PWM/VFM step-down DC/DC Converter

R1225N SERIES

NO. EA-097-0212

OUTLINE

The R1225N Series are CMOS-based PWM step-down DC/DC Converter controllers with low supply current.

Each of these ICs consists of an oscillator, a PWM control circuit, a reference voltage unit, an error amplifier, a soft-start circuit, a latch-type protection circuit, a PWM/VFM alternative circuit, a chip enable circuit, a phase compensation circuit, and an input voltage detect circuit. Further, protection circuit delay time adjuster circuit, and resistors for voltage detection are included. A low ripple, high efficiency step-down DC/DC converter can be easily composed of this IC with some external components, or a power-transistor, an inductor, a diode and capacitors.

With a PWM/VFM alternative circuit, when the load current is small, the operation is automatically switching into the VFM oscillator from PWM oscillator, therefore the efficiency at small load current is improved. The R1225NxxxC/D/K types, which are without a PWM/VFM alternative circuit, are also available.

If the term of maximum duty cycle keeps on a certain time, the embedded protection circuit works. It is latch-type protection circuit, and it works to latch an external Power MOSFET with keeping it off. To release the condition of protection, after disable this IC with a chip enable circuit, enable it again, or restart this IC with power-on. Delay Time for protection circuit is adjustable with an external capacitor. With a built-in UVLO function, when the input voltage is UVLO threshold or less, this IC keeps standby state, and saves its consumption current and avoids miss-operation. Further, if the set output voltage is equal or more than 2.1V, with a built-in start-up function, at the power-on moment until the input voltage becomes more than the set output voltage, DC/DC operation is halted and avoids miss-operation.

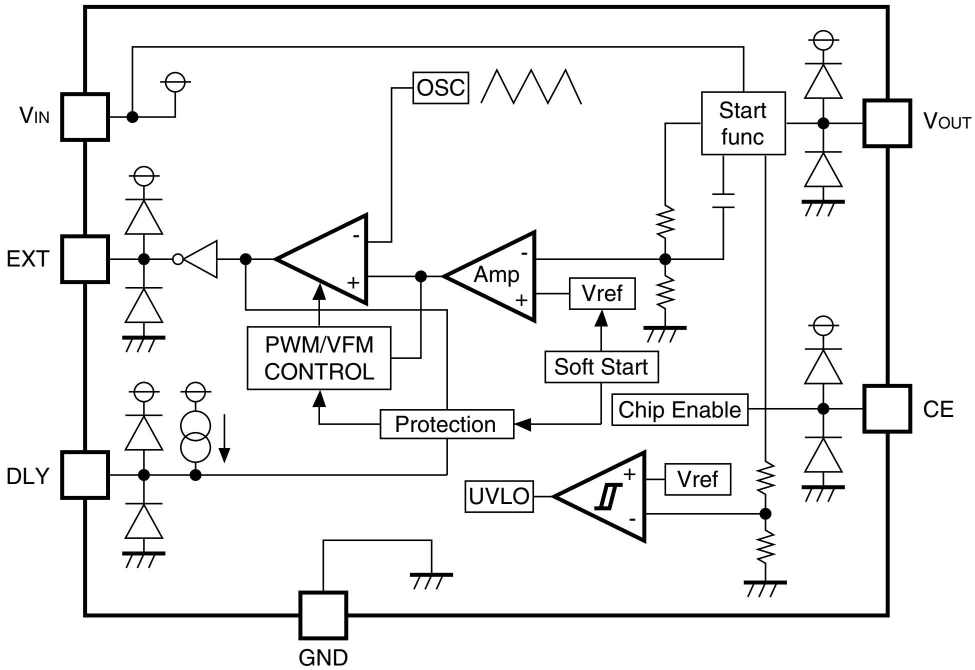
FEATURES

- Wide Range of Input Voltage..2.3V~18.5V
- Built-in Soft-start Function and Latch-type Protection Function
- Three options of Oscillator Frequency..................................180kHz, 300kHz, 500kHz
- High Efficiency ....Typ. 90%
- Output Voltage..Stepwise Setting with a step of 0.1V in the range of 1.2V ~ 6.0V
- Standby Current ....Typ. 0.0μA
- High Accuracy Output Voltage ....±2.0%
- Low Temperature-Drift Coefficient of Output Voltage..........Typ. ±100ppm/°C

APPLICATIONS

- Power source for hand-held communication equipment, cameras, video instruments such as VCRs, camcorders.
- Power source for battery-powered equipment.
- Power source for household electrical appliances.

BLOCK DIAGRAM



SELECTION GUIDE

In the R1225N Series, the output voltage, the oscillator frequency, the optional function, and the taping type for the ICs can be selected at the user's request.

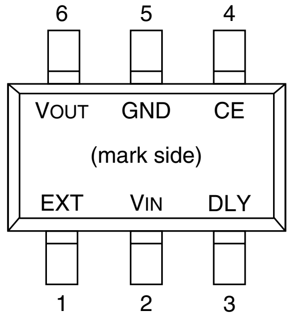
The selection can be made with designating the part number as shown below;

R1225Nxx2x-TR ←Part Number
↑↑↑ ↑
a bc d

Code	Contents
a	Setting Output Voltage(V_{OUT}): Stepwise setting with a step of 0.1V in the range of 1.2V to 6.0V is possible.
b	Designation of Oscillator Frequency 2: fixed
c	Designation of Optional Function A : 300kHz, with a PWM/VFM alternative circuit B : 500kHz, with a PWM/VFM alternative circuit C : 300kHz, without a PWM/VFM alternative circuit D : 500kHz, without a PWM/VFM alternative circuit J : 180kHz, with a PWM/VFM alternative circuit K : 180kHz, without a PWM/VFM alternative circuit
d	Designation of Taping Type: Refer to Taping specification. “TR” is prescribed as a standard.

PIN CONFIGURATION

SOT-23-6W



PIN DESCRIPTION

Pin No.	Symbol	Description
1	EXT	External Transistor Drive Pin (CMOS Output Type)
2	V_{IN}	Power Supply Pin
3	DLY	Pin for Setting External Capacitor for Protection Circuit Delay Time
4	CE	Chip Enable Pin (Active "H")
5	GND	Ground Pin
6	V_{OUT}	Pin for Monitoring Output Voltage

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	V_{IN} Supply Voltage	20	V
V_{EXT}	EXT Pin Output Voltage	-0.3~V_{IN}+0.3	V
V_{CE}	CE Pin Input Voltage	-0.3~V_{IN}+0.3	V
V_{OUT}	V_{OUT} Pin Input Voltage	-0.3~V_{IN}+0.3	V
V_{DLY}	V_{DLY} Pin Input Voltage	-0.3~+1.0	V
I_{EXT}	EXT Pin Inductor Drive Output Current	±50	mA
I_{DLY}	DLY Pin Output Current	±15	mA
P_D	Power Dissipation	250	mW
Topt	Operating Temperature Range	-40~+85	°C
Tstg	Storage Temperature Range	-55~+125	°C

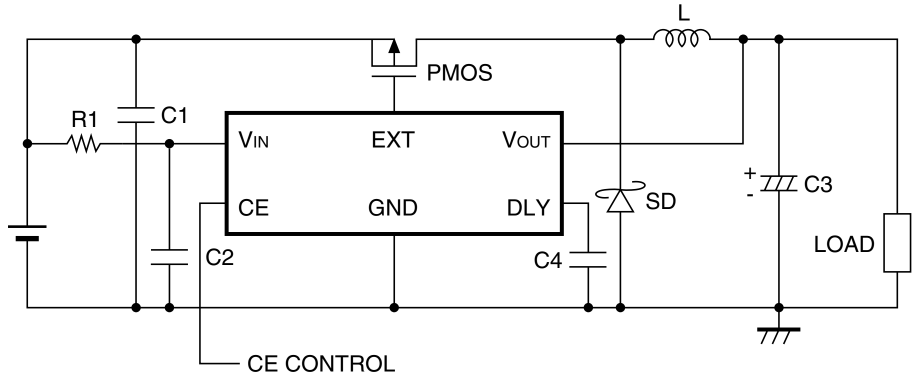
ELECTRICAL CHARACTERISTICS

- **R1225Nxx2X (X=A/B/C/D/J/K)**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		2.3		18.5	V
V_{OUT}	Step-down Output Voltage	$V_{IN}=V_{CE}+V_{SET}+1.5V$, $I_{OUT}=-100mA$ When $V_{SET} \leq 1.5V$, $V_{IN}=V_{CE}=3.0V$	$V_{SET}\times$ 0.98	V_{SET}	$V_{SET}\times$ 1.02	V
$\Delta V_{OUT}/\Delta T$	Step-down Output Voltage Temperature Coefficient	-40°C ≤ Topt ≤ 85°C		±100		ppm/°C
fosc	Oscillator Frequency	$V_{IN}=V_{CE}=V_{SET}+1.5V$, $I_{OUT}=-100mA$ When $V_{SET} \leq 1.5V$, $V_{IN}=V_{CE}=3.0V$ J/K version A/C version B/D version	 144 240 400	 180 300 500	 216 360 600	kHz
$\Delta f_{OSC}/\Delta T$	Oscillator Frequency Temperature Coefficient	-40°C ≤ Topt ≤ 85°C		±0.2		%/°C
I_{DD1}	Supply Current 1	$V_{IN}=V_{CE}=V_{OUT}=18.5V$ A/B/J/K version C version D version		 20 30 40	 50 60 80	μA
Istb	Standby Current	$V_{IN}=18.5V$, $V_{CE}=0V$, $V_{OUT}=0V$		0.0	0.5	μA
I_{EXTH}	EXT "H" Output Current	$V_{IN}=8V$, $V_{EXT}=7.9V$, $V_{OUT}=8V$, $V_{CE}=8V$		-17	-10	mA
I_{EXTL}	EXT "L" Output Current	$V_{IN}=8V$, $V_{EXT}=0.1V$, $V_{OUT}=0V$, $V_{CE}=8V$	20	30		mA
I_{SW}	DLY switch current	$V_{IN}=2.3V$, $V_{CE}=0V$, $V_{DLY}=0.1V$	1.0	2.0		mA
I_{CEH}	CE "H" Input Current	$V_{IN}=V_{CE}=V_{OUT}=18.5V$		0.0	0.5	μA
I_{CEL}	CE "L" Input Current	$V_{IN}=V_{OUT}=18.5V$, $V_{CE}=0V$	-0.5	0.0		μA
V_{CEH}	CE "H" Input Voltage	$V_{IN}=8V$, $V_{OUT}=0V$	1.5			V
V_{CEL}	CE "L" Input Voltage	$V_{IN}=8V$, $V_{OUT}=0V$			0.3	V
Maxdty	Oscillator Maximum Duty Cycle		100			%
VFMdty	VFM Duty Cycle	A/B/J version		35		%
$V_{UVLO}1$	UVLO Voltage	$V_{IN}=V_{CE}=2.5V$ to $1.5V$, $V_{OUT}=0V$	1.8	2.0	2.2	V
$V_{UVLO}2$	UVLO Release Voltage	$V_{IN}=V_{CE}=1.5V$ to $2.5V$, $V_{OUT}=0V$		$V_{UVLO}1$ +0.1	2.3	V
Tstart	Delay Time by Soft-Start function	$V_{IN}=V_{SET}+1.5V$, $I_{OUT}=-10mA$ $V_{CE}=0V \rightarrow V_{SET}+1.5V$	5	10	20	ms
Tprot	Delay Time for protection circuit	$V_{IN}=V_{CE}=V_{SET}+1.5V$ $V_{OUT}=V_{SET}+1.5V \rightarrow 0V$	10	20	35	ms

TYPICAL APPLICATION AND APPLICATION HINTS



PMOS : HAT1044M (Hitachi)	L : CR105-270MC (Sumida, 27μH)	
SD1 : RB063L-30 (Rohm)	C3 : 47μF (Tantalum Type)	
C1 : 10μF (Ceramic Capacitor)	C2 : 0.1μF (Ceramic Capacitor)	C4: 20nF(Ceramic Capacitor)
R1 : 10Ω		

When you use these ICs, consider the following issues;

- As shown in the block diagram, a parasitic diode is formed in each terminal, each of these diodes is not formed for load current, therefore do not use it in such a way. When you control the CE pin by another power supply, do not make its "H" level more than the voltage level of V_{IN} pin.

- The operation of Latch-type protection circuit is as follows;
  When the maximum duty cycle continues longer than the delay time for protection circuit, (Refer to the Electrical Characteristics) the protection circuit works to shutdown Power MOSFET with latching operation. Therefore when an input/output voltage difference is small, the protection circuit may work with small load current.
  To release the protection of latch status, after disable this IC with a chip enable circuit, enable it again, or restart this IC with power-on. However, in the case of restarting this IC with power-on, after the power supply is turned off, if a certain amount of charge remains in C_{IN}, or some voltage is forced to V_{IN} from C_{IN}, this IC might not be restarted even after power-on.

- Set external components as close as possible to the IC and minimize the connection between the components and the IC. In particular, a capacitor should be connected to V_{OUT} pin with the minimum connection. Make grounding sufficient and reinforce supplying. Large switching current flows through the connection of power line, an inductor and the connection of V_{OUT}. If the impedance of the connection of power supply is high, the voltage level of power supply of the IC fluctuates with the switching current. This may cause unstable operation of the IC.

- Use capacitors with a capacity of 22μF or more for V_{OUT} pin, and with good high frequency characteristics such as tantalum capacitors. We recommend to use capacitors with an allowable voltage which is at least twice as much as setting output voltage, in terms of the input capacitors, its voltage rating is twice or more than input voltage. This is because there may be a case where a spike-shaped high voltage is generated by an inductor when an external transistor is on and off.

- Choose an inductor that has sufficiently small D.C. resistance and large allowable current and is hard to reach magnetic saturation. If the value of inductance of an inductor is extremely small, the I_{LX} may exceed the absolute maximum rating at the maximum loading.
  Use an inductor with appropriate inductance.

- Use a diode of a Schottky type with high switching speed, and also pay attention to its current capacity.

- Do not use this IC under the condition with V_{IN} voltage at equal or less than minimum operating voltage.

- When the threshold level of an external power MOSFET is rather low and the drive-ability of voltage supplier is small, if the output pin is short circuit, input voltage may be equal or less than UVLO detector threshold. In this case, the devise is reset with UVLO function that is not the latch-protection function.

- With the PWM/VFM alternative circuit, when the on duty cycle of switching is 35% or less, the R1225N alters from PWM mode to VFM mode (Pulse skip mode). The purpose of this circuit is raising the efficiency with a light load by skipping the frequency and suppressing the consumption current. However, the ratio of output voltage against input voltage is 35% or less, (ex. $V_{IN}>8.6V$ and $V_{OUT}=3.0V$) even if the large current may be loaded, the IC keeps its VFM mode. As a result, frequency might be decreased, and oscillation waveform might be unstable. These phenomena are the typical characteristics of the IC with PWM/VFM alternative circuit.

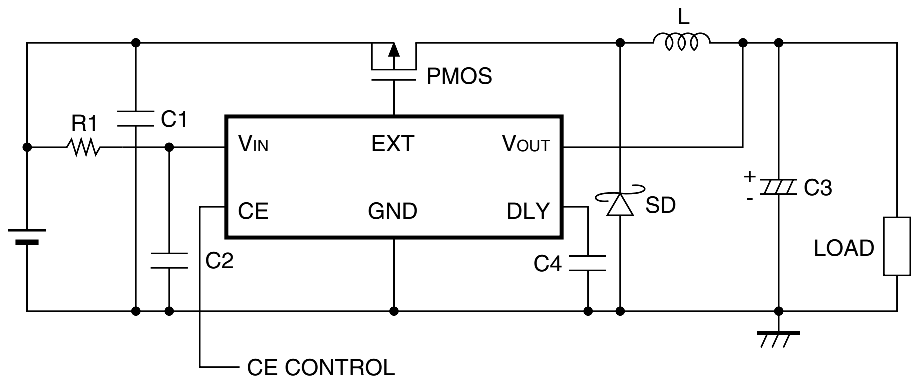
✰ The performance of power source circuits using these ICs extremely depends upon the peripheral circuits.
Pay attention in the selection of the peripheral circuits. In particular, design the peripheral circuits in a way that the values such as voltage, current, and power of each component, PCB patterns and the IC do not exceed their respected rated values.

