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R1212D SERIES

STEP-UP DC/DC CONTOLLER

OUTLINE

The R1212D Series are CMOS-based PWM step-up DC/DC converter controllers with low supply current.

Each of the R1212D Series consists of an oscillator, a PWM comparator circuit, a reference voltage unit, an error amplifier, a reference current unit, a protection circuit, and an under voltage lockout (UVLO) circuit. A low ripple, high efficiency step-up DC/DC converter can be composed of this IC with some external components, or an inductor, a diode, a power MOSFET, divider resisters, and capacitors.

Maximum duty cycle and the soft start time are easily adjustable with external resistors and capacitors. In terms of maximum duty cycle, with or without internal limit can be set by mask options. As for the protection circuit, after the soft-starting time, if the maximum duty cycle is continued for a certain period, the R1212D Series latch the external driver with its off state, or the latch-type protection circuit works.

The delay time for latch the state can be set with an external capacitor.

To release the protection circuit, restart with power-on (Voltage supplier is equal or less than UVLO detector threshold level).

FEATURES

- Input Voltage Range ....2.2V to 5.5V
- Built-in Latch-type Protection Function (Output Delay Time can be set with an external capacitor)
- Two Options of Basic Oscillator Frequency 700kHz, 1.4MHz, 300kHz
- Maximum Duty Cycle/Soft-start time ....Adjustable with external capacitors
  (If internal limit is set by version, Typ. 90% or Typ. 91.5%)
- High Reference Voltage Accuracy ....±1.5%
- U.V.L.O. Threshold level ....Typ.1.9V/2.1V/2.8V by mask option
- Small Temperature Coefficient of Reference Voltage   ...Typ.±150ppm/°C
- Package ....SON-8 (t=Max. 0.9mm)

APPLICATIONS

- Constant Voltage Power Source for portable equipment.
- Constant Voltage Power Source for LCD and CCD.

BLOCK DIAGRAM
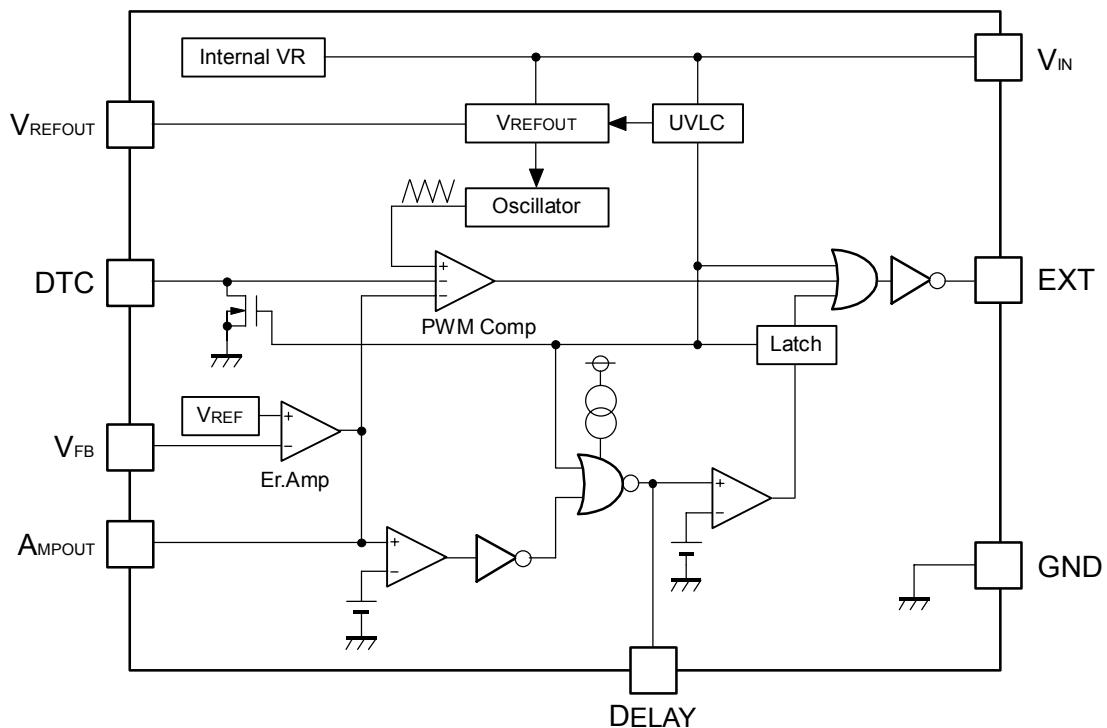
SELECTION GUIDE

In the R1212D Series, the oscillator frequency, UVLO detector threshold, and with/without internal limit of maximum duty cycle can be selected at the user's request.

The selection can be made with designating the part number as shown below;

R1212D10xx-TR-x ←Part Number
　　　　　↑　　　↑
　　　　　a　　　b

Code	Contents		
a	Oscillator Frequency	UVLO Detector Threshold	Internal Maximum Duty Limit
0A	Typ. 700kHz	Typ. 1.9V	No
0B	Typ. 1.4MHz	Typ. 1.9V	No
1A	Typ. 700kHz	Typ. 2.1V	Typ. 90%
1C	Typ. 300kHz	Typ. 2.1V	Typ. 91.5%
2A	Typ. 700kHz	Typ. 2.8V	Typ. 90%
2C	Typ. 300kHz	Typ. 2.8V	Typ. 91.5%
b	Designation of composition of pin plating -F: Lead free plating		

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PIN CONFIGURATION

SON-8

Top View

8 7 6 5

1 2 3 4

Bottom View

5 6 7 8

4 3 2 1
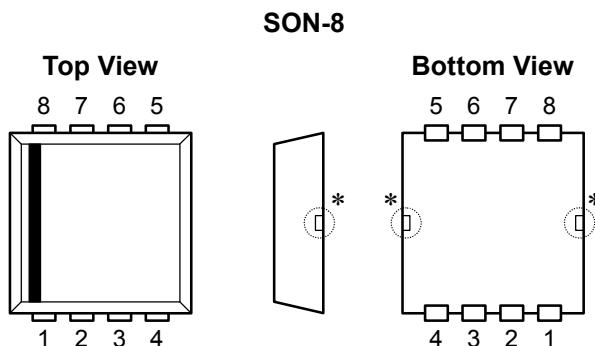
PIN DESCRIPTION

Pin No	Symbol	Description
1	EXT	External FET Drive Pin (CMOS Output)
2	GND	Ground Pin
3	DTC	Pin for Setting Maximum Duty Cycle and Soft start time
4	DELAY	Pin for External Capacitor (for Setting Output Delay of Protection)
5	V_{FB}	Feedback Pin for monitoring Output Voltage
6	V_{REFOUT}	Reference Voltage Output Pin
7	AMPOUT	Amplifier Output Pin
8	V_{IN}	Power Supply Pin for the IC

ABSOLUTE MAXIMUM RATINGS

(GND=0V)

Symbol	Item	Rating	Unit
V_{IN}	V_{IN} Pin Voltage	6.5	V
V_{EXT}	EXT Pin Output Voltage	$-0.3 \sim V_{IN}+0.3$	V
V_{DLY}	DELAY Pin Voltage	$-0.3 \sim V_{IN}+0.3$	V
V_{REFOUT}	V_{REFOUT} Pin Voltage	$-0.3 \sim V_{IN}+0.3$	V
V_{AMP}	AMPOUT Pin Voltage	$-0.3 \sim V_{IN}+0.3$	V
V_{DTC}	DTC Pin Voltage	$-0.3 \sim V_{IN}+0.3$	V
V_{FB}	V_{FB} Pin Voltage	$-0.3 \sim V_{IN}+0.3$	V
I_{AMP}	AMPOUT Pin Current	± 10	V
I_{ROUT}	V_{REFOUT} Pin Current	30	mA
I_{EXT}	EXT Pin Inductor Drive Output Current	± 80	mA
P_D	Power Dissipation (SON-8)[1]	480	mW
Topt	Operating Temperature Range	$-40 \sim +85$	°C
Tstg	Storage Temperature Range	$-55 \sim +125$	°C

*1) For Power Dissipation, please refer to PACKAGE INFORMATION to be described.

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ELECTRICAL CHARACTERISTICS

● **R1212D100A**
<div align="right">Topt=25°C</div>

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		2.2		5.5	V
V_{FB}	V_{FB} Voltage Tolerance	V_{IN}=3.3V	0.985	1.000	1.015	V
$\Delta V_{FB}/\Delta V_{IN}$	V_{FB} Voltage Line Regulation	V_{IN}: from 2.2V to 5.5V		3		mV
$\Delta V_{FB}/\Delta Topt$	V_{FB} Voltage Temperature Coefficient	$-40°C \leq Topt \leq 85°C$		±150		ppm/°C
I_{FB}	V_{FB} Input Current	V_{IN}=5.5V, V_{FB}=0V or 5.5V	−0.1		0.1	μA
A_V	Open Loop Voltage Gain	V_{IN}=3.3V		100		dB
f_T	Unity Gain Frequency Band	V_{IN}=3.3V, A_V=0		1.0		MHz
fosc	Oscillator Frequency	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	595	700	805	KHz
$\Delta fosc/\Delta V_{IN}$	Oscillator Frequency Line Regulation	V_{IN}: from 2.2V to 5.5V		50		KHz
$\Delta fosc/\Delta Topt$	Oscillator Frequency Temperature Coefficient	$-40°C \leq Topt \leq 85°C$		±1.0		KHz/°C
I_{DD1}	Supply Current 1	V_{IN}=5.5V, V_{DLY}=V_{FB}=0V EXT at no load		600	1000	μA
V_{REFOUT}	V_{REFOUT} Voltage	V_{IN}=3.3V,I_{ROUT}=1mA	1.478	1.500	1.522	V
I_{OUT}	V_{REFOUT} Maximum Output Current	V_{IN}=3.3V	10			mA
$\Delta V_{REFOUT}/\Delta V_{IN}$	V_{REFOUT} Line Regulation	V_{IN}: from 2.2V to 5.5V		5	10	mV
$\Delta V_{REFOUT}/\Delta I_{ROUT}$	V_{REFOUT} Load Regulation	V_{IN}=3.3V, I_{ROUT}: from 0.1mA to 5.0mA		6	15	mV
I_{lim}	V_{REFOUT} Short Current Limit	V_{IN}=3.3V, V_{REFOUT}=0V		20		mA
$\Delta V_{REFOUT}/\Delta Topt$	V_{REFOUT} Voltage Temperature Coefficient	$-40°C \leq Topt \leq 85°C$		±150		ppm/°C
R_{EXTH}	EXT "H" ON Resistance	V_{IN}=3.3V, I_{EXT}=−50mA		2.5	6.0	Ω
R_{EXTL}	EXT "L" ON Resistance	V_{IN}=3.3V, I_{EXT}=50mA		1.5	4.0	Ω
tr	EXT Rising Time	V_{IN}=3.3V, C_L=1000pF		12		ns
tf	EXT Falling Time	V_{IN}=3.3V, C_L=1000pF		8		ns
I_{DLY1}	DELAY Pin Charge Current	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	3.0	5.5	8.0	μA
I_{DLY2}	DELAY Pin Discharge Current	V_{IN}=V_{FB}=2.2V, V_{DLY}=0.1V	0.08	0.20	0.36	mA
V_{DLY}	DELAY Pin Detector Threshold	V_{IN}=3.3V, V_{FB}=0V, V_{DLY}=0V to 2V	0.95	1.00	1.05	V
V_{UVLO1}	UVLO Detector Threshold	V_{IN}=3.3V to 0V, V_{DLY}=V_{FB}=0V	1.8	1.9	2.0	V
V_{UVLO2}	UVLO Released Voltage	V_{IN}=0V to 3.3V, V_{DLY}=V_{FB}=0V		V_{UVLO1} + 0.2	2.2	V
V_{DTC0}	Duty=0% DTC Pin Voltage	V_{IN}=3.3V	0.05	0.18	0.25	V
V_{DTC20}	Duty=20% DTC Pin Voltage	V_{IN}=3.3V		0.3		V
V_{DTC80}	Duty=80% DTC Pin Voltage	V_{IN}=3.3V		0.75		V
V_{DTC100}	Duty=100% DTC Pin Voltage	V_{IN}=3.3V	0.80	0.87	1.00	V
I_{AMPH}	AMP "H" Output Current	V_{IN}=3.3V, V_{AMP}=1.0V, V_{FB}=0.9V	0.5	1.0	1.8	mA
I_{AMPL}	AMP "L" Output Current	V_{IN}=3.3V, V_{AMP}=1.0V, V_{FB}=1.1V	60	100	160	μA

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● **R1212D100B**   Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		2.2		5.5	V
V_{FB}	V_{FB} Voltage Tolerance	V_{IN}=3.3V	0.985	1.000	1.015	V
$\Delta V_{FB}/\Delta V_{IN}$	V_{FB} Voltage Line Regulation	V_{IN}: from 2.2V to 5.5V		3		mV
$\Delta V_{FB}/\Delta Topt$	V_{FB} Voltage Temperature Coefficient	$-40°C \leq Topt \leq 85°C$		±150		ppm/°C
I_{FB}	V_{FB} Input Current	V_{IN}=5.5V, V_{FB}=0V or 5.5V	-0.1		0.1	μA
A_V	Open Loop Voltage Gain	V_{IN}=3.3V		100		dB
f_T	Unity Gain Frequency Band	V_{IN}=3.3V, A_V=0		1.0		MHz
fosc	Oscillator Frequency	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	1.19	1.40	1.61	MHz
$\Delta fosc/\Delta V_{IN}$	Oscillator Frequency Line Regulation	V_{IN}: from 2.2V to 5.5V		100		KHz
$\Delta fosc/\Delta Topt$	Oscillator Frequency Temperature Coefficient	$-40°C \leq Topt \leq 85°C$		±2.0		KHz/°C
I_{DD1}	Supply Current 1	V_{IN}=5.5V, V_{DLY}=V_{FB}=0V EXT at no load		900	1800	μA
V_{REFOUT}	V_{REFOUT} Voltage	V_{IN}=3.3V, I_{ROUT}=1mA	1.478	1.500	1.522	V
I_{OUT}	V_{REFOUT} Maximum Output Current	V_{IN}=3.3V	10			mA
$\Delta V_{REFOUT}/\Delta V_{IN}$	V_{REFOUT} Line Regulation	V_{IN}: from 2.2V to 5.5V		5	10	mV
$\Delta V_{REFOUT}/\Delta I_{ROUT}$	V_{REFOUT} Load Regulation	V_{IN}=3.3V, I_{ROUT}: from 0.1mA to 5.0mA		6	15	mV
Ilim	V_{REFOUT} Short Current Limit	V_{IN}=3.3V, V_{REFOUT}=0V		20		mA
$\Delta V_{REFOUT}/\Delta Topt$	V_{REFOUT} Voltage Temperature Coefficient	$-40°C \leq Topt \leq 85°C$		±150		ppm/°C
R_{EXTH}	EXT "H" ON Resistance	V_{IN}=3.3V, I_{EXT}=-50mA		2.5	6.0	Ω
R_{EXTL}	EXT "L" ON Resistance	V_{IN}=3.3V, I_{EXT}=50mA		1.5	4.0	Ω
tr	EXT Rising Time	V_{IN}=3.3V, C_L=1000pF		12		ns
tf	EXT Falling Time	V_{IN}=3.3V, C_L=1000pF		8		ns
I_{DLY1}	DELAY Pin Charge Current	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	3.0	5.5	8.0	μA
I_{DLY2}	DELAY Pin Discharge Current	V_{IN}=V_{FB}=2.2V, V_{DLY}=0.1V	0.08	0.20	0.36	mA
V_{DLY}	DELAY Pin Detector Threshold	V_{FB}=0V, V_{DLY}=0V to 2V	0.95	1.00	1.05	V
V_{UVLO1}	UVLO Detector Threshold	V_{IN}=3.3V to 0V, V_{DLY}=V_{FB}=0V	1.8	1.9	2.0	V
V_{UVLO2}	UVLO Released Voltage	V_{IN}=0V to 3.3V, V_{DLY}=V_{FB}=0V		V_{UVLO1} + 0.2	2.2	V
V_{DTC0}	Duty=0% DTC Pin Voltage	V_{IN}=3.3V	0.05	0.18	0.25	V
V_{DTC20}	Duty=20% DTC Pin Voltage	V_{IN}=3.3V		0.3		V
V_{DTC80}	Duty=80% DTC Pin Voltage	V_{IN}=3.3V		0.75		V
V_{DTC100}	Duty=100% DTC Pin Voltage	V_{IN}=3.3V	0.80	0.87	1.00	V
I_{AMPH}	AMP "H" Output Current	V_{IN}=3.3V, V_{AMP}=1.0V, V_{FB}=0.9V	0.5	1.0	1.8	mA
I_{AMPL}	AMP "L" Output Current	V_{IN}=3.3V, V_{AMP}=1.0V, V_{FB}=1.1V	60	100	160	μA

● **R1212D101A**   Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		2.2		5.5	V
V_{FB}	V_{FB} Voltage Tolerance	V_{IN}=3.3V	0.985	1.000	1.015	V
$\Delta V_{FB}/\Delta V_{IN}$	V_{FB} Voltage Line Regulation	V_{IN}: from 2.2V to 5.5V		3		mV
$\Delta V_{FB}/\Delta Topt$	V_{FB} Voltage Temperature Coefficient	$-40°C \leqq Topt \leqq 85°C$		±150		ppm/°C
I_{FB}	V_{FB} Input Current	V_{IN}=5.5V, V_{FB}=0V or 5.5V	−0.1		0.1	μA
A_V	Open Loop Voltage Gain	V_{IN}=3.3V		100		dB
f_T	Unity Gain Frequency Band	V_{IN}=3.3V, A_V=0		1.0		MHz
fosc	Oscillator Frequency	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	595	700	805	KHz
$\Delta fosc/\Delta V_{IN}$	Oscillator Frequency Line Regulation	V_{IN}: from 2.2V to 5.5V		50		KHz
$\Delta fosc/\Delta Topt$	Oscillator Frequency Temperature Coefficient	$-40°C \leqq Topt \leqq 85°C$		±1.0		KHz/°C
I_{DD1}	Supply Current 1	V_{IN}=5.5V, V_{DLY}=V_{FB}=0V EXT at no load		600	1000	μA
V_{REFOUT}	V_{REFOUT} Voltage	V_{IN}=3.3V,I_{ROUT}=1mA	1.478	1.500	1.522	V
I_{OUT}	V_{REFOUT} Maximum Output Current	V_{IN}=3.3V	10			mA
$\Delta V_{REFOUT}/\Delta V_{IN}$	V_{REFOUT} Line Regulation	V_{IN}: from 2.2V to 5.5V		5	10	mV
$\Delta V_{REFOUT}/\Delta I_{ROUT}$	V_{REFOUT} Load Regulation	V_{IN}=3.3V, I_{ROUT}: from 0.1mA to 5.0mA		6	15	mV
Ilim	V_{REFOUT} Short Current Limit	V_{IN}=3.3V, V_{REFOUT}=0V		20		mA
$\Delta V_{REFOUT}/\Delta Topt$	V_{REFOUT} Voltage Temperature Coefficient	$-40°C \leqq Topt \leqq 85°C$		±150		ppm/°C
R_{EXTH}	EXT "H" ON Resistance	V_{IN}=3.3V, I_{EXT}=−50mA		2.5	6.0	Ω
R_{EXTL}	EXT "L" ON Resistance	V_{IN}=3.3V, I_{EXT}=50mA		1.5	4.0	Ω
tr	EXT Rising Time	V_{IN}=3.3V, C_L=1000pF		12		ns
tf	EXT Falling Time	V_{IN}=3.3V, C_L=1000pF		8		ns
I_{DLY1}	DELAY Pin Charge Current	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	3.0	5.5	8.0	μA
I_{DLY2}	DELAY Pin Discharge Current	V_{IN}=V_{FB}=2.2V, V_{DLY}=0.1V	0.08	0.20	0.36	mA
V_{DLY}	DELAY Pin Detector Threshold	V_{IN}=3.3V, V_{FB}=0V, V_{DLY}=0V to 2V	0.95	1.00	1.05	V
V_{UVLO1}	UVLO Detector Threshold	V_{IN}=3.3V to 0V, V_{DLY}=V_{FB}=0V	2.0	2.1	2.2	V
V_{UVLO2}	UVLO Released Voltage	V_{IN}=0V to 3.3V, V_{DLY}=V_{FB}=0V		V_{UVLO1} + 0.2	2.45	V
V_{DTC0}	Duty=0% DTC Pin Voltage	V_{IN}=3.3V	0.05	0.18	0.25	V
V_{DTC20}	Duty=20% DTC Pin Voltage	V_{IN}=3.3V		0.3		V
V_{DTC80}	Duty=80% DTC Pin Voltage	V_{IN}=3.3V		0.75		V
Maxduty	Maximum Duty Cycle	V_{IN}=3.3V	84	90	96	%
I_{AMPH}	AMP "H" Output Current	V_{IN}=3.3V, V_{AMP}=1.0V, V_{FB}=0.9V	0.5	1.0	1.8	mA
I_{AMPL}	AMP "L" Output Current	V_{IN}=3.3V, V_{AMP}=1.0V, V_{FB}=1.1V	60	100	160	μA

