RICOH

RP500x SERIES

NO.EA-155-070919

OUTLINE

The RP500X Series are CMOS-based step-down DC/DC Converters with synchronous rectifier.

Each of these ICs consists of an oscillator, a switching control circuit, a reference voltage unit, an error amplifier, a soft-start circuit, protection circuits, UVLO circuit, switching transistors, and so on. A low ripple, high efficiency step-down DC/DC converter can be easily composed of this IC with only an inductor and capacitors. In terms of the output voltage, since the feedback resistances are built-in, the voltage is fixed internally. 50mV(custom-made) step output can be set by laser-trim and 1.5% or 24mV tolerance depending on the output voltage is guaranteed.

Mode alternative circuit works automatically for improving the efficiency. Considering fixed noise frequency, PWM fixed control type is also available. As protection circuits, the current limit circuit which limits peak current of Lx at each clock cycle, and the latch type protection circuit which works if the term of the over-current condition keeps on a certain time exist. The latch-type protection circuit works to latch an internal driver with keeping it disable. To release the condition of the protection, after disabling this IC with a chip enable circuit, enable it again, or restart this IC with power-on or make the supply voltage at UVLO detector threshold level or lower than UVLO.

Since packages are PLP1820-6, SOT23-6, WLCSP-6 (0.16ϕ), high density mounting on boards is possible.

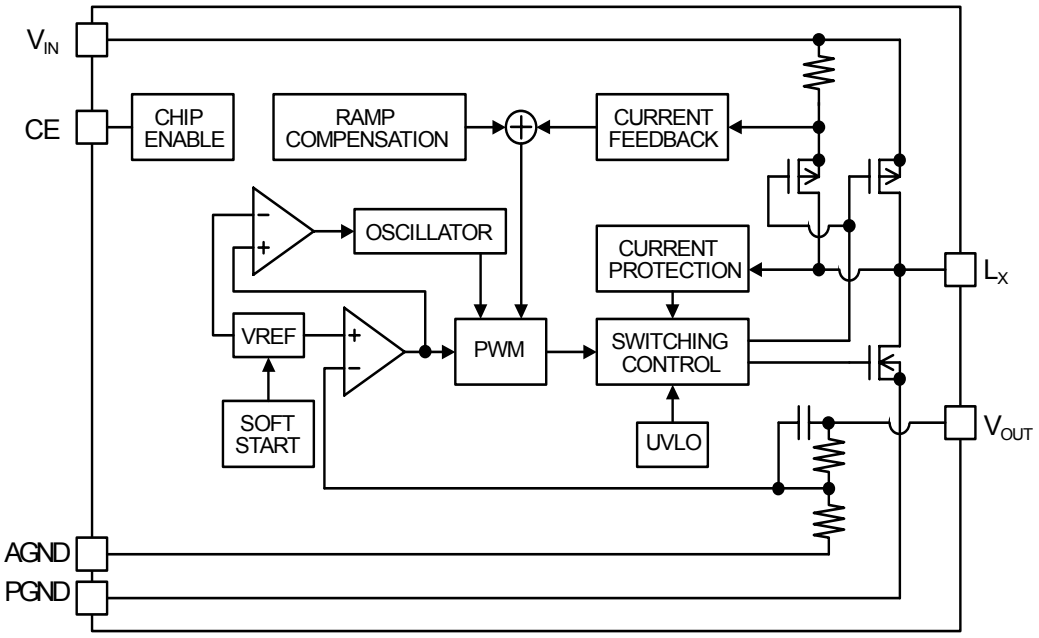
FEATURES

- Output Current..... Min. 400mA
- Input Voltage Range..... 2.55V to 5.50V
- Output Voltage..... 1.1V to 3.3V
- High Accuracy Output Voltage ..... ±1.5% (Vout≥1.6V)
  ±24mV (Vout<1.6V)
- Oscillator Frequency..... Typ. 1.2MHz/3.3MHz(We changed the product name of 3.3MHz device.)
- Built-in Soft start Function..... Typ.0.1ms
- Built-in Lx Peak Current Limit..... Typ. 900mA
- Built-in Latch type Protection..... Typ.1.5ms
- Built-in UVLO Function..... Typ. 2.2V
- Two choices of Switching Mode..... Automatic PWM/PFM mode change / PWM fixed
- Packages..... PLP1820-6, SOT23-6W, WLCSP-6 (0.16ϕ)

APPLICATIONS

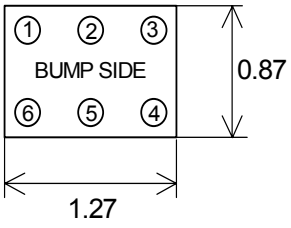
- Power source for portable equipment such as cellular, PDA, DSC, Notebook PC
- Power source for HDD
- Power source for Li-ion battery-used equipment

BLOCK DIAGRAM

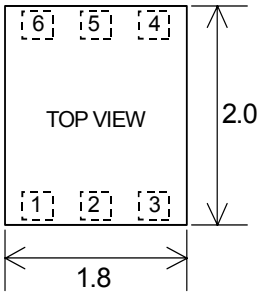


PIN CONFIGURATION

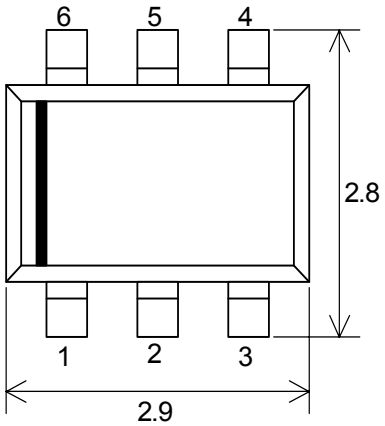
WL-CSP-6 (Under Development)



PLP-1820-6



SOT-23-6W



PIN DESCRIPTIONS

WLCSP-6 / SOT-23-6W

Pin No.	Symbol	Pin Description
1	V_{OUT}	Output
2	PGND	Ground
3	Lx	Lx Switching
4	V_{IN}	Voltage Supply
5	AGND	Ground
6	CE	Chip Enable (High Active)

PLP-1820-6

Pin No.	Symbol	Pin Description
1	CE	Chip Enable (High Active)
2	AGND	Ground
3	V_{IN}	Voltage Supply
4	Lx	Lx Switching
5	PGND	Ground
6	V_{OUT}	Output

ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Rating		Unit
Vin Supply Voltage	V_{IN}	6.5		V
Lx Pin Voltage	V_{LX}	-0.3 to V_{IN}+0.3		V
CE Pin Input Voltage	V_{CE}	-0.3 to V_{IN}+0.3		V
Vout Pin Voltage	V_{OUT}	-0.3 to V_{IN}+0.3		V
Lx Pin Output Current	I_{LX}	800		mA
Power Dissipation	P_D	PLP	880	mW
		SOT	430	
		WLCSP	T.B.D.	
Operating Temp. Range	Topt	-40 to 85		°C
Storage Temp. Range	Tstg	-55 to 125		°C

Selection Guide

In the RP500 series, output voltage, function options, etc. can be designated with user's request. Part number can be designated as follows:

RP500Xxxxx-xx ← Part Number
↑ ↑↑↑ ↑
a bcd e

Code	Contents
a	Designation of the package K: PLP-1820-6 N: SOT-23-6W Z: WL-CSP-6 (Under Development)
b	Designation of output voltage Designation is possible in the range from 1.1V to 3.3V with a step of 0.1V
c	Designation of the function (with or without PWM/PFM Alternative function, auto discharge function) 1:with PWM/PFM alternative, without auto discharge 2:without PWM/PFM alternative, without auto discharge 4:without PWM/PFM alternative function, with auto discharge function
d	Frequency A: 1.2MHz
e	Designation of the taping type: (-TR is the standard.)

