# 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) |

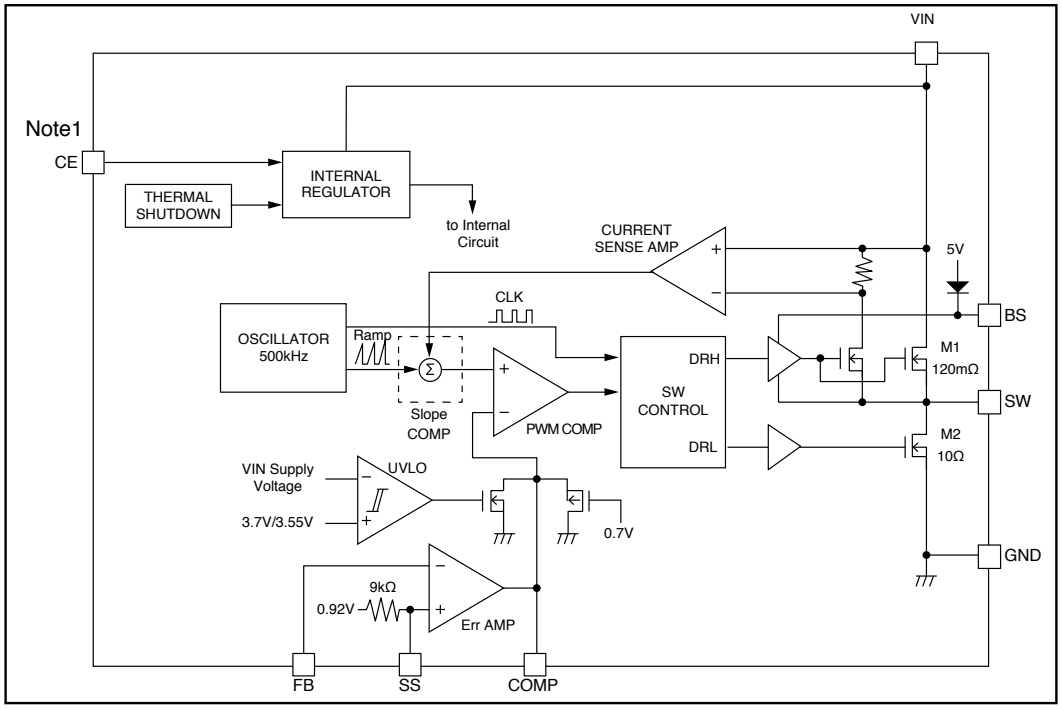
## Package

HSOP-8A

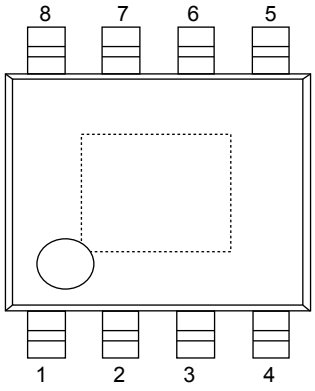
## Applications

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

## Block Diagram




## Pin Assignment




HSOP-8A
TOP VIEW

## 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

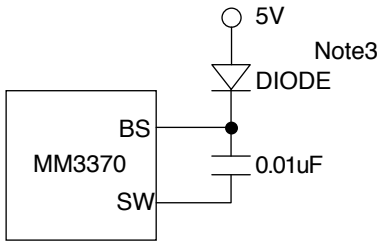
| Item | Symbol | Ratings | Units |
|---|---|---|---|
| Storage Temperature | Tstg | −55~+150 | °C |
| VIN Supply Voltage | $V_{VIN}MAX$ | −0.3~+30 | V |
| SW Pin Supply Voltage | $V_{SW}MAX$ | −1~VIN+0.3 | V |
| BS Pin Supply Voltage | $V_{BOOST}MAX$ | $V_{SW}$−0.3~$V_{SW}$+6 | V |
| FB Pin Supply Voltage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

Note2 : JEDEC51-7 standard 120×120×1.6$^{t}$mm

## Recommended Operating Conditions

| Item | Symbol | Ratings | Units |
|---|---|---|---|
| Operating Temperature | $T_{OPR}$ | −40~+85 | °C |
| Supply Voltage | $V_{OPR}$ | +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)