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● **R1212D101C**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		2.2		5.5	V
V_{FB}	V_{FB} Voltage Tolerance	V_{IN}=3.3V	0.985	1.000	1.015	V
$\Delta V_{FB}/\Delta V_{IN}$	V_{FB} Voltage Line Regulation	V_{IN}: from 2.2V to 5.5V		3		mV
$\Delta V_{FB}/\Delta Topt$	V_{FB} Voltage Temperature Coefficient	$-40°C \leq Topt \leq 85°C$		±150		ppm/°C
I_{FB}	V_{FB} Input Current	V_{IN}=5.5V, V_{FB}=0V or 5.5V	−0.1		0.1	μA
A_V	Open Loop Voltage Gain	V_{IN}=3.3V		100		dB
f_T	Unity Gain Frequency Band	V_{IN}=3.3V, A_V=0		1.0		MHz
fosc	Oscillator Frequency	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	240	300	360	KHz
$\Delta fosc/\Delta V_{IN}$	Oscillator Frequency Line Regulation	V_{IN}: from 2.2V to 5.5V		25		KHz
$\Delta fosc/\Delta Topt$	Oscillator Frequency Temperature Coefficient	$-40°C \leq Topt \leq 85°C$		±0.5		KHz/°C
I_{DD1}	Supply Current 1	V_{IN}=5.5V, V_{DLY}=V_{FB}=0V EXT at no load		400	800	μA
V_{REFOUT}	V_{REFOUT} Voltage	V_{IN}=3.3V, I_{ROUT}=1mA	1.478	1.500	1.522	V
I_{OUT}	V_{REFOUT} Maximum Output Current	V_{IN}=3.3V	10			mA
$\Delta V_{REFOUT}/\Delta V_{IN}$	V_{REFOUT} Line Regulation	V_{IN}: from 2.2V to 5.5V		5	10	mV
$\Delta V_{REFOUT}/\Delta I_{ROUT}$	V_{REFOUT} Load Regulation	V_{IN}=3.3V, I_{ROUT}: from 0.1mA to 5.0mA		6	15	mV
Ilim	V_{REFOUT} Short Current Limit	V_{IN}=3.3V, V_{REFOUT}=0V		20		mA
$\Delta V_{REFOUT}/\Delta Topt$	V_{REFOUT} Voltage Temperature Coefficient	$-40°C \leq Topt \leq 85°C$		±150		ppm/°C
R_{EXTH}	EXT "H" ON Resistance	V_{IN}=3.3V, I_{EXT}=−50mA		2.5	6.0	Ω
R_{EXTL}	EXT "L" ON Resistance	V_{IN}=3.3V, I_{EXT}=50mA		1.5	4.0	Ω
tr	EXT Rising Time	V_{IN}=3.3V, C_L=1000pF		12		ns
tf	EXT Falling Time	V_{IN}=3.3V, C_L=1000pF		8		ns
I_{DLY1}	DELAY Pin Charge Current	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	2.0	4.5	7.0	μA
I_{DLY2}	DELAY Pin Discharge Current	V_{IN}=V_{FB}=2.2V, V_{DLY}=0.1V	0.08	0.20	0.36	mA
V_{DLY}	DELAY Pin Detector Threshold	V_{IN}=3.3V, V_{FB}=0V, V_{DLY}=0V to 2V	0.95	1.00	1.05	V
V_{UVLO1}	UVLO Detector Threshold	V_{IN}=3.3V to 0V, V_{DLY}=V_{FB}=0V	2.0	2.1	2.2	V
V_{UVLO2}	UVLO Released Voltage	V_{IN}=0V to 3.3V, V_{DLY}=V_{FB}=0V		V_{UVLO1} + 0.2	2.45	V
V_{DTC0}	Duty=0% DTC Pin Voltage	V_{IN}=3.3V	0.05	0.18	0.25	V
V_{DTC20}	Duty=20% DTC Pin Voltage	V_{IN}=3.3V		0.3		V
V_{DTC80}	Duty=80% DTC Pin Voltage	V_{IN}=3.3V		0.75		V
Maxduty	Maximum Duty Cycle	V_{IN}=3.3V	85.5	91.5	97.5	%
I_{AMPH}	AMP "H" Output Current	V_{IN}=3.3V, V_{AMP}=1.0V, V_{FB}=0.9V	0.5	1.0	1.8	mA
I_{AMPL}	AMP "L" Output Current	V_{IN}=3.3V, V_{AMP}=1.0V, V_{FB}=1.1V	50	90	150	μA

● **R1212D102A**   Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		3.3		5.5	V
V_{FB}	V_{FB} Voltage Tolerance	V_{IN}=3.3V	0.985	1.000	1.015	V
$\Delta V_{FB}/\Delta V_{IN}$	V_{FB} Voltage Line Regulation	V_{IN}: from 2.2V to 5.5V		3		mV
$\Delta V_{FB}/\Delta Topt$	V_{FB} Voltage Temperature Coefficient	$-40°C \leq Topt \leq 85°C$		±150		ppm/°C
I_{FB}	V_{FB} Input Current	V_{IN}=5.5V, V_{FB}=0V or 5.5V	-0.1		0.1	μA
A_V	Open Loop Voltage Gain	V_{IN}=3.3V		100		dB
f_T	Unity Gain Frequency Band	V_{IN}=3.3V, A_V=0		1.0		MHz
fosc	Oscillator Frequency	V_{IN}=3.3V, $V_{DLY}=V_{FB}$=0V	595	700	805	KHz
$\Delta fosc/\Delta V_{IN}$	Oscillator Frequency Line Regulation	V_{IN}: from 2.2V to 5.5V		50		KHz
$\Delta fosc/\Delta Topt$	Oscillator Frequency Temperature Coefficient	$-40°C \leq Topt \leq 85°C$		±1.0		KHz/°C
I_{DD1}	Supply Current 1	V_{IN}=5.5V, $V_{DLY}=V_{FB}$=0V EXT at no load		600	1000	μA
V_{REFOUT}	V_{REFOUT} Voltage	V_{IN}=3.3V, I_{ROUT}=1mA	1.478	1.500	1.522	V
I_{OUT}	V_{REFOUT} Maximum Output Current	V_{IN}=3.3V	10			mA
$\Delta V_{REFOUT}/\Delta V_{IN}$	V_{REFOUT} Line Regulation	V_{IN}: from 2.2V to 5.5V		5	10	mV
$\Delta V_{REFOUT}/\Delta I_{ROUT}$	V_{REFOUT} Load Regulation	V_{IN}=3.3V, I_{ROUT}: from 0.1mA to 5.0mA		6	15	mV
Ilim	V_{REFOUT} Short Current Limit	V_{IN}=3.3V, V_{REFOUT}=0V		20		mA
$\Delta V_{REFOUT}/\Delta Topt$	V_{REFOUT} Voltage Temperature Coefficient	$-40°C \leq Topt \leq 85°C$		±150		ppm/°C
R_{EXTH}	EXT "H" ON Resistance	V_{IN}=3.3V, I_{EXT}=-50mA		2.5	6.0	Ω
R_{EXTL}	EXT "L" ON Resistance	V_{IN}=3.3V, I_{EXT}=50mA		1.5	4.0	Ω
tr	EXT Rising Time	V_{IN}=3.3V, C_L=1000pF		12		ns
tf	EXT Falling Time	V_{IN}=3.3V, C_L=1000pF		8		ns
I_{DLY1}	DELAY Pin Charge Current	V_{IN}=3.3V, $V_{DLY}=V_{FB}$=0V	3.0	5.5	8.0	μA
I_{DLY2}	DELAY Pin Discharge Current	$V_{IN}=V_{FB}$=2.2V, V_{DLY}=0.1V	0.08	0.20	0.36	mA
V_{DLY}	DELAY Pin Detector Threshold	V_{IN}=3.3V, V_{FB}=0V, V_{DLY}=0V to 2V	0.95	1.00	1.05	V
V_{UVLO1}	UVLO Detector Threshold	V_{IN}=3.3V to 0V, $V_{DLY}=V_{FB}$=0V	2.6	2.8	3.0	V
V_{UVLO2}	UVLO Released Voltage	V_{IN}=0V to 3.3V, $V_{DLY}=V_{FB}$=0V		V_{UVLO1} + 0.25	3.3	V
V_{DTC0}	Duty=0% DTC Pin Voltage	V_{IN}=3.3V	0.05	0.18	0.25	V
V_{DTC20}	Duty=20% DTC Pin Voltage	V_{IN}=3.3V		0.3		V
V_{DTC80}	Duty=80% DTC Pin Voltage	V_{IN}=3.3V		0.75		V
Maxduty	Maximum Duty Cycle	V_{IN}=3.3V	84	90	96	%
I_{AMPH}	AMP "H" Output Current	V_{IN}=3.3V, V_{AMP}=1.0V, V_{FB}=0.9V	0.5	1.0	1.8	mA
I_{AMPL}	AMP "L" Output Current	V_{IN}=3.3V, V_{AMP}=1.0V, V_{FB}=1.1V	60	100	160	μA

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● **R1212D102C**   Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		3.3		5.5	V
V_{FB}	V_{FB} Voltage Tolerance	V_{IN}=3.3V	0.985	1.000	1.015	V
$\Delta V_{FB}/\Delta V_{IN}$	V_{FB} Voltage Line Regulation	V_{IN}: from 2.2V to 5.5V		3		mV
$\Delta V_{FB}/\Delta Topt$	V_{FB} Voltage Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±150		ppm/°C
I_{FB}	V_{FB} Input Current	V_{IN}=5.5V, V_{FB}=0V or 5.5V	−0.1		0.1	μA
A_V	Open Loop Voltage Gain	V_{IN}=3.3V		100		dB
f_T	Unity Gain Frequency Band	V_{IN}=3.3V, A_V=0		1.0		MHz
fosc	Oscillator Frequency	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	240	300	360	KHz
$\Delta fosc/\Delta V_{IN}$	Oscillator Frequency Line Regulation	V_{IN}: from 2.2V to 5.5V		25		KHz
$\Delta fosc/\Delta Topt$	Oscillator Frequency Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±0.5		KHz/°C
I_{DD1}	Supply Current 1	V_{IN}=5.5V, V_{DLY}=V_{FB}=0V EXT at no load		400	800	μA
V_{REFOUT}	V_{REFOUT} Voltage	V_{IN}=3.3V, I_{ROUT}=1mA	1.478	1.500	1.522	V
I_{OUT}	V_{REFOUT} Maximum Output Current	V_{IN}=3.3V	10			mA
$\Delta V_{REFOUT}/\Delta V_{IN}$	V_{REFOUT} Line Regulation	V_{IN}: from 2.2V to 5.5V		5	10	mV
$\Delta V_{REFOUT}/\Delta I_{ROUT}$	V_{REFOUT} Load Regulation	V_{IN}=3.3V, I_{ROUT}: from 0.1mA to 5.0mA		6	15	mV
Ilim	V_{REFOUT} Short Current Limit	V_{IN}=3.3V, V_{REFOUT}=0V		20		mA
$\Delta V_{REFOUT}/\Delta Topt$	V_{REFOUT} Voltage Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±150		ppm/°C
R_{EXTH}	EXT "H" ON Resistance	V_{IN}=3.3V, I_{EXT}=−50mA		2.5	6.0	Ω
R_{EXTL}	EXT "L" ON Resistance	V_{IN}=3.3V, I_{EXT}=50mA		1.5	4.0	Ω
tr	EXT Rising Time	V_{IN}=3.3V, C_L=1000pF		12		ns
tf	EXT Falling Time	V_{IN}=3.3V, C_L=1000pF		8		ns
I_{DLY1}	DELAY Pin Charge Current	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	2.0	4.5	7.0	μA
I_{DLY2}	DELAY Pin Discharge Current	V_{IN}=V_{FB}=2.2V, V_{DLY}=0.1V	0.08	0.20	0.36	mA
V_{DLY}	DELAY Pin Detector Threshold	V_{IN}=3.3V, V_{FB}=0V, V_{DLY}=0V to 2V	0.95	1.00	1.05	V
V_{UVLO1}	UVLO Detector Threshold	V_{IN}=3.3V to 0V, V_{DLY}=V_{FB}=0V	2.6	2.8	3.0	V
V_{UVLO2}	UVLO Released Voltage	V_{IN}=0V to 3.3V, V_{DLY}=V_{FB}=0V		V_{UVLO1} + 0.25	3.30	V
V_{DTC0}	Duty=0% DTC Pin Voltage	V_{IN}=3.3V	0.05	0.18	0.25	V
V_{DTC20}	Duty=20% DTC Pin Voltage	V_{IN}=3.3V		0.3		V
V_{DTC80}	Duty=80% DTC Pin Voltage	V_{IN}=3.3V		0.75		V
Maxduty	Maximum Duty Cycle	V_{IN}=3.3V	85.5	91.5	97.5	%
I_{AMPH}	AMP "H" Output Current	V_{IN}=3.3V, V_{AMP}=1.0V, V_{FB}=0.9V	0.5	1.0	1.8	mA
I_{AMPL}	AMP "L" Output Current	V_{IN}=3.3V, V_{AMP}=1.0V, V_{FB}=1.1V	50	90	150	μA

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TYPICAL APPLICATIONS AND TECHNICAL NOTES

Inductor	LDR655312T-100(TDK) [R1212DxxxA]			
	LDR655312T-4R7(TDK) [R1212DxxxB]			
	LDR655312T-220(TDK) [R1212DxxxC]			
NMOS	CPH6415 (Sanyo)			
Diode	CRS02 (Toshiba)			
C1	2.2μF	C6	0.1μF	
C2	1μF	C7	0.1μF	
C3	1.5μF	Set V	5V	10V	15V
C4	1000pF[R1212DxxxA]	R1	120kΩ	180kΩ	140kΩ
	680pF[R1212DxxxB]	R2	30kΩ	20kΩ	10kΩ
	1500pF[R1212DxxxC]	R3	1kΩ		
C5	1000pF[R1212DxxxA]	R4	4.7kΩ		
	680pF[R1212DxxxB]	R5	240kΩ		
	1500pF[R1212DxxxC]	R6	300kΩ		

Use a 1μF or more capacitance value of bypass capacitor between V_{IN} pin and GND, C1 as shown in the typical application above. Connect the capacitor as short as possible to the IC.

- In terms of the capacitor for setting delay time of the latch protection, C2 is shown in typical application above. Latch delay time depends on this C2 value. Refer to the Latch Protection Operation Timing Chart.

- Connect a 1μF or more value of capacitor between V_{OUT} and GND, C3 as shown in typical application above. (Recommended value is from 10μF to 22μF.) If the operation of the composed DC/DC converter may be unstable, use a tantalum type capacitor instead of ceramic type

- Connect a capacitor between V_{REFOUT} and GND, C6 as shown in typical application of the previous page. The capacitance value of C6 is between 0.1μF and 1.0μF.

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- **Output Voltage Setting Method and Phase Compensation Making Method**

- The feedback voltage is controlled into 1.0V. The output voltage can be set with divider resistors for voltage setting, R1 and R2 as shown in typical application of the previous page. Refer to the next formula.

$$\text{Output Voltage} = V_{FB} \times (R1+R2)/R2$$

Output Voltage is adjustable with setting various resistor values combination.

R1+R2 should be equal or less than 500kΩ.

As for the DC/DC converter, depending on the load current and external components such as L and C, phase may loss around 180°. In such case, phase margin becomes less and may be unstable. To avoid this situation, make the phase margin more. The pole is made with external components L and C.

$$F_{pole} \sim 1/\{2 \times \pi \times \sqrt{(L \times C3)}\}$$

C4, C5, R3, and R4 shown in the diagram are for making phase compensation. The gain of the system can be set with using these resistors and capacitors. Each value in the diagram is just an example.

R4 and C5 make zero (the backward phase).

$$F_{zero} \sim 1/(2 \times \pi \times R4 \times C5)$$

Choose the R4 and C5 value so as to make the cutoff frequency of this zero point close to the cutoff frequency of the pole by external components, L and C.

For example, supposed that L=10μH and C_{OUT} (C3) =10μF, the cutoff frequency of the pole is approximately 16kHz. Therefore make the cutoff frequency of the zero point close to 16kHz. Then R4=4.7kΩ and C5=1000pF are appropriate values.

As for setting the gain, the ratio of the composite resistor (RT: RT=R1$\times$R2/(R1+R2)) to R4 is the key.
If the R4 against the composite resistor, R_T, is large, the gain becomes also large. If the gain is large, the response characteristic is improved, however, too large gain makes the system be unstable.

If the spike noise of V_{OUT} may be large, the spike noise may be picked into V_{FB} pin, and the unstable operation may result. In this case, a resistor R3, shown in typical application of the previous page. The recommended resistance value of R3 is in the range from 1kΩ to 5kΩ. Then, noise level will be decreased.

Further, R1 and C4 makes another zero point (the backward phase).

$$F_{zero} \sim 1/(2 \times \pi \times R1 \times C4)$$

Make the cutoff frequency of this zero point be lower than the cutoff frequency of the pole by external components, or, L and C. Herein, R1=180kΩ and C4=1000pF are appropriate values.

- Select the Power MOSFET, the diode, capacitors and the inductor within ratings (Voltage, Current, Power) of this IC. Choose the power MOSFET with low threshold voltage depending on the input voltage to be able to turn on the FET completely. Choose the diode with low V_F such as Shottky type with low reverse current I_R, and with fast switching speed. When an external transistor is switching, spike voltage may be generated caused by an inductor, therefore recommended voltage tolerance of capacitor connected to V_{OUT} is twice as much as the setting voltage or more.

- The soft-start time and the maximum duty cycle setting method
  The soft-start time and the maximum duty cycle can be set with R5, R6, and C7 values connected to the V_{REFOUT} pin and the DTC pin. (Refer to the timing chart: Soft-start operation.)