How to set the delay time of protection circuit

The equation describes how to calculate the delay time of protection circuit from the value of an external capacitor C4.

$T_{DLY}=C4\times10^{6}$ sec (In this equation, $1000pF \leq C4 \leq 1\mu F$

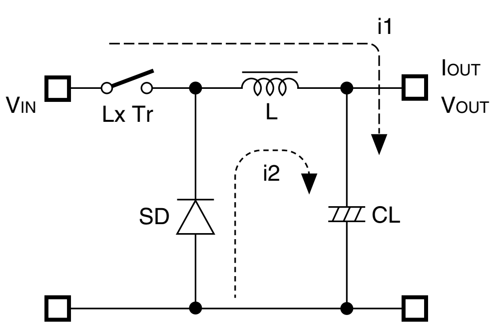
Without the external capacitor, a certain delay time exists, therefore, if the external capacitor is less than 1000pF, the error will increase. Further, if the external capacitor value is beyond 1µF, the time required to discharge the C4 will be long, and this may cause the miss-operation. For example, if the protection circuit may work and released, soon after that the protection may work. In that case, C4 has not discharged completely yet, therefore, the delay time may be shorter than expected.



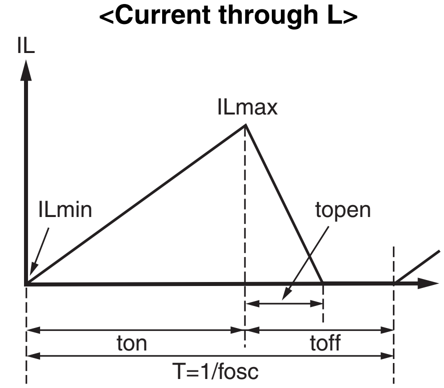
OPERATION of step-down DC/DC converter and Output Current

The step-down DC/DC converter charges energy in the inductor when Lx transistor is ON, and discharges the energy from the inductor when Lx transistor is OFF and controls with less energy loss, so that a lower output voltage than the input voltage is obtained. The operation will be explained with reference to the following diagrams:

<Basic Circuits>



<Current through L>



Step 1: Lx Tr. turns on and current IL (=i1) flows, and energy is charged into CL. At this moment, IL increases from ILmin (=0) to reach ILmax in proportion to the on-time period (ton) of LX Tr.

Step 2: When Lx Tr. turns off, Schottky diode (SD) turns on in order that L maintains IL at ILmax, and current IL (=i2) flows.

Step 3: IL decreases gradually and reaches ILmin after a time period of topen, and SD turns off, provided that in the continuous mode, next cycle starts before IL becomes to 0 because toff time is not enough. In this case, IL value is from this ILmin (>0).

In the case of PWM control system, the output voltage is maintained by controlling the on-time period (ton), with the oscillator frequency (fosc) being maintained constant.

- **Discontinuous Conduction Mode and Continuous Conduction Mode**

The maximum value (ILmax) and the minimum value (ILmin) current which flow through the inductor is the same as those when Lx Tr. turns on and when it turns off.

The difference between ILmax and ILmin, which is represented by ΔI;

$\Delta I = ILmax - ILmin = V_{OUT} \times topen/L = (V_{IN} - V_{OUT}) \times ton/L$ ....Equation 1

Where, $T = 1/fosc = ton + toff$

$duty (\%) = ton/T \times 100 = ton \times fosc \times 100$

$topen \leq toff$

In Equation 1, $V_{OUT} \times topen/L$ and $(V_{IN} - V_{OUT}) \times ton/L$ are respectively shown the change of the current at ON, and the change of the current at OFF.

When the output current (I_{OUT}) is relatively small, topen < toff as illustrated in the above diagram. In this case, the energy is charged in the inductor during the time period of ton and is discharged in its entirely during the time period of toff, therefore ILmin becomes to zero (ILmin=0). When I_{OUT} is gradually increased, eventually, topen becomes to toff (topen=toff), and when I_{OUT} is further increased, ILmin becomes larger than zero (ILmin>0). The former mode is referred to as the discontinuous mode and the latter mode is referred to as continuous mode.

In the continuous mode, when Equation 1 is solved for ton and assumed that the solution is tonc,

$tonc = T \times V_{OUT}/V_{IN}$ ....Equation 2

When ton<tonc, the mode is the discontinuous mode, and when ton=tonc, the mode is the continuous mode.

OUTPUT CURRENT AND SELECTION OF EXTERNAL COMPONENTS

When Lx Tr. is "ON":

(Wherein, Ripple Current P-P value is described as I_{RP}, ON resistance of LX Tr. is described as Rp the direct current of the inductor is described as R_L.)

$V_{IN}=V_{OUT}+(Rp+R_L)\times I_{OUT}+L\times I_{RP}/ton$ .... Equation 3

When Lx Tr. is "OFF":

$L\times I_{RP}/toff=V_F+V_{OUT}+R_L\times I_{OUT}$ .... Equation 4

Put Equation 4 to Equation 3 and solve for ON duty, ton/(toff+ton)=D_{ON},

$D_{ON}=(V_{OUT}+V_F+R_L\times I_{OUT})/(V_{IN}+V_F-Rp\times I_{OUT})$ .... Equation 5

Ripple Current is as follows;

$I_{RP}=(V_{IN}-V_{OUT}-Rp\times I_{OUT}-R_L\times I_{OUT})\times D_{ON}/f/L$ .... Equation 6

Wherein, peak current that flows through L, Lx Tr., and SD is as follows;

$ILmax=I_{OUT}+I_{RP}/2$ .... Equation 7

Consider ILmax, condition of input and output and select external components.

★ The above explanation is directed to the calculation in an ideal case in continuous mode.

External Components

1. Inductor

Select an inductor that peak current does not exceed ILmax. If larger current than allowable current flows, magnetic saturation occurs and make transform efficiency worse.

When the load current is definite, the smaller value of L, the larger the ripple current.

Provided that the allowable current is large in that case and DC current is small, therefore, for large output current, efficiency is better than using an inductor with a large value of L and vice versa.

2. Diode

Use a diode with low V_F (Schottky type is recommended.) and high switching speed.

Reverse voltage rating should be more than V_{IN} and current rating should be equal or more than ILmax.

3. Capacitors

As for C_{IN}, use a capacitor with low ESR (Equivalent Series Resistance) and a capacity of at least 10μF for stable operation.

C_{OUT} can reduce ripple of Output Voltage, therefore 47μF or more value of tantalum type capacitor is recommended.

4. Lx Transistor

Pch Power MOSFET is required for this IC.

Its breakdown voltage between gate and source should be a few V higher than Input Voltage.

In the case of Input Voltage is low, to turn on MOSFET completely, to use a MOSFET with low threshold voltage is effective.

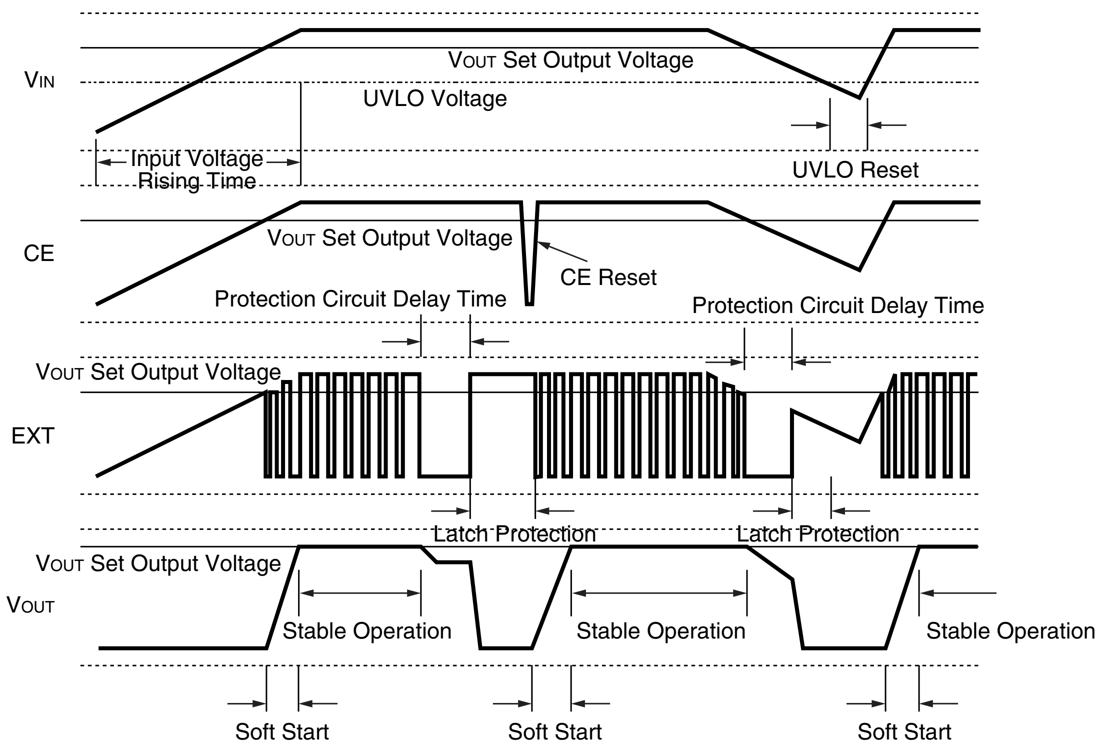
If a large load current is necessary for your application and important, choose a MOSFET with low ON resistance for good efficiency.

If a small load current is mainly necessary for your application, choose a MOSFET with low gate capacity for good efficiency.

Maximum continuous drain current of MOSFET should be larger than peak current, ILmax.

TIMING CHART

Case 1. Set V_{OUT} Voltage >2.1V (Set V_{OUT} Voltage>UVLO Voltage)



The timing chart shown above describes the changing process of input voltage rising, stable operating, operating with large current, reset with CE pin, stable operating, input voltage falling, input voltage recovering, and stable operating.

First, until when the input voltage (V_{IN}) reaches the set output voltage, the circuit inside keeps the condition of pre-standby.

Second, after V_{IN} becomes beyond the set output voltage, soft-start operation starts, when the soft-start operation finishes, the operation becomes stable.

If too large current flows through the circuit because of short or other reasons, EXT signal ignores that during the delay time of protection circuit. (The current value depends on the circuit.)

After the delay time passes, the latch protection works, or EXT signal will be "H", then output will turn off. To release the latch protection, input voltage should be equal or lower than UVLO level, or restart with CE (Once turn off the circuit with CE and turn it on again). In the timing charge above, release the latch function is realized with CE signal from "L" to "H". After removing the cause of large current and the reset with CE, soft-start operation starts and after the soft-start time, the operation will be back to stable.

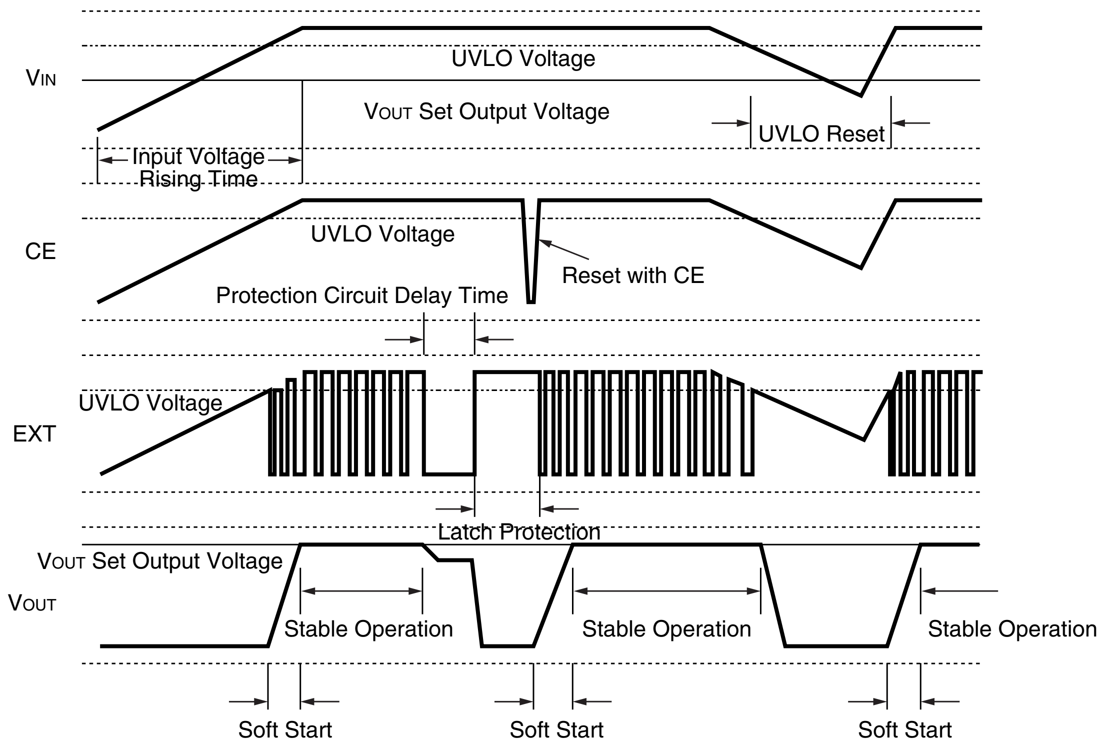
If the V_{IN} becomes lower than the set V_{OUT}, that situation is same as large current condition, so protection circuit may be ready to work, therefore, after the delay time of protection circuit, EXT will be "H" and the output turns off.

Further, if the V_{IN} is lower than UVLO voltage, the circuit inside will be stopped by UVLO function.

After that, if V_{IN} rises, until when the V_{IN} reaches the set output voltage, the circuit inside keeps the condition of pre-standby.

Then after V_{IN} becomes beyond the set output voltage, soft-start operation starts, when the soft-start operation finishes, the operation becomes stable.

Case 2. Set V_{OUT} Voltage ≤ 2.0V (Set V_{OUT} Voltage < UVLO Voltage)



The timing chart shown above describes the changing process of input voltage rising, stable operating, operating with large current, reset with CE pin, stable operating, input voltage falling, input voltage recovering, and stable operating.

First, until when the input voltage (V_{IN}) reaches the UVLO voltage, the circuit inside keeps the condition of pre-standby.

Second, after V_{IN} becomes beyond the UVLO voltage, soft-start operation starts, when the soft-start operation finishes, the operation becomes stable.

If too large current flows through the circuit because of short or other reasons, EXT signal ignores that during the delay time of protection circuit. (The current value depends on the circuit.)

After the delay time passes, the latch protection works, or EXT signal will be "H", then output will turn off. To release the latch protection, input voltage should be equal or lower than UVLO level, or restart with CE (Once turn off the circuit with CE and turn it on again). In the timing charge above, release the latch function is realized with CE signal from "L" to "H". After removing the cause of large current and the reset with CE, soft-start operation starts and after the soft-start time, the operation will be back to stable.