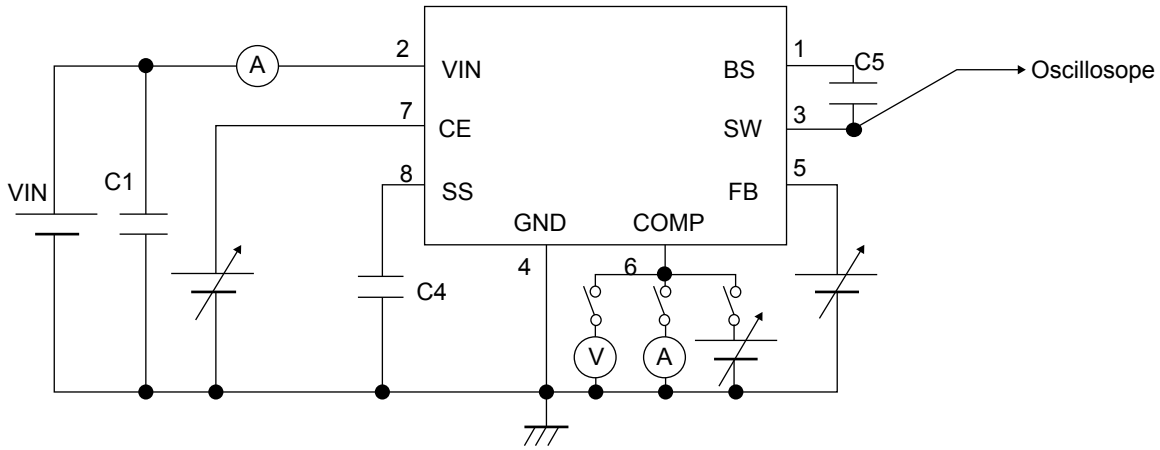
| Item | Symbol | Measurement conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| VIN Input Voltage Range | $V_{IN}$ | | 7 | | 27 | V |
| Supply Current | $I_{SS1}$ | $V_{CE}$=3V, $V_{FB}$=1.4V | | 0.8 | 1.2 | mA |
| Shutdown Supply Current | $I_{SS2}$ | $V_{CE}$=0V | | 20 | 40 | μA |
| Feedback Voltage | $V_{FB}$ | 7V≦$V_{IN}$≦27V | 0.90 | 0.92 | 0.94 | V |
| Maximum Output Current | $I_{OMAX}$ | | 3.0 | | | A |
| Error Amplifier Transconductance | $G_{EA}$ | ⊿$I_{COMP}$=±10μA | | 800 | | μA/V |
| High-Side Switch On-Resistance (Note4) | $R_{ONH}$ | | | 120 | | mΩ |
| Low-Side Switch On-Resistance | $R_{ONL}$ | | | 10 | | Ω |
| High-Side Switch Leakage Current | $I_{LEAK}$ | $V_{CE}$=0V, $V_{SW}$=0V | | 0.1 | 10 | μA |
| Short Circuit Current Limit (Note4) | $I_{LIM}$ | | | 8 | | A |
| Oscillation Frequency | fsw | | 400 | 500 | 600 | kHz |
| Maximum Duty Cycle | $D_{MAX}$ | $V_{FB}$=0.8V | | 88 | | % |
| Minimum ON Time (Note4) | $T_{ON}$ | | | 120 | | ns |
| CE Pin Threshold Voltage | $V_{CET}$ | | 1.1 | 1.4 | 1.7 | V |
| UVLO Detection Voltage(Note5) | $V_{UVLO}$ | $V_{IN}$ Rising | 3.4 | 3.7 | 4.0 | V |
| UVLO Hysteresis Voltage | ⊿$V_{UVLO}$ | | | 150 | | mV |
| Thermal Shutdown (Note4) | THD | | | 160 | | °C |

Note4 : Guaranteed by design.