Output Current and Selection of External Components

\<Basic Circuit\>

\<Circuit through L\>

Discontinuous Mode	Continuous Mode
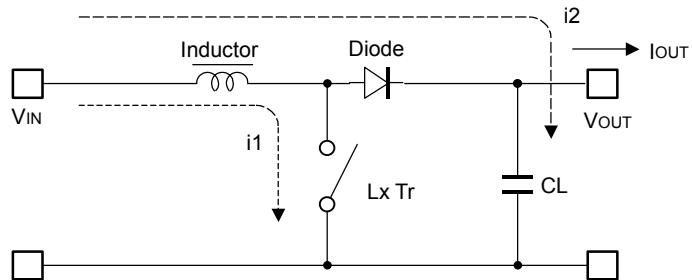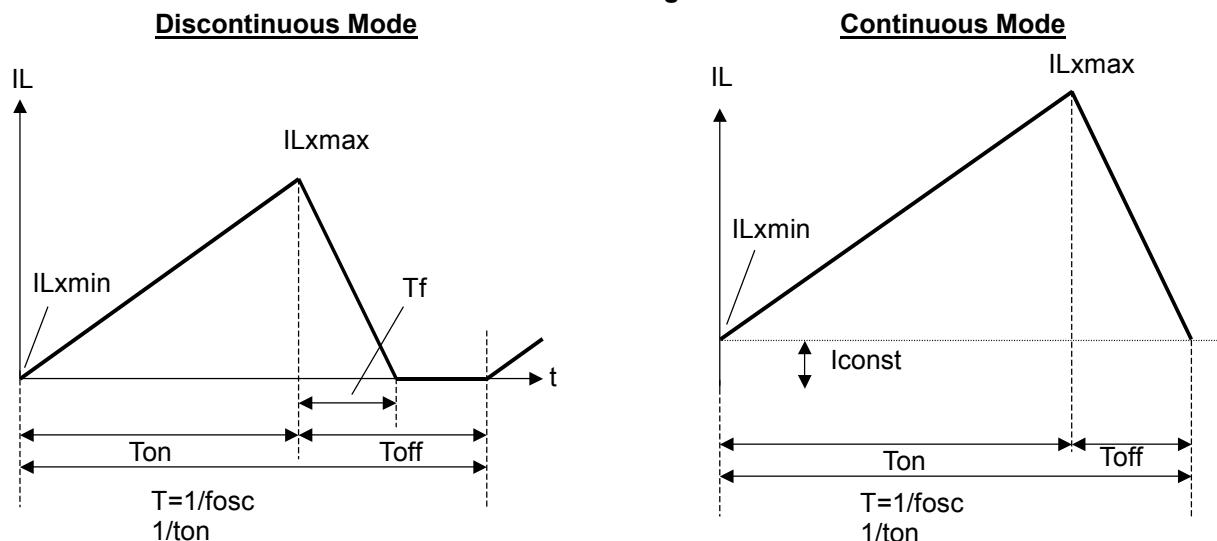
There are two modes, or discontinuous mode and continuous mode for the PWM step-up switching regulator depending on the continuous characteristic of inductor current.

During on time of the transistor, when the voltage added on to the inductor is described as V_{IN}, the current is $V_{IN} \times t/L$. Therefore, the electric power, P_{ON}, which is supplied with input side, can be described as in next formula.

$$P_{ON} = \int_0^{Ton} V_{IN}{}^2 \times t/L \ dt \ \text{..Formula 1}$$

With the step-up circuit, electric power is supplied from power source also during off time. In this case, input current is described as $(V_{OUT} - V_{IN}) \times t/L$, therefore electric power, P_{OFF} is described as in next formula.

$$P_{OFF} = \int_0^{Tf} V_{IN} \times (V_{OUT} - V_{IN}) \times t/L \ dt \ \text{...Formula 2}$$

In this formula, Tf means the time of which the energy saved in the inductance is being emitted. Thus average electric power, or P_{AV} is described as in the next formula.

$$P_{AV} = 1/(T_{ON} + T_{OFF}) \times \{\int_0^{Ton} V_{IN}{}^2 \times t/L \ dt + \int_0^{Tf} V_{IN} \times (V_{OUT} - V_{IN}) \times t/L \ dt\} \ \text{...............................Formula 3}$$

In PWM control, when Tf = Toff is true, the inductor current becomes continuos, then the operation of switching regulator becomes continuous mode.

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In the continuous mode, the deviation of the current is equal between on time and off time.

$$V_{IN} = T_{ON}/L = (V_{OUT} - V_{IN}) \times T_{off}/L$$ .... Formula 4

Further, the electric power, P_{AV} is equal to output electric power, $V_{OUT} \times I_{OUT}$, thus,

$$I_{OUT} = f_{OSC} \times V_{IN}^2 \times T_{ON}^2 / \{2 \times L \times (V_{OUT} - V_{IN})\} = V_{IN}^2 \times T_{ON}/(2 \times L \times V_{OUT})$$ .... Formula 5

When I_{OUT} becomes more than formula 5, the current flows through the inductor, then the mode becomes continuous. The continuous current through the inductor is described as Iconst, then,

$$I_{OUT} = f_{OSC} \times V_{IN}^2 \times T_{ON}^2 / \{2 \times L \times (V_{OUT} - V_{IN})\} + V_{IN} \times Iconst/V_{OUT}$$ .... Formula 6

In this moment, the peak current, ILxmax flowing through the inductor and the driver Tr. is described as follows:

$$ILx\,max = Iconst + V_{IN} \times T_{ON}/L$$ .... Formula 7

With the formula 4,6, and ILxmax is,

$$ILx\,max = V_{OUT}/V_{IN} \times I_{OUT} + V_{IN} \times T_{ON}/(2 \times L)$$ .... Formula 8

Therefore, peak current is more than I_{OUT}. Considering the value of ILxmax, the condition of input and output, and external components should be selected.

In the formula 7, peak current ILxmax at discontinuous mode can be calculated. Put Iconst=0 in the formula.

The explanation above is based on the ideal calculation, and the loss caused by L_X switch and external components is not included. The actual maximum output current is between 50% and 80% of the calculation. Especially, when the IL_X is large, or V_{IN} is low, the loss of V_{IN} is generated with the on resistance of the switch. As for V_{OUT}, Vf (as much as 0.3V) of the diode should be considered.

TIMING CHART

\<Soft-start Operation\>

The timing chart below describes the state of each pin from the power-on until the IC entering the stable operation.

By raising the voltage of the DTC pin slowly, the switching duty cycle is limited, and prevent the drastic voltage rising (over-shoot) and inrush current.

When the V_{IN} voltage becomes equal or more than the UVLO released voltage ($V_{UVLO}+V_{HYS}$), V_{REFOUT} operation starts. Following with the increase of the voltage level of V_{REFOUT}, the internal oscillator begins to operate, then the DTC voltage is also rising, then, soft-start operation starts. When the DTC voltage crosses the chopping wave level inside the IC, EXT pin starts switching, then, step-up operation begins. During this term, the output voltage does not reach the set output voltage. Therefore the output of the amplifier is "H". Besides, the protection circuit may work and the IC charges the DELAY pin. Because of this, the soft-start time should be set shorter than the latch protection delay time.

After the initial stage, when the output voltage reaches the set output voltage, the level of AMPOUT becomes the normal state. In other words, the level is determined with the input voltage, the output voltage, and the output current. When the level of AMPOUT becomes falling, charging the DELAY pin stops and discharges to the GND. The soft-start time (the time for the DTC pin voltage becoming to V_{DTC} level) can be estimated with the next formula.

$T \cong 1/\alpha \times \ln(V_{DTC} \times \alpha/\beta + 1)$, herein, $\alpha = -1/C_7 \times (1/R_5 + 1/R_6)$, and $\beta = V_{REFOUT}/(C_7 \times R_5)$.

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<Latch Protection Operation>
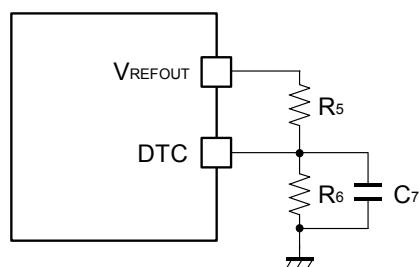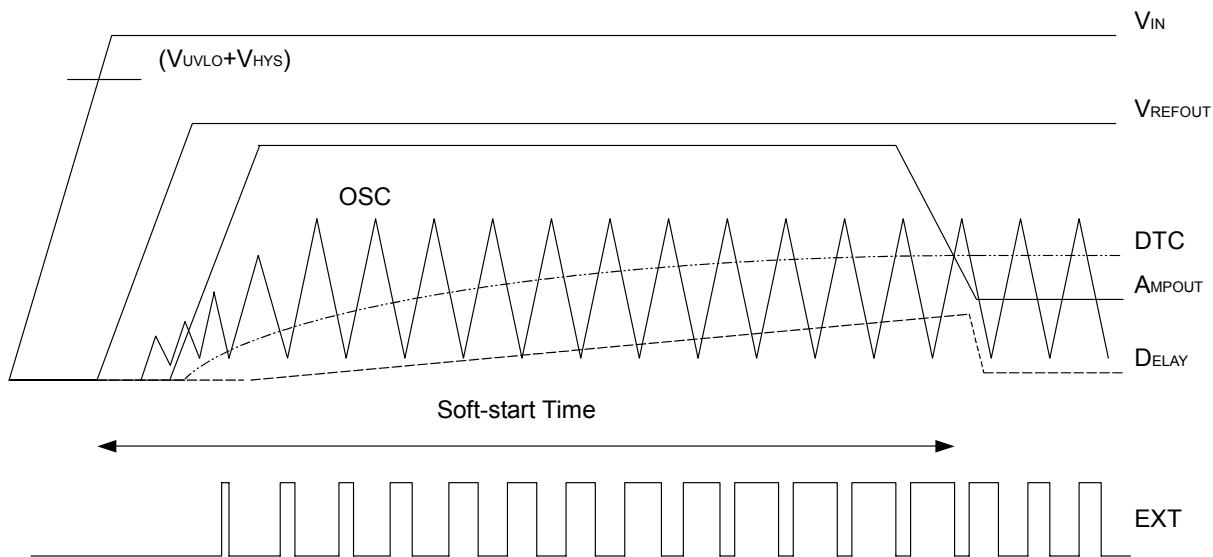
The operation of Latch protection circuit is as follows: When AMPOUT becomes "H" and the IC detects maximum duty cycle, charge to an external capacitor, C2 of D_{ELAY} pin starts. The maximum duty cycle continues and the voltage of DELAY pin reaches delay voltage detector threshold, V_{DLY}, outputs "L" to EXT pin and turns off the external power MOSFET.

To release the latch protection operation, make the supply voltage down to UVLO detector threshold or lower, and make it rise up to the normal input voltage.

Once after becoming the maximum duty cycle, if the duty cycle decreases before latch operation works, the charging the capacitor stops immediately, and the DELAY pin voltage is fixed at GND level with I_{DLY2}.

The delay time of latch protection can be calculated with C2, V_{DLY}, and the delay pin charge current, I_{DLY1}, as in the next formula.

$t = C2 \times V_{DLY}/I_{DLY1}$
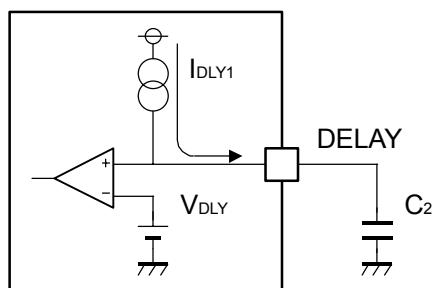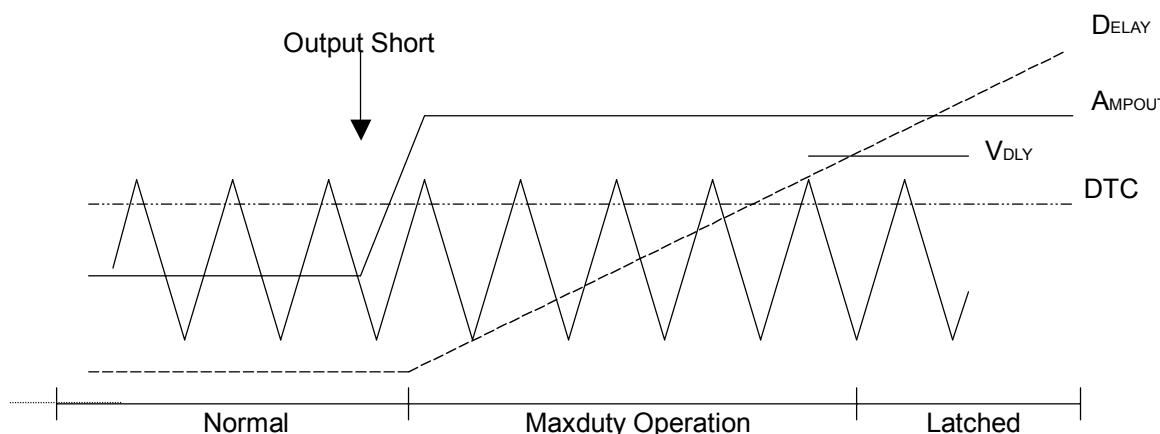
TEST CIRCUITS
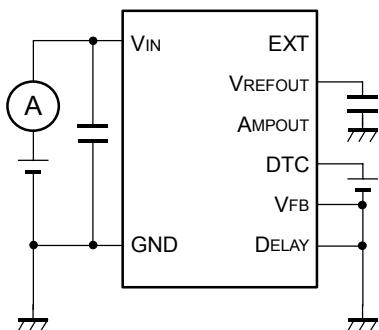
Fig.1 Consumption Current Test Circuit
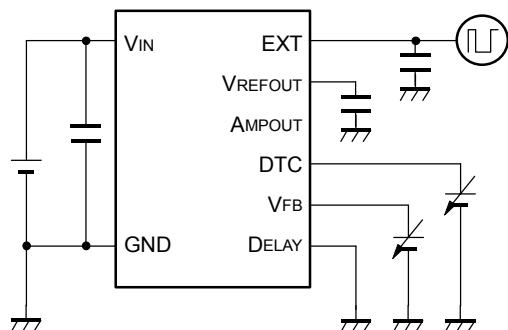
**Fig.2 Oscillator Frequency, V_{FB} Voltage,
Duty Cycle, EXT rising time/falling time Test Circuit**
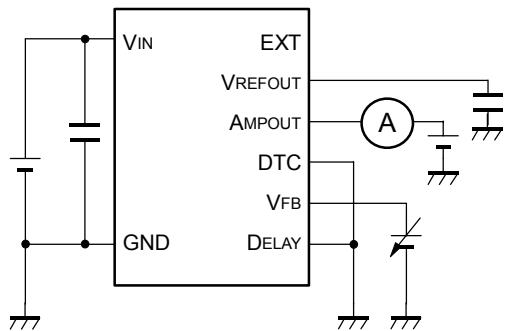
**Fig.3 AMP "L" Output Current/
"H" Output Current Test Circuit**
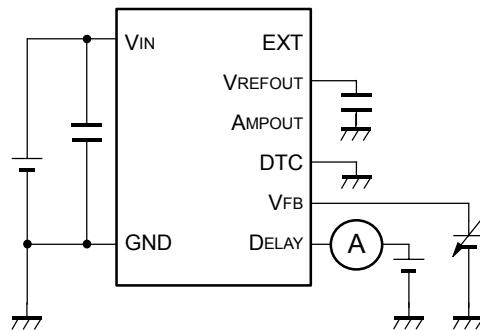
**Fig.4 D_{ELAY} Pin Charge Current/
Discharge Current Test Circuit**
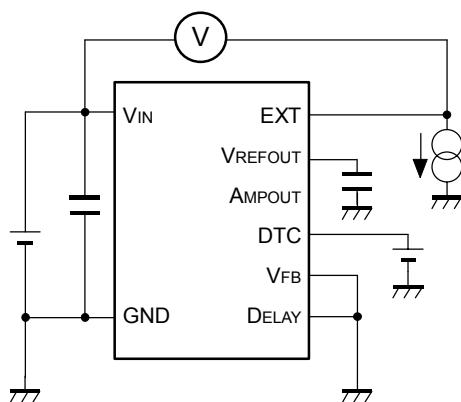
Fig.5 EXT "H" ON Resistance Test Circuit
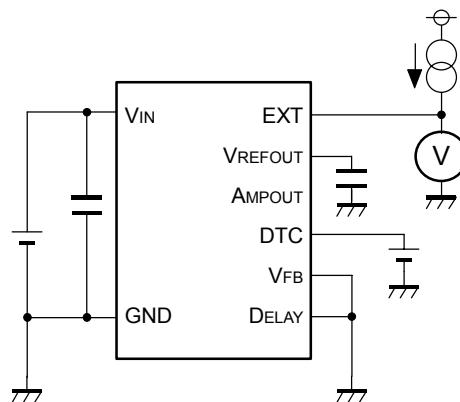
Fig.6 EXT "L" ON Resistance Test Circuit

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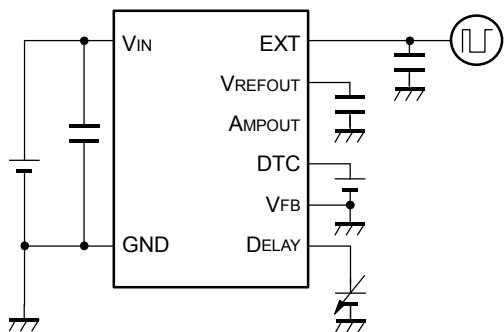
Fig.7 D_{ELAY} Pin Detector Threshold Test Circuit
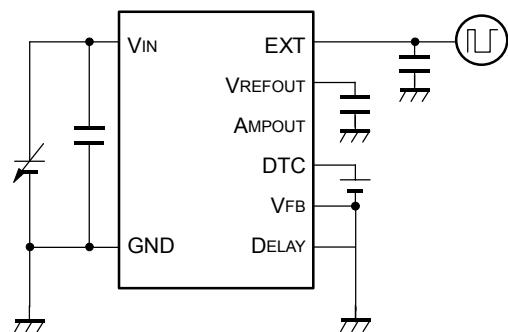
Fig.8 UVLO Detector Threshold/Released Voltage Test Circuit
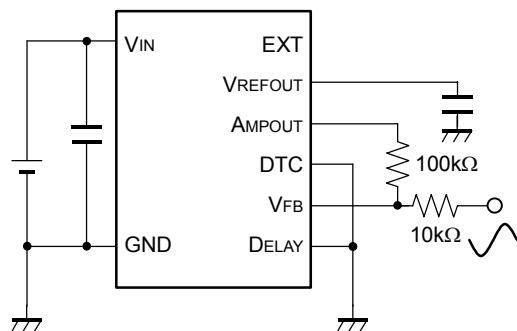
Fig.9 Error AMP Gain/Phase Test Circuit
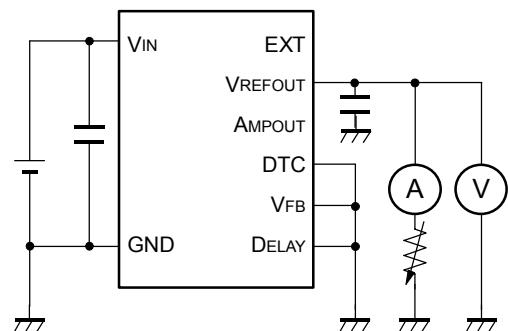
Fig.10 V_{REFOUT} Voltage Test Current
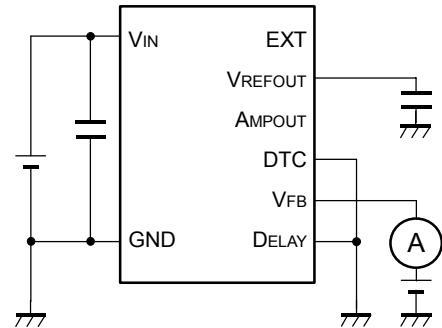
Fig.11 V_{FB} Leakage Current Test Circuit

