NIPPON PRECISION CIRCUITS INC.

SM6702 series

PFM Step-up DC/DC Converter

OVERVIEW

The SM6702 series are step-up DC/DC converter ICs, fabricated using NPC's Molybdenum-gate CMOS process. They incorporate reference voltage source, error amplifier, oscillator, start-up circuit, PFM (Pulse Frequency Modulation) control circuit into a single chip. The only external components required are a Coil, Diode and output smoothing capacitors to form a step-up DC/DC converter. They employ PFM voltage control circuits to achieve high efficiency, stable constant-voltage output.

FEATURES

- Power dissipation : 24 µW at V_{IN} = 1.5 V, V_{OUT} = 3.0 V, I_{OUT} = 100 µA
- Start-up input voltage : 0.9 V (max) at R_L = 30 kΩ
- Output voltage : 2.2 V to 3.3 V, available in 0.1 Vstep
- High efficiency : 85% at V_{IN} = 1.5 V, V_{OUT} = 3.0 V, I_{OUT} = 1 mA
- Low ripple voltage
- Package : SOT23-3, SOT89-3

APPLICATIONS

- PDA, Mobile IT equipment
- Digital Stil Camera
- Pager
- Constant-voltage sources for battery-operated equipment
- Local voltage sources

ORDERING INFORMATION

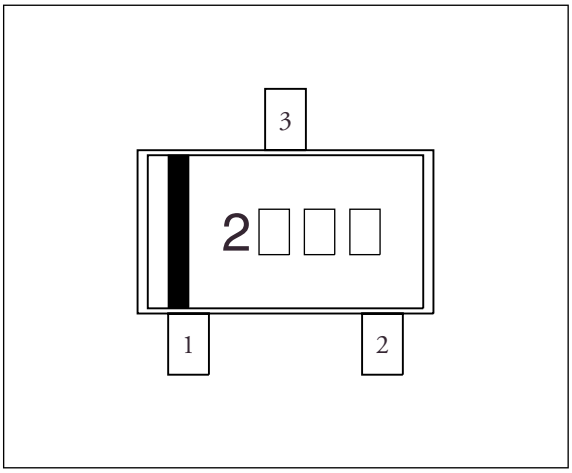
Device	Output voltage[1]	Package
SM6702-33HB	3.3 V	SOT89-3
SM6702-30HA	3.0 V	SOT23-3
SM6702-30HB	3.0 V	SOT89-3
SM6702-27HA	2.7 V	SOT23-3
SM6702-27HB	2.7 V	SOT89-3
SM6702-24HA	2.4 V	SOT23-3

1. Stepwise setting with a step of 0.1V in the range of 2.2V to 3.3V is available.

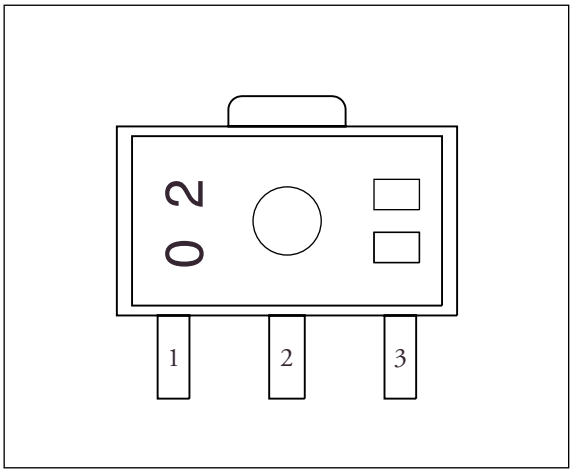
PINOUT

(Top view)

SM6702–××HA(SOT23–3)



SM6702–××HB(SOT89–3)



