C_{VL},C_{CLAMP}) as close to the IC as possible.

(1) In order to stabilize V_{IN} voltage level, we recommend that a by-pass capacitor (C_{IN}) be connected as close as possible to the V_{IN} and GND pins.
(2) Please mount each external component as close to the IC as possible.
(3) Wire external components as close to the IC as possible and use thick, short connecting traces to reduce the circuit impedance.
(4) Make sure that the GND traces are as thick as possible, as variations in ground potential caused by high ground currents at the time of switching may result in instability of the IC.

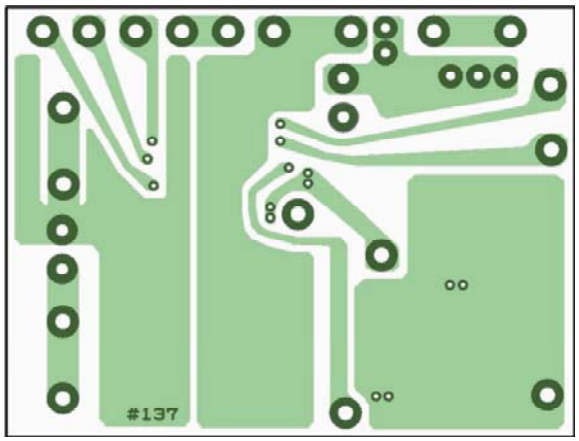
■NOTE ON USE (Continued)

10. Instructions of pattern layouts (Continued)

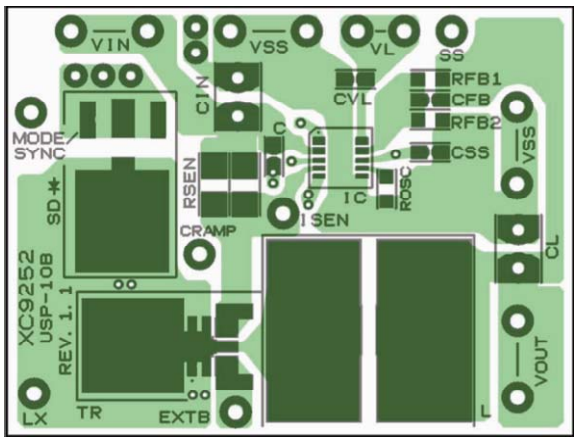
<Reference Pattern Layout>



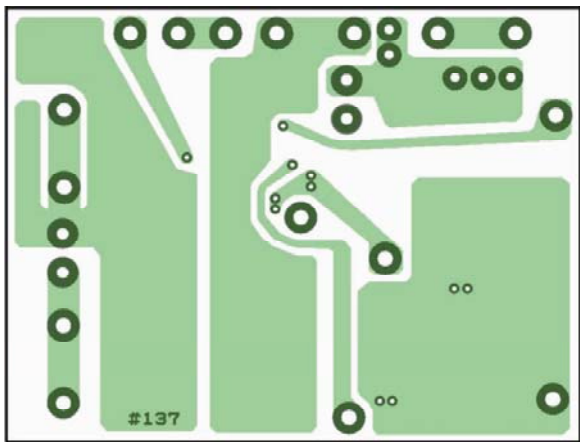
TSSOP-16 (Front)



TSSOP-16 (Back)



USP-10B (Front)



USP-10B (Back)

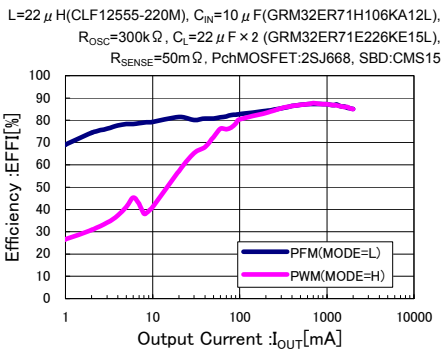
11. In general, semiconductor components have a possibility to have variation of electrical specifications due to the (cosmic) radiation exposure. Therefore this product has the same possibility. Please inform us in advance if your system might have a possibility to be exposed to the (cosmic) radiation in the production process (assembly, test, etc.).

12. Torex places an importance on improving our products and their reliability.
We request that users incorporate fail-safe designs and post-aging protection treatment when using Torex products in their systems.

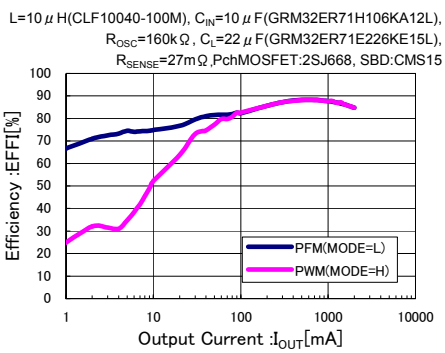
■TYPICAL PERFORMANCE CHARACTERISTICS

(1) Efficiency vs. Output current

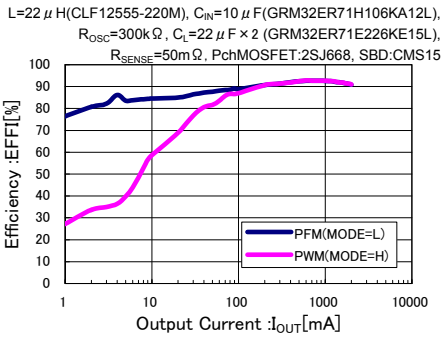
XC9252x08A(V_{IN}=12V, V_{OUT}=3.3V, f_{OSC}=280kHz)



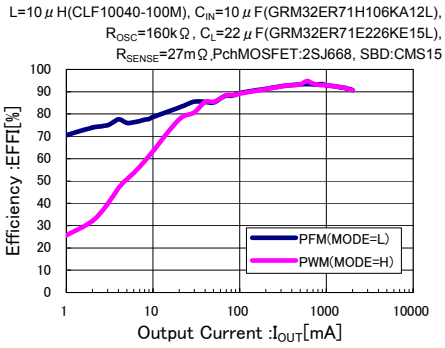
XC9252x08A(V_{IN}=12V, V_{OUT}=3.3V, f_{OSC}=460kHz)



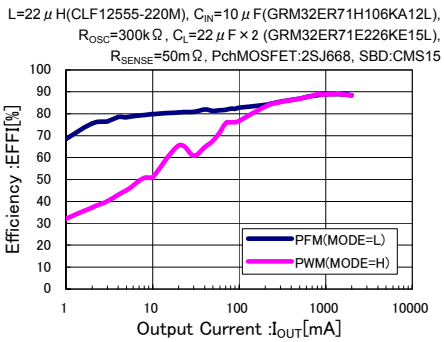
XC9252x08A(V_{IN}=12V, V_{OUT}=5.7V, f_{OSC}=280kHz)



