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Synchronous Buck Converter Integrated FET

BD9106FVM BD9107FVM BD9109FVM BD9110NV BD9120HFN

●General Description

ROHM's high efficiency step-down switching regulators (BD9106FVM,BD9107FVM,BD9109FVM,BD9110NV,BD9120HFN) are the power supply designed to produce a low voltage including 1 volts from 5/3.3 volts power supply line. Offers high efficiency with our original pulse skip control technology and synchronous rectifier. Employs a current mode control system to provide faster transient response to sudden change in load.

●Features

- Offers fast transient response with current mode PWM control system.
- Offers highly efficiency for all load range with synchronous rectifier (Nch/Pch FET) and SLLM™ (Simple Light Load Mode) Incorporates soft-start function.
- Incorporates thermal protection and ULVO functions.
- Incorporates short-current protection circuit with time delay function.
- Incorporates shutdown function

●Application

Power supply for LSI including DSP, Micro computer and ASIC

●Key Specifications

- Input voltage range
  - BD9120HFN: 2.7V to 4.5V
  - BD9106FVM,BD9107FVM: 4.0V to 5.5V
  - BD9109FVM,BD9110NV: 4.5V to 5.5V
- Output voltage range
  - BD9109FVM: 3.30V ± 2%
  - BD9120HFN: 1.0V to 1.5V
  - BD9107FVM: 1.0V to 1.8V
  - BD9106FVM,BD9110NV: 1.0V to 2.5V
- Output current
  - BD9106FVM, BD9109FVM, BD9120HFN: 0.8A(Max.)
  - BD9107FVM: 1.2A(Max.)
  - BD9110NV: 2.0A(Max.)
- Switching frequency: 1MHz(Typ.)
- FET ON resistance

	Pch(Typ.) / Nch(Typ.)
BD9110NV:	200mΩ / 150mΩ
BD9106FVM,BD9107FVM:	350mΩ / 250mΩ
BD9120HFN,BD9109FVM:	350mΩ / 250mΩ

- Standby current: 0μA(Typ.)
- Operating temperature range
  - BD9110NV: -25℃ to +105℃
  - BD9120HFN,BD9106FVM: -25℃ to +85℃
  - BD9107FVM,BD9109FVM: -25℃ to +85℃

●Packages

	(Typ.)	(Typ.)	(Max.)
HSON8	2.90mm	x 3.00mm	x 0.60mm
MSOP8	2.90mm	x 4.00mm	x 0.90mm
SON008V5060	5.00mm	x 6.00mm	x 1.00mm

●Typical Application Circuit

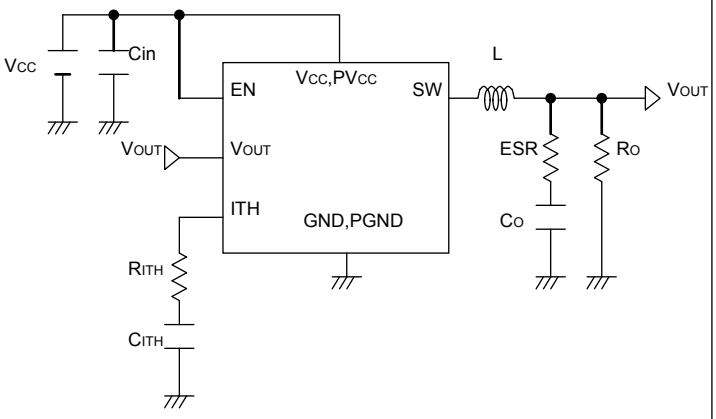
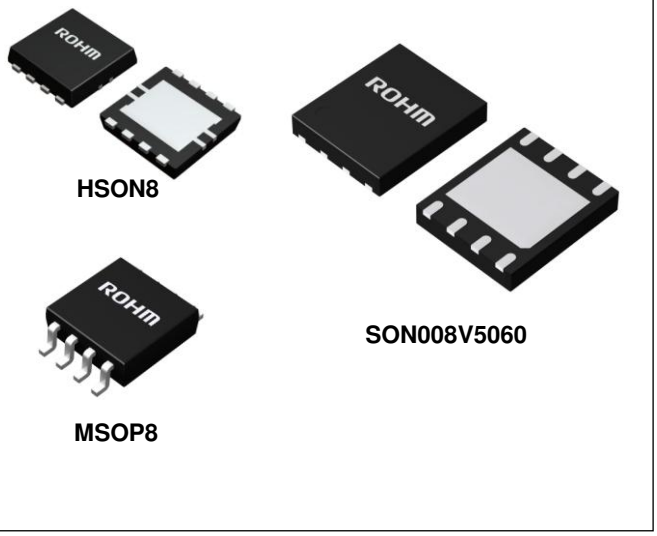


Fig.1 Typical Application Circuit



○Product structure：Silicon monolithic integrated circuit ○This product is not designed protection against radioactive rays.

●Pin Configurations

(Top View)

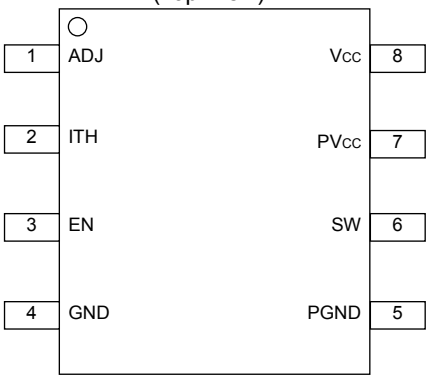


Fig.2 BD9106FVM, BD9107FVM

(Top View)

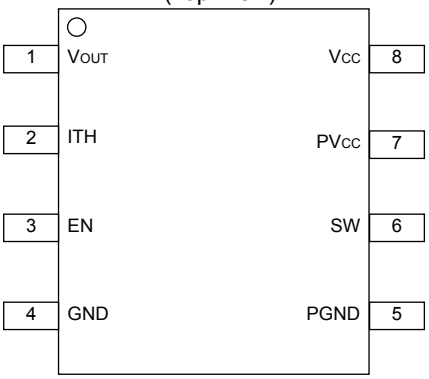


Fig.3 BD9109FVM

(Top View)

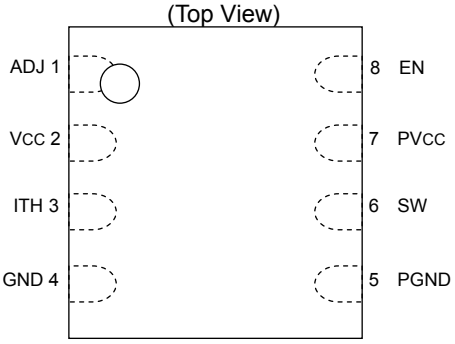


Fig.4 BD9110NV

(Top View)

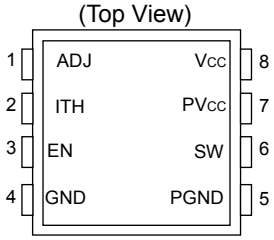


Fig.5 BD9120HFN

●Pin Descriptions

【BD9106FVM, BD9107FVM, BD9109FVM】

Pin No.	Pin name	PIN function
1	ADJ/VOUT	Output voltage detect pin/ ADJ for BD9106・07FVM
2	ITH	GmAmp output pin/Connected phase compensation capacitor
3	EN	Enable pin(Active High)
4	GND	Ground
5	PGND	Nch FET source pin
6	SW	Pch/Nch FET drain output pin
7	PVCC	Pch FET source pin
8	VCC	VCC power supply input pin

【BD9110NV】

Pin No.	Pin name	PIN function
1	ADJ	Output voltage adjust pin
2	VCC	VCC power supply input pin
3	ITH	GmAmp output pin/Connected phase compensation capacitor
4	GND	Ground
5	PGND	Nch FET source pin
6	SW	Pch/Nch FET drain output pin
7	PVCC	Pch FET source pin
8	EN	Enable pin(Active High)

【BD9120HFN】

Pin No.	Pin name	PIN function
1	ADJ	Output voltage adjust pin
2	ITH	GmAmp output pin/Connected phase compensation capacitor
3	EN	Enable pin(Active High)
4	GND	Ground
5	PGND	Nch FET source pin
6	SW	Pch/Nch FET drain output pin
7	PVCC	Pch FET source pin
8	VCC	VCC power supply input pin

●Ordering Information

B D 9 1 x x x x - x x

Part Number

Package
NV:SON008V5060
HFN:HSON8
FVM:MSOP8

Packaging and forming specification
E2: Embossed tape and reel
TR: Embossed tape and reel

●Lineup

Operating Temperature Range	Input voltage range	Output voltage range	Output Current (Max.)	UVLO Threshold voltage (Typ.)	Package		Orderable Part Number
-25℃ to +85℃	4.0V to 5.5V	Adjustable (1.0 to 2.5V)	0.8A	3.4V	MSOP8	Reel of 3000	BD9106FVM-TR
		Adjustable (1.0 to 1.8V)	1.2A	2.7V	MSOP8	Reel of 3000	BD9107FVM-TR
	4.5V to 5.5V	3.30±2%	0.8A	3.8V	MSOP8	Reel of 3000	BD9109FVM-TR
	2.7V to 4.5V	Adjustable (1.0 to 1.5V)	0.8A	2.5V	HSON8	Reel of 3000	BD9120HFN-TR
-25℃ to +105℃	4.5V to 5.5V	Adjustable (1.0 to 2.5V)	2.0A	3.7V	SON008V5060	Reel of 2000	BD9110NV-E2

●Absolute Maximum Ratings (Ta=25℃)

Parameter	Symbol	Limits			Unit
		BD910xFVM	BD9110NV	BD9120HFN	
Vcc voltage	Vcc	-0.3 to +7 *1	-0.3 to +7 *1	-0.3 to +7 *1	V
PVcc voltage	PVcc	-0.3 to +7 *1	-0.3 to +7 *1	-0.3 to +7 *1	V
EN voltage	EN	-0.3 to +7	-0.3 to +7	-0.3 to +7	V
SW,ITH voltage	SW,ITH	-0.3 to +7	-0.3 to +7	-0.3 to +7	V
Power dissipation 1	Pd1	387.5*2	900*4	1350*6	mW
Power dissipation 2	Pd2	587.4*3	3900*5	1750*7	mW
Operating temperature range	Topr	-25 to +85	-25 to +105	-25 to +85	℃
Storage temperature range	Tstg	-55 to +150	-55 to +150	-55 to +150	℃
Maximum junction temperature	Tjmax	+150	+150	+150	℃

*1 Pd should not be exceeded.
*2 Derating in done 3.1mW/℃ for temperatures above Ta=25℃.
*3 Derating in done 4.7mW/℃ for temperatures above Ta=25℃, Mounted on 70mm×70mm×1.6mm Glass Epoxy PCB.
*4 Derating in done 7.2mW/℃ for temperatures above Ta=25℃, Mounted on 70mm×70mm×1.6mm Glass Epoxy PCB which has 1 layer (3%) of copper on the back side).
*5 Derating in done 31.2mW/℃ for temperatures above Ta=25℃, Mounted on a board according to JESD51-7.
*6 Derating in done 10.8mW/℃ for temperatures above Ta=25℃, Mounted on 70mm×70mm×1.6mm Glass Epoxy PCB which has 1 layer (7%) of copper on the back side).
*7 Derating in done 14mW/℃ for temperatures above Ta=25℃, Mounted on 70mm×70mm×1.6mm Glass Epoxy PCB which has 1 layer (6.5%) of copper on the back side).

●Recommended Operating Ratings (Ta=25℃)

Parameter	Symbol	BD9106FVM		BD9107FVM		BD9109FVM		BD9110NV		BD9120HFN		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Vcc voltage	Vcc *8	4.0	5.5	4.0	5.5	4.5	5.5	4.5	5.5	2.7	4.5	V
PVcc voltage	PVcc *8	4.0	5.5	4.0	5.5	4.5	5.5	4.5	5.5	2.7	4.5	V
EN voltage	EN	0	Vcc	0	Vcc	0	Vcc	0	Vcc	0	Vcc	V
SW average output current	Isw *8	-	0.8	-	1.2	-	0.8	-	2.0	-	0.8	A

*8 Pd should not be exceeded.