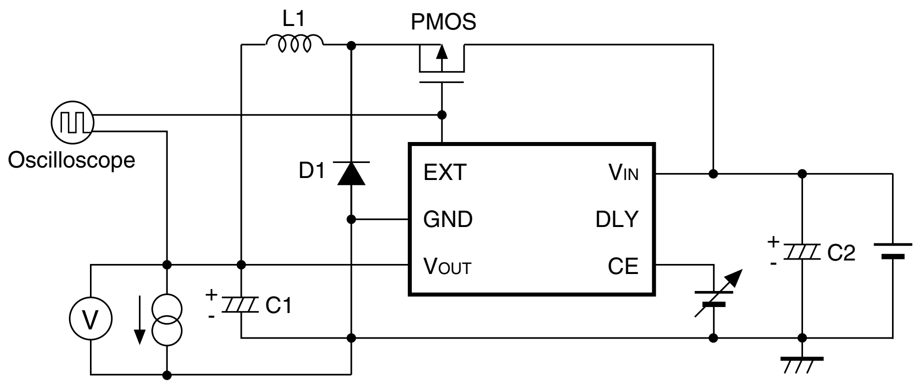
Further, if the V_{IN} is lower than UVLO voltage, the circuit inside will be stopped by UVLO function.

After that, if V_{IN} rises, until when the V_{IN} reaches UVLO voltage, the circuit inside keeps the condition of pre-standby.

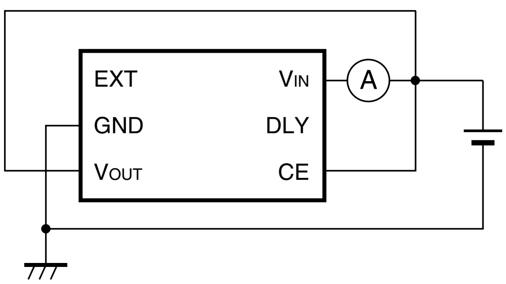
Then after V_{IN} becomes beyond the UVLO voltage, soft-start operation starts, when the soft-start operation finishes, the operation becomes stable.

TEST CIRCUITS

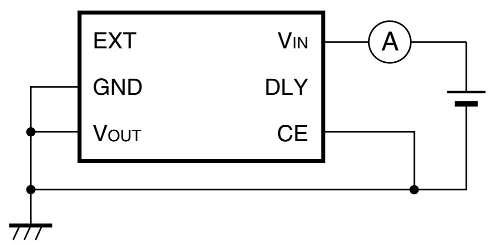
A) Output Voltage, Oscillator Frequency, CE “H” Input Voltage, CE “L” Input Voltage, Soft-start time



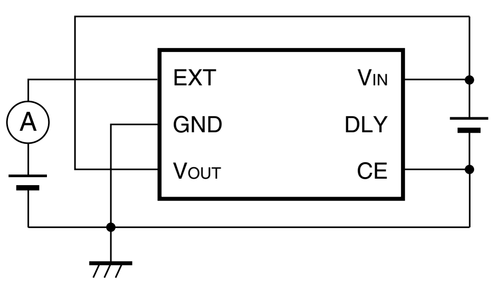
B) Supply Current 1



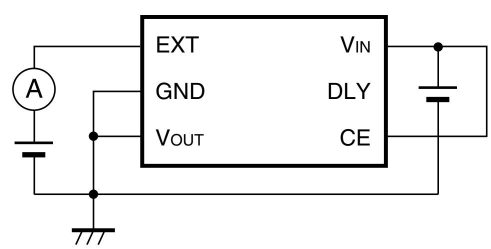
C) Standby Current



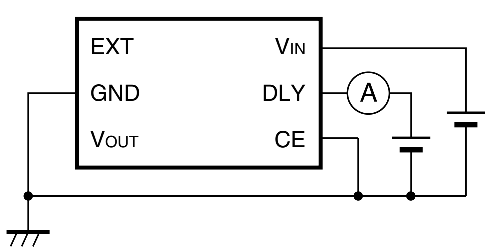
D) EXT “H” Output Current



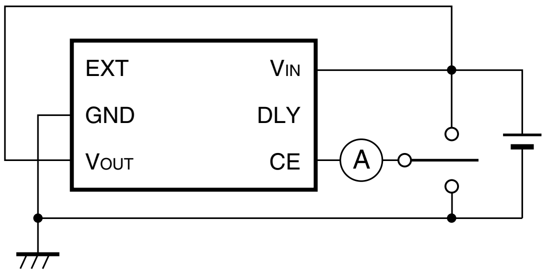
E) EXT “L” Output Current



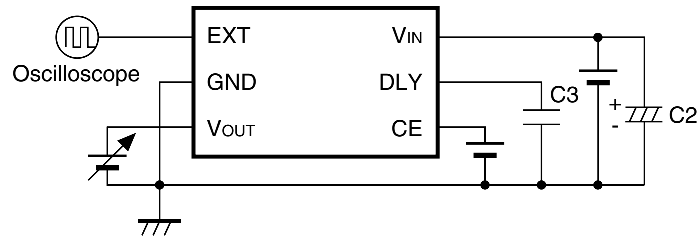
F) DLY Switch Current



G) CE “H” Input Current, CE “L” Input Current



H) Output Delay Time for Protection Circuit



PMOS : HAT1044M (Hitachi) L : CD104-270MC (Sumida, 27μH)

SD1 : RB491D (Rohm)

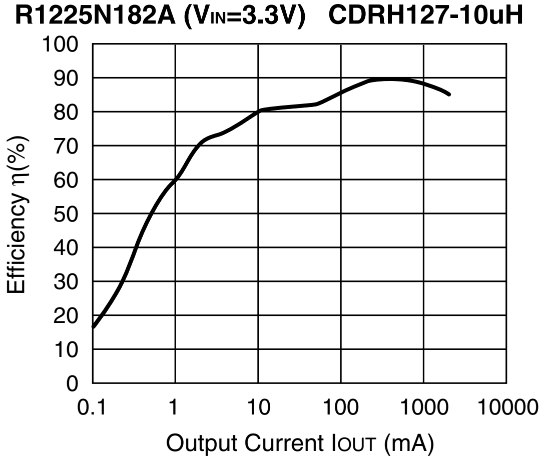
C1 : 47μF (Tantalum Type) C2 : 47μF (Tantalum Type) C3: 20nF(Ceramic Type)

TYPICAL CHARACTERISTICS

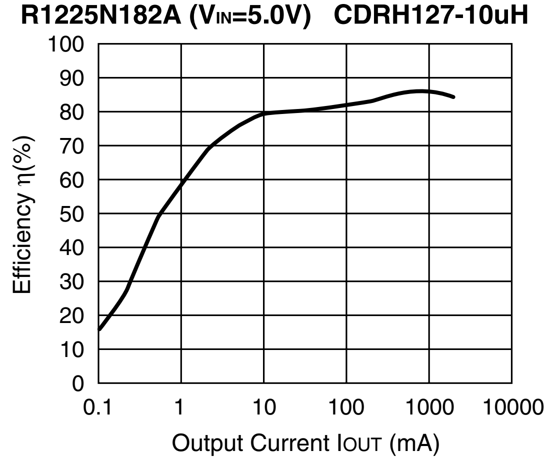
Almost all the characteristics of R1225N series are same as R1224N Series. Except the following characteristics, refer to the datasheet of R1224N Series.

