

# High Voltage Operation Step-down DCDC Converter Monolithic IC MM3370

## Outline

This IC is a diode rectifier-type step-down DCDC converter IC with integrated Power MOS FET. The IC operates at a maximum output current of 3A. This is suitable for power supplies of LCTVs and DVD recorders because of its more stable load transient response (changes from 1A to 2A, approx. 50mV) and wider input voltage range (7 to 27V) .

## Features

1. Soft Start Function
2. Shut Down Function
3. Current Limit Function
4. Electrical Characteristics
 

Operating Supply Voltage	7~27V
Output Voltage	0.92V~
Reference Voltage Accuracy	±2%
Maximum Output Current	3A
Oscillation Frequency	500kHz
Consumption Current	0.8mA (operation) 20µA (power-off)

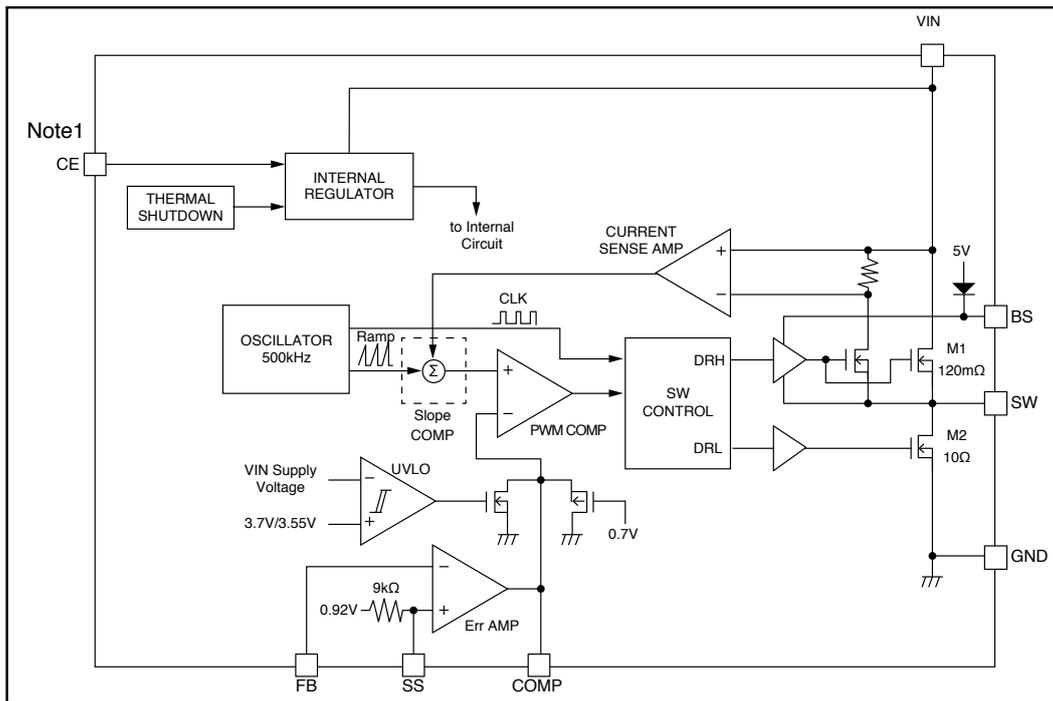
## Package

HSOP-8A

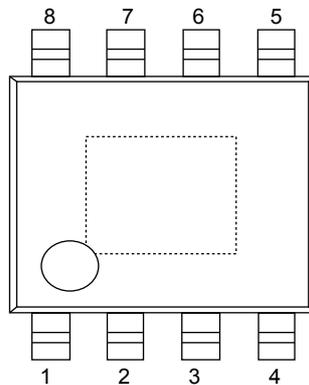
## Applications

1. DVD Recorders
2. Blu-ray Disc Recorders
3. TVs

Block Diagram



Pin Assignment



HSOP-8A  
TOP VIEW

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## Pin Description

Pin No.	Pin name	Input/Output	Pin description
1	BS	INPUT	Boost Capacitor Connection pin
2	VIN	INPUT	Power Supply Voltage Input pin
3	SW	OUTPUT	Inductor Connection pin
4	GND	INPUT	Ground pin
5	FB	INPUT	Feedback Input pin
6	COMP	OUTPUT	Compensation Node pin
7	CE	INPUT	Chip Enable Input pin
8	SS	INPUT	Soft Start Control Input pin