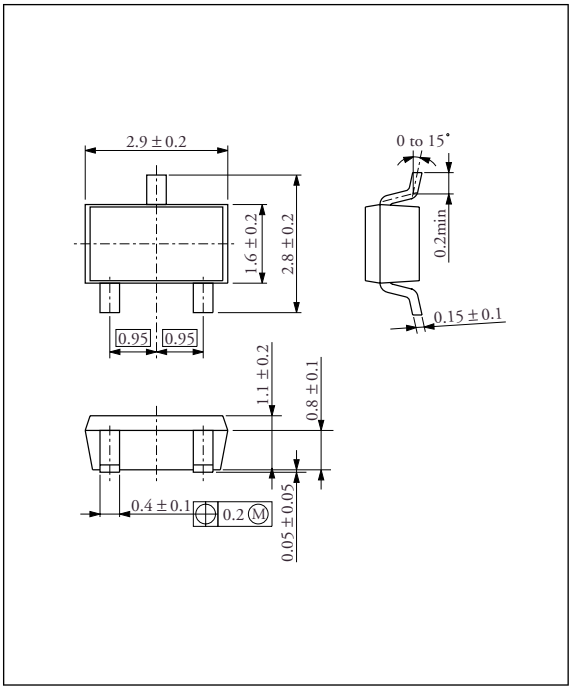
PIN DESCRIPTION

Number		Name	Description
SM6702–××HA	SM6702–××HB		
1	1	VSS	Ground
2	3	LX	Switching pin
3	2	OUT	Output (device supply pin)

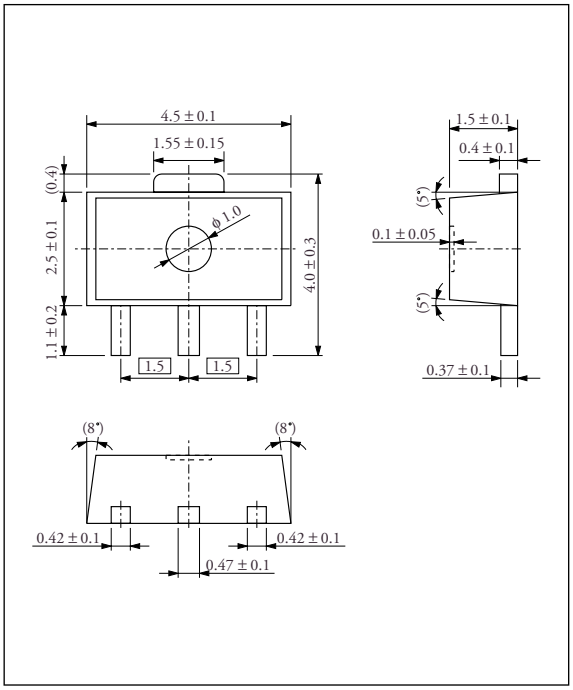
PACKAGE DIMENSIONS

(Unit : mm)

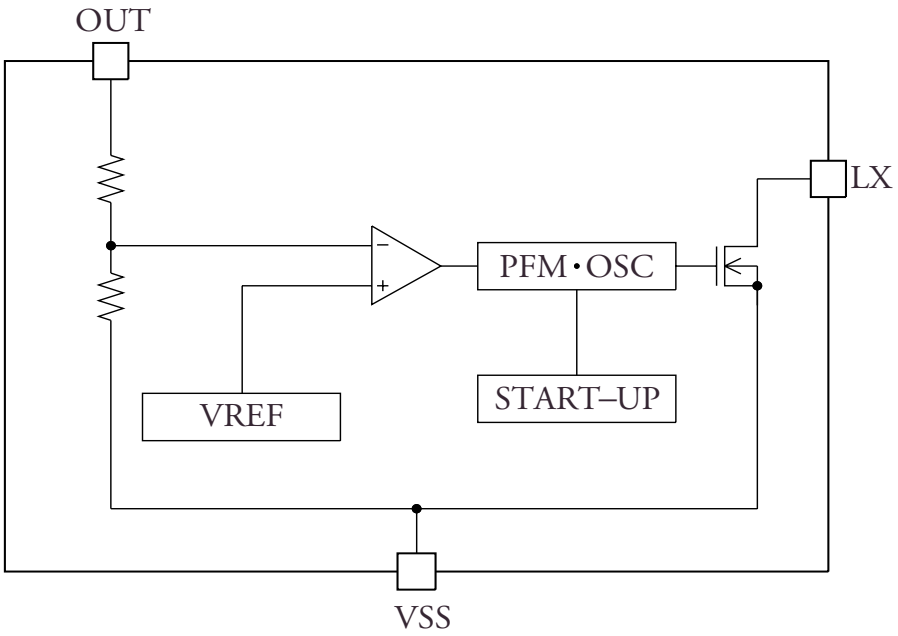
SM6702–××HA(SOT23–3)



