AS1224N

20uA Quiescent, 180/300/500kHz, Step-Down DCDC

From Santa Clara, United States of America

Leading Performance: 2.3-18.5V Input, 1.2-6.0V (0.1V step), 1.0V-Vin Output

Features

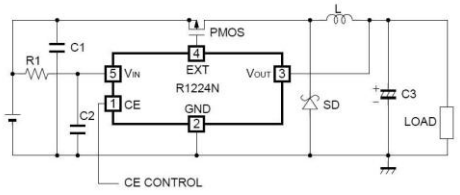
- High Efficiency Step Down Converter
- Typical Efficiency 90%
- Wide Vin Range from 2.3V to 18.5V
- 180/300/500kHz Fixed Frequency Low Noise Operation
- Power Save Mode at Light Load Currents
- Low Quiescent Current: Typ. 20uA
- Low Dropout operation: 100% Duty Cycle
- Soft Start
- Under-voltage Lockout (UVLO)
- Available package: SOT-23-5

Applications

- Hand-held communication Equipment
- Cameras, video instruments
- Battery-powered equipment
- Household electrical appliances

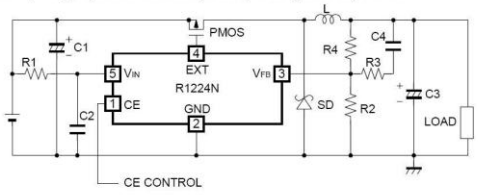
Typical Application

(1) Fixed Output Voltage Type (AS1224Nxx2E/F/G/H/L/M except xx=10)



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

(2) Adjustable Output Type (AS1224N102G/H/M) Example: Output Voltage=3.2V



PMOS: HAT1044M (Hitachi) L : CR105-270MC (Sumida, 27μH)
SD1 : RB063L-30 (Rohm) C3 : 47μF (Tantalum Type)
C1 : 10μF (Ceramic Type) C2 : 0.1μF (Ceramic Type) C4: 1000pF (Ceramic Type)
R1 : 10Ω, R2=22kΩ, R3=2.7kΩ, R4=33kΩ

Overview

The AS1224N Series are 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 phase compensation circuit, a soft-start circuit, a protection circuit, a PWM/VFM alternative circuit, a chip enable circuit, resistors for output voltage detect, and input voltage detect circuit. A low ripple and high efficiency step-down DC/DC converter can be easily composed of this IC with only several external components, or a power-transistor, an inductor, a diode and capacitors. Output Voltage is fixed or can be adjustable with external resistors (Adjustable types are without PWM/VFM alternative circuit).

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. Several types of the AS1224Nxxx, which are without a PWM/VFM alternative circuit, are also available.

If the term of maximum duty cycles keeps on a certain time, the embedded protection circuit works. The protection circuit is Reset-type protection circuit, and it works to restart the operation with soft-start and repeat this operation until maximum duty cycle condition is released. When the cause of large load current or something else is removed, the operation is automatically released and returns to normal operation. Further, built-in UVLO function works when the input voltage is equal or less than UVLO threshold, it makes this IC be standby and suppresses the consumption current and avoid an unstable operation.

Selection Guide

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
AS1224Nxx2*-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

xx: The output voltage can be designated in the range from 1.2V(12) to 6.0V(60) in 0.1V steps.
(For externally adjustable output voltage type, feedback voltage of 1.0V(10).)

* : The oscillator frequency, the modulation method and the output voltage adjustment are options as follows.

Code	Oscillator frequency	PWM/VFM alternative circuit	Output voltage adjustment
E	300kHz	Yes	No
F	500kHz	Yes	No
G	300kHz	No	Yes
H	500kHz	No	Yes
L	180kHz	Yes	No
M	180kHz	No	Yes

Pin Description

Pin No	Symbol	Pin Description
1	CE	Chip Enable Pin ("H" Active)
2	GND	Ground Pin
3	V_{OUT} (V_{FB})	Pin for Monitoring Output Voltage (Feedback Voltage)
4	EXT	External Transistor Drive Pin (CMOS Output)
5	V_{IN}	Power Supply Pin

Electrical Characteristics R1224Nxx2x (x=E/F/G/H/L/M, Ta=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} ×0.98	V_{SET}	V_{SET} ×1.02	V
$\Delta V_{OUT}/\Delta Topt$	Step-down Output Voltage Temperature Coefficient	$-40°C\leq Topt\leq 85°C$		±100		ppm/°C
fosc	Oscillator Frequency	$V_{IN}=V_{CE}=V_{SET}+1.5V$, $I_{OUT}=-100mA$ L/M Version E/G Version F/H Version	144 240 400	180 300 500	216 360 600	kHz
$\Delta fosc/\Delta Topt$	Oscillator Frequency Temperature Coefficient	$-40°C\leq Topt\leq 85°C$		±0.2		%/°C
I_{DD1}	Supply Current 1	$V_{IN}=V_{CE}=V_{OUT}=18.5V$ E/F/L/M Version G version H version		20 30 40	50 60 80	µA
Istandby	Standby Current	$V_{IN}=18.5V$, $V_{CE}=0V$, $V_{OUT}=0V$		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_{CEH}	CE "H" Input Current	$V_{IN}=V_{CE}=V_{OUT}=18.5V$		0	0.5	µA
I_{CEL}	CE "L" Input Current	$V_{IN}=V_{OUT}=18.5V$, $V_{CE}=0V$	−0.5	0		µA
V_{CEH}	CE "H" Input Voltage	$V_{IN}=8V$, $I_{OUT}=-10mA$	1.5			V
V_{CEL}	CE "L" Input Voltage	$V_{IN}=8V$, $I_{OUT}=-10mA$			0.3	V
Maxduty	Oscillator Maximum Duty Cycle		100			%
VFMdty	VFM Duty Cycle	E/F/L Version		35		%
V_{UVLO1}	UVLO Voltage	$V_{IN}=V_{CE}=2.5V$ to 1.5V, $V_{OUT}=0V$	1.8	2.0	2.2	V
V_{UVLO2}	UVLO Release Voltage	$V_{IN}=V_{CE}=1.5V$ to 2.5V, $V_{OUT}=0V$		V_{UVLO1} +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	$V_{IN}=V_{CE}=V_{SET}+1.5V$ $V_{OUT}=V_{SET}+1.5V\rightarrow 0V$	5	15	30	ms

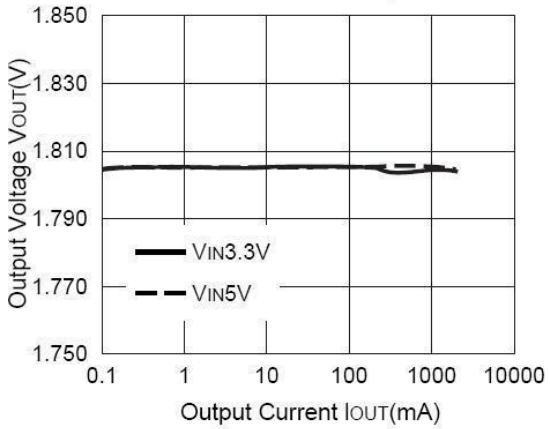
Electrical Characteristics AS1224N102x (x=G/H/M, Ta=25 C)

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		2.3		18.5	V
V_{FB}	Feedback Voltage	V_{IN}=V_{CE}=3.0V, I_{OUT}=−100mA	0.98	1.00	1.02	V
$\Delta V_{FB}/\Delta Topt$	Feedback Voltage Temperature Coefficient	−40°C≤Topt≤85°C		±100		ppm/°C
fosc	Oscillator Frequency	V_{IN}=V_{CE}=2.5V, I_{OUT}=−100mA M Version G Version H Version	144 240 400	180 300 500	216 360 600	kHz
$\Delta fosc/\Delta Topt$	Oscillator Frequency Temperature Coefficient	−40°C≤Topt≤85°C		±0.2		%/°C
I_{DD1}	Supply Current 1	V_{IN}=V_{CE}=V_{FB}=18.5V M Version G Version H Version		20 30 40	50 60 80	μA
Istandby	Standby Current	V_{IN}=18.5V, V_{CE}=0V, V_{FB}=0V		0	0.5	μA
I_{EXTH}	EXT "H" Output Current	V_{IN}=8V, V_{EXT}=7.9V, V_{FB}=8V, V_{CE}=8V		−17	−10	mA
I_{EXTL}	EXT "L" Output Current	V_{IN}=8V, V_{EXT}=0.1V, V_{FB}=0V, V_{CE}=8V	20	30		mA
I_{CEH}	CE "H" Input Current	V_{IN}=V_{CE}=V_{FB}=18.5V		0	0.5	μA
I_{CEL}	CE "L" Input Current	V_{IN}=V_{FB}=18.5V, V_{CE}=0V	−0.5	0		μA
V_{CEH}	CE "H" Input Voltage	V_{IN}=8V, I_{OUT}=−10mA	1.5			V
V_{CEL}	CE "L" Input Voltage	V_{IN}=8V, I_{OUT}=−10mA			0.3	V
Maxduty	Oscillator Maximum Duty Cycle		100			%
V_{UVLO1}	UVLO Voltage	V_{IN}=V_{CE}=2.5V to 1.5V, V_{FB}=0V	1.8	2.0	2.2	V
V_{UVLO2}	UVLO Release Voltage	V_{IN}=V_{CE}=1.5V to 2.5V, V_{FB}=0V		V_{UVLO1} +0.1	2.3	V
tstart	Delay Time by Soft-Start function	V_{IN}=2.5V, I_{OUT}=−10mA V_{CE}=0V→2.5V	5	10	20	ms
tprot	Delay Time for protection circuit	V_{IN}=V_{CE}=2.5V V_{FB}=2.5V→0V	5	15	30	ms

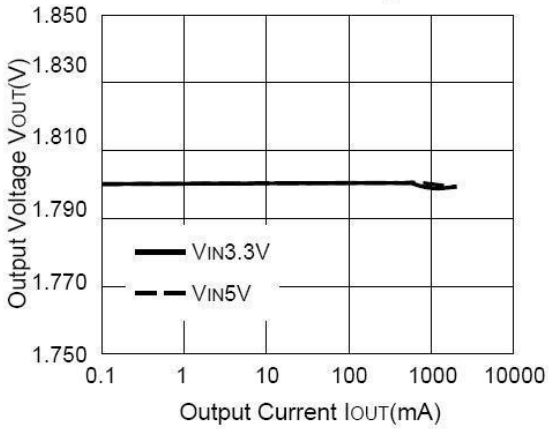
Typical Characteristics

1)Output Voltage vs. Output Current (*Note)