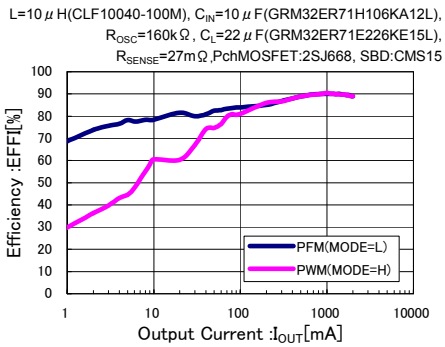
XC9252x08A(V_{IN}=12V, V_{OUT}=5.7V, f_{OSC}=460kHz)



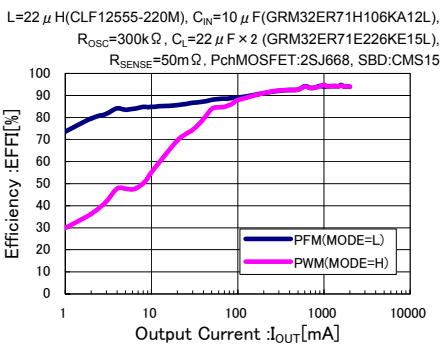
XC9252x08A(V_{IN}=24V, V_{OUT}=5.7V, f_{OSC}=280kHz)



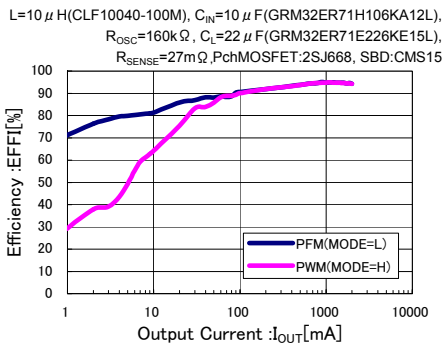
XC9252x08A(V_{IN}=24V, V_{OUT}=5.7V, f_{OSC}=460kHz)



XC9252x08A(V_{IN}=24V, V_{OUT}=12V, f_{OSC}=280kHz)



XC9252x08A(V_{IN}=24V, V_{OUT}=12V, f_{OSC}=460kHz)

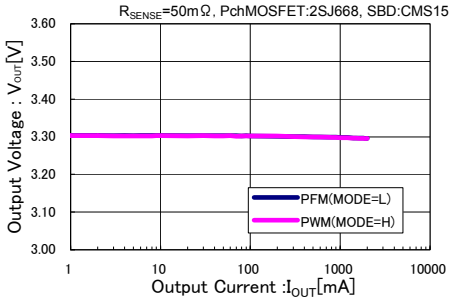


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(2) Output Voltage vs. Output Current

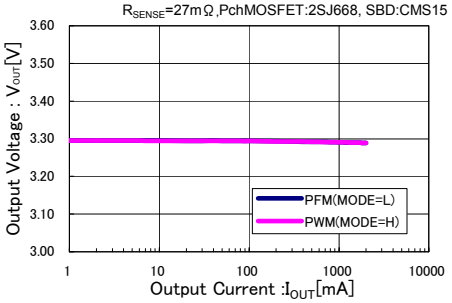
XC9252x08A(V_{IN}=12V, V_{OUT}=3.3V, f_{OSC}=280kHz)

L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=300kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



XC9252x08A(V_{IN}=12V, V_{OUT}=3.3V, f_{OSC}=460kHz)

L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



XC9252x08A(V_{IN}=12V, V_{OUT}=5.7V, f_{OSC}=280kHz)

L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
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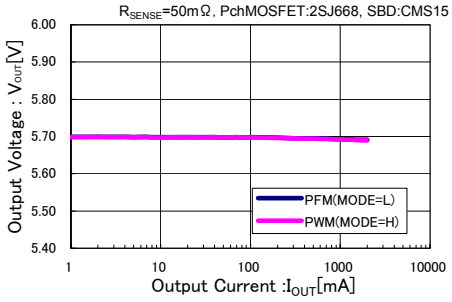
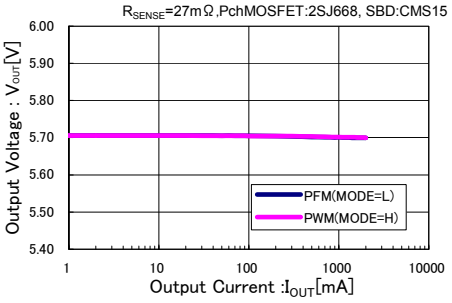
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



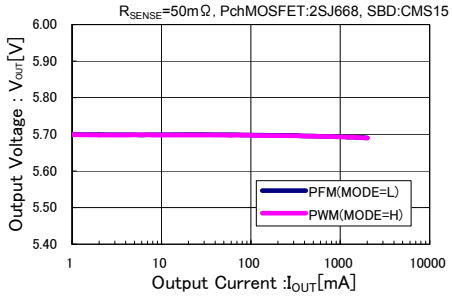
XC9252x08A(V_{IN}=12V, V_{OUT}=5.7V, f_{OSC}=460kHz)

L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



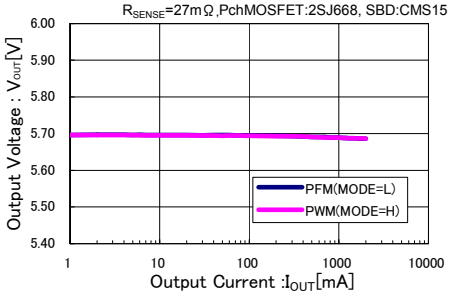
XC9252x08A(V_{IN}=24V, V_{OUT}=5.7V, f_{OSC}=280kHz)

L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=300kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



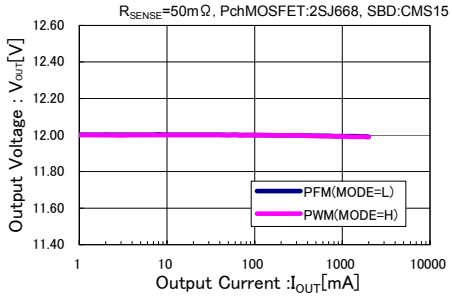
XC9252x08A(V_{IN}=24V, V_{OUT}=5.7V, f_{OSC}=460kHz)

L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



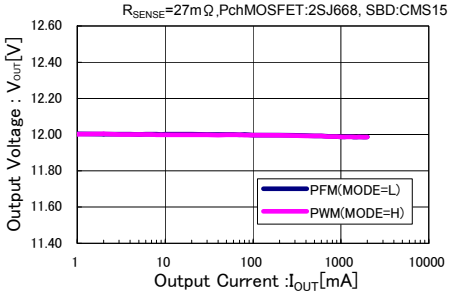
XC9252x08A(V_{IN}=24V, V_{OUT}=12V, f_{OSC}=280kHz)