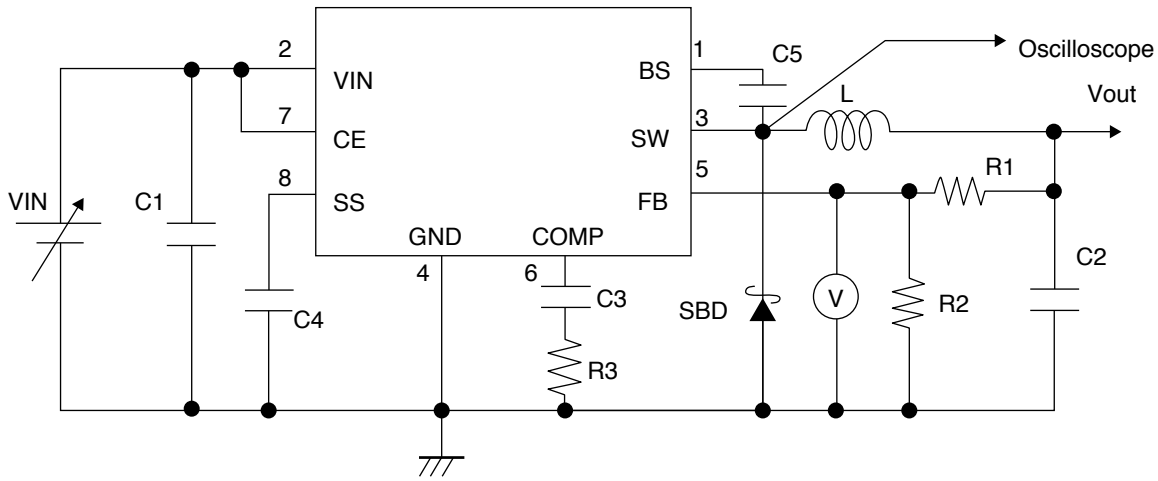
Note5 : When VIN is from UVLO detection voltage 3.7V(TYP.) to VIN input voltage 7V(MIN.) , the switching output operates intermittent and the output.