R1212D
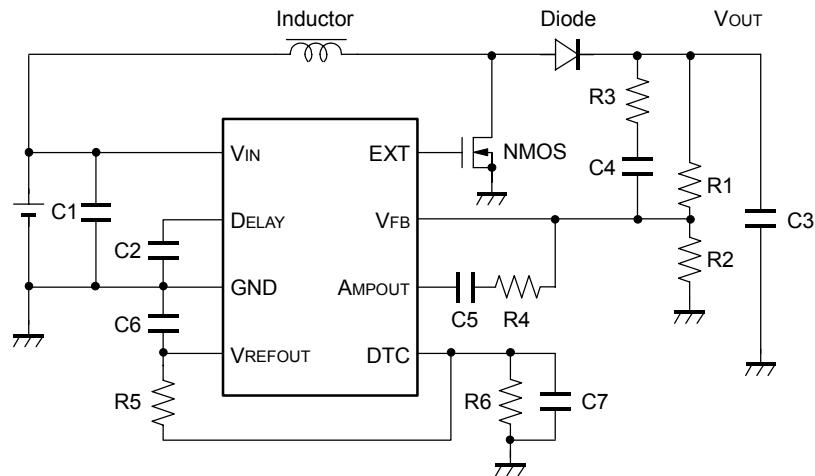
Fig.12 Output Current vs. Output Voltage/Efficiency, Response Characteristics Test Circuit

Inductor	LDR655312T-100(TDK) [R1212DxxxA]				
	LDR655312T-4R7(TDK) [R1212DxxxB]				
	LDR655312T-220(TDK) [R1212DxxxC]				
NMOS	CPH6415 (Sanyo)				
Diode	CRS02 (Toshiba)				
C1	2.2μF	C6	0.1μF		
C2	1μF	C7	0.1μF		
C3	15μF	SetV	5V	10V	15V
C4	1000pF[R1212DxxxA]	R1	120kΩ	180kΩ	140kΩ
	680pF[R1212DxxxB]	R2	30kΩ	20kΩ	10kΩ
	1500pF[R1212DxxxC]	R3	1kΩ		
C5	1000pF[R1212DxxxA]	R4	4.7kΩ		
	680pF[R1212DxxxB]	R5	240kΩ		
	1500pF[R1212DxxxC]	R6	300kΩ		

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TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (Topt=25°C)
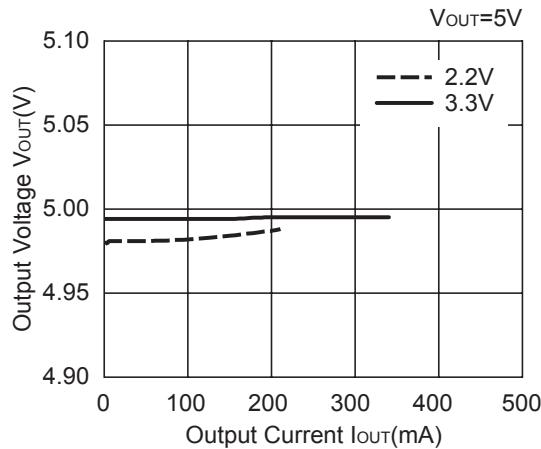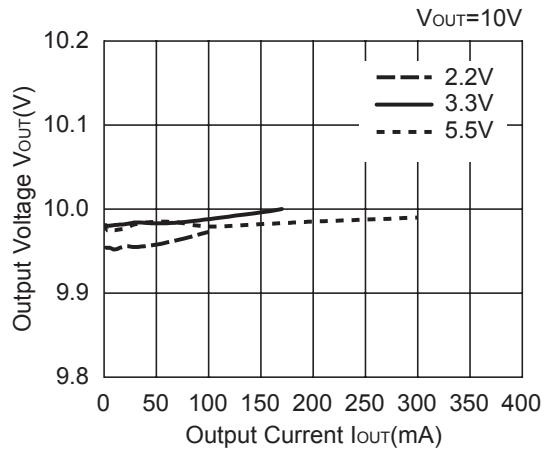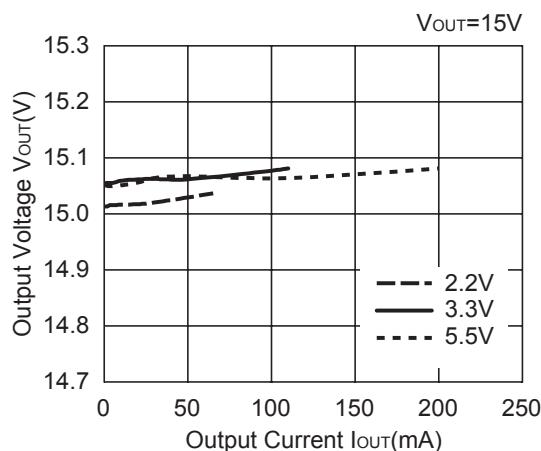
R1212D100A

V_OUT=5V

R1212D100A

V_OUT=10V

R1212D100A

V_OUT=15V

R1212D100B

V_OUT=5V

R1212D100B

V_OUT=10V

R1212D100B

V_OUT=15V

R1212D101C

V$_{OUT}$=5V

R1212D101C

V$_{OUT}$=10V

R1212D101C

V$_{OUT}$=15V
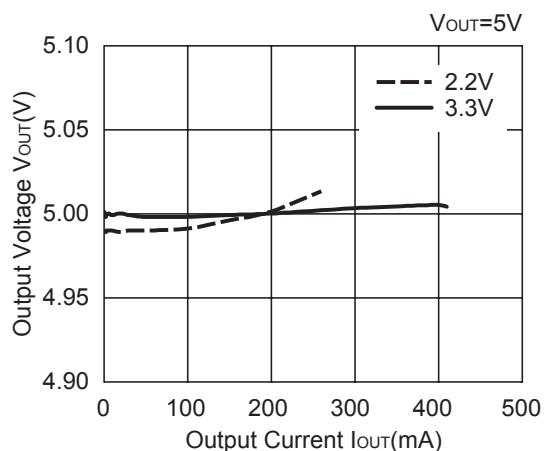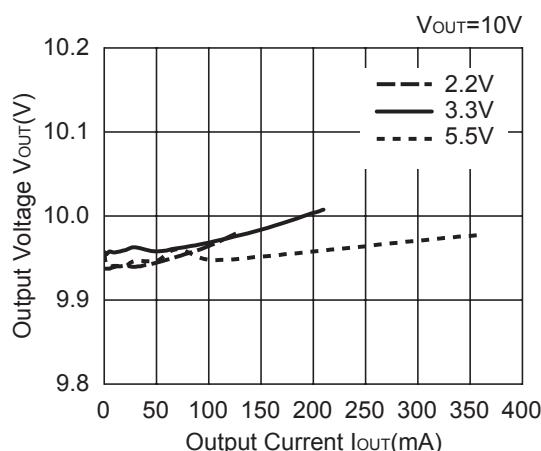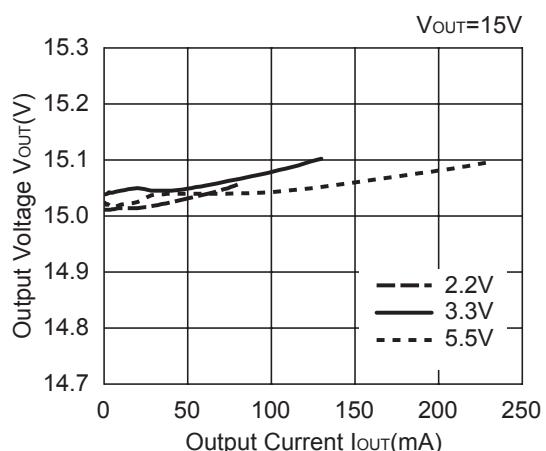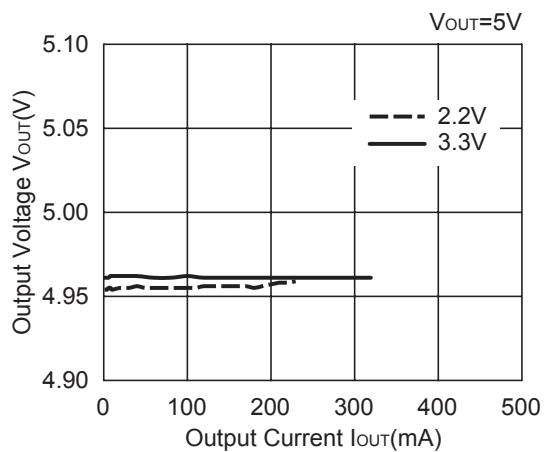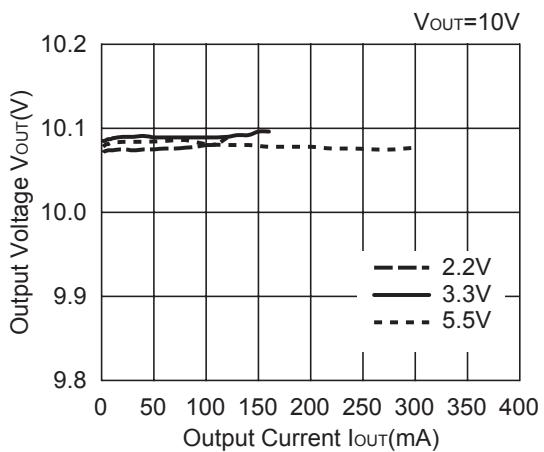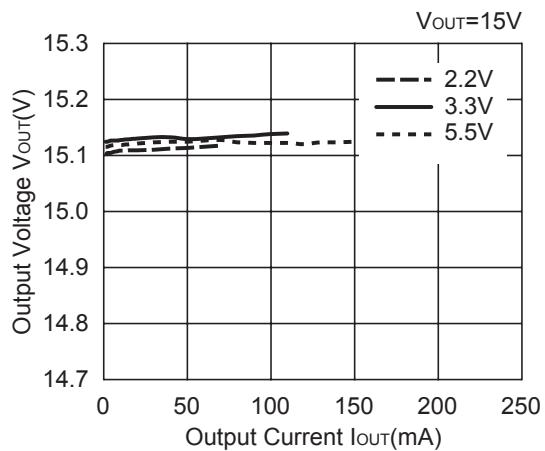
2) Efficiency vs. Output Current (Topt=25°C)
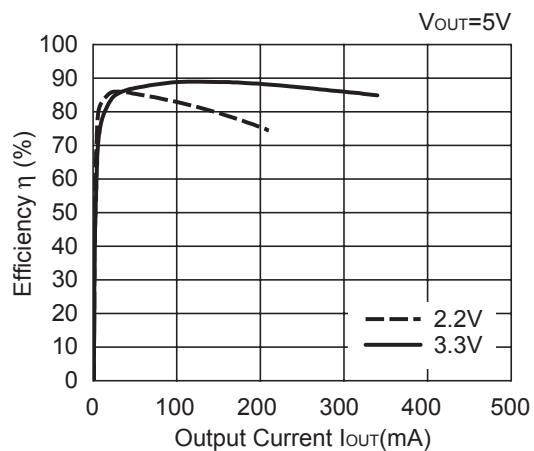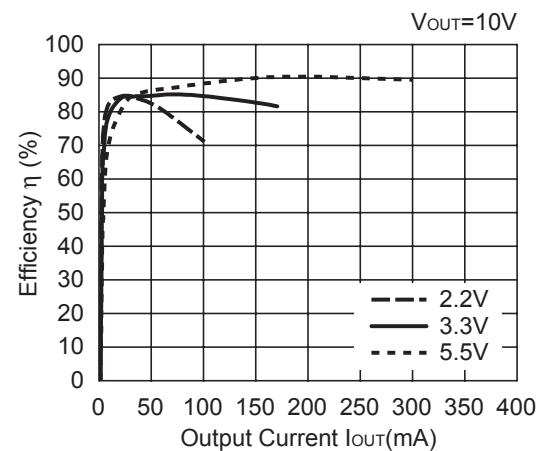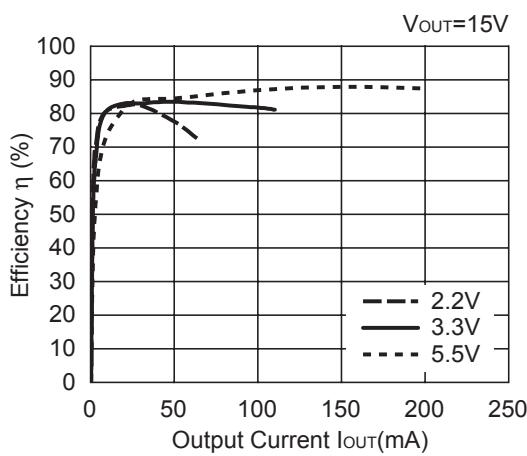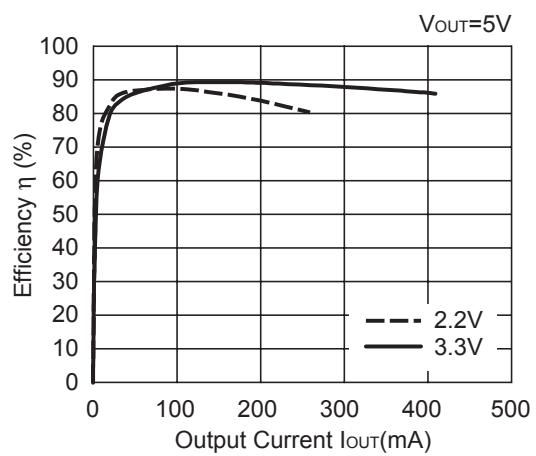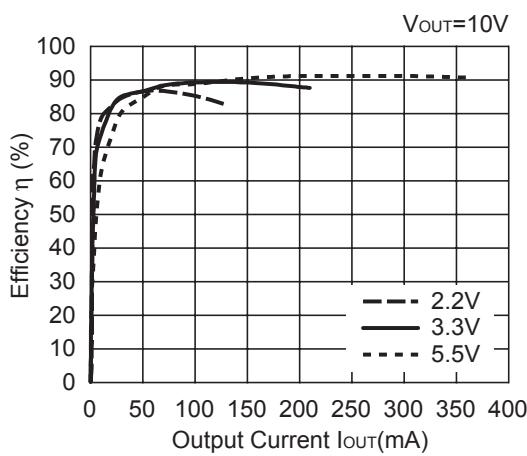
R1212D100A

V$_{OUT}$=5V

R1212D100A

V$_{OUT}$=10V

RICOH

R1212D100A

$V_{OUT}=15V$

Efficiency η (%) vs Output Current I_{OUT}(mA)

- - - 2.2V
—— 3.3V
······ 5.5V

R1212D100B

$V_{OUT}=5V$

Efficiency η (%) vs Output Current I_{OUT}(mA)

- - - 2.2V
—— 3.3V

R1212D100B

$V_{OUT}=10V$

Efficiency η (%) vs Output Current I_{OUT}(mA)

- - - 2.2V
—— 3.3V
······ 5.5V

R1212D100B

$V_{OUT}=15V$

Efficiency η (%) vs Output Current I_{OUT}(mA)

- - - 2.2V
—— 3.3V
······ 5.5V

R1212D101C

$V_{OUT}=5V$

Efficiency η (%) vs Output Current I_{OUT}(mA)

- - - 2.2V
—— 3.3V

R1212D101C

$V_{OUT}=10V$

Efficiency η (%) vs Output Current I_{OUT}(mA)

- - - 2.2V
—— 3.3V
······ 5.5V

RICOH

R1212D101C

V_{OUT}=15V

Efficiency η (%) vs Output Current I_{OUT}(mA)

- - - 2.2V
——— 3.3V
· · · · 5.5V

3) V_{FB} Voltage vs. Input Voltage (Topt =25°C)
R1212D100x

Feedback Voltage V_{FB}(mV) vs. Input Voltage V_{IN}(V)

4) V_{FB} Voltage vs. Temperature
R1212D100x

V_{IN}=3.3V

Feedback Voltage V_{FB}(mV) vs. Temperature Topt(°C)
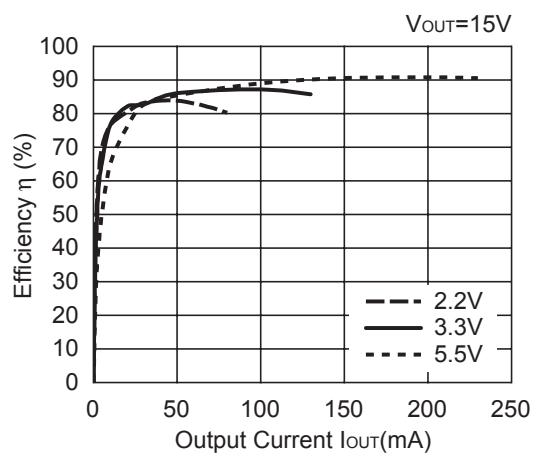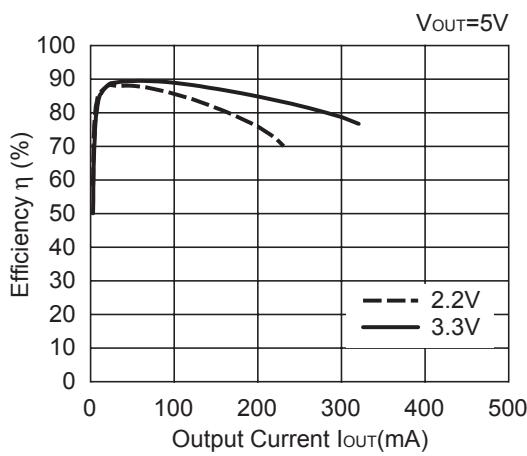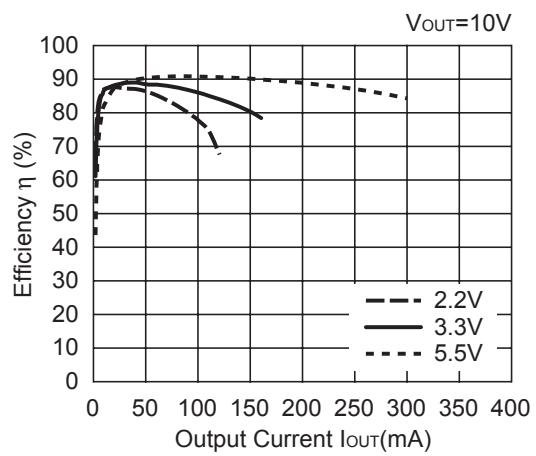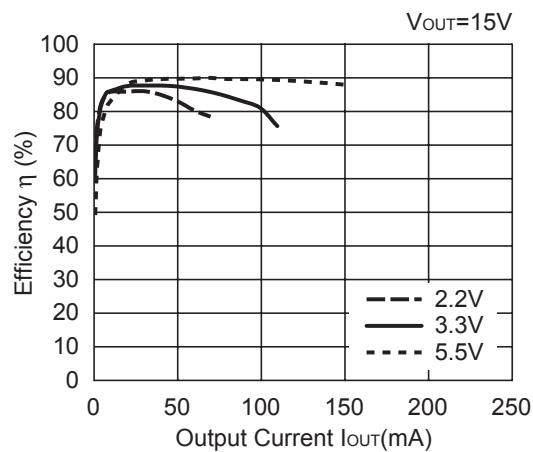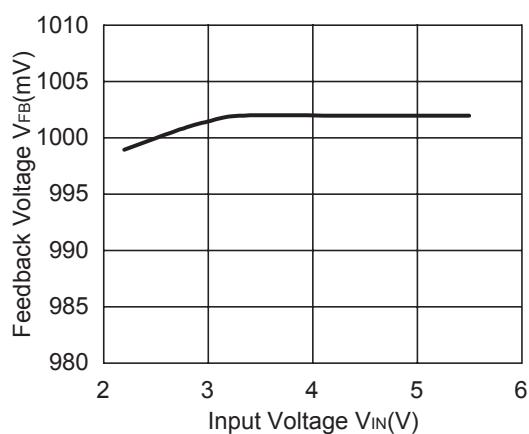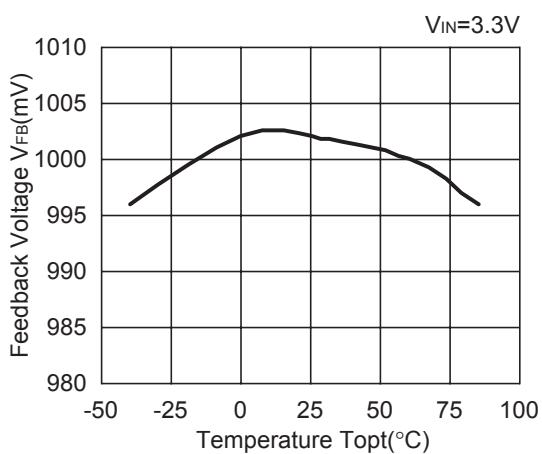
5) Oscillator Frequency vs. Input Voltage (Topt=25°C)