●Electrical Characteristics

◎BD9106FVM (Ta=25℃, VCC=5V, EN=VCC, R1=20kΩ, R2=10kΩ unless otherwise specified.)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Standby current	ISTB	-	0	10	μA	EN=GND
Bias current	ICC	-	250	400	μA	
EN Low voltage	VENL	-	GND	0.8	V	Standby mode
EN High voltage	VENH	2.0	VCC	-	V	Active mode
EN input current	IEN	-	1	10	μA	VEN=5V
Oscillation frequency	FOSC	0.8	1	1.2	MHz	
Pch FET ON resistance *9	RONP	-	0.35	0.60	Ω	PVCC=5V
Nch FET ON resistance *9	RONN	-	0.25	0.50	Ω	PVCC=5V
ADJ Voltage	VADJ	0.780	0.800	0.820	V	
Output voltage *9	VOUT	-	1.200	-	V	
ITH sink current	ITHSI	10	20	-	μA	ADJ=H
ITH source current	ITHSO	10	20	-	μA	ADJ=L
UVLO threshold voltage	VUVLOTh	3.2	3.4	3.6	V	VCC=H→L
UVLO hysteresis voltage	VUVLOHys	50	100	200	mV	
Soft start time	TSS	1.5	3	6	ms	
Timer latch time	TLATCH	0.5	1	2	ms	

*9 Outgoing inspection is not done on all products

◎BD9107FVM (Ta=25℃, VCC=5V, EN=VCC, R1=20kΩ, R2=10kΩ unless otherwise specified.)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Standby current	ISTB	-	0	10	μA	EN=GND
Bias current	ICC	-	250	400	μA	
EN Low voltage	VENL	-	GND	0.8	V	Standby mode
EN High voltage	VENH	2.0	VCC	-	V	Active mode
EN input current	IEN	-	1	10	μA	VEN=5V
Oscillation frequency	FOSC	0.8	1	1.2	MHz	
Pch FET ON resistance *9	RONP	-	0.35	0.60	Ω	PVCC=5V
Nch FET ON resistance *9	RONN	-	0.25	0.50	Ω	PVCC=5V
ADJ Voltage	VADJ	0.780	0.800	0.820	V	
Output voltage *9	VOUT	-	1.200	-	V	
ITH sink current	ITHSI	10	20	-	μA	VOUT =H
ITH source current	ITHSO	10	20	-	μA	VOUT =L
UVLO threshold voltage	VUVLOTh	2.6	2.7	2.8	V	VCC=H→L
UVLO hysteresis voltage	VUVLOHys	150	300	600	mV	
Soft start time	TSS	0.5	1	2	ms	
Timer latch time	TLATCH	0.5	1	2	ms	

*9 Outgoing inspection is not done on all products

◎BD9109FVM (Ta=25℃, VCC=PVCC=5V, EN= VCC unless otherwise specified.)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Standby current	ISTB	-	0	10	μA	EN=GND
Bias current	ICC	-	250	400	μA	
EN Low voltage	VENL	-	GND	0.8	V	Standby mode
EN High voltage	VENH	2.0	VCC	-	V	Active mode
EN input current	IEN	-	1	10	μA	VEN=5V
Oscillation frequency	FOSC	0.8	1	1.2	MHz	
Pch FET ON resistance *9	RONP	-	0.35	0.60	Ω	PVCC=5V
Nch FET ON resistance *9	RONN	-	0.25	0.50	Ω	PVCC=5V
Output voltage	VOUT	3.234	3.300	3.366	V	
ITH sink current	ITHSI	10	20	-	μA	VOUT =H
ITH source current	ITHSO	10	20	-	μA	VOUT =L
UVLO threshold voltage	VUVLO1	3.6	3.8	4.0	V	VCC=H→L
UVLO hysteresis voltage	VUVLO2	3.65	3.9	4.2	V	VCC=L→H
Soft start time	TSS	0.5	1	2	ms	
Timer latch time	TLATCH	1	2	3	ms	SCP/TSD operated
Output Short circuit Threshold Voltage	VSCP	-	2	2.7	V	VOUT =H→L

*9 Outgoing inspection is not done on all products

◎BD9110NV (Ta=25℃, V_{CC}=PV_{CC}=5V, EN=V_{CC}, R_1=10kΩ,R_2=5kΩ unless otherwise specified.)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Standby current	I_{STB}	-	0	10	μA	EN=GND
Bias current	I_{CC}	-	250	350	μA	
EN Low voltage	V_{ENL}	-	GND	0.8	V	Standby mode
EN High voltage	V_{ENH}	2.0	V_{CC}	-	V	Active mode
EN input current	I_{EN}	-	1	10	μA	V_{EN}=5V
Oscillation frequency	F_{OSC}	0.8	1	1.2	MHz	
Pch FET ON resistance *9	R_{ONP}	-	200	320	mΩ	PV_{CC}=5V
Nch FET ON resistance *9	R_{ONN}	-	150	270	mΩ	PV_{CC}=5V
ADJ Voltage	V_{ADJ}	0.780	0.800	0.820	V	
Output voltage *9	V_{OUT}	-	1.200	-	V	
ITH sink current	I_{THSI}	10	20	-	μA	V_{OUT} =H
ITH source current	I_{THSO}	10	20	-	μA	V_{OUT} =L
UVLO threshold voltage	V_{UVLOTh}	3.5	3.7	3.9	V	V_{CC}=H→L
UVLO hysteresis voltage	$V_{UVLOHys}$	50	100	200	mV	
Soft start time	T_{SS}	2.5	5	10	ms	
Timer latch time	T_{LATCH}	0.5	1	2	ms	

*9 Outgoing inspection is not done on all products

◎BD9120HFN (Ta=25℃, V_{CC}=PV_{CC}=3.3V, EN=V_{CC}, R_1=20kΩ, R_2=10kΩ unless otherwise specified.)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Standby current	I_{STB}	-	0	10	μA	EN=GND
Bias current	I_{CC}	-	200	400	μA	
EN Low voltage	V_{ENL}	-	GND	0.8	V	Standby mode
EN High voltage	V_{ENH}	2.0	V_{CC}	-	V	Active mode
EN input current	I_{EN}	-	1	10	μA	V_{EN}=3.3V
Oscillation frequency	F_{OSC}	0.8	1	1.2	MHz	
Pch FET ON resistance *9	R_{ONP}	-	0.35	0.60	Ω	PV_{CC}=3.3V
Nch FET ON resistance *9	R_{ONN}	-	0.25	0.50	Ω	PV_{CC}=3.3V
ADJ Voltage	V_{ADJ}	0.780	0.800	0.820	V	
Output voltage *9	V_{OUT}	-	1.200	-	V	
ITH sink current	I_{THSI}	10	20	-	μA	V_{OUT} =H
ITH source current	I_{THSO}	10	20	-	μA	V_{OUT} =L
UVLO threshold voltage	V_{UVLO1}	2.400	2.500	2.600	V	V_{CC}=H→L
UVLO hysteresis voltage	V_{UVLO2}	2.425	2.550	2.700	V	V_{CC}=L→H
Soft start time	T_{SS}	0.5	1	2	ms	
Timer latch time	T_{LATCH}	1	2	3	ms	SCP/TSD operated
Output Short circuit Threshold Voltage	V_{SCP}	-	V_{OUT}×0.5	V_{OUT}×0.7	V	V_{OUT} =H→L