* 0.05V step is also available as a custom code.

ELECTRICAL CHARACTERISTICS

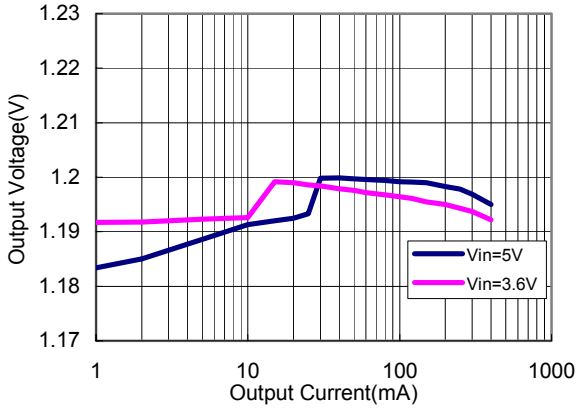
Symbol	Item	Condition	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		2.55		5.50	V
V_{OUT}	Step-down Output Voltage	V_{IN}=V_{CE}=3.6V or V_{SET}+1V VOUT≥1.6V VOUT<1.6V	 -1.5% -0.024		 +1.5% 0.024	V
$\Delta V_{OUT}/\Delta T$	Step-down Output Voltage Temperature Coefficient	-40°C≤T_{OPT}≤85°C		±100		ppm/°C
F_{OSC}	Oscillator Frequency	V_{IN}=V_{CE}=3.6V or V_{SET}+1V	-20%	1.2	+20%	MHz
ISS1	Supply Current 1	V_{IN}=V_{CE}=5.5V,V_{OUT}=0		400	500	µA
ISS2	Supply Current 2	V_{IN}=V_{CE}=5.5V,V_{OUT}=5.5V		100	160	µA
ISTB	Standby Current	V_{IN}=5.5V,V_{CE}=0V		0	5	µA
I_{CEH}	CE "H" Input Current	V_{IN}=V_{CE}=5.5V	-1	0	1	µA
I_{CEL}	CE "L" Input Current	V_{IN}=5.5V,V_{CE}=0V	-1	0	1	µA
I_{VOUTH}	VOUT "H" Input Current	V_{IN}=V_{OUT}=5.5V,V_{CE}=0V	-1	0	1	µA
I_{VOUTL}	VOUT "L" Input Current	V_{IN}=5.5V,V_{CE}=V_{OUT}=0V	-1	0	1	µA
$I_{LXLEAKH}$	Lx Leakage Current "H"	V_{IN}=V_{Lx}=5.5V,V_{CE}=0V	-1	0	5	µA
$I_{LXLEAKL}$	Lx Leakage Current "L"	V_{IN}=5.5V,V_{CE}=V_{Lx}=0V	-5	0	1	µA
V_{CEH}	CE "H" Input Voltage	V_{IN}=5.5V	1.0			V
V_{CEL}	CE "L" Input Voltage	V_{IN}=5.5V			0.4	V
R_{ONP}	On Resistance of Pch Tr.	I_{Lx}=-100mA		0.5		Ω
R_{ONN}	On Resistance of Nch Tr.	I_{Lx}=-100mA		0.5		Ω
Maxdty	Max Duty Ratio		100			%
T_{START}	Soft-start Time	V_{IN}=V_{CE}=3.6V or V_{SET}+1V		120	150	µs
I_{LXLIM}	Lx Current Limit	V_{IN}=V_{CE}=3.6V or V_{SET}+1V	600	900		mA
T_{PROT}	Protection Delay Time	V_{IN}=V_{CE}=3.6V or V_{SET}+1V	0.5	1.5	5.0	ms
V_{UVLO1}	UVLO Detector Voltage	V_{IN}=V_{CE}	2.1	2.2	2.3	V
V_{UVLO2}	UVLO Released Voltage	V_{IN}=V_{CE}	2.2	2.3	2.4	V

*) Test circuit is "OPEN LOOP" and V_{IN}=V_{CE}=3.6V or V_{SET}+1V, AGND=PGND=0V unless otherwise noted.

TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

RP500X121A



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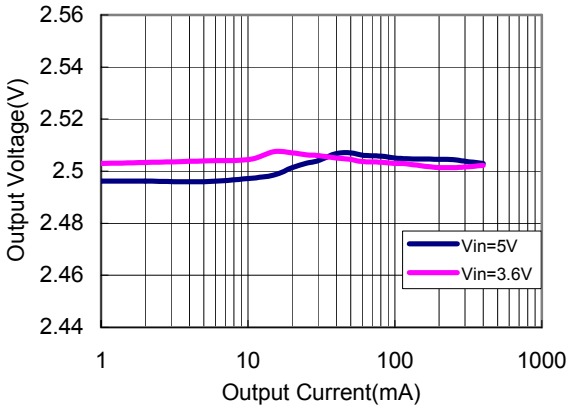

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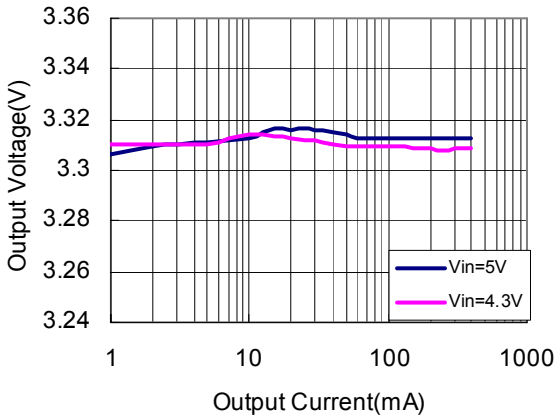

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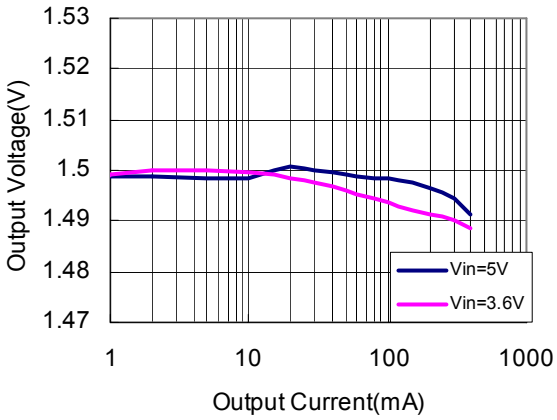
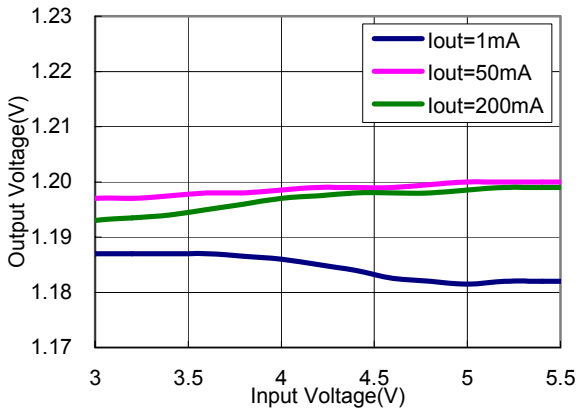