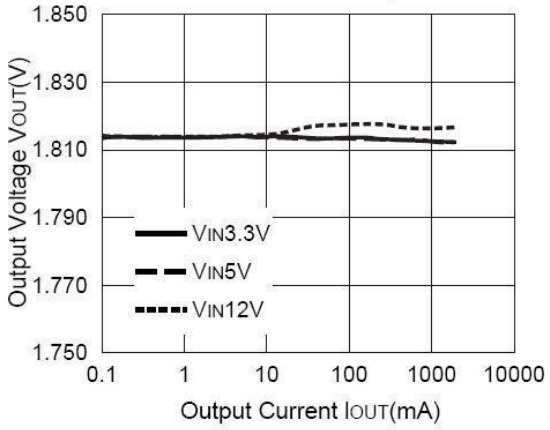
AS1224N182E L=10μH



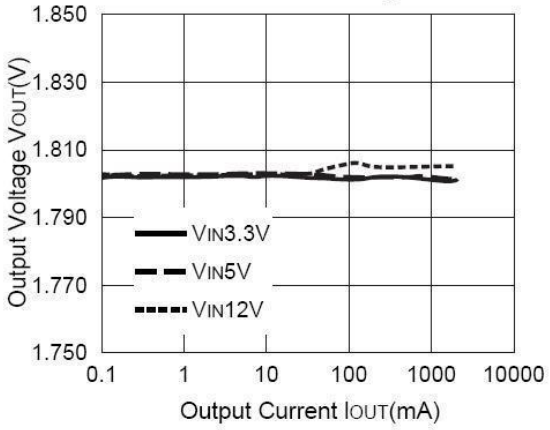
AS1224N182F L=10μH



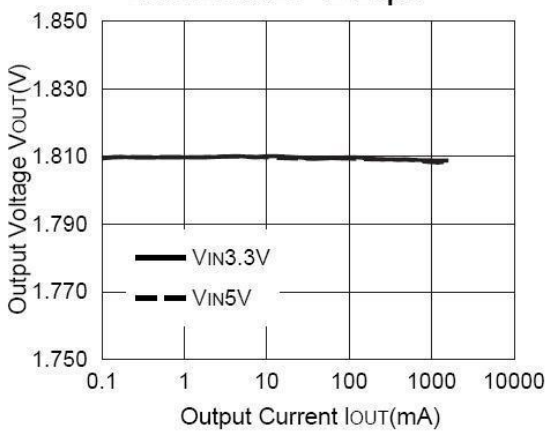
AS1224N182G L=10μH



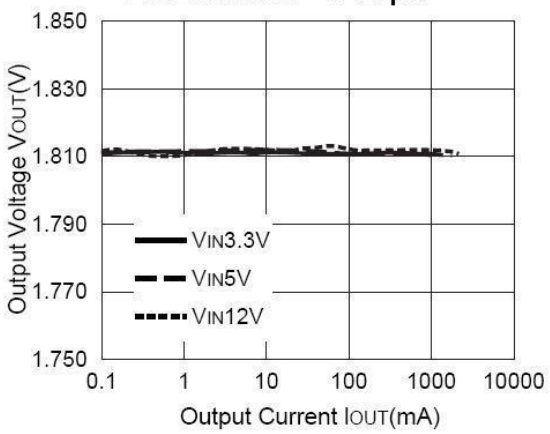
AS1224N182H L=10μH



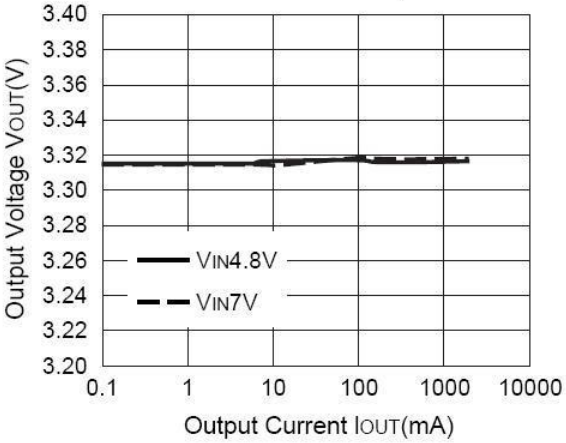
AS1224N182L L=27μH



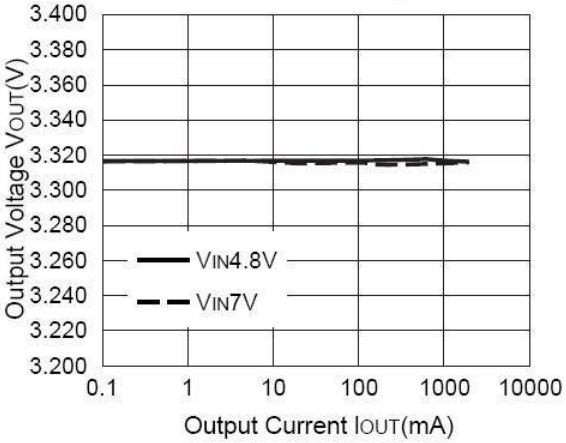
AS1224N182M L=27μH



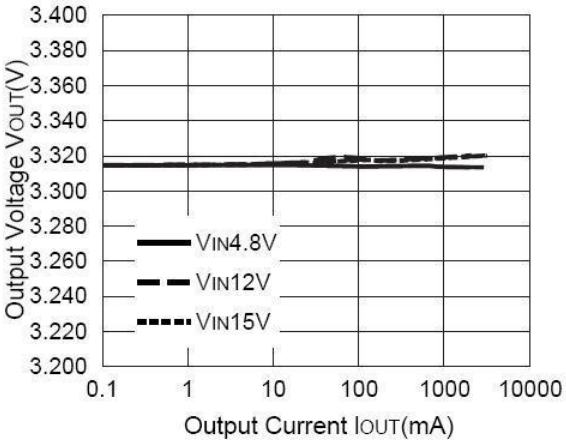
AS1224N332E L=10µH



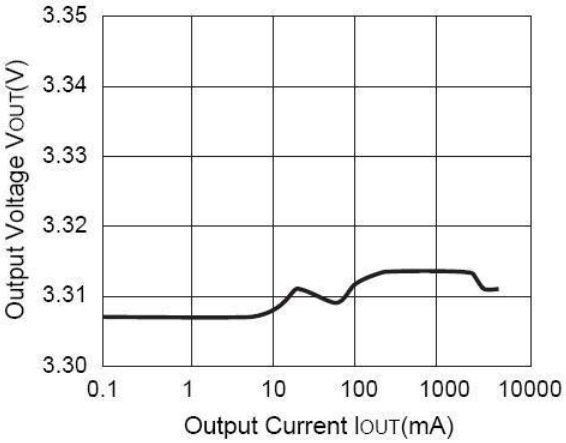
AS1224N332F L=10µH



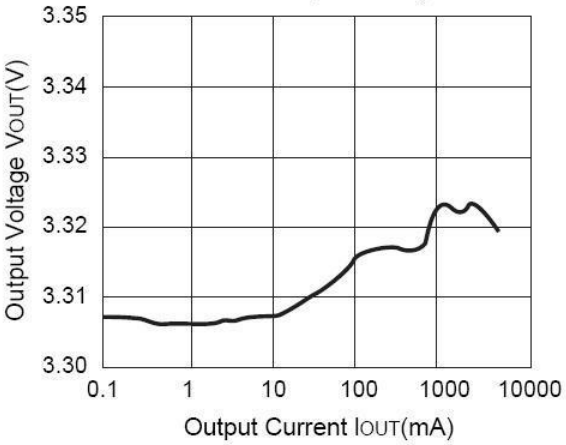
AS1224N332G L=10µH



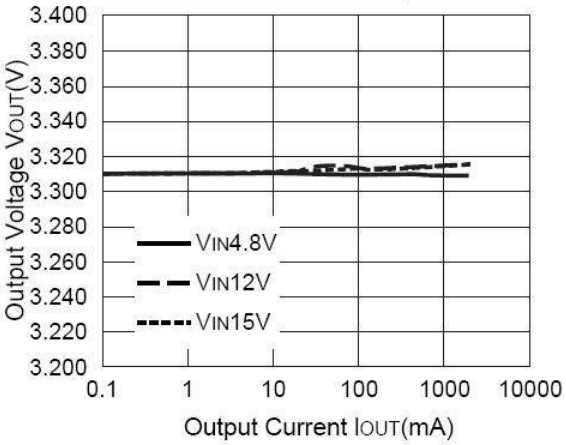
AS1224N332G (VIN=10V)



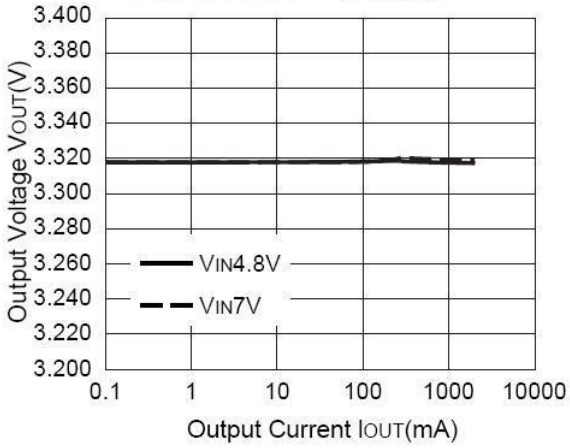
AS1224N332G (VIN=16V)



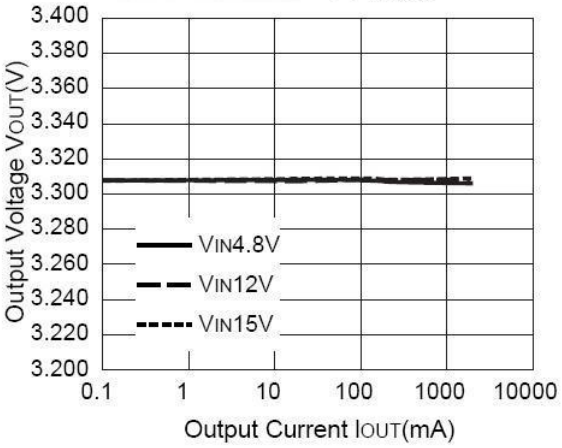
AS1224N332H L=10µH



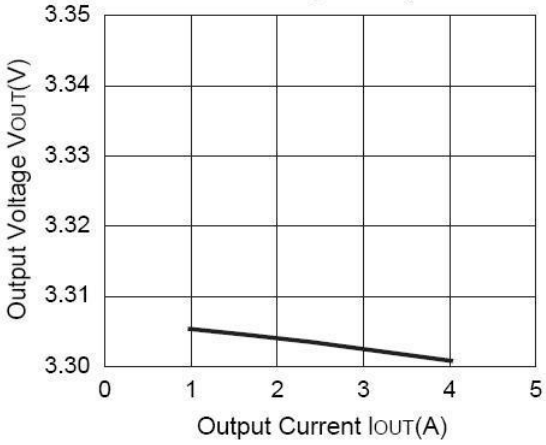
AS1224N332L L=27μH



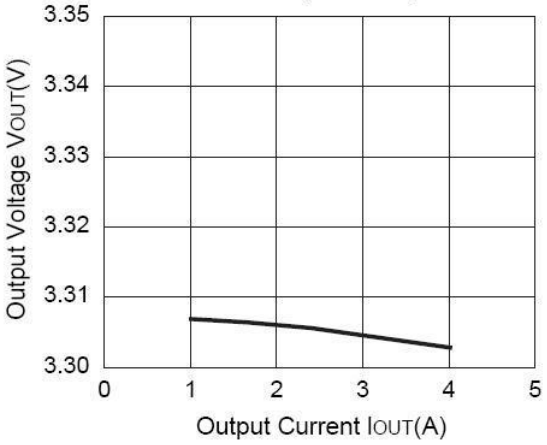
AS1224N332M L=27μH



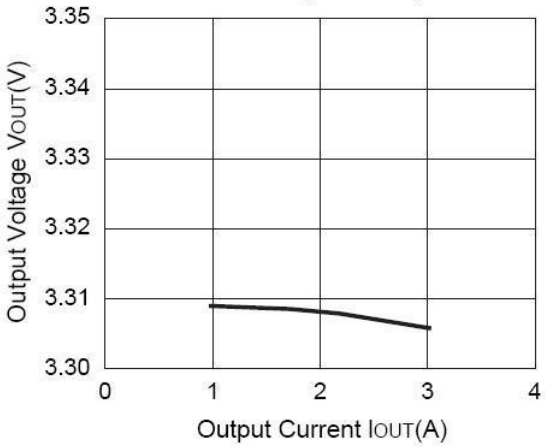
AS1224N332M (VIN=5V)



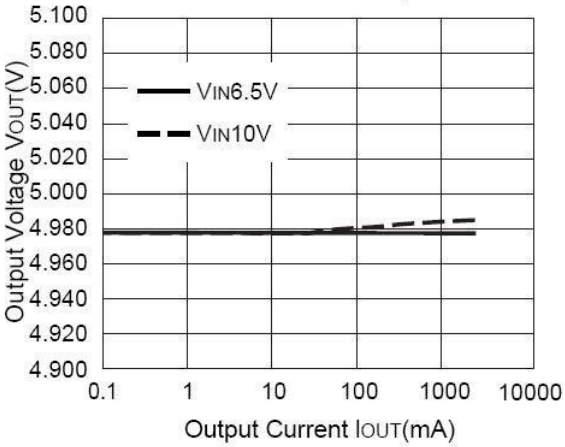
AS1224N332M (VIN=10V)



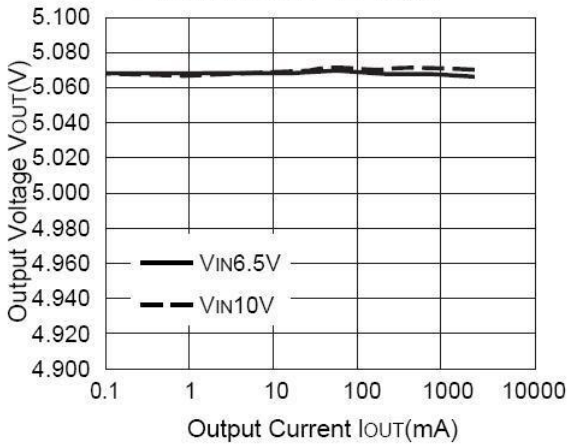
AS1224N332M (VIN=18V)



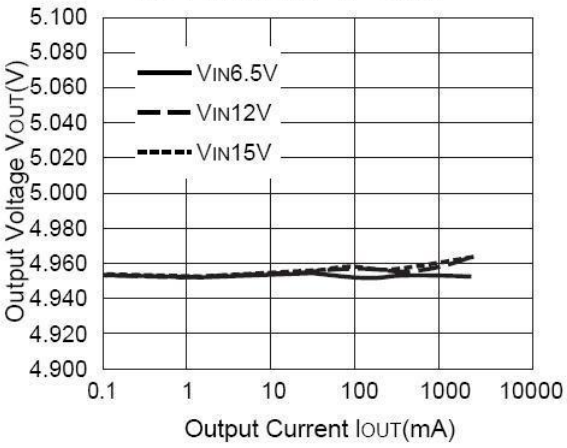
AS1224N502E L=10μH



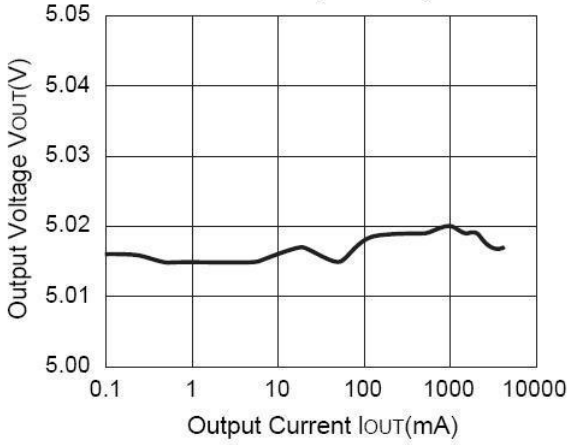
AS1124N502F L=10μH



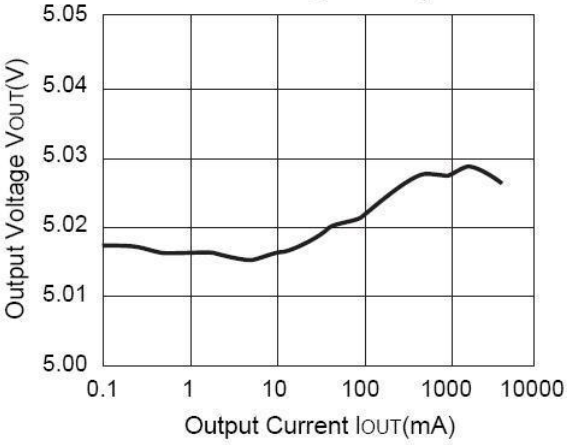
AS1224N502G L=10μH



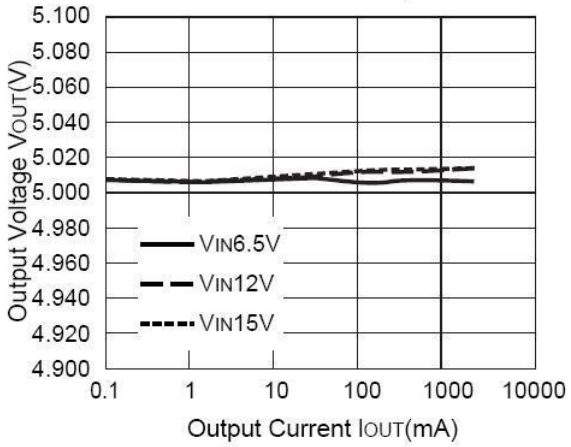
AS1224N502G (VIN=10V)



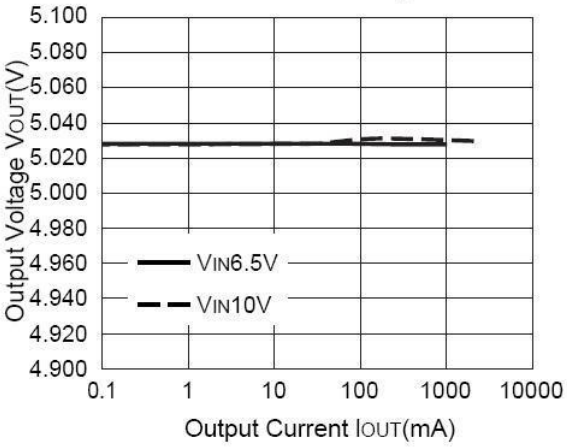
AS1224N502G (VIN=16V)



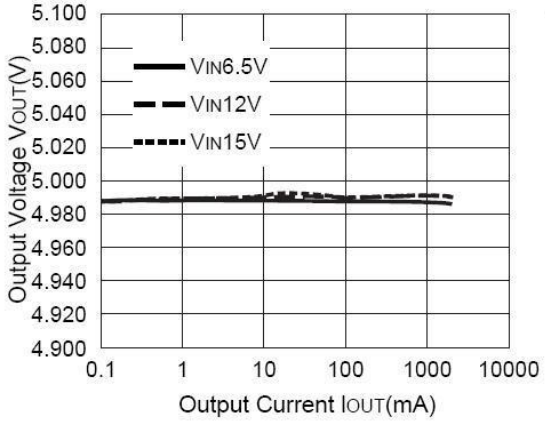
AS1224N502H L=10μH



AS1224N502L L=27μH



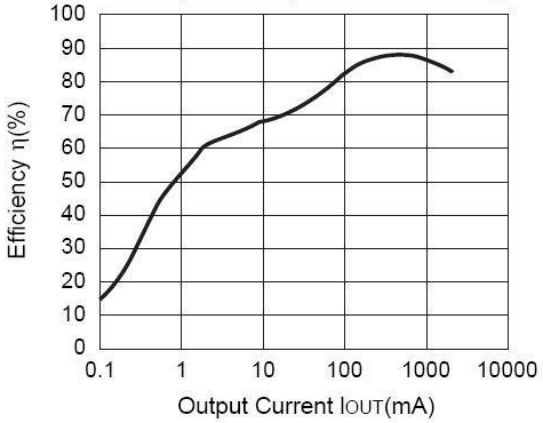
AS1224N502M L=27μH



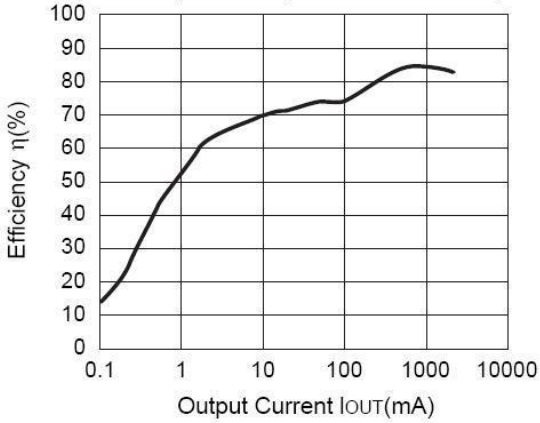
*Note: Typical characteristics 1) are obtained with using the following components;
PMOS: IRF7406 (IR)
L : CDRH127-100MC (Sumida: 10μH)
SD : RB083L-20 (Rohm)
C1 : 25SC47 (Sanyo/OS-con: 47μF/25V)×2
C2 : 0.1μF (Ceramic Type)
C3 : 10SA220 (Sanyo/OS-con: 220μF/10V)
R1 : 10Ω

2) Efficiency vs. Output Current (*Note)