R1212D100A

Oscillator Frequency fosc(kHz) vs. Input Voltage V_{IN}(V)

R1212D100B

Oscillator Frequency fosc(kHz) vs. Input Voltage V_{IN}(V)

RICOH

R1212D101C

Oscillator Frequency fosc(kHz) vs Input Voltage V$_{IN}$(V)
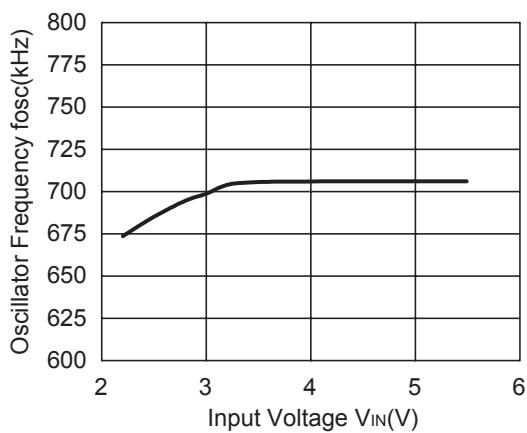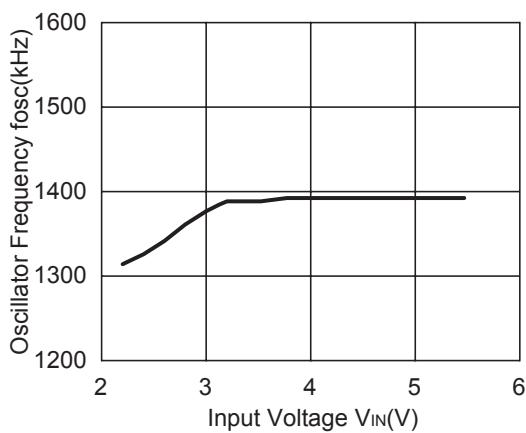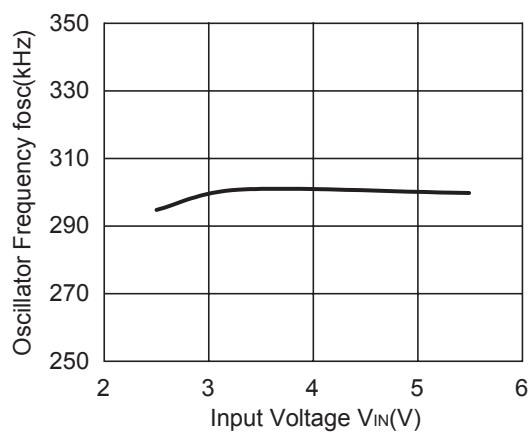
6) Oscillator Frequency vs. Temperature

R1212D10xA

V$_{IN}$=3.3V

Oscillator Frequency fosc(kHz) vs Temperature Topt(°C)

R1212D10xB

V$_{IN}$=3.3V

Oscillator Frequency fosc(kHz) vs Temperature Topt(°C)

R1212D10xC

V$_{IN}$=3.3V

Oscillator Frequency fosc(kHz) vs Temperature Topt(°C)
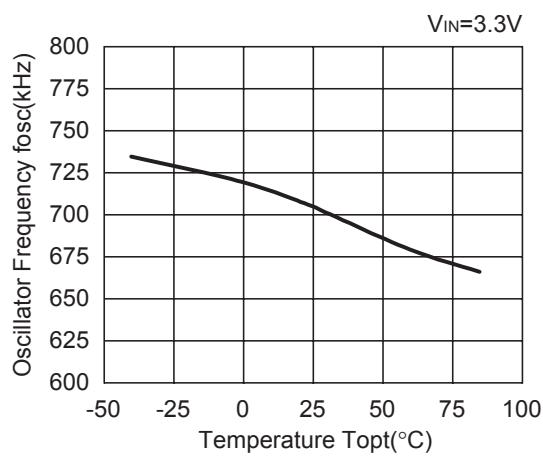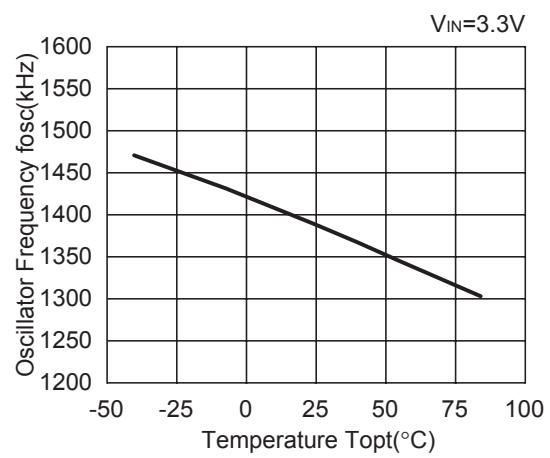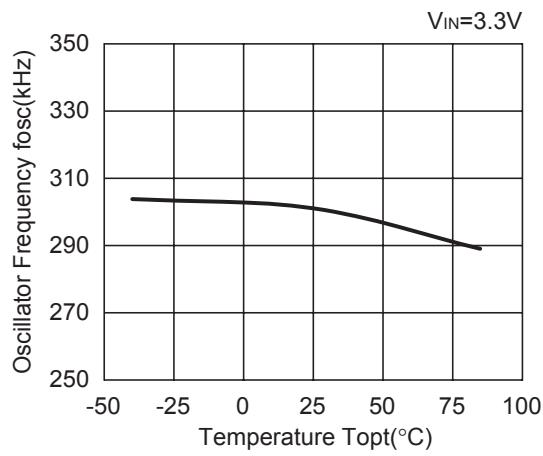
7) Supply Current vs. Input Voltage (Topt=25°C at no load)

R1212D100A

EXT at no load

Supply Current I$_{DD}$(uA) vs. Input Voltage V$_{IN}$(V)

R1212D100B

EXT at no load

Supply Current I$_{DD}$(uA) vs. Input Voltage V$_{IN}$(V)

R1212D101C

EXT at no load

Supply Current I$_{DD}$(uA) vs. Input Voltage V$_{IN}$(V)
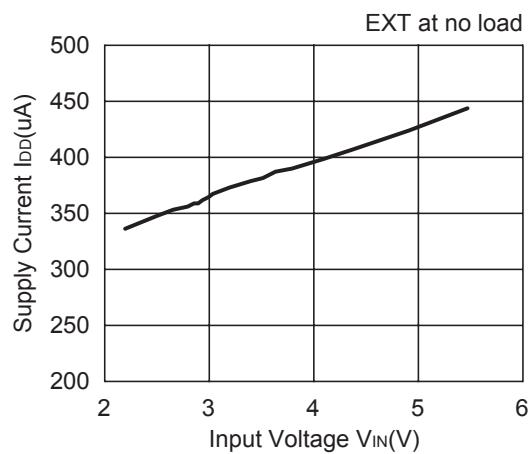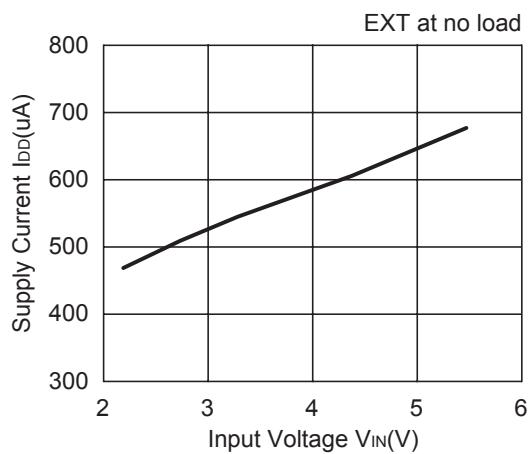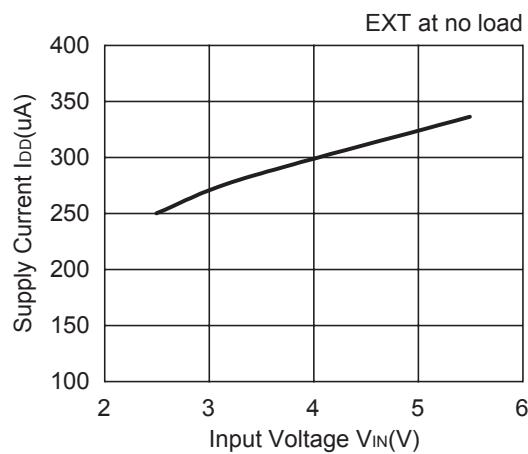
8) Supply Current vs. Temperature

R1212D10xA

V$_{IN}$=5.5V, EXT at no load

Supply Current I$_{DD}$(uA) vs. Temperature Topt(°C)

R1212D10xB

V$_{IN}$=5.5V, EXT at no load

Supply Current I$_{DD}$(uA) vs. Temperature Topt(°C)

RICOH
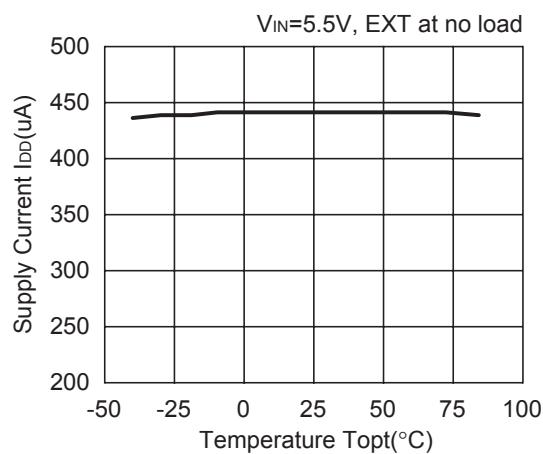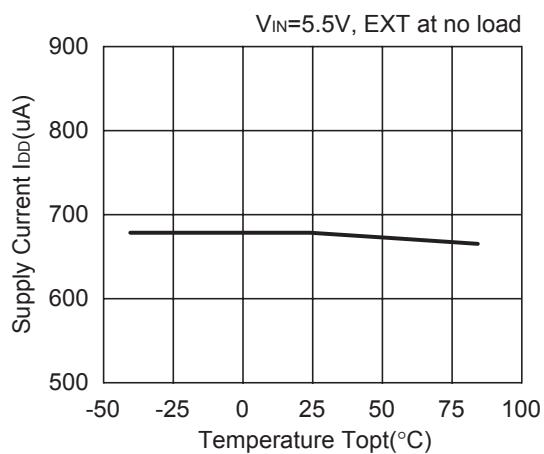
R1212D10xC

V_{IN}=5.5V, EXT at no load
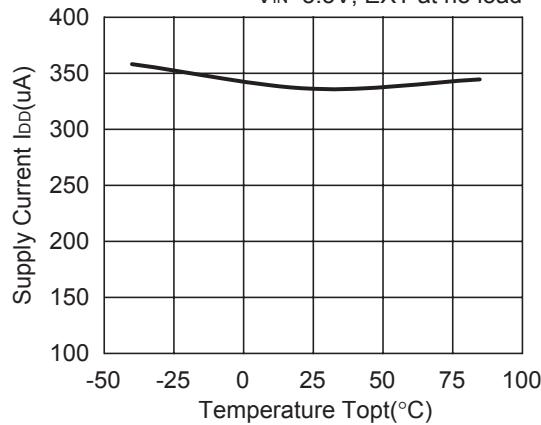
9) EXT "L" On Resistance vs. Temperature
R1212D10xx

V_{IN}=3.3V, I_{EXT}=50mA

10) EXT "H" On Resistance vs. Temperature
R1212D10xx
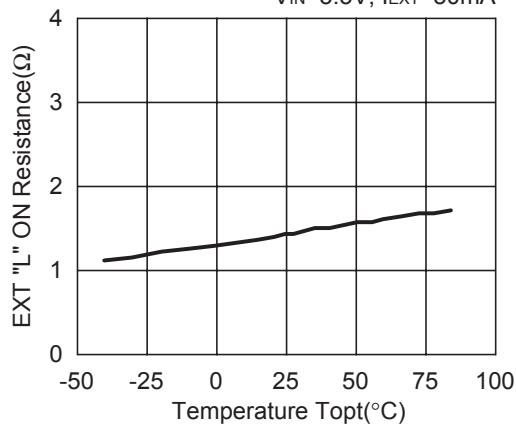
V_{IN}=3.3V, I_{EXT}=50mA

11) EXT Rising Time vs. Temperature
R1212D10xx
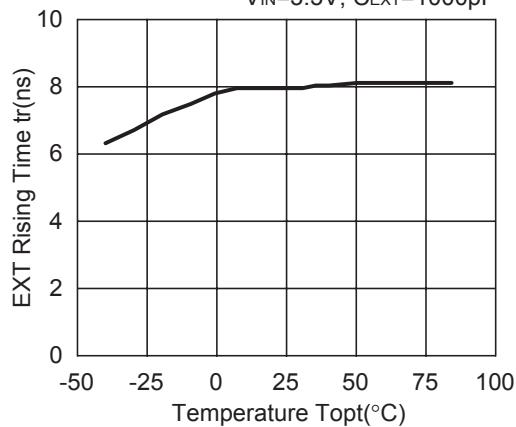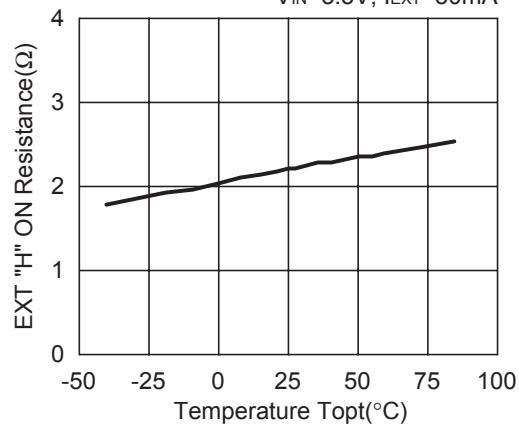
V_{IN}=3.3V, C_{EXT}=1000pF

12) EXT Falling Time vs. Temperature
R1212D10xx

V_{IN}=3.3V, C_{EXT}=1000pF
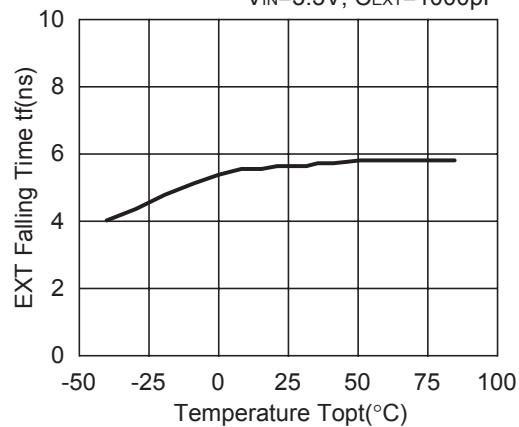
13) Duty Cycle vs. DTC Voltage (0% to 100%) (Topt=25°C)

R1212D100A

C_{EXT}=1000pF

Duty Cycle Duty(%) vs. *DTC Voltage V_{DTC}(V)*

R1212D100B

C_{EXT}=1000pF

Duty Cycle Duty(%) vs. *DTC Voltage V_{DTC}(V)*

R1212D101A

C_{EXT}=1000pF

Duty Cycle Duty(%) vs. *DTC Voltage V_{DTC}(V)*

R1212D101C

C_{EXT}=1000pF

Duty Cycle Duty(%) vs. *DTC Voltage V_{DTC}(V)*
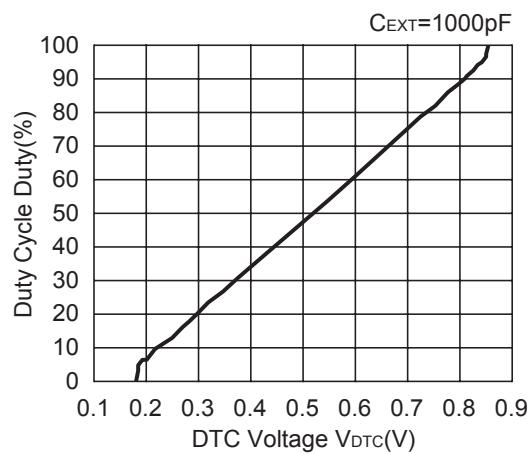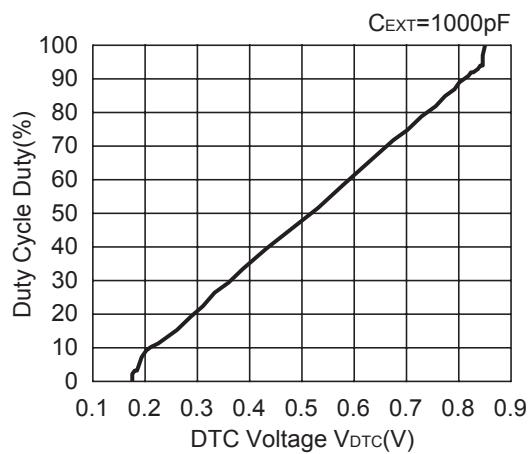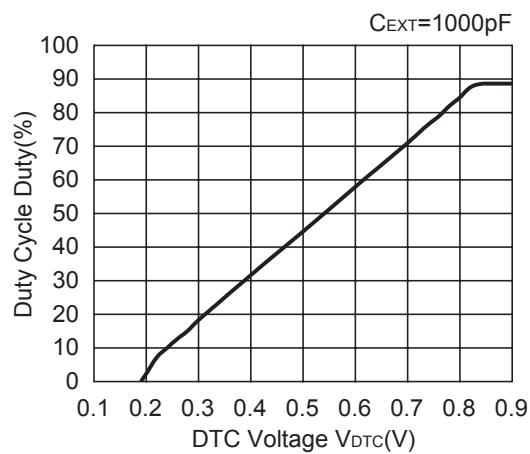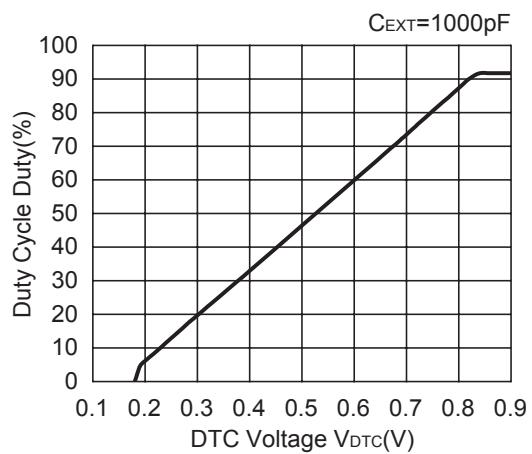
14) Duty Cycle vs. Temperature