SM6702–××HB(SOT89–3)



BLOCK DIAGRAM



SPECIFICATIONS

Absolute Maximum Ratings

T_a = 25 °C

Parameter	Symbol	Condition	Rating	Unit
LX impressed voltage	V_{LX}		5	V
OUT impressed voltage	V_{OUT}		4	V
LX output current	I_{LX}		200	mA
Power dissipation	P_D	SM6702–××HA	150	mW
		SM6702–××HB	500	
Operating temperature	T_{opr}		– 20 to 70	°C
Storage temperature	T_{stg}		– 40 to 125	°C

Electrical Characteristics

L = 330 µH, C = 22 µF, T_a = 25 °C, V_{SS} = 0 V

Parameter	Symbol	Condition		Rating			Unit
				min	typ	max	
Start-up voltage	V_{st}	R_L = 30 kΩ		–	–	0.9	V
Holding voltage	V_{hold}	R_L = 3 kΩ		–	–	0.7	V
Current consumption	I_{SS}	V_{IN} = 1.5 V, R_L = 30 kΩ		–	8	16	µA
Output voltage	V_{OUT}	V_{IN} = 1.5 V, R_L = 3 kΩ		V_{target} × 0.975	V_{target}	V_{target} × 1.025	V
LX output current	I_{LX}	$V_{OUT} = V_{target} - 0.1$, V_{LX} = 0.4 V	$2.2 \le V_{target} \le 2.7$	60	–	–	mA
			$2.8 \le V_{target} \le 3.3$	80	–	–	
LX leakage current	I_{LXL}	$V_{OUT} = V_{LX}$ = 3.5 V		–	–	1	µA
Maximum oscillator frequency	f_{OSC}	$V_{OUT} = V_{target} - 0.1$		80	100	120	kHz
Switch ON duty cycle	Duty	$V_{OUT} = V_{target} - 0.1$		65	75	85	%
Input voltage range	V_{IN}			–	–	V_{target} + 0.2	V

V_{target} : Setting output voltage

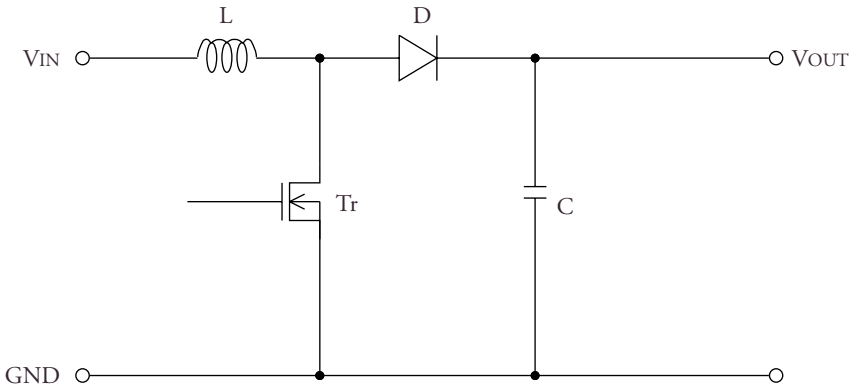
FUNCTIONAL DESCRIPTION

Step-up Principle

The SM6702 series use a transistor to switch the input supply in a non-isolated chopper switching regulator configuration. The figure below shows the basic step-up switching regulator circuit.

If the transistor is ON for an interval t_{ON} and then instantly turned OFF, the energy stored in the coil L during the interval t_{ON} generates a voltage V_L across the coil. This voltage is superimposed on the input voltage such that the peak voltage reaches $V_{IN} + V_L$ which forces the diode D to conduct and release the stored energy into the output.