*9 Outgoing inspection is not done on all products

●**Block Diagram**

【BD9106FVM, BD9107FVM】

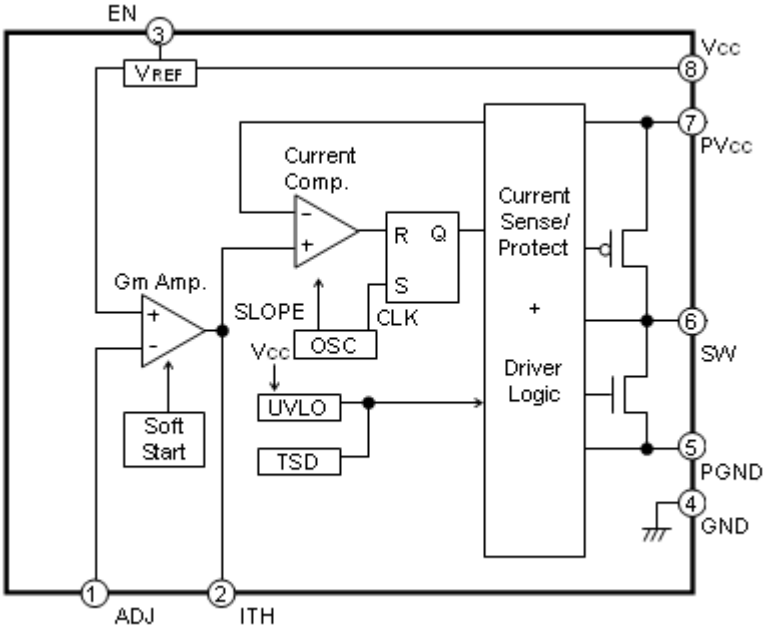


Fig.6 BD9106FVM, BD9107FVM Block Diagram

【BD9109FVM】

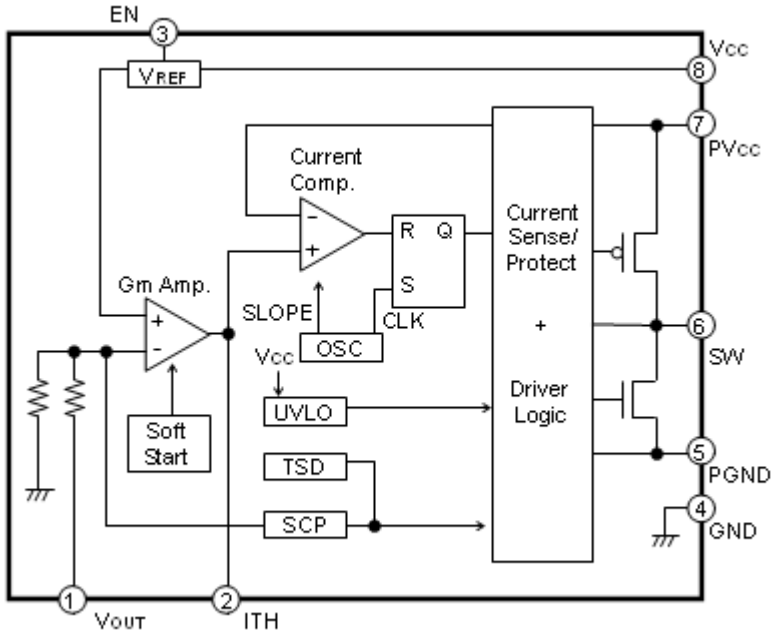


Fig.7 BD9109FVM Block Diagram

【BD9110NV】

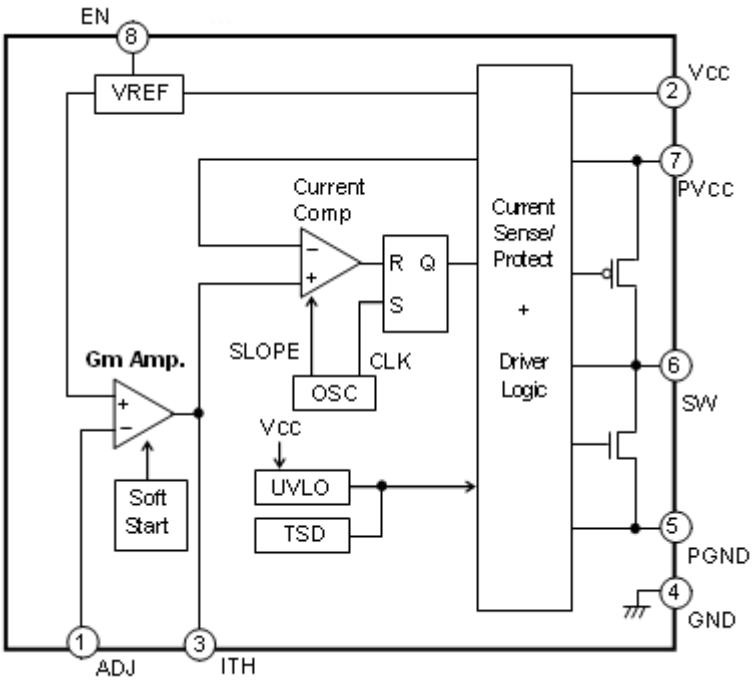


Fig.8 BD9110NV Block Diagram

【BD9120HFN】

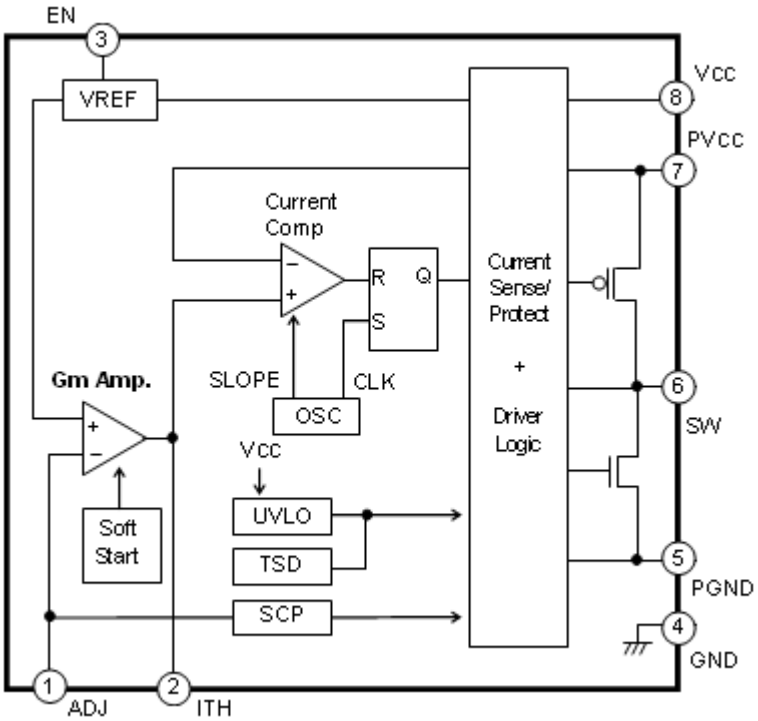


Fig.9 BD9120HFN Block Diagram

●**Typical Performance Curves**

【BD9106FVM】

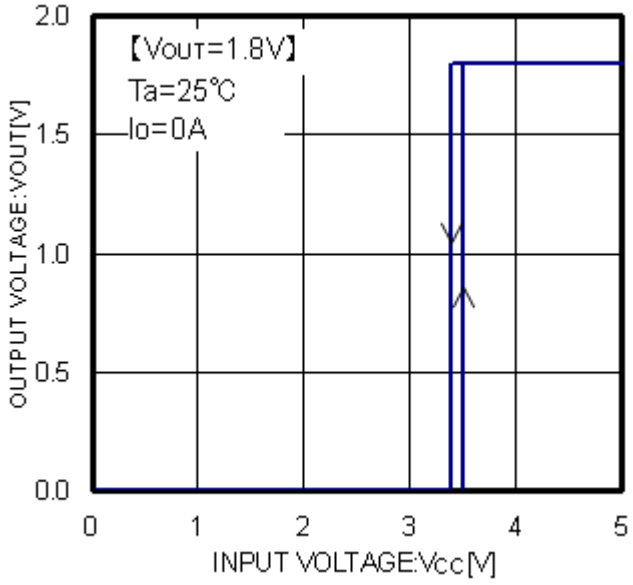


Fig.10 Vcc-Vout

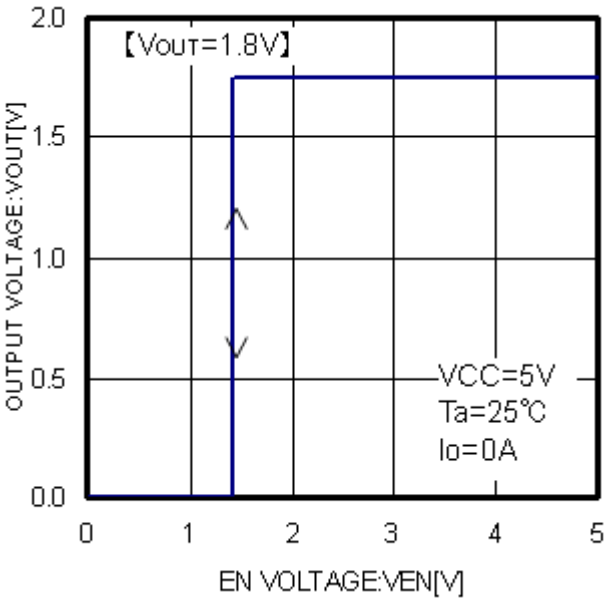


Fig.11 Ven-Vout

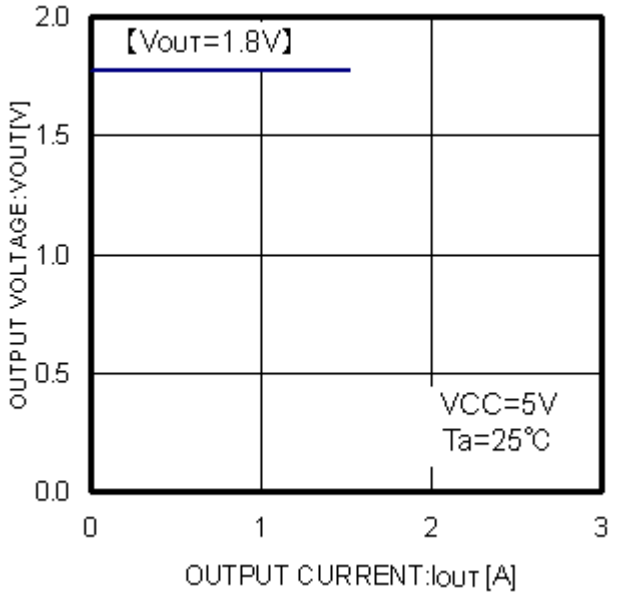


Fig.12 Iout-Vout

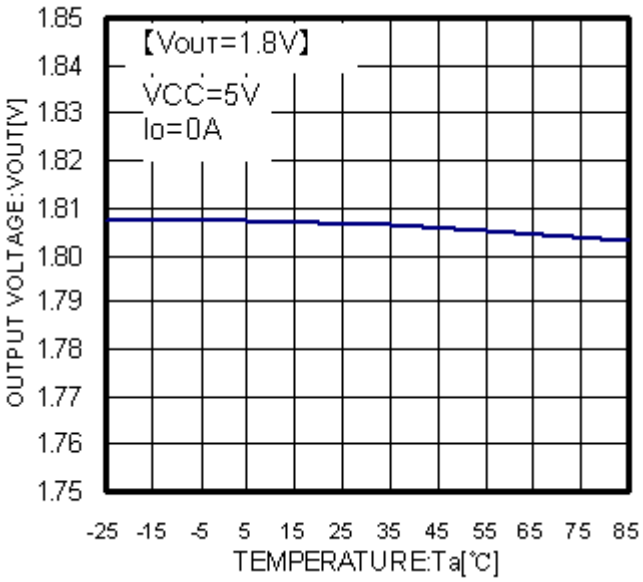