## Absolute Maximum Ratings

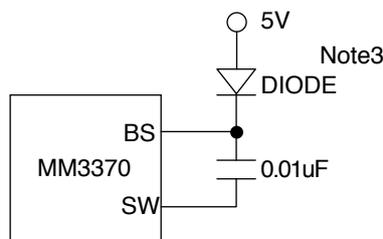
Item	Symbol	Ratings	Units
Storage Temperature	Tstg	-55~+150	°C
VIN Supply Voltage	V <sub>VIN</sub> MAX	-0.3~+30	V
SW Pin Supply Voltage	V <sub>SW</sub> MAX	-1~VIN+0.3	V
BS Pin Supply Voltage	V <sub>BOOST</sub> MAX	V <sub>SW</sub> -0.3~V <sub>SW</sub> +6	V
FB Pin Supply Voltage	V <sub>FB</sub> MAX	-0.3~+5.5	V
CE Pin Supply Voltage	V <sub>CE</sub> MAX	-0.3~+30	V
SS Pin Supply Voltage	V <sub>SS</sub> MAX	-0.3~+5.5	V
COMP Pin Supply Voltage	V <sub>COMP</sub> MAX	-0.3~+5.5	V
Power Dissipation	Pd	2000 (Note2)	mW

Note2 : JEDEC51-7 standard 120×120×1.6<sup>t</sup>mm

## Recommended Operating Conditions

Item	Symbol	Ratings	Units
Operating Temperature	T <sub>OPR</sub>	-40~+85	°C
Supply Voltage	V <sub>OPR</sub>	+7~+27	V

Note3 : The internal boost regulator leads to the efficiency improvement when it stabilizes and VIN is low by connecting the external boot strap diode.



**Electrical Characteristics**

(Except where noted otherwise VIN=12V, Ta=25°C)

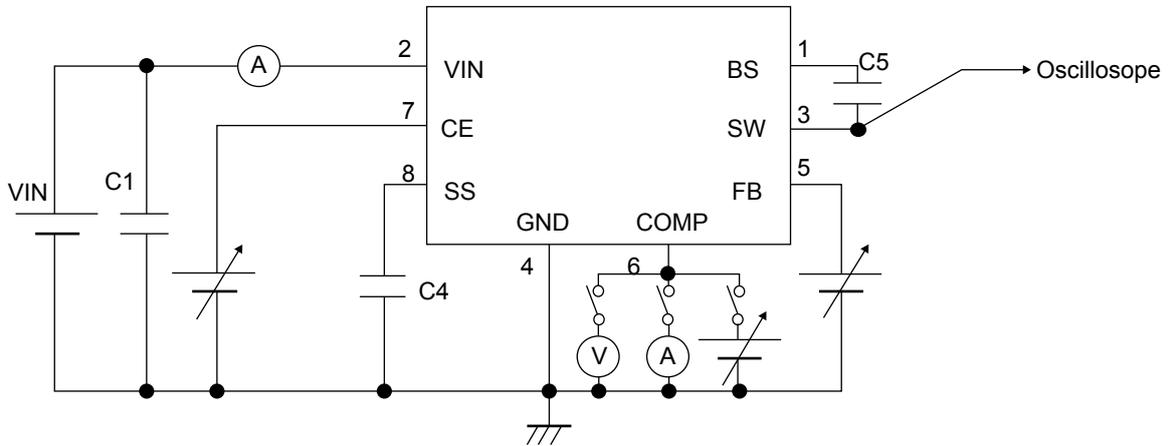
Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
VIN Input Voltage Range	VIN		7		27	V
Supply Current	ISS1	VCE=3V, VFB=1.4V		0.8	1.2	mA
Shutdown Supply Current	ISS2	VCE=0V		20	40	μA
Feedback Voltage	VFB	7V ≤ VIN ≤ 27V	0.90	0.92	0.94	V
Maximum Output Current	IOMAX		3.0			A
Error Amplifier Transconductance	GEA	ΔI <sub>COMP</sub> =±10μA		800		μA/V
High-Side Switch On-Resistance (Note4)	RONH			120		mΩ
Low-Side Switch On-Resistance	RONL			10		Ω
High-Side Switch Leakage Current	I <sub>LEAK</sub>	VCE=0V, V <sub>SW</sub> =0V		0.1	10	μA
Short Circuit Current Limit (Note4)	I <sub>LIM</sub>			8		A
Oscillation Frequency	f <sub>SW</sub>		400	500	600	kHz
Maximum Duty Cycle	D <sub>MAX</sub>	V <sub>FB</sub> =0.8V		88		%
Minimum ON Time (Note4)	T <sub>ON</sub>			120		ns
CE Pin Threshold Voltage	V <sub>CET</sub>		1.1	1.4	1.7	V
UVLO Detection Voltage(Note5)	V <sub>UVLO</sub>	VIN Rising	3.4	3.7	4.0	V
UVLO Hysteresis Voltage	ΔV <sub>UVLO</sub>			150		mV
Thermal Shutdown (Note4)	THD			160		°C