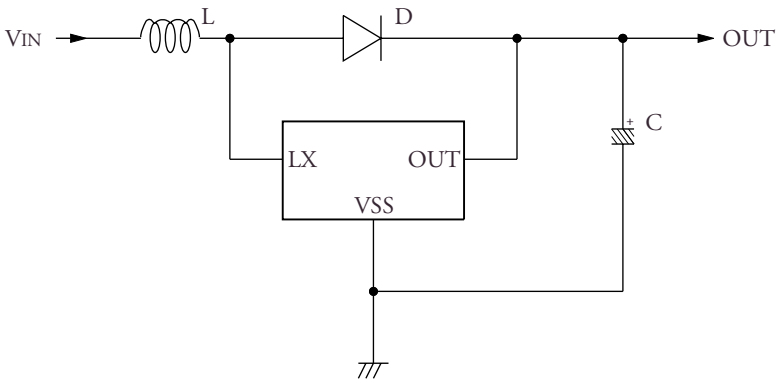
During normal operation, the above switching occurs repeatedly at a frequency controlled by an oscillator (which can change depending on the input and output load conditions), generating a square wave output which is then smoothed by the output capacitor C. Thus the output voltage ($V_{OUT} > V_{IN}$) has been stepped up.



PFM Control

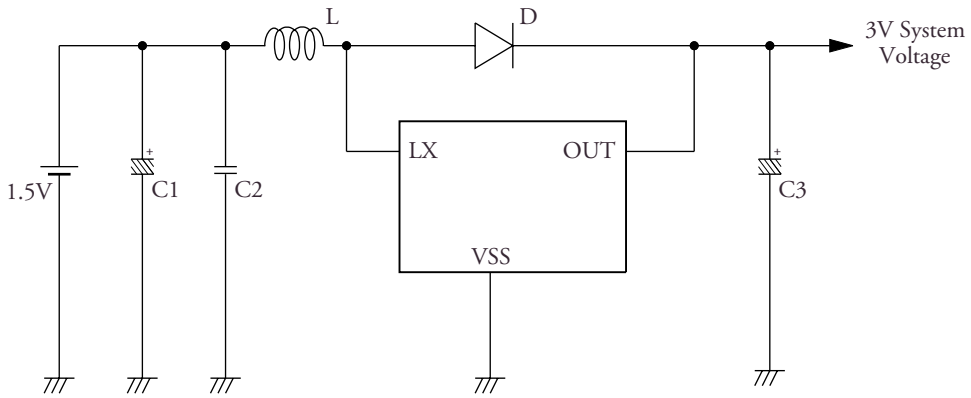
In SM6702 series, the LX transistor ON interval is fixed, and the OFF interval varies in response to the input voltage and load changes. Thus the resulting switching cycle frequency varies, called pulse frequency modulation.

BASIC CIRCUIT



Coil (L) : 330 µH
Diode (D) : MA721 (Matsushita Schottky diode)
Capacitor (C_L) : 22 µF tantalum