L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=300kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



XC9252x08A(V_{IN}=24V, V_{OUT}=12V, f_{OSC}=460kHz)

L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15

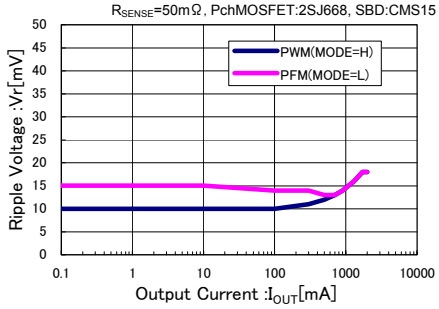


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(3) Ripple Voltage vs. Output Current

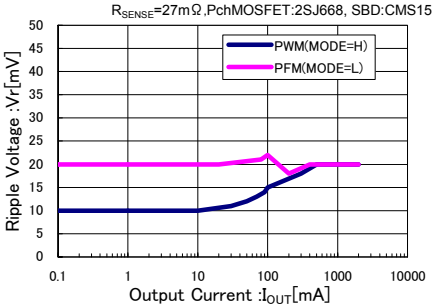
XC9252x08A(V_{IN}=12V, V_{OUT}=5V, f_{OSC}=280kHz)

L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=300kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



XC9252x08A(V_{IN}=12V, V_{OUT}=5V, f_{OSC}=460kHz)

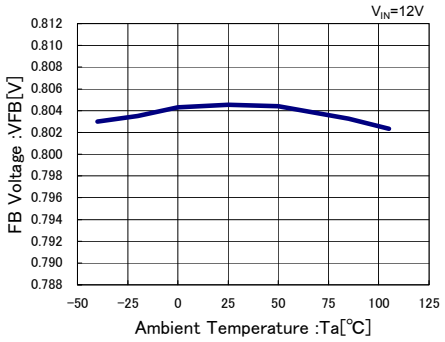
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



※ when the MODE/SYNC pin is "L", ripple voltage will increase while the PWM and PFM controls switch depending on the conditions of input and output voltage, peripheral components. The ripple voltage can be minimized by operating PWM control state, which the MODE/SYNC pin is "H" or the external clock is synchronized.

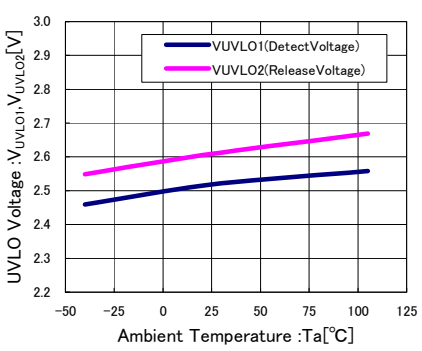
(4) FB Voltage vs. Ambient Temperature

XC9252x08A



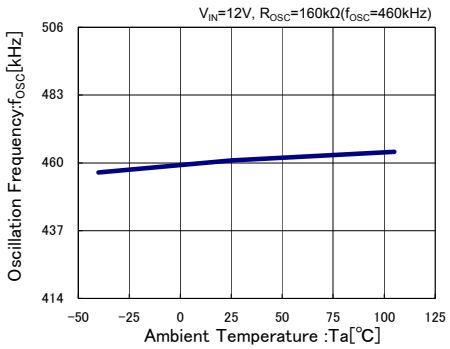
(5) UVLO Voltage vs. Ambient Temperature

XC9252x08A

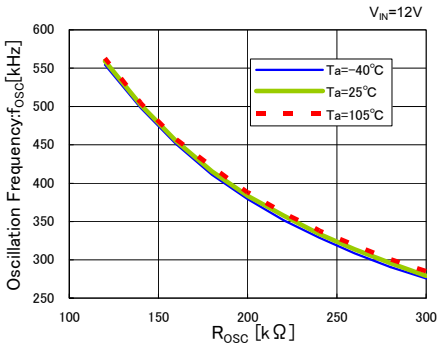


(6) Oscillation Frequency vs. Ambient Temperature

XC9252x08A

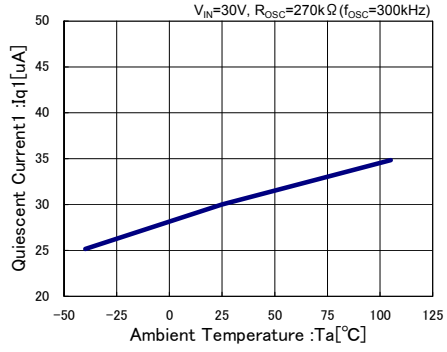


XC9252x08A

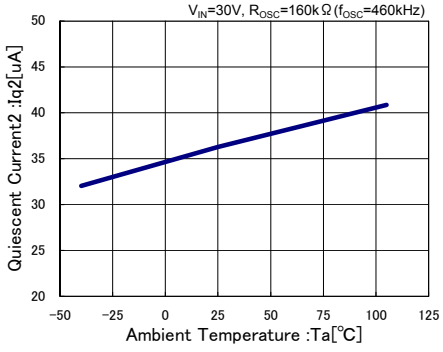


(7) Quiescent Current vs. Ambient Temperature

XC9252x08A

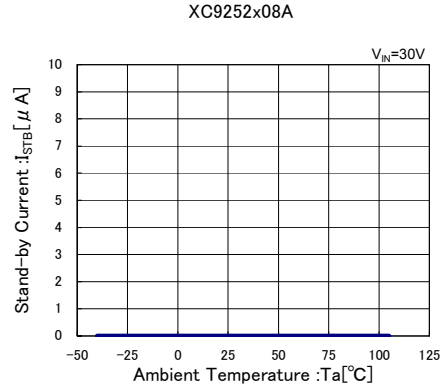


XC9252x08A

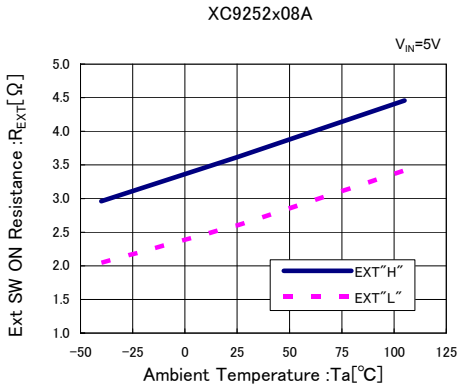


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

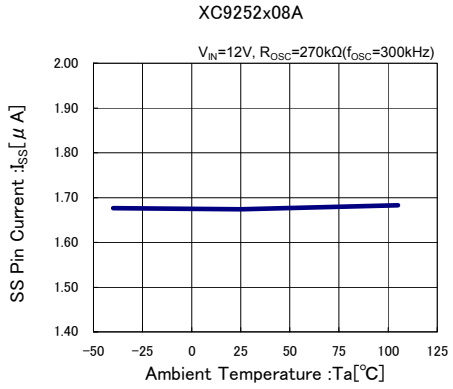
(8) Stand-by Current vs. Ambient Temperature