## Test Circuit

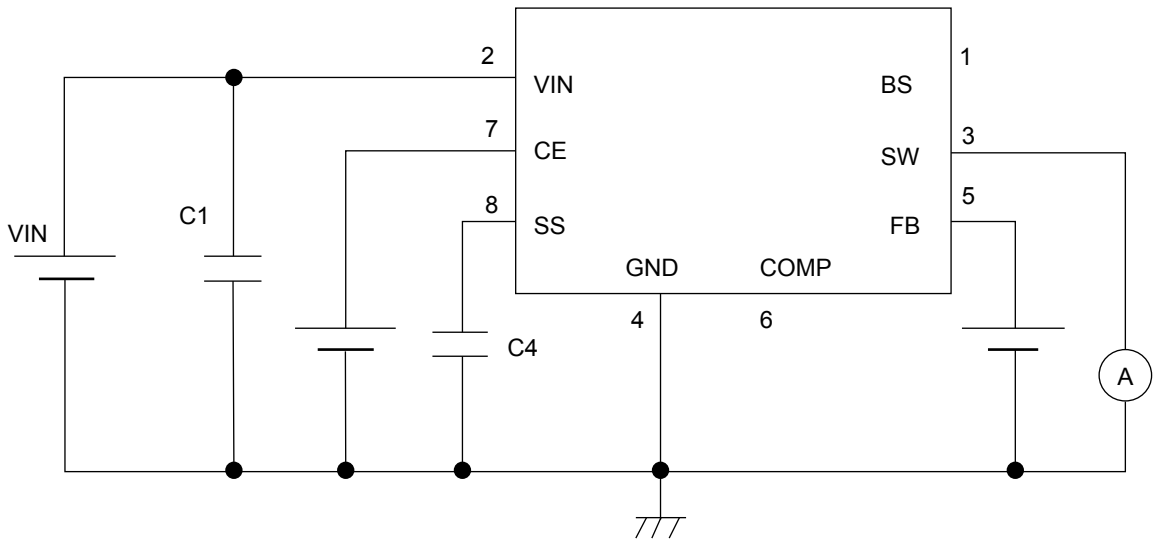
### Test Circuit 1




### Test Circuit 2




### Test Circuit 3



# 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.

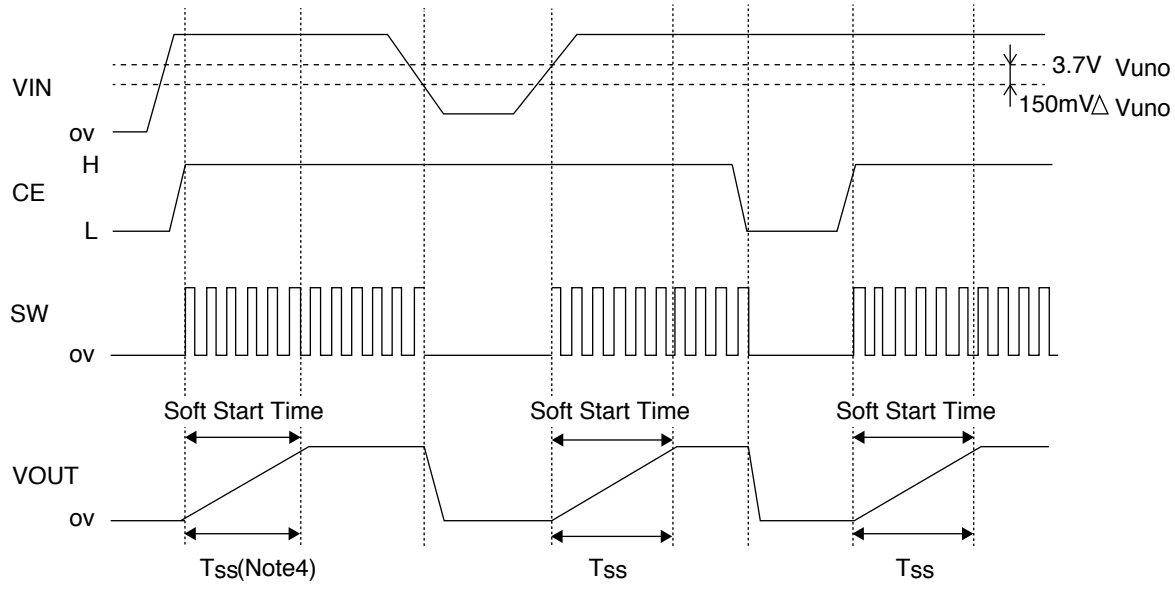
· Slope-COMP
It is a circuit that adds the amount of the current of MOSFET detected in the triangular wave generated with the oscillator with a current sense amplifier. The added shape of waves is output to PWMCOMP.

· 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.