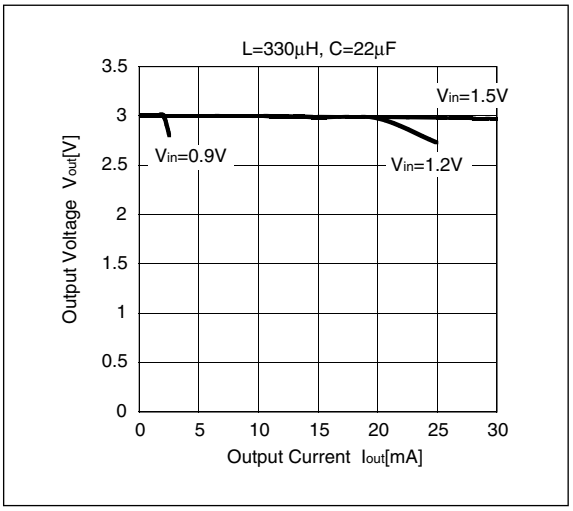
TYPICAL APPLICATION CIRCUIT

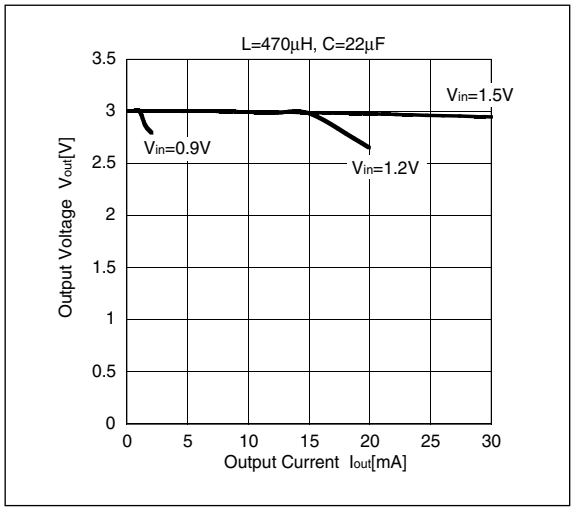


Coil (L) : 330 µH
Schottky Diode (D)
Capacitor (C1) : 22 µF tantalum
Capacitor (C2) : 0.22 µF ceramic
Capacitor (C3) : 22 µF tantalum

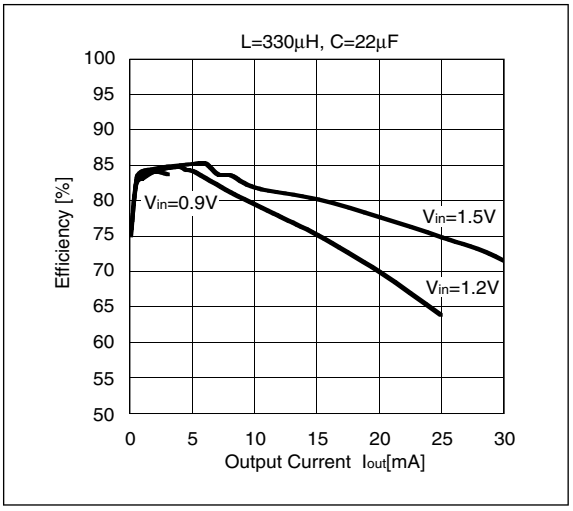
BASIC CHARACTERISTICS SM6702-30HA (V_{out} : 3.0V)

