RICOH

R1212D SERIES

STEP-UP DC/DC CONTROLLER

NO.EA-109-100311

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 resistors, 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).

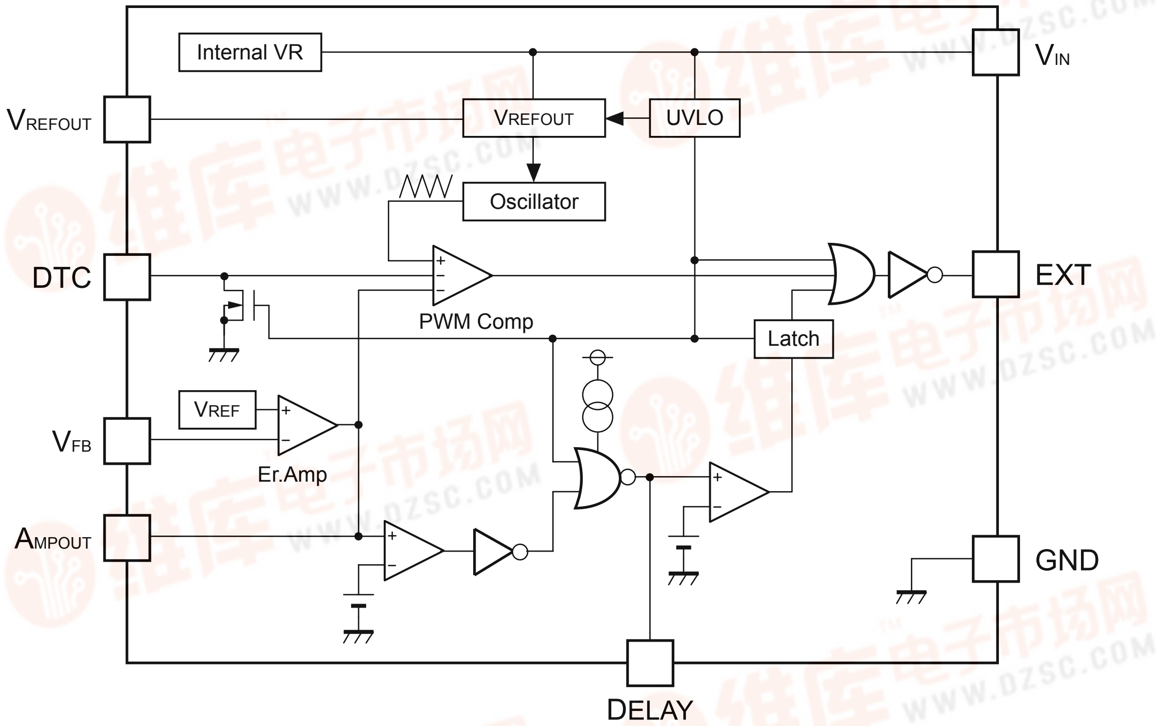
FEATURES

- 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%
- UVLO Threshold level .... Typ.1.9V/2.1V/2.8V by mask option
- Small Temperature Coefficient of Reference Voltage ... Typ.±150ppm/°C
- Package SON-8

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.

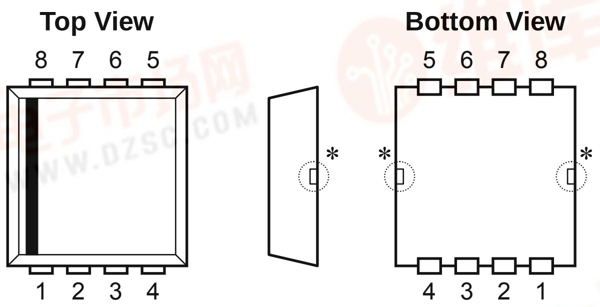
The selection can be made with designating the part number as shown below;

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 solder plating			

PIN CONFIGURATION

SON-8



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

*) Tab suspension leads are GND level. (They are connected to the reverse side of this IC.)
The tab suspension leads should be open and do not connect to other wires or land patterns.

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 to V_{IN}+0.3	V
V_{DLY}	DELAY Pin Voltage	−0.3 to V_{IN}+0.3	V
V_{REFOUT}	V_{REFOUT} Pin Voltage	−0.3 to V_{IN}+0.3	V
V_{AMP}	AMPOUT Pin Voltage	−0.3 to V_{IN}+0.3	V
V_{DTC}	DTC Pin Voltage	−0.3 to V_{IN}+0.3	V
V_{FB}	V_{FB} Pin Voltage	−0.3 to 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)*	480	mW
Topt	Operating Temperature Range	−40 to 85	°C
Tstg	Storage Temperature Range	−55 to 125	°C

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

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field.

The functional operation at or over these absolute maximum ratings is not assured.

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

ELECTRICAL CHARACTERISTICS

- **R1212D100A**

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	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	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

• 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_{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

● R1212D101A

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		2.5		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 2.5V to 5.5V		3		mV
$\Delta V_{FB}/\Delta Topt$	V_{FB} Voltage Temperature Coefficient	$-40°C \le Topt \le 85°C$		±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 2.5V to 5.5V		50		kHz
$\Delta fosc/\Delta Topt$	Oscillator Frequency Temperature Coefficient	$-40°C \le Topt \le 85°C$		±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 2.5V 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	$-40°C \le Topt \le 85°C$		±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}=2.5V, 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

- **R1212D101C**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		2.5		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 2.5V to 5.5V		3		mV
$\Delta V_{FB}/\Delta Topt$	V_{FB} Voltage Temperature Coefficient	$-40°C \le Topt \le 85°C$		±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 2.5V to 5.5V		25		kHz
$\Delta fosc/\Delta Topt$	Oscillator Frequency Temperature Coefficient	$-40°C \le Topt \le 85°C$		±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 2.5V 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	$-40°C \le Topt \le 85°C$		±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}=2.5V, 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

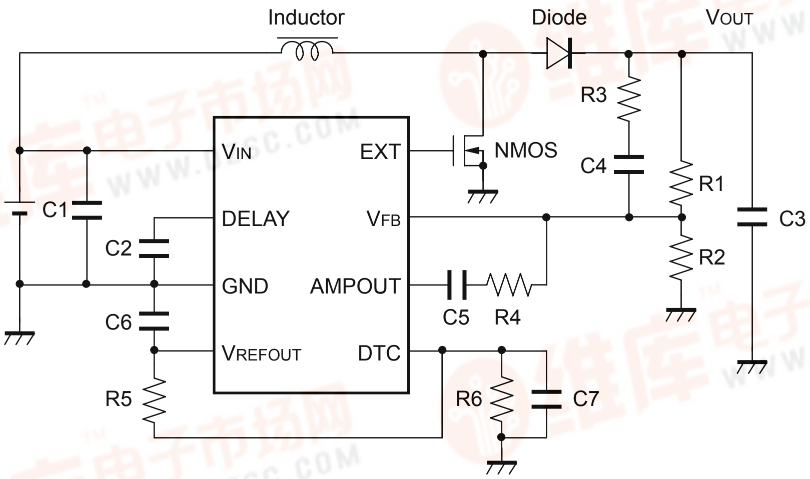
Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		3.3		5.5	V
V_{FB}	V_{FB} Voltage Tolerance	V_{IN}=3.3V	0.985	1.000	1.015	V
$\Delta V_{FB}/\Delta V_{IN}$	V_{FB} Voltage Line Regulation	V_{IN}: from 3.3V to 5.5V		3		mV
$\Delta V_{FB}/\Delta Topt$	V_{FB} Voltage Temperature Coefficient	$-40°C \leq Topt \leq 85°C$		±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 3.3V 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 3.3V 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}=3.3V, 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

- **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 3.3V 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 3.3V 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 3.3V 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}=3.3V, 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

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
C2	1µF
C3	1.5µF
C4	1000pF[R1212DxxxA]
	680pF[R1212DxxxB]
	1500pF[R1212DxxxC]
C5	1000pF[R1212DxxxA]
	680pF[R1212DxxxB]
	1500pF[R1212DxxxC]
C6	0.1µF
C7	0.1µF

Set V_{OUT}	5V	10V	15V
R1	120kΩ	180kΩ	140kΩ
R2	30kΩ	20kΩ	10kΩ
R3	1kΩ		
R4	4.7kΩ		
R5	240kΩ		
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.

● 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.

  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.

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

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).

$$Fzero \sim 1/(2\times\pi\times R4\times C5)$$

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×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).

$$Fzero \sim 1/(2\times\pi\times R1\times C4)$$

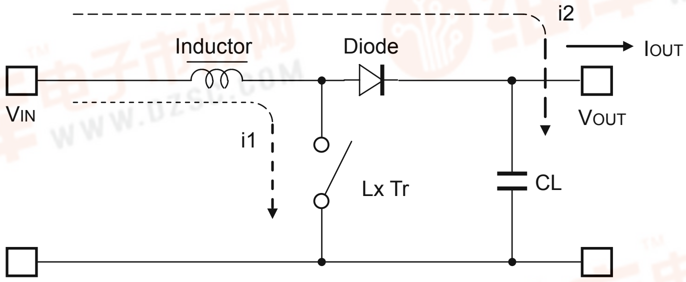
Make the cutoff frequency of this zero point be lower than the cutoff frequency of the pole by external components, or, L and C. Herein, R1=180kΩ and C4=1000pF are appropriate values.

- 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.)

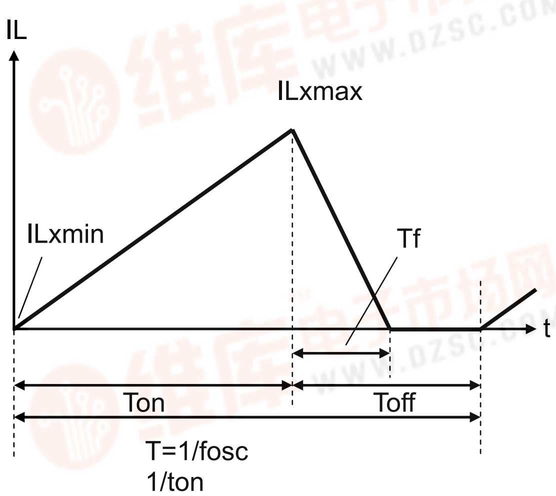
Output Current and Selection of External Components

<Basic Circuit>

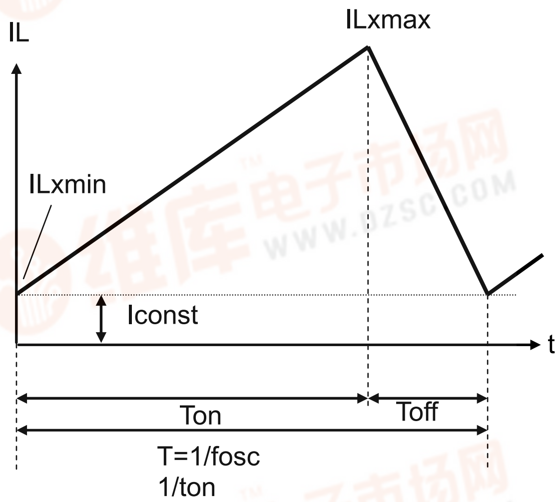


<Circuit through L>

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.

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

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

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

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

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,

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

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

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

With the formula 4,6, and ILxmax is,

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

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>

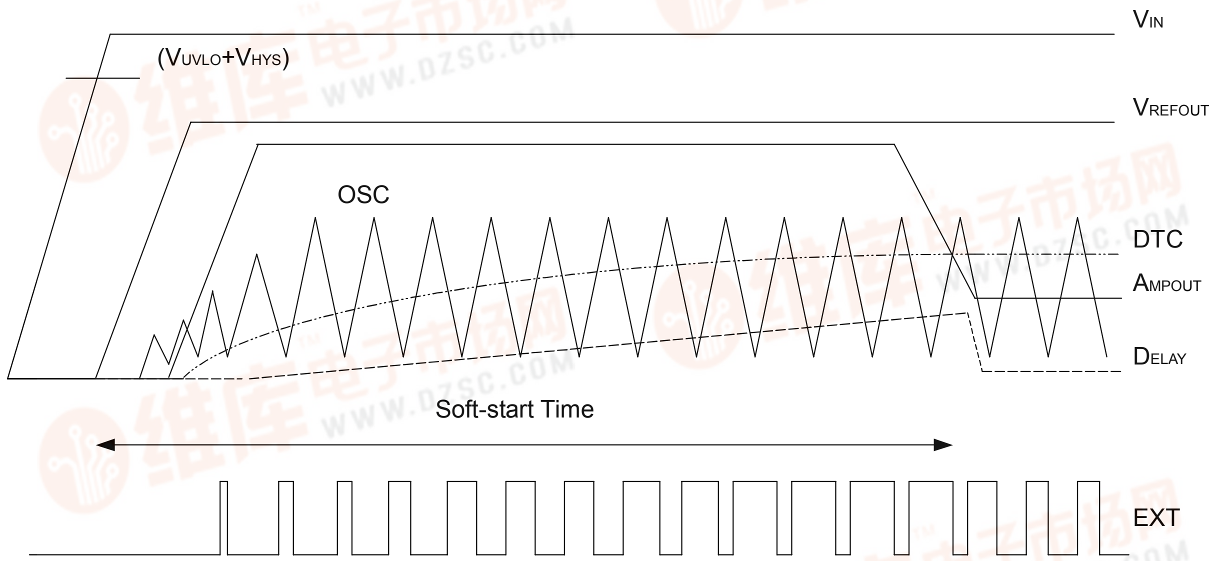
The timing chart below describes the state of each pin from the power-on until the IC entering the stable operation.

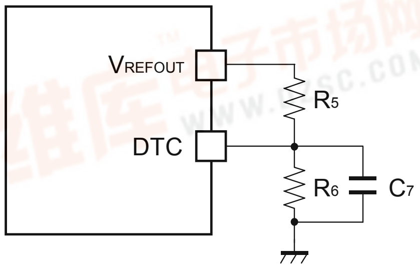
By raising the voltage of the DTC pin slowly, the switching duty cycle is limited, and prevent the drastic voltage rising (over-shoot) and inrush current.

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 $\beta=V_{REFOUT}/(C_7\times R_5)$.





<Latch Protection Operation>

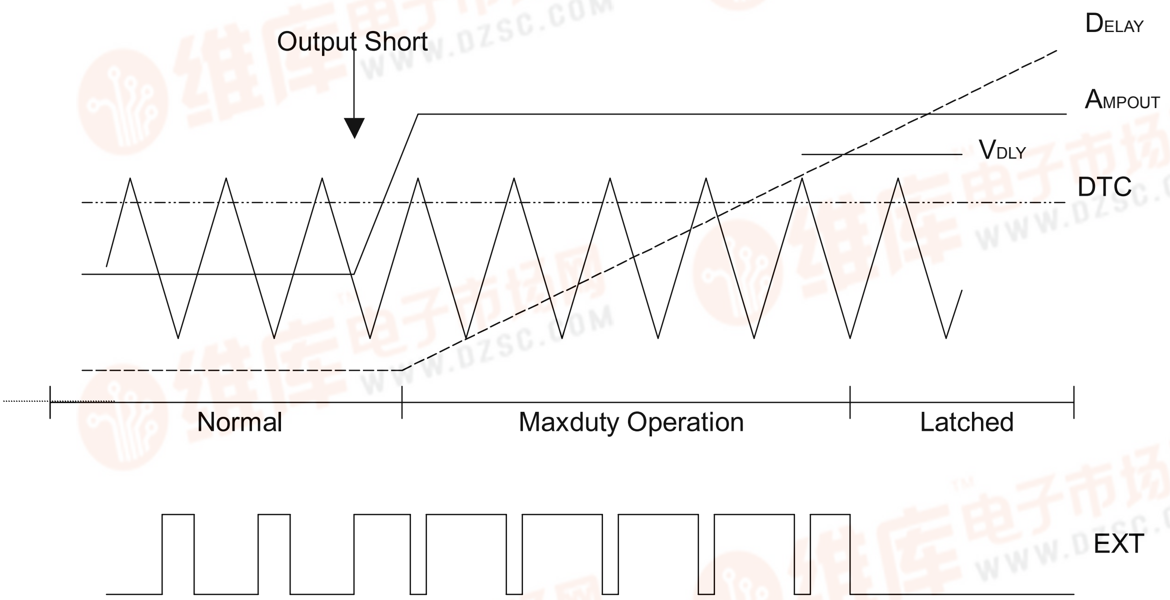
The operation of Latch protection circuit is as follows: When AMPOUT becomes "H" and the IC detects maximum duty cycle, charge to an external capacitor, C2 of DELAY pin starts. The maximum duty cycle continues and the voltage of DELAY pin reaches delay voltage detector threshold, V_{DLY}, outputs "L"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

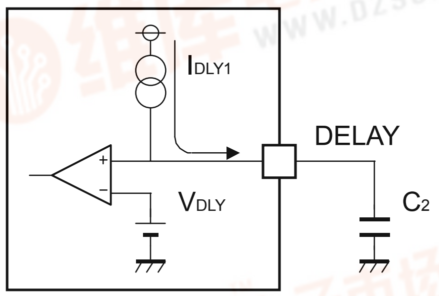
To release the latch protection operation, make the supply voltage down to UVLO detector threshold or lower, and make it rise up to the normal input voltage.