2) Output Voltage vs. Input Voltage

RP500X121A



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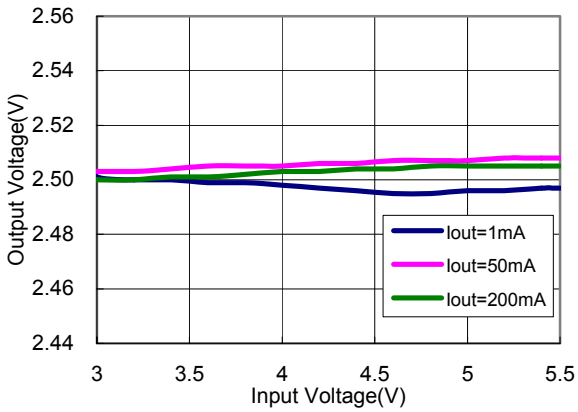

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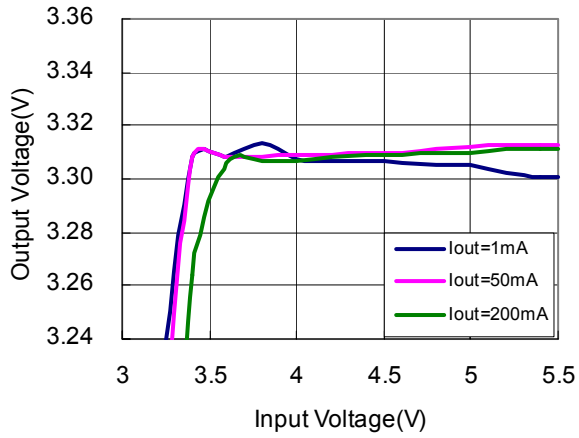

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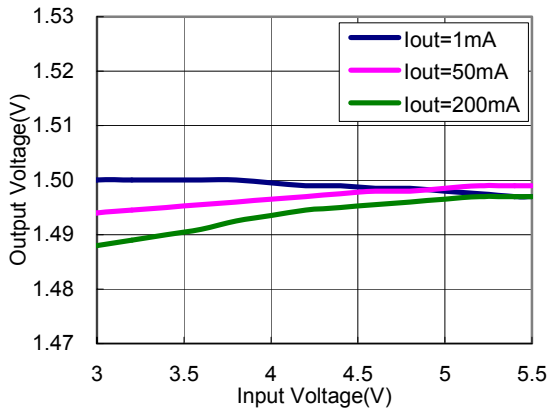
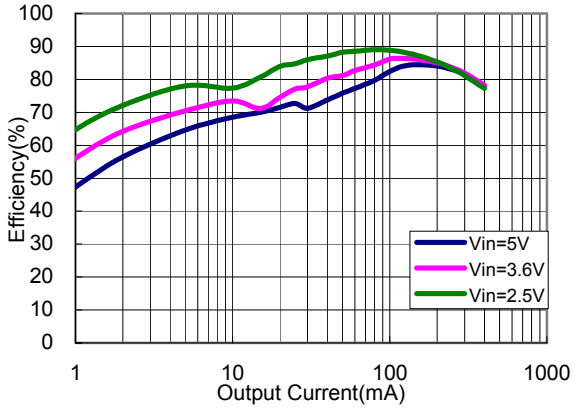


3) Efficiency vs. Output Current

RP500X121A



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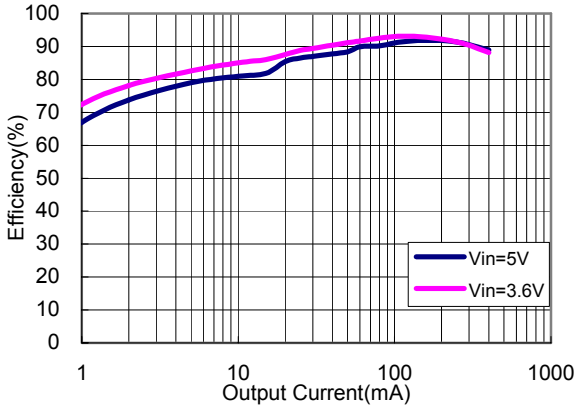

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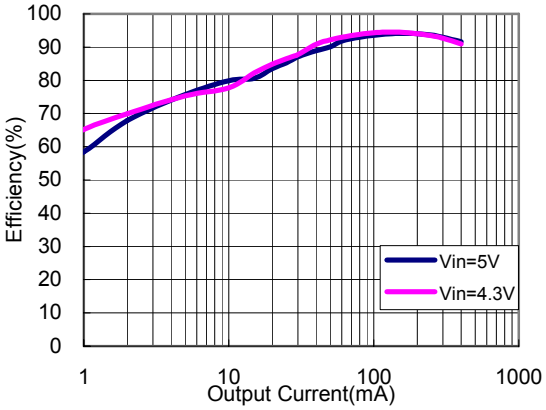

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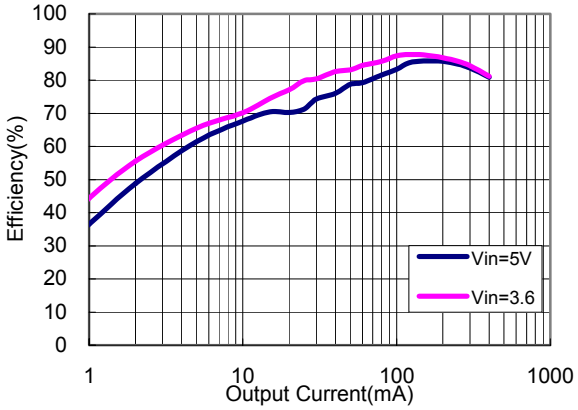
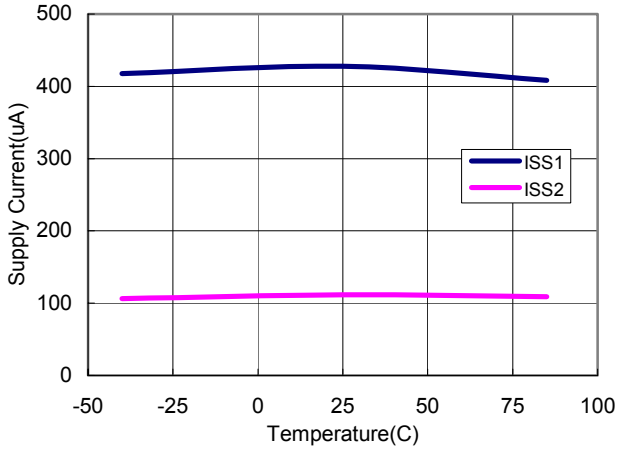