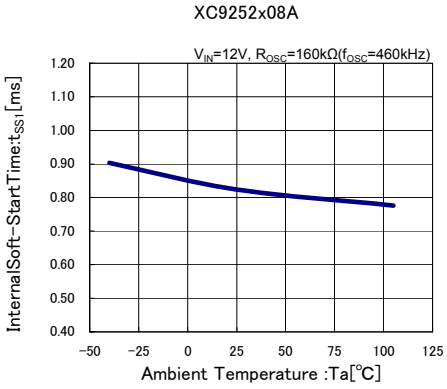
(9) Ext SW ON Resistance vs. Ambient Temperature



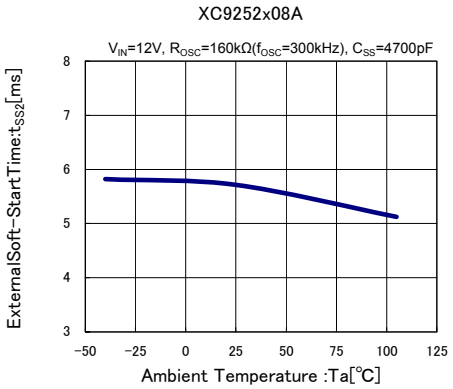
(10) SS Pin Current vs. Ambient Temperature



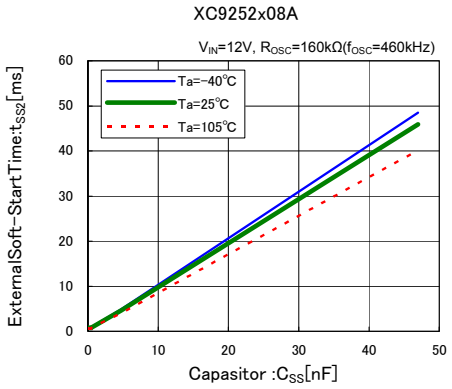
(11) Internal Soft-Start Time vs. Ambient Temperature



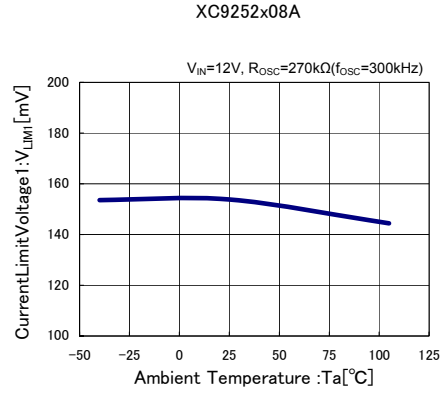
(12) External Soft-Start Time vs. Ambient Temperature

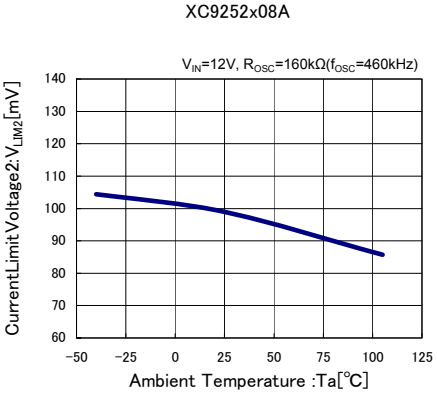


(13) External Soft-Start Time vs. CSS



(14) Current Limit Voltage vs. Ambient Temperature

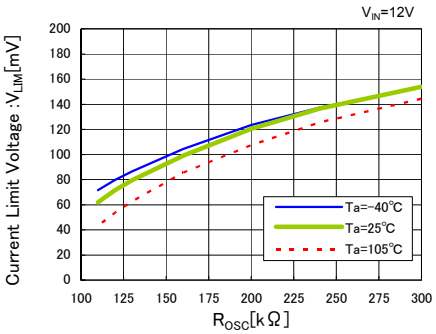




■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

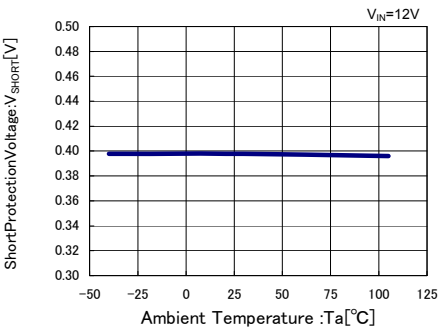
(15) Current Limit Voltage vs. R_{OSC}

XC9252x08A



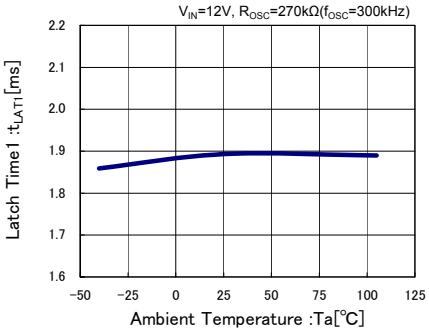
(16) Short Protection Threshold Voltage vs. Temperature

XC9252x08A

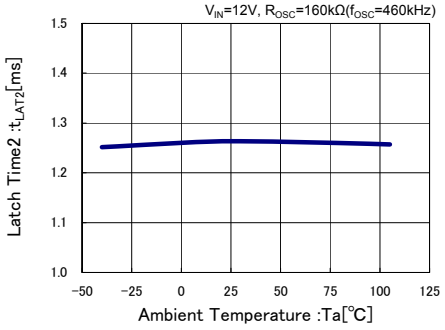


(17) Latch Time vs. Ambient Temperature

XC9252C08A

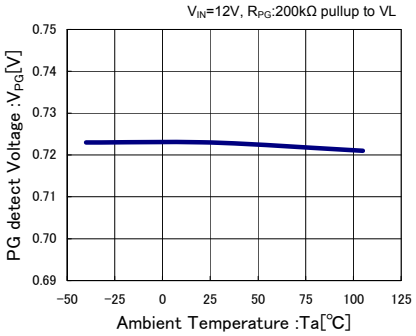


XC9252C08A



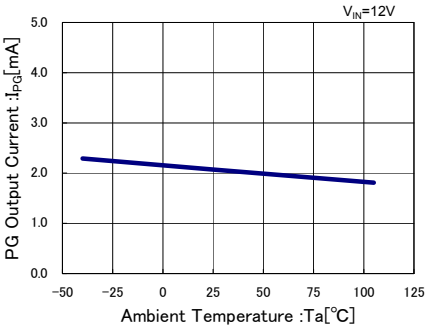
(18) PG Detect Voltage vs. Ambient Temperature