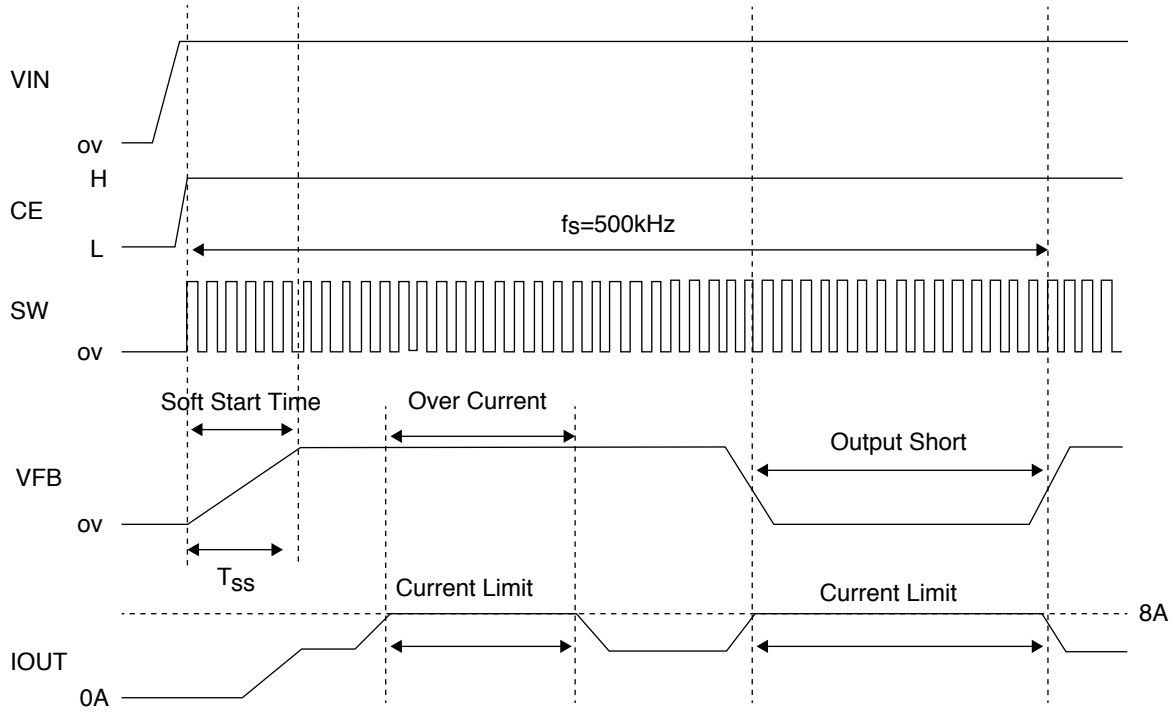
## Timing Chart

### (1) Start Up




Note6: $T_{SS}$(ms)=45xC4(uF)

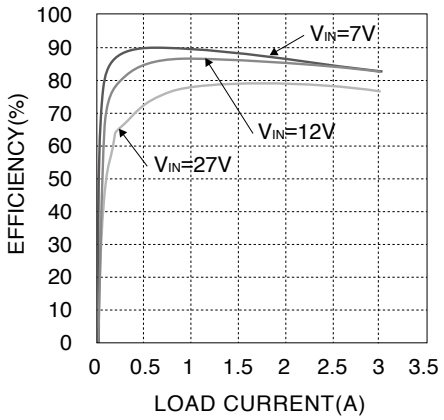
### (2) Over Current Detection



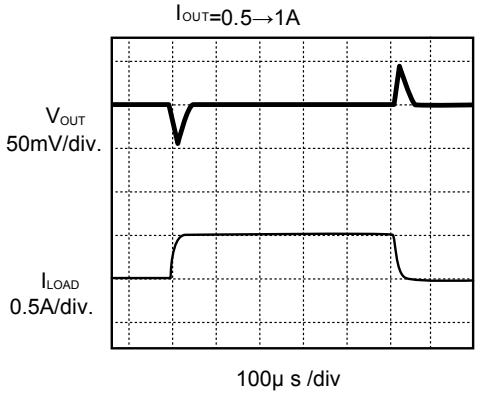

* The values indicate representative values.