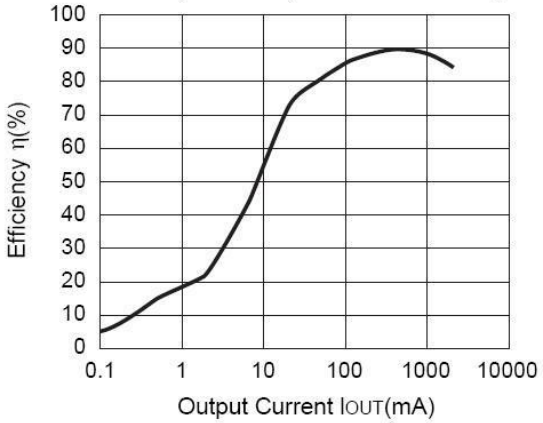
AS1224N182F (VIN=3.3V) CDRH127-10μH



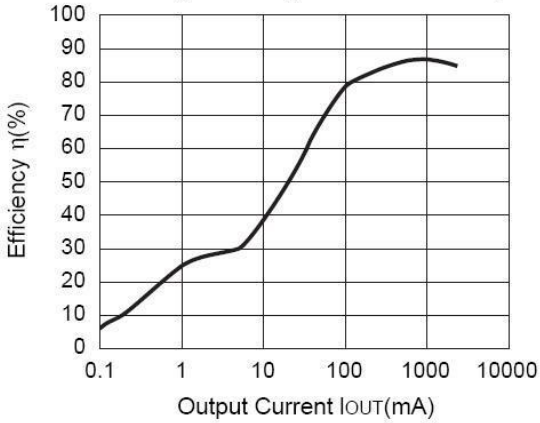
AS1224N182F (VIN=5.0V) CDRH127-10μH



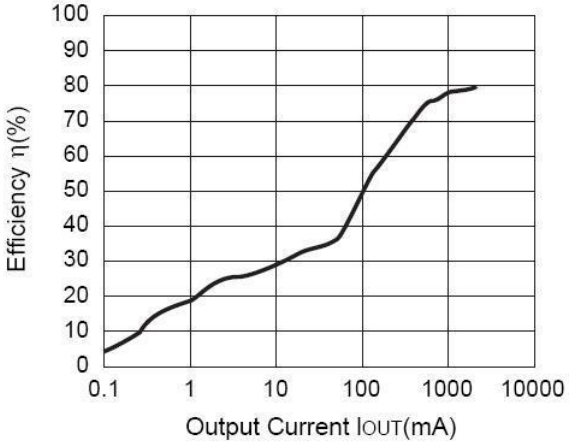
AS1224N182G (VIN=3.3V) CDRH127-10μH



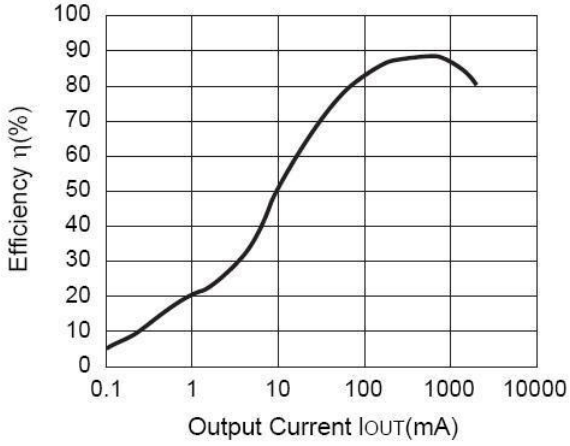
AS1224N182G (VIN=5.0V) CDRH127-10μH



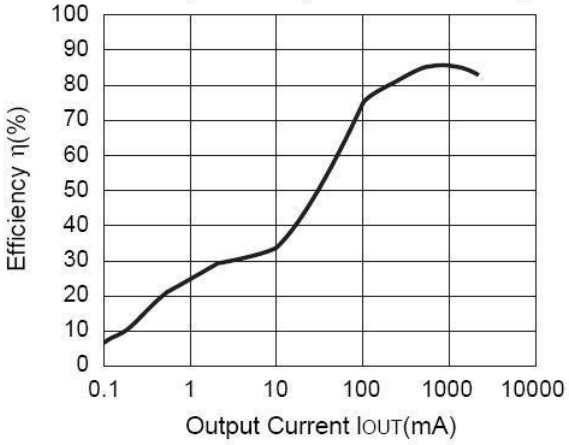
AS1224N182G (V_{IN}=12V) CDRH127-10µH



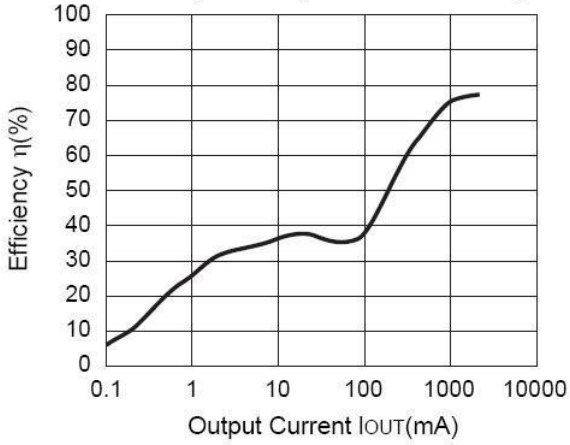
AS1224N182H (V_{IN}=3.3V) CDRH127-10µH



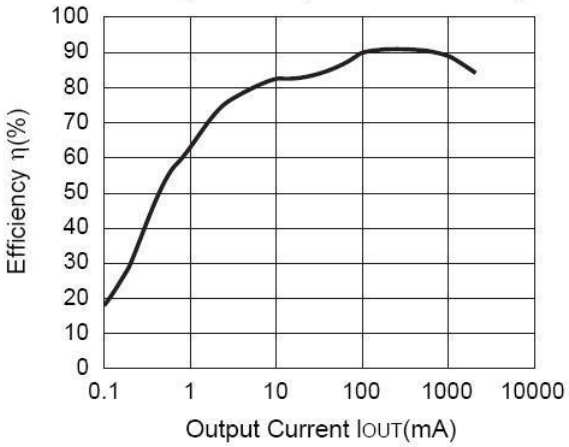
AS1224N182H (V_{IN}=5.0V) CDRH127-10µH



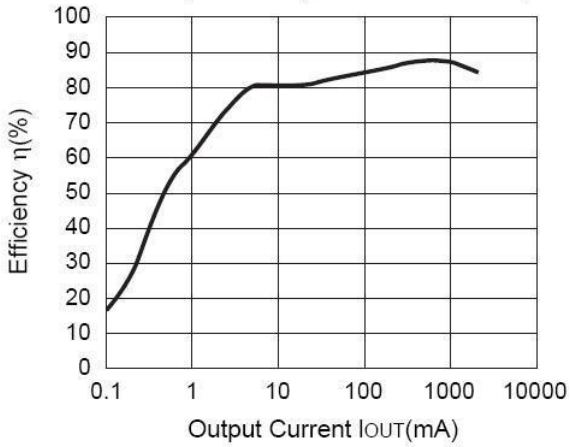
AS1224N182H (V_{IN}=12V) CDRH127-10µH



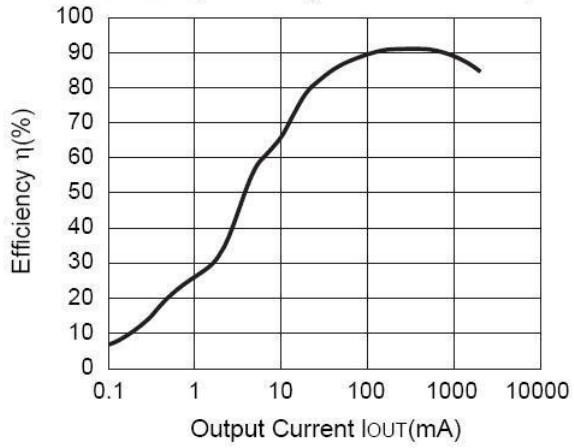
AS1224N182L (V_{IN}=3.3V) CDRH127-27µH



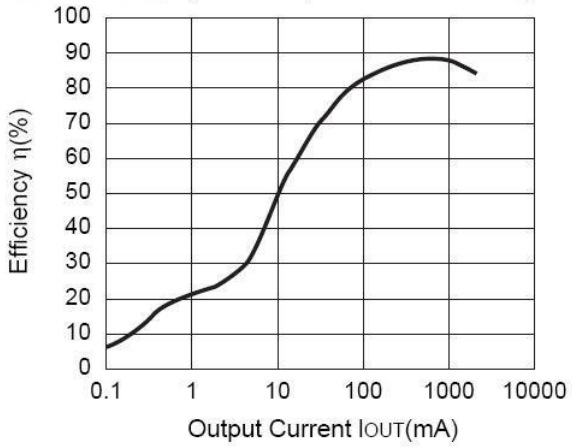
AS1224N182L (V_{IN}=5.0V) CDRH127-27µH



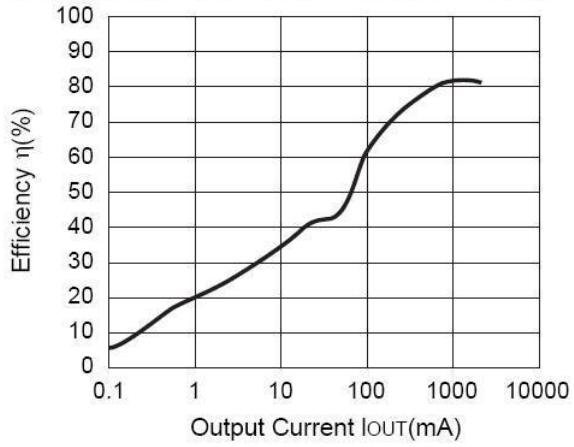
AS1224N182M (V_{IN}=3.3V) CDRH127-27µH



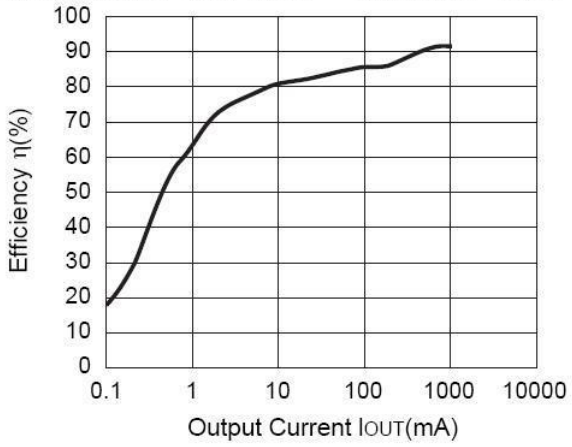
AS1224N182M (V_{IN}=5.0V) CDRH127-27µH



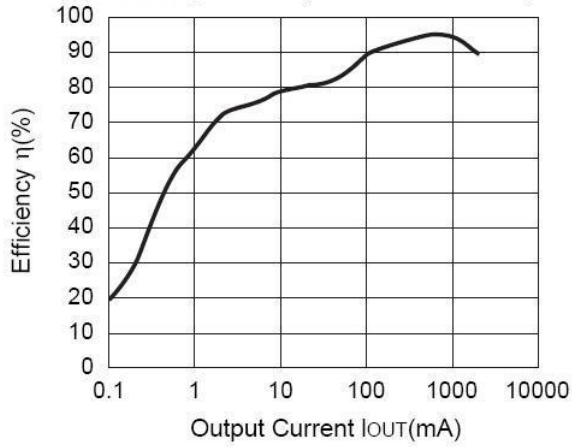
AS1224N182M (V_{IN}=12V) CDRH127-27µH



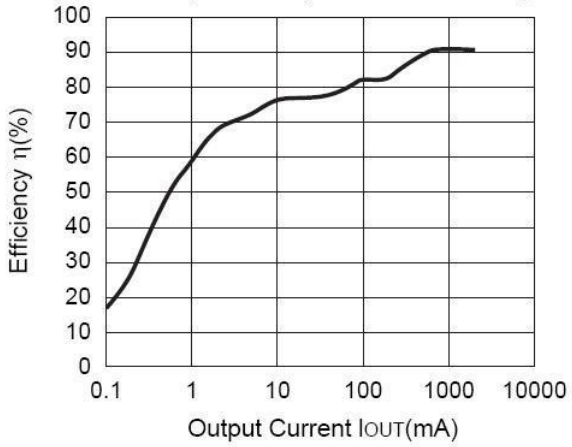
AS1224N332E (V_{IN}=7.0V) CDRH127-10µH



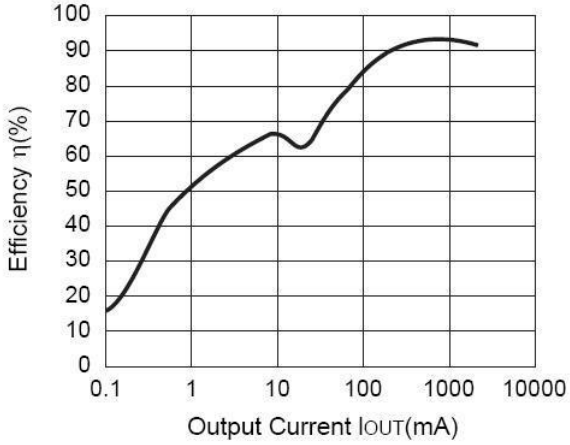
AS1224N332E (V_{IN}=4.8V) CDRH127-10µH



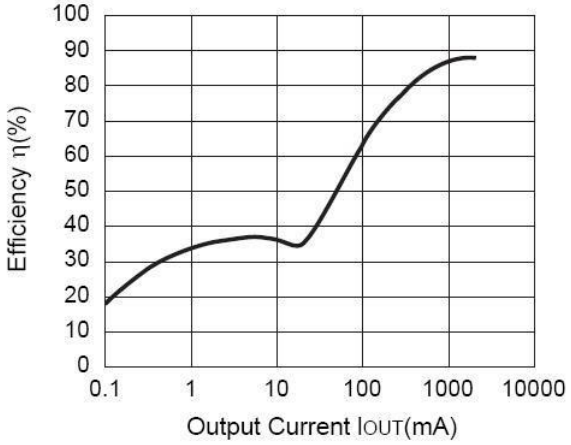
AS1224N332F (V_{IN}=7.0V) CDRH127-10µH



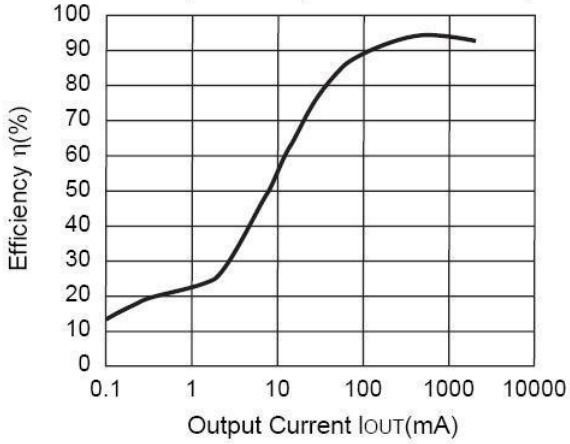
AS1224N332F (V_{IN}=4.8V) CDRH127-10μH



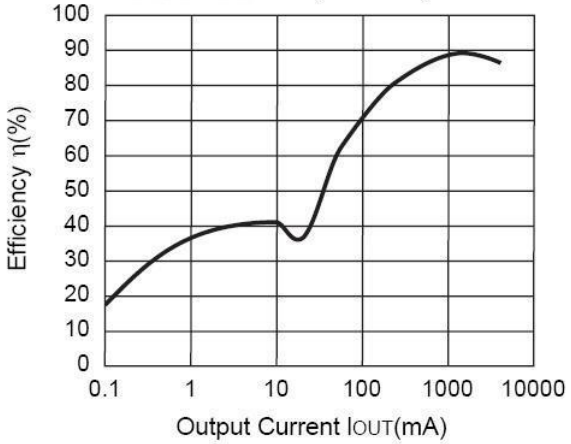
AS1224N332G (V_{IN}=12V) CDRH127-10μH



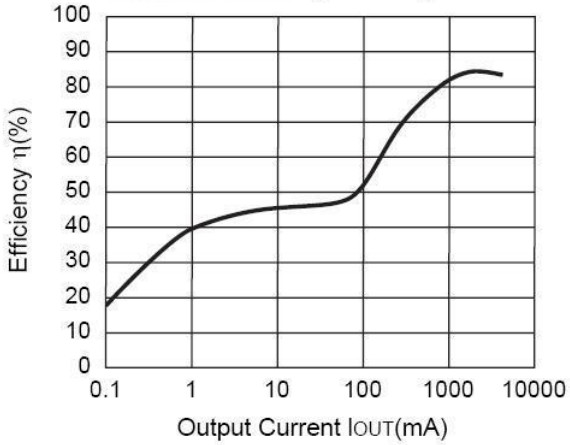
AS1224N332G (V_{IN}=4.8V) CDRH127-10μH



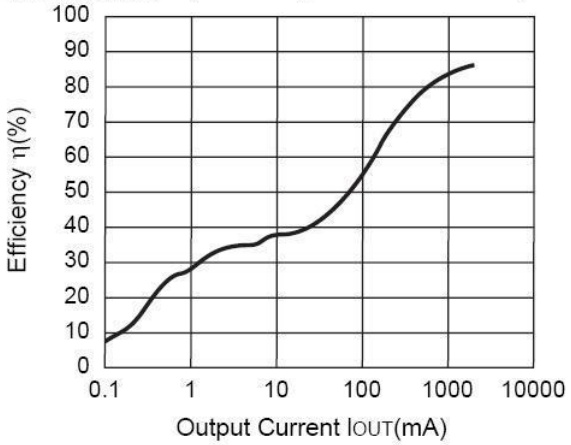
AS1224N332G (V_{IN}=10V)