XC9252x08A



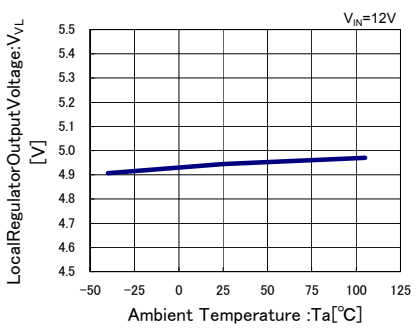
(19) PG Output Current vs. Ambient Temperature

XC9252x08A



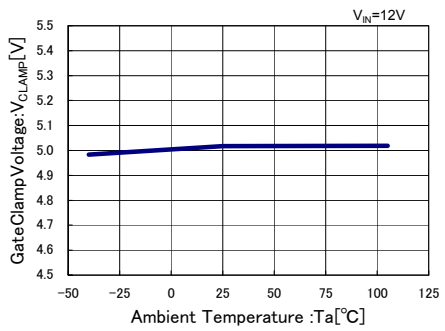
(20) Local Regulator Output Voltage vs. Ambient Temperature

XC9252x08A



(21) Gate Clamp Voltage vs. Ambient Temperature

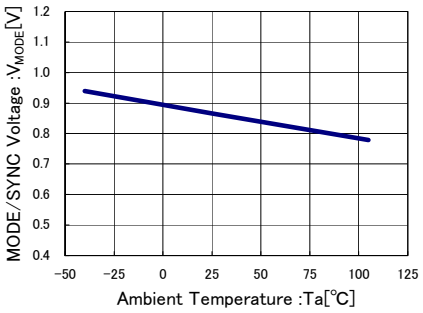
XC9252x08A



■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

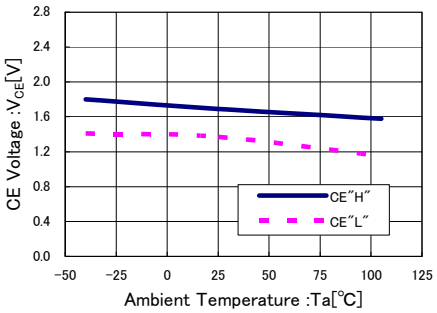
(22) MODE/SYNC Voltage vs. Ambient Temperature

XC9252x08A



(23) CE Voltage vs. Ambient Temperature

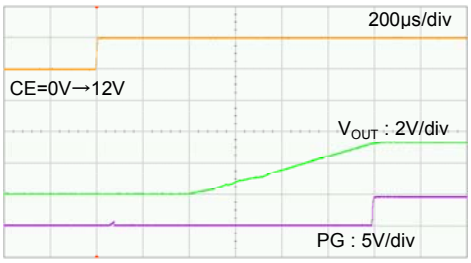
XC9252x08A



(24) CE Rising Response

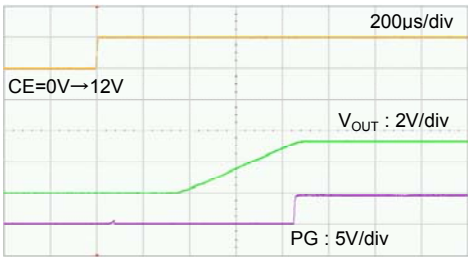
XC9252x08A、f_{OSC}=300kHz

V_{IN}=12V, V_{CE}=0→12V, V_{OUT}=3.3V, I_{OUT}=1A, C_{SS}:OPEN
L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=270kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



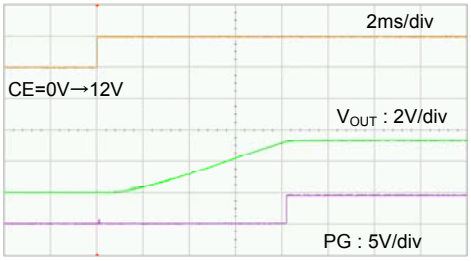
XC9252x08A、f_{OSC}=460kHz

V_{IN}=12V, V_{CE}=0→12V, V_{OUT}=3.3V, I_{OUT}=1A, C_{SS}:OPEN
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



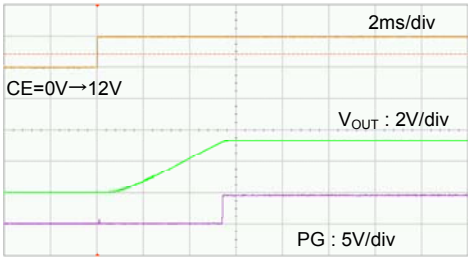
XC9252x08A、f_{OSC}=300kHz

V_{IN}=12V, V_{CE}=0→12V, V_{OUT}=3.3V, I_{OUT}=1A, C_{SS}:4700pF
L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=270kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



XC9252x08A、f_{OSC}=460kHz

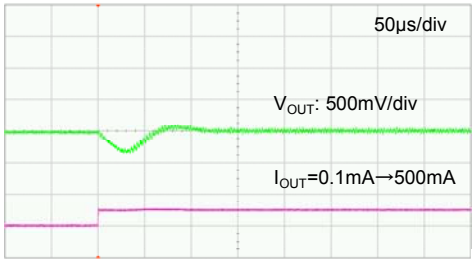
V_{IN}=12V, V_{CE}=0→12V, V_{OUT}=3.3V, I_{OUT}=1A, C_{SS}:4700pF
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



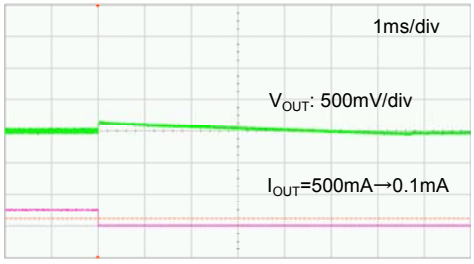
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(25) Load Transient Response (MODE=L, PFM/PWM Control)

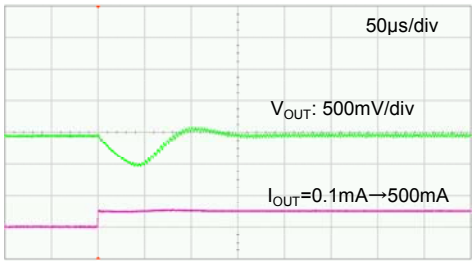
XC9252x08A、f_{OSC}=300kHz
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=0.1mA→500mA
L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=270kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