1) Efficiency vs. Output Current

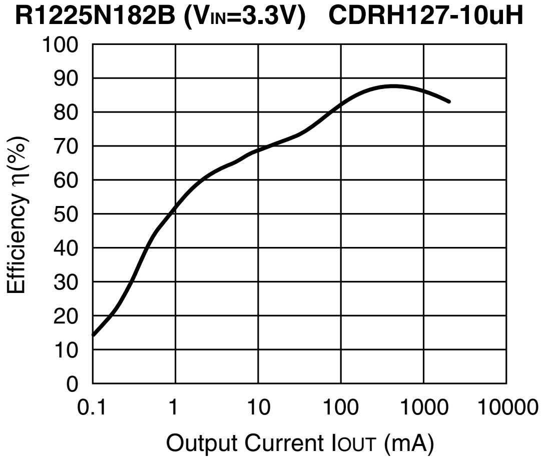
R1225N182A (V_{IN}=3.3V) CDRH127-10uH



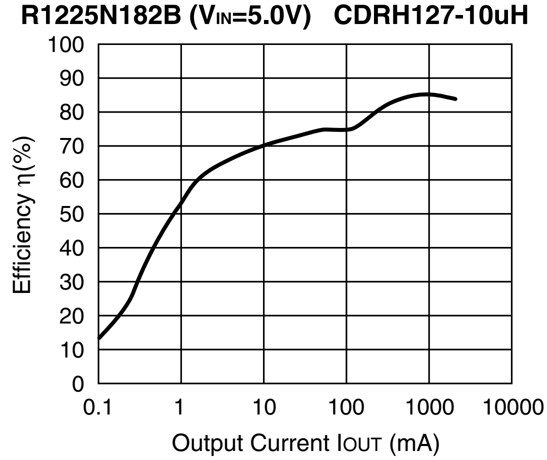
R1225N182A (V_{IN}=5.0V) CDRH127-10uH



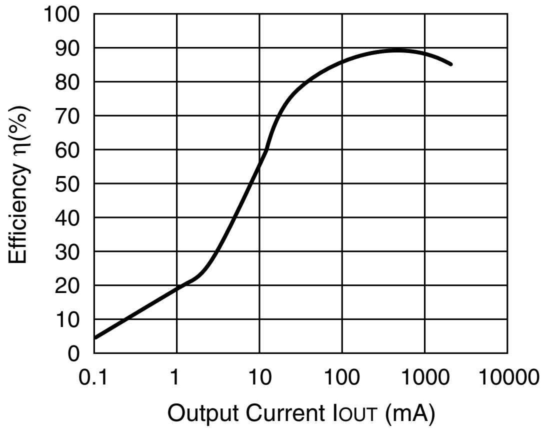
R1225N182B (V_{IN}=3.3V) CDRH127-10uH



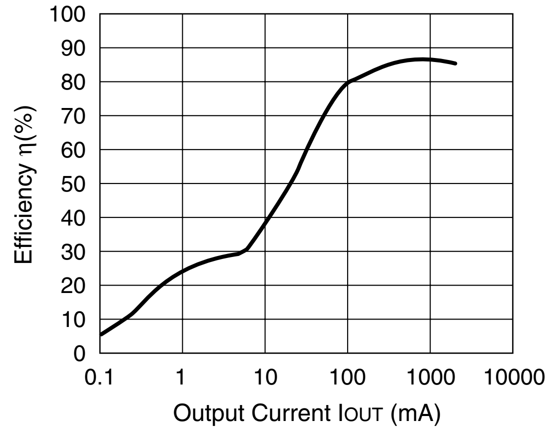
R1225N182B (V_{IN}=5.0V) CDRH127-10uH



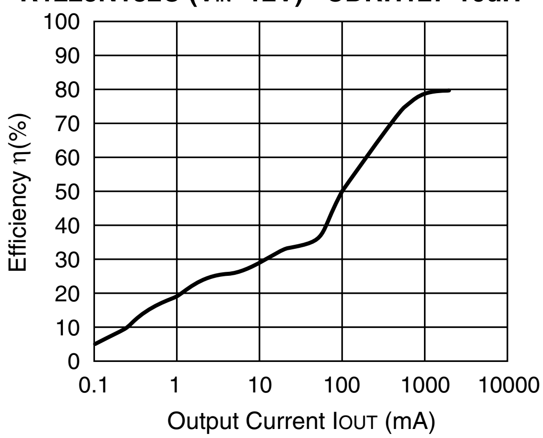
R1225N182C (V_{IN}=3.3V) CDRH127-10uH



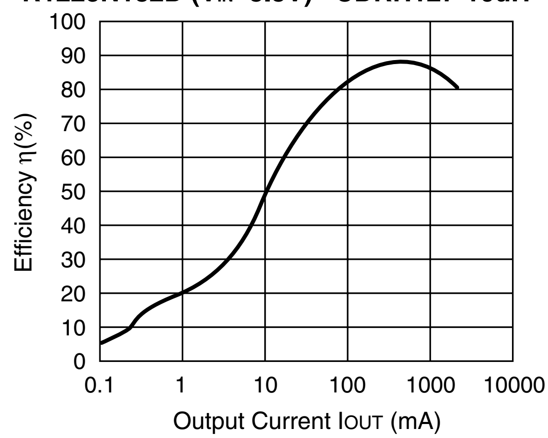
R1225N182C (V_{IN}=5.0V) CDRH127-10uH



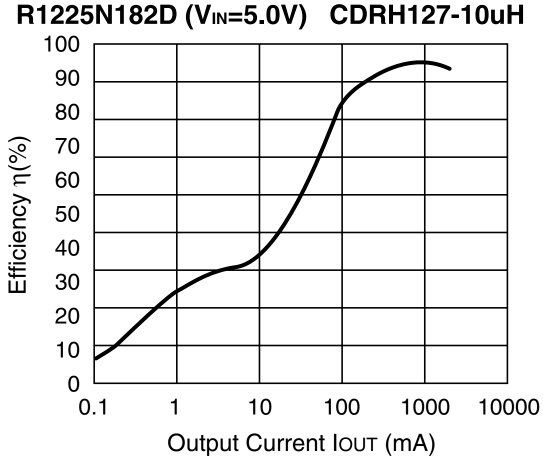
R1225N182C (V_{IN}=12V) CDRH127-10uH



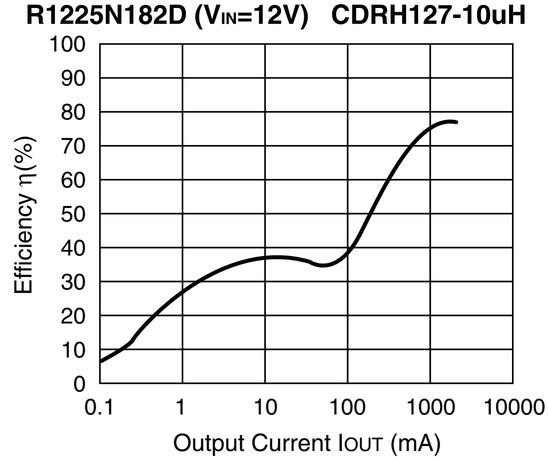
R1225N182D (V_{IN}=3.3V) CDRH127-10uH



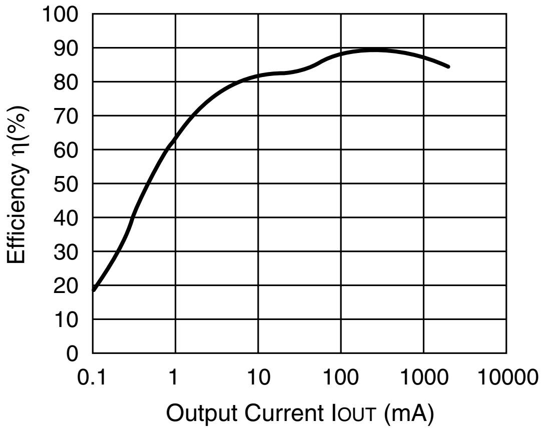
R1225N182D (V_{IN}=5.0V) CDRH127-10uH



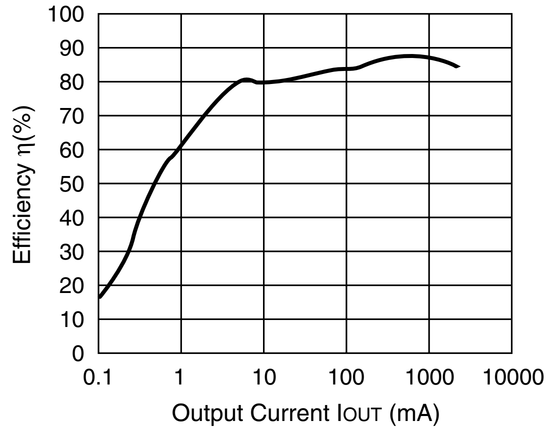
R1225N182D (V_{IN}=12V) CDRH127-10uH



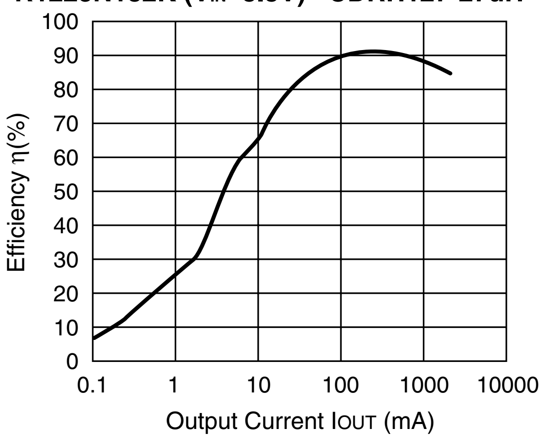
R1225N182J (V_{IN}=3.3V) CDRH127-27uH



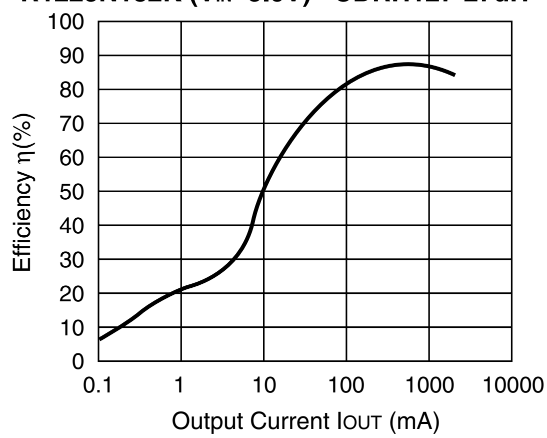
R1225N182J (V_{IN}=5.0V) CDRH127-27uH



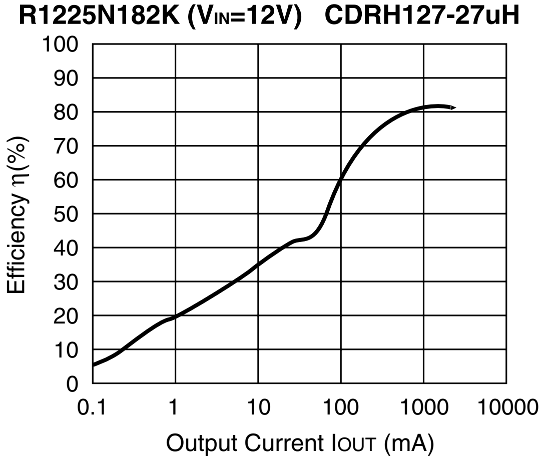
R1225N182K (V_{IN}=3.3V) CDRH127-27uH



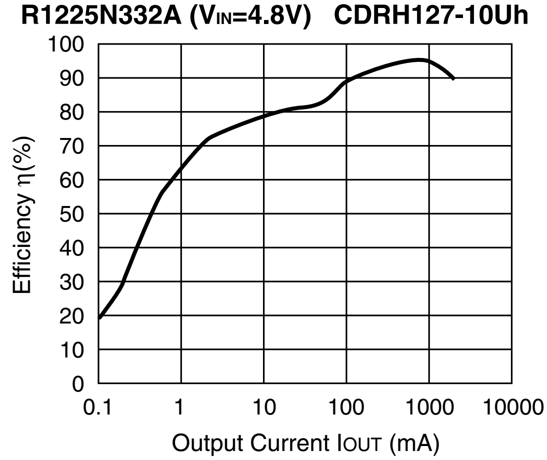
R1225N182K (V_{IN}=5.0V) CDRH127-27uH



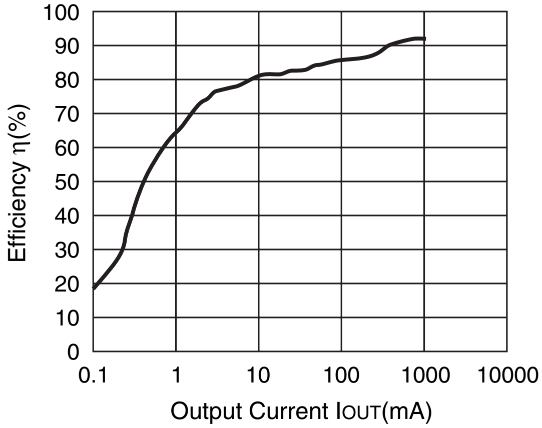
R1225N182K (V_{IN}=12V) CDRH127-27uH



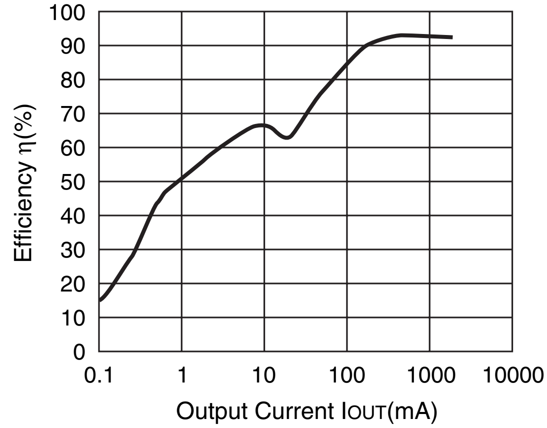
R1225N332A (V_{IN}=4.8V) CDRH127-10Uh



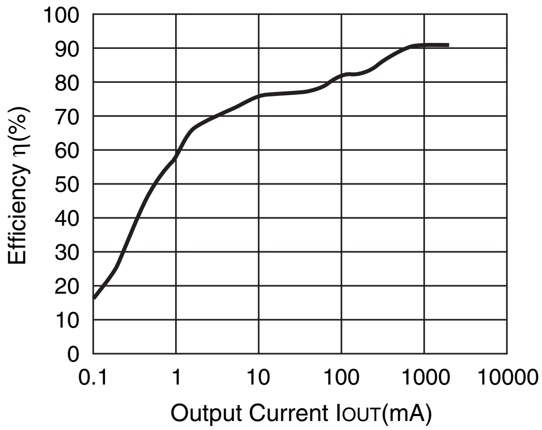
R1225N332A (V_{IN}=7.0V) CDRH127-10uH



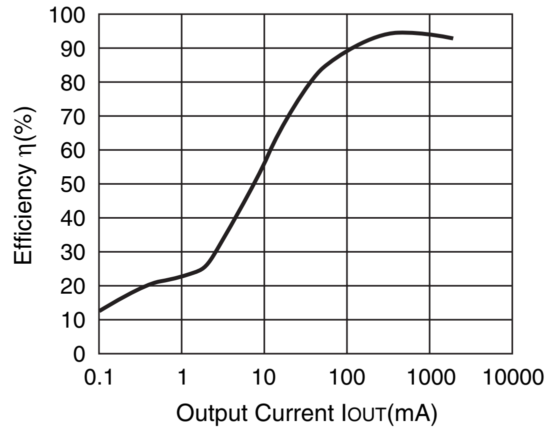
R1225N332B (V_{IN}=4.8V) CDRH127-10uH



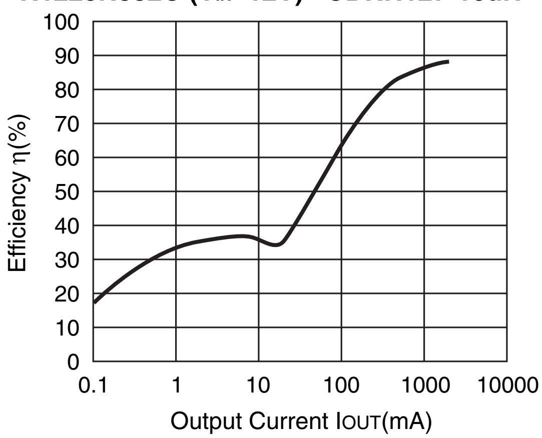