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

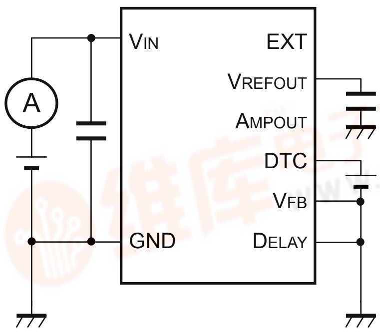


Fig.1 Consumption Current Test Circuit

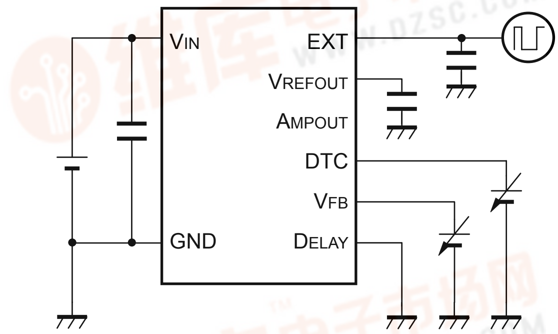


Fig.2 Oscillator Frequency, VFB Voltage, Duty Cycle, EXT rising time/falling time Test Circuit

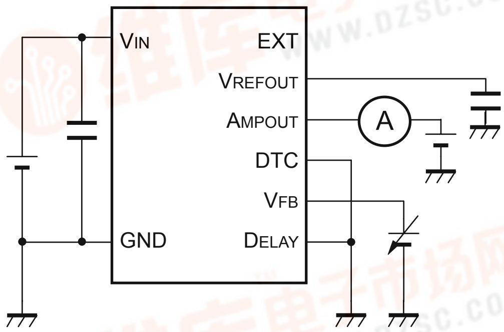


Fig.3 AMP "L" Output Current/ "H" Output Current Test Circuit

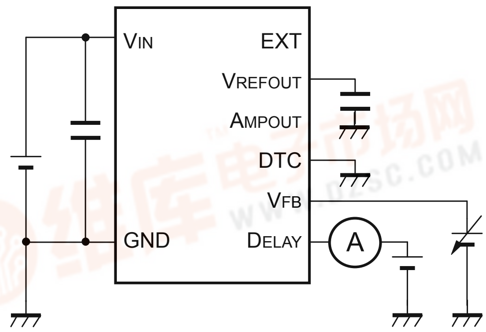


Fig.4 DELAY Pin Charge Current/ Discharge Current Test Circuit

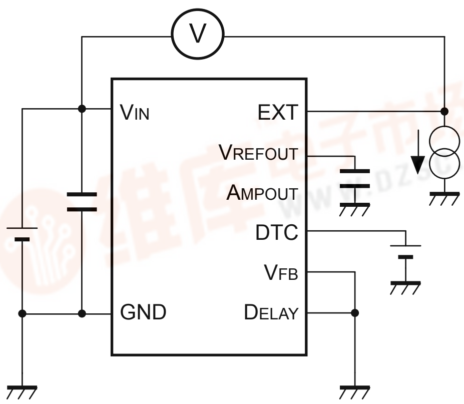


Fig.5 EXT "H" ON Resistance Test Circuit

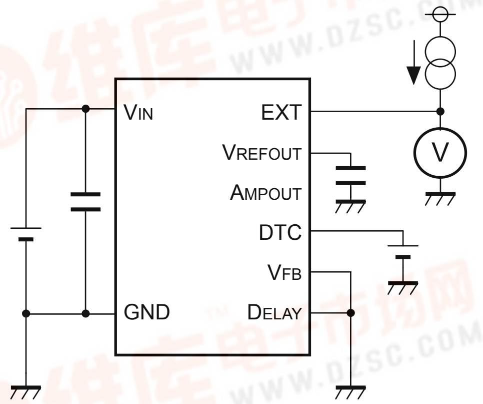


Fig.6 EXT "L" ON Resistance Test Circuit

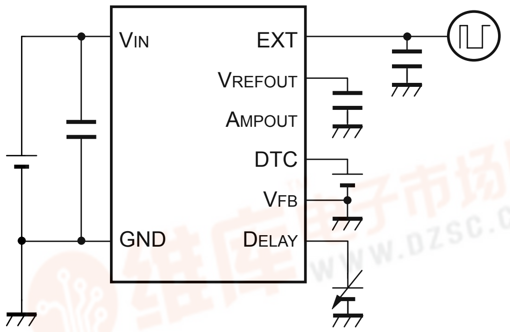


Fig.7 DELAY Pin Detector Threshold Test Circuit

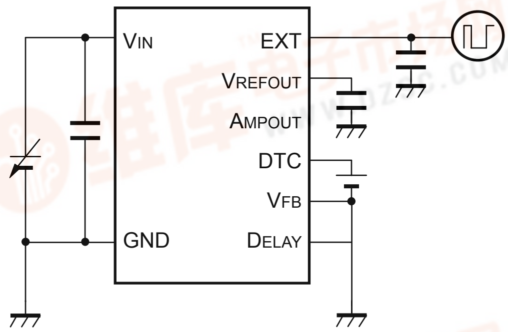


Fig.8 UVLO Detector Threshold/Released Voltage Test Circuit

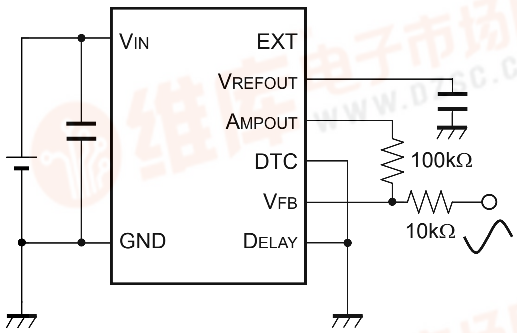


Fig.9 Error AMP Gain/Phase Test Circuit

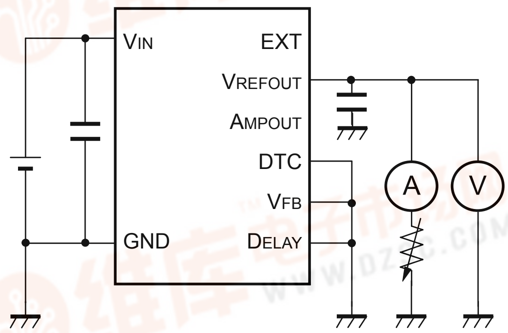


Fig.10 VREFOUT Voltage Test Current

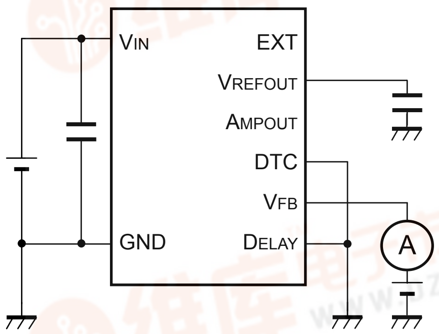


Fig.11 VFB Leakage Current Test Circuit

RICOH

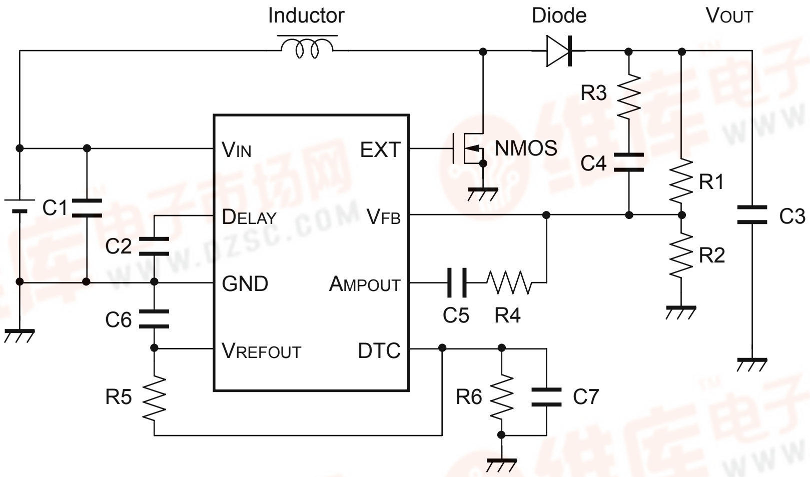


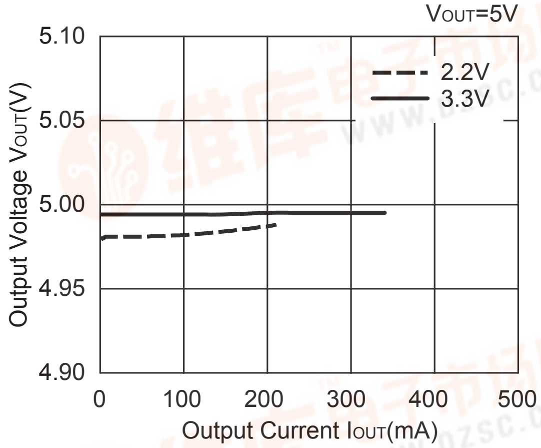
Fig.12 Output Current vs. Output Voltage/Efficiency, Response Characteristics Test Circuit