Note4 : Guaranteed by design.

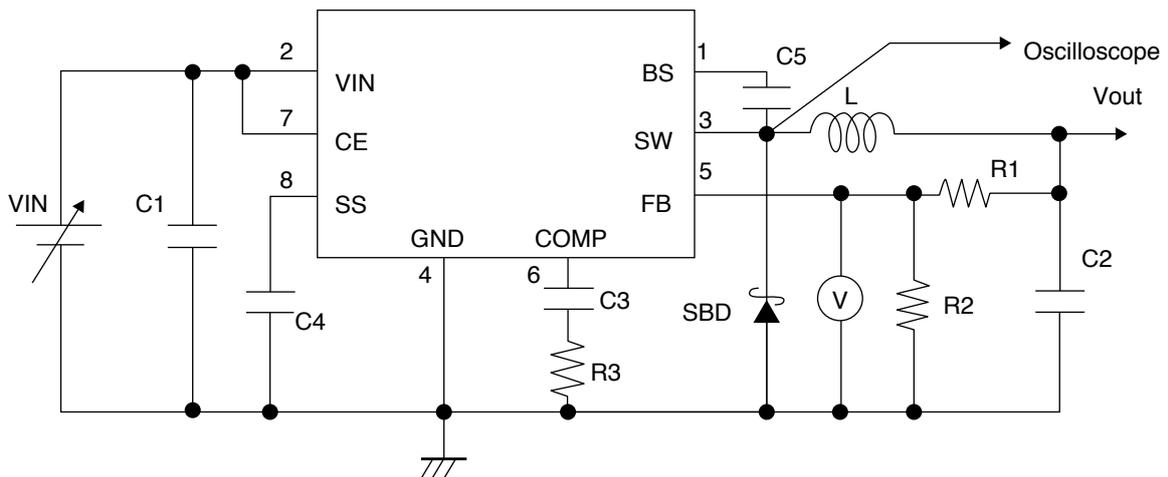
Note5 : When VIN is from UVLO detection voltage 3.7V(TYP.) to VIN input voltage 7V(MIN.) , the switching output operates intermittent and the output.

