NCP1404 Series

Product Preview

350 mA PWM/PFM Step-Up DC-DC Converter with Low Battery Detector

The NCP1404 series are monolithic PWM/PFM step–up DC to DC converters which can automatically change operation mode from PWM to PFM at light loads to improve efficiency at light loads. With only four external components, this series allow a simple means to implement highly efficient converters for powering up portable equipment up to 350 mA loading.

Additionally, this series is featured with a Low Battery Detector to monitor battery voltage. The NCP1404 device series are available in space–saving TSOP–6 package with five standard regulated output voltages. Additional voltages that range from 1.8 V to 5.0 V in 100 mV steps can be manufactured.

Features

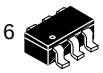
- Low Start–Up Voltage of 0.8 V
- PWM Oscillator Frequency of 600 kHz at 20% Accuracy
- High Efficiency 85% at I_{OUT} = 200 mA, V_{IN} = 2.5 V, V_{OUT} = 3.3 V
- Output Current up to 350 mA at V_{IN} = 2.5 V, V_{OUT} = 3.3 V
- Duty Ratio: 17% to 85% typ. PWM Control
  17% typ. PFM Control
- Output Voltage Accuracy ±2.5%
- Low Battery Detection with Open–drain Detector Output
- Separated Power Supply Pin
- Low Profile and Minimum External Parts
- Micro Miniature TSOP–6

Typical Applications

- Digital Cameras
- Cellular Telephones
- Personal Digital Assistants (PDA)
- Camcorders
- Electronic Games
- Pagers
- Portable Audio (MP3)
- Handheld Instruments

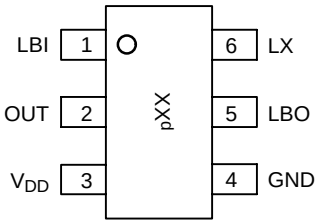
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TSOP–6
SN SUFFIX
CASE 318G

PIN CONNECTIONS AND MARKING DIAGRAM



(Top View)

XX = Specific Device Code
d = Date Code

See specific marking information in the ordering information table on page 3 of this data sheet.

ORDERING INFORMATION

Device	Package	Shipping
NCP1404SN19T1	TSOP–6	3000/Tape & Reel
NCP1404SN27T1	TSOP–6	3000/Tape & Reel
NCP1404SN30T1	TSOP–6	3000/Tape & Reel
NCP1404SN33T1	TSOP–6	3000/Tape & Reel
NCP1404SN50T1	TSOP–6	3000/Tape & Reel

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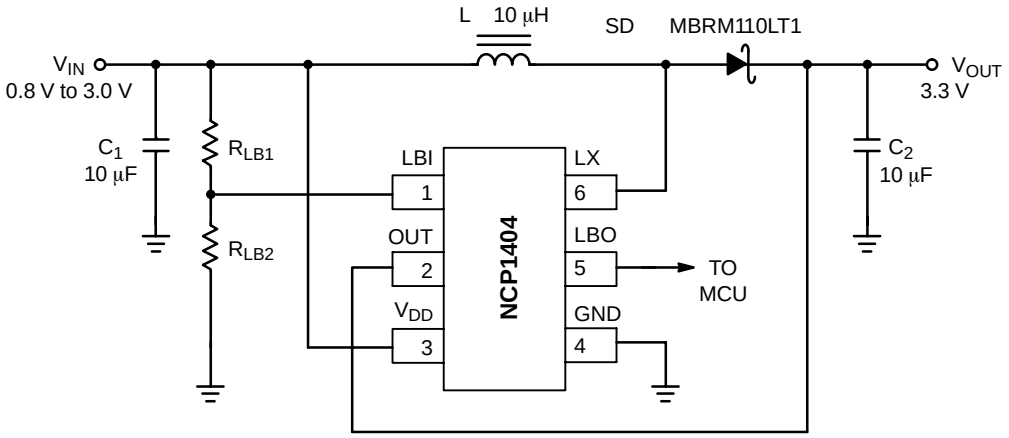