Fig.13 Ta-Vout

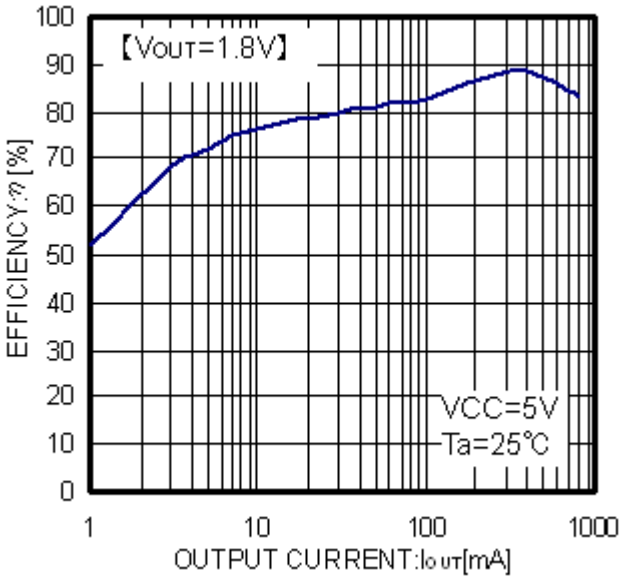


Fig.14 Efficiency

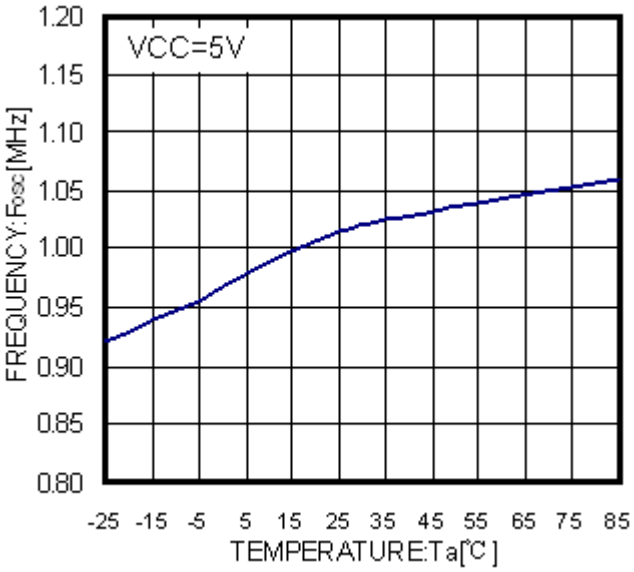


Fig.15 Ta-Fosc

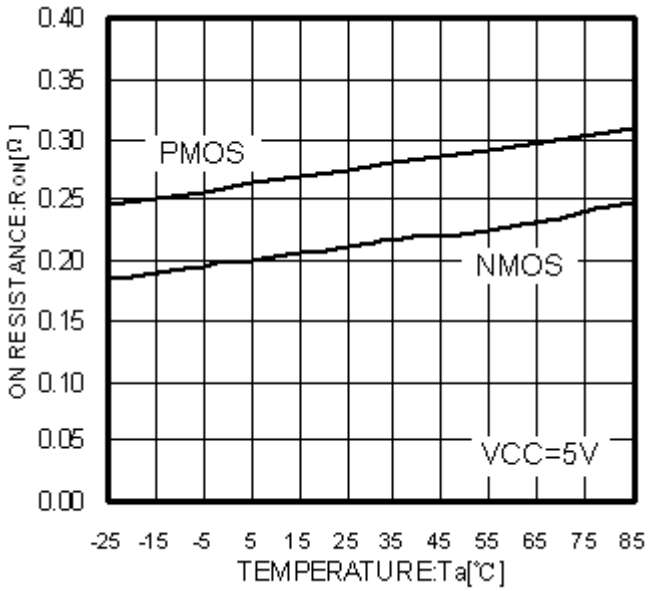


Fig.16 Ta-Ronn, Ronp

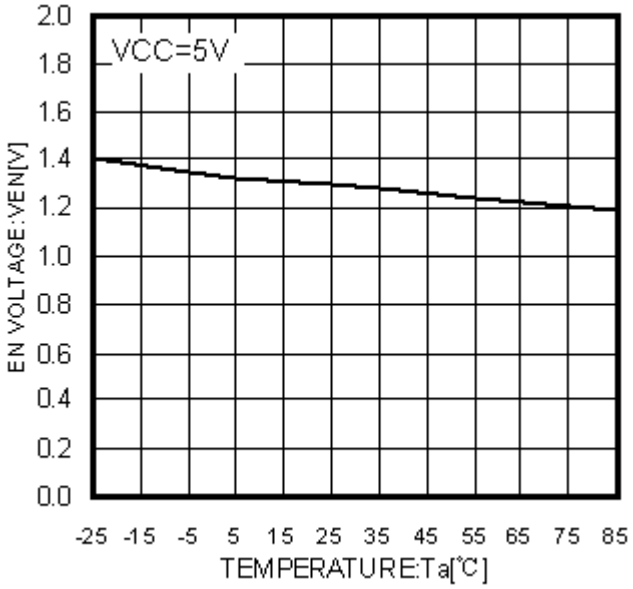


Fig.17 Ta-Ven

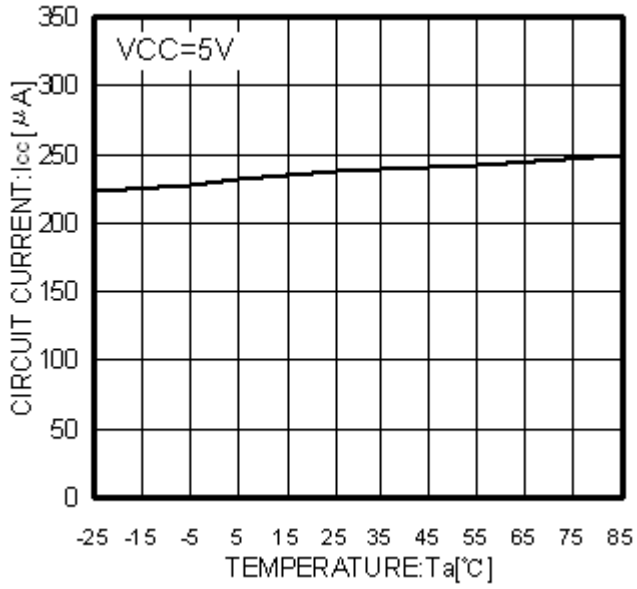


Fig.18 Ta-Icc

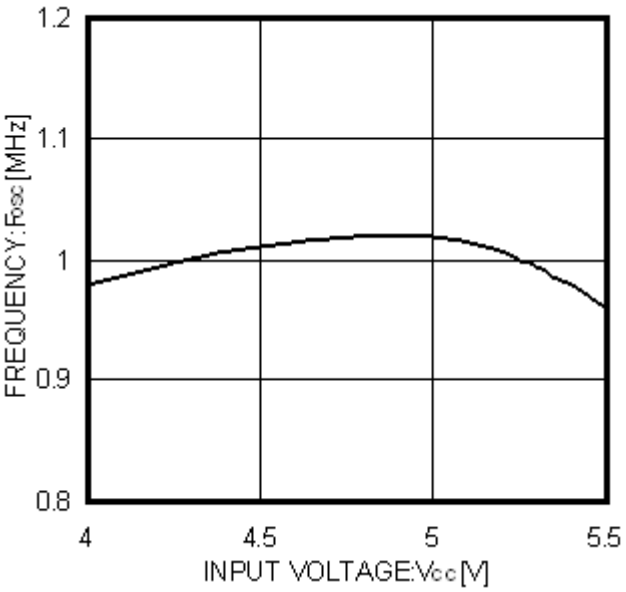


Fig.19 Vcc-Fosc

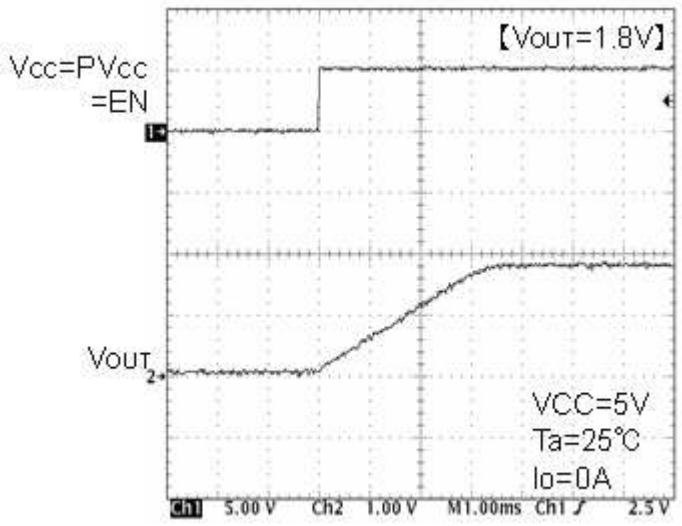


Fig.20 Soft start waveform

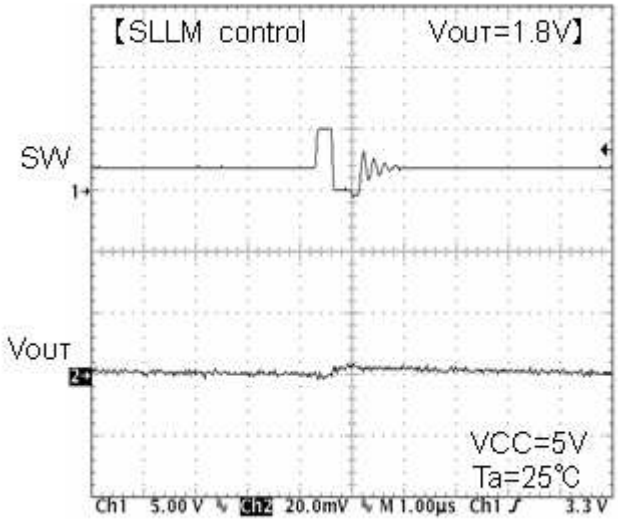


Fig.21 SW waveform Io=10mA

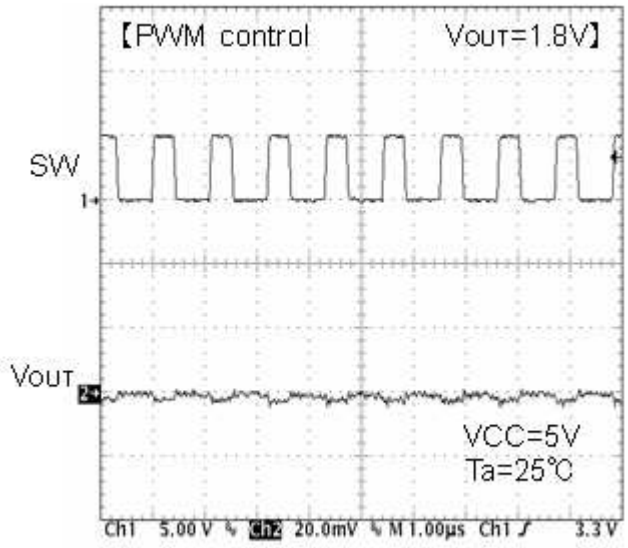


Fig.22 SW waveform Io=200mA

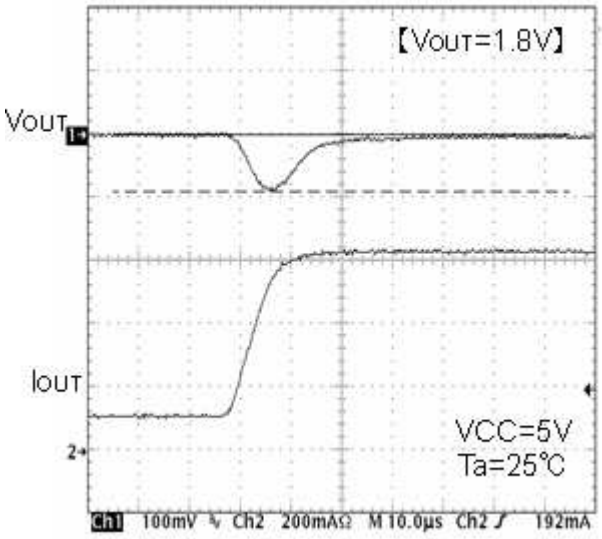


Fig. 23 Transient response
Io=100→600mA(10µs)