Test Circuit

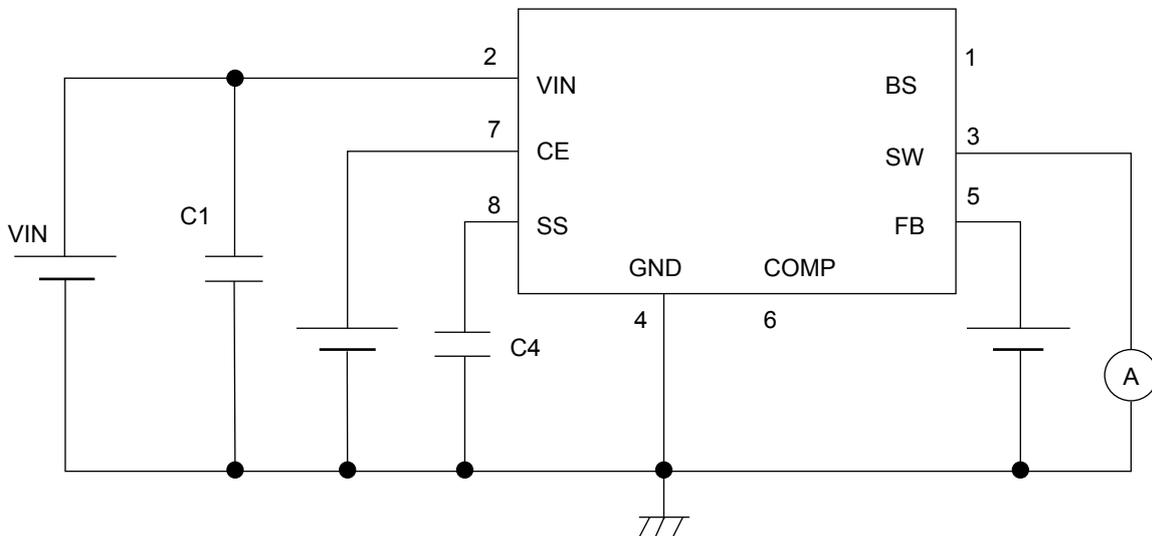
Test Circuit 1



Test Circuit 2



Test Circuit 3



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## Device Operation

### Description

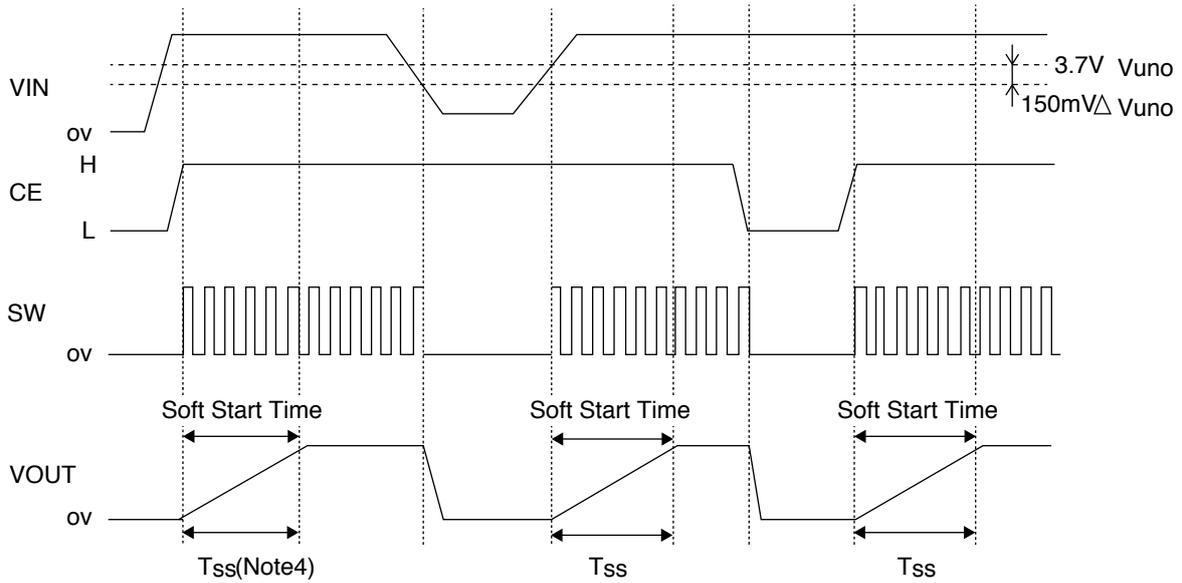
MM3370 is step-down converter with built-in MOSFET of the low on resistance in single-chip. It is able to supply up to 3A of load current within the wide range from 7V in the input voltage to 27V. To operate by the current mode control, the simplification of the phase amends, the improvement of the load response characteristic, and the improvement of the line regulation characteristic have been achieved. The output voltage is input to the FB PIN through the connected resistance, and amplified through the internal error amplifier. It is output to the COMP PIN in the error amplifier compared with an internal standard voltage (= SS PIN) and Duty is controlled.