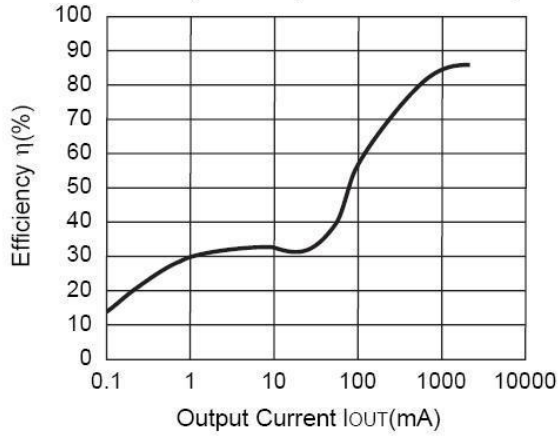
AS1224N332G (V_{IN}=16V)



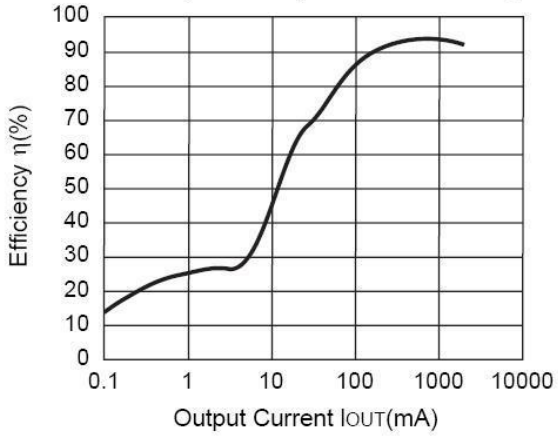
AS1224N332G (V_{IN}=15V) CDRH127-10μH



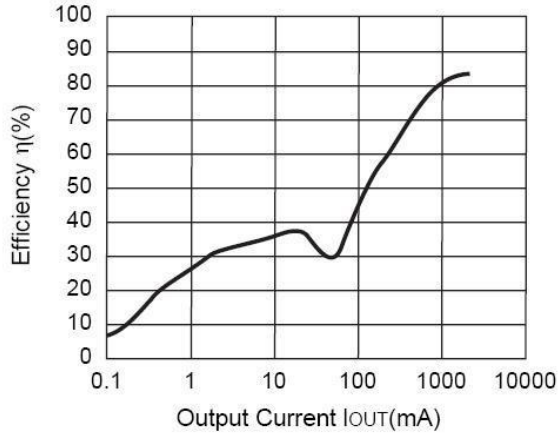
AS1224N332H (V_{IN}=12V) CDRH127-10µH



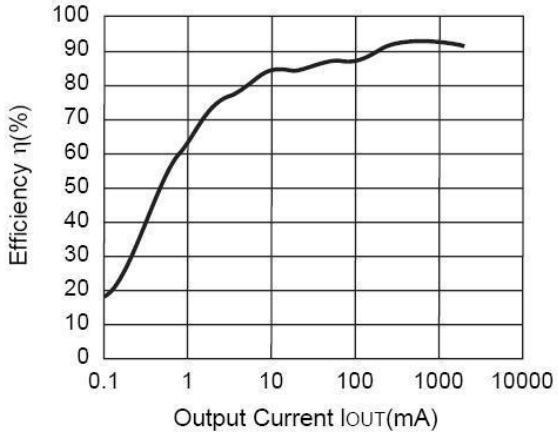
AS1224N332H (V_{IN}=4.8V) CDRH127-10µH



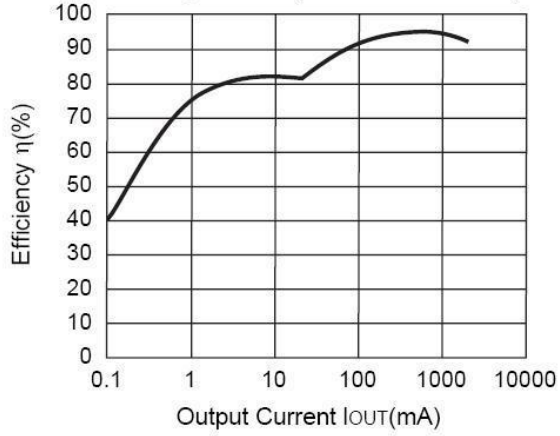
AS1224N332H (V_{IN}=15V) CDRH127-10µH



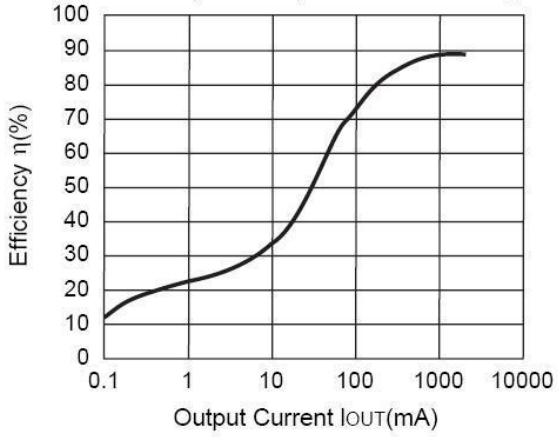
AS1224N332L (V_{IN}=7.0V) CDRH127-27µH



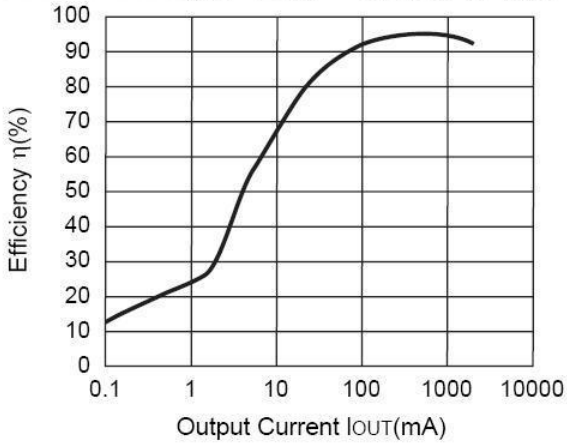
AS1224N332L (V_{IN}=4.8V) CDRH127-27µH



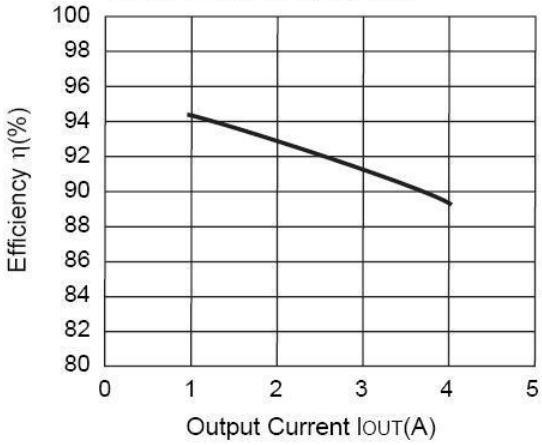
AS1224N332M (V_{IN}=12V) CDRH127-27µH



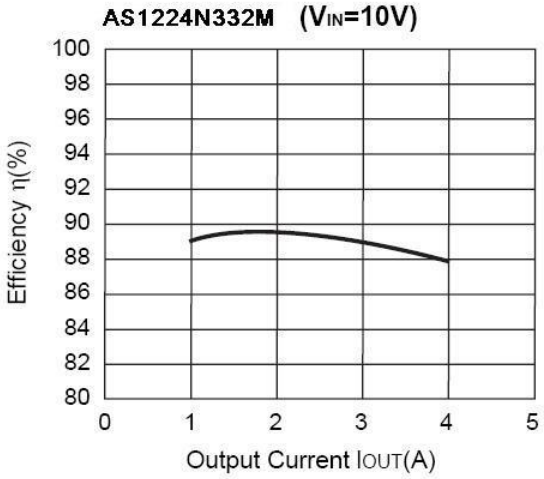
AS1224N332M (V_{IN}=4.8V) CDRH127-27µH



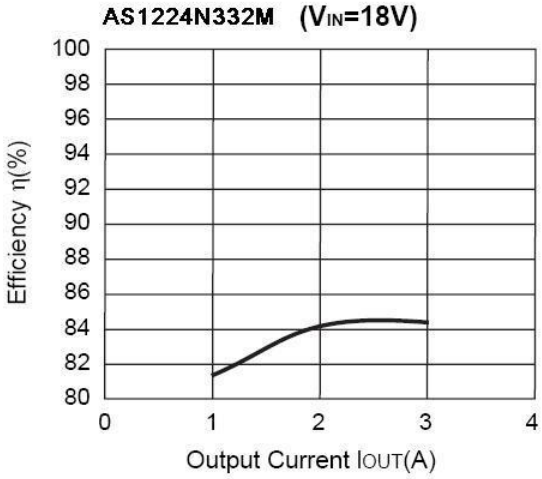
AS1224N332M (V_{IN}=5V)



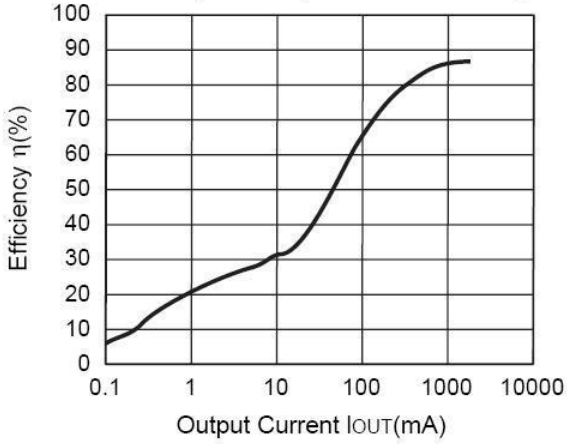
AS1224N332M (V_{IN}=10V)



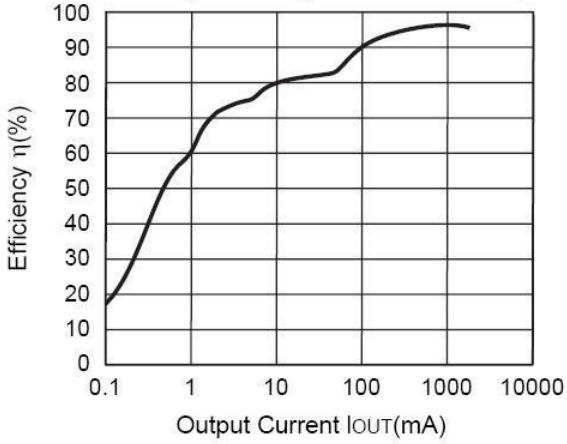
AS1224N332M (V_{IN}=18V)



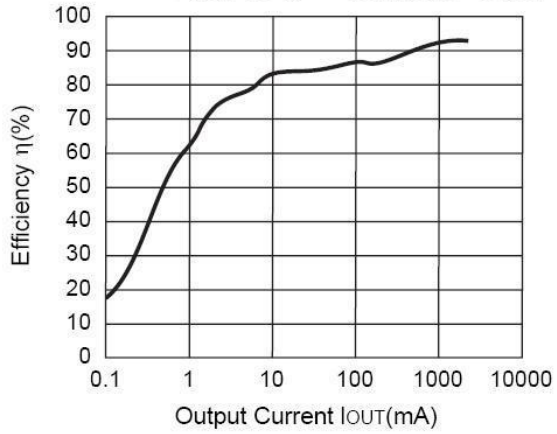
AS1224N332M (V_{IN}=15V) CDRH127-27µH



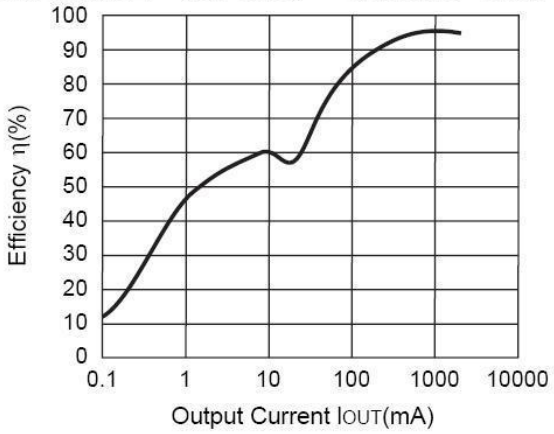
AS1224N502E (V_{IN}=6.5V) CDRH127-10µH



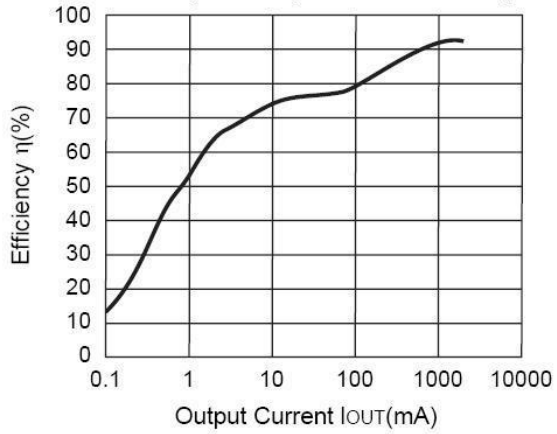
AS1224N502E (V_{IN}=10V) CDRH127-10µH



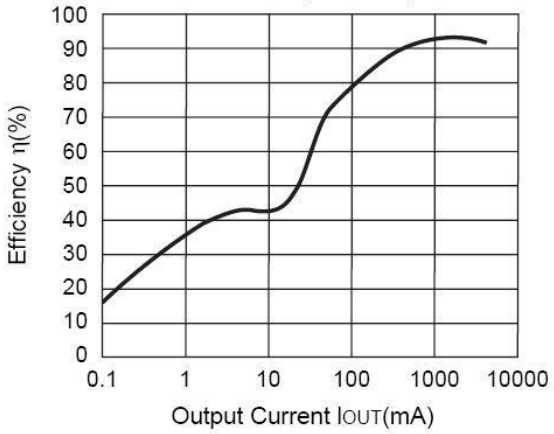
AS1124N502F (V_{IN}=6.5V) CDRH127-10µH



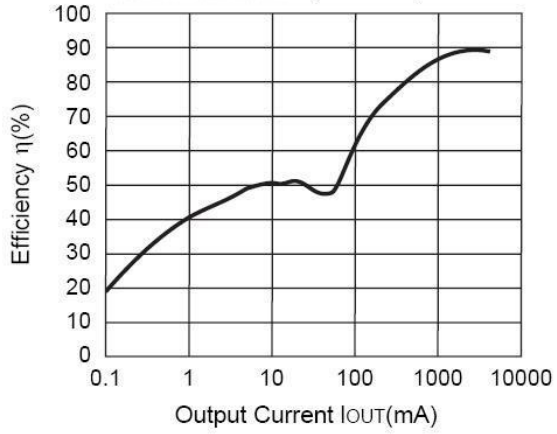
AS1124N502F (V_{IN}=10V) CDRH127-10µH



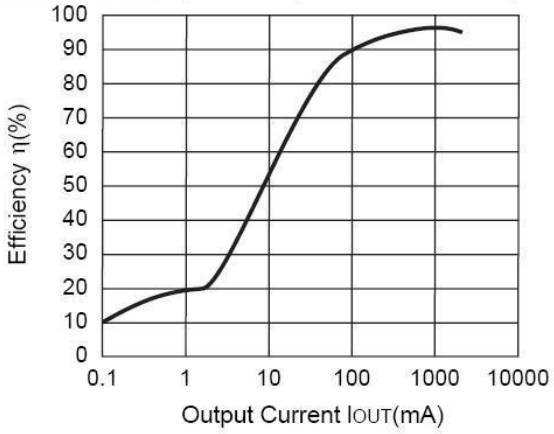
AS1224N502G (V_{IN}=10V)