R1212D100A

V_{DTC}=0.75V, C_{EXT}=1000pF

Duty Cycle Duty(%) vs. *Temperature Topt(°C)*

R1212D100B

V_{DTC}=0.75V, C_{EXT}=1000pF

Duty Cycle Duty(%) vs. *Temperature Topt(°C)*

RICOH
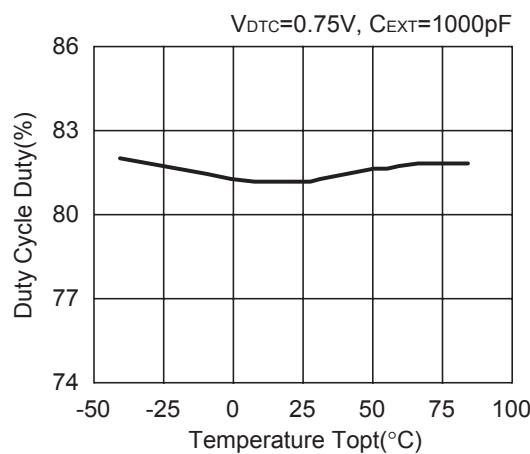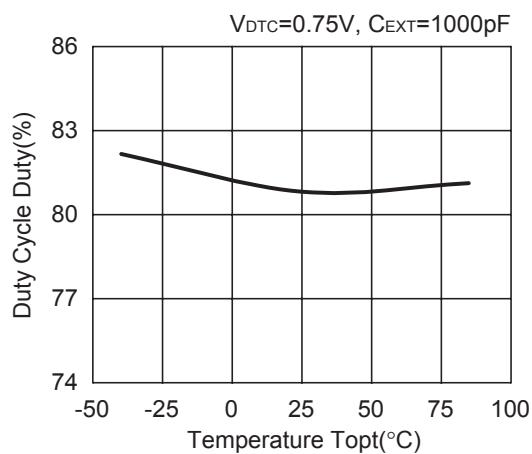
15) Maxduty vs. Temperature

R1212D101A
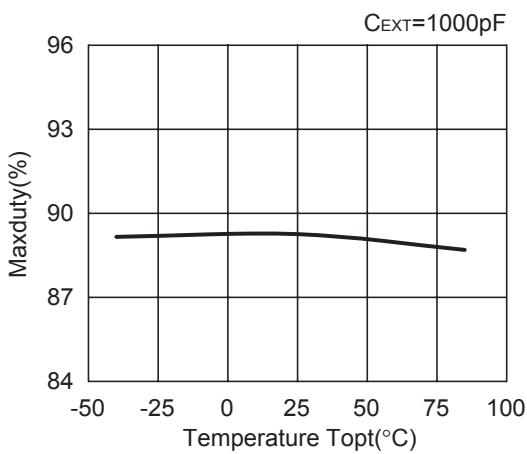
C_{EXT}=1000pF

R1212D101C

C_{EXT}=1000pF

16) AMP "L" Output Current vs. Temperature

R1212D10xA/B

V_{IN}=3.3V, A_{MPOUT}=1V

R1212D10xC

V_{IN}=3.3V, A_{MPOUT}=1V
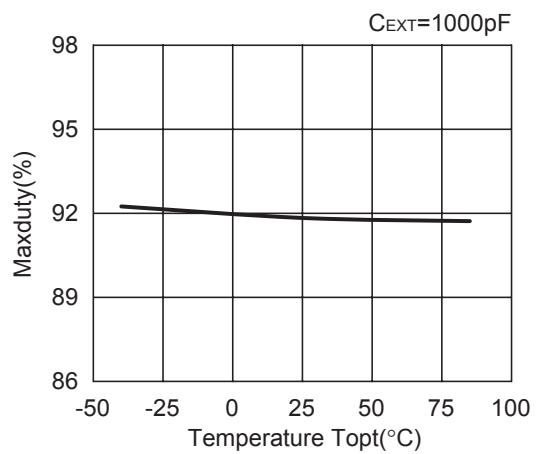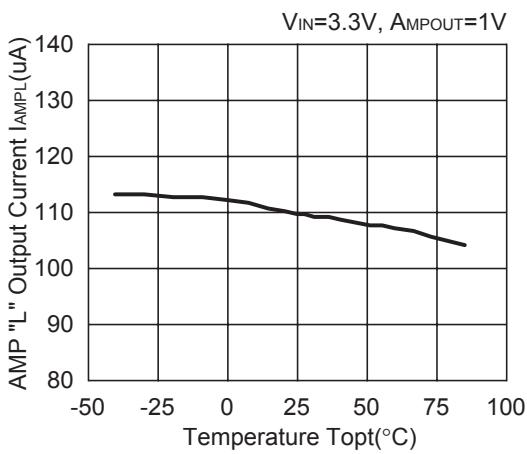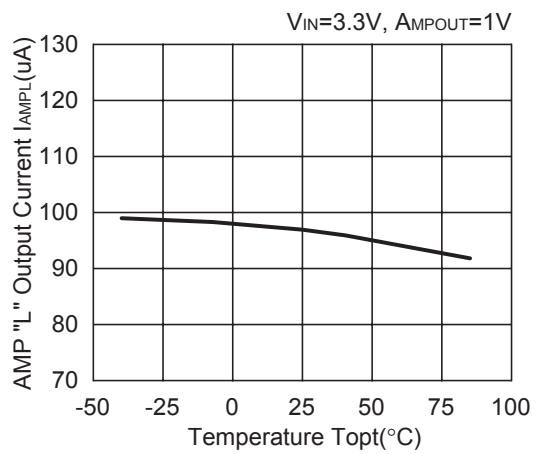
17) AMP "H" Output Current vs. Temperature

R1212D10xx

V_{IN}=3.3V, A_{MPOUT}=1V
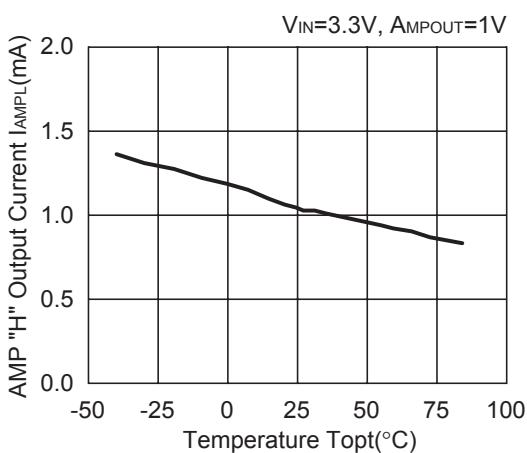
18) UVLO Detector Threshold UVLO Released Voltage vs. Temperature

R1212D100x

UVLO Detector Threshold/Released Voltage (V) vs. Temperature Topt(°C)

Released Voltage

Detector Threshold

R1212D101x

UVLO Detector Threshold/Released Voltage (V) vs. Temperature Topt(°C)

Released Voltage

Detector Threshold

R1212D102x

UVLO Detector Threshold/Released Voltage (V) vs. Temperature Topt(°C)

Released Voltage

Detector Threshold
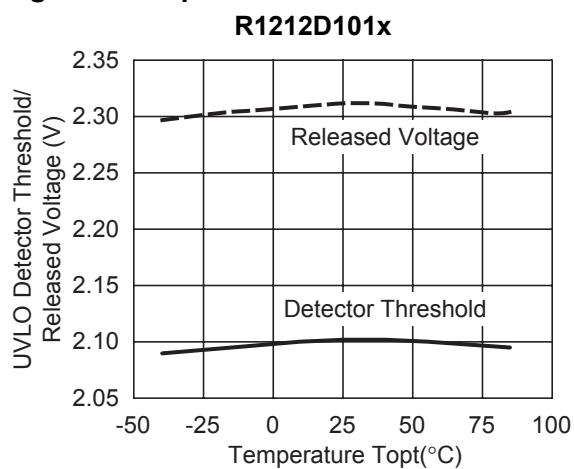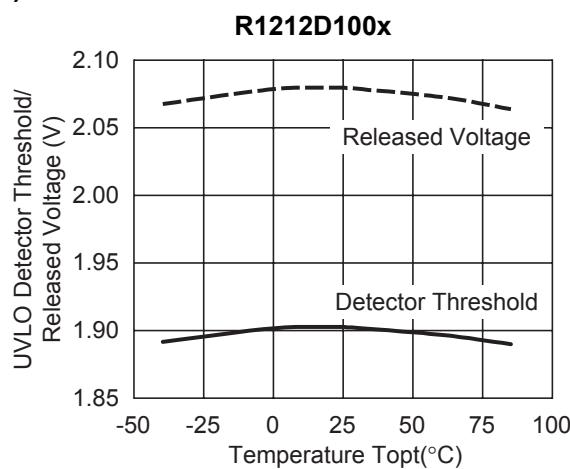
19) D$_{ELAY}$ Pin Detector Threshold vs. Temperature

R1212D10xx

V_{IN}=3.3V

D$_{ELAY}$ Pin Detector Voltage V_{DLY}(V) vs. Temperature Topt(°C)

20) D$_{ELAY}$ Pin Charge Current vs. Temperature

R1212D10xA/B

V_{IN}=3.3V

D$_{ELAY}$ Pin Charge Current I_{DLY1}(uA) vs. Temperature Topt(°C)

R1212D10xC

V_{IN}=3.3V

D$_{ELAY}$ Pin Charge Current I_{DLY1}(uA) vs. Temperature Topt(°C)

RICOH
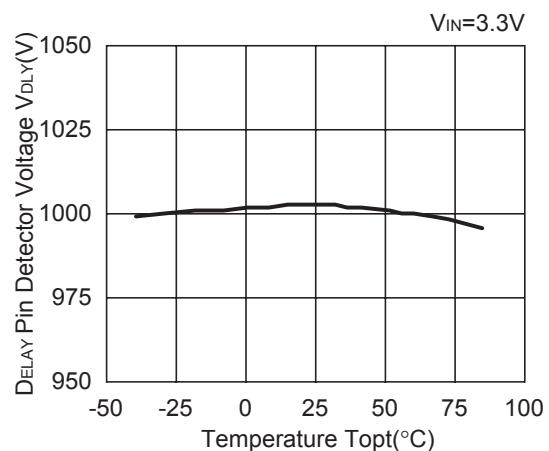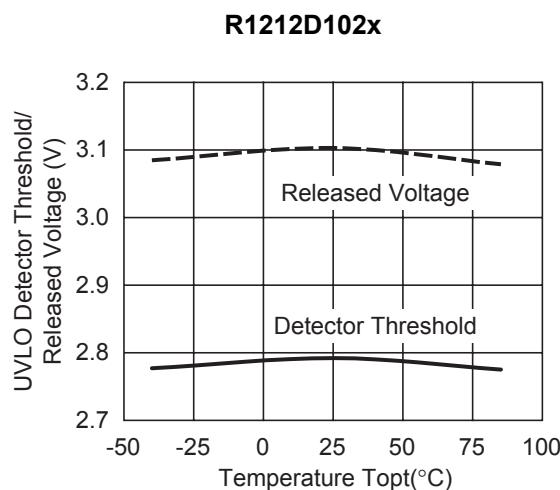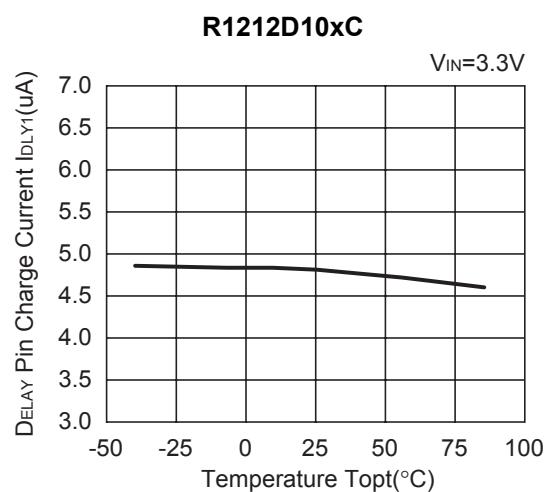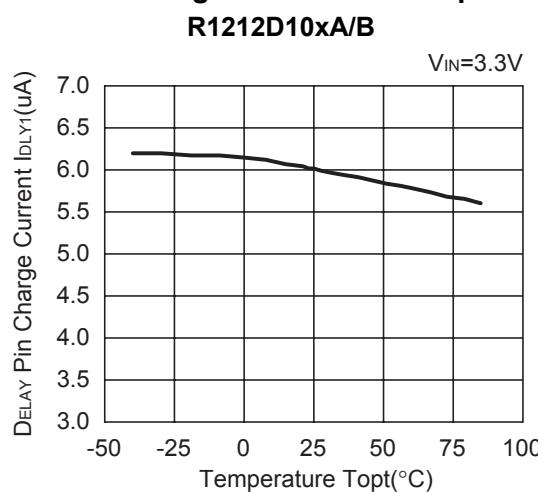
21) D<small>ELAY</small> **Pin Discharge Current vs. Temperature**
R1212D10xx

V<small>IN</small>=2.2V, V<small>DLY</small>=0.1V
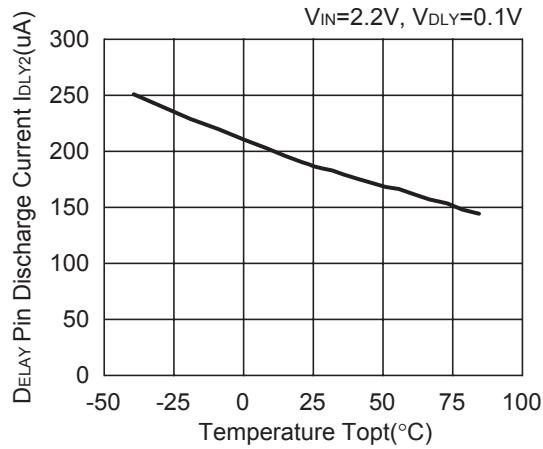
22) V<small>REFOUT</small> **Voltage vs. Temperature**
R1212D10xx

V<small>IN</small>=3.3V
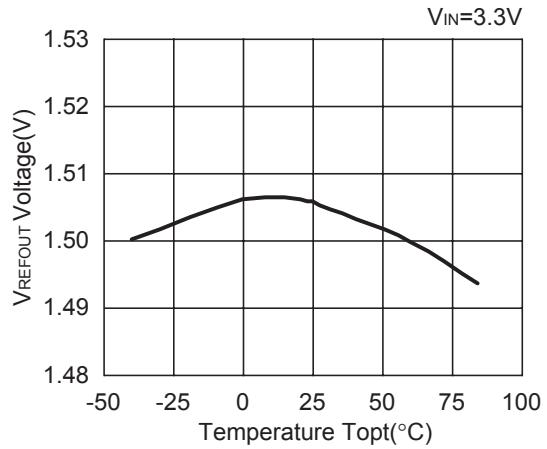
23) V<small>REFOUT</small> **Voltage vs. Input Voltage (Topt=25°C) 24)** V<small>REFOUT</small> **Voltage vs. Output Current (1) (Topt=25°C)**
R1212D10xx   **R1212D10xx**

V<small>IN</small>=2.2V
V<small>IN</small>=3.3V
V<small>IN</small>=5.5V
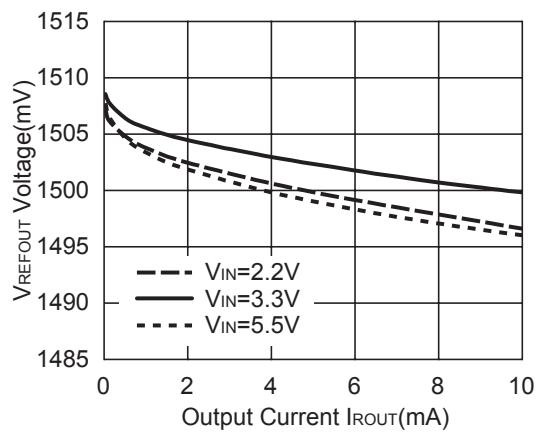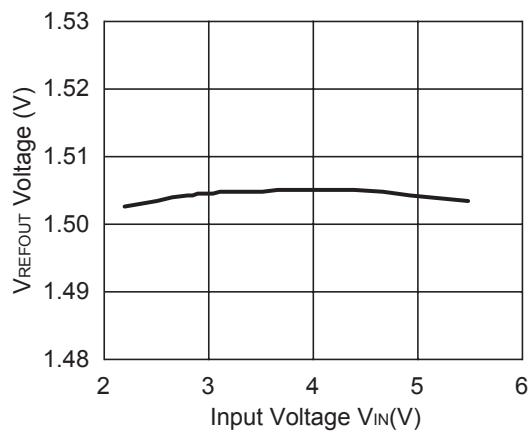
25) V<small>REFOUT</small> **Voltage vs. Output Current (2) (Topt=25°C) 26) Error Amplifier Gain/Phase vs. Frequency (Topt=25°C)**
R1212D10xx   **R1212D10xx**

V<small>IN</small>=2.2V
V<small>IN</small>=3.3V
V<small>IN</small>=5.5V

V<small>IN</small>=3.3V

Phase

Gain

RICOH
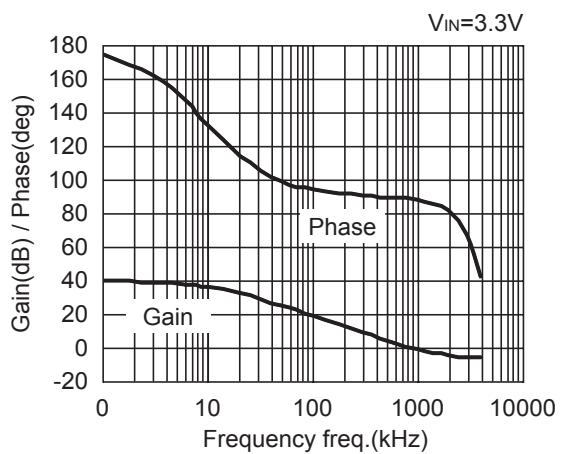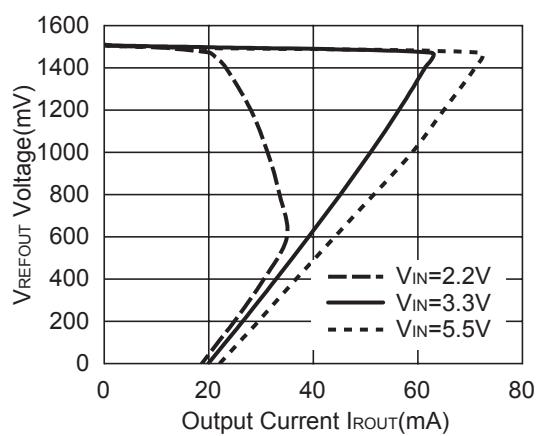
27) Power-on Response (V$_{IN}$=3.3V, Topt=25°C)