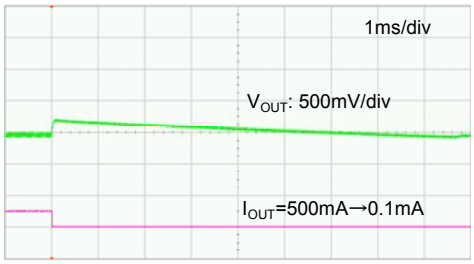
XC9252x08A、f_{OSC}=300kHz
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=500mA→0.1mA
L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=270kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



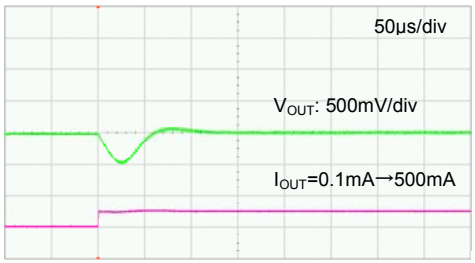
XC9252x08A、f_{OSC}=300kHz
V_{IN}=12V, V_{OUT}=5.0V, I_{OUT}=0.1mA→500mA
L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=270kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



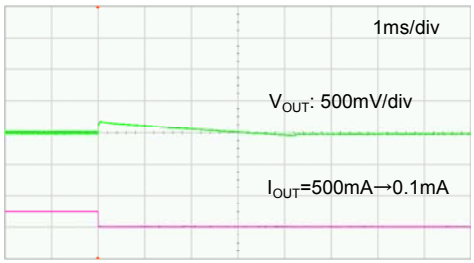
XC9252x08A、f_{OSC}=300kHz
V_{IN}=12V, V_{OUT}=5.0V, I_{OUT}=500mA→0.1mA
L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=270kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



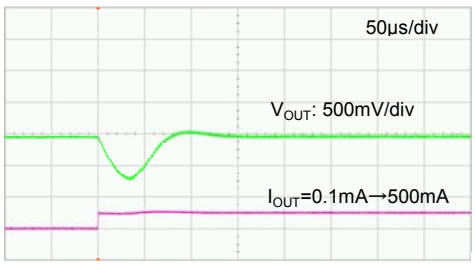
XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=0.1mA→500mA
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



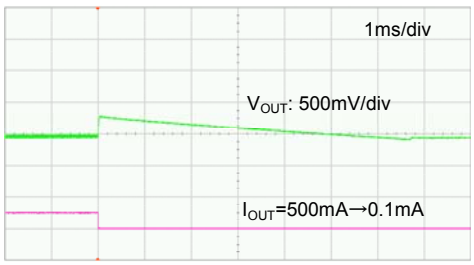
XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=500mA→0.1mA
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=5.0V, I_{OUT}=0.1mA→500mA
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



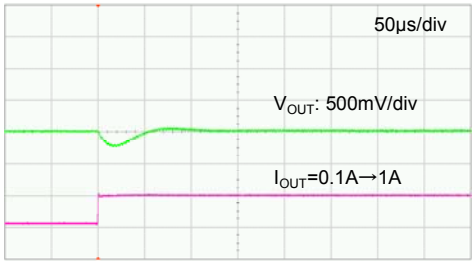
XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=5.0V, I_{OUT}=500mA→0.1mA
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



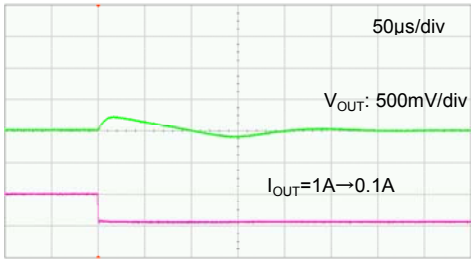
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(26) Load Transient Response（MODE=H, PWM Control)

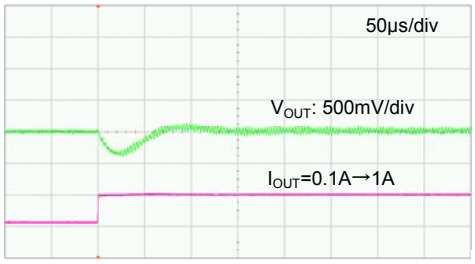
XC9252x08A、f_{OSC}=300kHz
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=0.1A→1A
L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=270kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



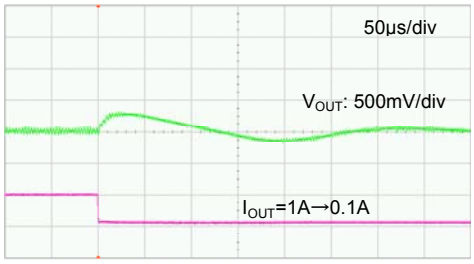
XC9252x08A、f_{OSC}=300kHz
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=1A→0.1A
L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=270kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



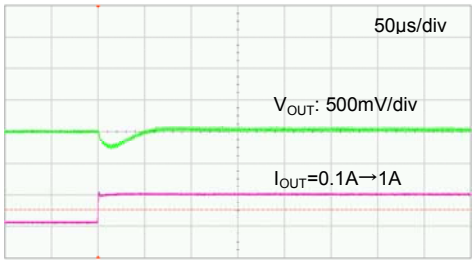
XC9252x08A、f_{OSC}=300kHz
V_{IN}=12V, V_{OUT}=5.0V, I_{OUT}=0.1A→1A
L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=270kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



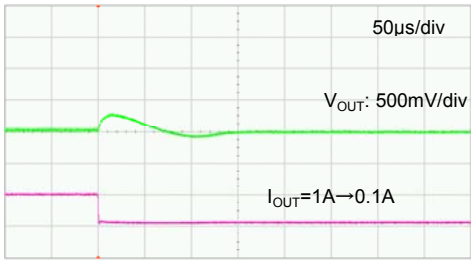
XC9252x08A、f_{OSC}=300kHz
V_{IN}=12V, V_{OUT}=5.0V, I_{OUT}=1A→0.1A
L=22μH(CLF12555-220M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=270kΩ, C_L=22μF×2 (GRM32ER71E226KE15L),
R_{SENSE}=50mΩ, PchMOSFET:2SJ668, SBD:CMS15



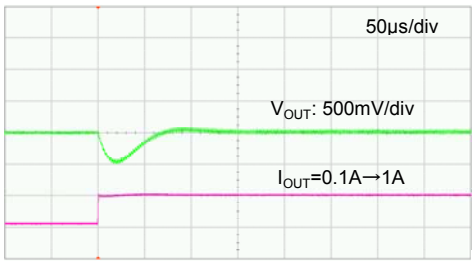
XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=0.1A→1A
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