## Characteristics (Except where noted otherwise VIN=12V, VOUT=3.3V, L=10µH, Ta=25°C)

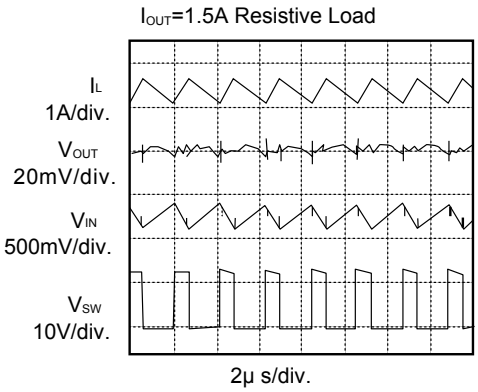
■ Output Current-Efficiency



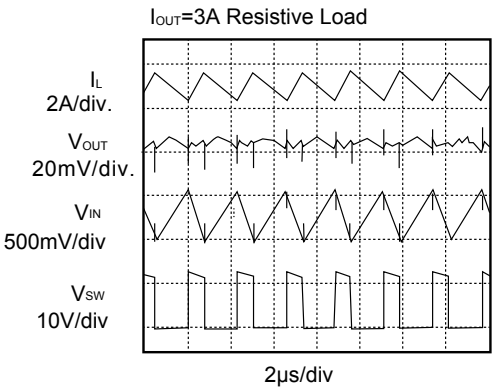

■ Load Transient Response



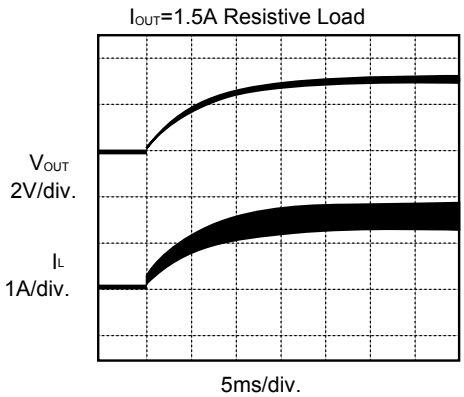

■ Steady State test



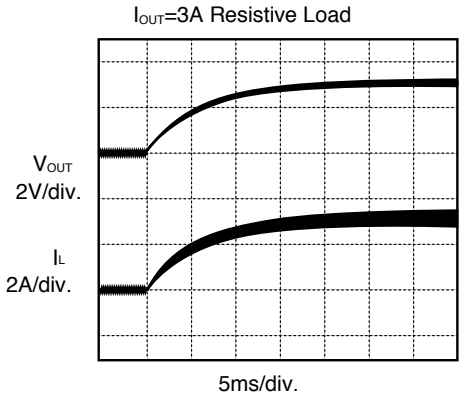

■ Steady State test



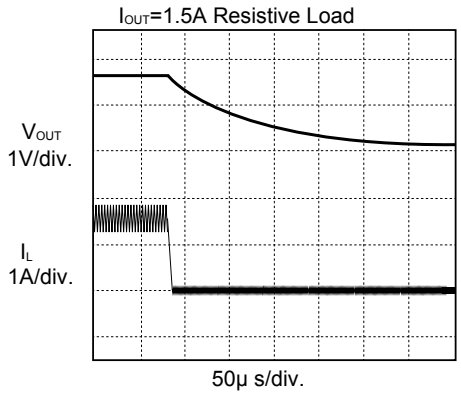

■ Startup through Enable



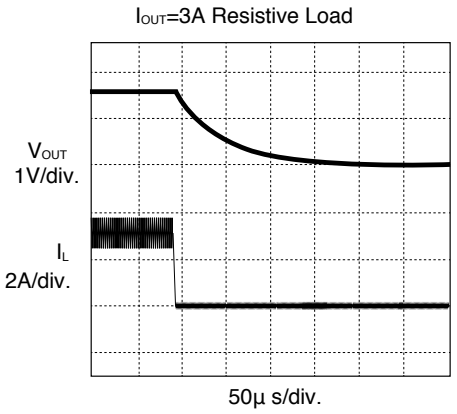

■ Startup through Enable



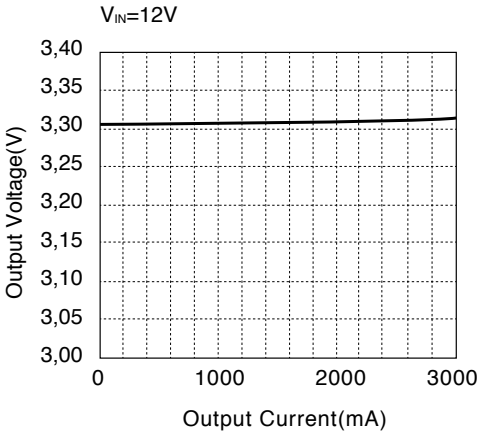
■ Shutdown through Enable



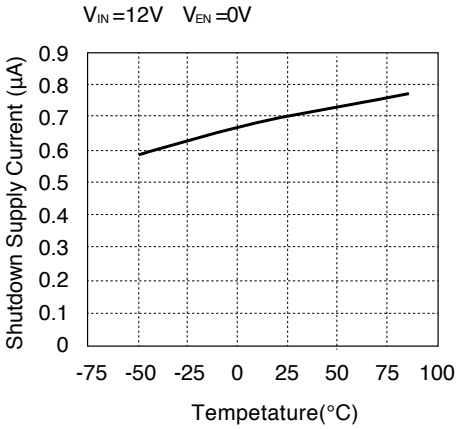