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		

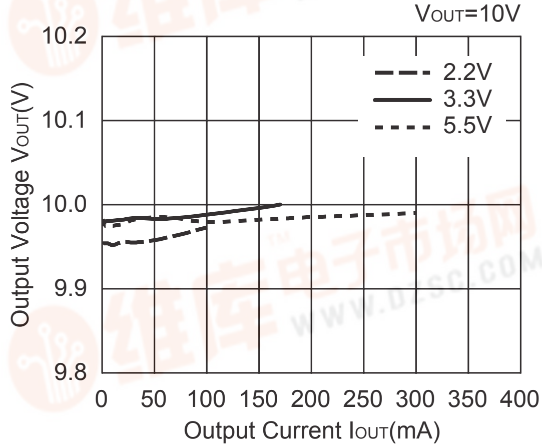
TYPICAL CHARACTERISTICS

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

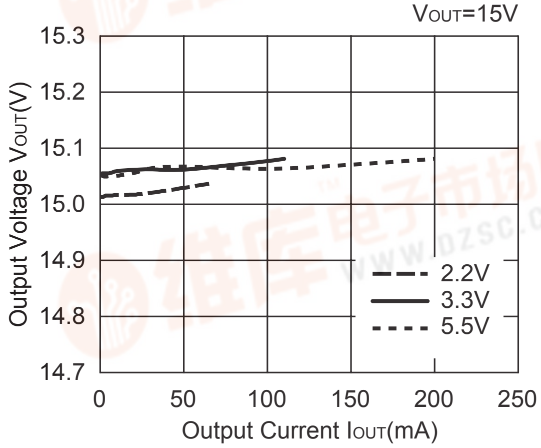
R1212D100A



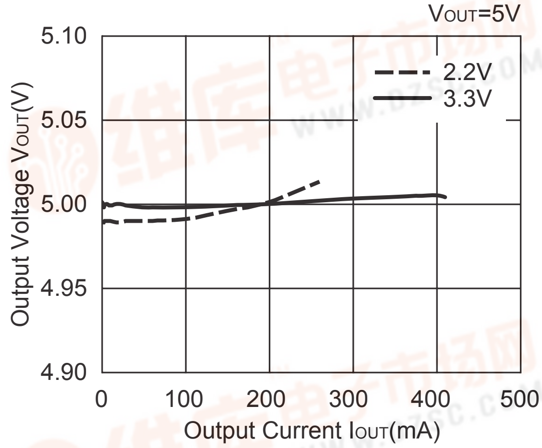
R1212D100A



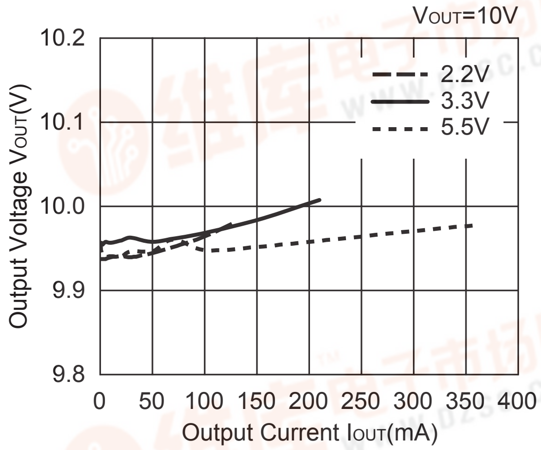
R1212D100A



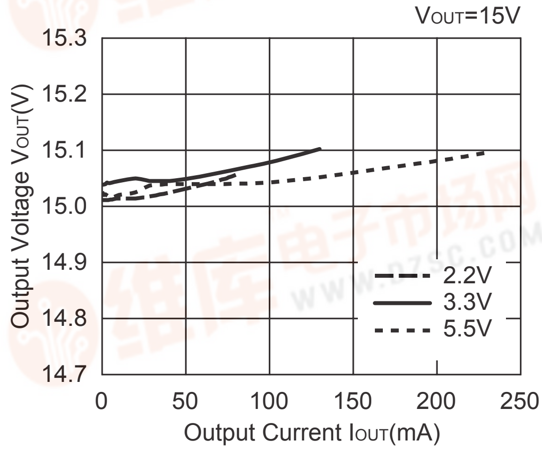
R1212D100B

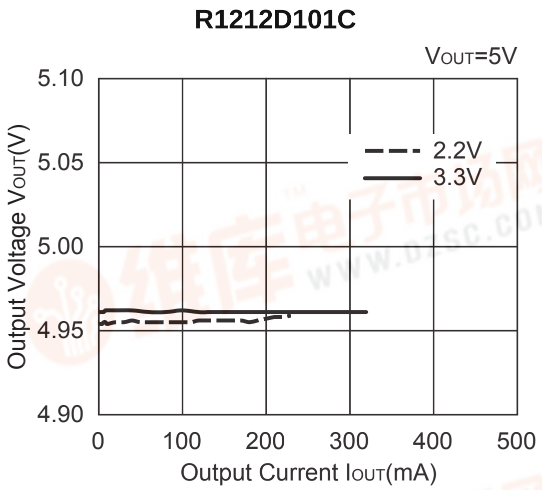


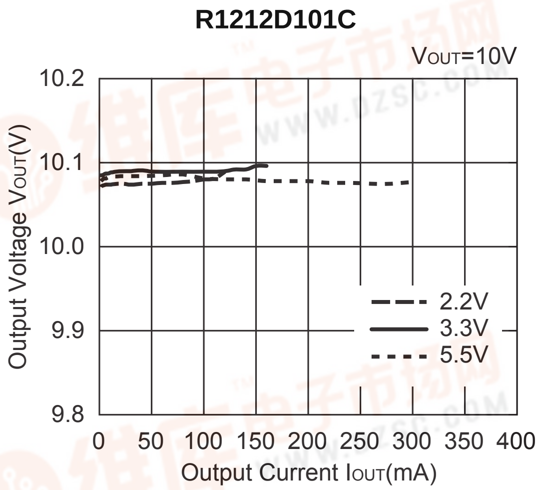
R1212D100B

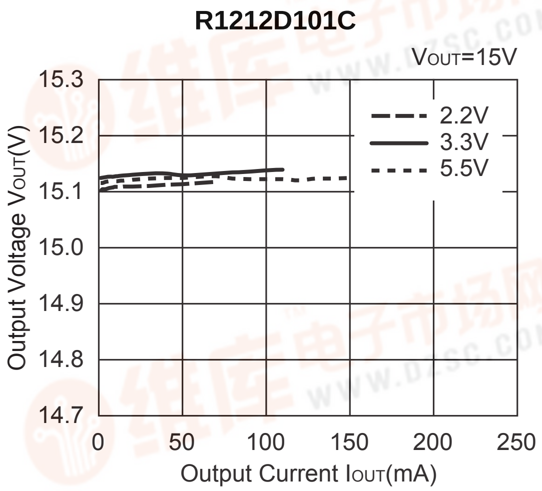


R1212D100B

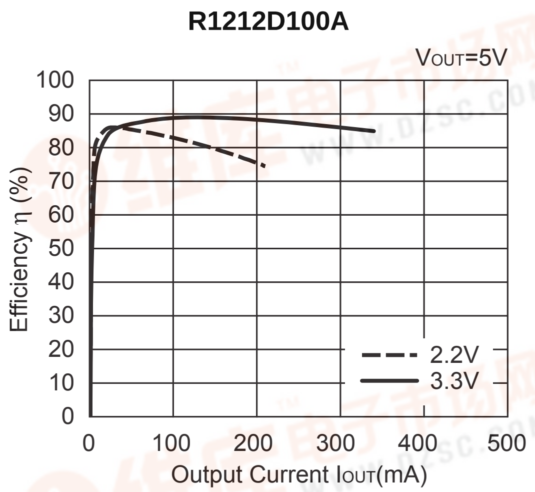


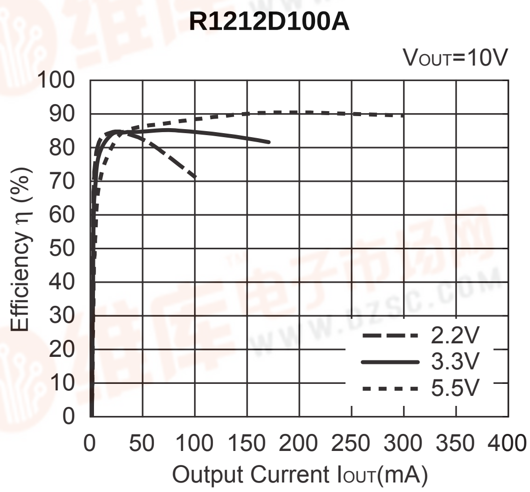




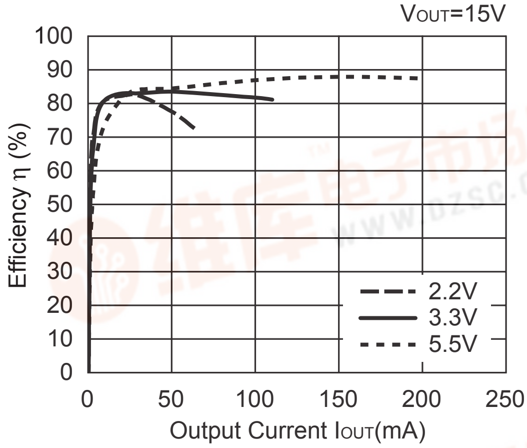


2) Efficiency vs. Output Current (Topt=25°C)

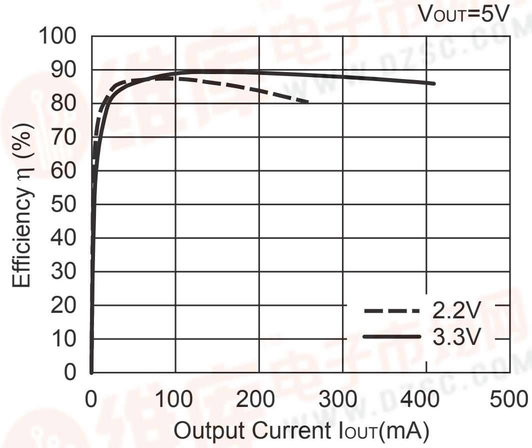




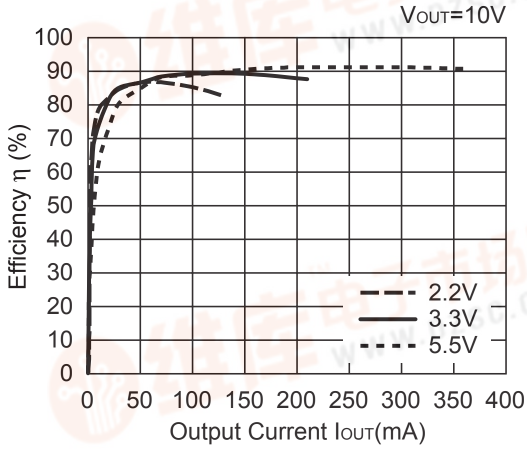
R1212D100A



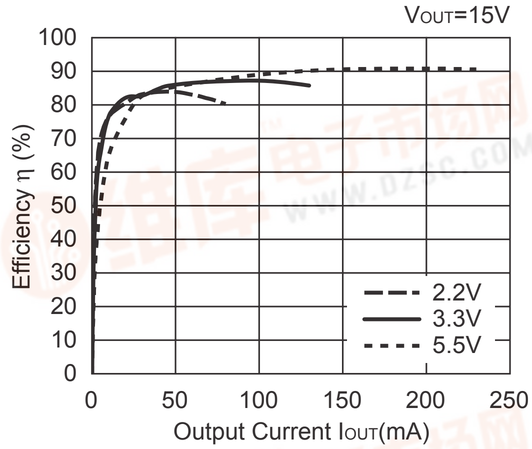
R1212D100B



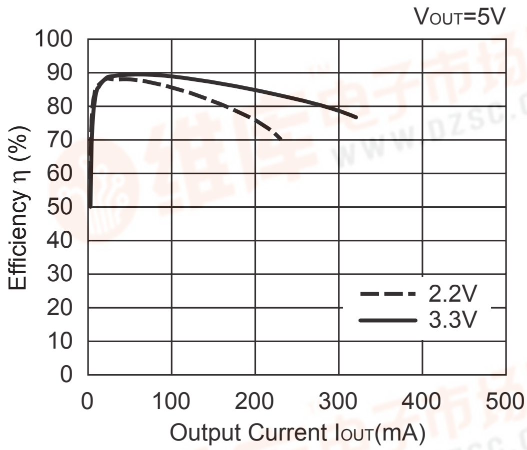
R1212D100B



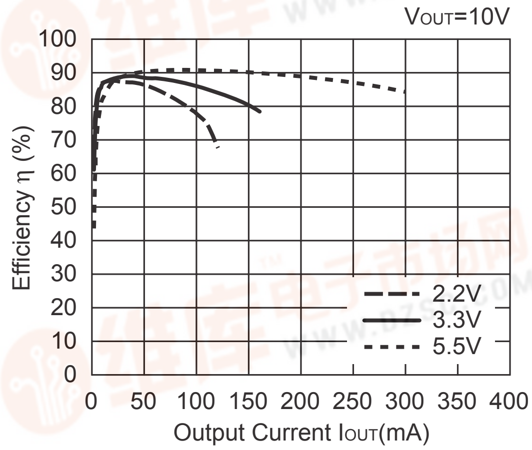
R1212D100B

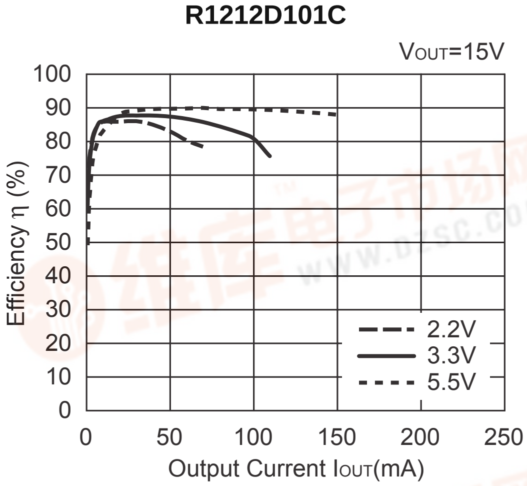


R1212D101C

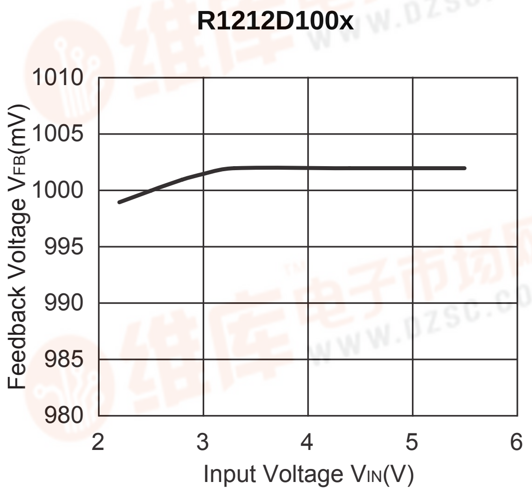


R1212D101C

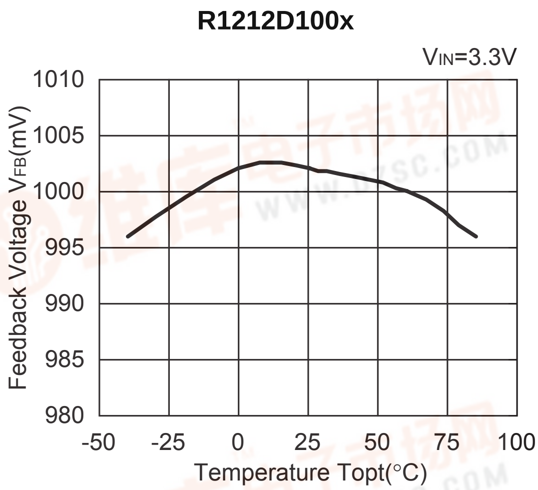




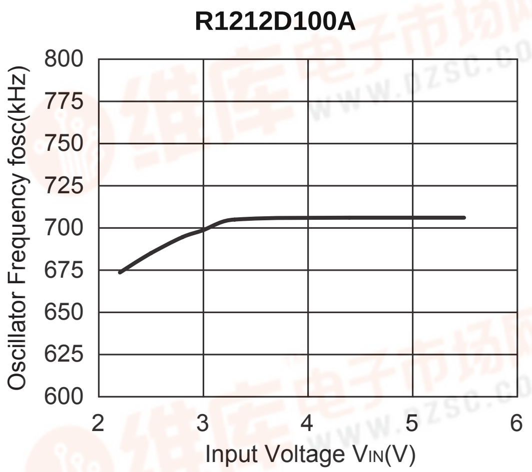
3) VFB Voltage vs. Input Voltage (Topt=25°C)

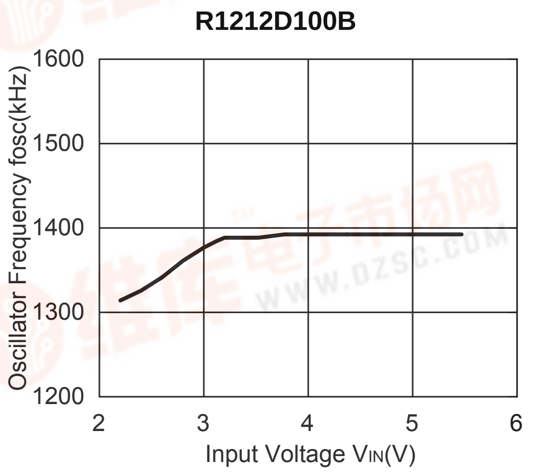


4) VFB Voltage vs. Temperature

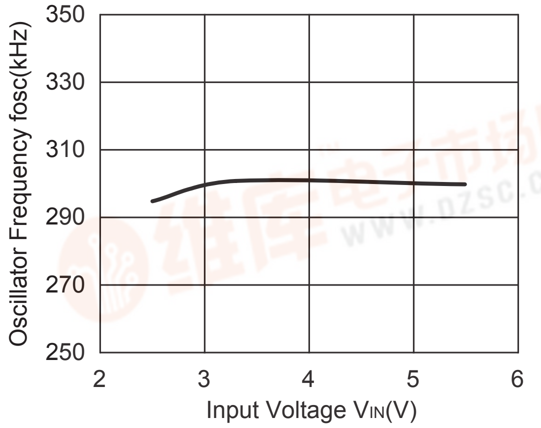


5) Oscillator Frequency vs. Input Voltage (Topt=25°C)



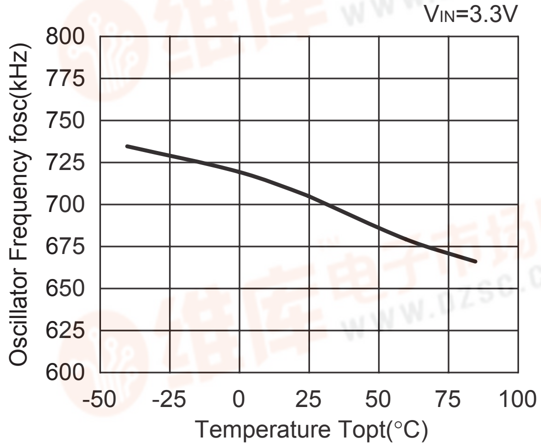


R1212D101C

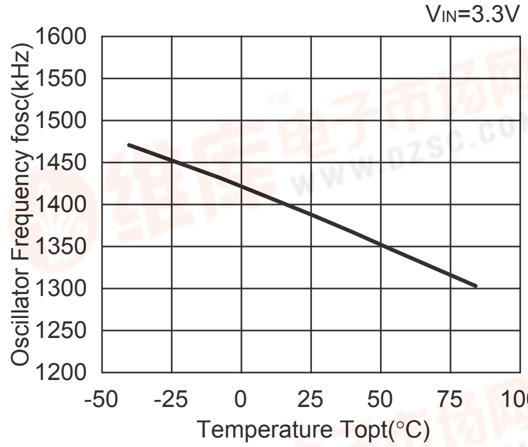


6) Oscillator Frequency vs. Temperature

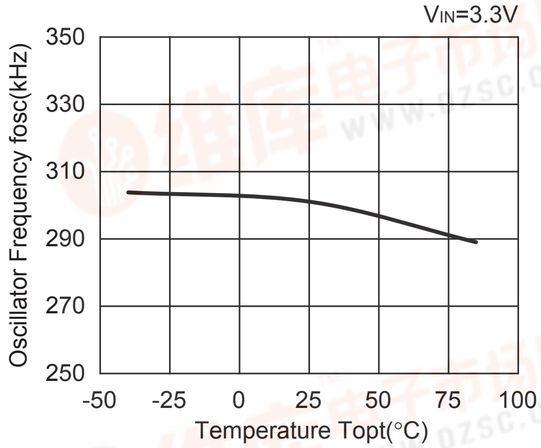
R1212D10xA



R1212D10xB



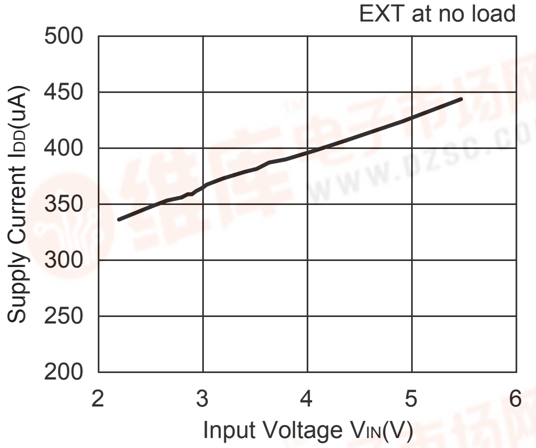
R1212D10xC



7) Supply Current vs. Input Voltage (Topt=25°C at no load)