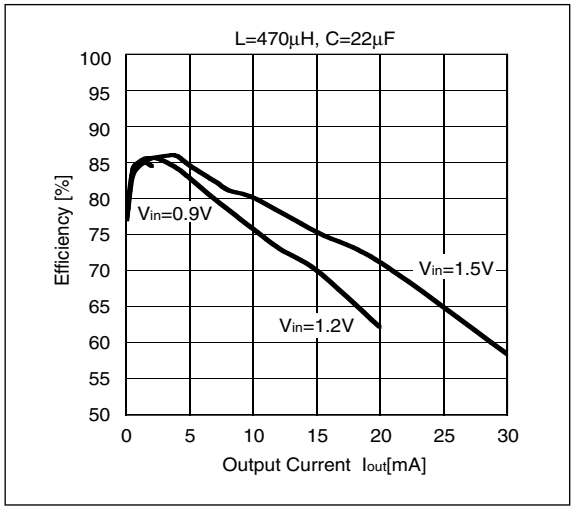
Output voltage vs. Output current



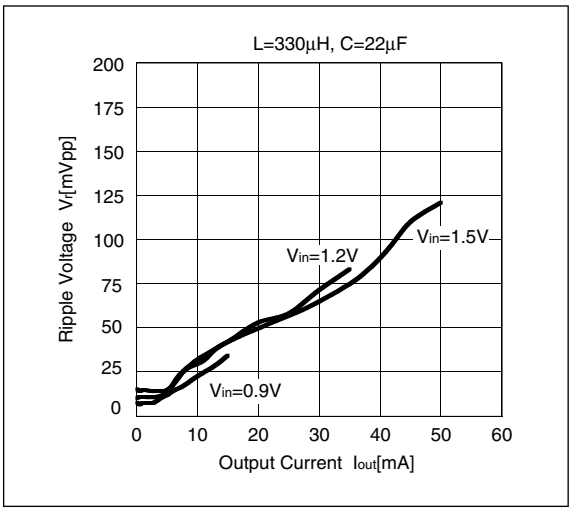


Efficiency vs. Output current

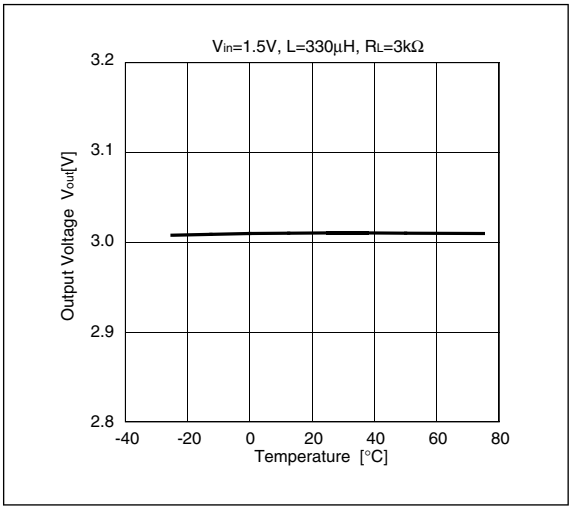




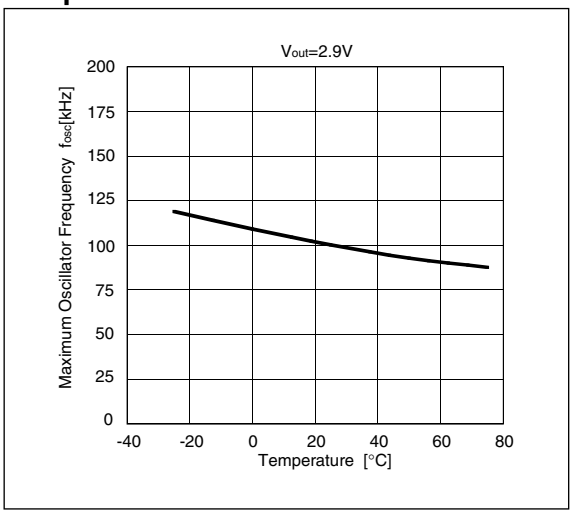
Ripple voltage vs. Output current



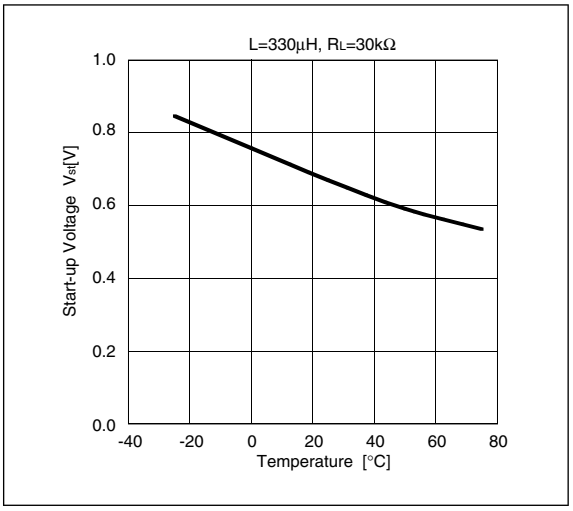
Output voltage vs. Temperature



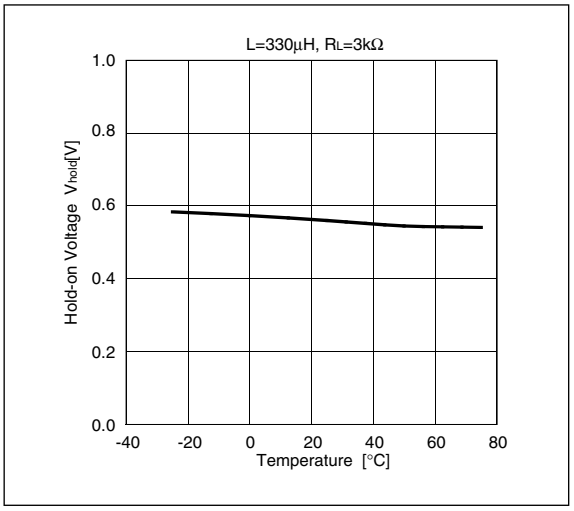
Maximum oscillator frequency vs. Temperature