4) Supply Current 1, 2 vs. Temperature

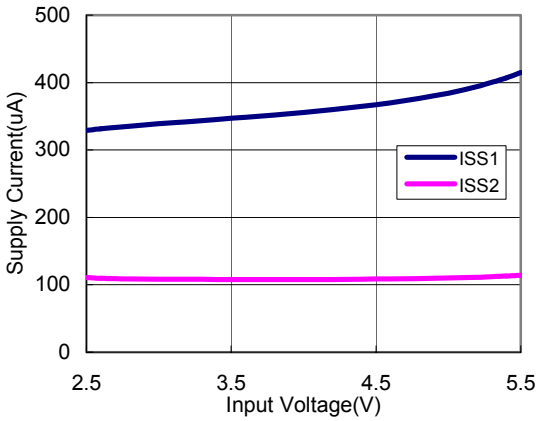
RP500X151A

V_{IN}=V_{CE}=5.5V



5) Supply Current 1,2 vs. Input Voltage

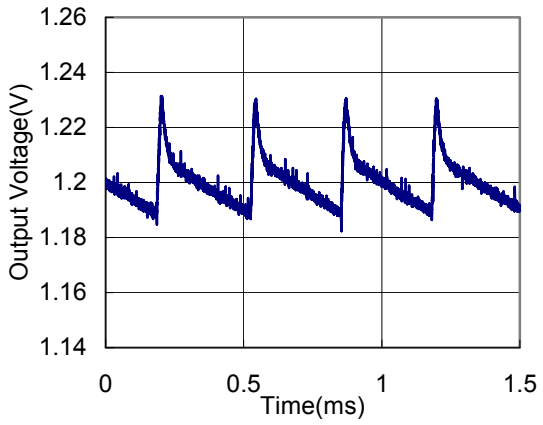
RP500X151A



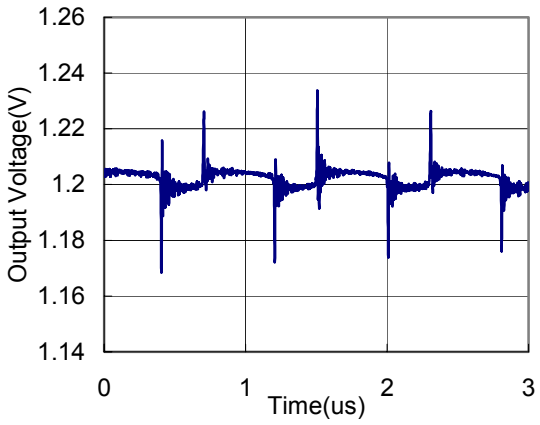
6) DC/DC Output Waveform

RP500X121A C_{IN}=C_{OUT}=Ceramic10uF, L=4.7uH

I_{OUT}=1mA

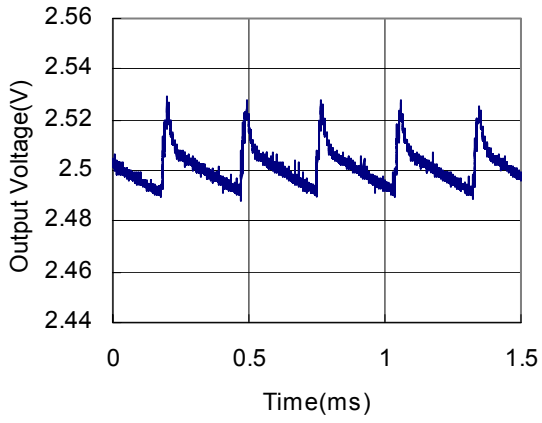


I_{OUT}=200mA

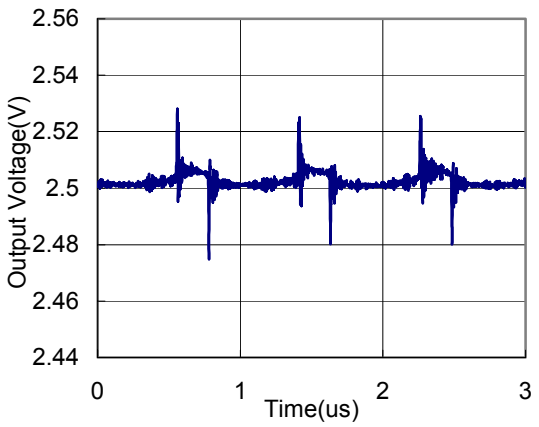


RP500X251A C_{IN}=C_{OUT}=Ceramic10uF, L=4.7uH

I_{OUT}=1mA

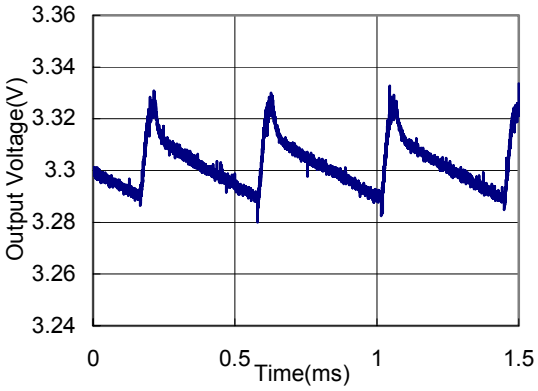


I_{OUT}=200mA

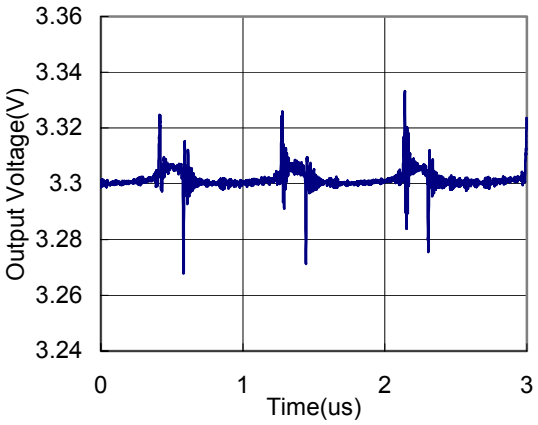


RP500X331A CIN=COUT=Ceramic10uF, L=4.7uH

IOUT=1mA

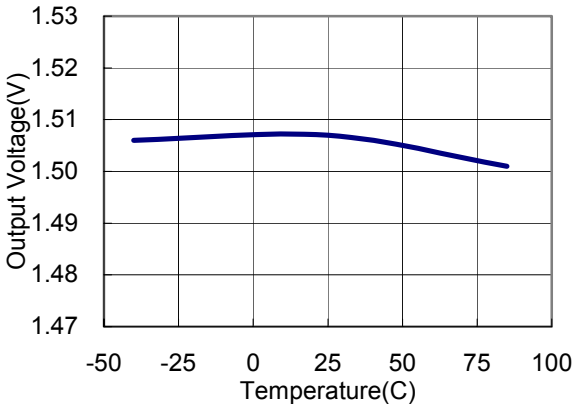


IOUT=200mA



7) Output Voltage vs. Temperature

RP500X151A



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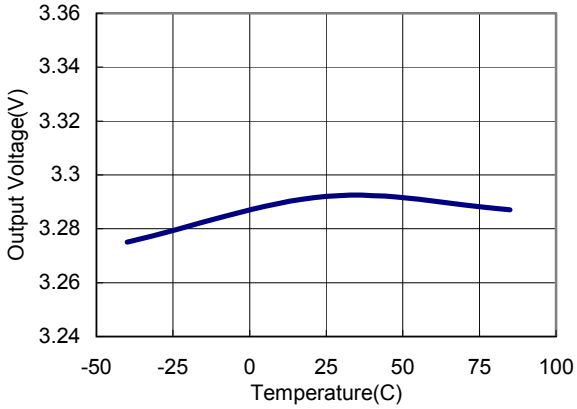
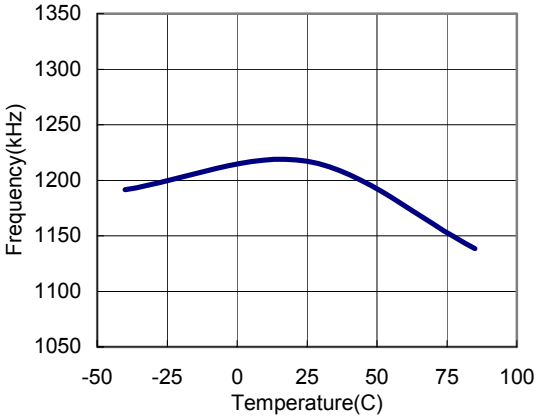
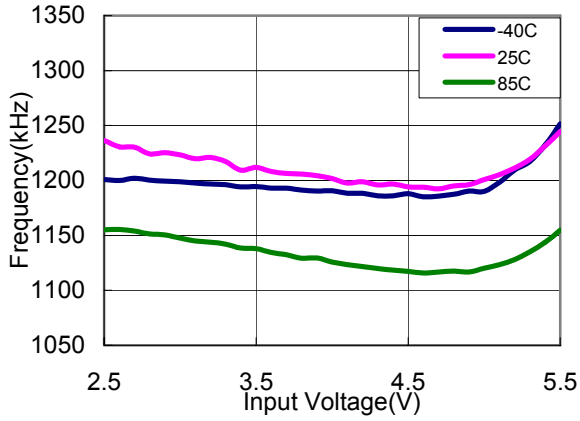