R1212D100A

Set V$_{OUT}$=5V, I$_{OUT}$=10mA

R1212D100A

Set V$_{OUT}$=5V, I$_{OUT}$=100mA

R1212D100A

Set V$_{OUT}$=10V, I$_{OUT}$=10mA

R1212D100A

Set V$_{OUT}$=10V, I$_{OUT}$=100mA

R1212D100A

Set V$_{OUT}$=15V, I$_{OUT}$=10mA

R1212D100A

Set V$_{OUT}$=15V, I$_{OUT}$=100mA

RICOH

R1212D100B

Set V$_{OUT}$=5V, I$_{OUT}$=10mA

R1212D100B

Set V$_{OUT}$=5V, I$_{OUT}$=100mA

R1212D100B

Set V$_{OUT}$=10V, I$_{OUT}$=10mA

R1212D100B

Set V$_{OUT}$=10V, I$_{OUT}$=100mA

R1212D100B

Set V$_{OUT}$=15V, I$_{OUT}$=10mA

R1212D100B

Set V$_{OUT}$=15V, I$_{OUT}$=100mA

RICOH

R1212D101C

Set V$_{OUT}$=15V, I$_{OUT}$=10mA

R1212D101C

Set V$_{OUT}$=5V, I$_{OUT}$=100mA

R1212D101C

Set V$_{OUT}$=10V, I$_{OUT}$=10mA

R1212D101C

Set V$_{OUT}$=10V, I$_{OUT}$=100mA

R1212D101C

Set V$_{OUT}$=15V, I$_{OUT}$=10mA

R1212D101C

Set V$_{OUT}$=15V, I$_{OUT}$=10mA

RICOH

28) Load Transient Response (V$_{IN}$=3.3V, Topt=25°C)
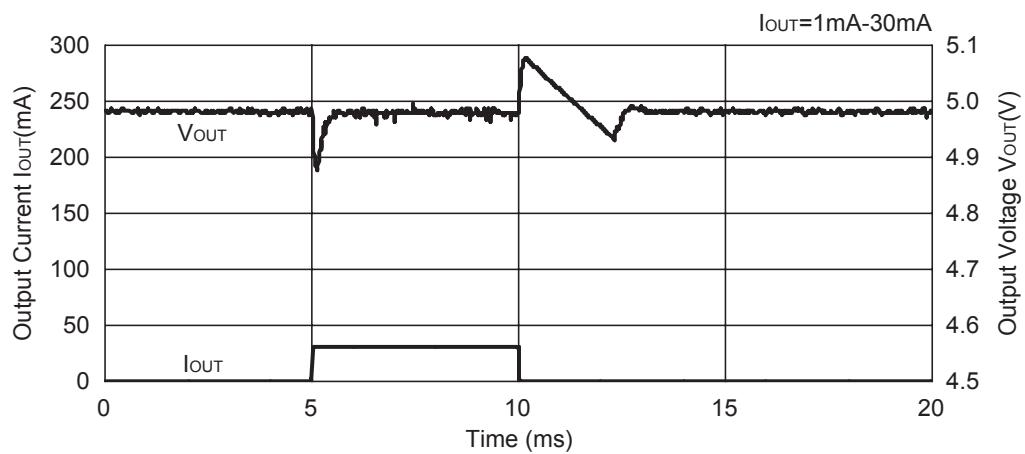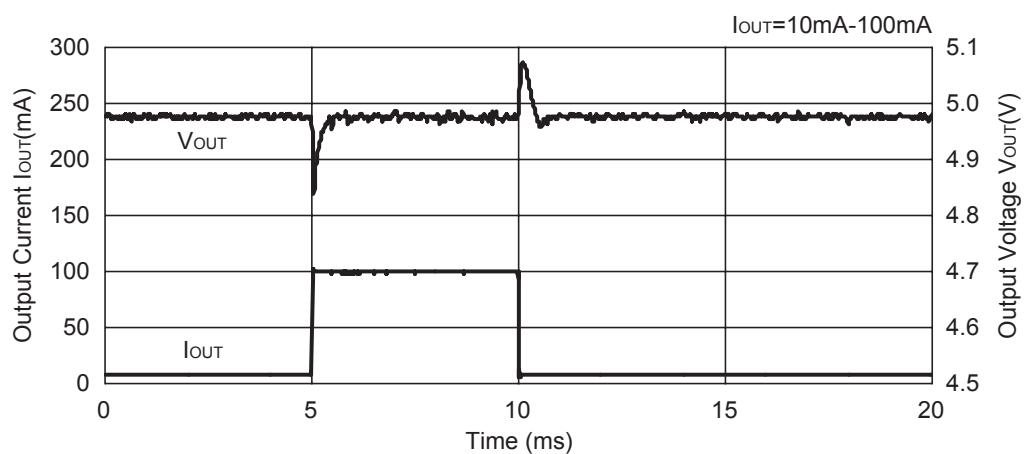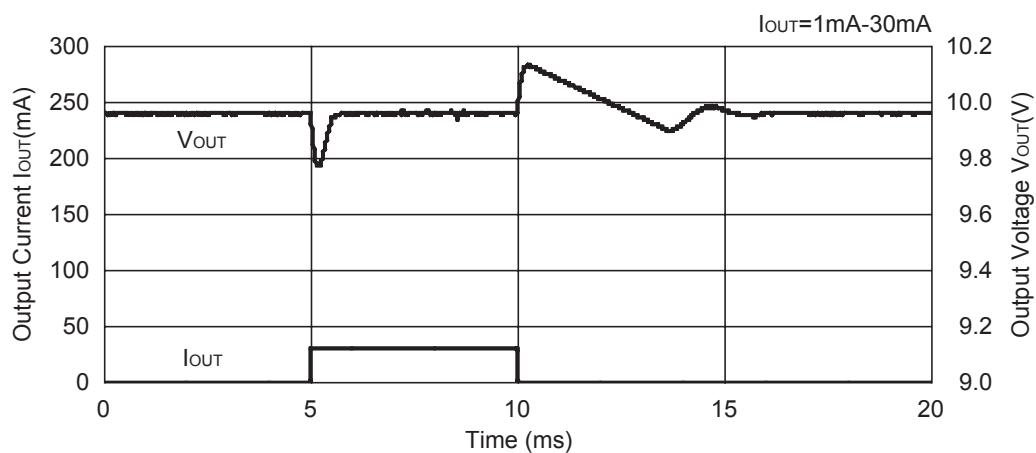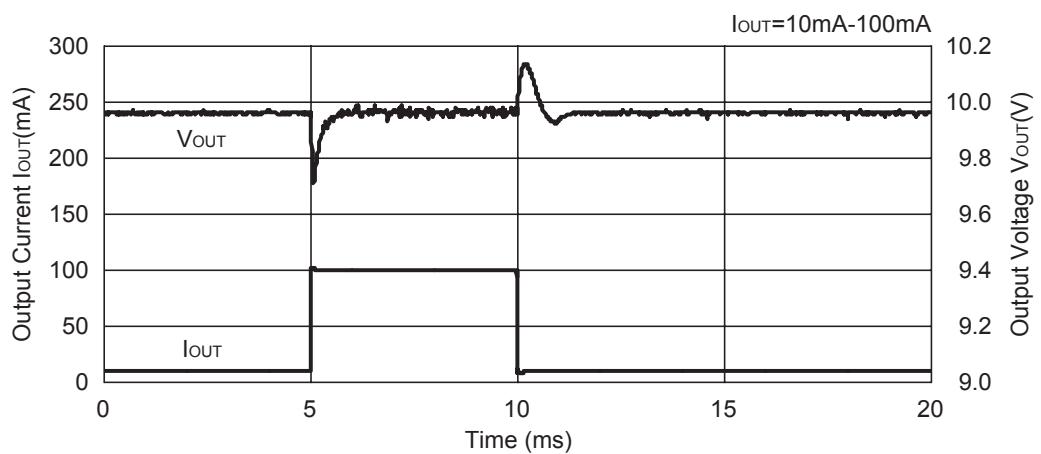
R1212D100A