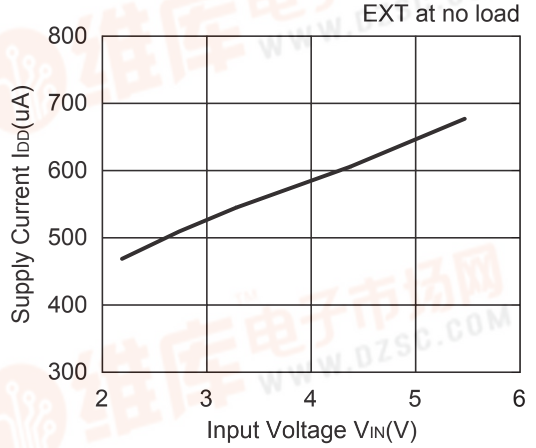
R1212D100A

EXT at no load



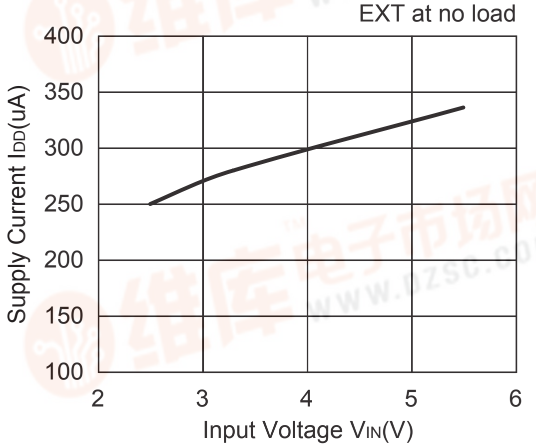
R1212D100B

EXT at no load



R1212D101C

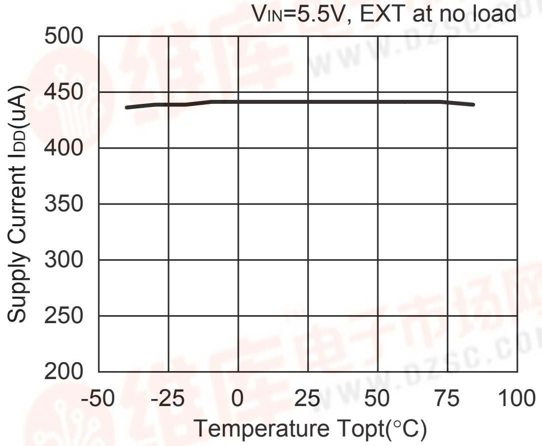
EXT at no load



8) Supply Current vs. Temperature

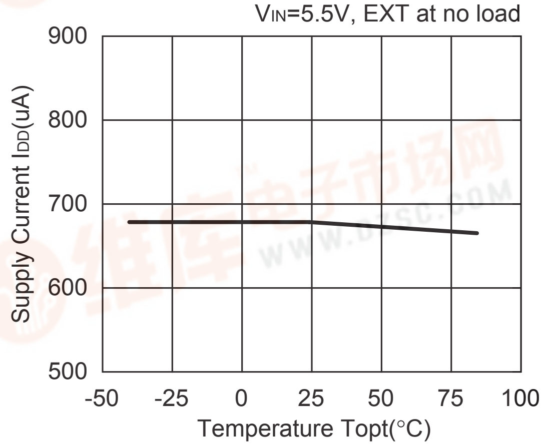
R1212D10xA

VIN=5.5V, EXT at no load



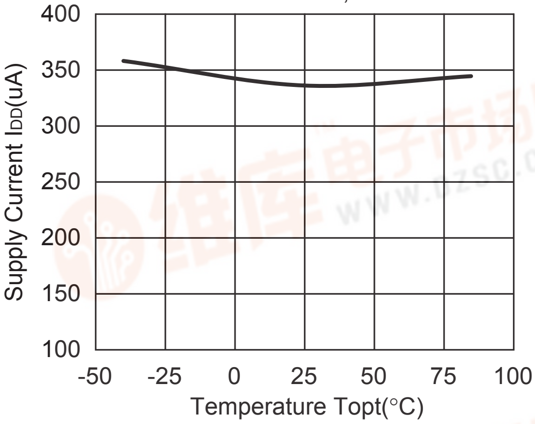
R1212D10xB

VIN=5.5V, EXT at no load



R1212D10xC

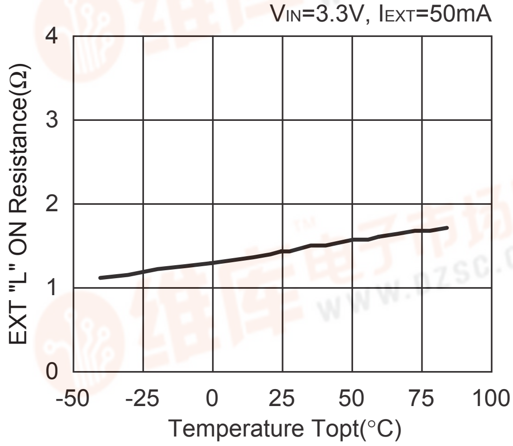
V_{IN}=5.5V, EXT at no load



9) EXT "L" On Resistance vs. Temperature

R1212D10xx

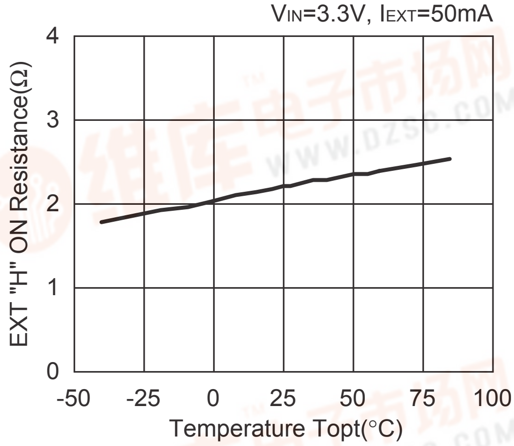
V_{IN}=3.3V, I_{EXT}=50mA



10) EXT "H" On Resistance vs. Temperature

R1212D10xx

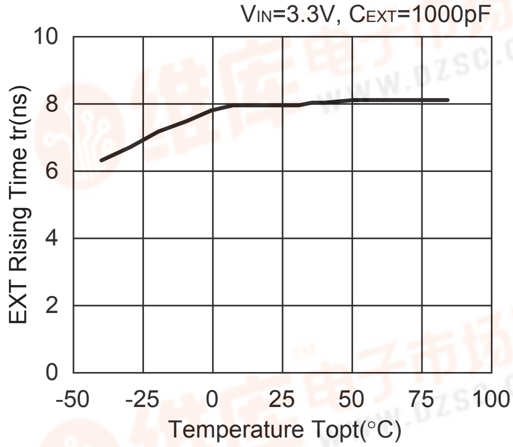
V_{IN}=3.3V, I_{EXT}=50mA



11) EXT Rising Time vs. Temperature

R1212D10xx

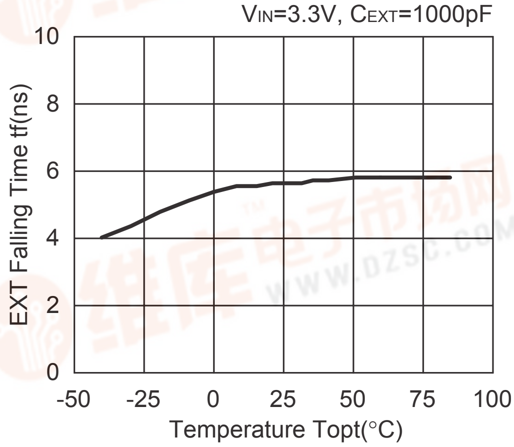
V_{IN}=3.3V, C_{EXT}=1000pF



12) EXT Falling Time vs. Temperature

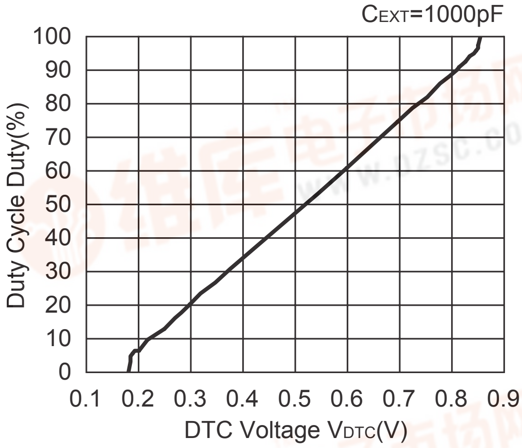
R1212D10xx

V_{IN}=3.3V, C_{EXT}=1000pF

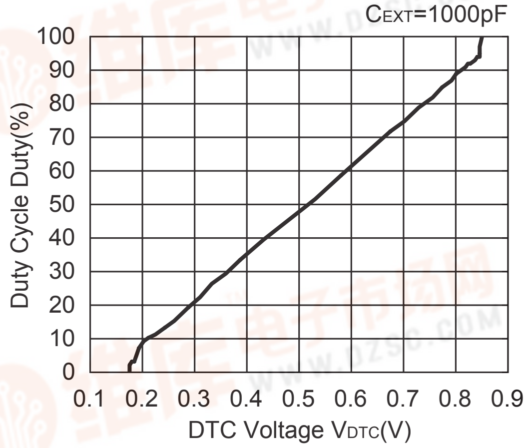


13) Duty Cycle vs. DTC Voltage (0% to 100%) (Topt=25°C)