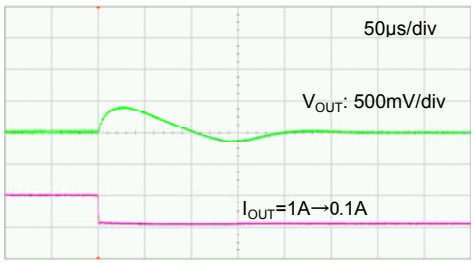
XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=1A→0.1A
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=5.0V, I_{OUT}=0.1A→1A
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



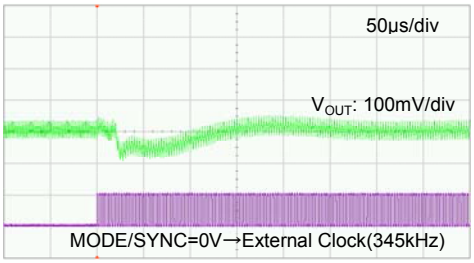
XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=5.0V, I_{OUT}=1A→0.1A
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



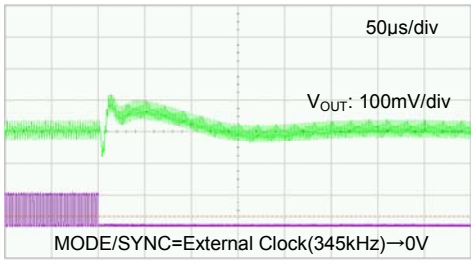
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(27) Transient Response（MODE/SYNC=L⇔External Clock) (Continued)

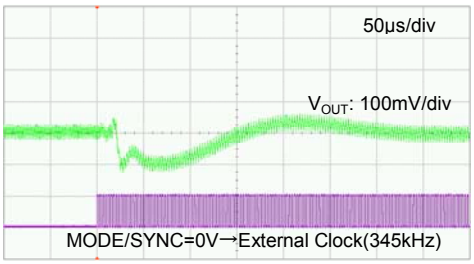
XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=1A, f_{OSC}=460kHz→345kHz
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



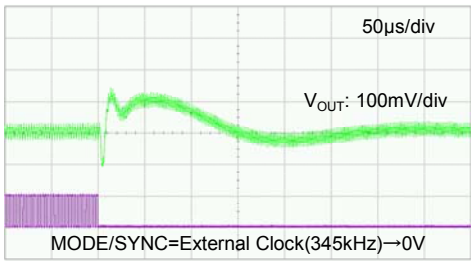
XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=1A, f_{OSC}=345kHz→460kHz
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



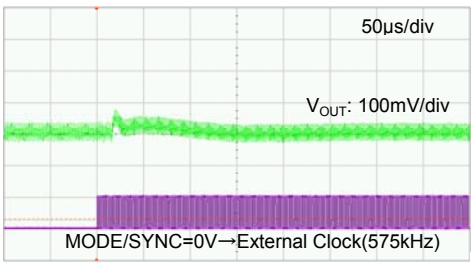
XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=5.0V, I_{OUT}=1A, f_{OSC}=460kHz→345kHz
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



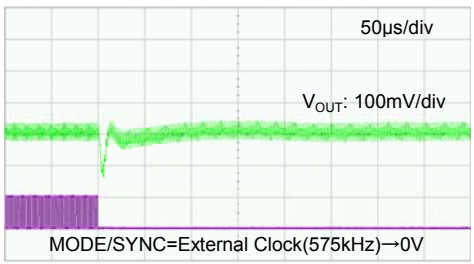
XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=5.0V, I_{OUT}=1A, f_{OSC}=345kHz→460kHz
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



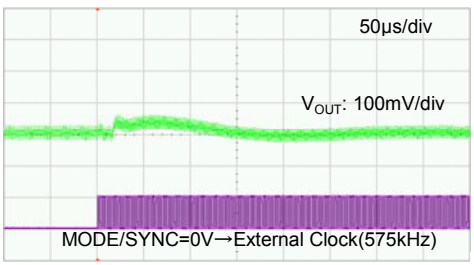
XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=1A, f_{OSC}=460kHz→575kHz
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



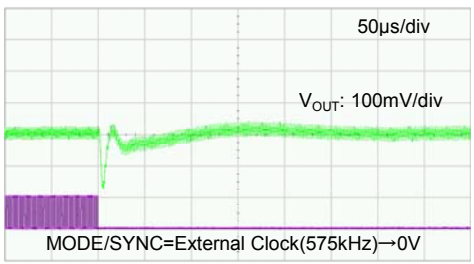
XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=1A, f_{OSC}=575kHz→460kHz
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15



XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=5.0V, I_{OUT}=1A, f_{OSC}=460kHz→575kHz
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15

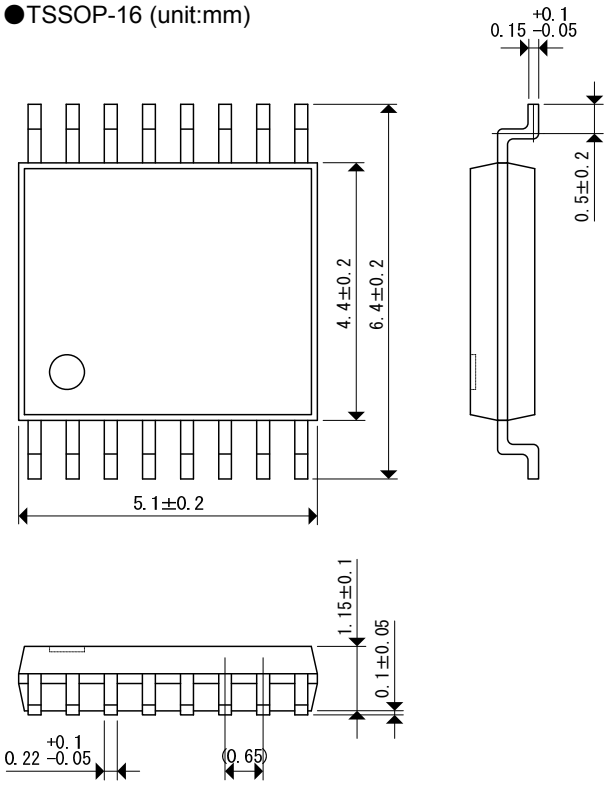


XC9252x08A、f_{OSC}=460kHz
V_{IN}=12V, V_{OUT}=5.0V, I_{OUT}=1A, f_{OSC}=575kHz→460kHz
L=10μH(CLF10040-100M), C_{IN}=10μF(GRM32ER71H106KA12L),
R_{OSC}=160kΩ, C_L=22μF(GRM32ER71E226KE15L),
R_{SENSE}=27mΩ,PchMOSFET:2SJ668, SBD:CMS15