I$_{OUT}$=1mA-30mA

R1212D100A

I$_{OUT}$=10mA-100mA

R1212D100A

I$_{OUT}$=1mA-30mA

RICOH

R1212D100A

I$_{OUT}$=10mA-100mA

R1212D100A

I$_{OUT}$=1mA-30mA

R1212D100A

I$_{OUT}$=10mA-100mA

RICOH

R1212D100B

I_OUT=1mA-30mA

R1212D100B

I_OUT=10mA-100mA

R1212D100B

I_OUT=1mA-30mA

RICOH

R1212D100B

I_{OUT}=10mA-100mA

R1212D100B

I_{OUT}=1mA-30mA

R1212D100B

I_{OUT}=10mA-100mA

RICOH

R1212D101C

I_OUT=1mA-30mA

R1212D101C

I_OUT=10mA-100mA

R1212D101C

I_OUT=1mA-30mA

R1212D101C

I_{OUT}=10mA-100mA

R1212D101C

I_{OUT}=1mA-30mA

R1212D101C

I_{OUT}=10mA-100mA

RICOH
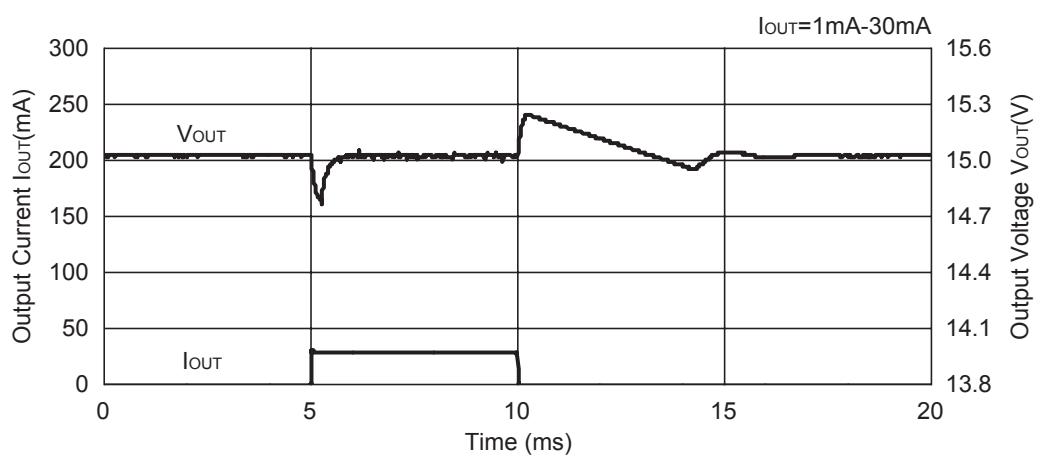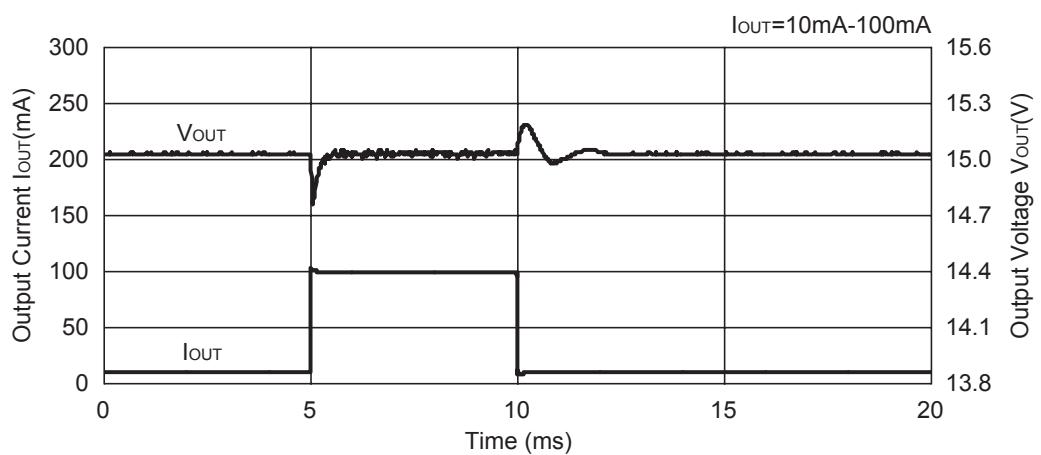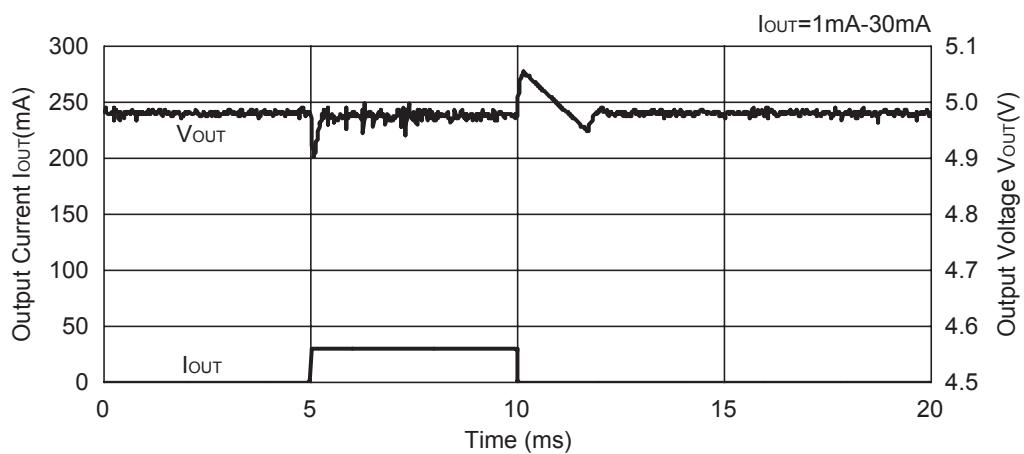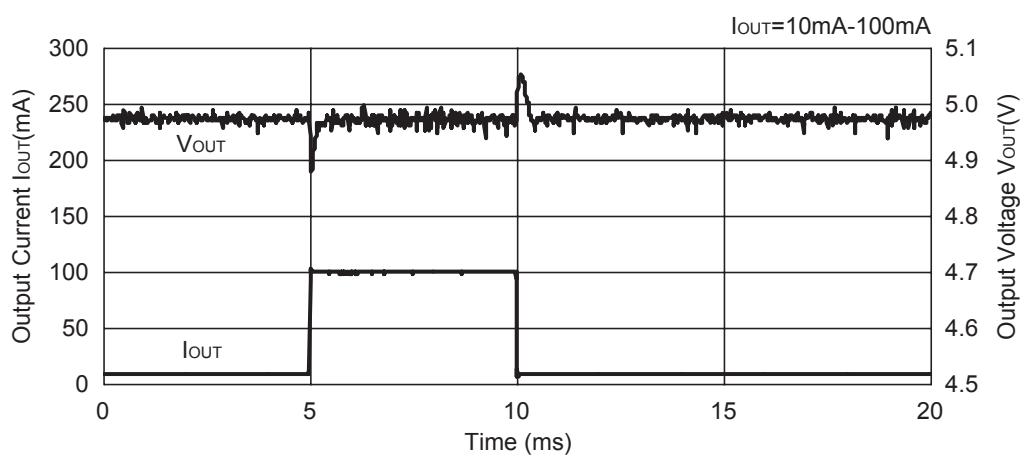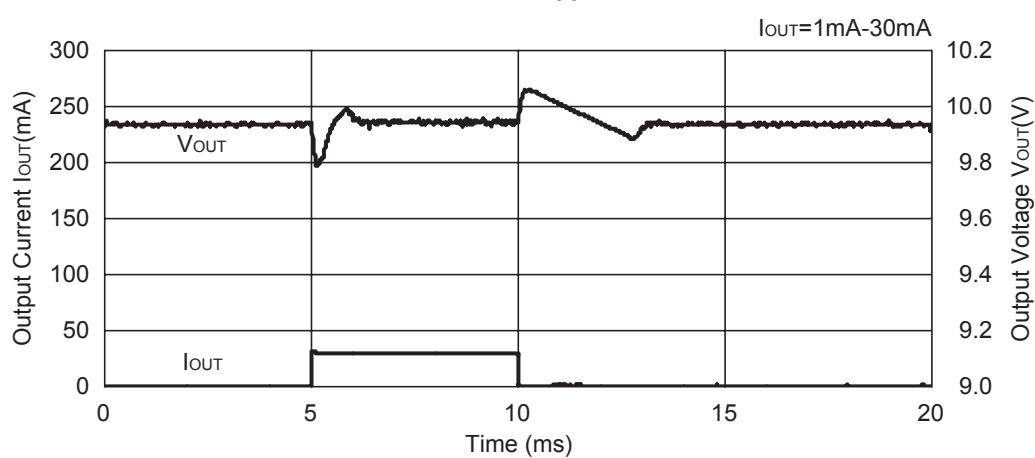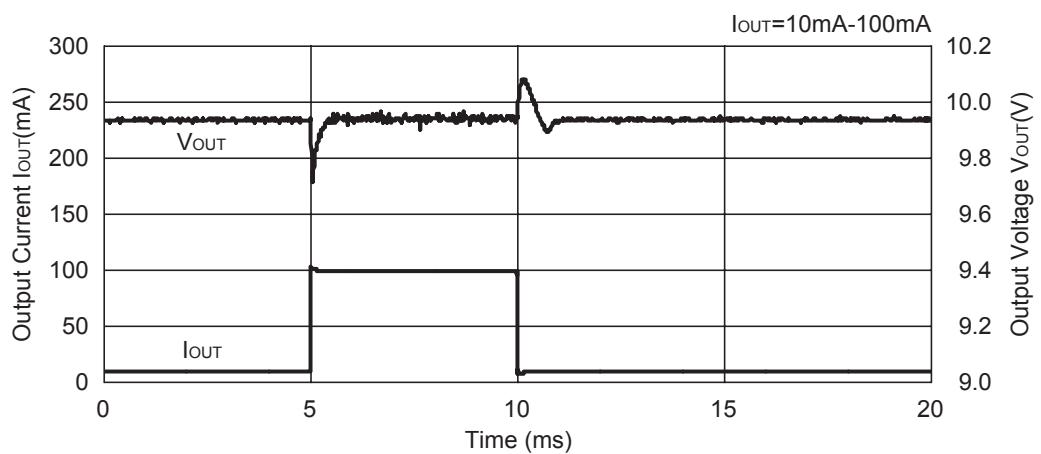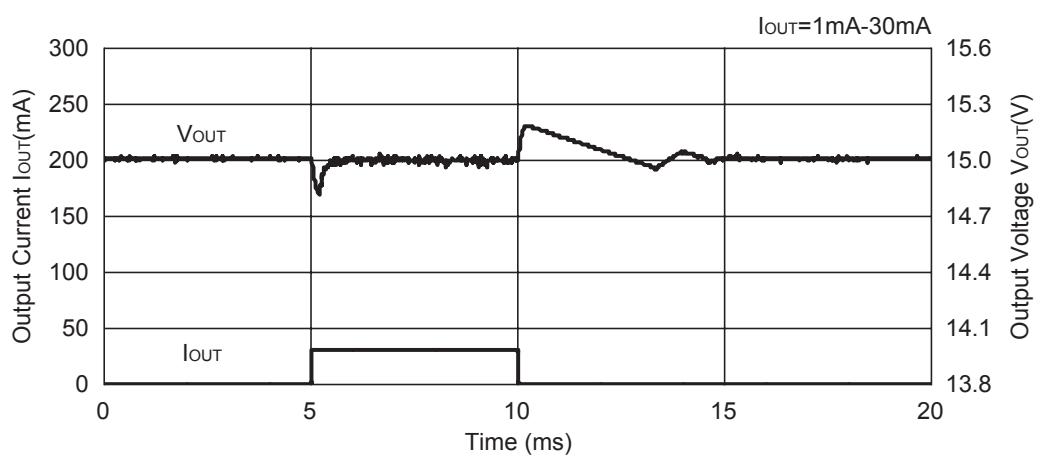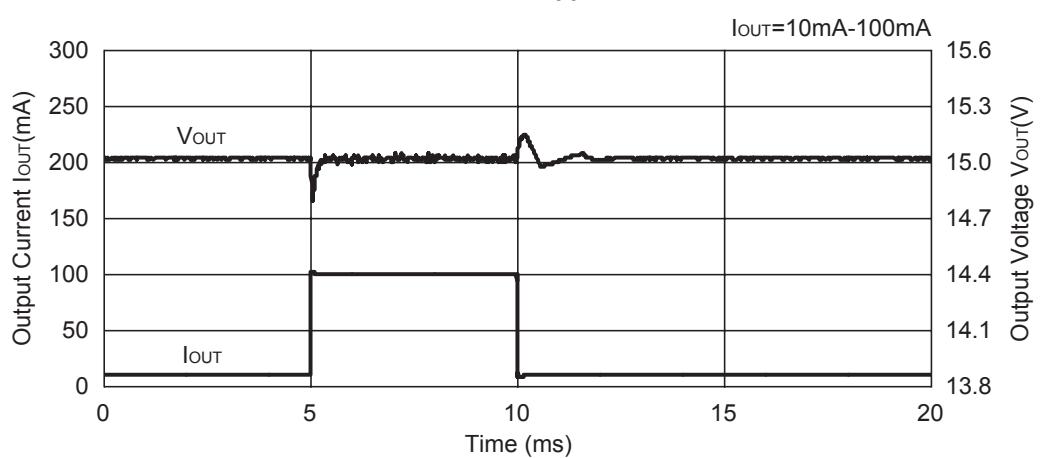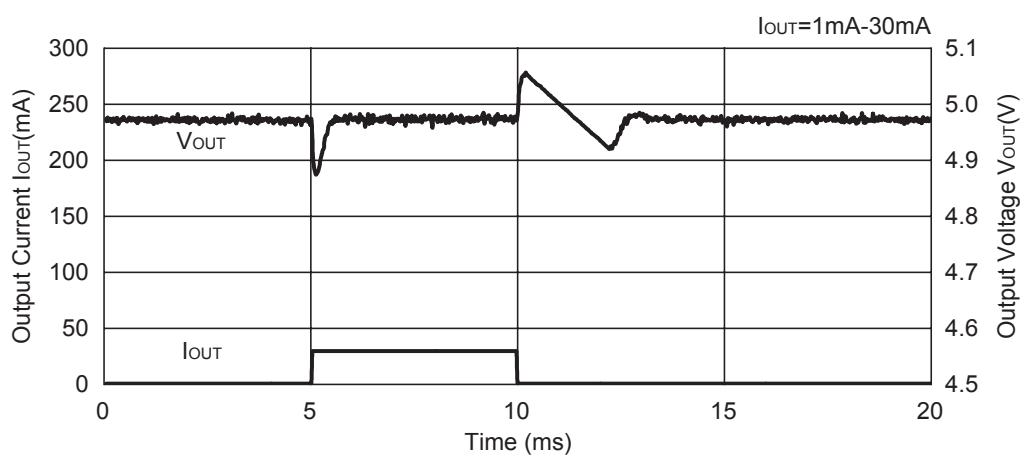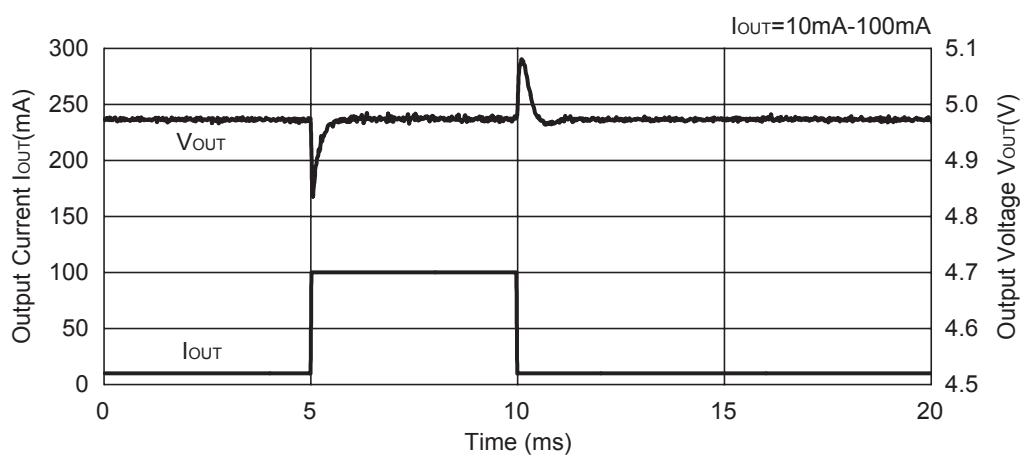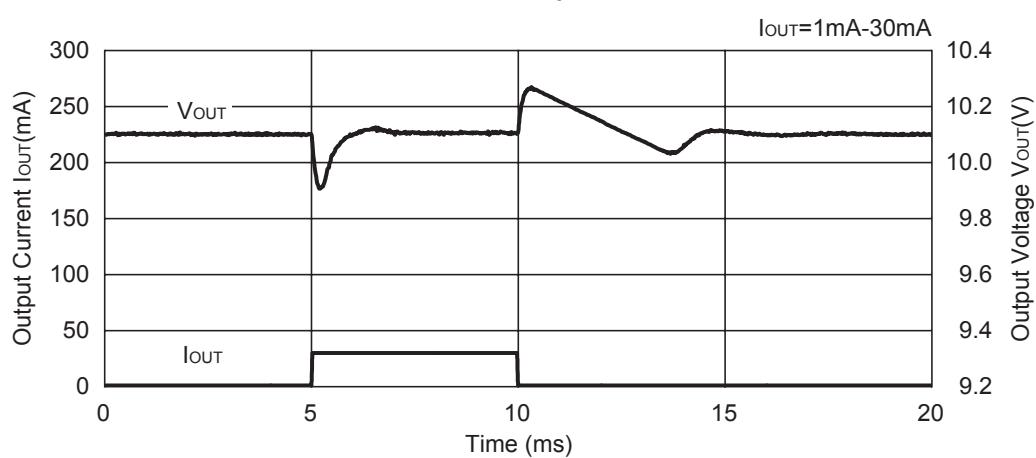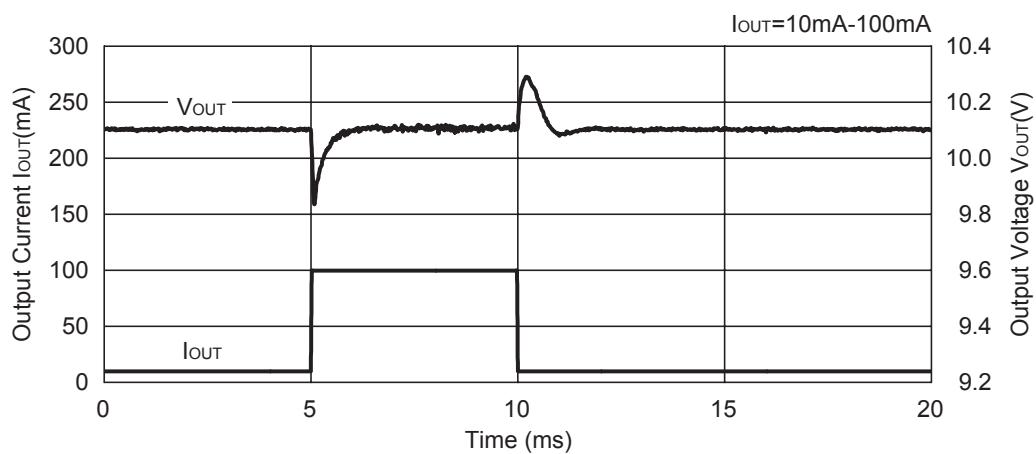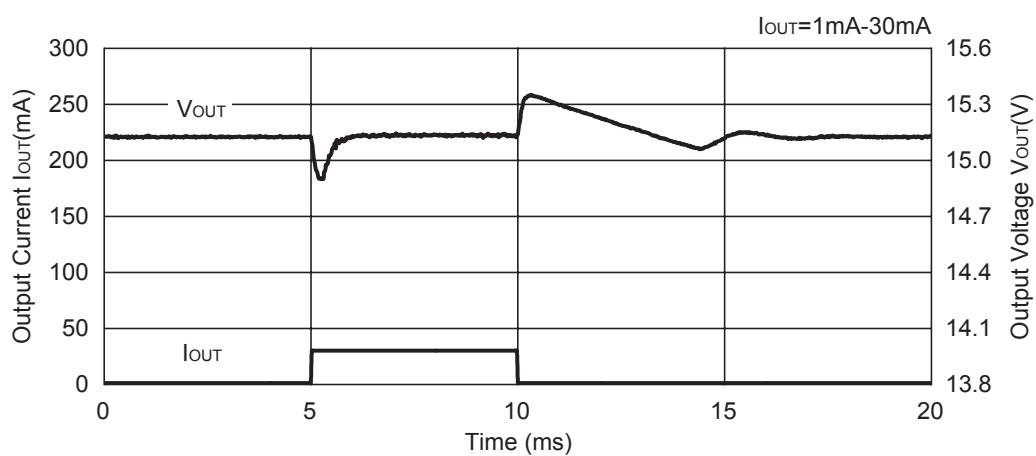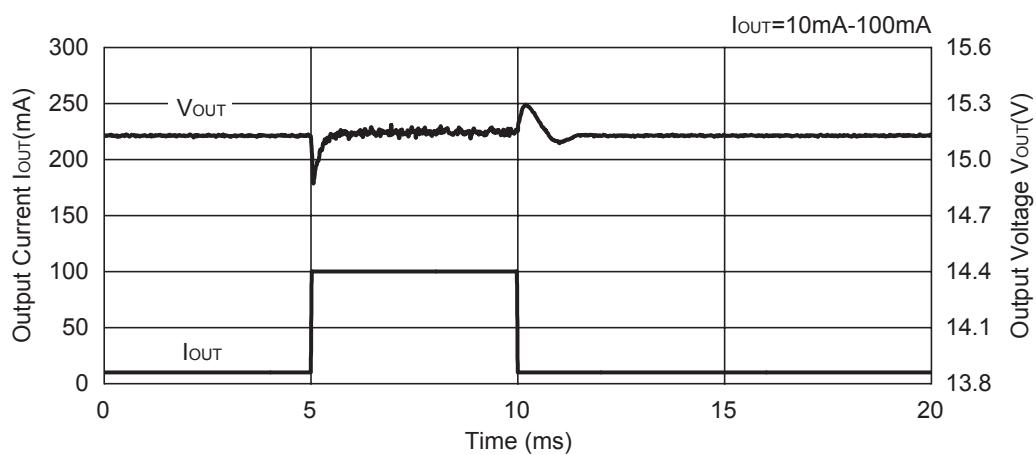
● **SON-8**   Unit: mm

PACKAGE DIMENSIONS

2.9±0.2
0.475TYP
2.8±0.2
3.0±0.2
0.13±0.05
0.13±0.05
0.9MAX.
0.65
0.3±0.1

$0.15^{+0.1}_{-0.15}$
$0.15^{+0.1}_{-0.15}$
0.23±0.1
0.2±0.1
0.2±0.1

Bottom View

※ Attention : Tab suspension leads in the parts have V$_{DD}$ or GND level. (They are connected to the reverse side of this IC.) Refer to PIN DISCRIPTION. Do not connect to other wires or land patterns.

TAPING SPECIFICATION

0.2±0.1
$\phi1.5^{+0.1}_{0}$
4.0±0.1
2.0±0.05
1.75±0.1
3.5±0.05
8.0±0.3
3.2
3.3
⌀1.1±0.1
2.0MAX.
4.0±0.1

TR
User Direction of Feed
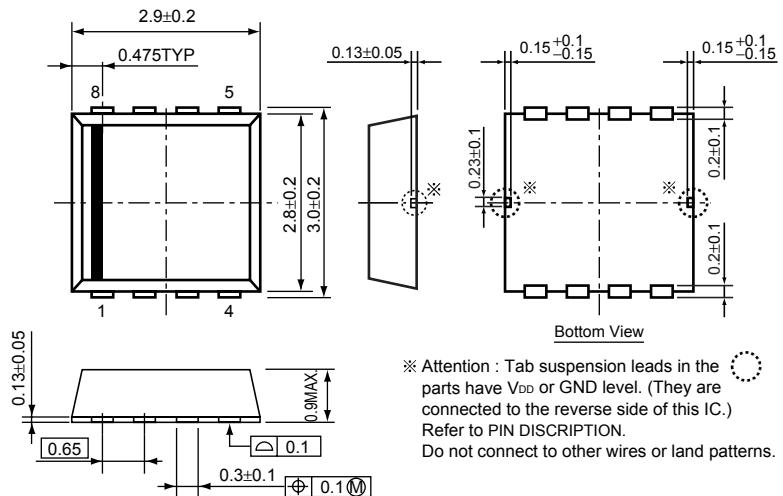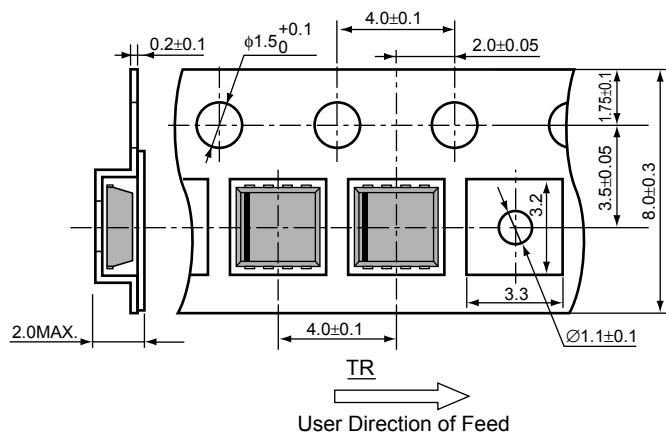
TAPING REEL DIMENSIONS

(1reel=3000pcs)

21±0.8
2±0.5
11.4±1.0
9.0±0.3
⌀13±0.2
⌀ 60^{+1}_{0}
⌀ $180^{0}_{-1.5}$

RICOH
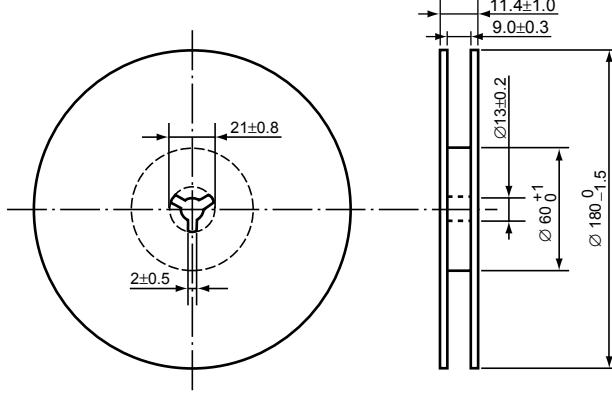
POWER DISSIPATION (SON-8)

This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board.
This specification is based on the measurement at the condition below:

Measurement Conditions

	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plactic (Double sided)
Board Dimensions	40mm $\times$ 40mm $\times$ 1.6mm
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%
Through-hole	ϕ0.5mm $\times$ 44pcs

Measurement Result

(Topt=25°C,Tjmax=125°C)

|	Standard Land Pattern	Free Air
Power Dissipation	480mW	300mW
Thermal Resistance	θja=(125−25°C)/0.48W=208°C/W	333°C/W
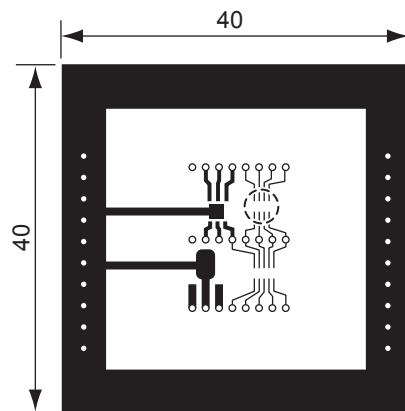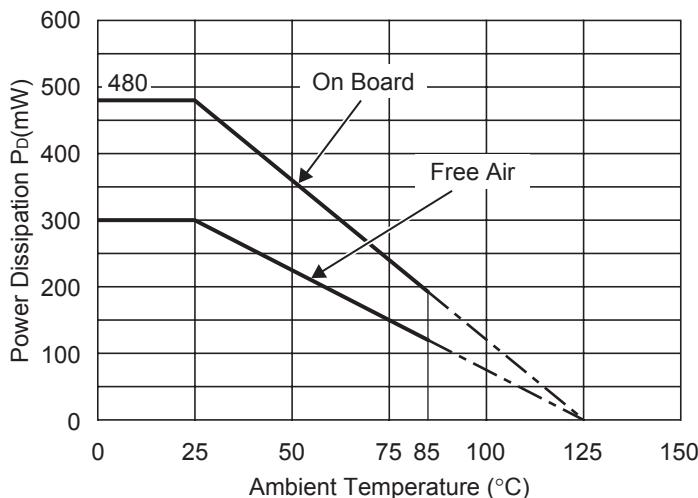
Power Dissipation

**Measurement Board Pattern**
IC Mount Area (Unit : mm)

RECOMMENDED LAND PATTERN

(Unit: mm)

RICOH
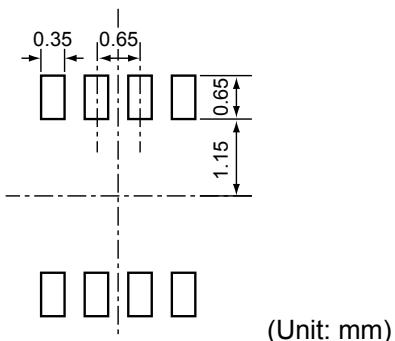
R1212D SERIES MARK SPECIFICATION

● **SON-8**
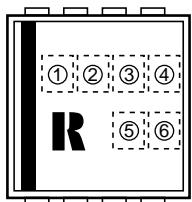
① to ④   : Product Code (refer to Part Number vs. Product Code)

⑤, ⑥   : Lot Number

● **Part Number vs. Product Code**

Part Number	Product Code			
	①	②	③	④
R1212D002A	F	0	2	A
R1212D100A	F	1	0	A
R1212D100B	F	1	0	B
R1212D101A	F	1	1	A
R1212D102A	F	1	2	A
R1212D101C	F	1	1	C
R1212D102C	F	1	2	C

RICOH

ООО "ЛайфЭлектроникс"   **"LifeElectronics" LLC**

Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

Мы предлагаем:

- Конкурентоспособные цены и скидки постоянным клиентам.
- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.

- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.

- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.

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Email: org@lifeelectronics.ru

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