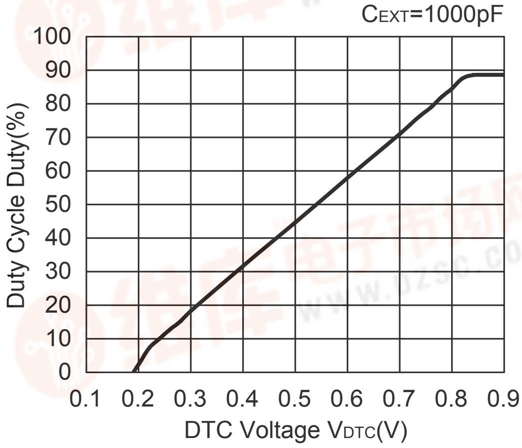
R1212D100A



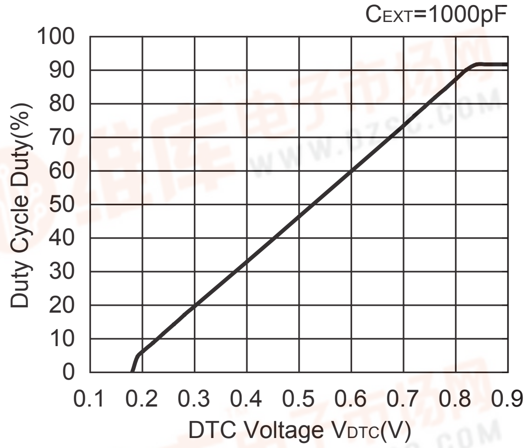
R1212D100B



R1212D101A

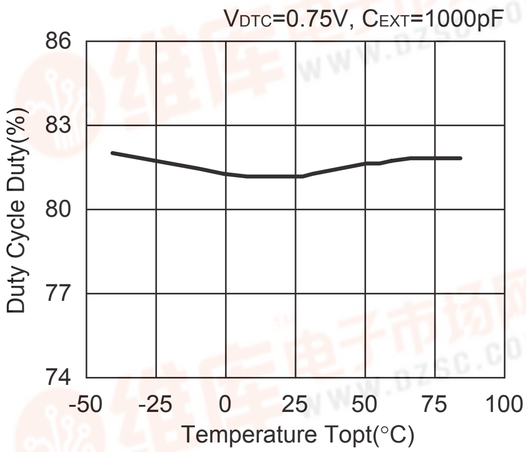


R1212D101C

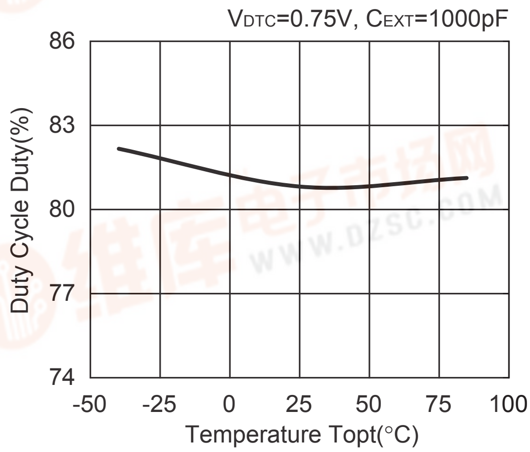


14) Duty Cycle vs. Temperature

R1212D100A

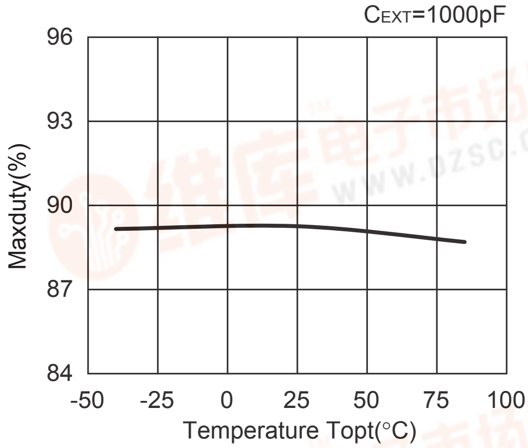


R1212D100B

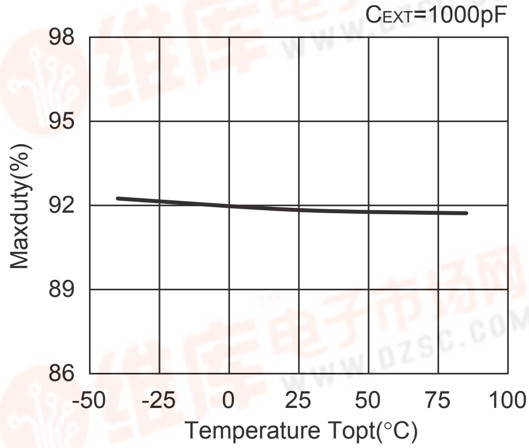


15) Maxduty vs. Temperature

R1212D101A

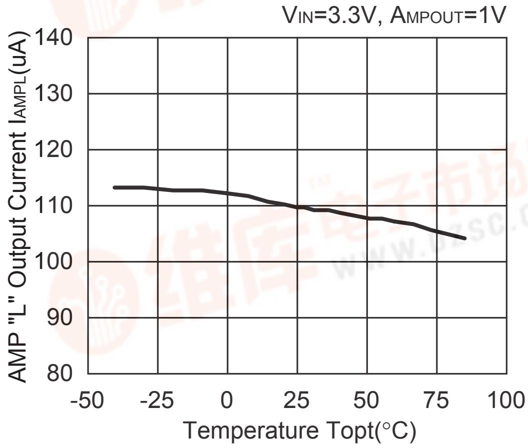


R1212D101C

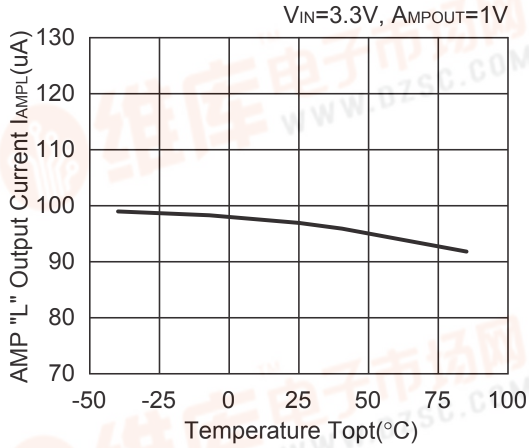


16) AMP "L" Output Current vs. Temperature

R1212D10xA/B

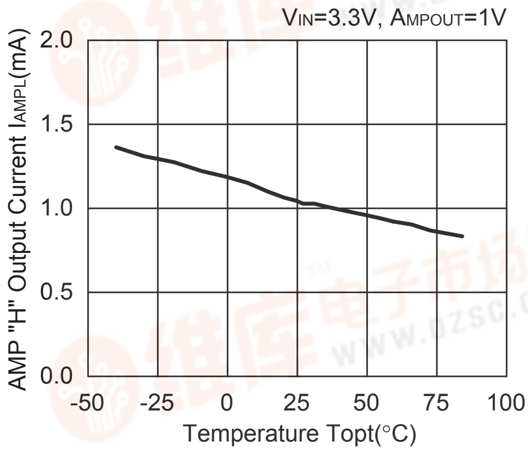


R1212D10xC

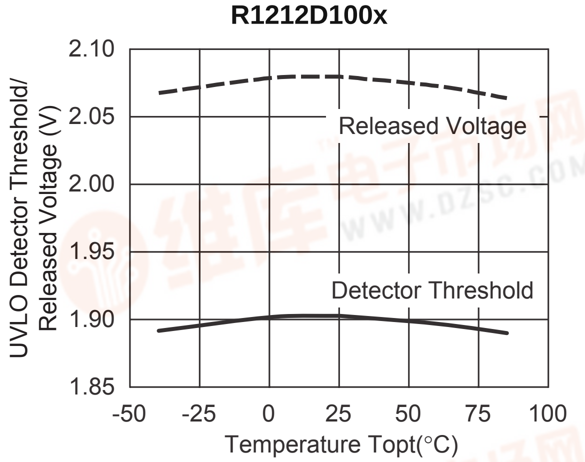


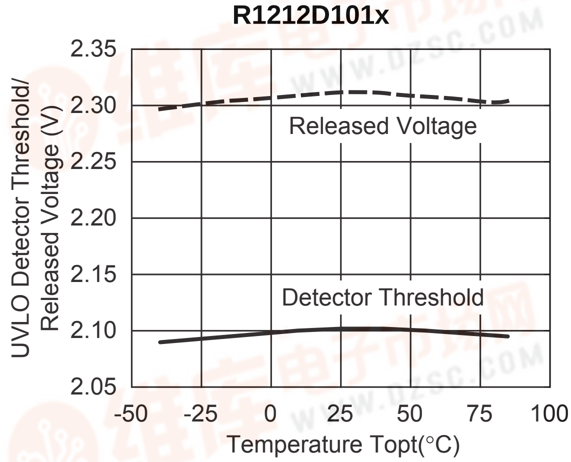
17) AMP "H" Output Current vs. Temperature

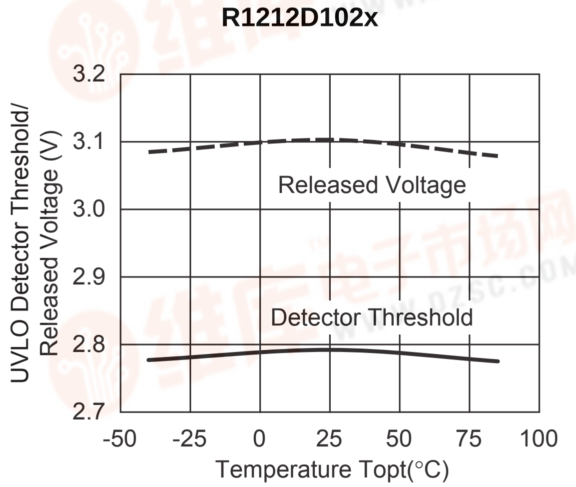
R1212D10xx



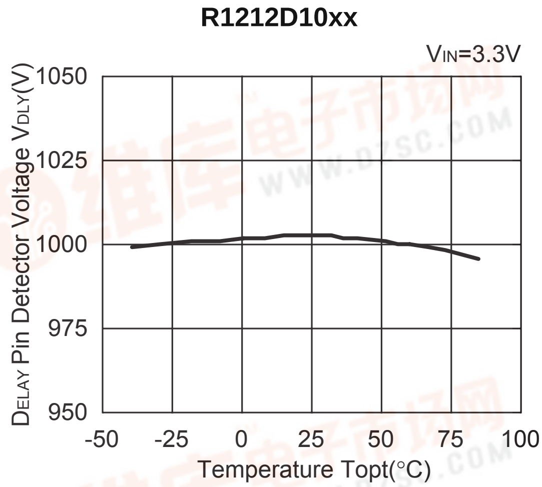
18) UVLO Detector Threshold UVLO Released Voltage vs. Temperature



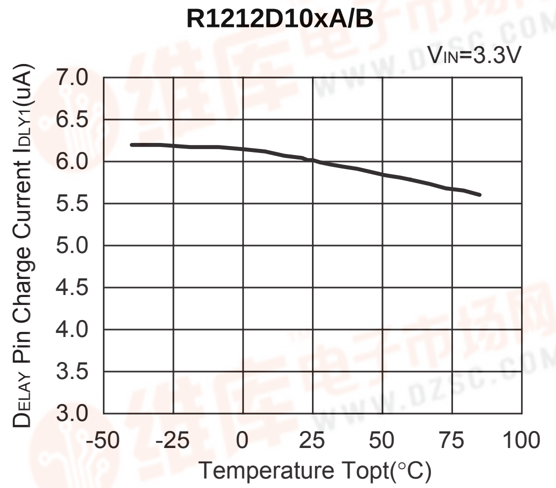


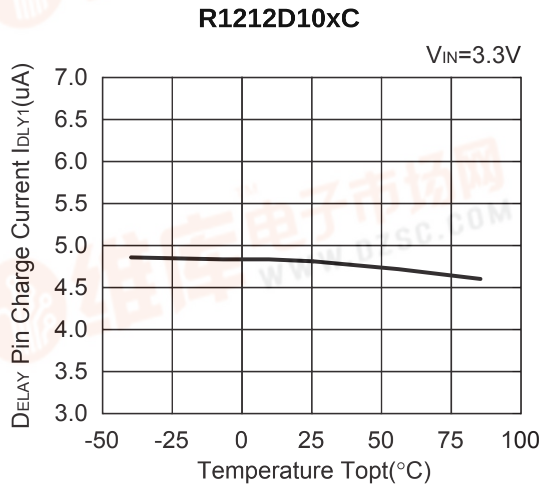


19) DELAY Pin Detector Threshold vs. Temperature



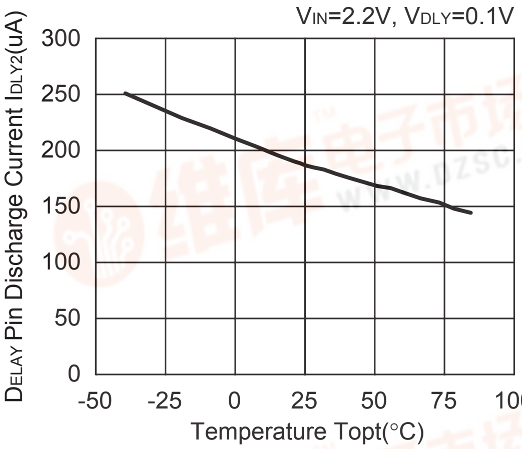
20) DELAY Pin Charge Current vs. Temperature





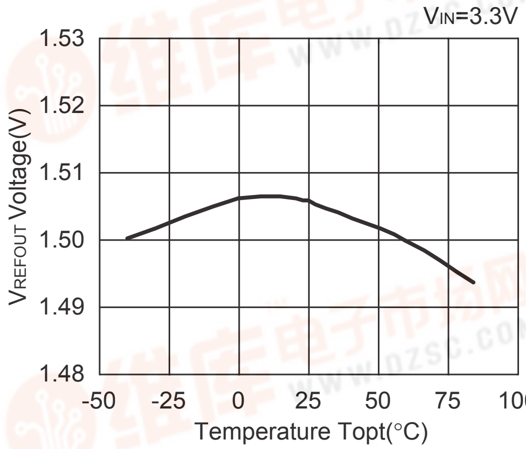
21) DELAY Pin Discharge Current vs. Temperature

R1212D10xx



22) VREFOUT Voltage vs. Temperature

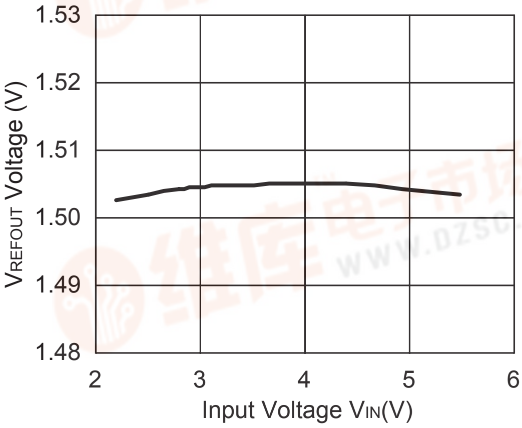
R1212D10xx



23) VREFOUT Voltage vs. Input Voltage

(Topt=25°C)

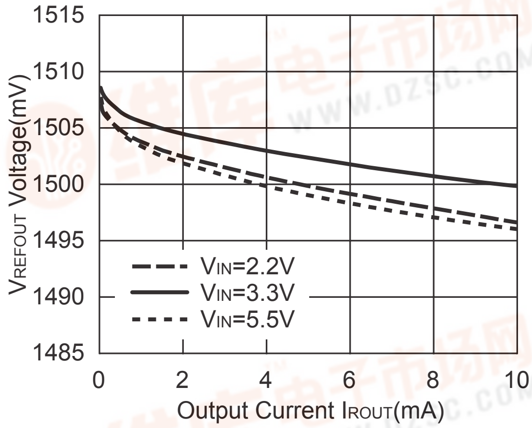
R1212D10xx



24) VREFOUT Voltage vs. Output Current (1)

(Topt=25°C)

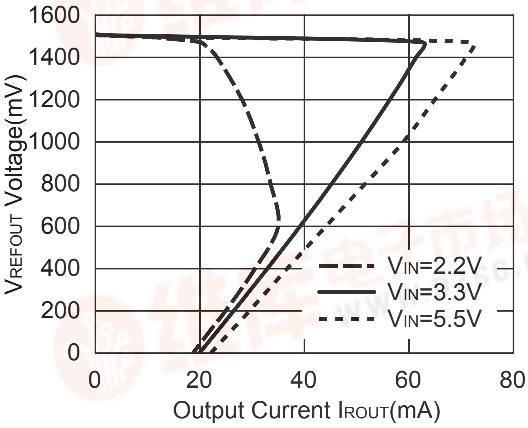
R1212D10xx



25) VREFOUT Voltage vs. Output Current (2)

(Topt=25°C)

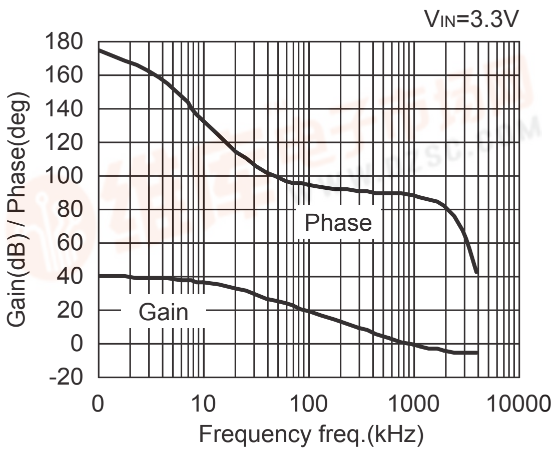
R1212D10xx



26) Error Amplifier Gain/Phase vs. Frequency

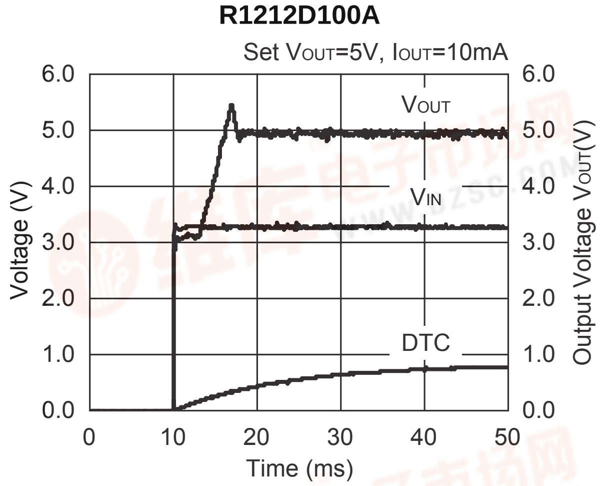
(Topt=25°C)

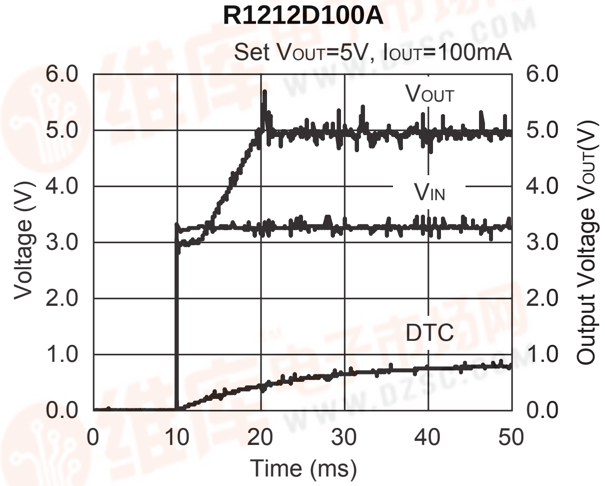
R1212D10xx

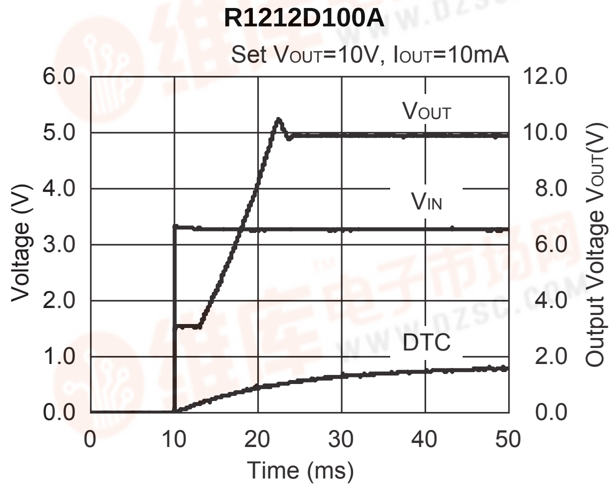


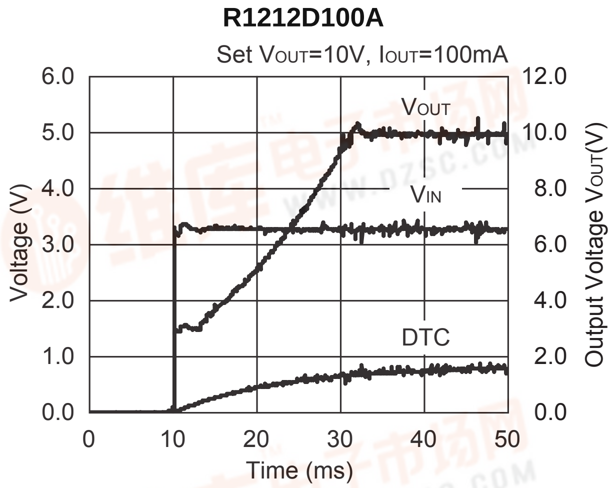
RICOH

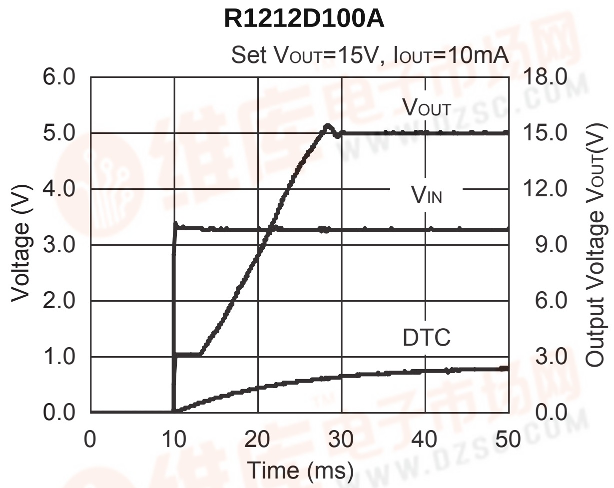
27) Power-on Response (V_{IN}=3.3V, Topt=25°C)