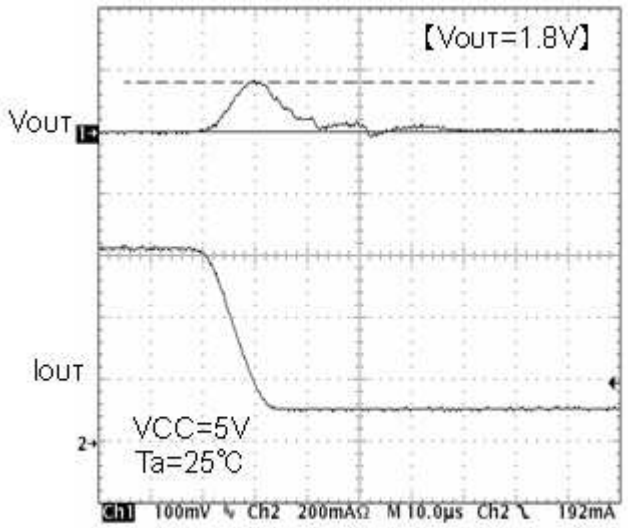


Fig.24 Transient response
Io=600→100mA(10µs)

【BD9107FVM】

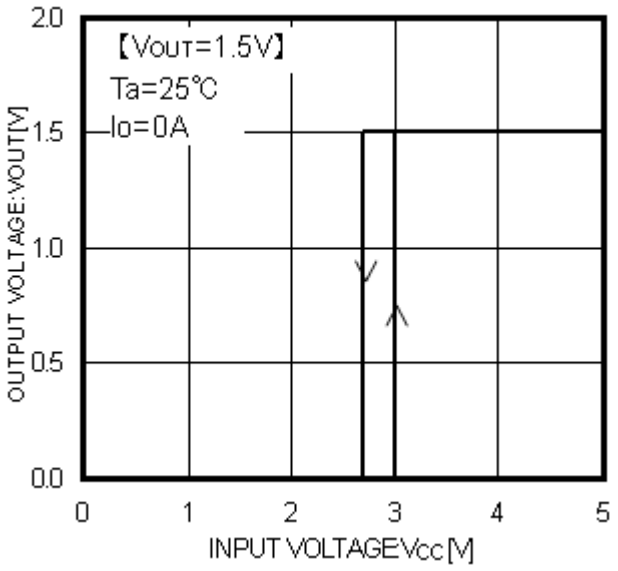


Fig.25 Vcc-Vout

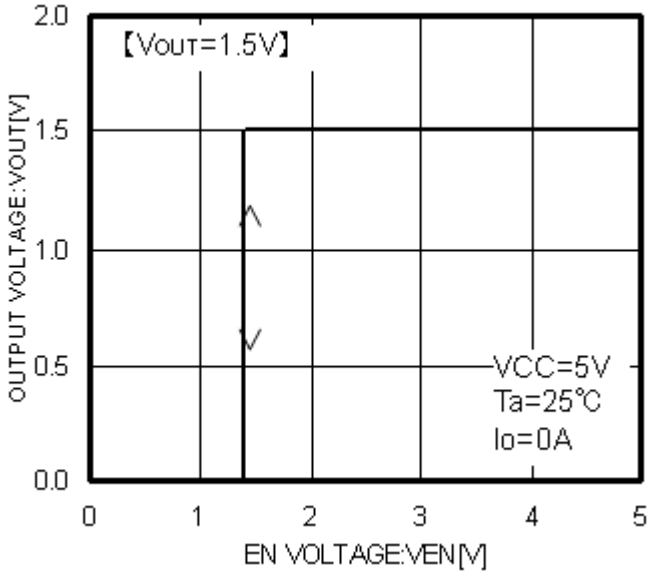


Fig.26 Ven-Vout

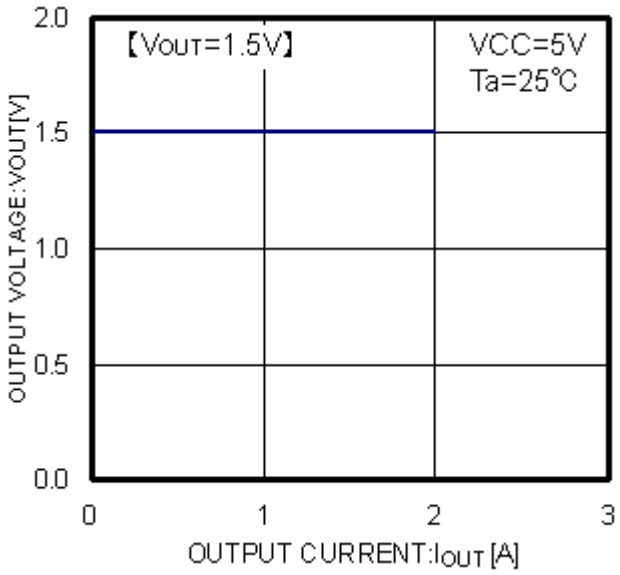


Fig.27 Iout-Vout

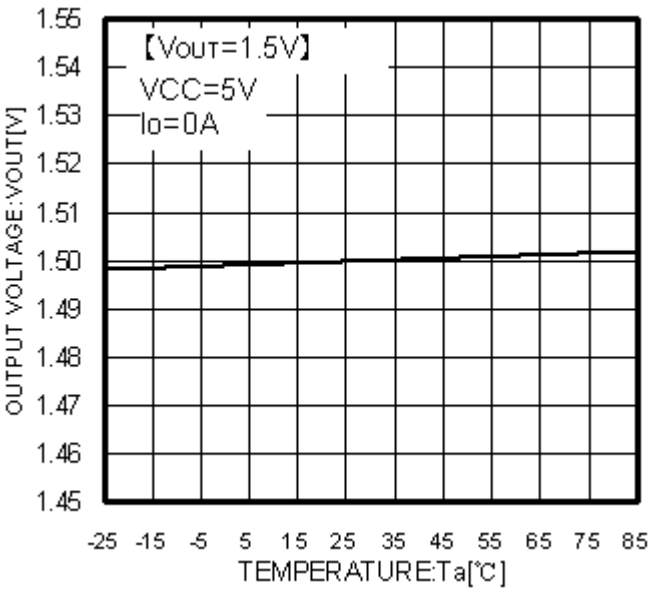


Fig.28 Ta-Vout

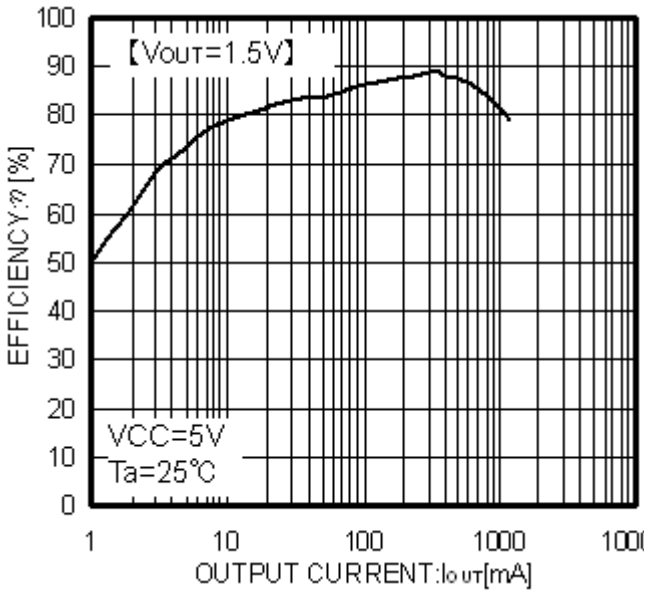


Fig.29 Efficiency

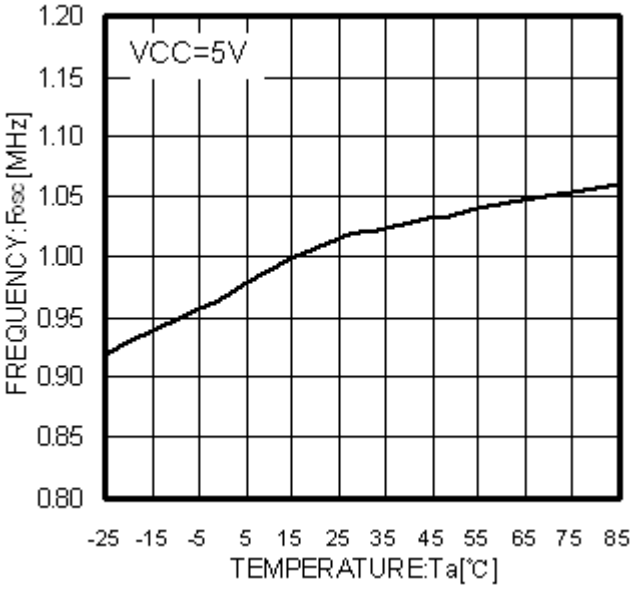


Fig.30 Ta-Fosc

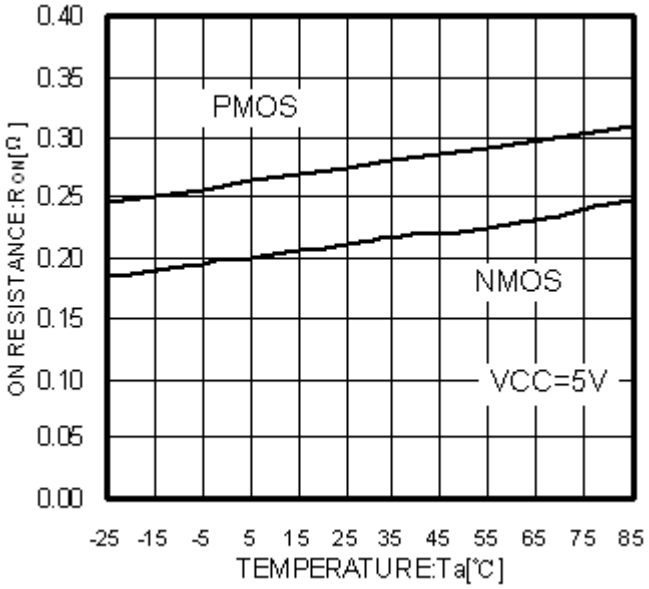


Fig.31 Ta-RONN, RONP

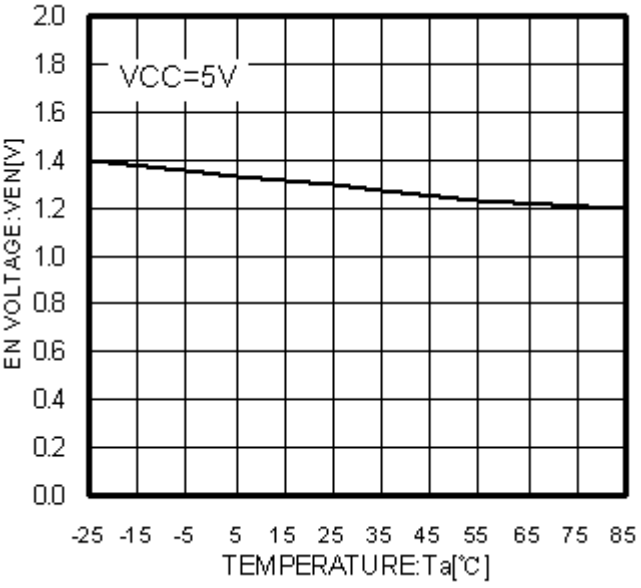


Fig.32 Ta-VEN

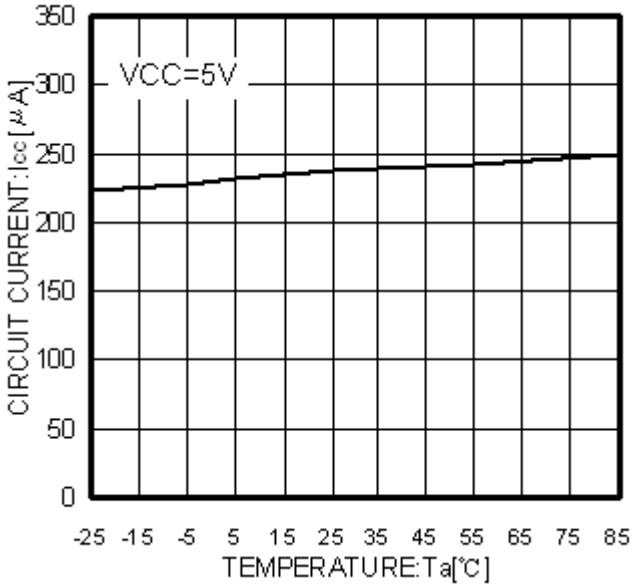


Fig.33 Ta-Icc

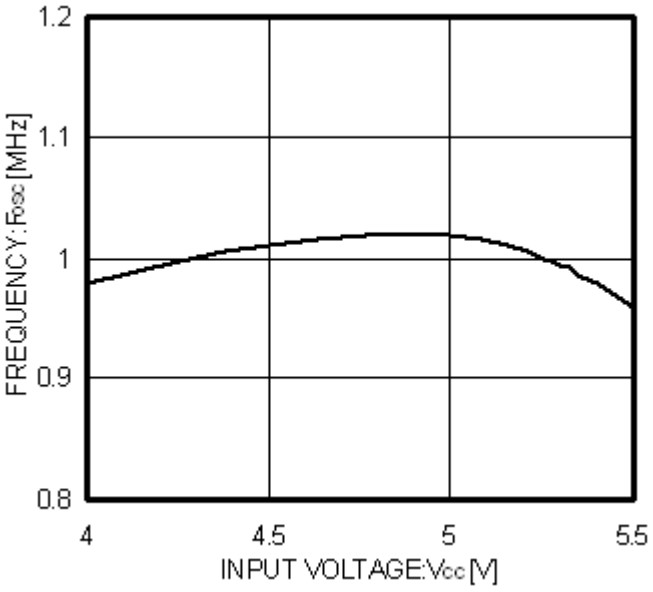


Fig.34 Vcc-Fosc

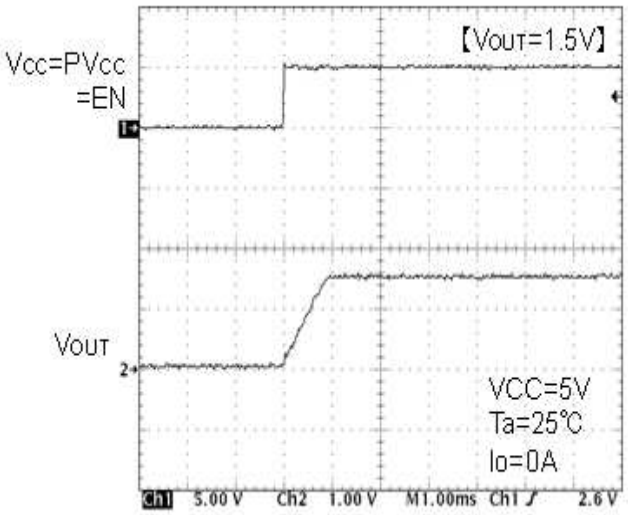


Fig.35 Soft start waveform

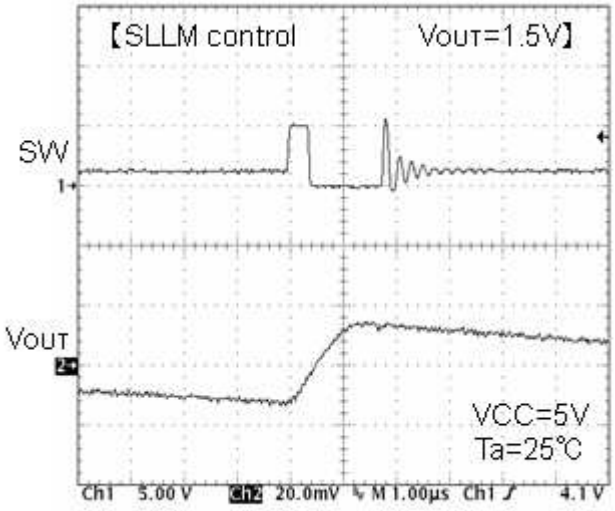


Fig.36 SW waveform Io=10mA

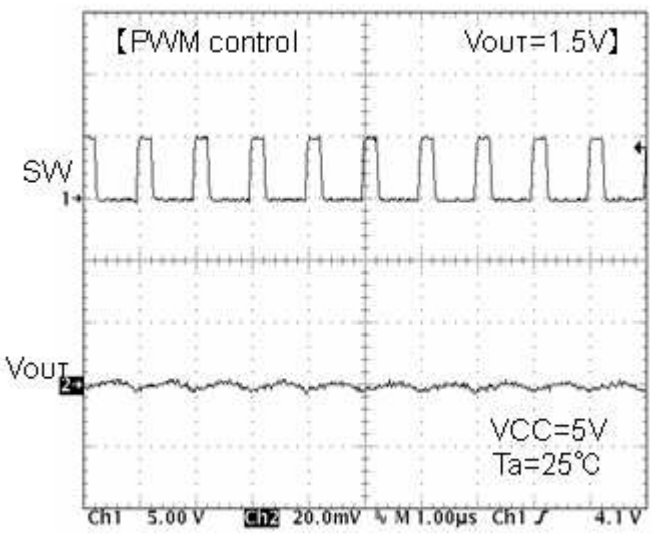


Fig.37 SW waveform Io=500mA

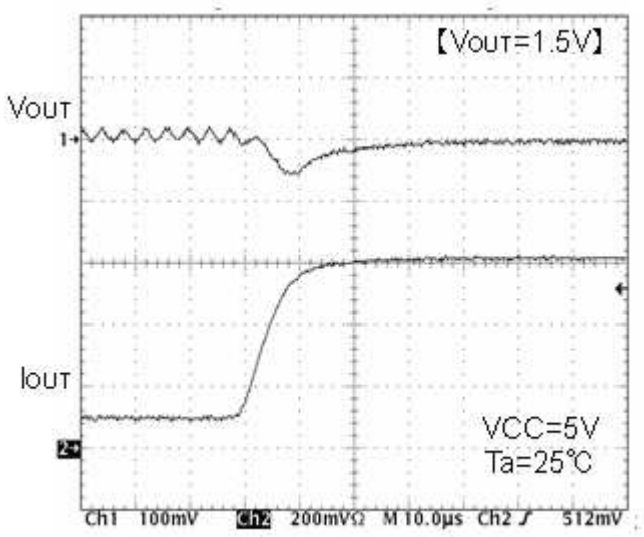


Fig. 38 Transient response
Io=100→600mA(10µs)

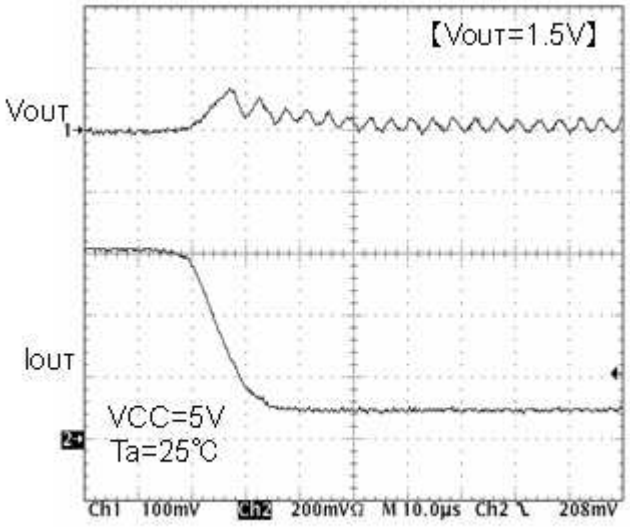


Fig.39 Transient response
Io=600→100mA(10µs)