8) Oscillator Frequency vs. Temperature

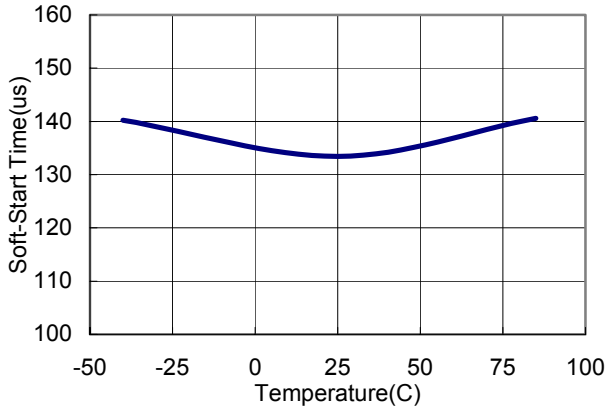
VIN=3.6V



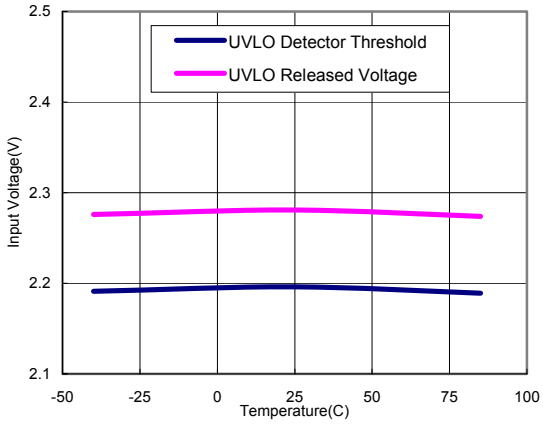
9) Oscillator Frequency vs. Input Voltage



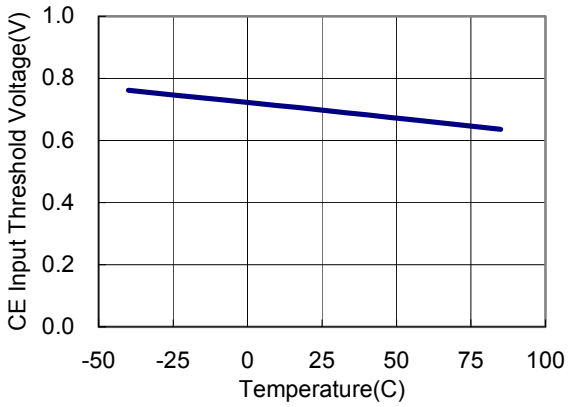
10) Soft-start Time vs. Temperature



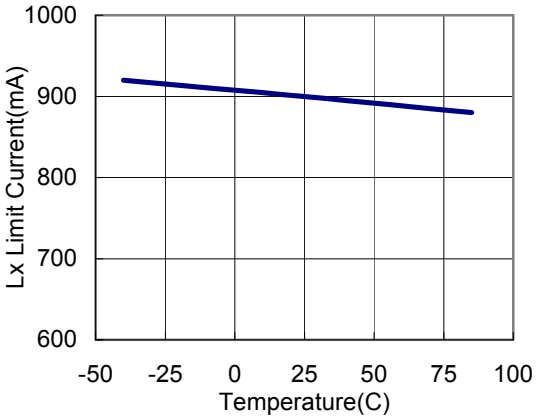
11) UVLO Detector threshold/Released Voltage vs. Temperature



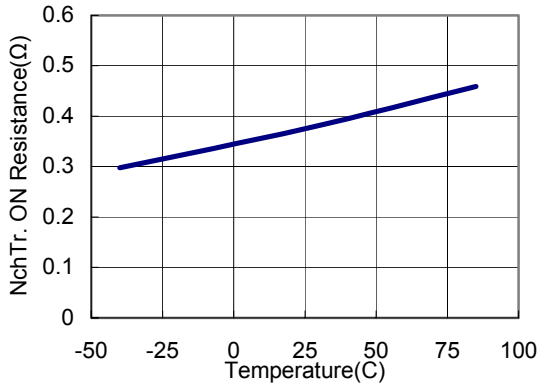
12) CE Input Threshold Voltage vs. Temperature



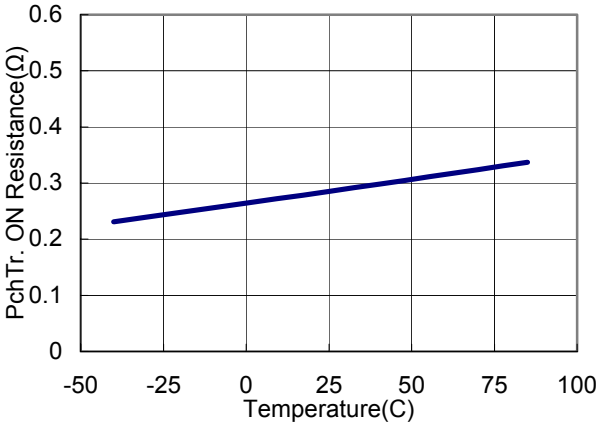
13) Lx Current Limit vs. Temperature



14) Nch Transistor On Resistance vs. Temperature



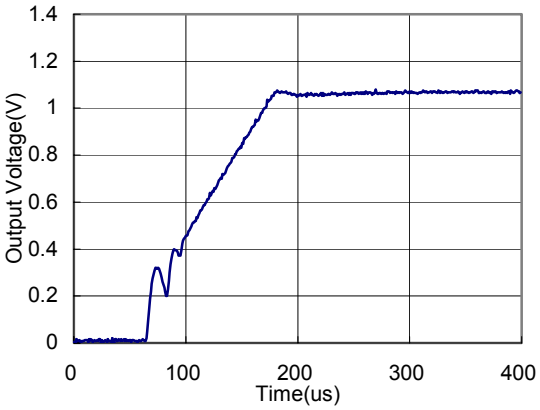
15) Pch Transistor On Resistance vs. Temperature



16) Turn-on Waveform

CIN=COUT=Ceramic10uF, L=4.7uH

RP500X111A



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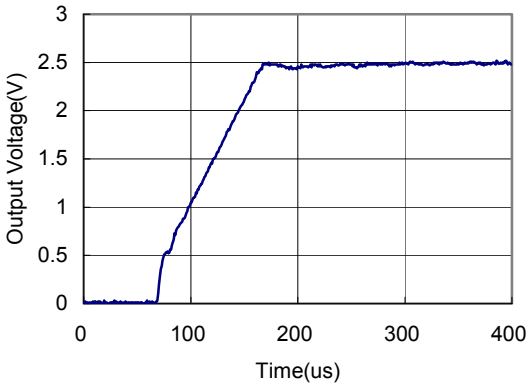