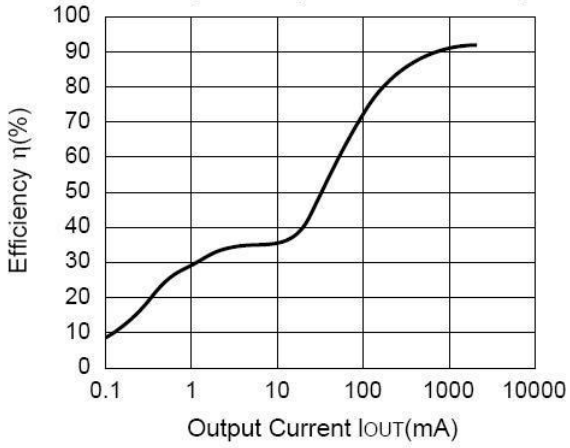
AS1224N502G (V_{IN}=16V)



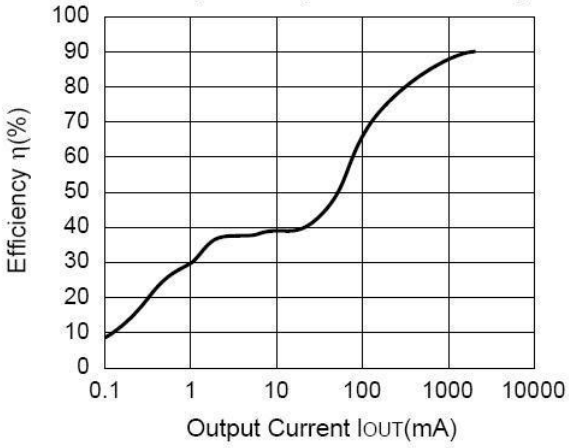
AS1224N502G (V_{IN}=6.5V) CDRH127-10µH



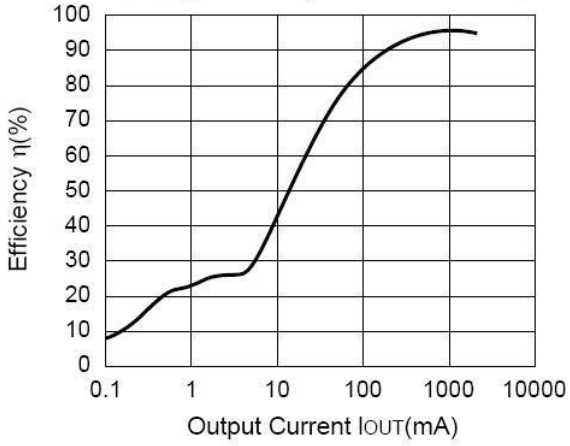
AS1224N502G (V_{IN}=12V) CDRH127-10µH



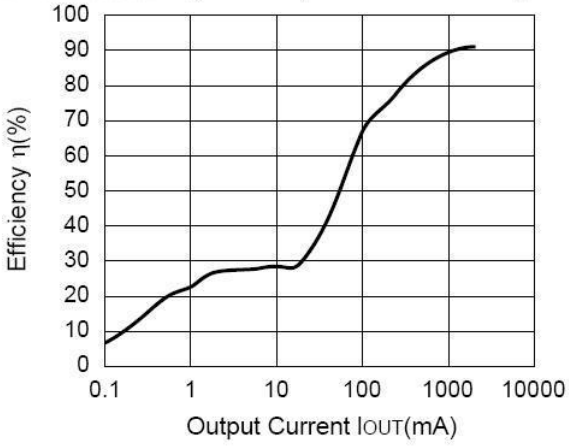
AS1224N502G (V_{IN}=15V) CDRH127-10µH



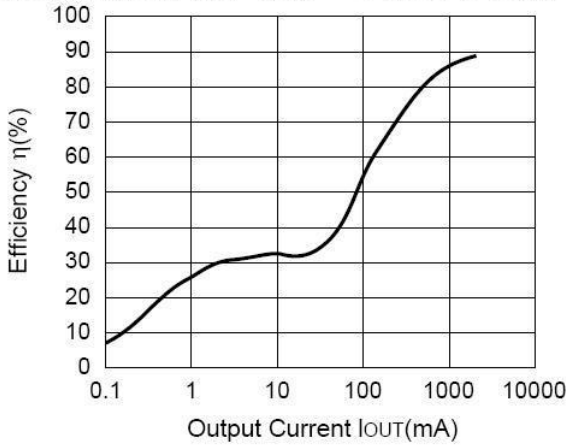
AS1224N502H (V_{IN}=6.5V) CDRH127-10µH



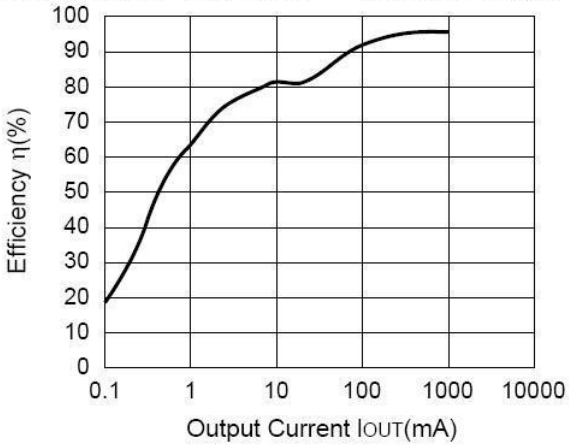
AS1224N502H (V_{IN}=12V) CDRH127-10µH



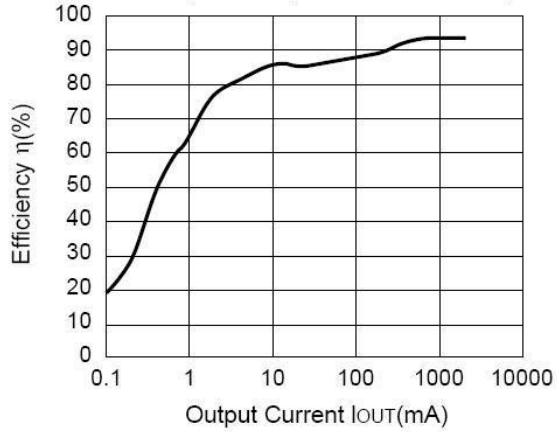
AS1224N502H (V_{IN}=15V) CDRH127-10µH



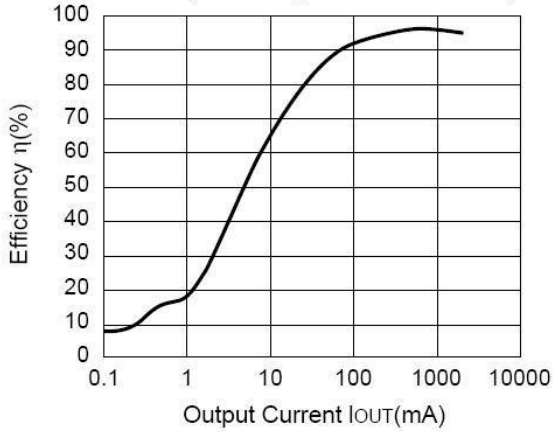
AS1224N502L (V_{IN}=6.5V) CDRH127-27µH



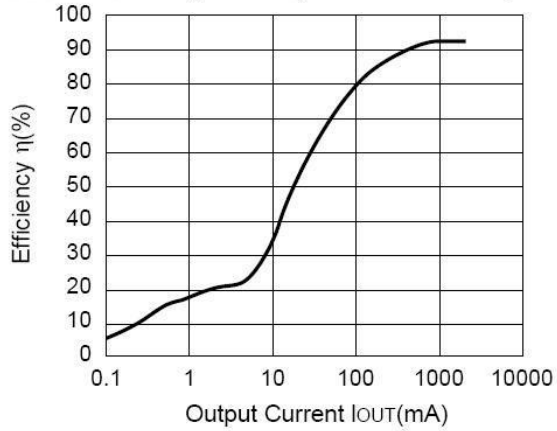
AS1224N502L (V_{IN}=10V) CDRH127-27µH



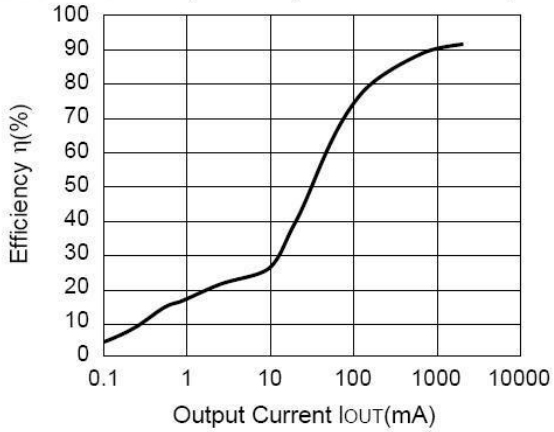
AS1224N502M (V_{IN}=6.5V) CDRH127-27µH



AS1224N502M (V_{IN}=12V) CDRH127-27µH



AS1224N502M (V_{IN}=15V) CDRH127-27µH

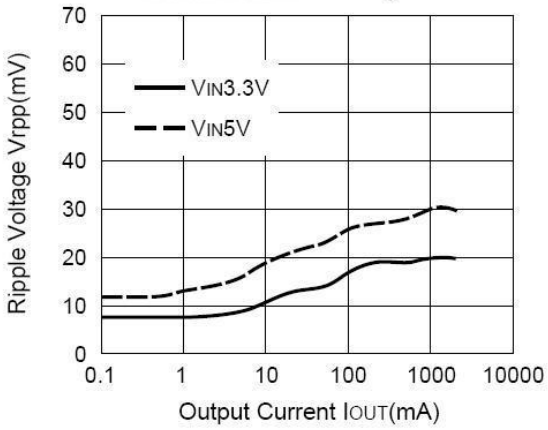


*Note: Typical characteristics 2) are obtained with using the following components;

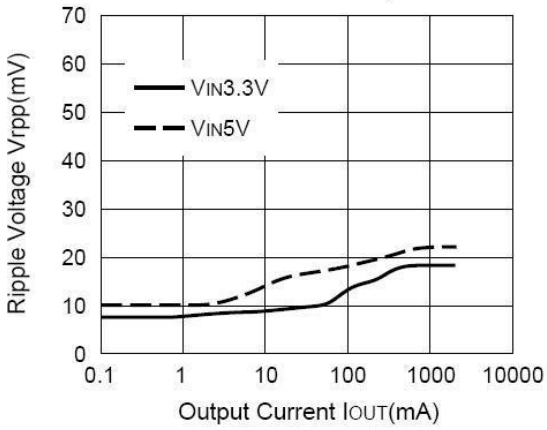
PMOS: IRF7406 (IR)
L : CDRH127-100MC (Sumida: 10µH)
SD : RB083L-20 (Rohm)
C1 : 25SC47 (Sanyo/OS-con: 47µF/25V)×2
C2 : 0.1µF (Ceramic Type)
C3 : 10SA220 (Sanyo/OS-con: 220µF/10V)
R1 : 10Ω