R1225N332B (V_{IN}=7.0V) CDRH127-10uH



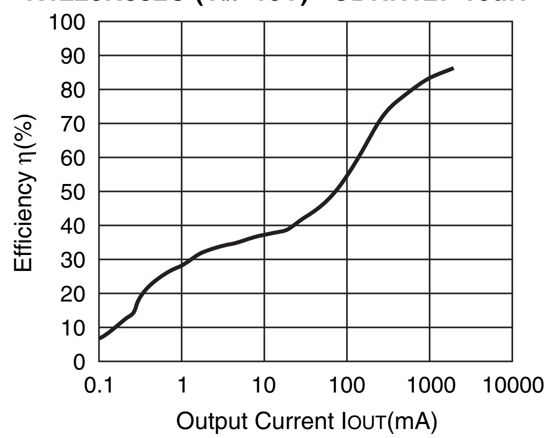
R1225N332C (V_{IN}=4.8V) CDRH127-10uH



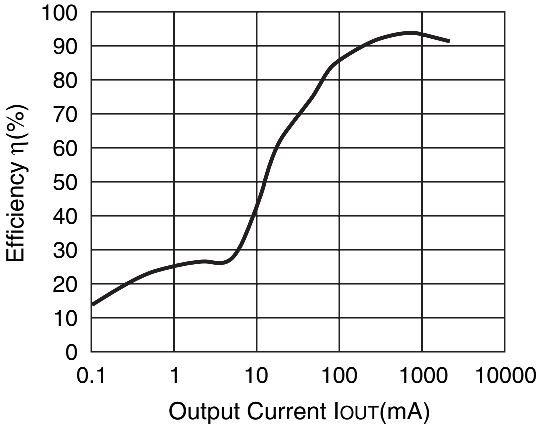
R1225N332C (V_{IN}=12V) CDRH127-10uH



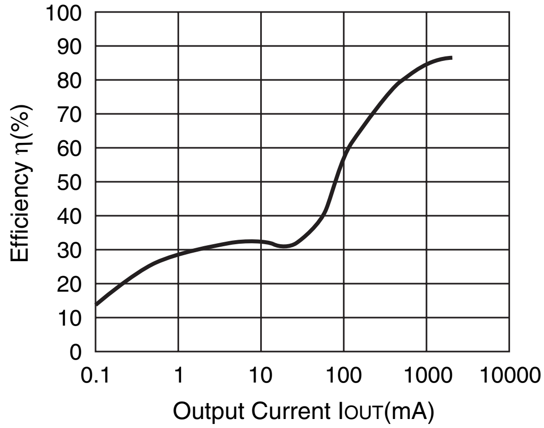
R1225N332C (V_{IN}=15V) CDRH127-10uH



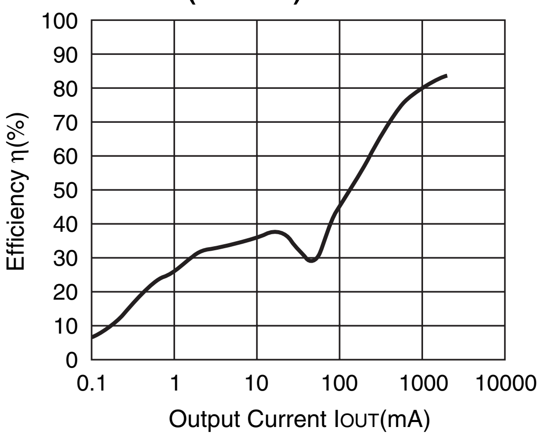
R1225N332D (VIN=4.8V) CDRH127-10uH



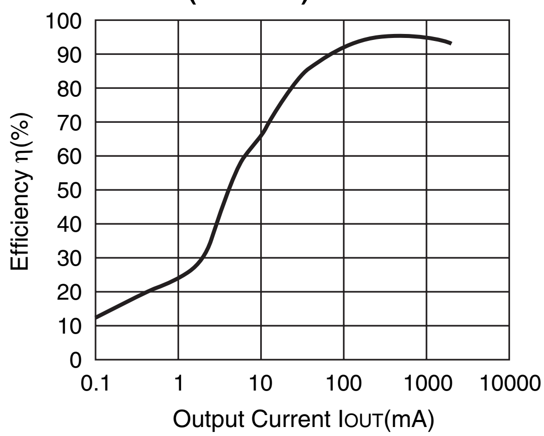
R1225N332D (VIN=12V) CDRH127-10uH



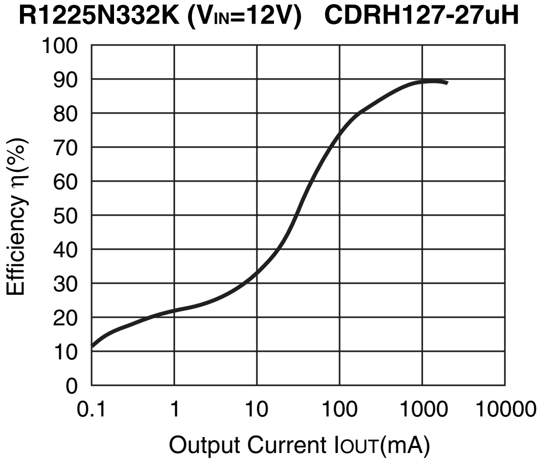
R1225N332D (VIN=15V) CDRH127-10uH



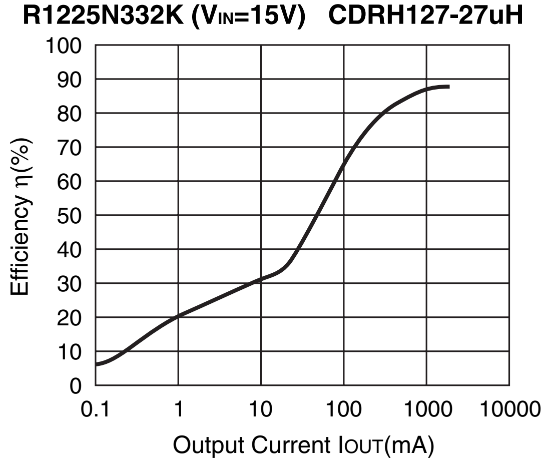
R1225N332K (VIN=4.8V) CDRH127-27uH



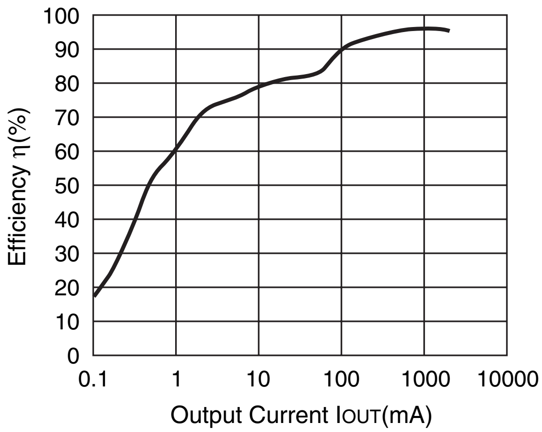
R1225N332K (VIN=12V) CDRH127-27uH



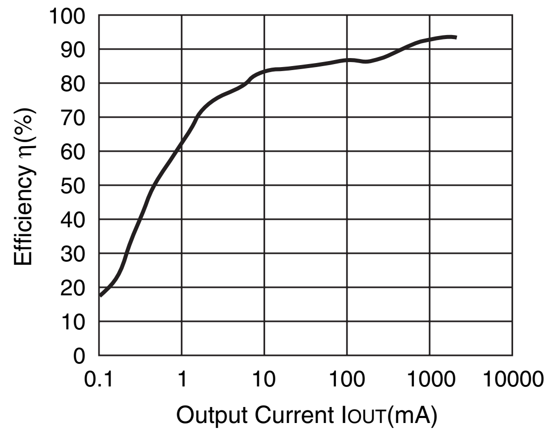
R1225N332K (VIN=15V) CDRH127-27uH



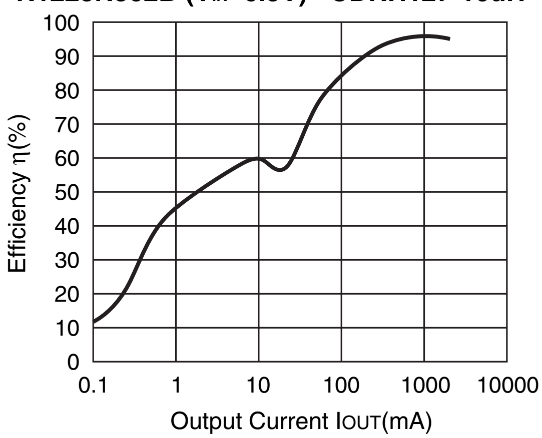
R1225N502A (V_{IN}=6.5V) CDRH127-10uH



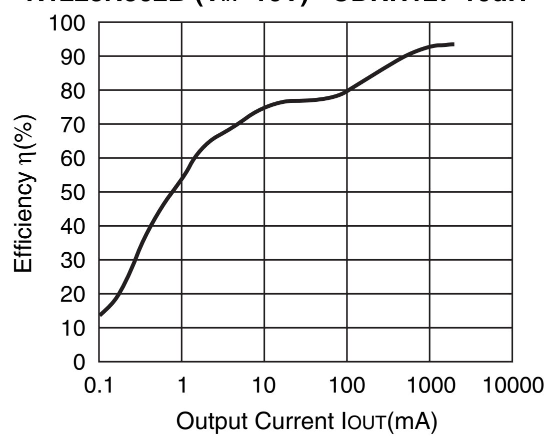
R1225N502A (V_{IN}=10V) CDRH127-10uH



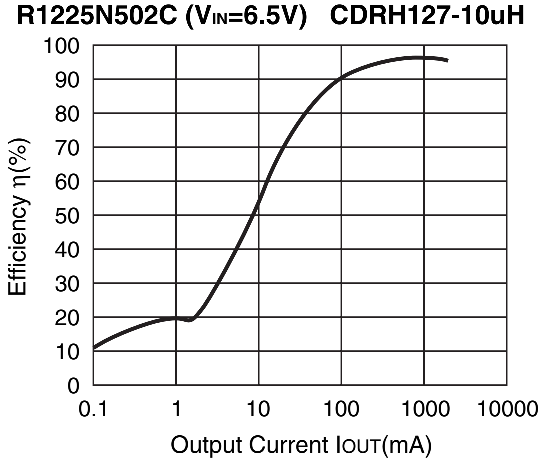
R1225N502B (V_{IN}=6.5V) CDRH127-10uH



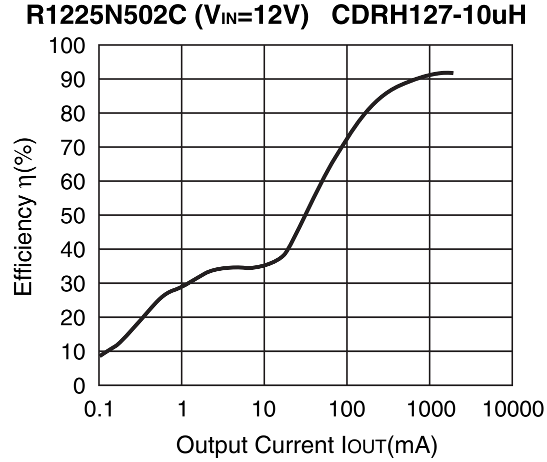
R1225N502B (V_{IN}=10V) CDRH127-10uH



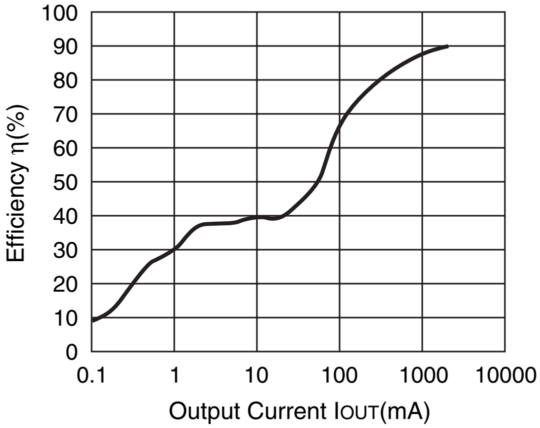
R1225N502C (V_{IN}=6.5V) CDRH127-10uH



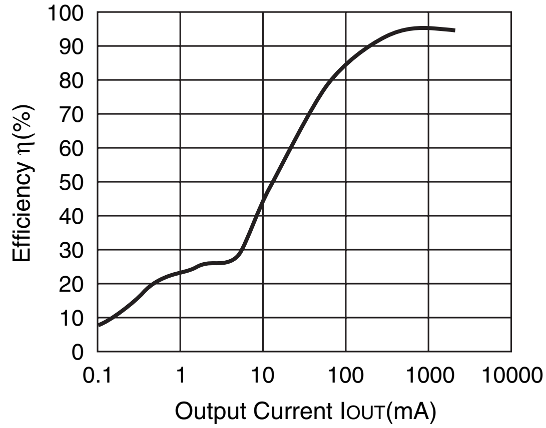
R1225N502C (V_{IN}=12V) CDRH127-10uH



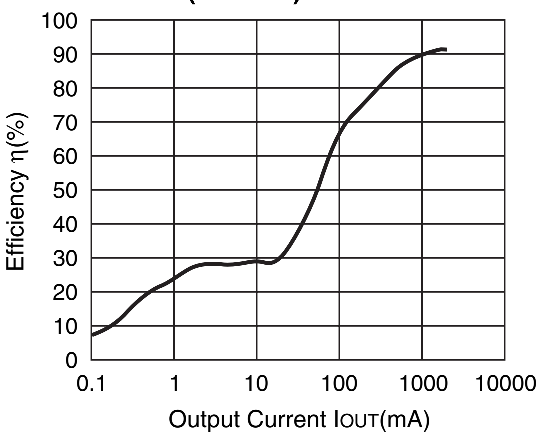
R1225N502C (VIN=15V) CDRH127-10uH



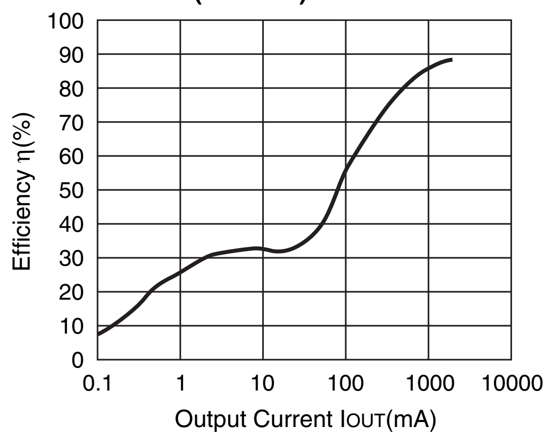
R1225N502D (VIN=6.5V) CDRH127-10uH



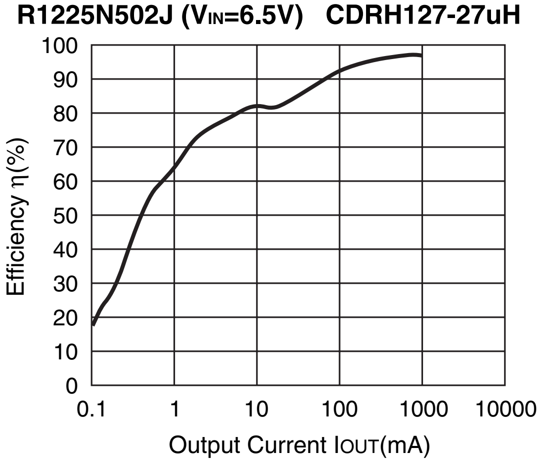
R1225N502D (VIN=12V) CDRH127-10uH



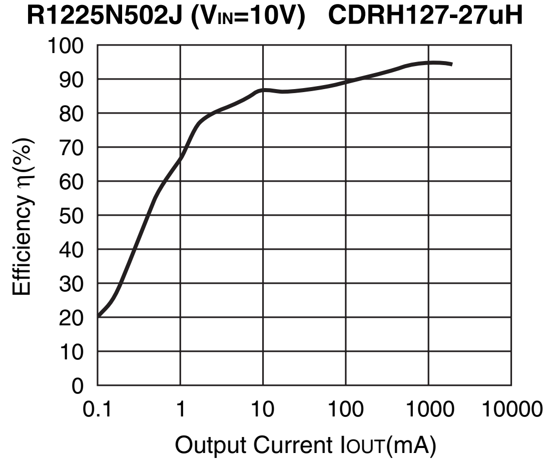
R1225N502D (VIN=15V) CDRH127-10uH