■ Shutdown through Enable



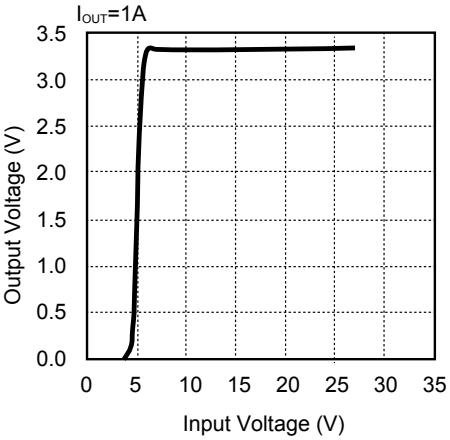

■ LOAD REGULATION



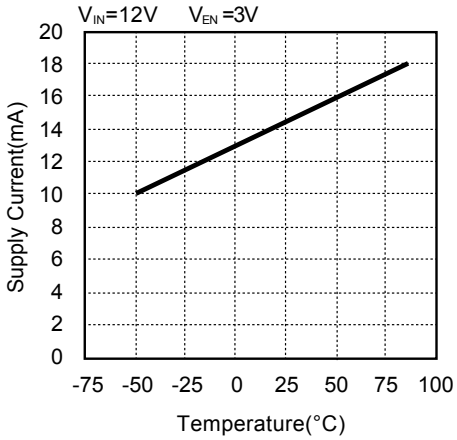

■ Shutdown Supply Current -Temperature



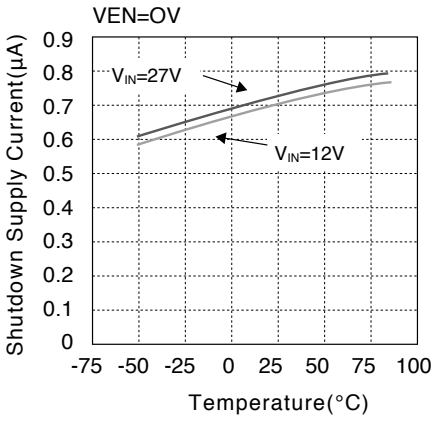

■ Line Regulation



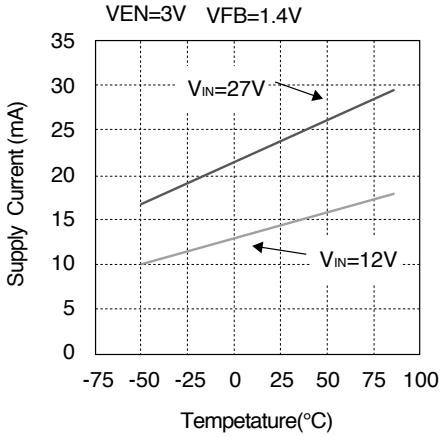

■ Supply Current -Temperature



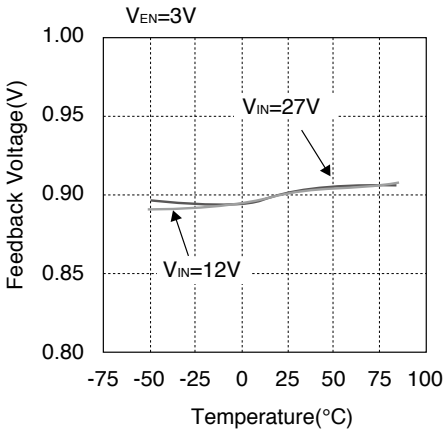
■ Shutdown Supply Current -Temperature



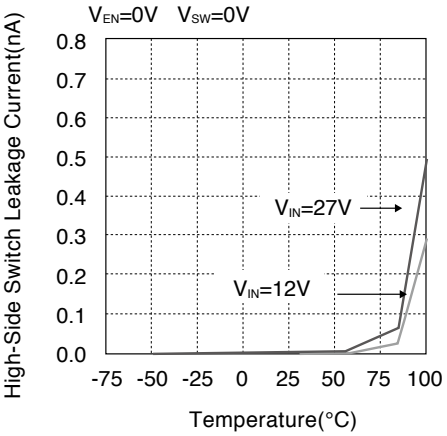

■ Supply Current -Temperature




■ Feedback Voltage-Temperature




■ High-Side Switch Leakage Current-Temperature




■ Oscillation Frequency-Temperature