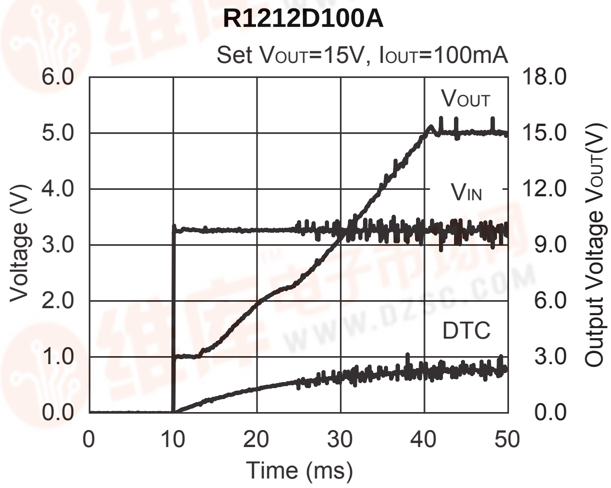


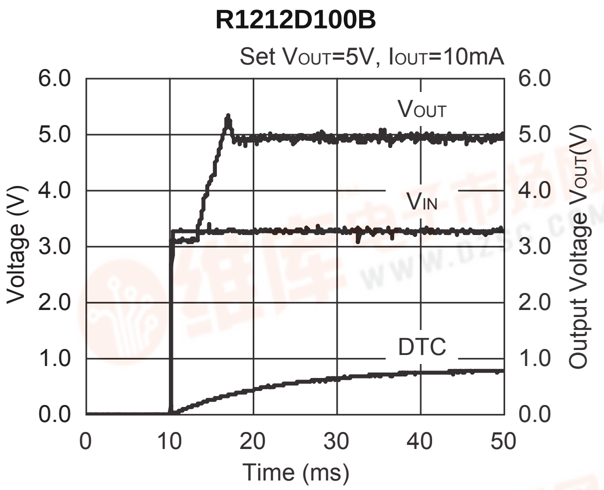


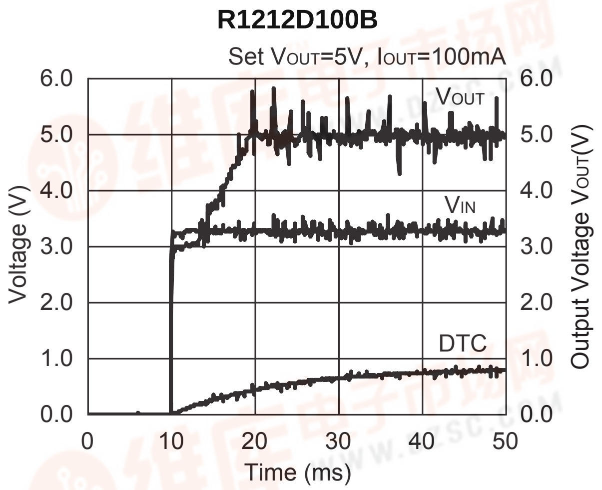


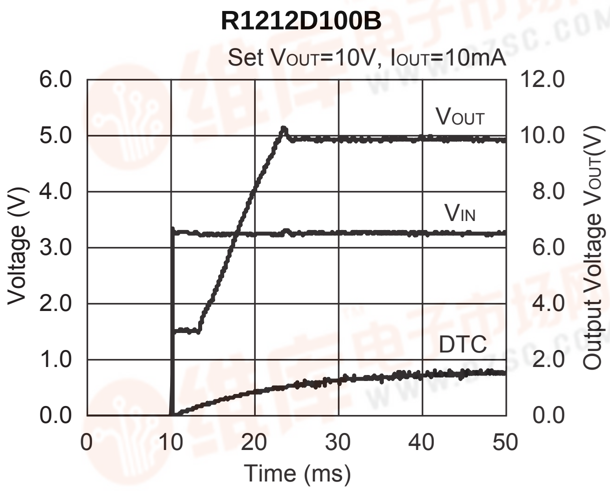


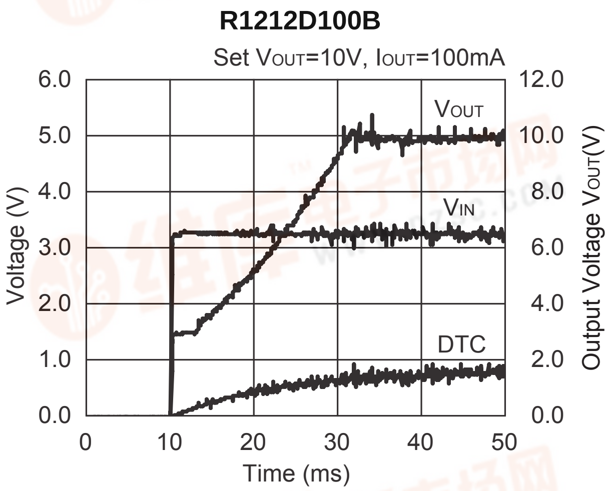


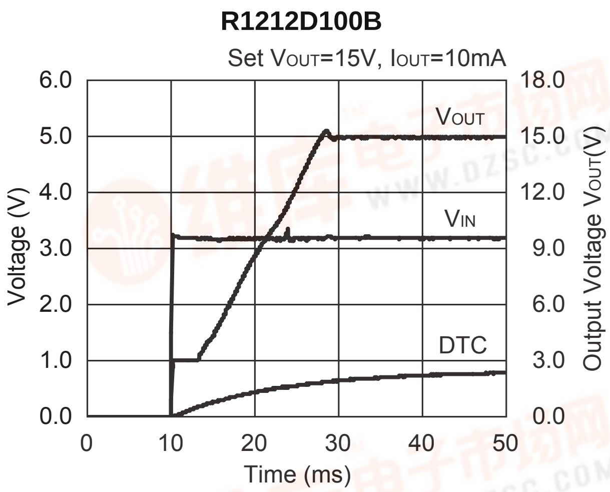


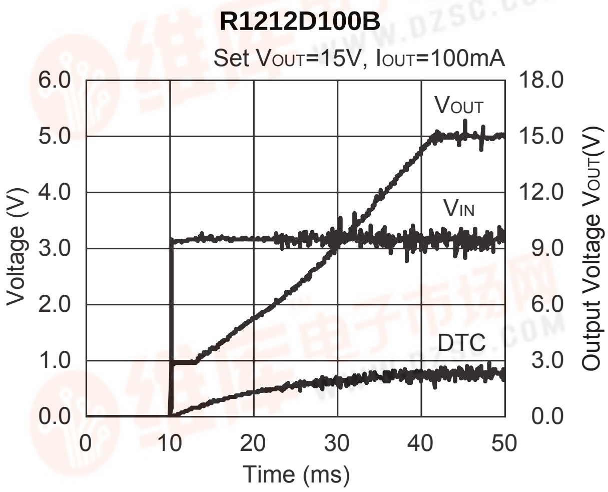

R1212D100B
Set VOUT=5V, IOUT=10mA
VOUT
VIN
DTC
Voltage (V)
Output Voltage VOUT(V)
Time (ms)


R1212D100B
Set VOUT=5V, IOUT=100mA
VOUT
VIN
DTC
Voltage (V)
Output Voltage VOUT(V)
Time (ms)


R1212D100B
Set VOUT=10V, IOUT=10mA
VOUT
VIN
DTC
Voltage (V)
Output Voltage VOUT(V)
Time (ms)

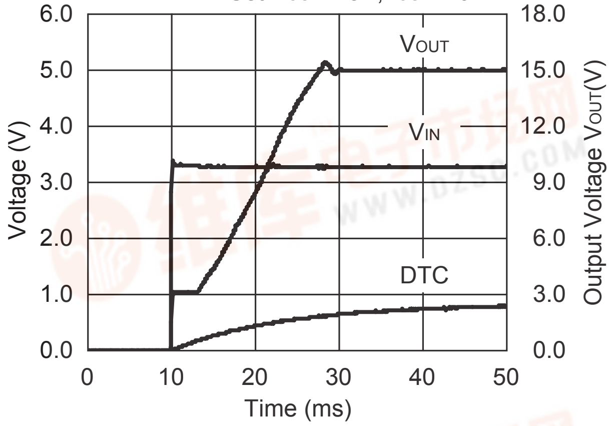

R1212D100B
Set VOUT=10V, IOUT=100mA
VOUT
VIN
DTC
Voltage (V)
Output Voltage VOUT(V)
Time (ms)


R1212D100B
Set VOUT=15V, IOUT=10mA
VOUT
VIN
DTC
Voltage (V)
Output Voltage VOUT(V)
Time (ms)


R1212D100B
Set VOUT=15V, IOUT=100mA
VOUT
VIN
DTC
Voltage (V)
Output Voltage VOUT(V)
Time (ms)