【BD9109FVM】

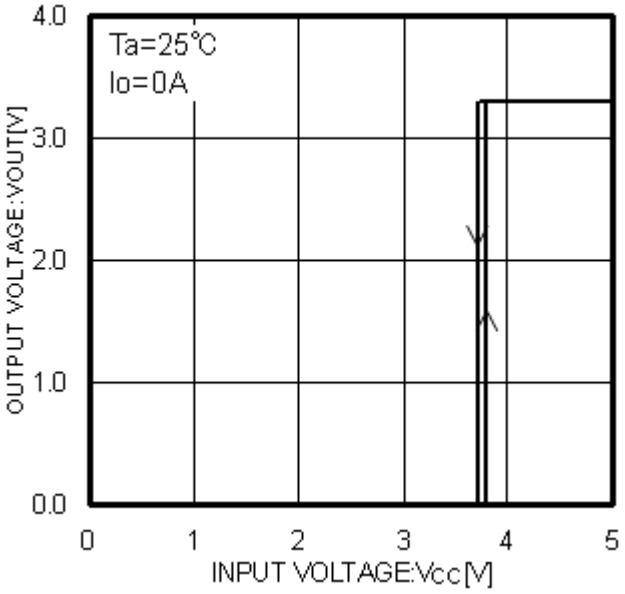


Fig.40 Vcc-Vout

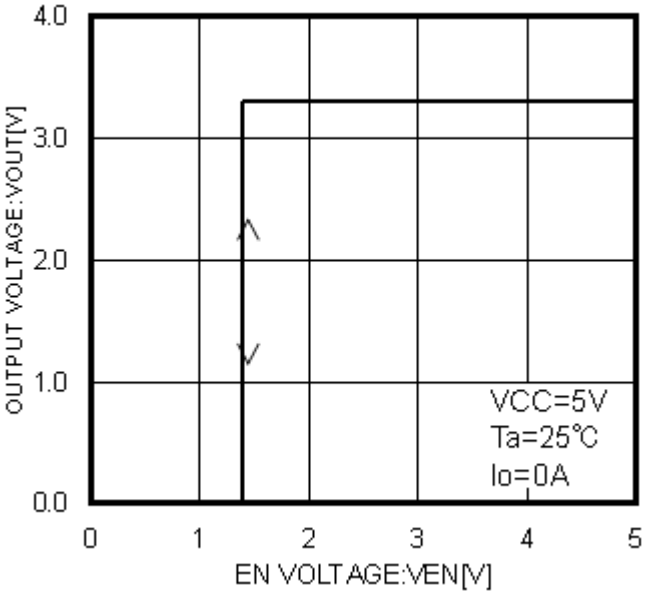


Fig.41 Ven-Vout

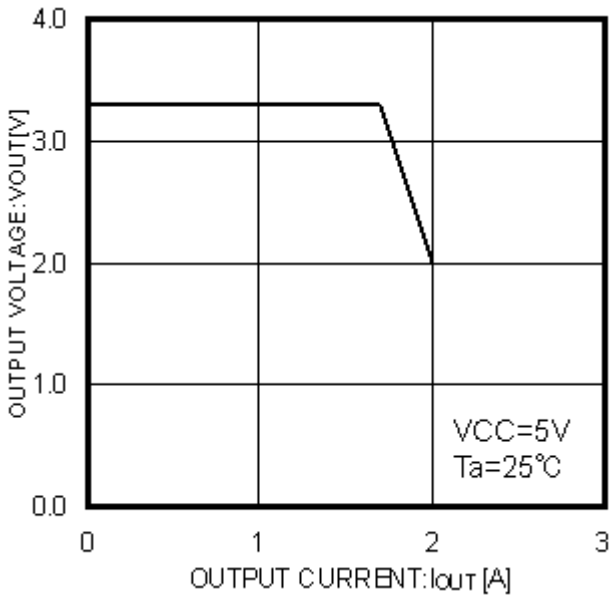


Fig.42 Iout-Vout

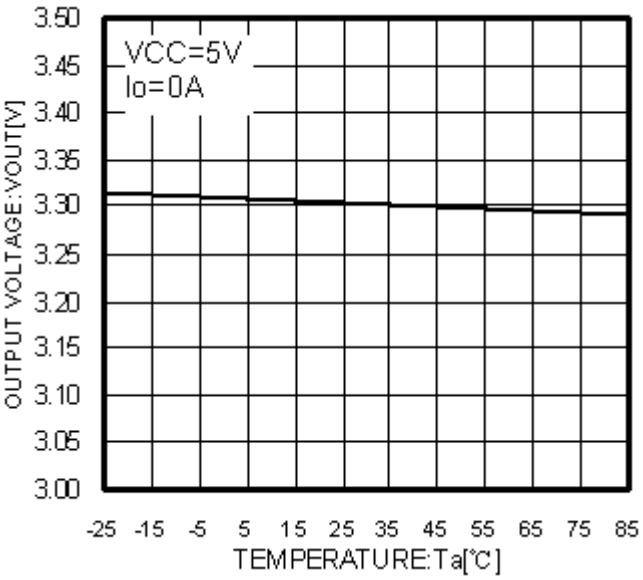


Fig. 43 Ta-Vout

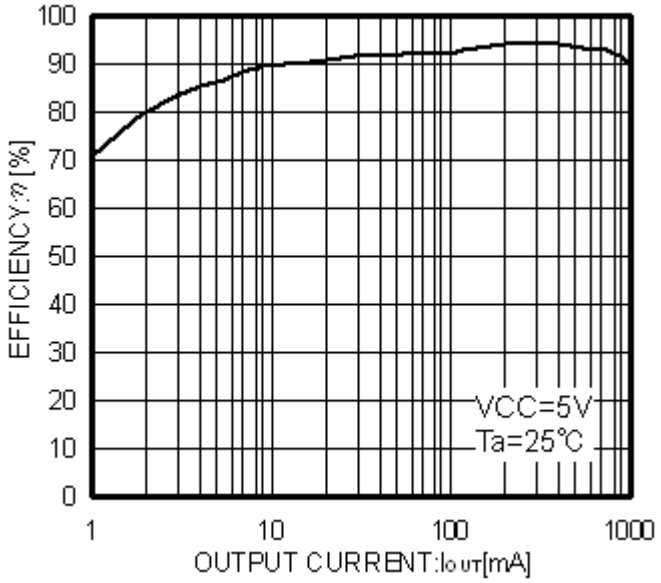


Fig.44 Efficiency

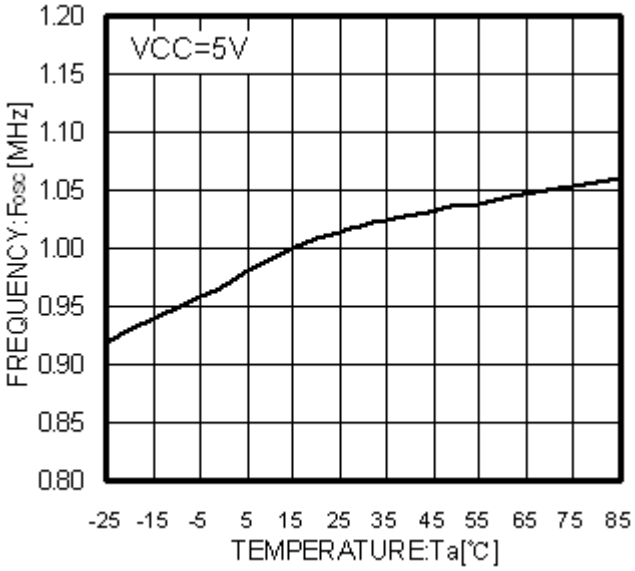


Fig.45 Ta-Fosc

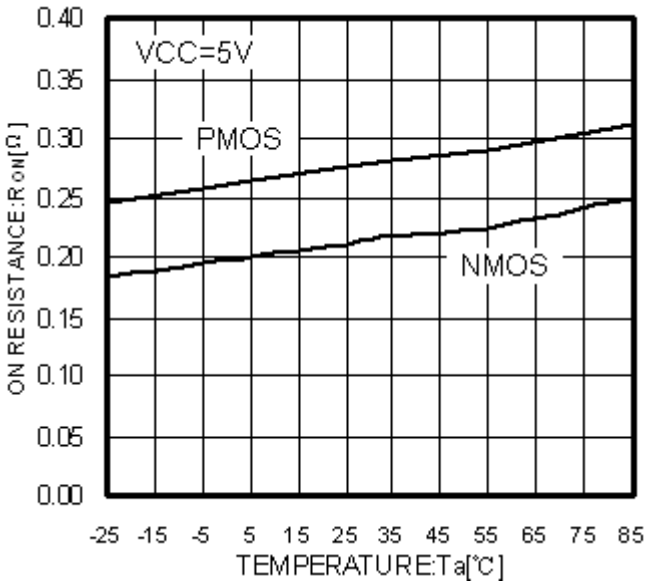


Fig.46 Ta-Ronn, Ronp

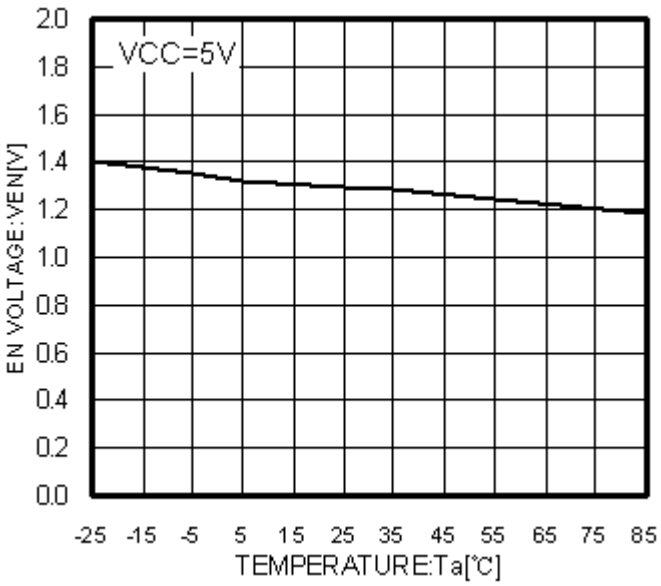


Fig.47 Ta-Ven

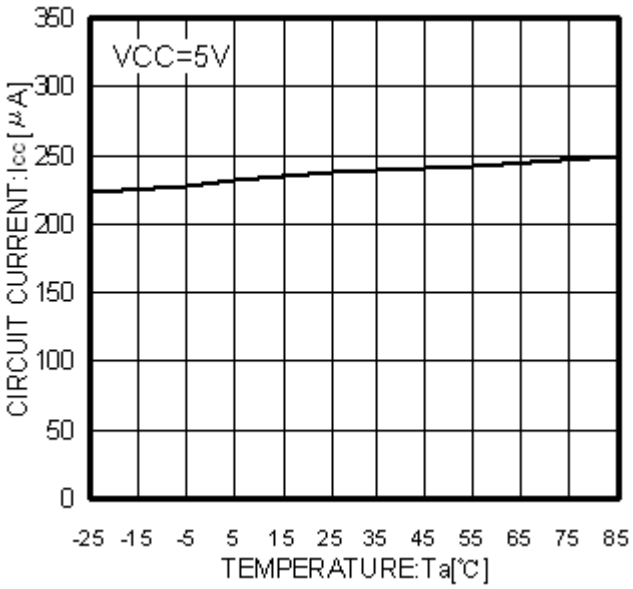


Fig.48 Ta-Icc

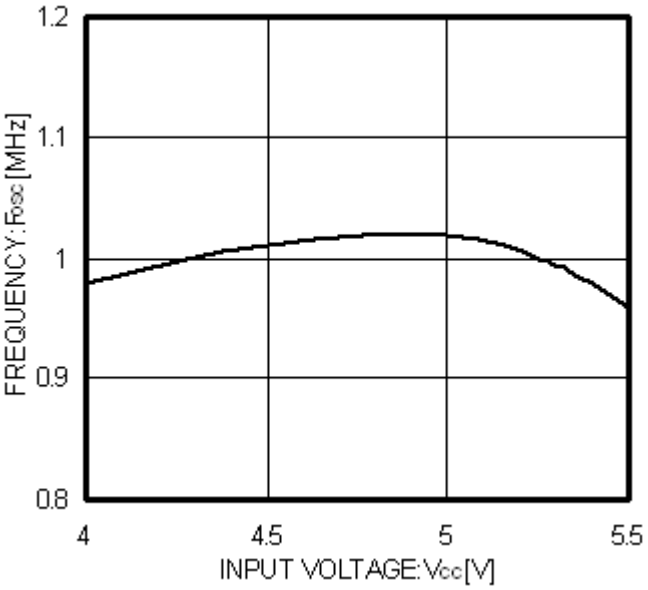


Fig.49 Vcc-Fosc

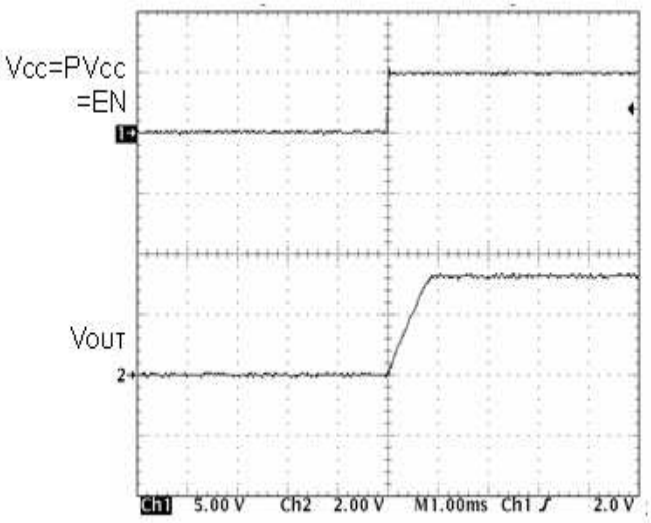


Fig.50 Soft start waveform

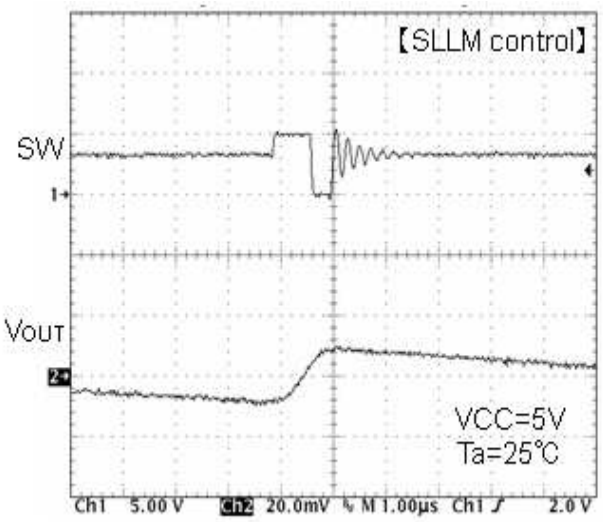


Fig.51 SW waveform Io=10mA

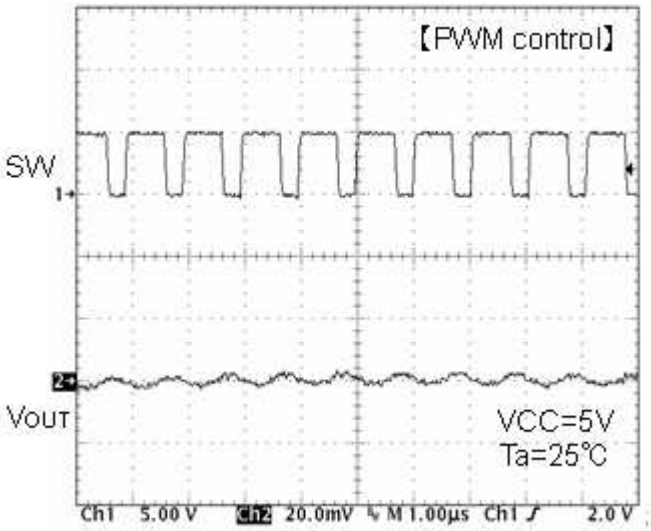


Fig.52 SW waveform Io=500mA

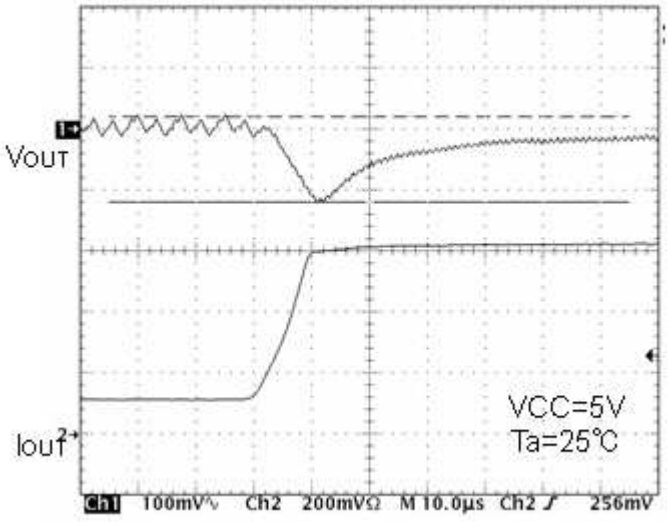


Fig. 53 Transient response
Io=100→600mA(10µs)

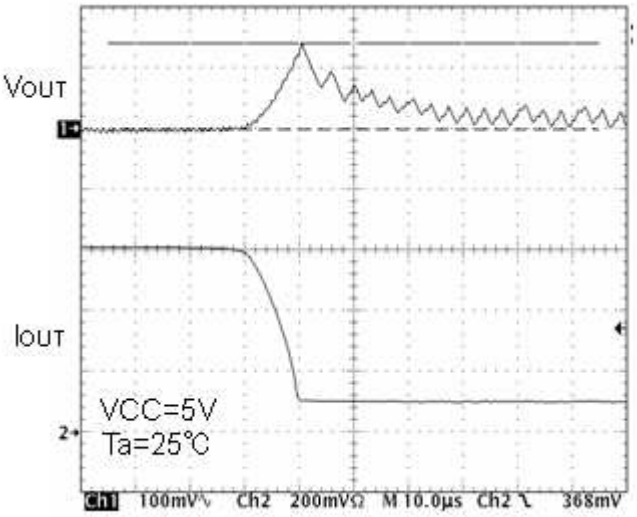


Fig.54 Transient response
Io=600→100mA(10µs)