3) Ripple Voltage vs. Output Current

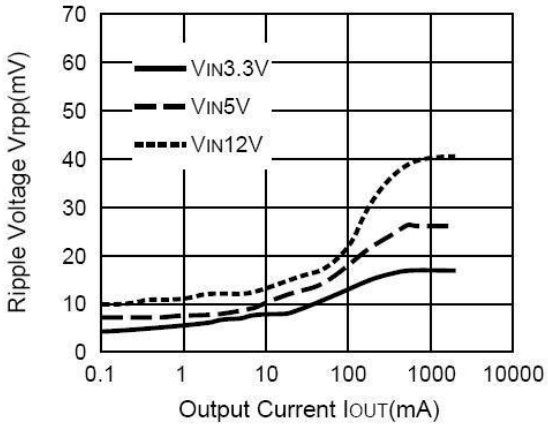
AS1224N182E L=10µH



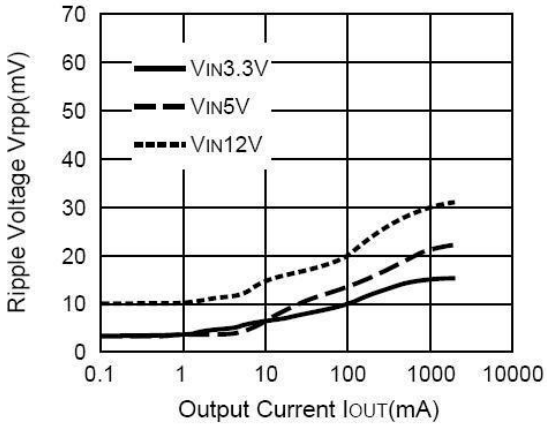
AS1224N182F L=10µH



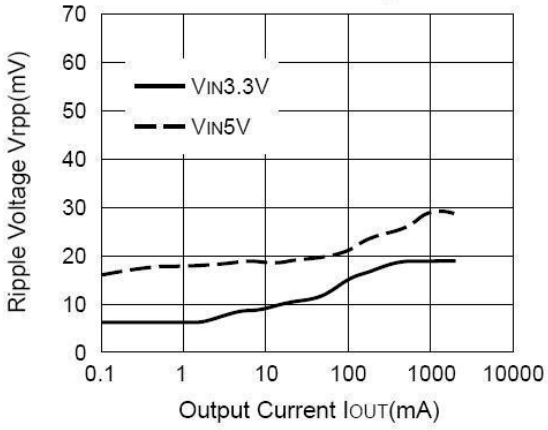
AS1224N182G L=10µH



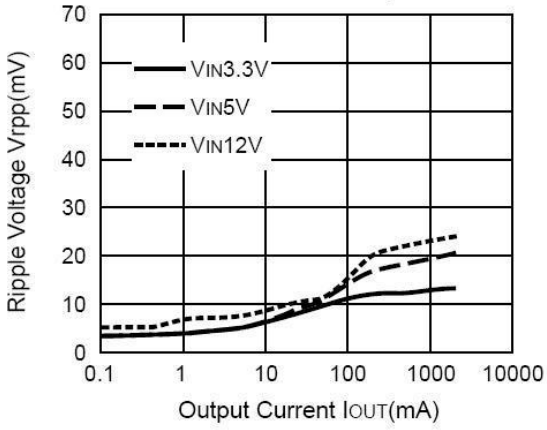
AS1224N182H L=10µH



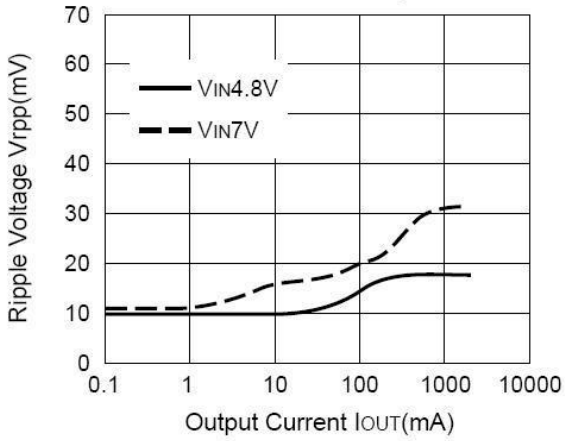
AS1224N182L L=27µH



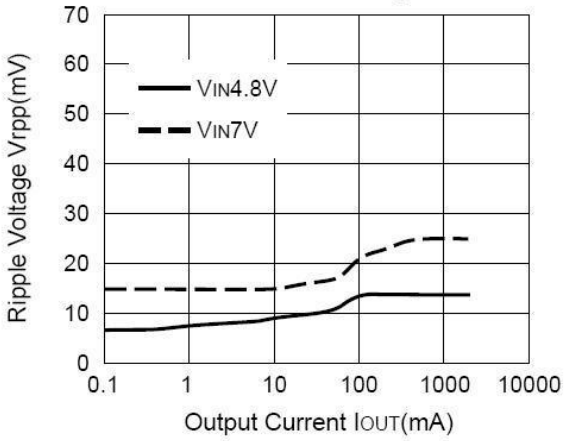
AS1224N182M L=27µH



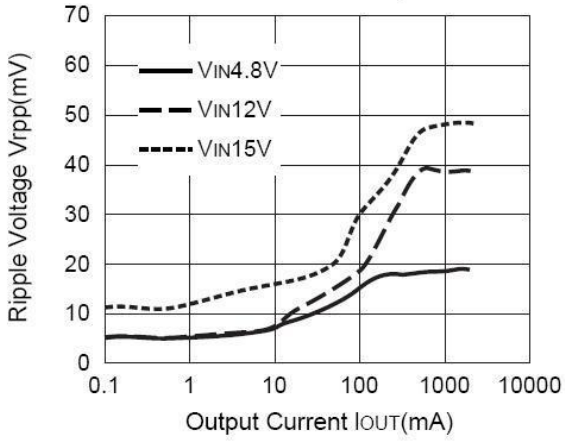
AS1224N332E L=10µH



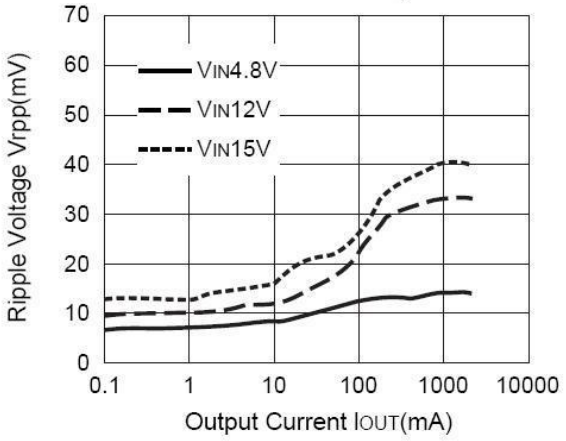
AS1224N332F L=10µH



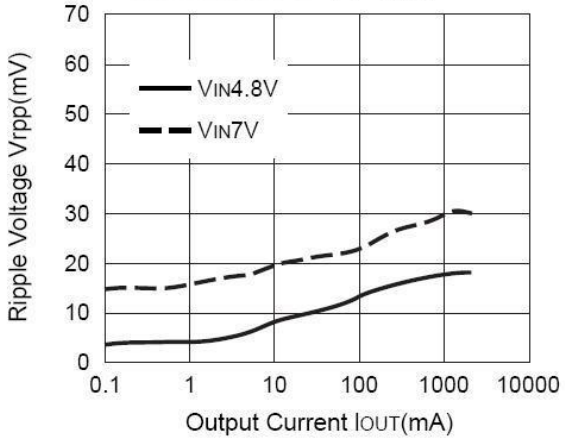
AS1224N332G L=10µH



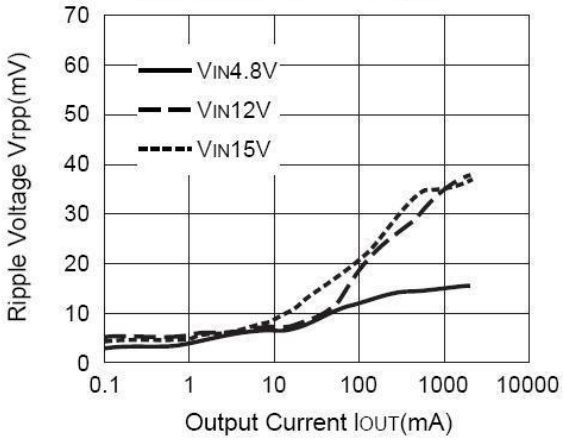
AS1224N332H L=10µH



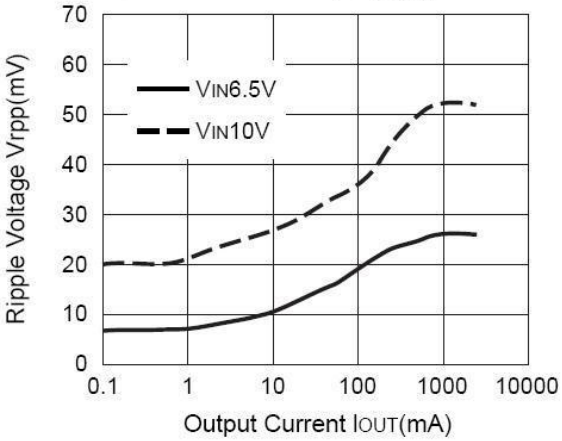
AS1224N332L L=27µH



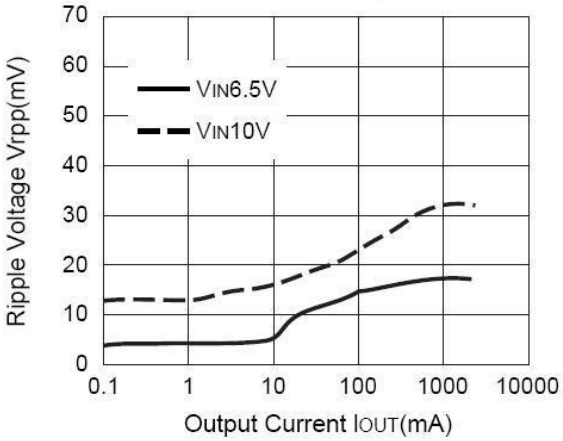
AS1224N332M L=27µH



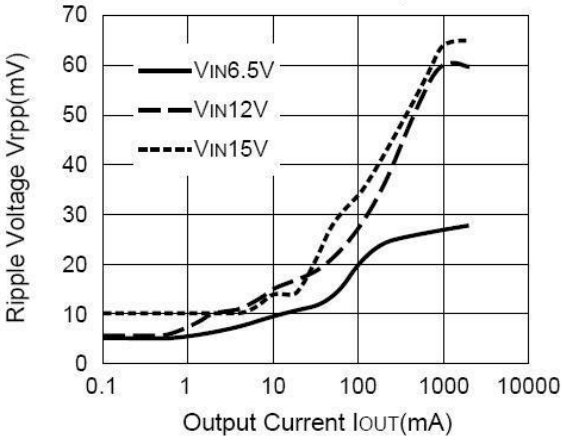
AS1224N502E L=10µH



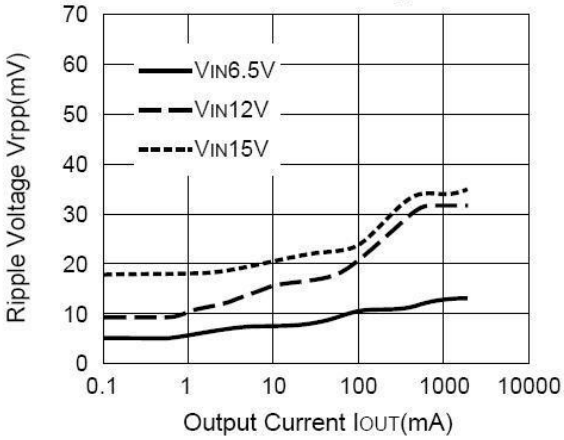
AS1124N502F L=10µH



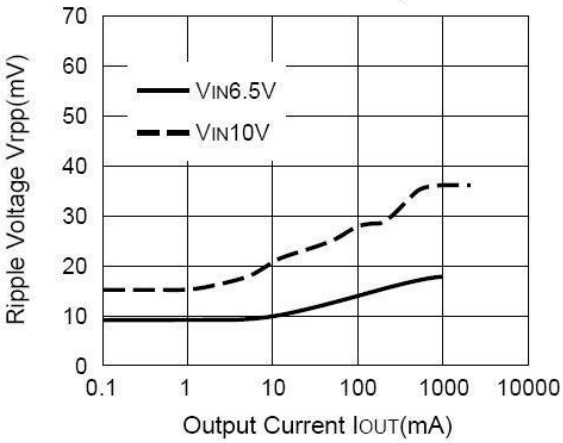
AS1224N502G L=10µH



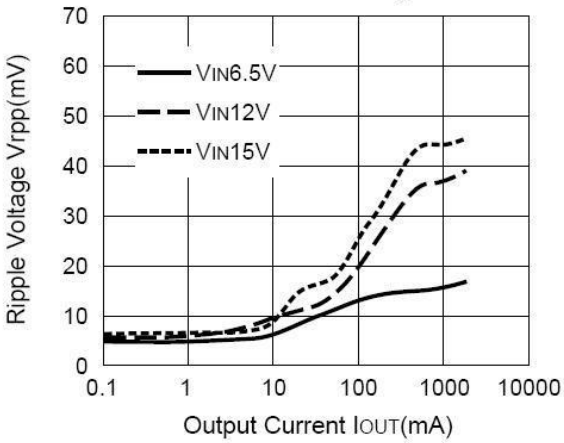
AS1224N502H L=10µH



AS1224N502L L=27µH

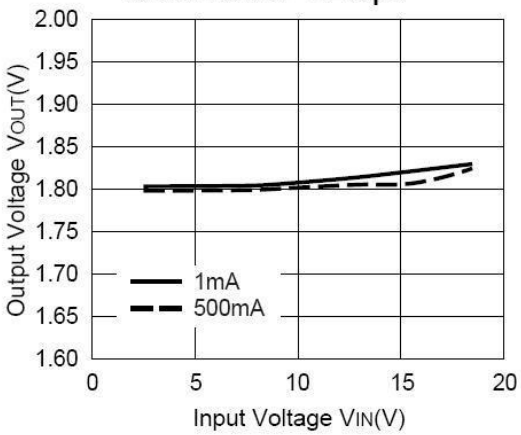


AS1224N502M L=27µH

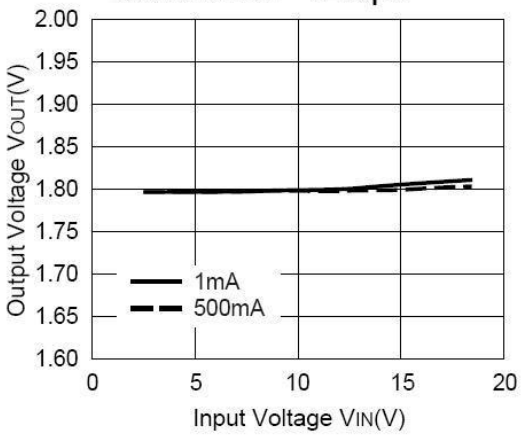


4) Output Voltage vs. Input Voltage

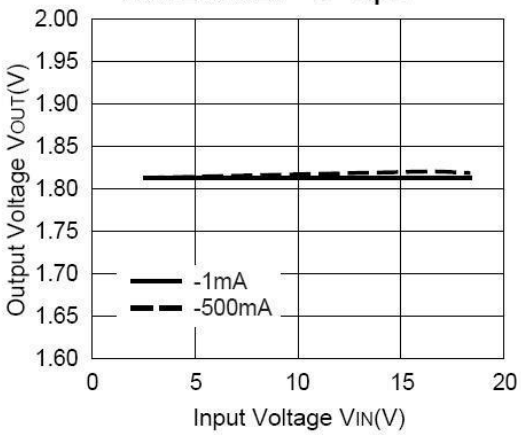
AS1224N182E L=10µH



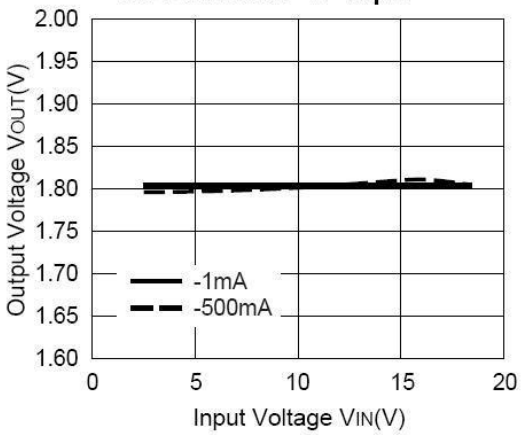
AS1224N182F L=10µH



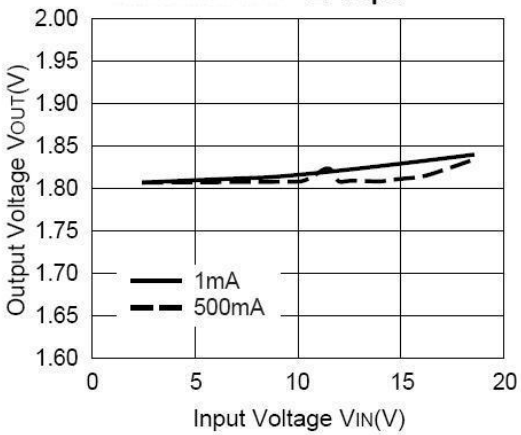