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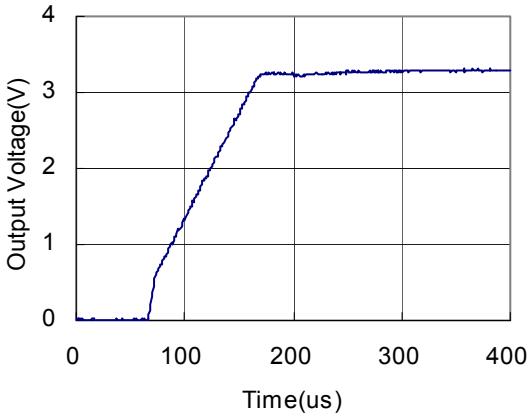

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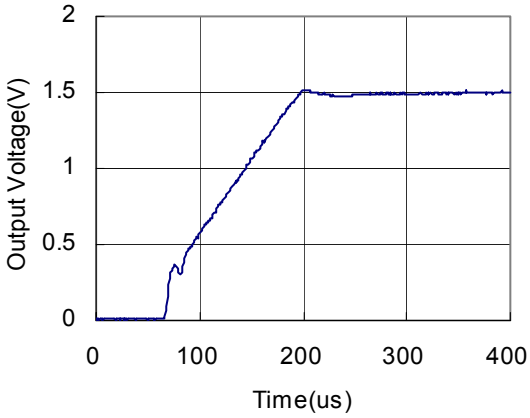
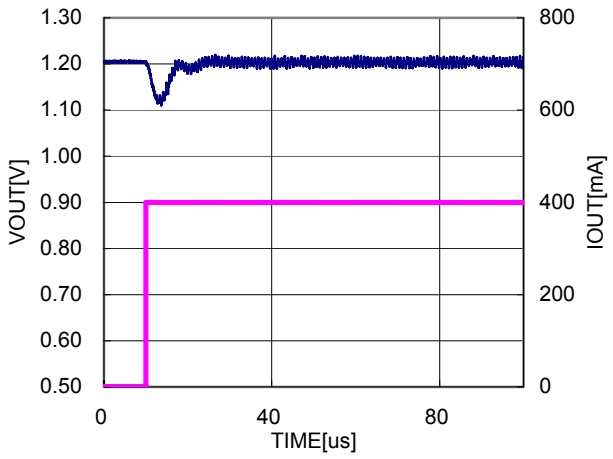


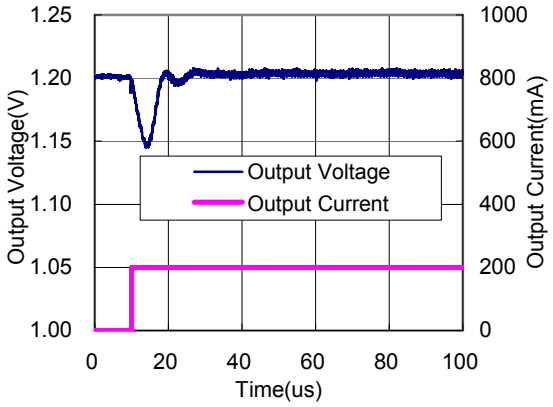
17) Load Transient Response (Tr=Tf=1us)