### Operation Explanation

- INTERNAL REGURATOR  
Constant voltage generation block for internal circuit.
- THERMAL SHUTDOWN  
Over Temperature Protection block.  
When the temperature of the chip exceeds 160°C (TYP), it is set that it shuts down.
- Err AMP  
Error Amplifier. It is a circuit that compares reference voltage with the feedback voltage. Because the COMP PIN that outputs the result of compare it with the SS PIN where reference voltage hangs is output as a terminal, external parts can be connected.
- OSCILLATOR  
Oscillator. It is a circuit that generates the switching frequency.
- Slope-COMP  
It is a circuit that adds the amount of the current of MOSFET detected in the triangular wave generated with the oscillator with a current sense amplifier. The added shape of waves is output to PWMCOMP.
- CURRENT SENSE AMP  
It adds to the triangular wave generated with the oscillator by detecting the current on high side MOSFET, and converting the voltage.
- PWM COMP  
The ErrAMP output is compared with the Slope-COMP output and Duty of the switching is decided.

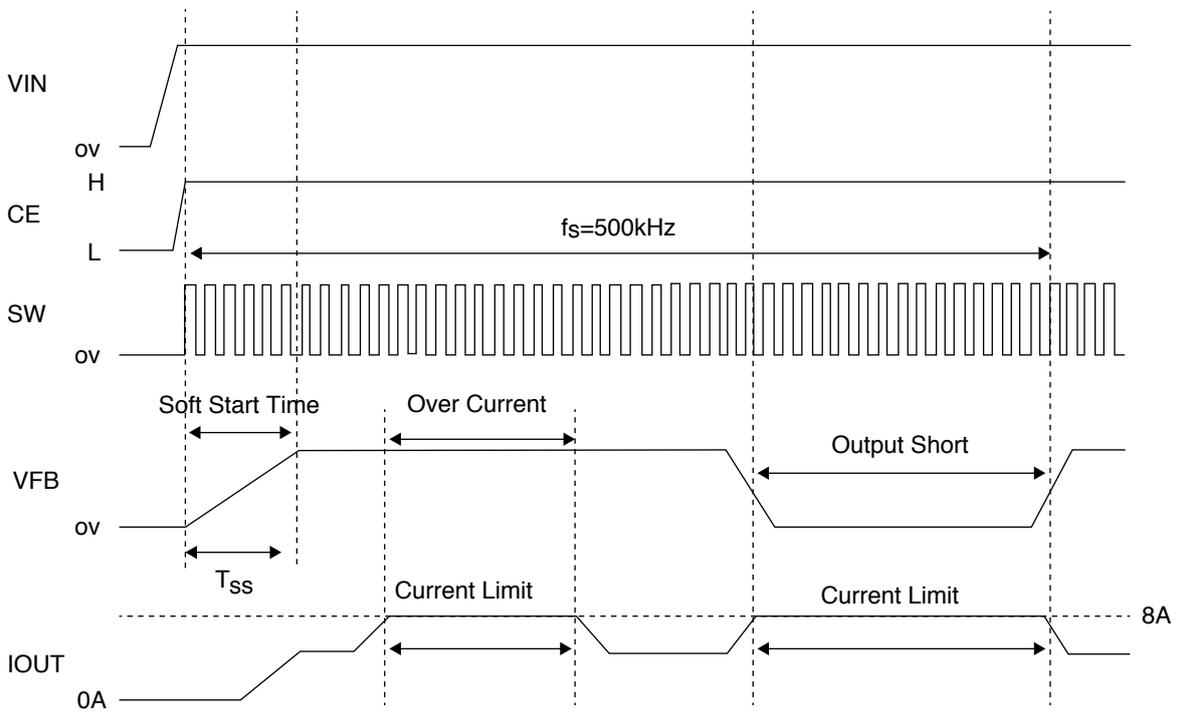
## Timing Chart

### (1) Start Up



Note6:  $T_{ss}(ms) = 45 \times C4(\mu F)$

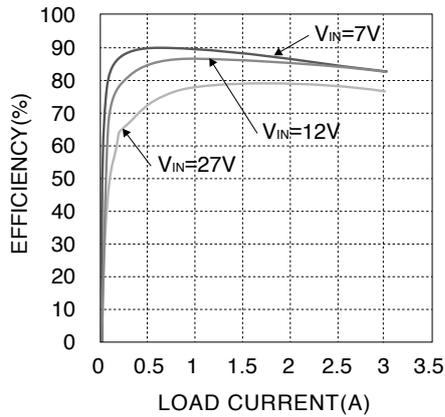
### (2) Over Current Detection



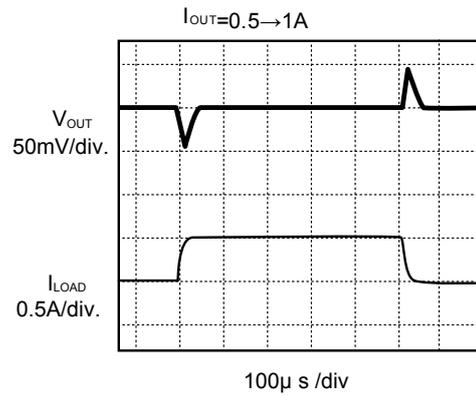
\* The values indicate representative values.