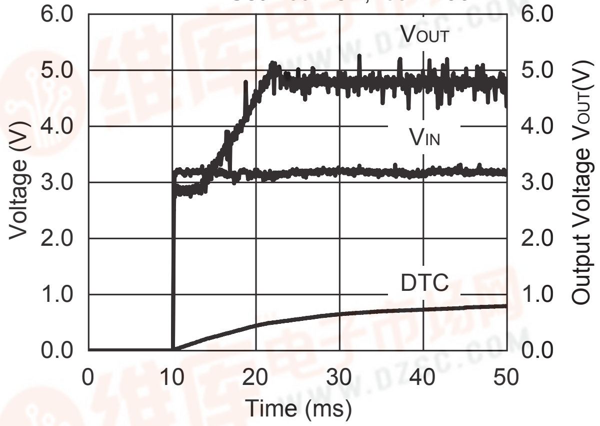
R1212D101C

Set V_{OUT}=15V, I_{OUT}=10mA



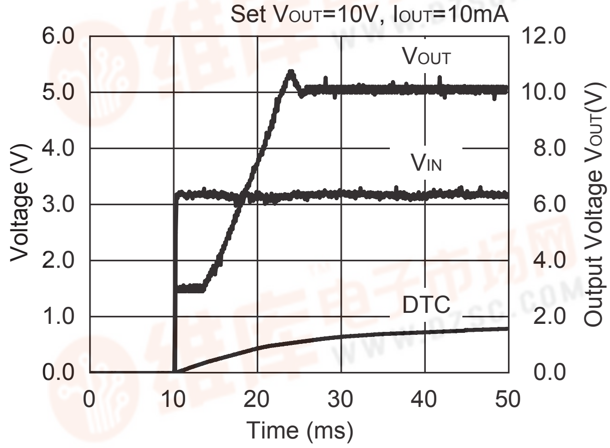
R1212D101C

Set V_{OUT}=5V, I_{OUT}=100mA



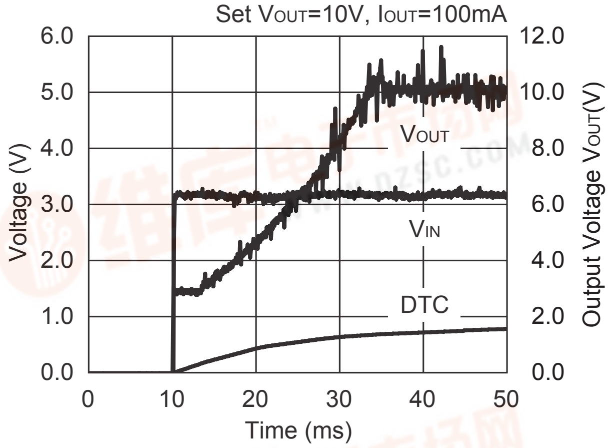
R1212D101C

Set V_{OUT}=10V, I_{OUT}=10mA



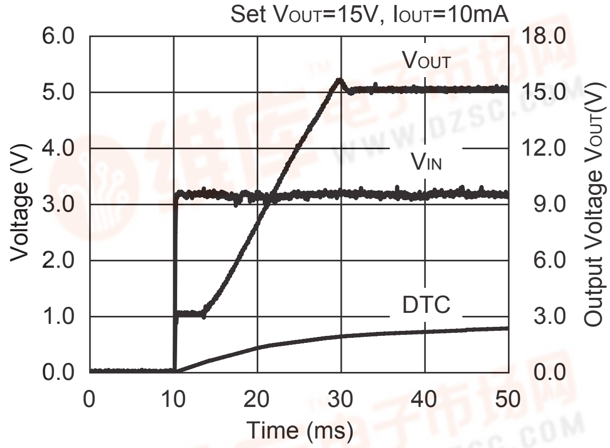
R1212D101C

Set V_{OUT}=10V, I_{OUT}=100mA



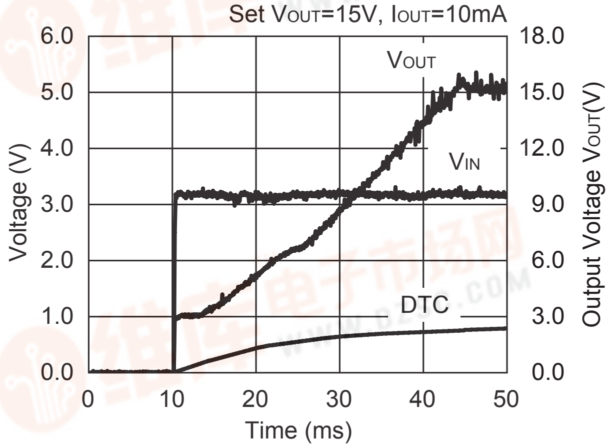
R1212D101C

Set V_{OUT}=15V, I_{OUT}=10mA

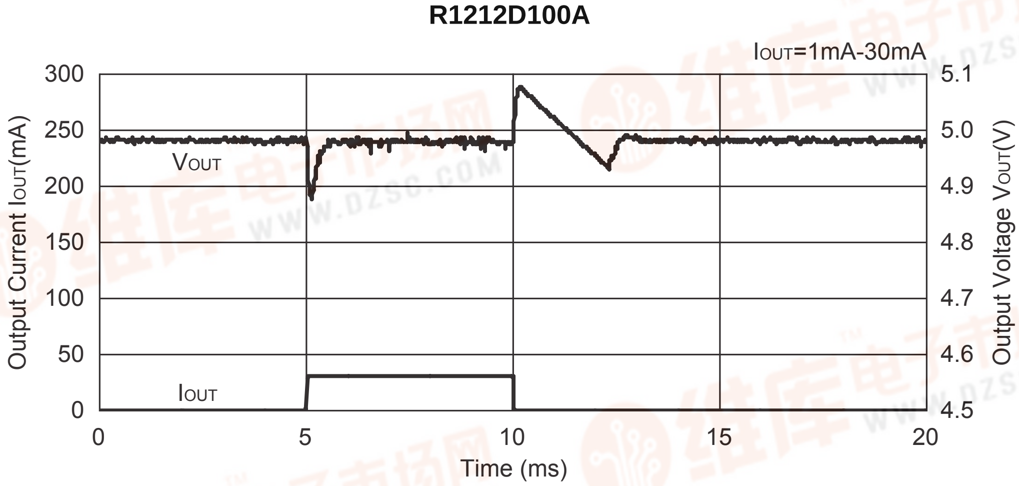


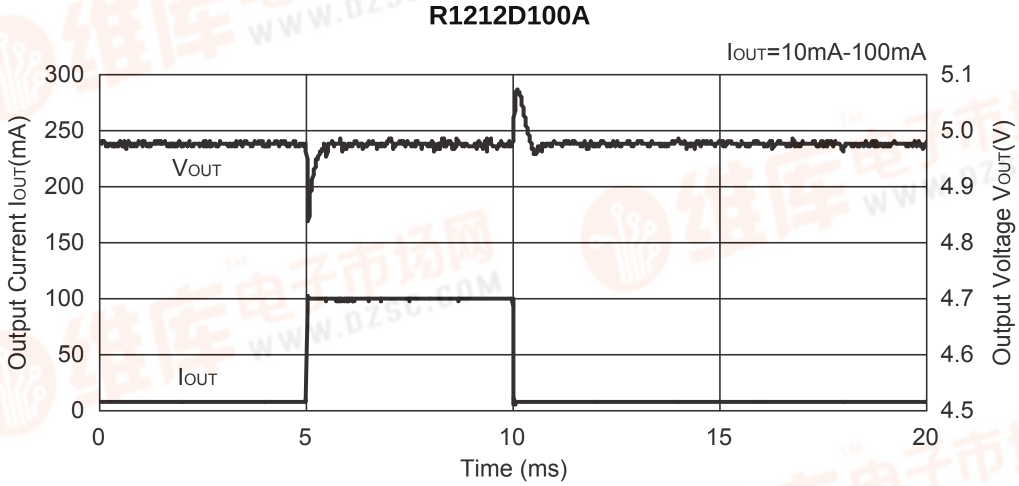
R1212D101C

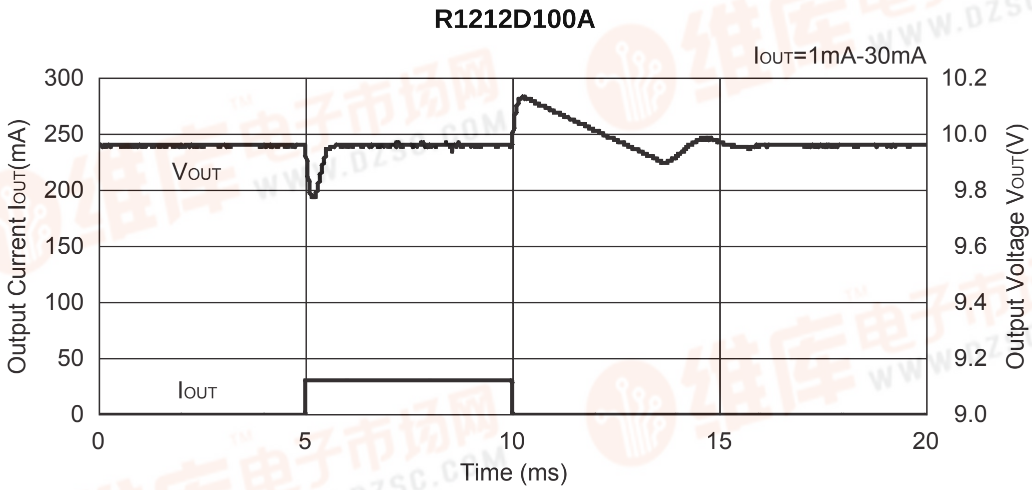
Set V_{OUT}=15V, I_{OUT}=10mA



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

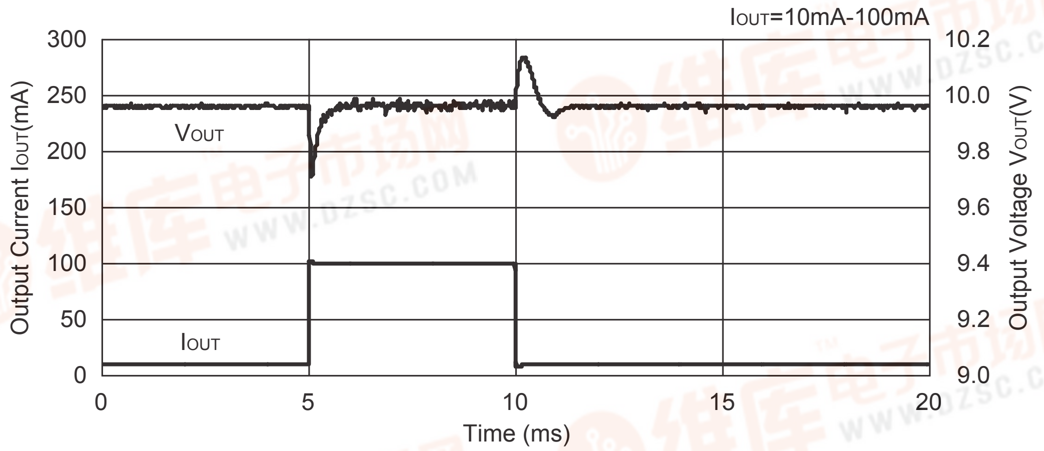




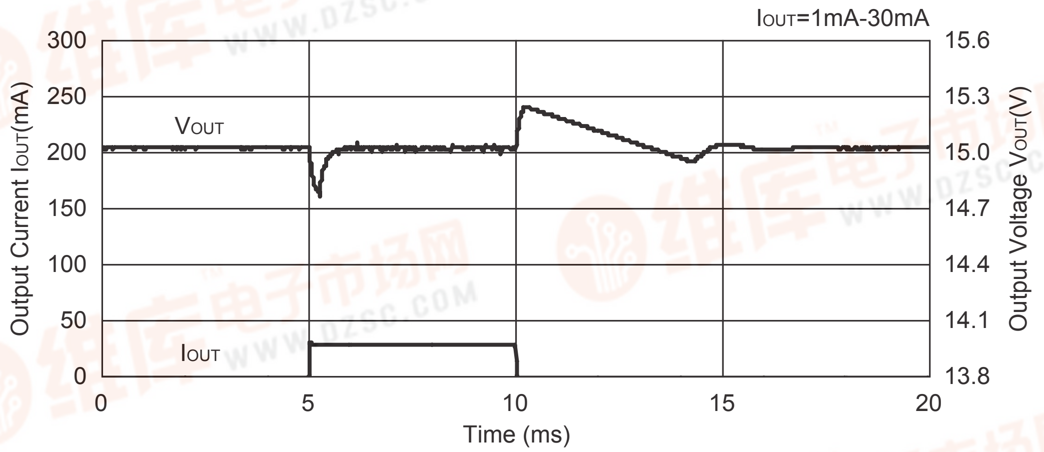


RICOH

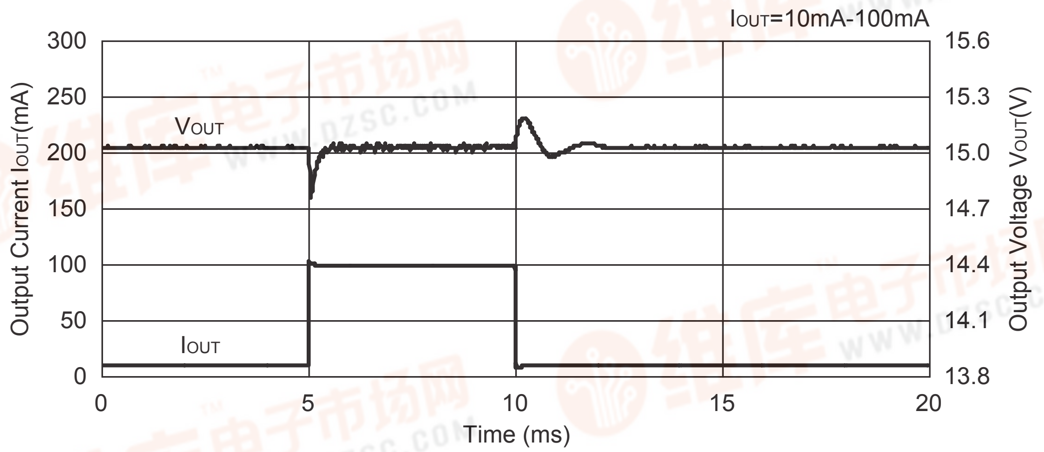
R1212D100A



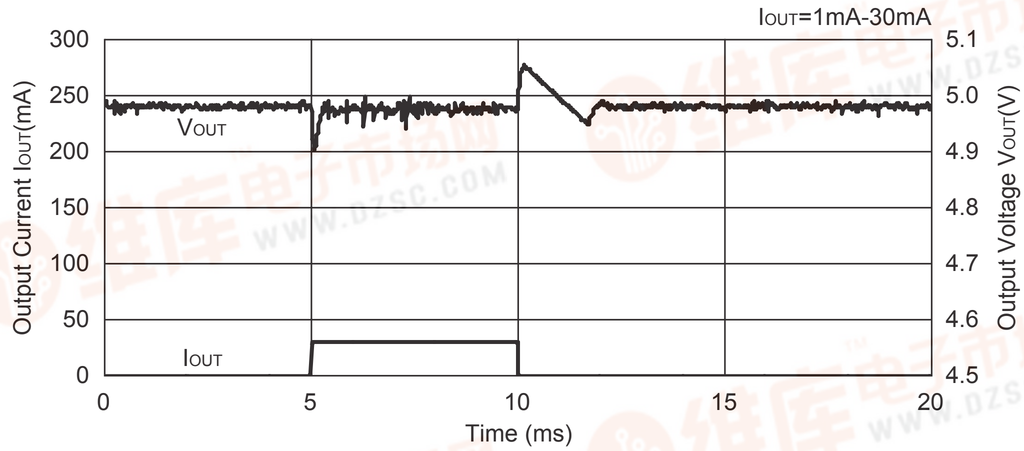
R1212D100A



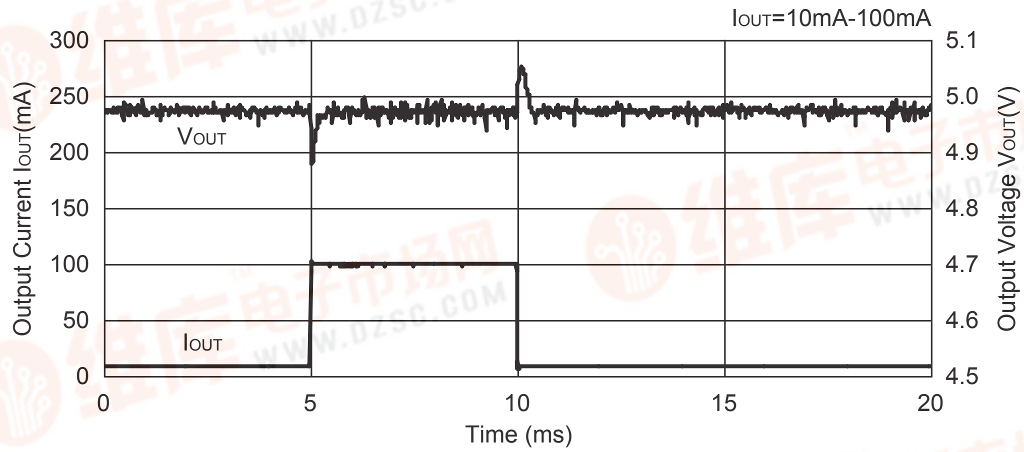
R1212D100A



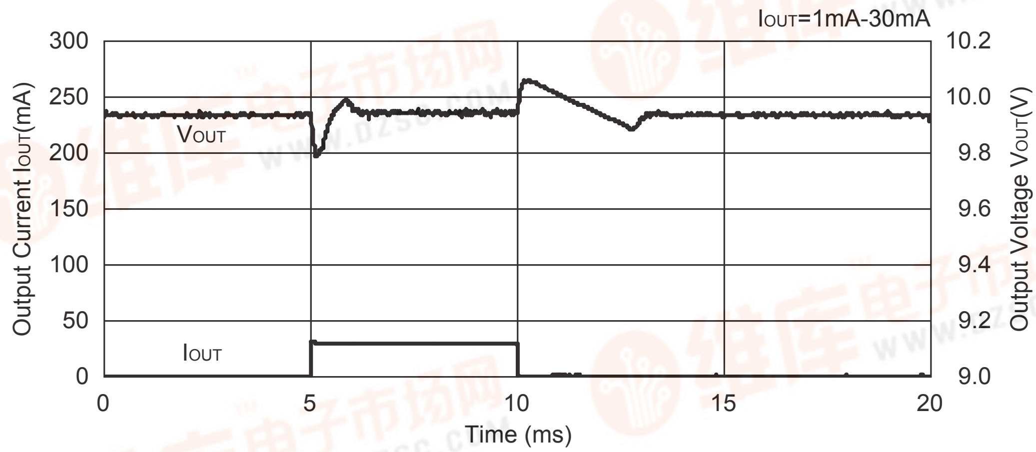
R1212D100B

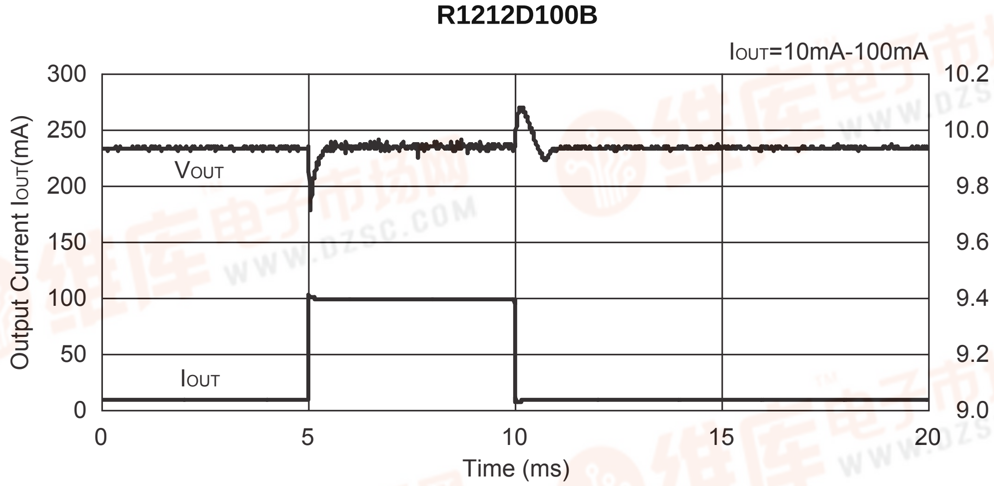


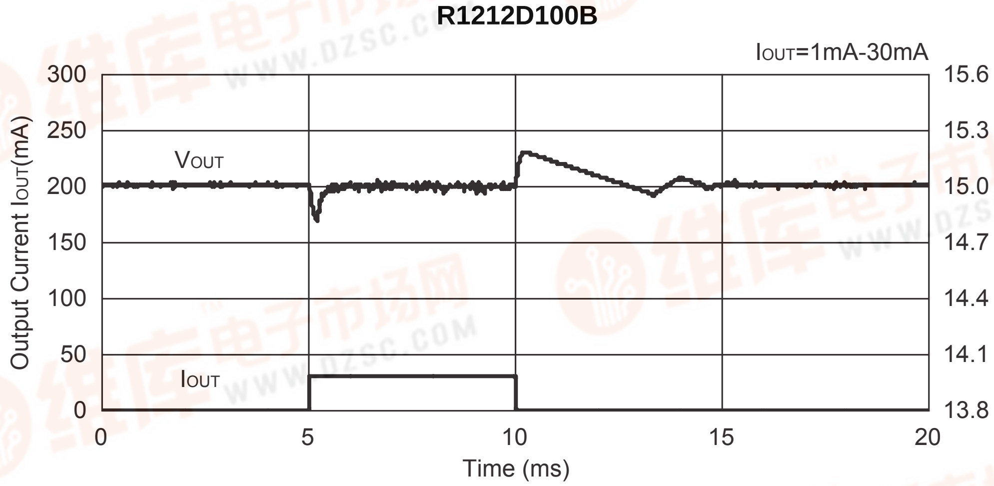
R1212D100B

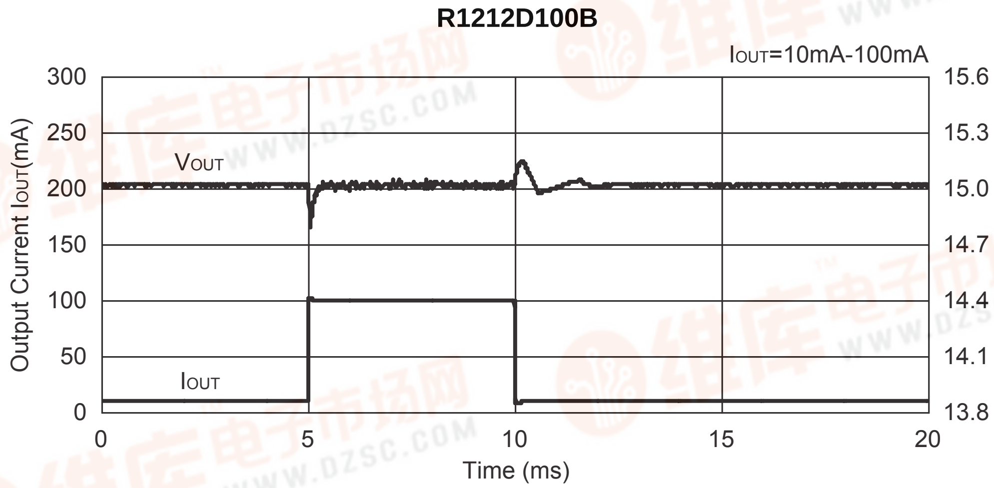


R1212D100B

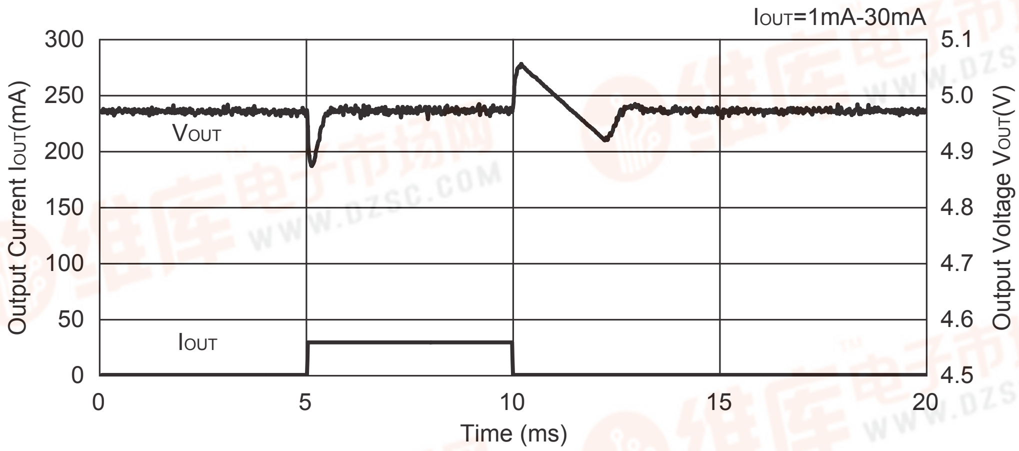



R1212D100B
IOUT=10mA-100mA
VOUT
IOUT
Output Current IOUT(mA)
Output Voltage VOUT(V)
300
250
200
150
100
50
0
10.2
10.0
9.8
9.6
9.4
9.2
9.0
0
5
10
15
20
Time (ms)

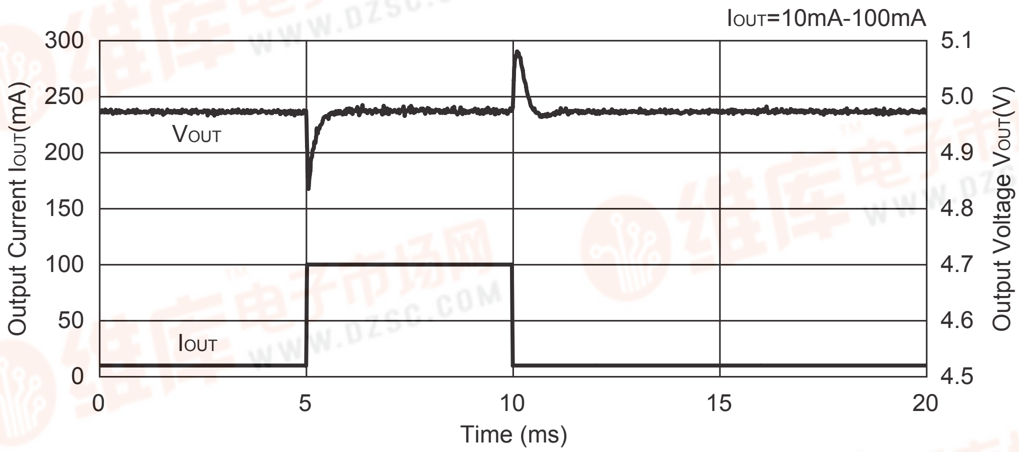

R1212D100B
IOUT=1mA-30mA
VOUT
IOUT
Output Current IOUT(mA)
Output Voltage VOUT(V)
300
250
200
150
100
50
0
15.6
15.3
15.0
14.7
14.4
14.1
13.8
0
5
10
15
20
Time (ms)


R1212D100B
IOUT=10mA-100mA
VOUT
IOUT
Output Current IOUT(mA)
Output Voltage VOUT(V)
300
250
200
150
100
50
0
15.6
15.3
15.0
14.7
14.4
14.1
13.8
0
5
10
15
20
Time (ms)

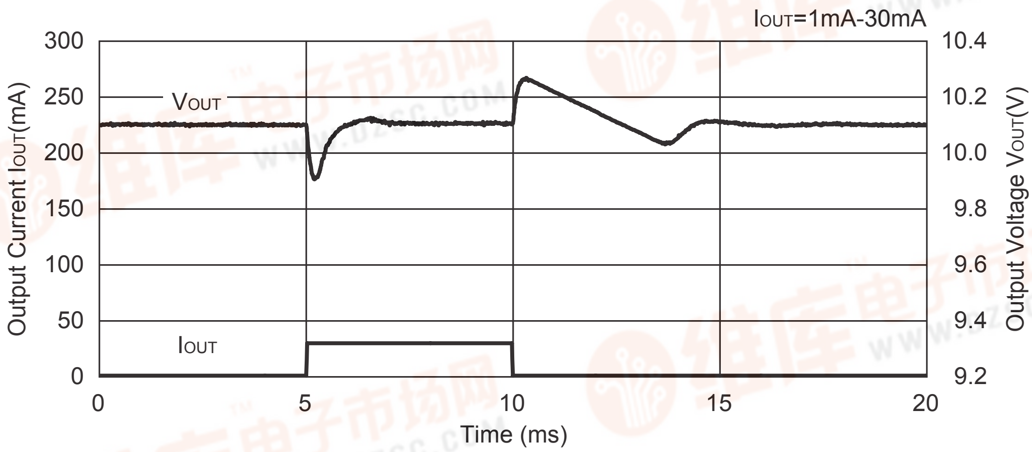
R1212D101C

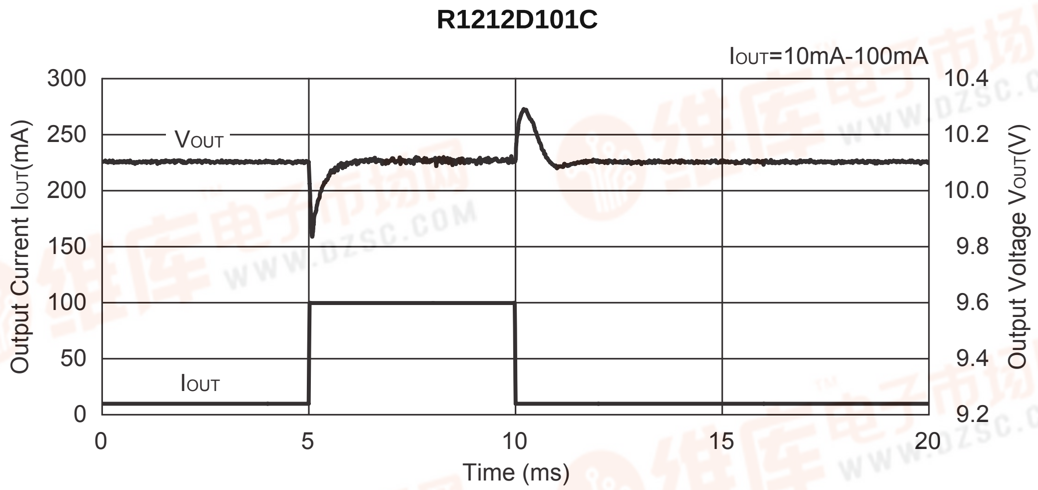


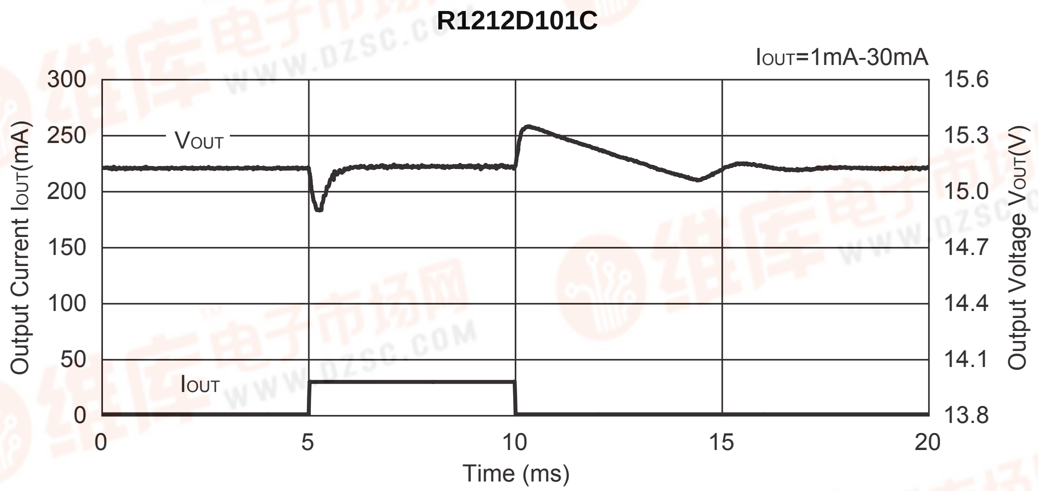
R1212D101C

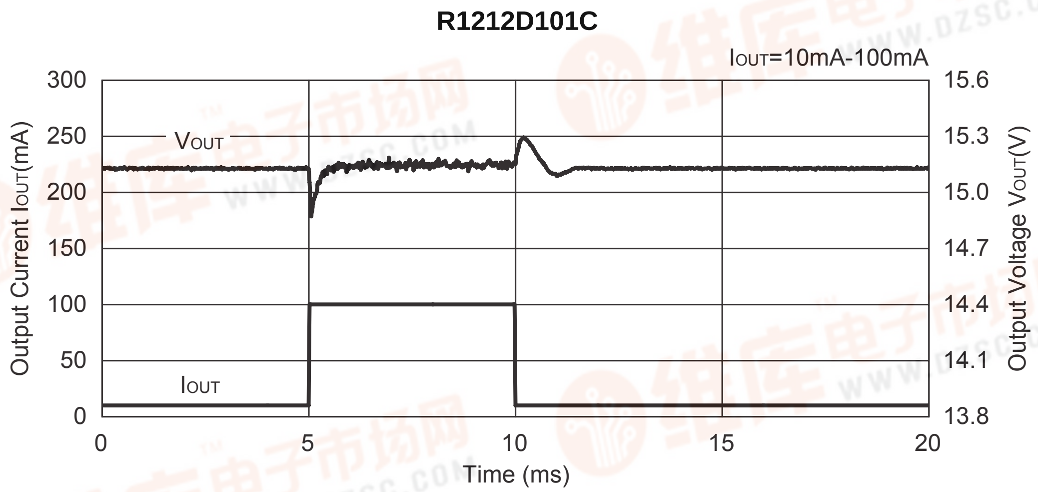


R1212D101C




R1212D101C
IOUT=10mA-100mA
VOUT
IOUT
Output Current IOUT(mA)
Output Voltage VOUT(V)
Time (ms)
0
5
10
15
20
0
50
100
150
200
250
300
9.2
9.4
9.6
9.8
10.0
10.2
10.4


R1212D101C
IOUT=1mA-30mA
VOUT
IOUT
Output Current IOUT(mA)
Output Voltage VOUT(V)
Time (ms)
0
5
10
15
20
0
50
100
150
200
250
300
13.8
14.1
14.4
14.7
15.0
15.3
15.6


R1212D101C
IOUT=10mA-100mA
VOUT
IOUT
Output Current IOUT(mA)
Output Voltage VOUT(V)
Time (ms)
0
5
10
15
20
0
50
100
150
200
250
300
13.8
14.1
14.4
14.7
15.0
15.3
15.6

1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to Ricoh sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without prior written consent of Ricoh.
3. Please be sure to take any necessary formalities under relevant laws or regulations before exporting or otherwise taking out of your country the products or the technical information described herein.