【BD9110NV】

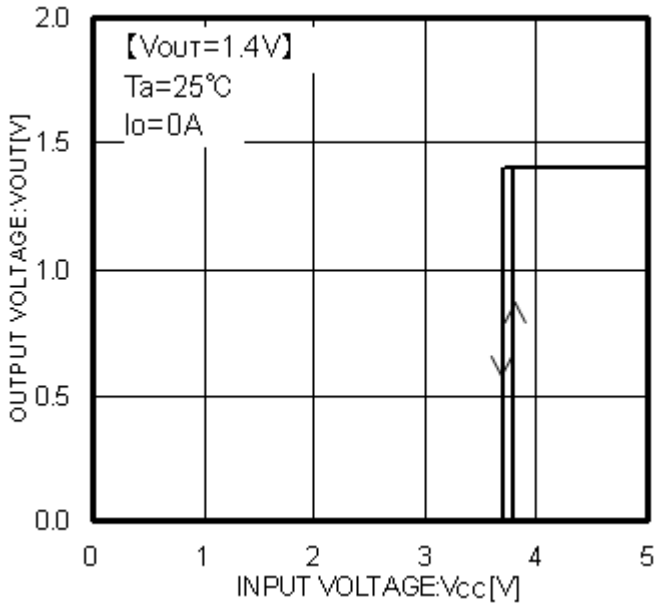


Fig.55 Vcc-Vout

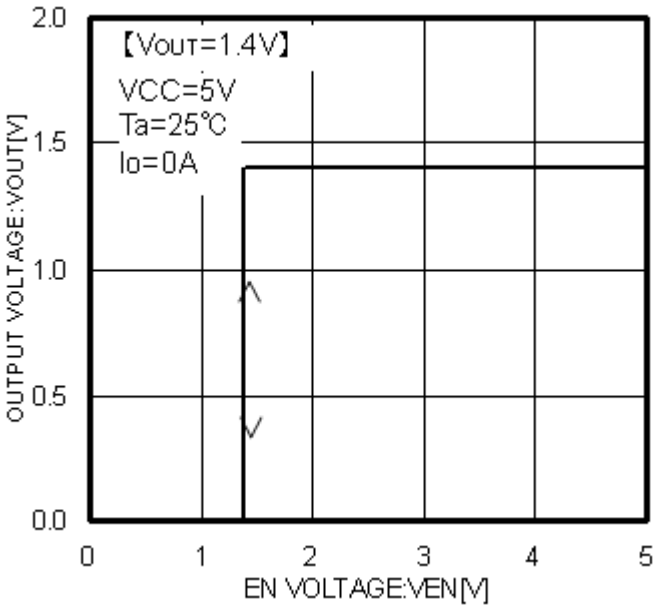


Fig.56 Ven-Vout

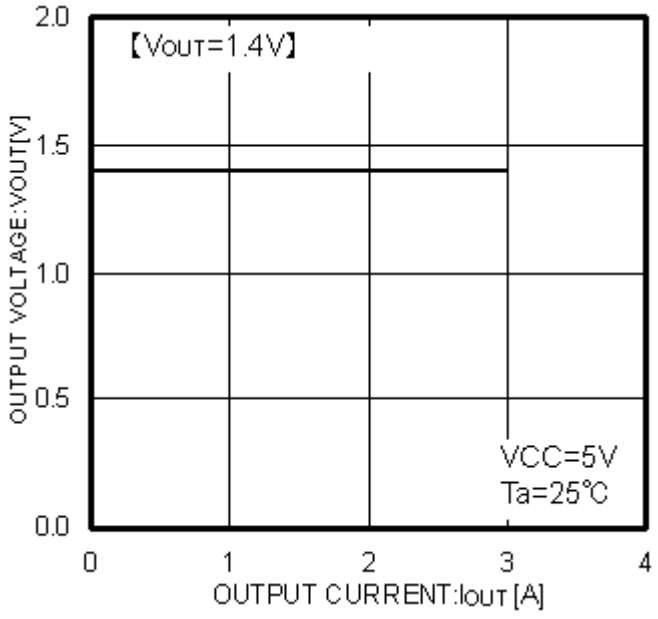


Fig.57 Iout-Vout

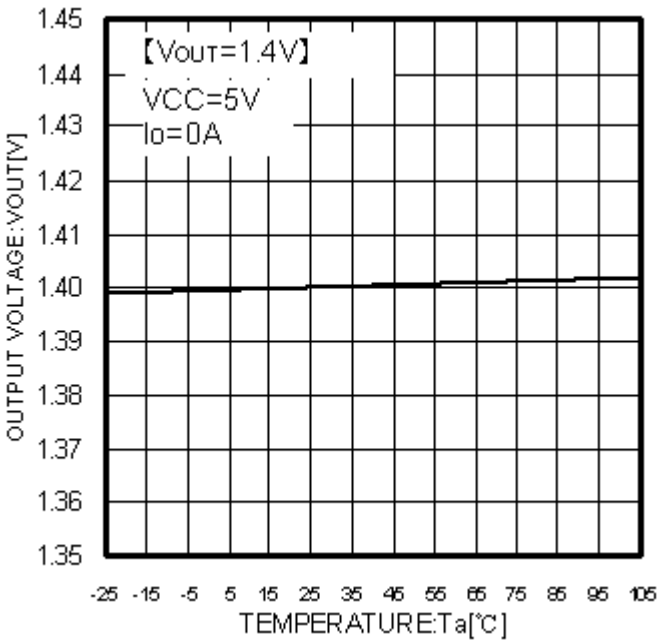


Fig. 58 Ta-Vout

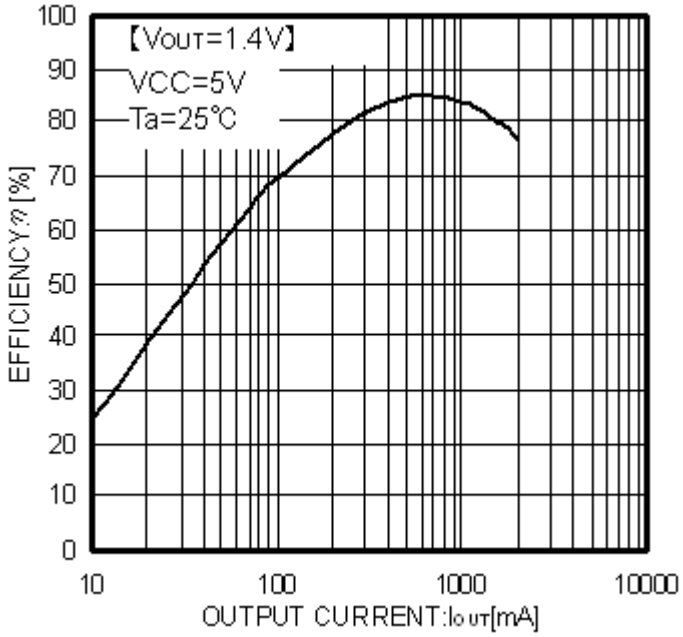


Fig.59 Efficiency

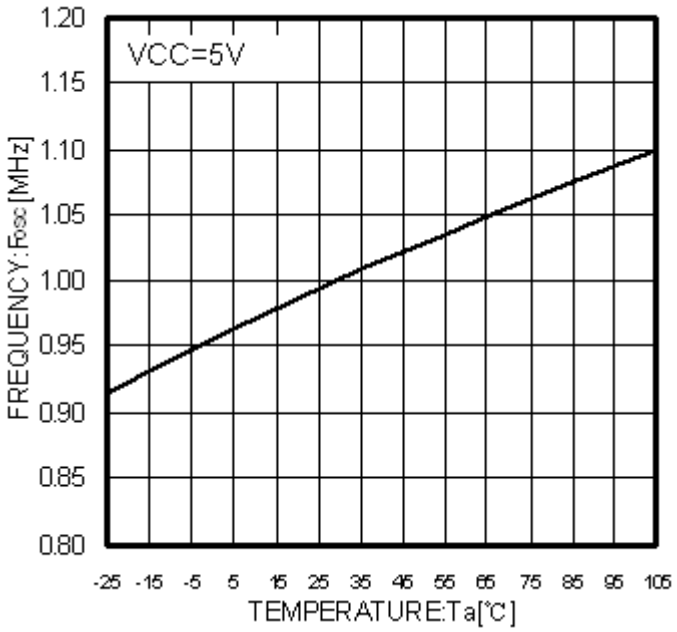


Fig.60 Ta-Fosc

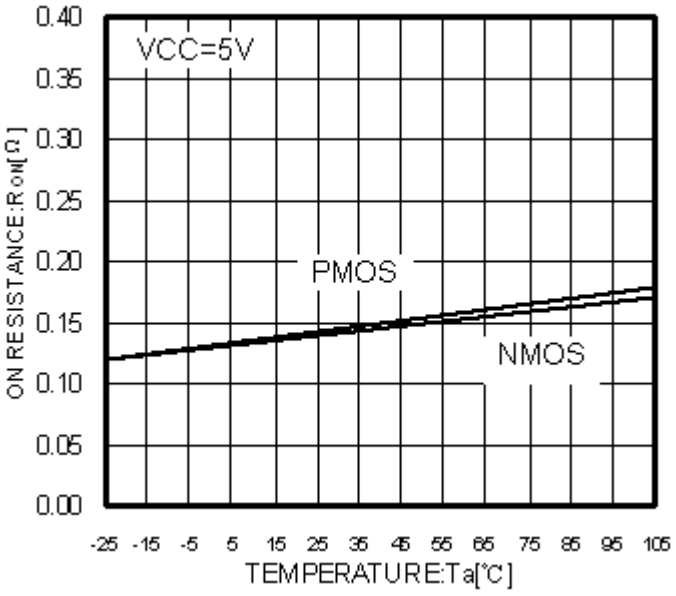


Fig.61 Ta-Ronn, Ronp

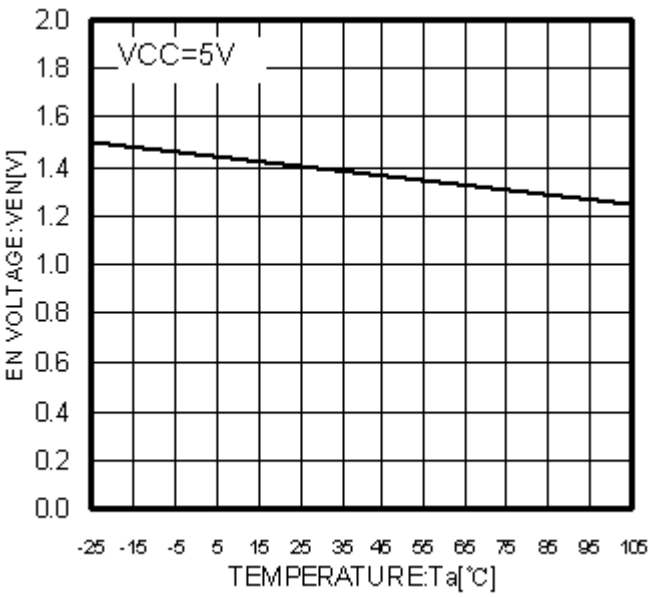


Fig.62 Ta-Ven

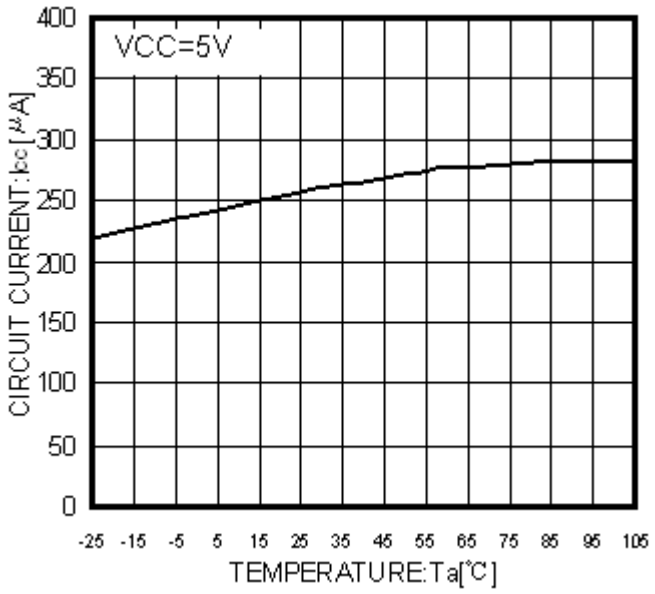


Fig.63 Ta-Icc

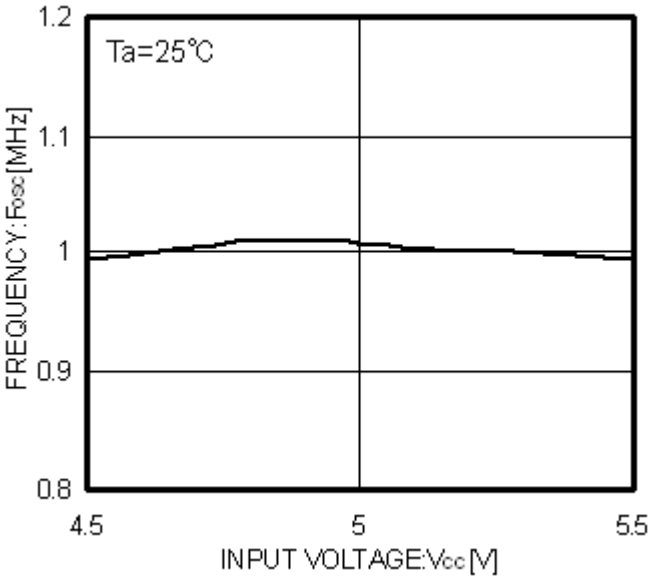


Fig.64 Vcc-Fosc

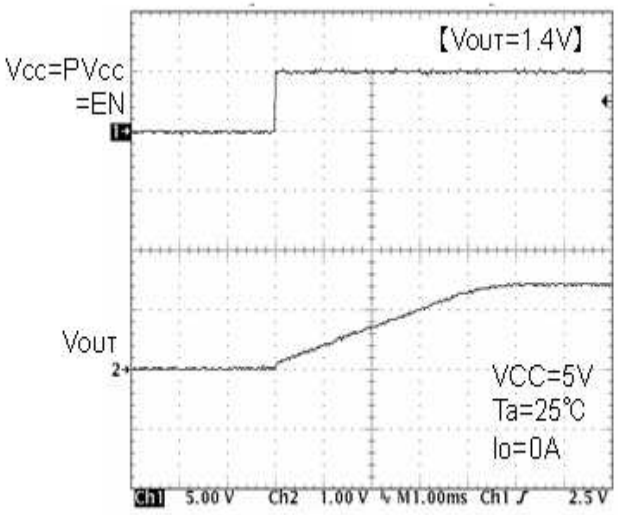


Fig.65 Soft start waveform

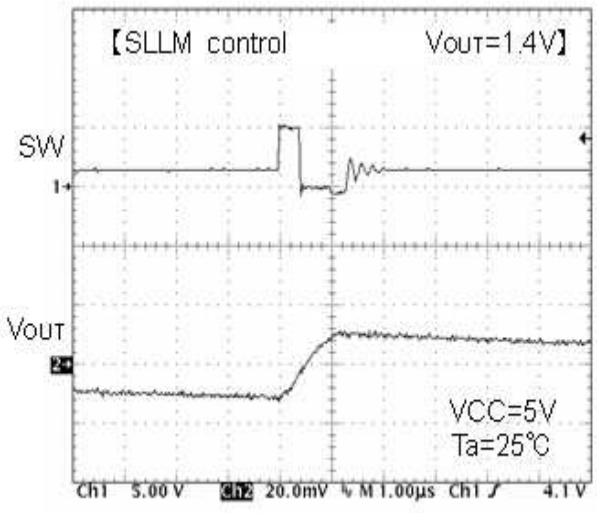


Fig.66 SW waveform Io=10mA

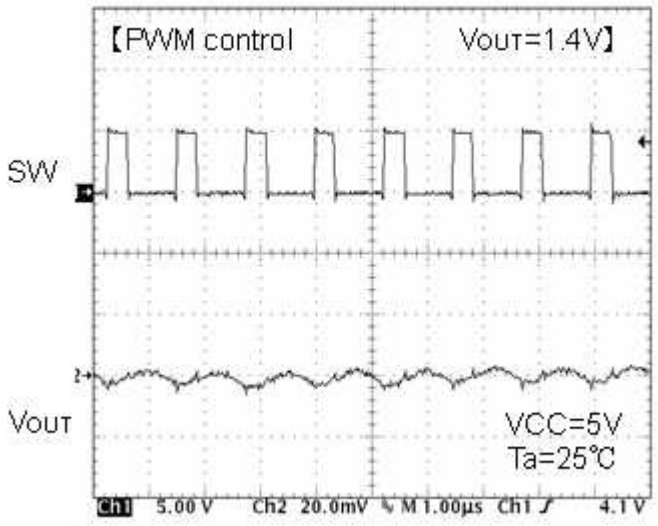


Fig.67 SW waveform Io=500mA

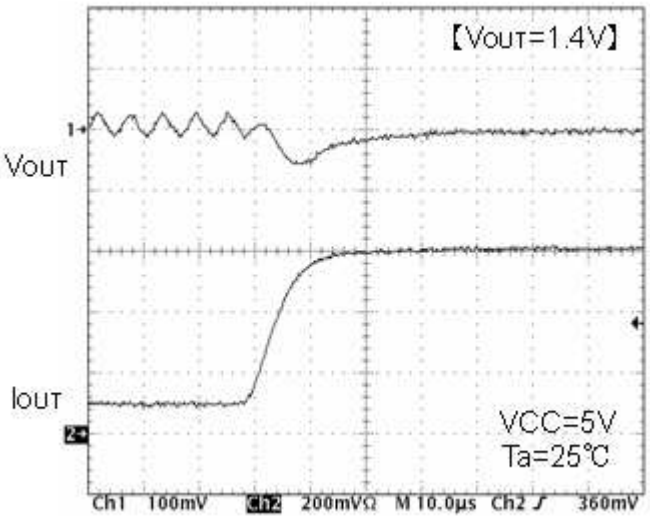


Fig. 68 Transient response
Io=100→600mA(10µs)