**Characteristics** (Except where noted otherwise  $V_{IN}=12V$ ,  $V_{OUT}=3.3V$ ,  $L=10\mu H$ ,  $T_a=25^\circ C$ )

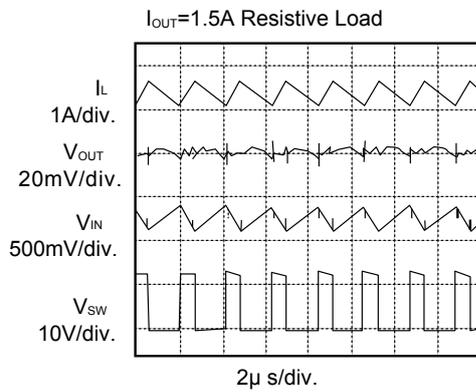
■ Output Current-Efficiency



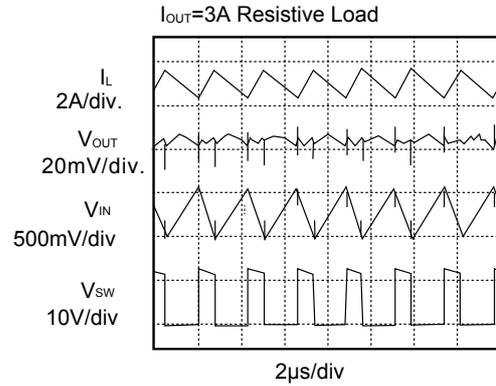
■ Load Transient Response



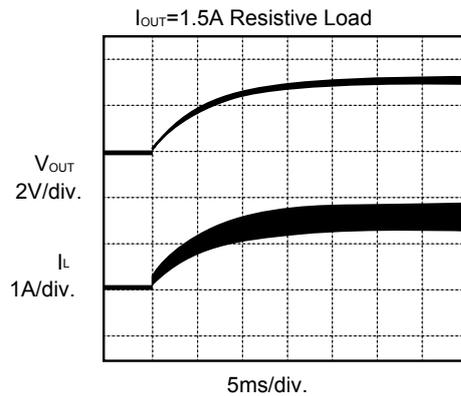
■ Steady State test



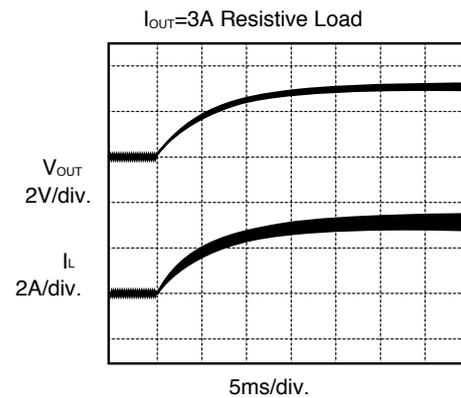
■ Steady State test