RP500X121X Vin=3.6V, Iout=0mA to 400mA

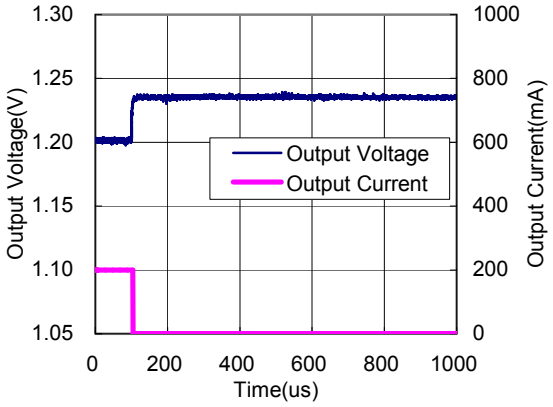


RP500X121A C_{IN}=C_{OUT}=Ceramic10uF, L=4.7uH,V_{IN}=3.6V

I_{OUT}=0mA to 200mA

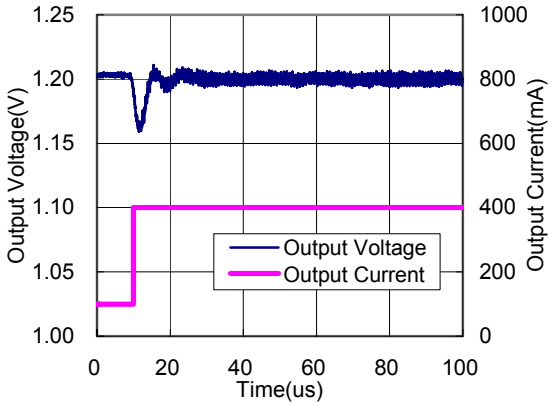


I_{OUT}=200mA to 0mA

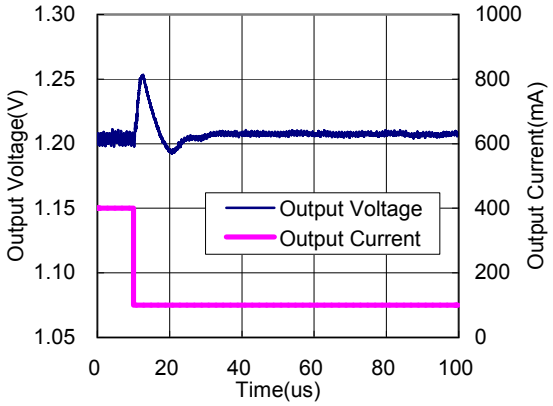


RP500X121A C_{IN}=C_{OUT}=Ceramic10uF, L=4.7uH,V_{IN}=3.6V

I_{OUT}=100mA to 400mA

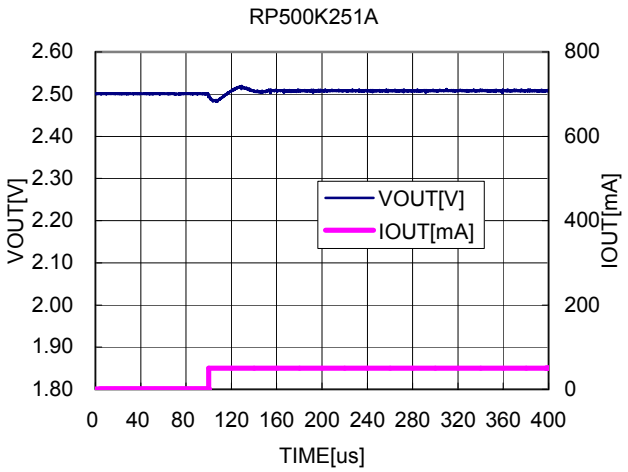


I_{OUT}=400mA to 100mA



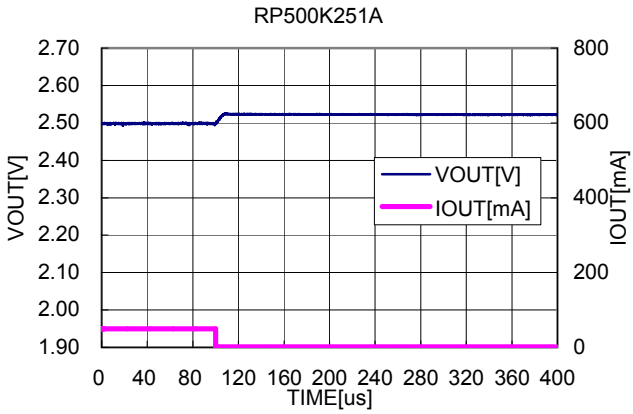
RP500X251X Vin=5V, Iout=0 to 50mA

RP500K251A

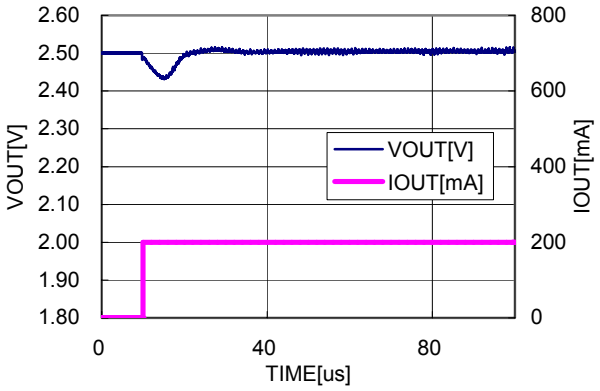


RP500X251X Vin=5V, Iout=50mA to 0mA

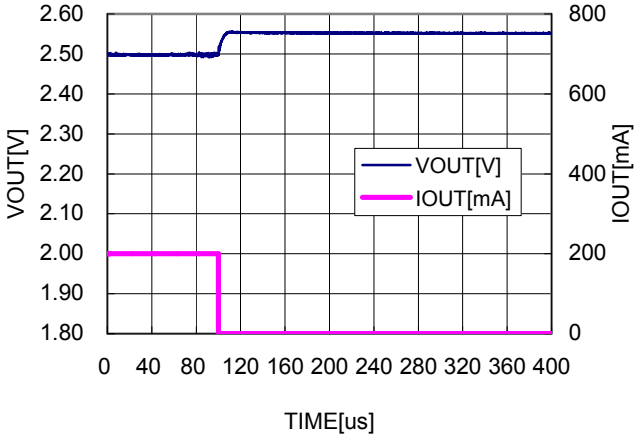
RP500K251A



RP500X251X Vin=5V, Iout=0 to 200mA

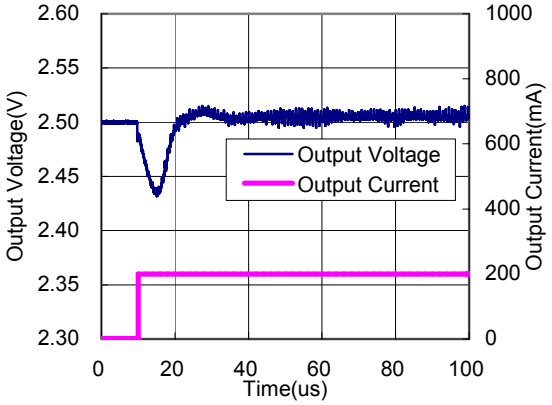


RP500X251X Vin=5V, Iout=200mA to 0mA

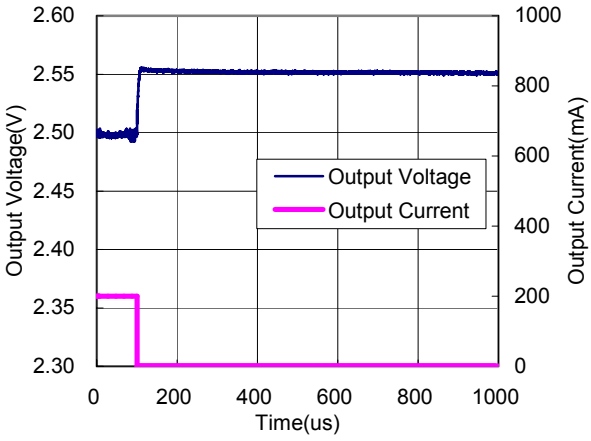


RP500X251A CIN=COUT=Ceramic10uF, L=4.7uH,VIN=5.0 V

IOUT=0mA to 200mA

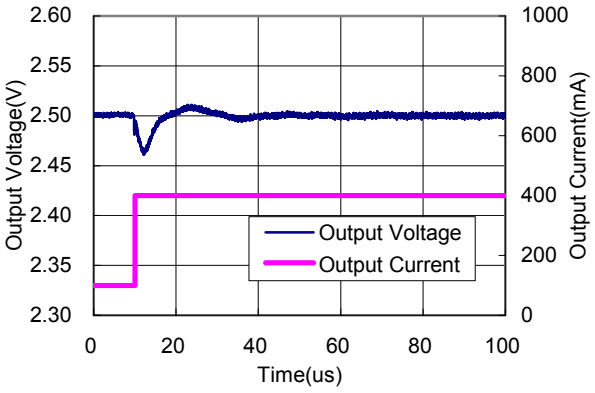


IOUT=200mA to 0mA

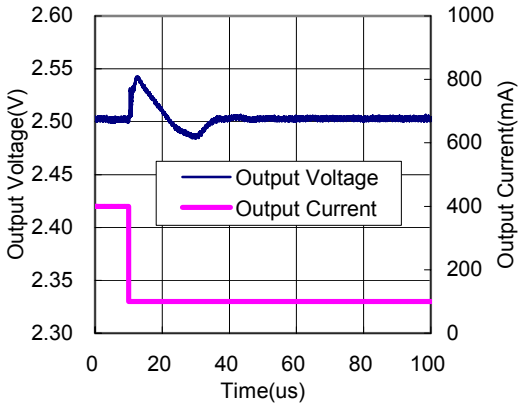


RP500X251A CIN=COUT=Ceramic10uF, L=4.7uH,VIN=5.0 V