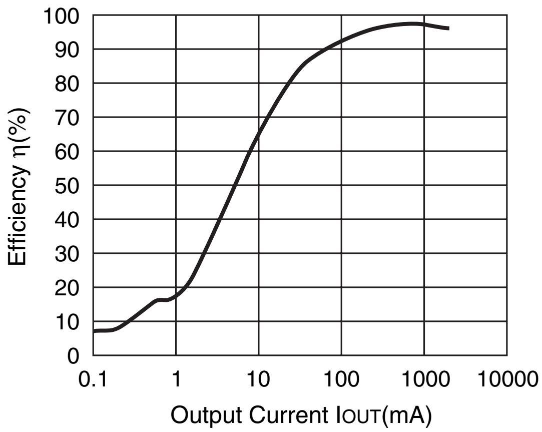
R1225N502J (VIN=6.5V) CDRH127-27uH



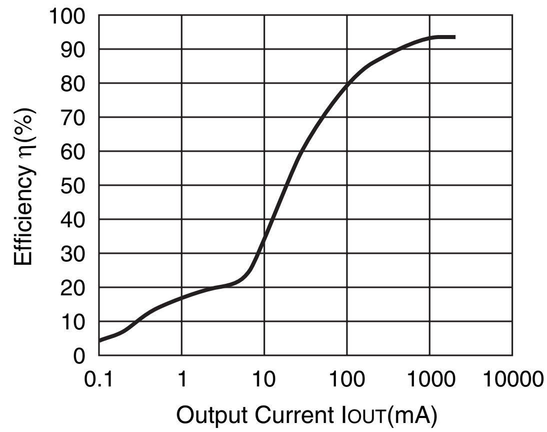
R1225N502J (VIN=10V) CDRH127-27uH



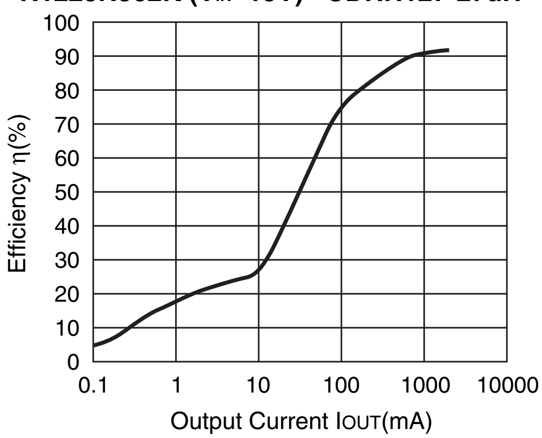
R1225N502K (V_{IN}=6.5V) CDRH127-27uH



R1225N502K (V_{IN}=12V) CDRH127-27uH

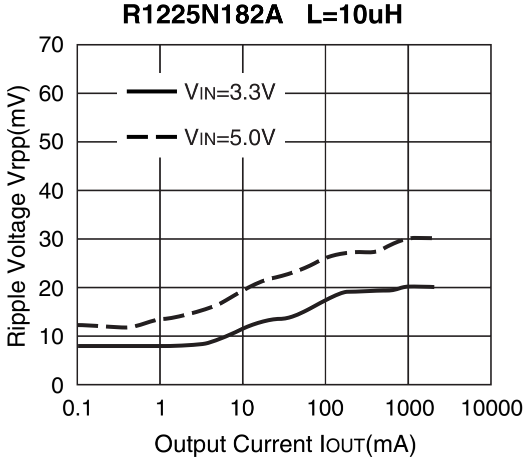


R1225N502K (V_{IN}=15V) CDRH127-27uH

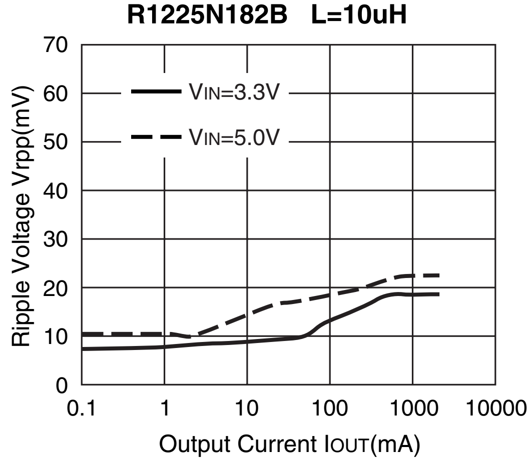


2) Ripple Voltage vs. Output Current

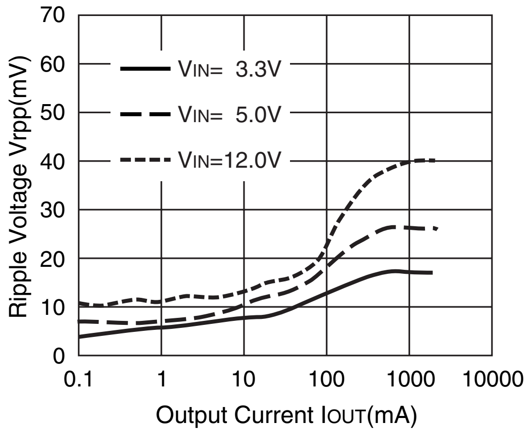
R1225N182A L=10uH



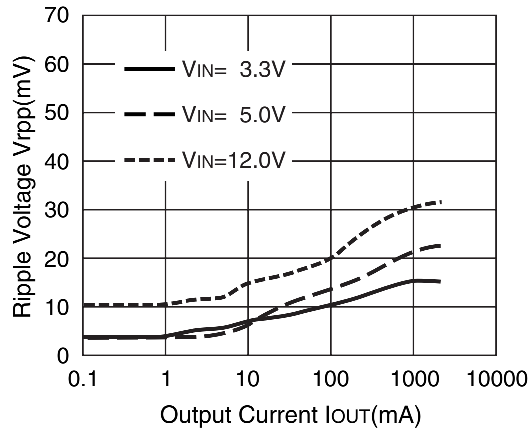
R1225N182B L=10uH



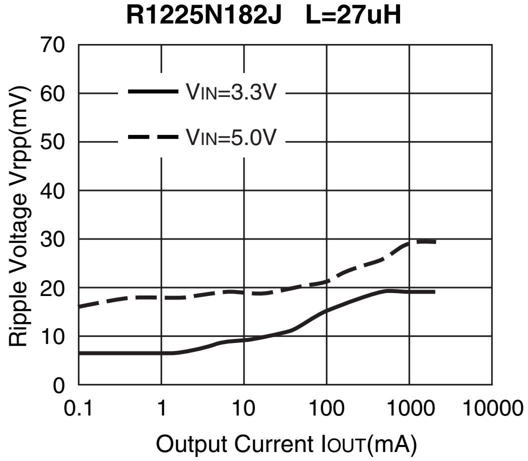
R1225N182C L=10uH



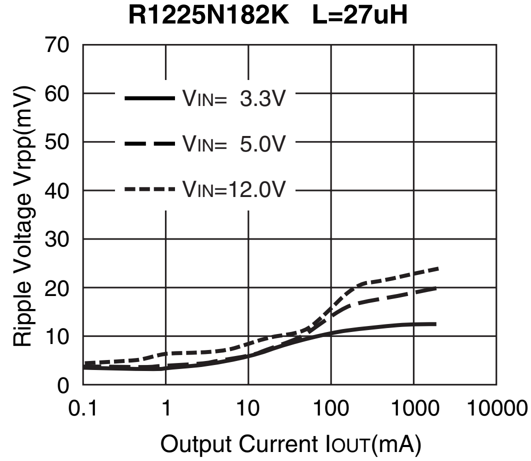
R1225N182D L=10uH



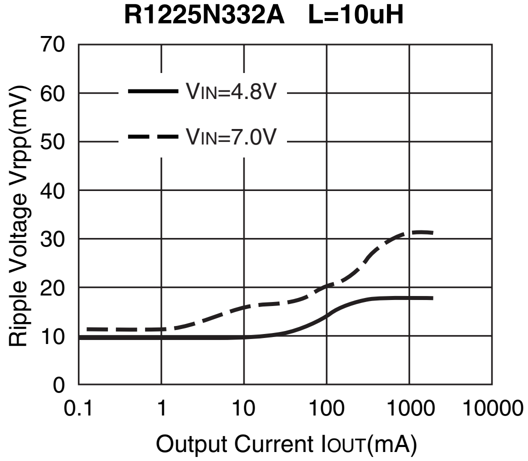
R1225N182J L=27uH



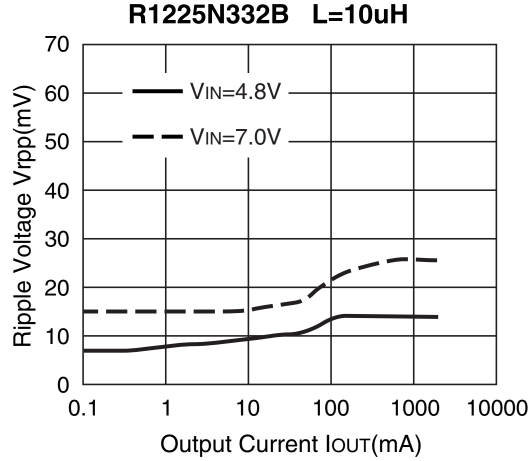
R1225N182K L=27uH



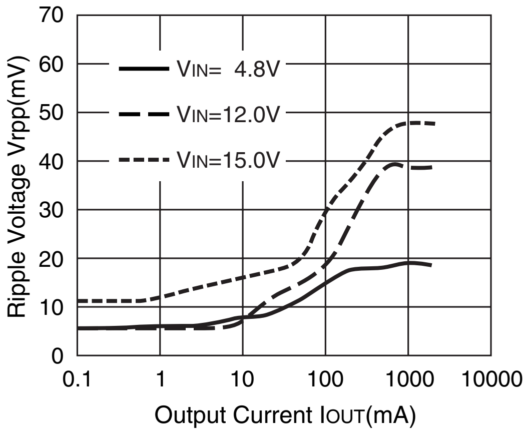
R1225N332A L=10uH



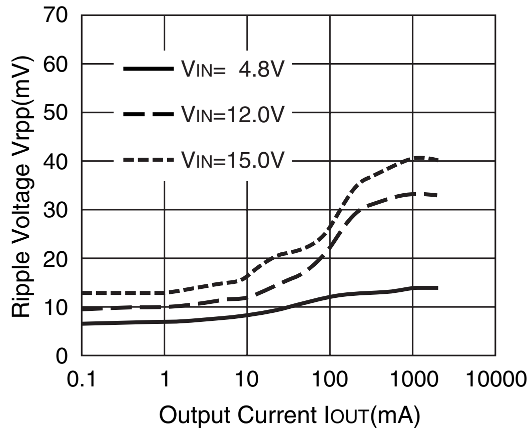
R1225N332B L=10uH



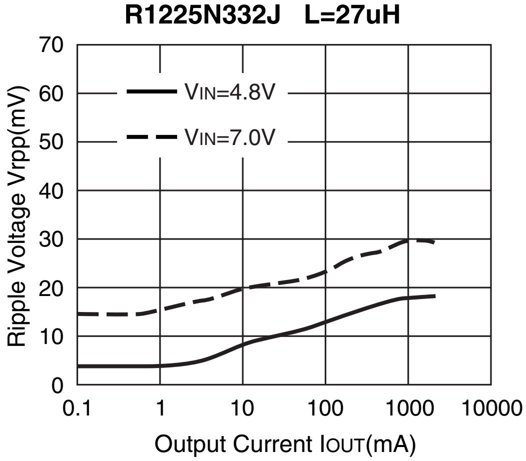
R1225N332C L=10uH



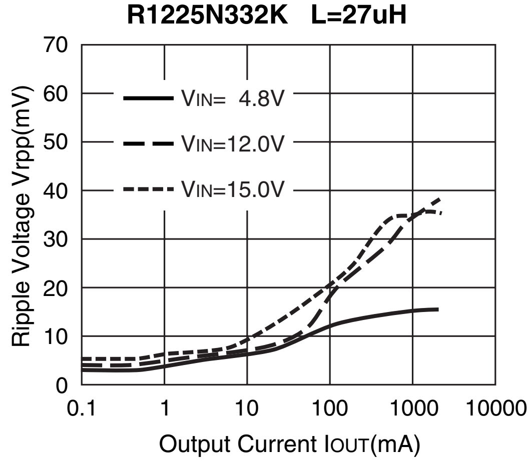
R1225N332D L=10uH



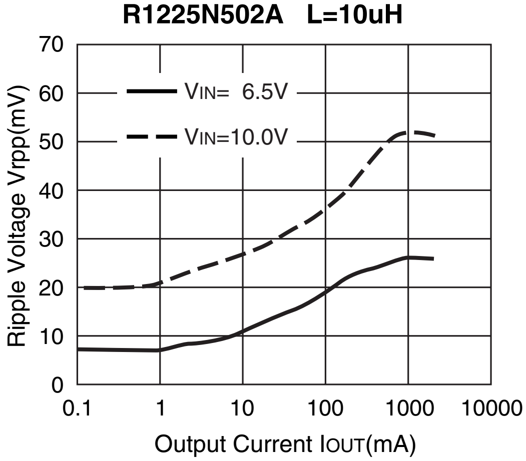
R1225N332J L=27uH



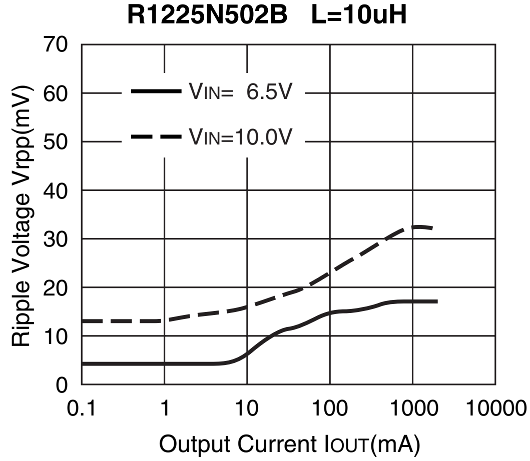
R1225N332K L=27uH



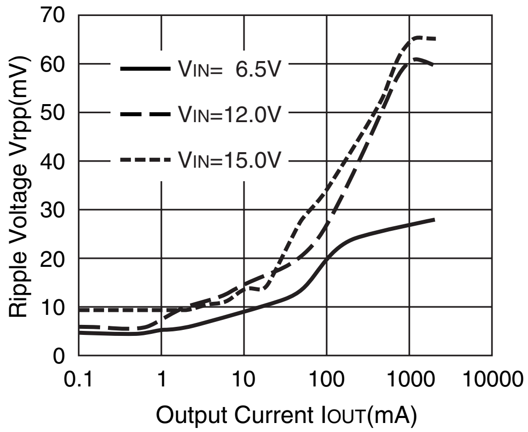
R1225N502A L=10uH



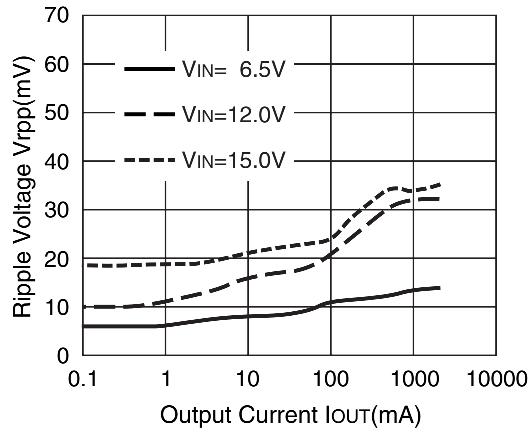
R1225N502B L=10uH



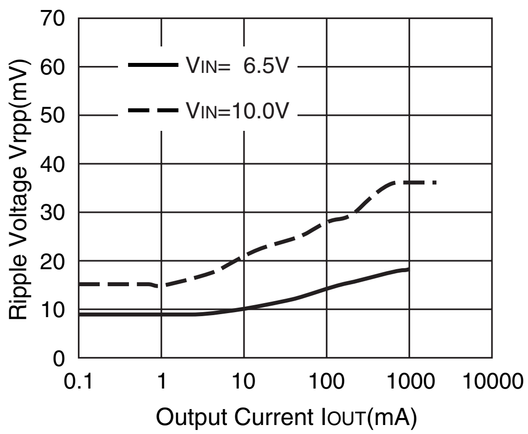
R1225N502C L=10uH



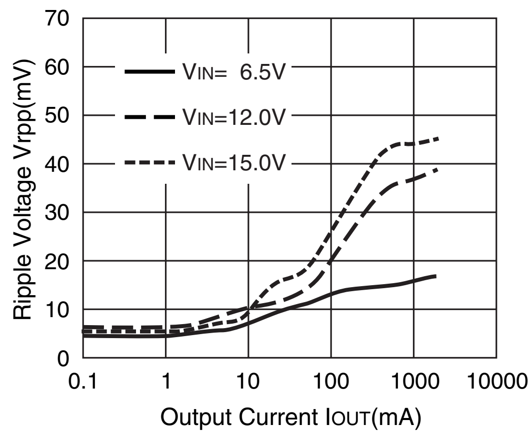
R1225N502D L=10uH



R1225N502J L=27uH

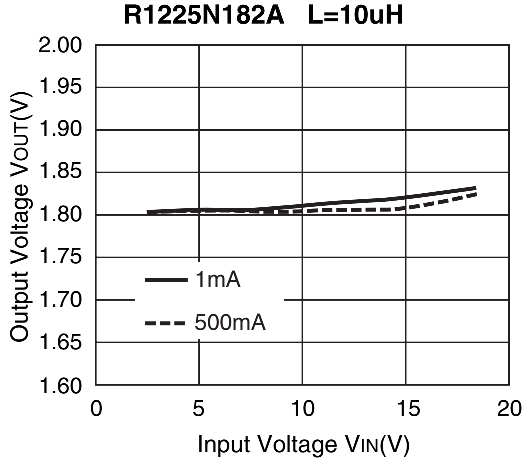


R1225N502K L=27uH

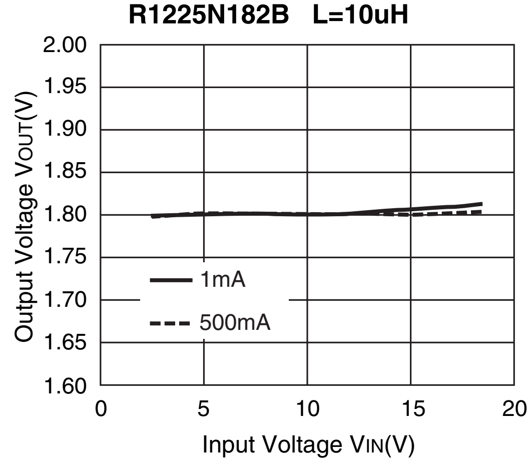