4. The technical information described in this document shows typical characteristics of and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under Ricoh's or any third party's intellectual property rights or any other rights.
5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death (aircraft, spacevehicle, nuclear reactor control system, traffic control system, automotive and transportation equipment, combustion equipment, safety devices, life support system etc.) should first contact us.
6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, firecontainment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. Anti-radiation design is not implemented in the products described in this document.
8. Please contact Ricoh sales representatives should you have any questions or comments concerning the products or the technical information.

RICOH COMPANY., LTD. Electronic Devices Company

■Ricoh presented with the Japan Management Quality Award for 1999.
Ricoh continually strives to promote customer satisfaction, and shares the achievements of its management quality improvement program with people and society.

日本経営品質賞 1999年度受賞

■Ricoh awarded ISO 14001 certification.
The Ricoh Group was awarded ISO 14001 certification, which is an international standard for environmental management systems, at both its domestic and overseas production facilities. Our current aim is to obtain ISO 14001 certification for all of our business offices.

RoHS Compliant

Ricoh completed the organization of the Lead-free production for all of our products. After Apr. 1, 2006, we will ship out the lead free products only. Thus, all products that will be shipped from now on comply with RoHS Directive.

http://www.ricoh.com/LSI/

RICOH COMPANY, LTD.
Electronic Devices Company
● Shin-Yokohama office (International Sales)
3-2-3, Shin-Yokohama, Kohoku-ku, Yokohama City, Kanagawa 222-8530, Japan
Phone: +81-45-477-1697 Fax: +81-45-477-1698

RICOH EUROPE (NETHERLANDS) B.V.
● Semiconductor Support Centre
Prof. W.H.Keesomlaan 1, 1183 DL Amstelveen, The Netherlands
P.O.Box 114, 1180 AC Amstelveen
Phone: +31-20-5474-309 Fax: +31-20-5474-791

RICOH ELECTRONIC DEVICES KOREA Co., Ltd.
11 floor, Haesung 1 building, 942, Daechidong, Gangnamgu, Seoul, Korea
Phone: +82-2-2135-5700 Fax: +82-2-2135-5705

RICOH ELECTRONIC DEVICES SHANGHAI Co., Ltd.
Room403, No.2 Building, 690#Bi Bo Road, Pu Dong New district, Shanghai 201203, People's Republic of China
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

RICOH COMPANY, LTD.
Electronic Devices Company
● Taipei office
Room109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623