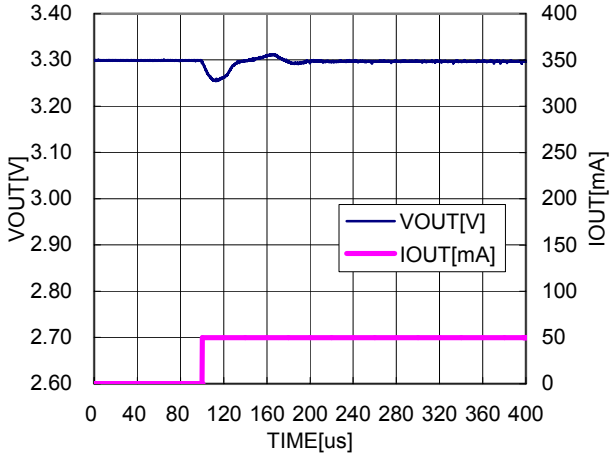
IOUT=100mA to 400mA



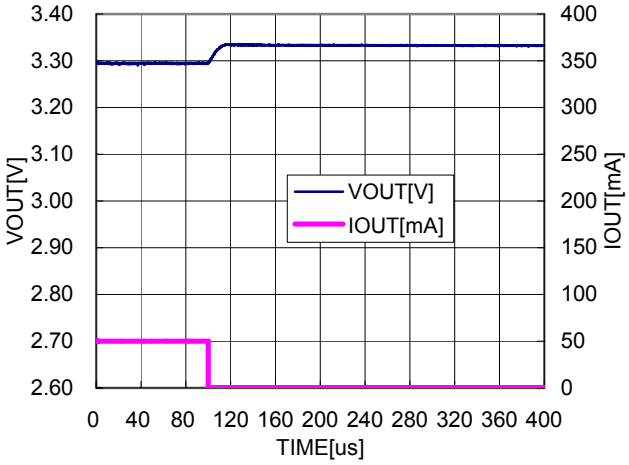
IOUT=400mA to 100mA



RP500X331X Vin=5V, Iout=0mA to 50mA

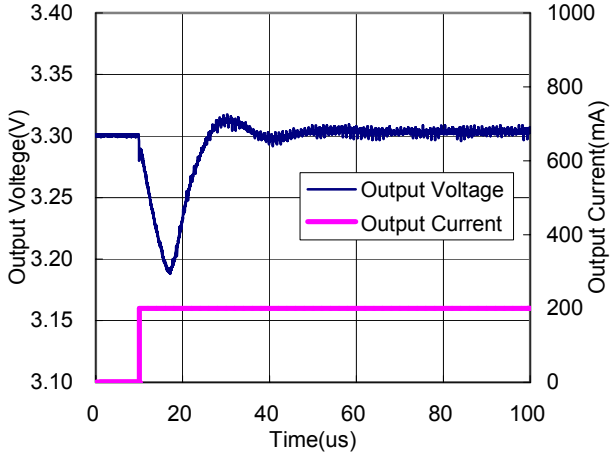


RP500X331X Vin=5V, Iout=50mA to 0mA

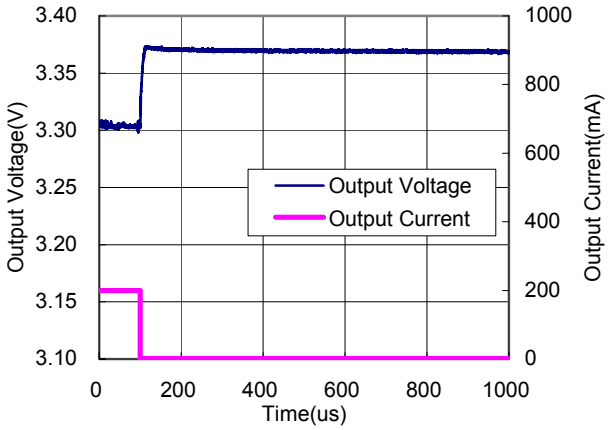


RP500X331A C_{IN}=C_{OUT}=Ceramic10uF, L=4.7uH,V_{IN}=5.0 V

I_{OUT}=0mA to 200mA

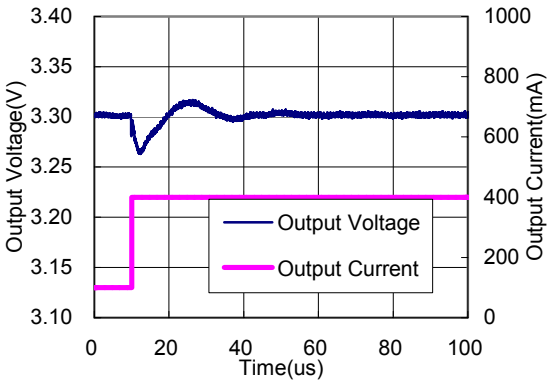


I_{OUT}=200mA to 0mA

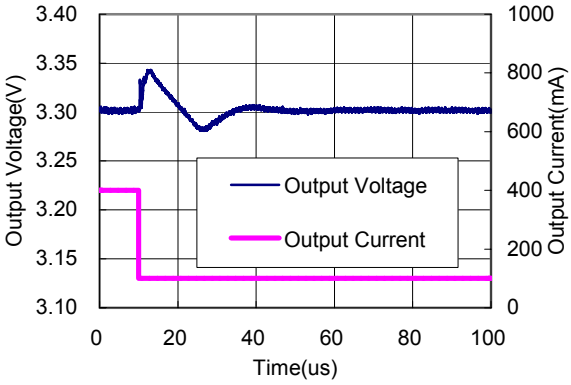


RP500X331A CIN=COUT=Ceramic10uF, L=4.7uH,VIN=5.0 V

I_{OUT}=100mA to 400mA

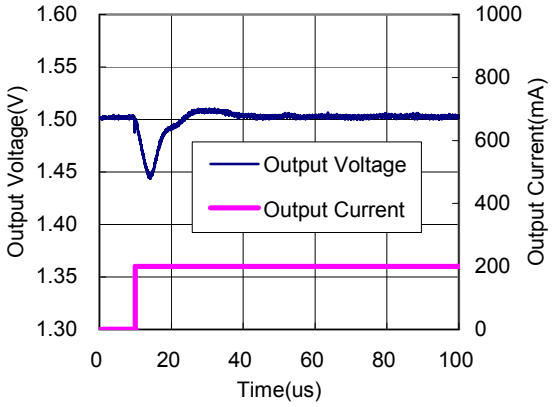


I_{OUT}=400mA to 100mA

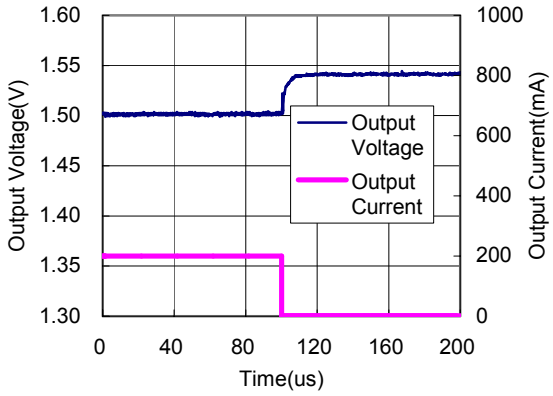


RP500X152A CIN=COUT=Ceramic10uF, L=4.7uH,VIN=3.6V

IOUT=0mA to 200mA

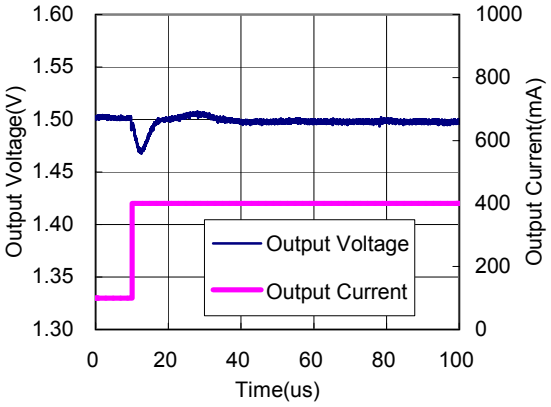


IOUT=200mA to 0mA

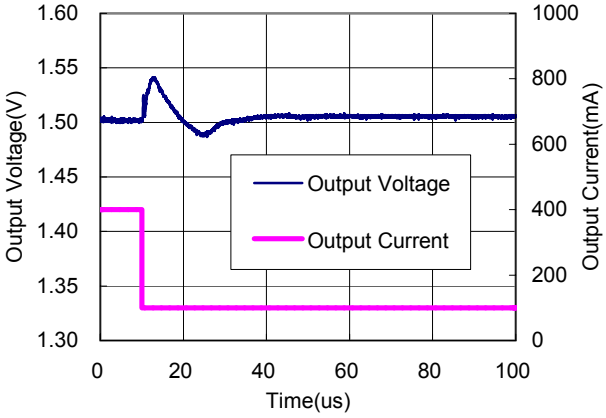


RP500X152A CIN=COUT=Ceramic10uF, L=4.7uH,VIN=3.6V

IOUT=100mA to 400mA



IOUT=400mA to 100mA



TYPICAL APPLICATION

External Components

CIN	10 µF (Ceramic)
COUT	10µF (for 1.2MHz type)
L	4.7µH (for 1.2MHz type)