3) Input Voltage vs. Output Voltage

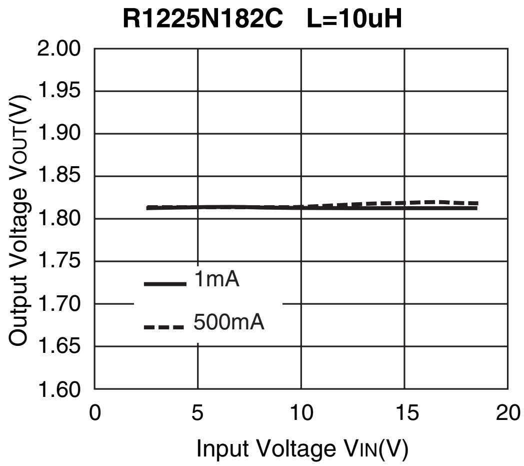
R1225N182A L=10uH

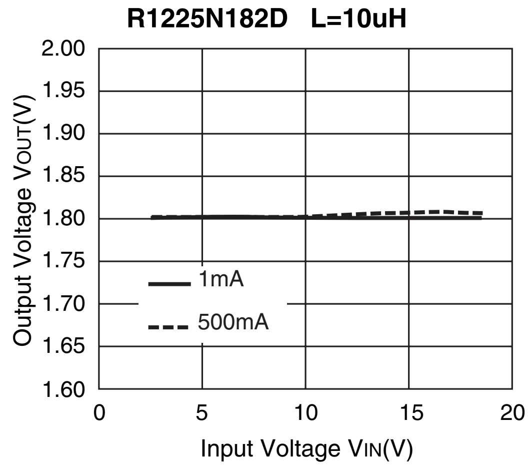


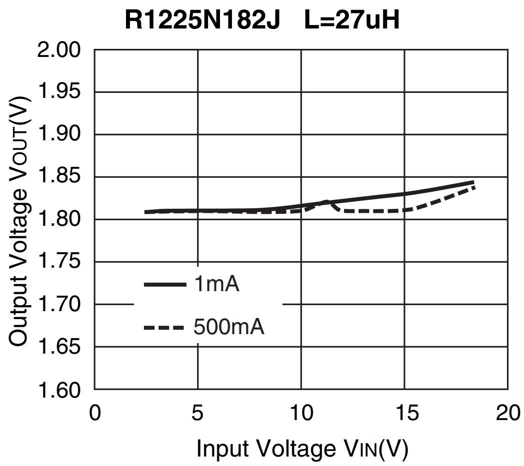
R1225N182B L=10uH

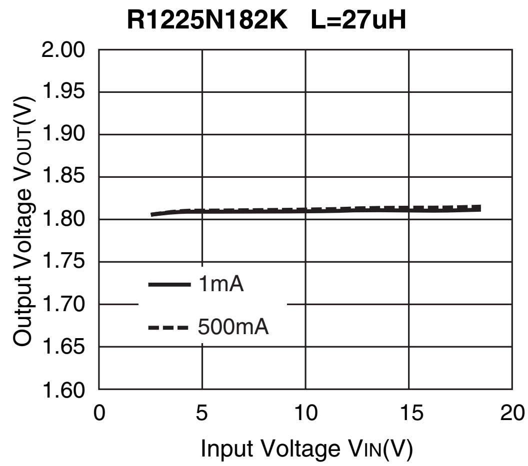


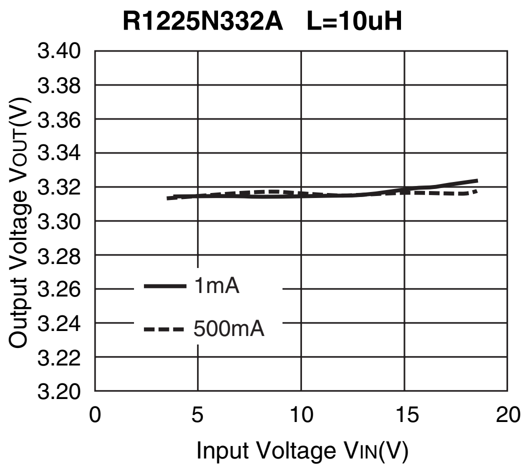
RICOH

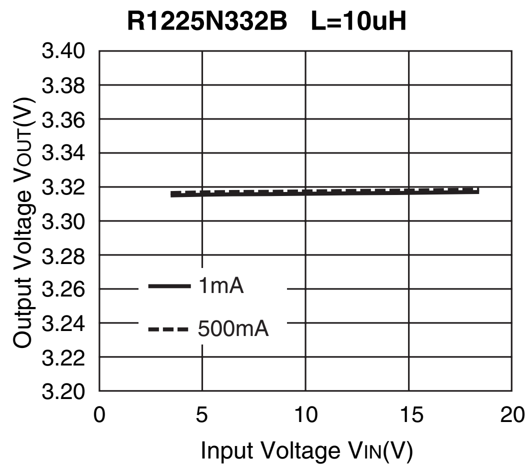

R1225N182C L=10uH
Output Voltage VOUT(V)
Input Voltage VIN(V)
1mA
500mA

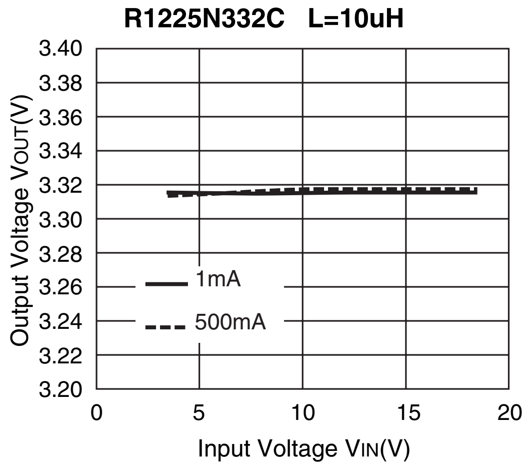

R1225N182D L=10uH
Output Voltage VOUT(V)
Input Voltage VIN(V)
1mA
500mA

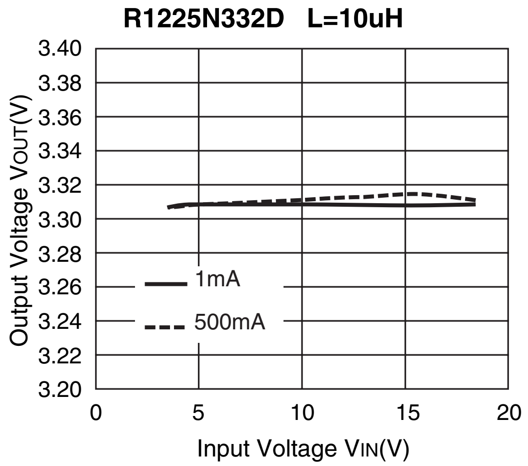

R1225N182J L=27uH
Output Voltage VOUT(V)
Input Voltage VIN(V)
1mA
500mA

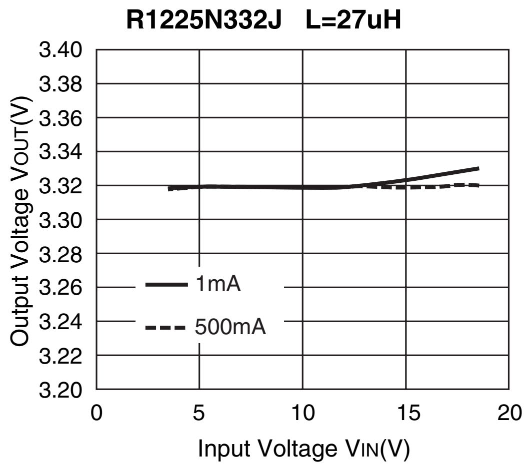

R1225N182K L=27uH
Output Voltage VOUT(V)
Input Voltage VIN(V)
1mA
500mA

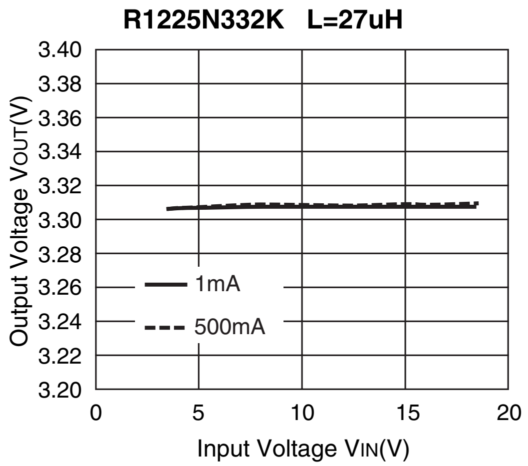

R1225N332A L=10uH
Output Voltage VOUT(V)
Input Voltage VIN(V)
1mA
500mA


R1225N332B L=10uH
Output Voltage VOUT(V)
Input Voltage VIN(V)
1mA
500mA

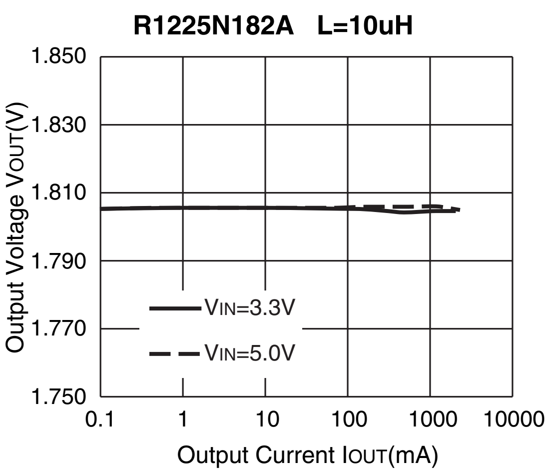


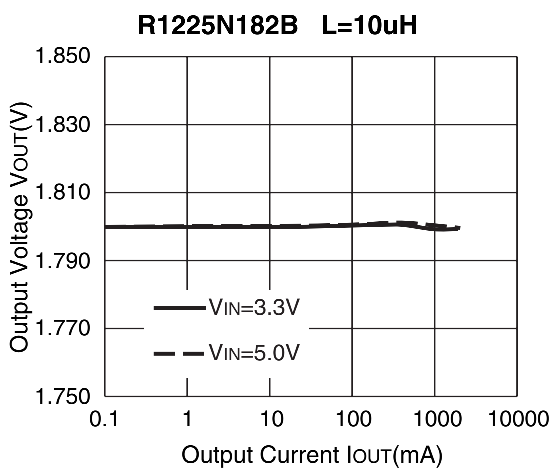




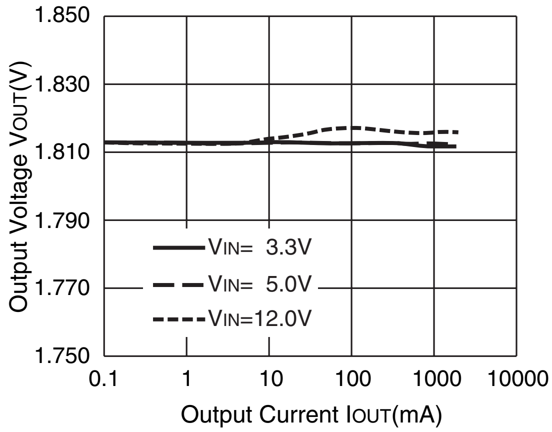


4) Output Voltage vs. Output Current

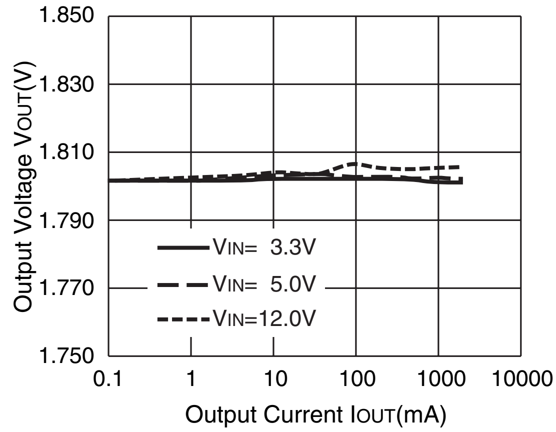




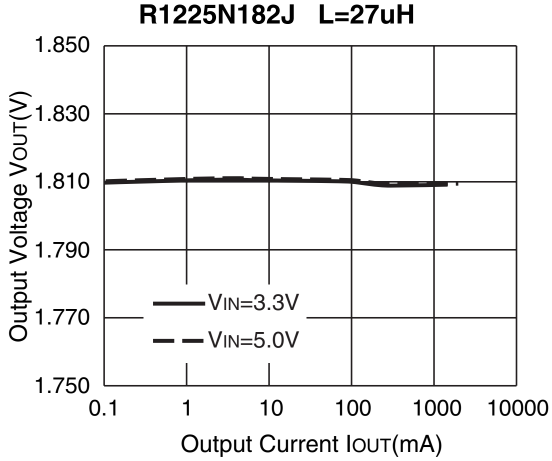
R1225N182C L=10uH



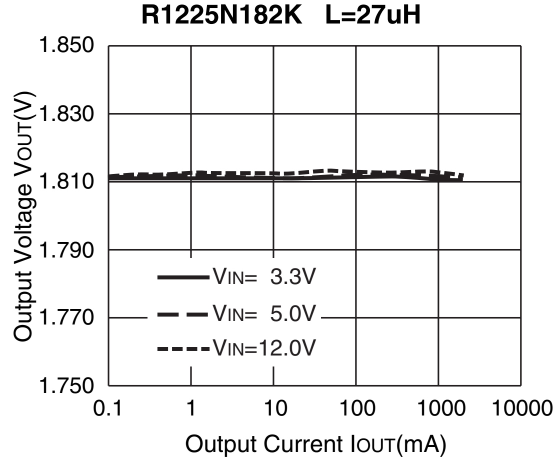
R1225N182D L=10uH



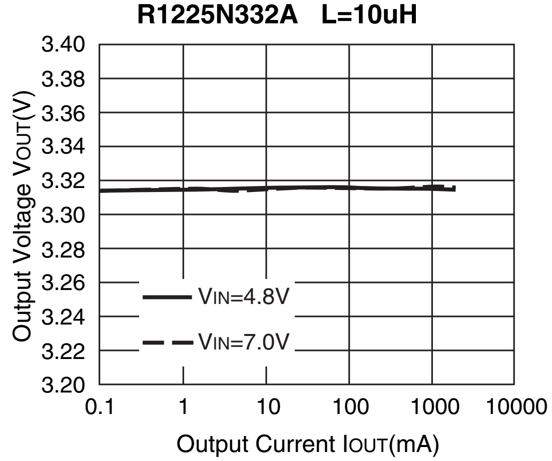
R1225N182J L=27uH



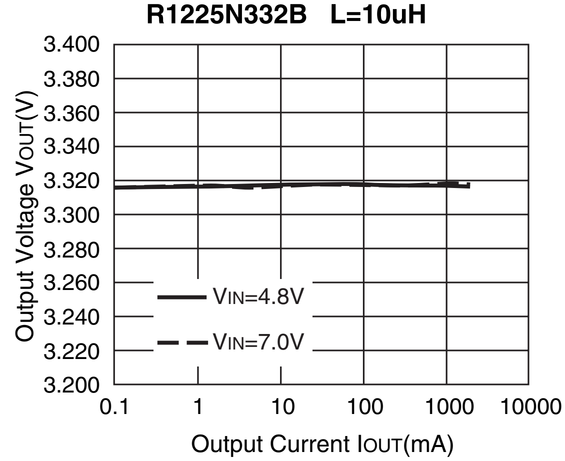
R1225N182K L=27uH



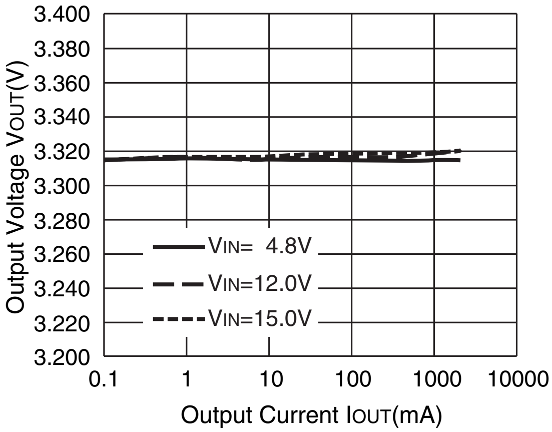
R1225N332A L=10uH



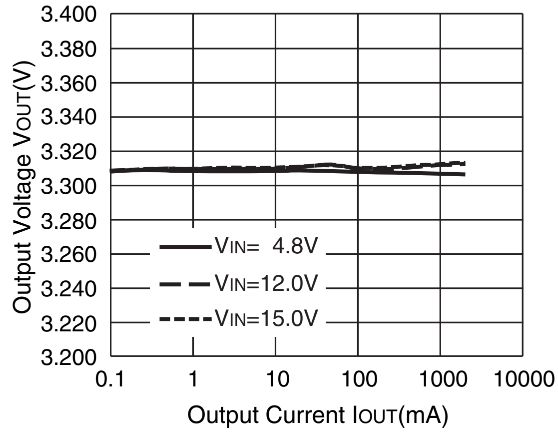
R1225N332B L=10uH



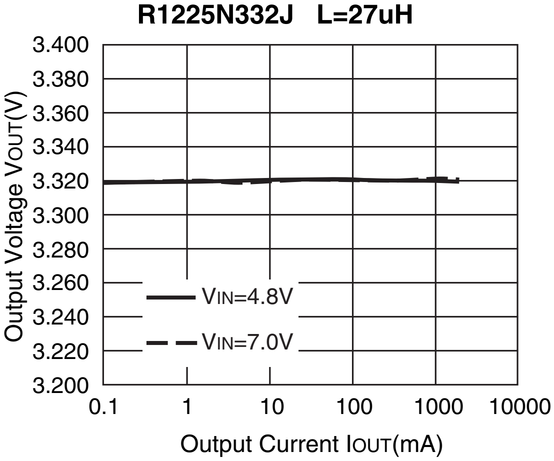