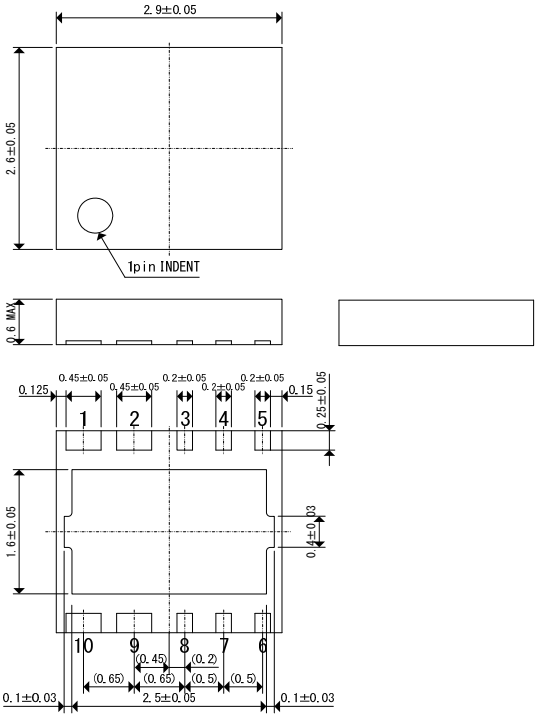


■PACKAGING INFORMATION

●TSSOP-16 (unit:mm)

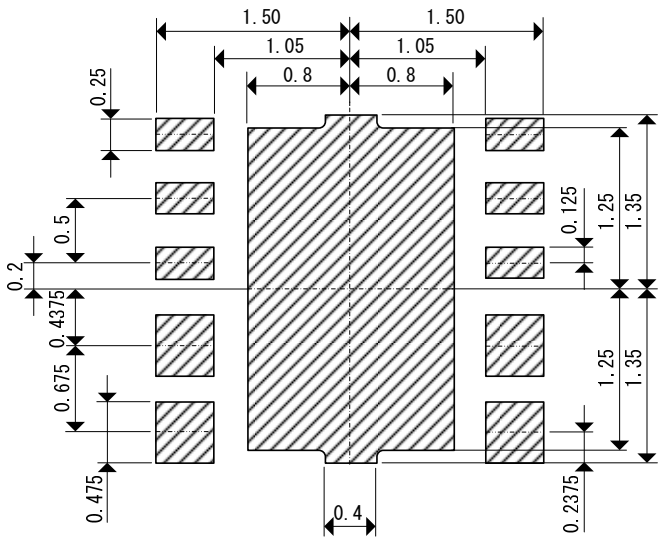


●USP-10B (unit: mm)

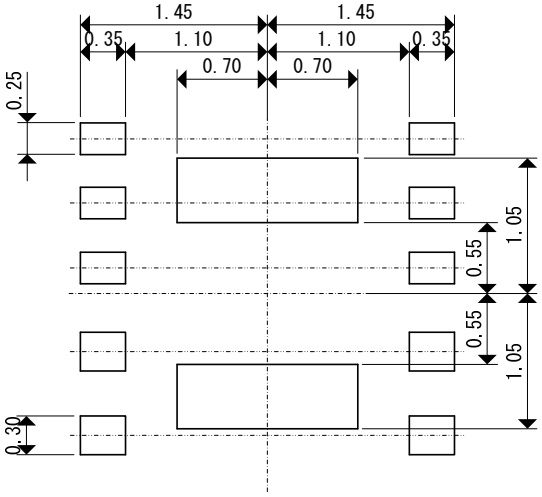


* The side of pins are not gilded, but nickel is used.
* Pin #1, #2, #9 and #10 is wider than other pins.

●USP-10B (unit: mm)　Reference Pattern Layout

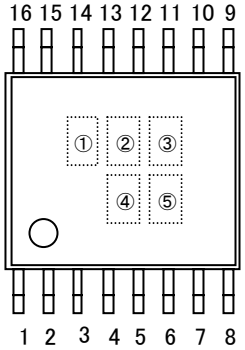


●USP-10B (unit: mm)　Reference Metal Mask Design

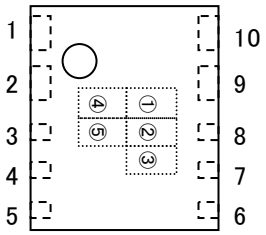


■MARKING RULE

TSSOP-16



USP-10B



① represents products series

MARK	PRODUCT SERIES
1	XC9252******-G

② represents products type

MARK	TYPE	PRODUCT SERIES
A	Standard type	XC9252A*****-G
B	Without chip enable, power-good	XC9252B*****-G
C	Standard type with latch protection	XC9252C*****-G

③ represents reference voltage and oscillation frequency

MARK	VOLTAGE (V)	OSCILLATION FREQUENCY	PRODUCT SERIES
A	0.8	Adjustable	XC9252*08A**-G

④⑤ represents production lot number
01～09, 0A～0Z, 11～9Z, A1～A9, AA～AZ, B1～ZZ in order.
(G, I, J, O, Q, W excluded)
* No character inversion used.

1. The product and product specifications contained herein are subject to change without notice to improve performance characteristics. Consult us, or our representatives before use, to confirm that the information in this datasheet is up to date.

2. The information in this datasheet is intended to illustrate the operation and characteristics of our products. We neither make warranties or representations with respect to the accuracy or completeness of the information contained in this datasheet nor grant any license to any intellectual property rights of ours or any third party concerning with the information in this datasheet.

3. Applicable export control laws and regulations should be complied and the procedures required by such laws and regulations should also be followed, when the product or any information contained in this datasheet is exported.

4. The product is neither intended nor warranted for use in equipment of systems which require extremely high levels of quality and/or reliability and/or a malfunction or failure which may cause loss of human life, bodily injury, serious property damage including but not limited to devices or equipment used in 1) nuclear facilities, 2) aerospace industry, 3) medical facilities, 4) automobile industry and other transportation industry and 5) safety devices and safety equipment to control combustions and explosions. Do not use the product for the above use unless agreed by us in writing in advance.

5. Although we make continuous efforts to improve the quality and reliability of our products; nevertheless Semiconductors are likely to fail with a certain probability. So in order to prevent personal injury and/or property damage resulting from such failure, customers are required to incorporate adequate safety measures in their designs, such as system fail safes, redundancy and fire prevention features.

6. Our products are not designed to be Radiation-resistant.

7. Please use the product listed in this datasheet within the specified ranges.

8. We assume no responsibility for damage or loss due to abnormal use.

9.

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