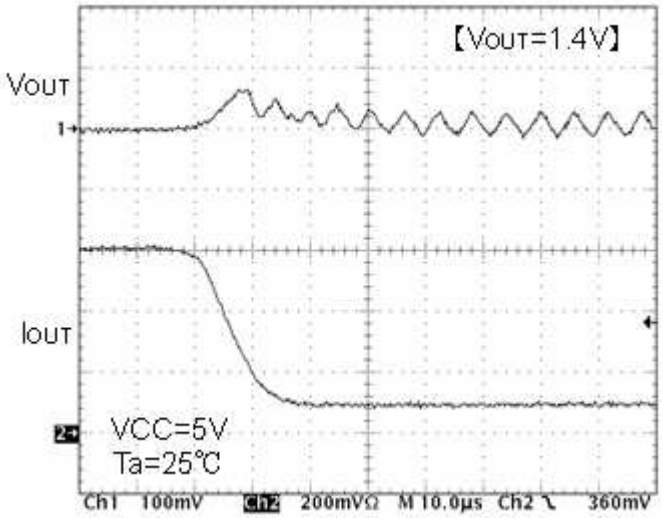


Fig.69 Transient response
Io=600→100mA(10µs)

【BD9120HFN】

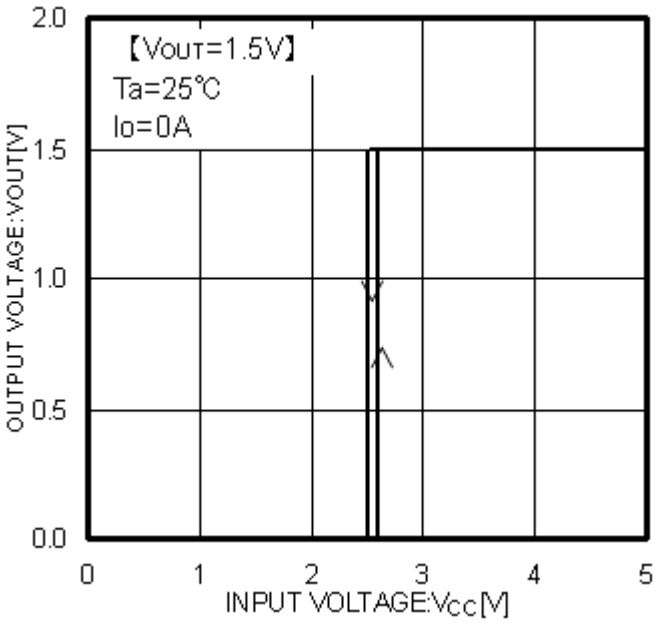


Fig.70 Vcc-Vout

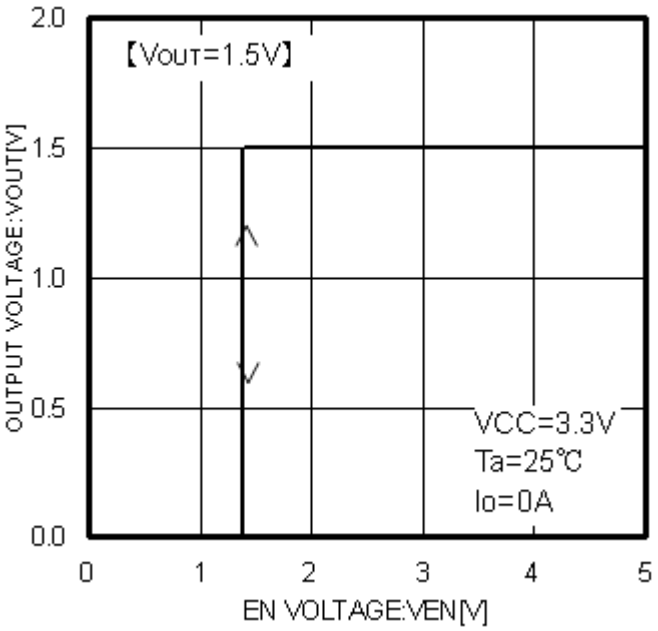


Fig.71 Ven-Vout

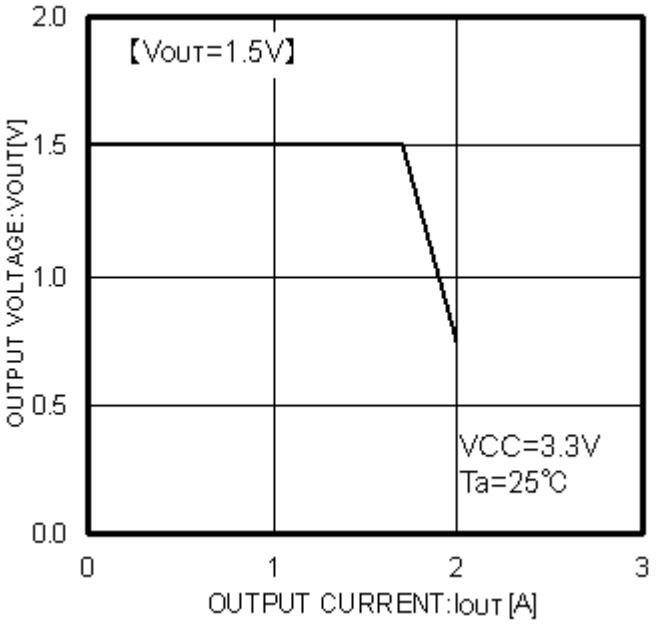


Fig.72 Iout-Vout

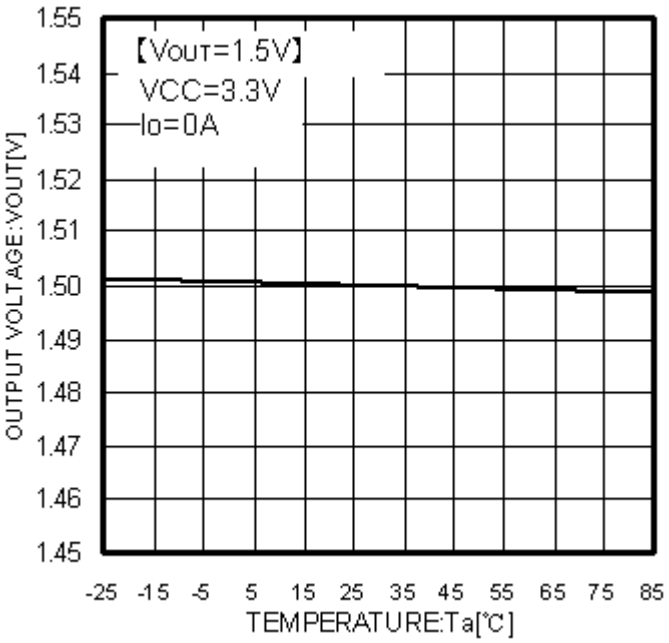


Fig. 73 Ta-Vout

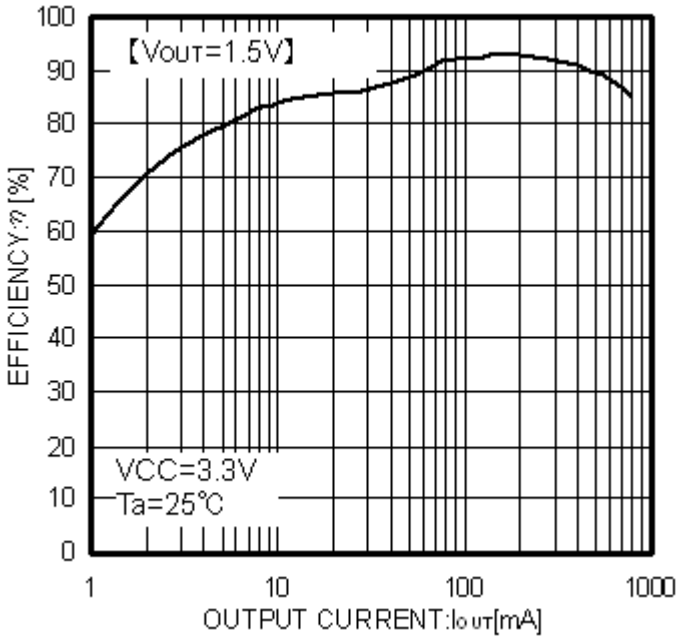


Fig.74 Efficiency

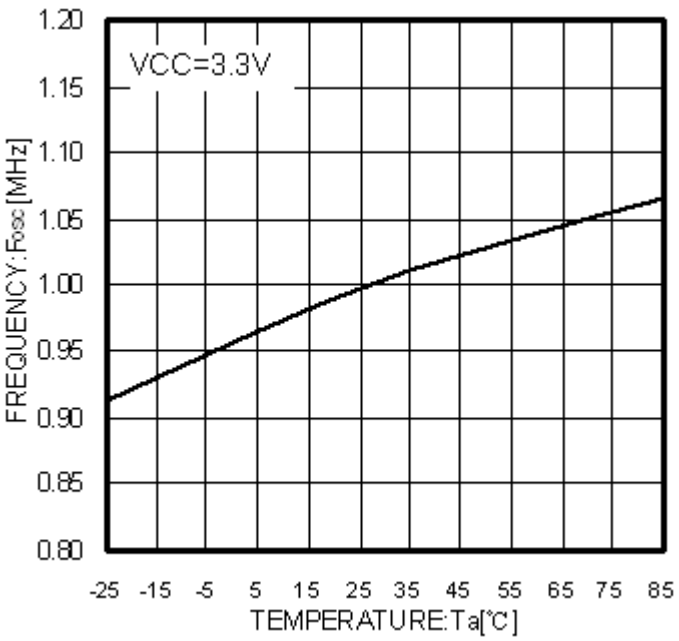


Fig.75 Ta-Fosc

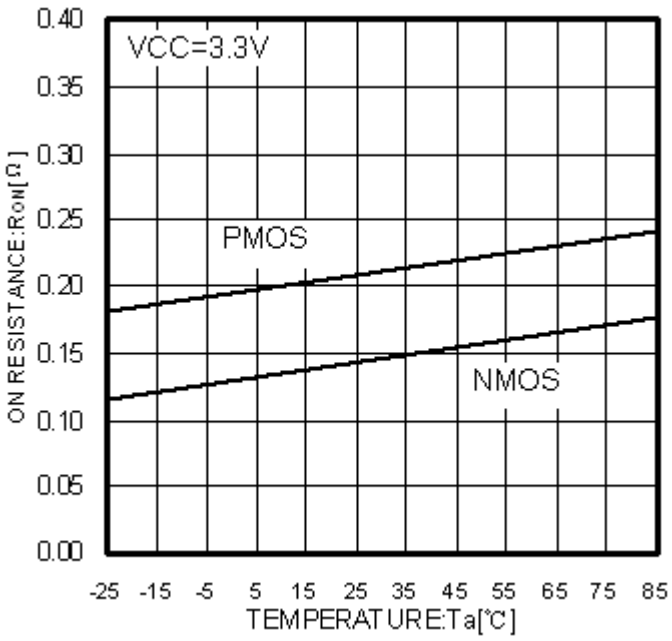


Fig.76 Ta-Ronn, Ronp

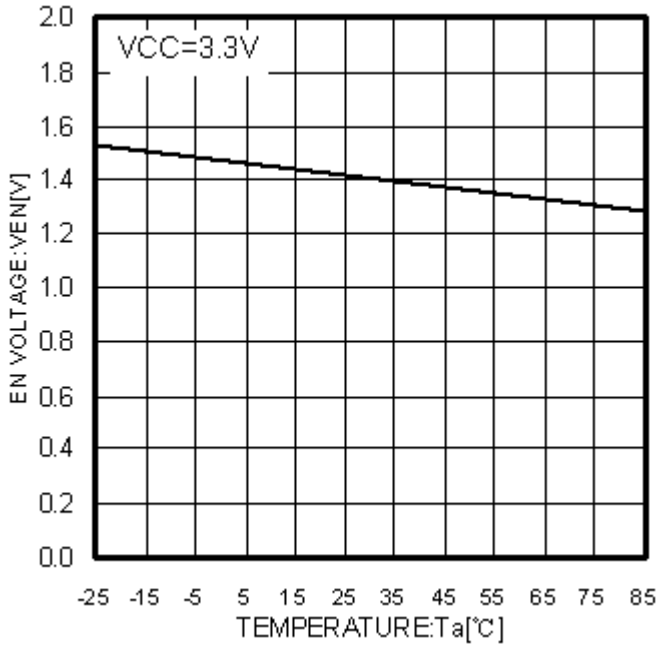


Fig.77 Ta-Ven