R1225N332C L=10uH



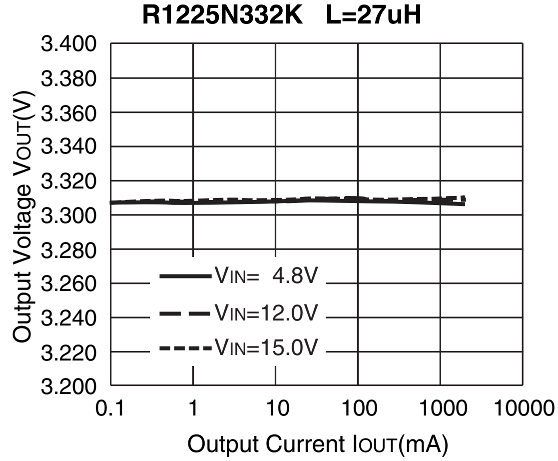
R1225N332D L=10uH



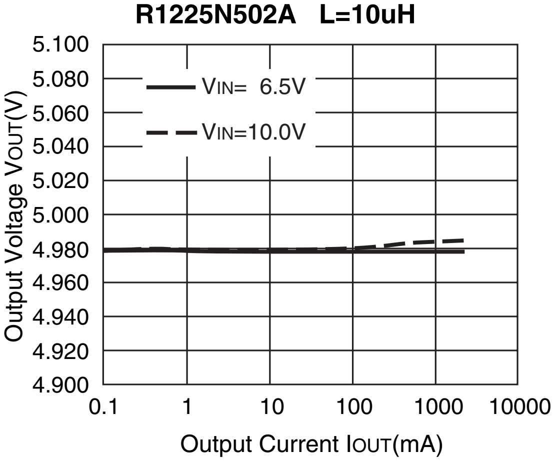
R1225N332J L=27uH



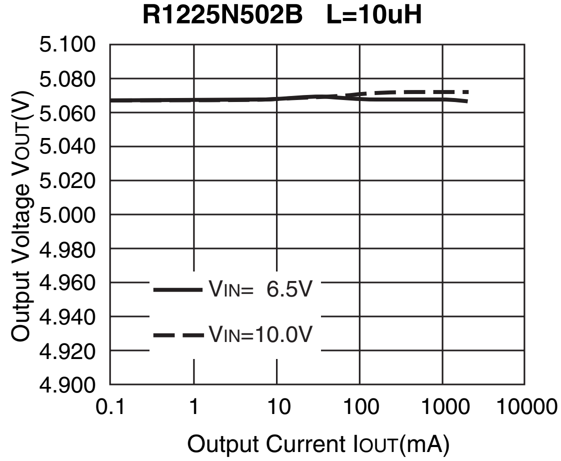
R1225N332K L=27uH

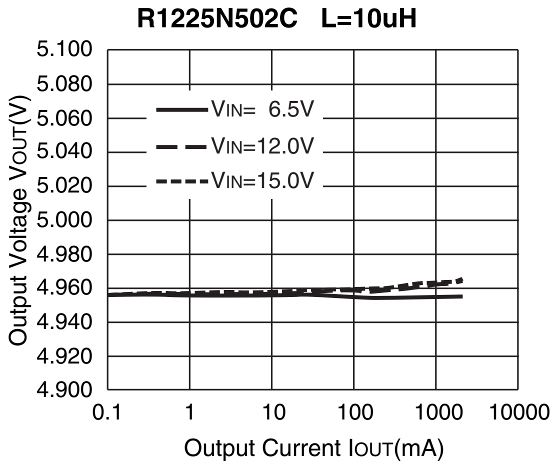


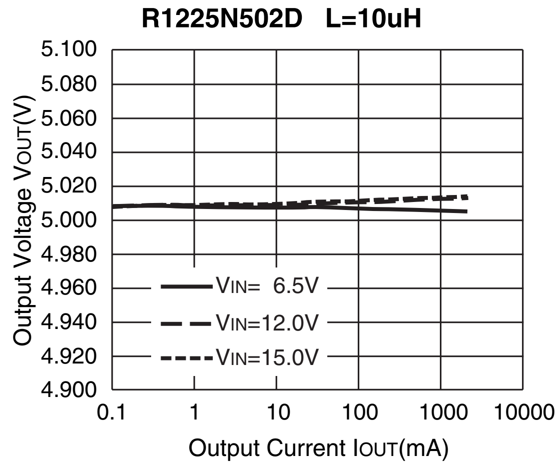
R1225N502A L=10uH

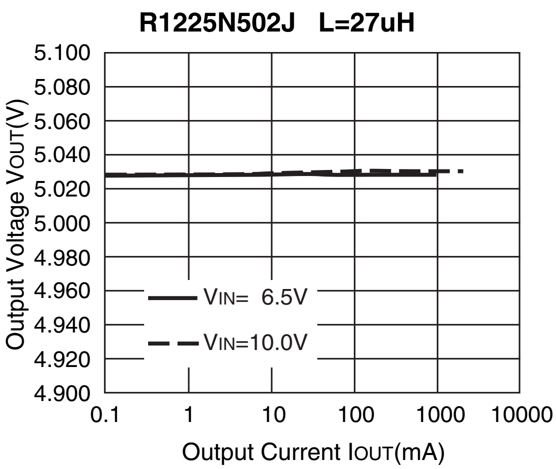


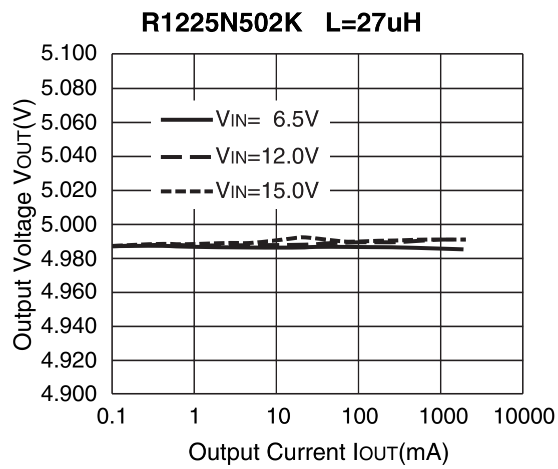
R1225N502B L=10uH



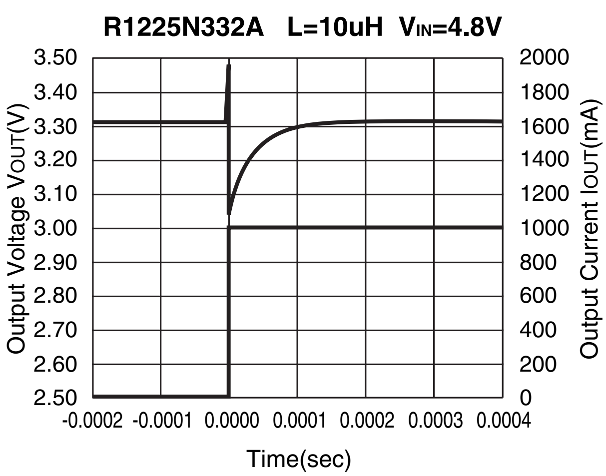


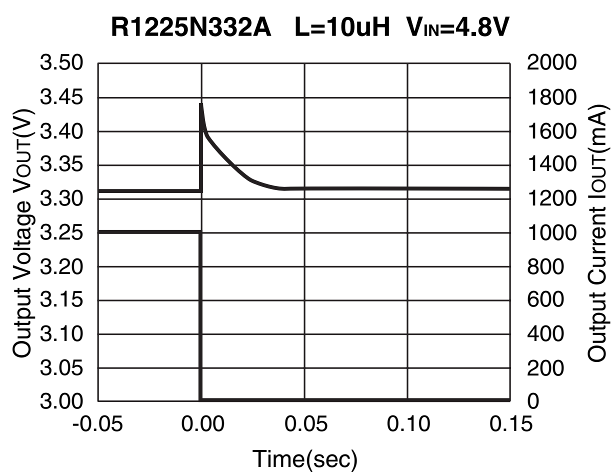


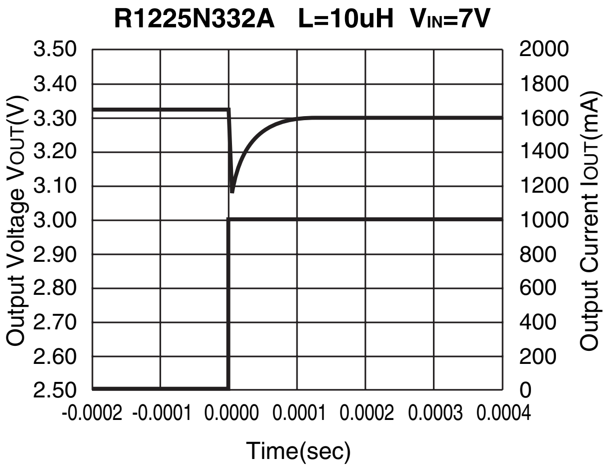


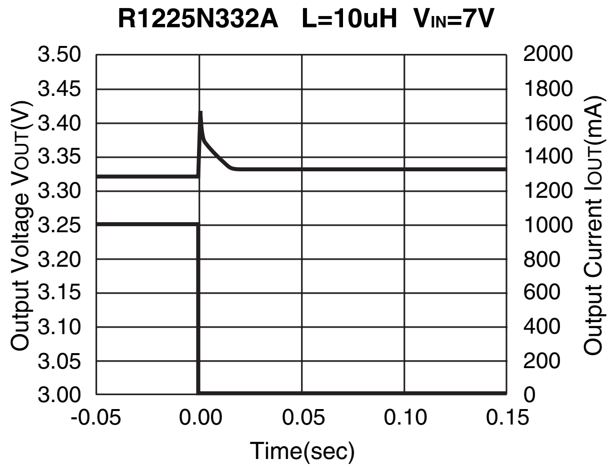


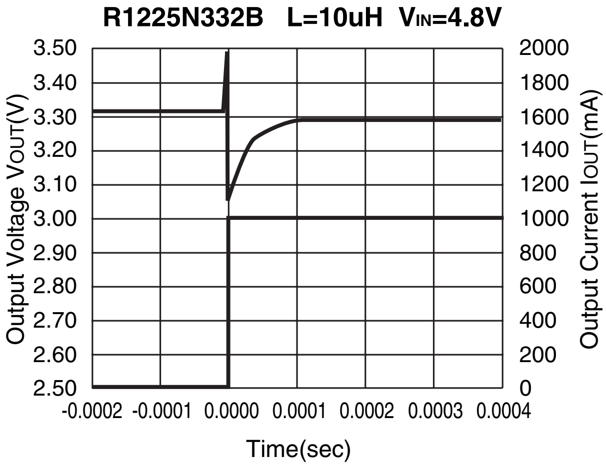
5) Load Transient Response

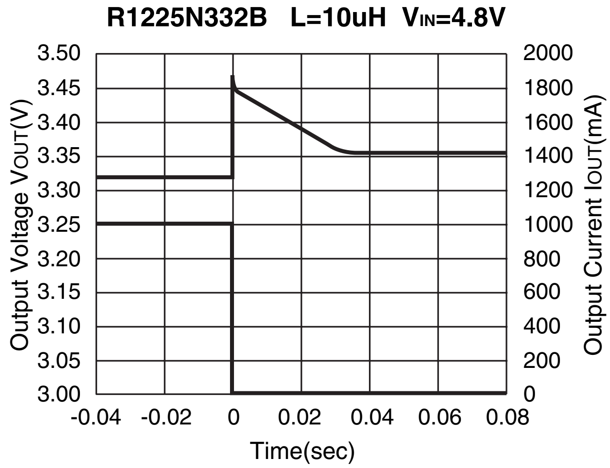


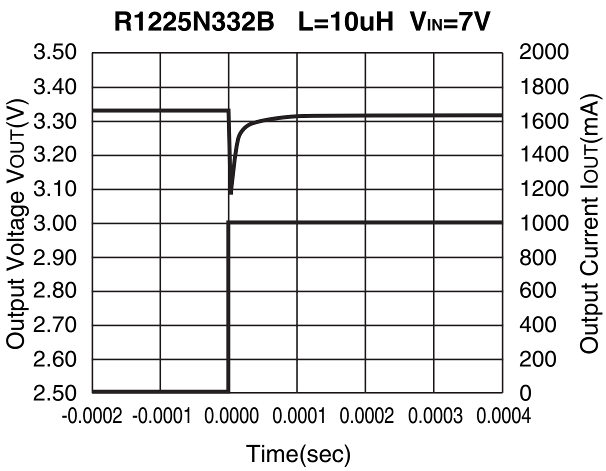


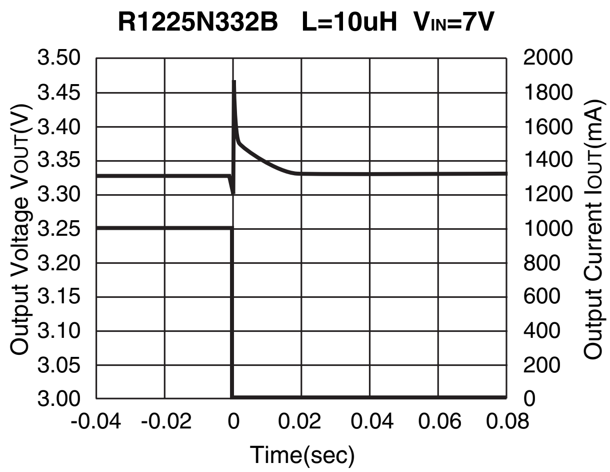

R1225N332A L=10uH VIN=7V
Output Voltage VOUT(V)
Output Current IOUT(mA)
Time(sec)


R1225N332A L=10uH VIN=7V
Output Voltage VOUT(V)
Output Current IOUT(mA)
Time(sec)


R1225N332B L=10uH VIN=4.8V
Output Voltage VOUT(V)
Output Current IOUT(mA)
Time(sec)

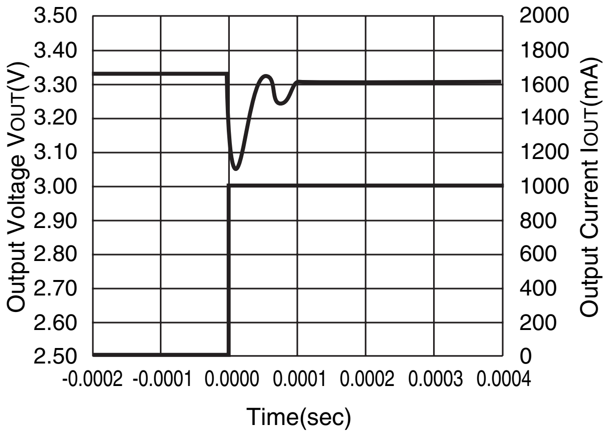

R1225N332B L=10uH VIN=4.8V
Output Voltage VOUT(V)
Output Current IOUT(mA)
Time(sec)


R1225N332B L=10uH VIN=7V
Output Voltage VOUT(V)
Output Current IOUT(mA)
Time(sec)

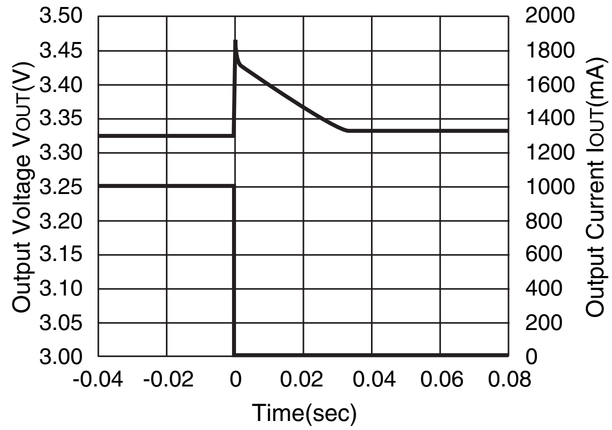

R1225N332B L=10uH VIN=7V
Output Voltage VOUT(V)
Output Current IOUT(mA)
Time(sec)

RICOH

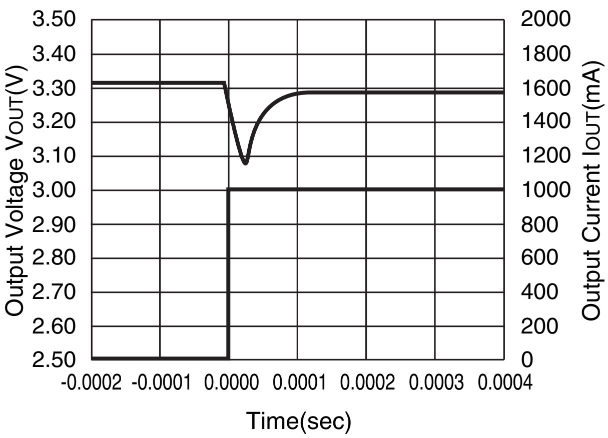
R1225N332J L=27uH V_{IN}=4.8V



R1225N332J L=27uH V_{IN}=4.8V



R1225N332J L=10uH V_{IN}=7V



R1225N332J L=27uH V_{IN}=7V