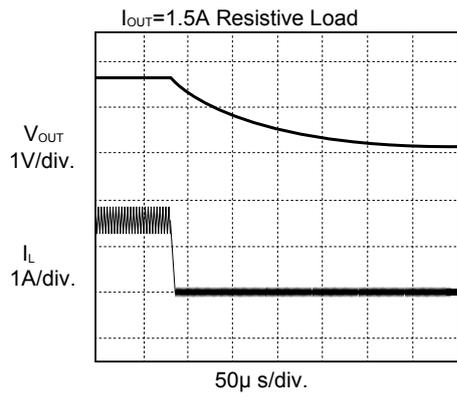
■ Startup through Enable



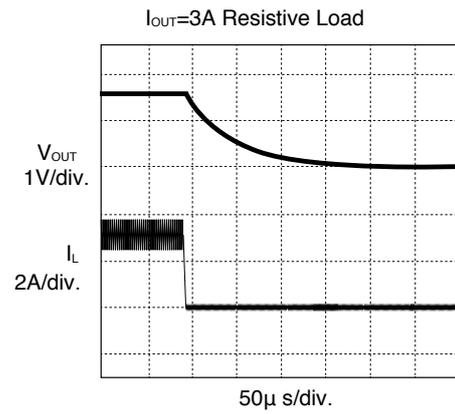
■ Startup through Enable



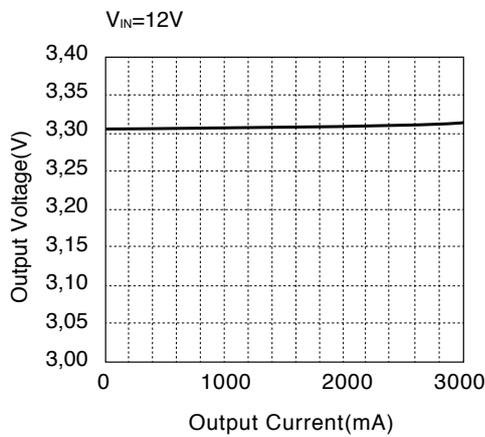
■ Shutdown through Enable



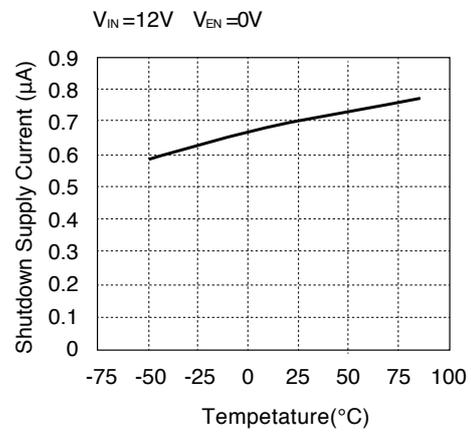
■ Shutdown through Enable



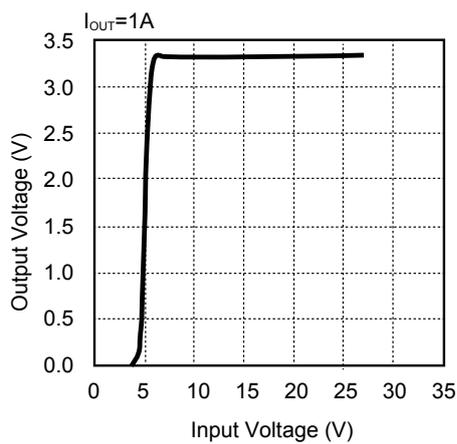
■ LOAD REGULATION



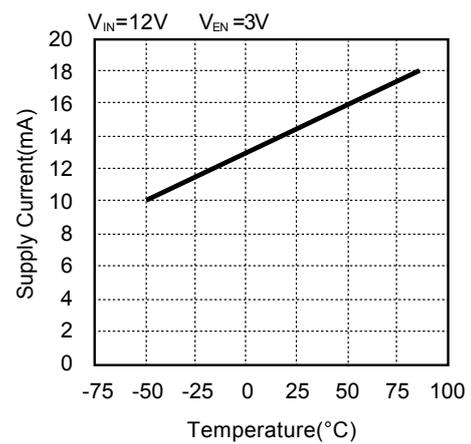
■ Shutdown Supply Current -Temperature