AS1224N182G L=10µH



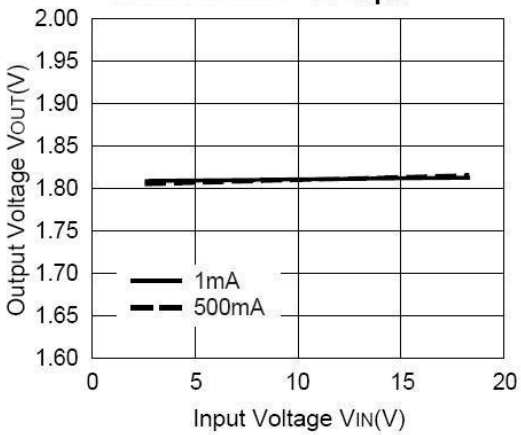
AS1224N182H L=10µH



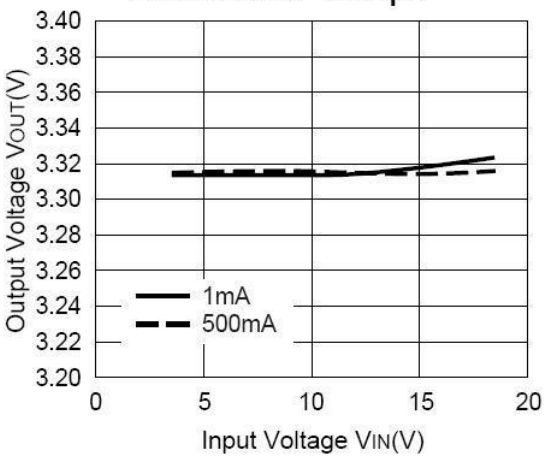
AS1224N182L L=27µH



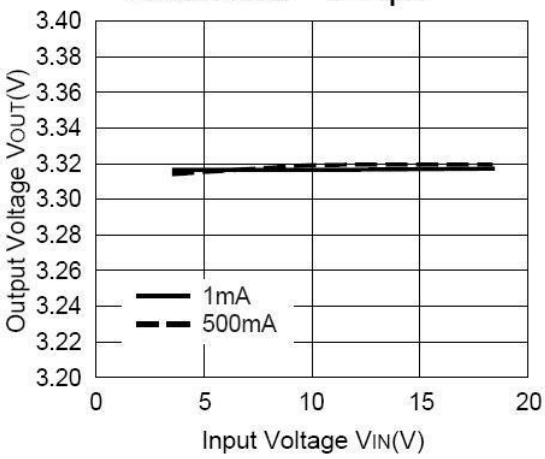
AS1224N182M L=27µH



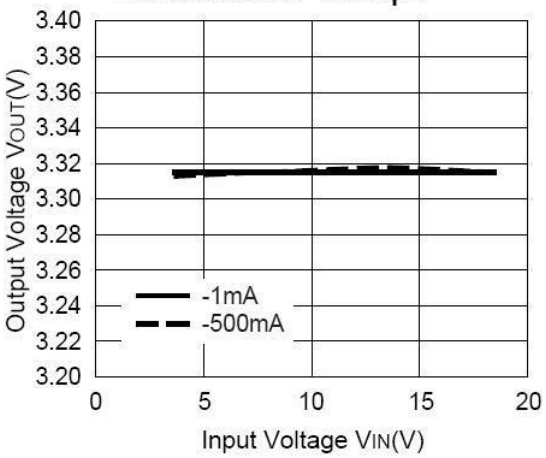
AS1224N332E L=10µH



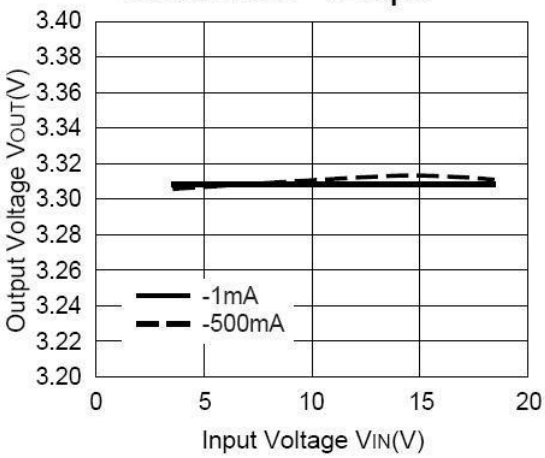
AS1224N332F L=10µH



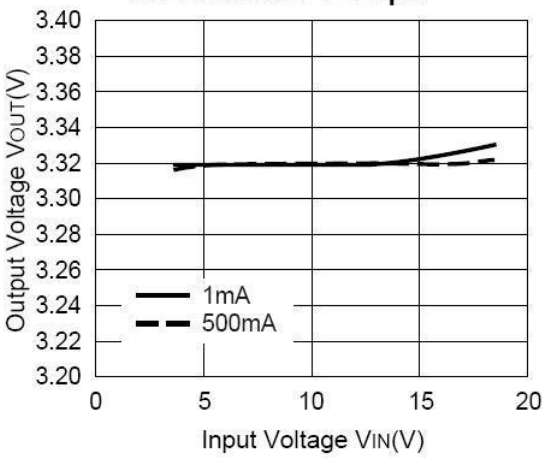
AS1224N332G L=10µH



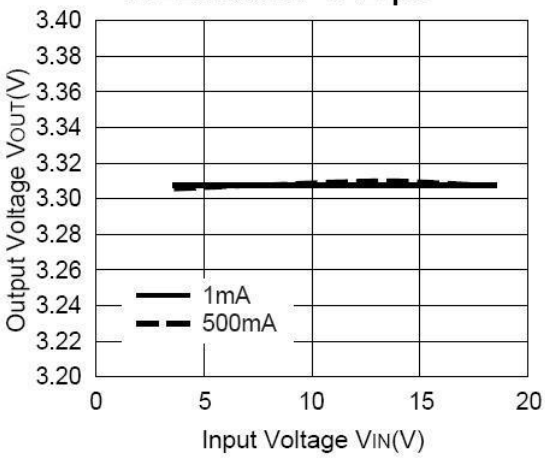
AS1224N332H L=10µH



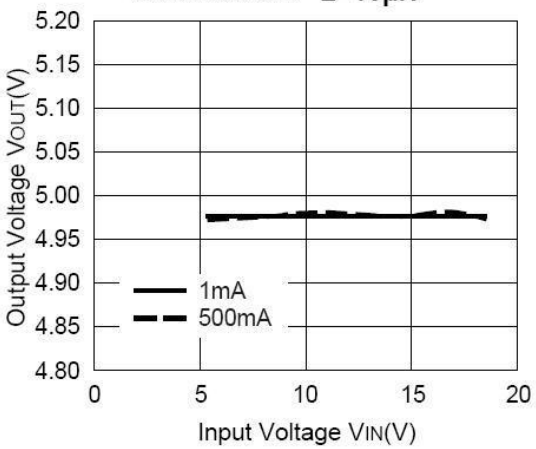
AS1224N332L L=27µH



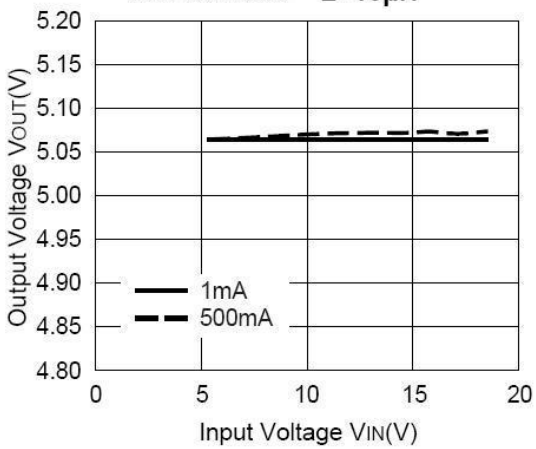
AS1224N332M L=27µH



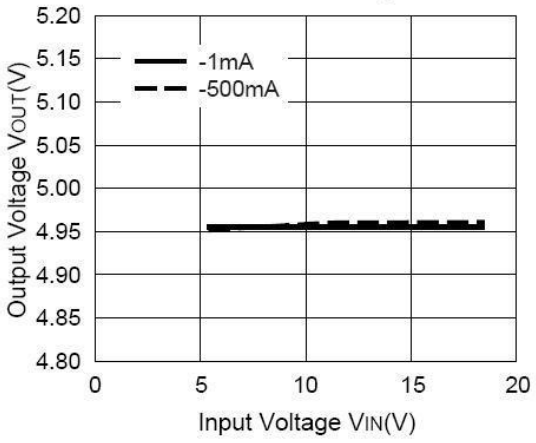
AS1224N502E L=10µH



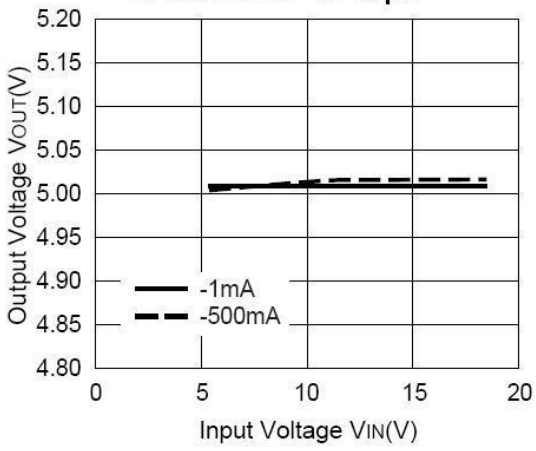
AS1124N502F L=10µH



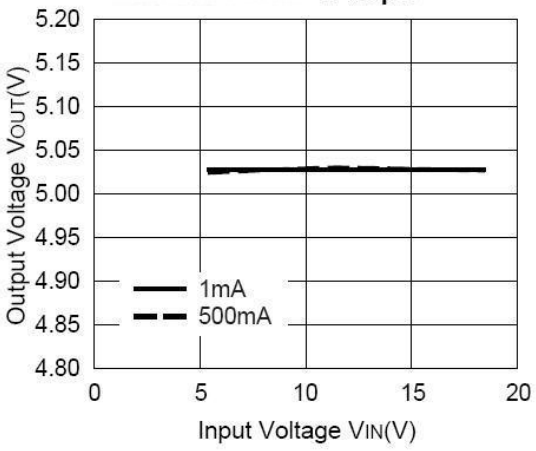
AS1224N502G L=10µH



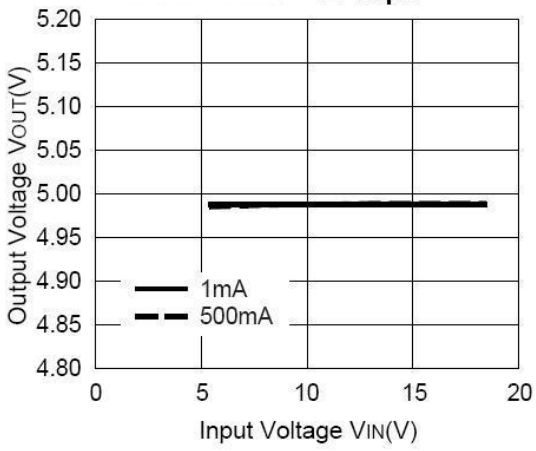
AS1224N502H L=10µH



AS1224N502L L=27µH

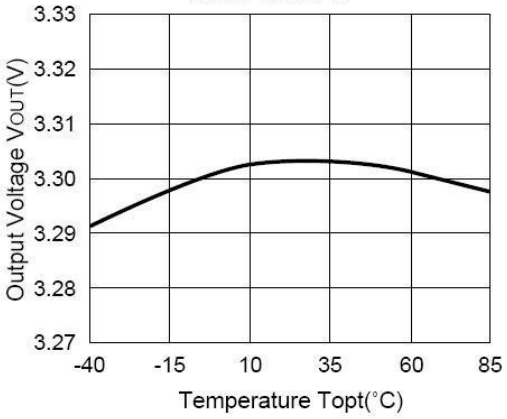


AS1224N502M L=27µH

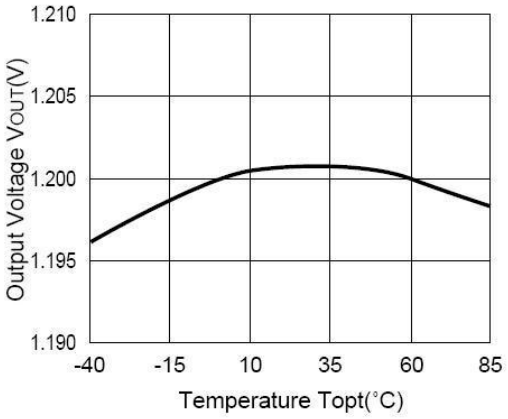


5) Output Voltage vs. Temperature

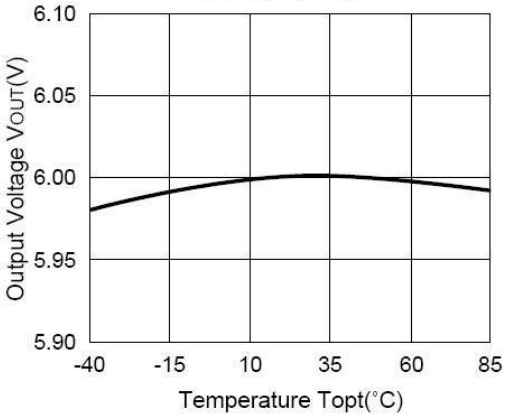
AS1224N332E



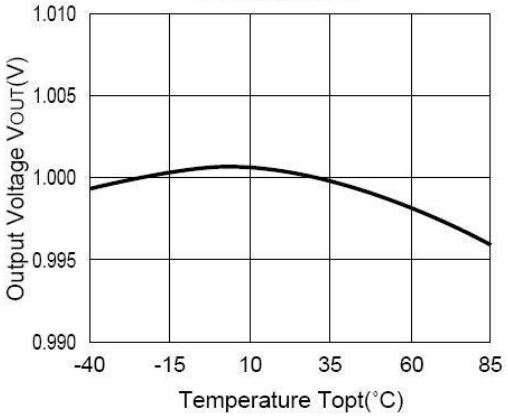
AS1224N122F



AS1224N602L

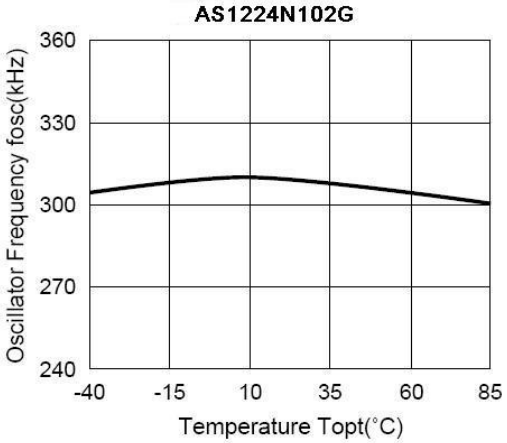


AS1224N102G

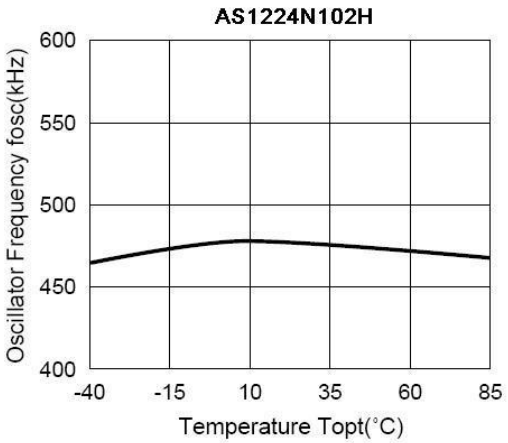


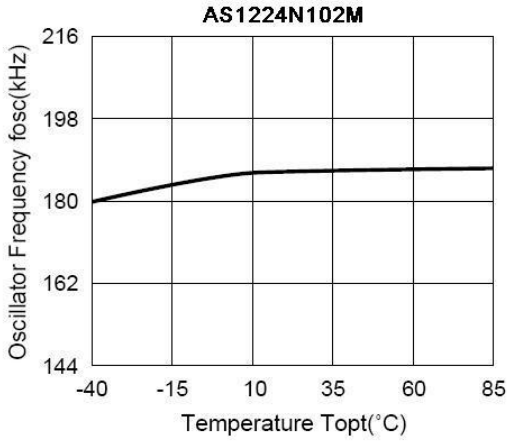
6) Oscillator Frequency vs. Temperature

AS1224N102G

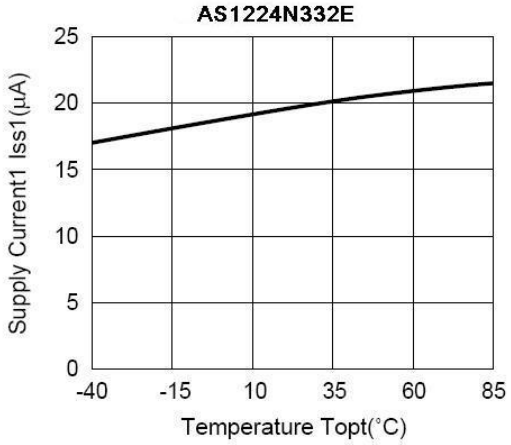