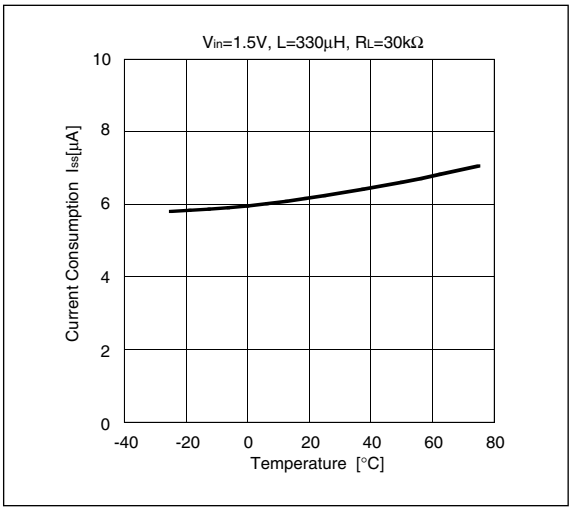
Start-up voltage vs. Temperature



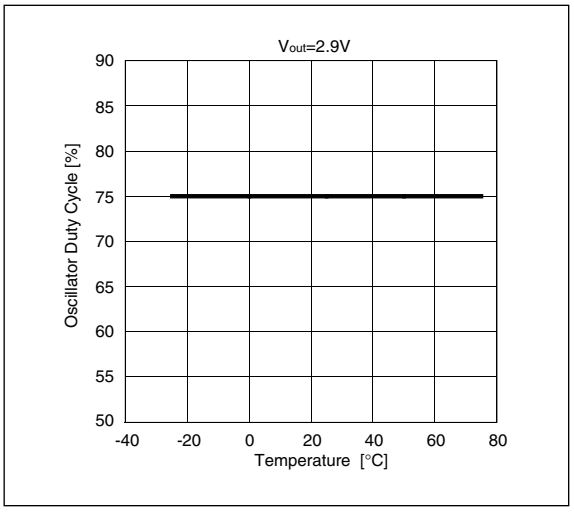
Hold-on voltage vs. Temperature



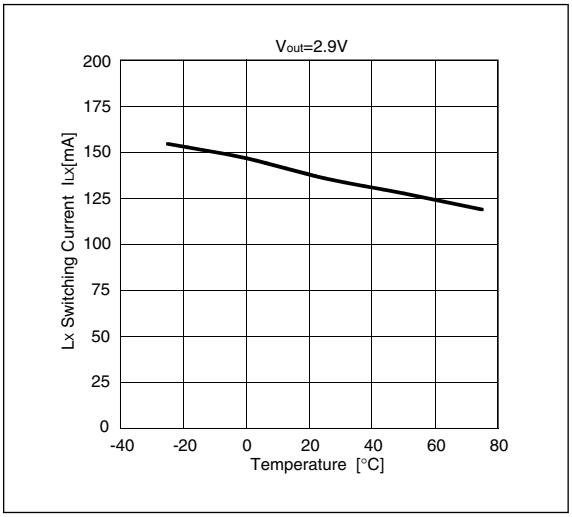
Current consumption vs. Temperature



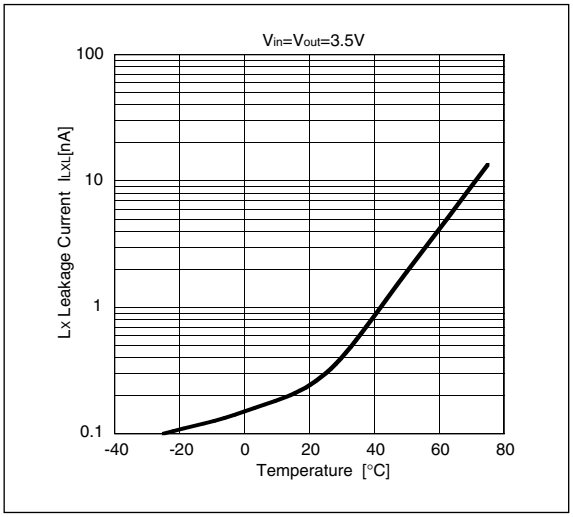
Oscillator duty cycle vs. Temperature



LX switching current vs. Temperature



LX leakage current vs. Temperature



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NIPPON PRECISION CIRCUITS INC.

NIPPON PRECISION CIRCUITS INC.

4-3, Fukuzumi 2-chome
Koto-ku, Tokyo 135-8430, Japan
Telephone: +81-3-3642-6661
Facsimile: +81-3-3642-6698
http://www.npc.co.jp/
Email: sales@ npc.co.jp

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