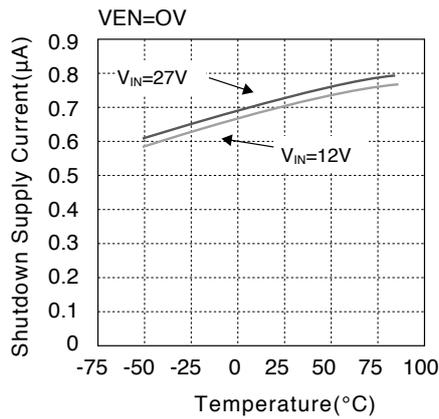
■ Line Regulation



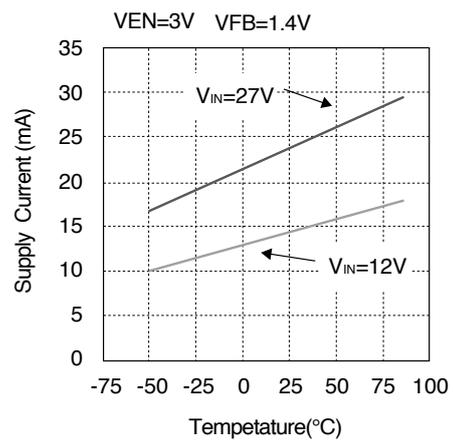
■ Supply Current -Temperature



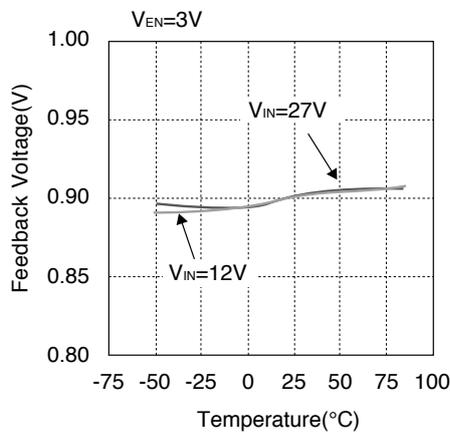
■ Shutdown Supply Current -Temperature



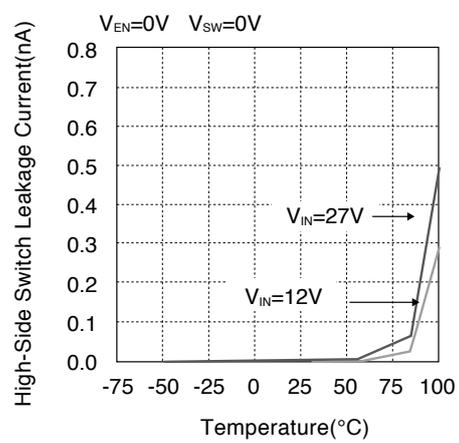
■ Supply Current -Temperature



■ Feedback Voltage-Temperature



■ High-Side Switch Leakage Current-Temperature



■ Oscillation Frequency-Temperature