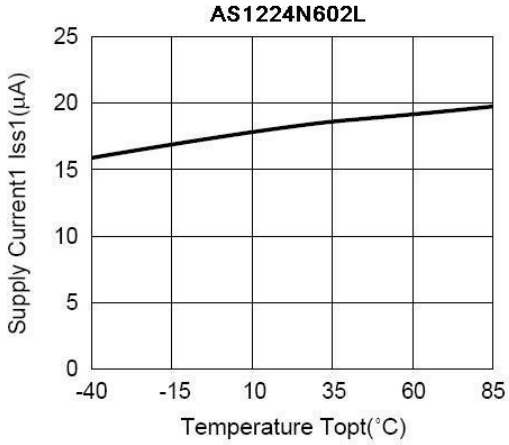
AS1224N102H

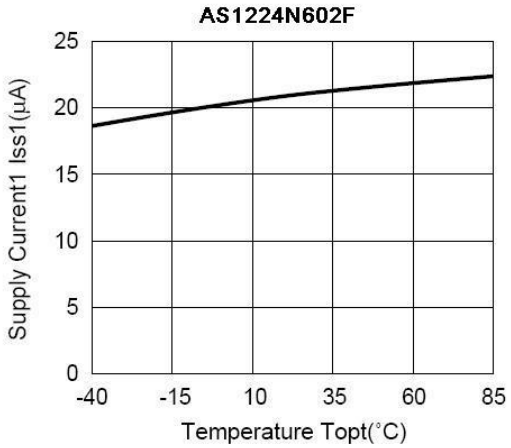


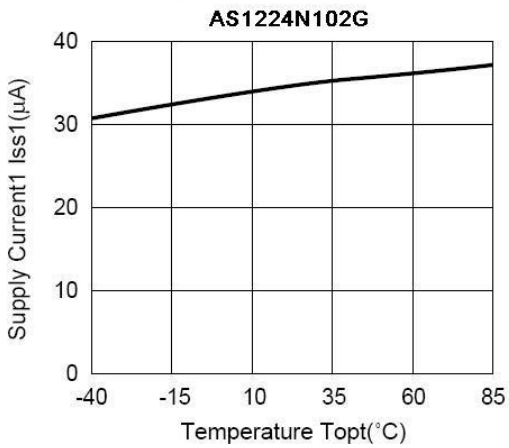


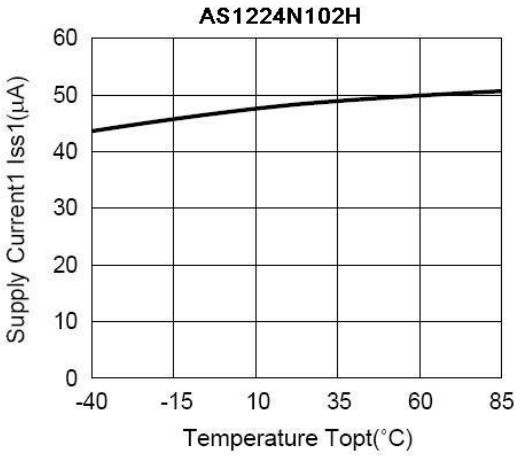
7) Supply Current vs. Temperature

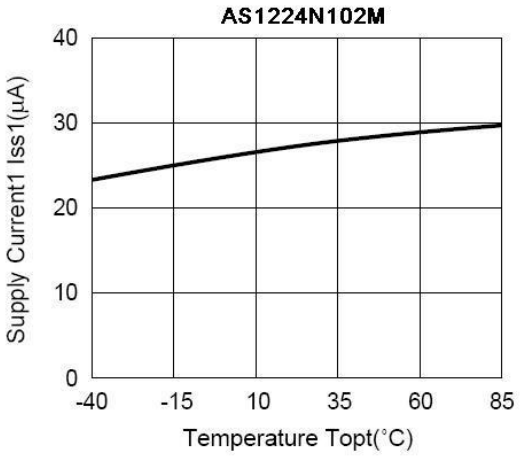




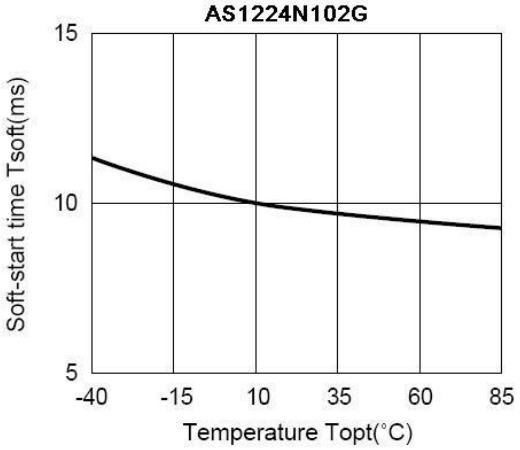




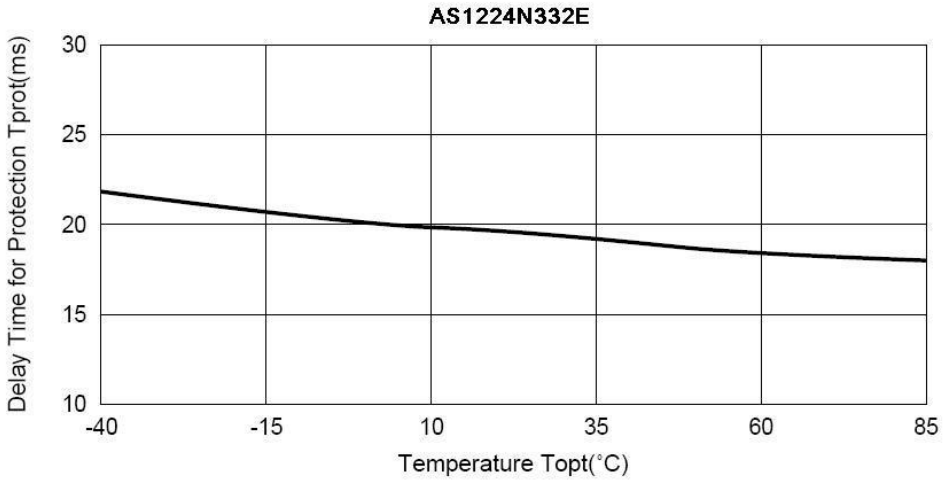




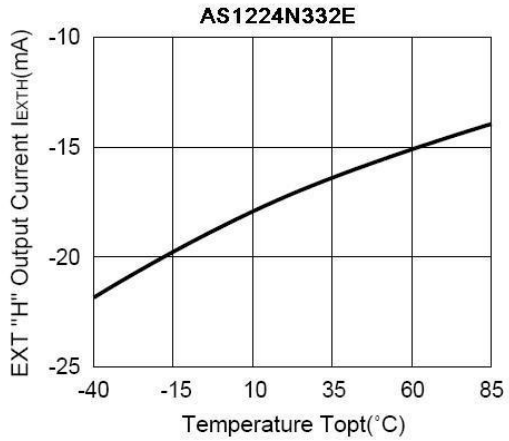
8) Soft-start time vs. Temperature



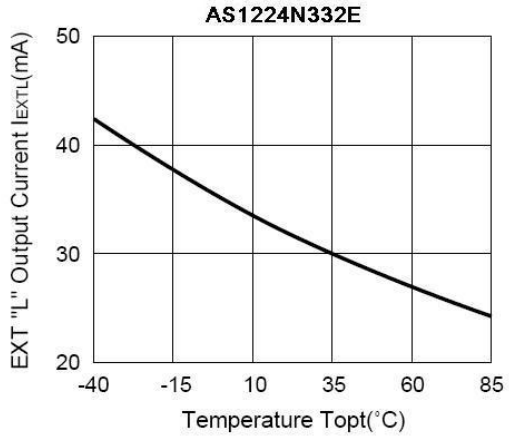
9) Delay Time for Protection vs. Temperature



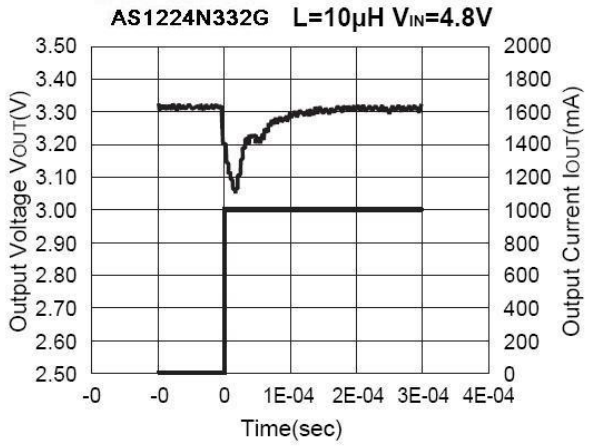
10) EXT "H" Output Current vs. Temperature

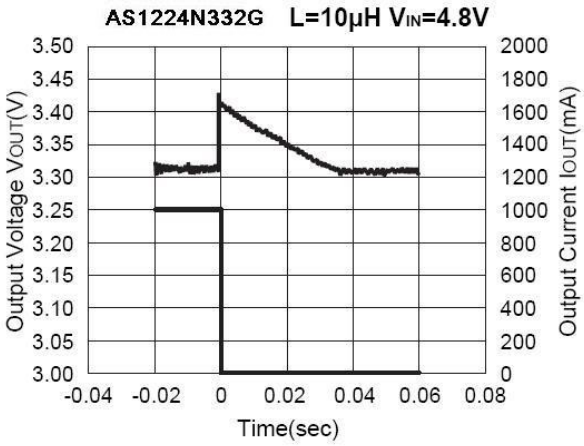


11) EXT "L" Output Current vs. Temperature

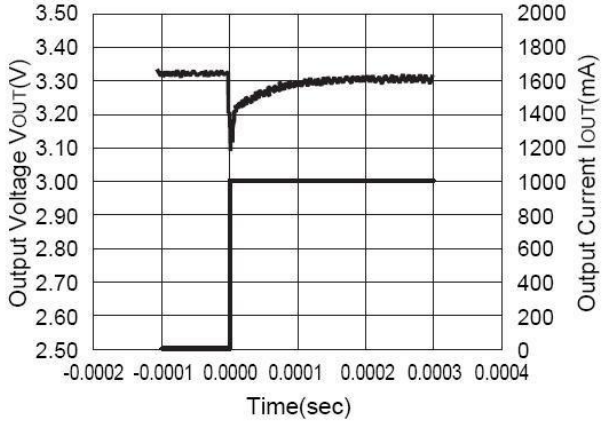


12) Load Transient Response

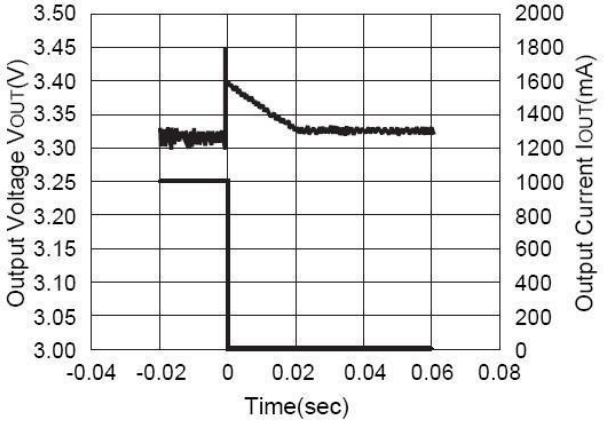




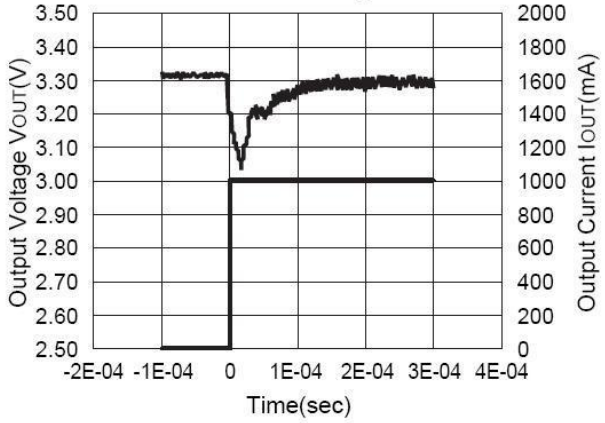
AS1224N332G L=10µH V_{IN}=10V



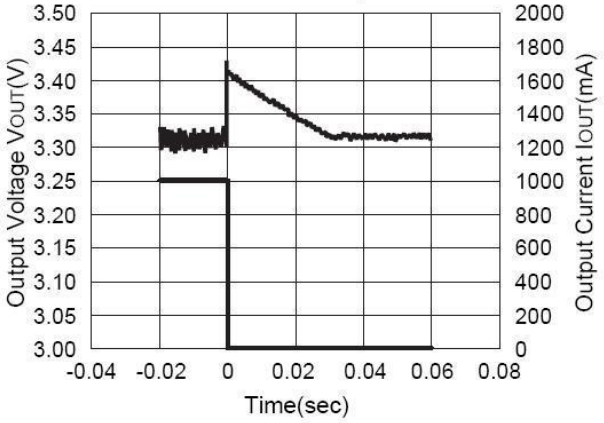
AS1224N332G L=10µH V_{IN}=10V



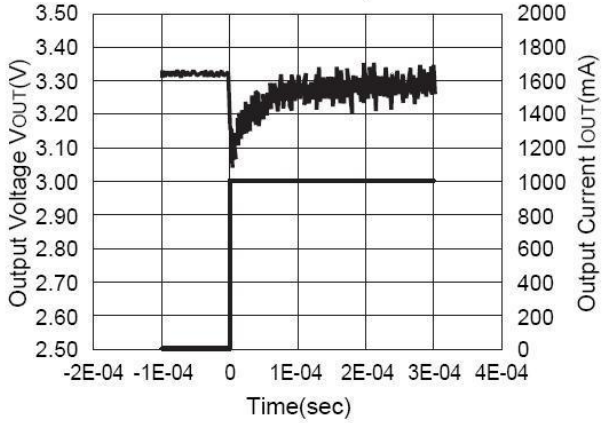
AS1224N332H L=10µH V_{IN}=4.8V



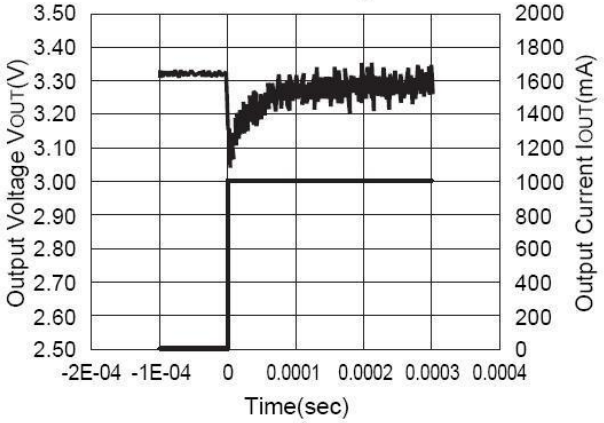
AS1224N332H L=10µH V_{IN}=4.8V

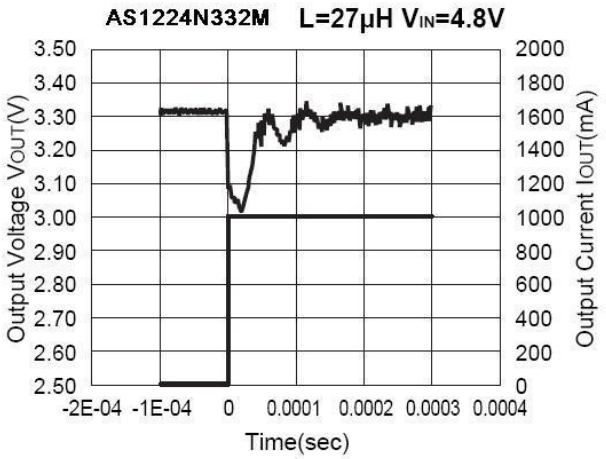


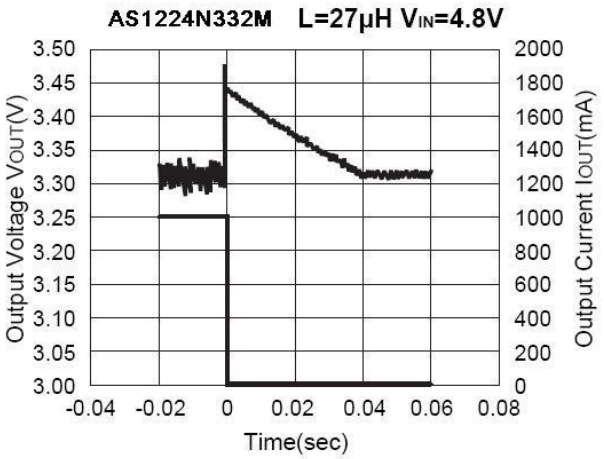
AS1224N332H L=10µH V_{IN}=10V

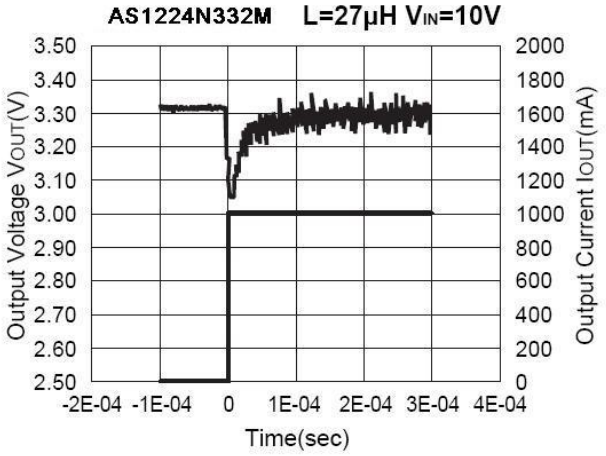


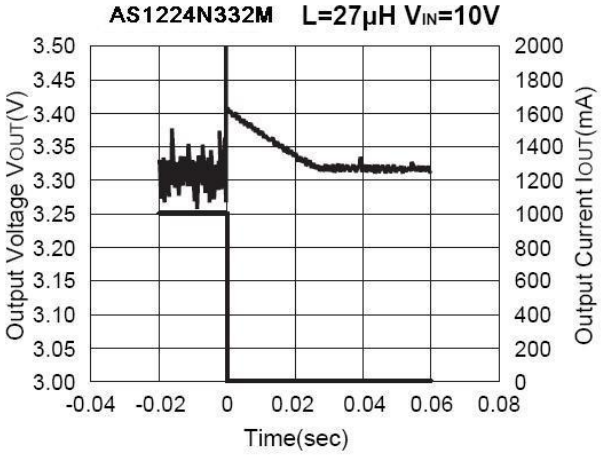
AS1224N332H L=10µH V_{IN}=10V











12) UVLO Voltage vs. Temperature