Figure 1. Typical Step–Up Converter Application

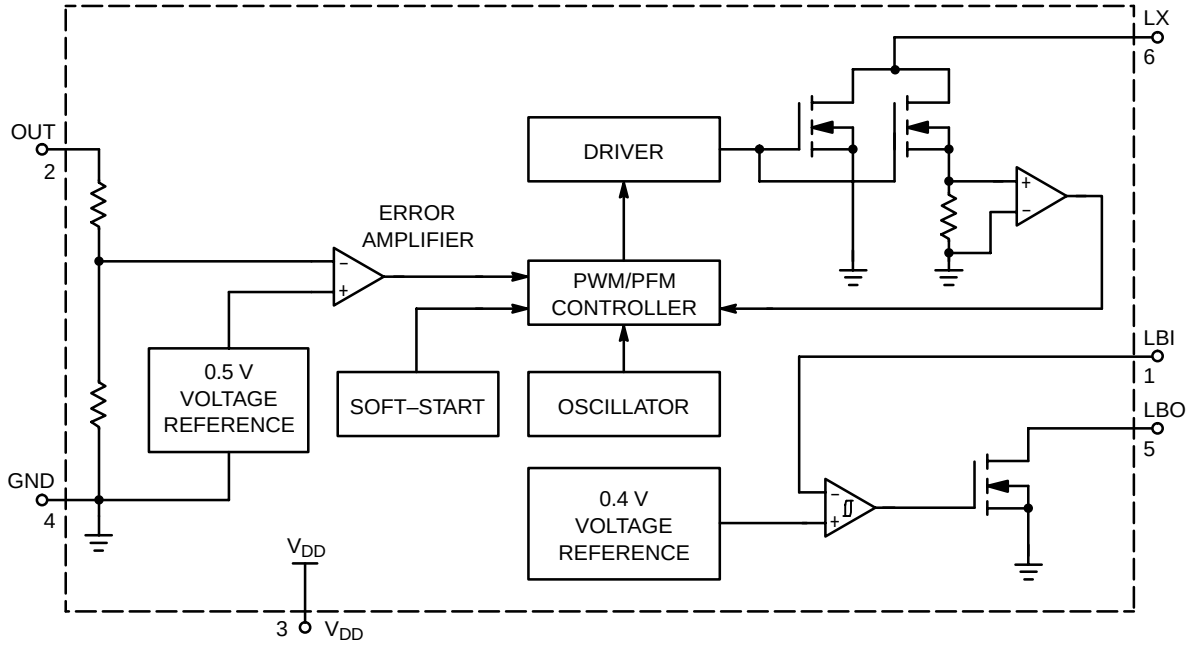


Figure 2. Representative Block Diagram

PIN FUNCTION DESCRIPTIONS

Pin	Symbol	Description
1	LBI	Low battery detection input pin
2	OUT	Output voltage monitor pin
3	V_{DD}	Power supply pin
4	GND	Ground pin
5	LBO	Low battery detection output pin
6	LX	External inductor connection pin to power switch drain

ORDERING INFORMATION

Device	Output Voltage	Frequency	Device Marking	Package	Shipping
NCP1404SN19T1	1.9 V	600 kHz	DB?	TSOP–6	3000 Units per 7 Inch Reel
NCP1404SN27T1	2.7 V	600 kHz	DB?		
NCP1404SN30T1	3.0 V	600 kHz	DB?		
NCP1404SN33T1	3.3 V	600 kHz	DB?		
NCP1404SN50T1	5.0 V	600 kHz	DB?		

NOTE: The ordering information lists five standard output voltage device options. Additional device with output voltage ranging from 1.8 V to 5.0 V in 100 mV increments can be manufactured. Contact your ON Semiconductor representative for availability.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Voltage (Pin 3)	V_{DD}	–0.3 to 6.0	V
Input/Output Pins Pin 1, Pin 2, Pin 5, Pin 6 Voltage	V_{IO}	–0.3 to 6.0	V
LX Pin Peak Sink Current	I_{LX}	1000	mA
Thermal Resistance Junction to Air	$R_{\theta JA}$	250	°C/W
Operating Ambient Temperature Range	T_A	–40 to + 85	°C
Operating Junction Temperature Range	T_J	–40 to + 125	°C
Storage Temperature Range	T_{stg}	–55 to +150	°C

1. This device series contains ESD protection and exceeds the following tests:
   Human Body Model (HBM) ±2.0 kV per JEDEC standard: JESD22–A114.
   Machine Model (MM) ±200 V per JEDEC standard: JESD22–A115.
2. Latch–up Current Maximum Rating: ±150 mA per JEDEC standard: JESD78.
3. Moisture Sensitivity Level (MSL): 1 per IPC/JEDEC standard: J–STD–020A.

ELECTRICAL CHARACTERISTICS (For all values T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
OSCILLATOR					
Frequency (V_{OUT} = V_{SET} × 0.96) (Note 4)	f_{OSC}	480	600	720	kHz
Frequency Temperature Coefficient (T_A = –40 to +85°C)	Δf	–	0.11	–	%/°C
Maximum PWM Duty Cycle (V_{OUT} = V_{SET} × 0.96)	D_{MAX}	70	78	86	%
PFM Duty Cycle	D_{PFM}	12	17	22	%
Minimum Start–up Voltage (I_O = 0 mA, V_{DD} = V_{OUT} = V_{SET})	V_{start}	–	0.8	0.95	V
Minimum Start–up Voltage Temperature Coefficient (T_A = –40 to +85°C)	ΔV_{start}	–	–1.6	–	mV/°C
Soft–Start Time (V_{OUT} = V_{SET})	t_{SS}	0.3	2.0	–	ms
LX (PIN 6)					
Internal Switching N–Channel FET Drain Voltage	V_{LX}	–	–	6.0	V
LX On–State Current (V_{DD} = V_{OUT} = V_{SET} × 0.96, V_{LX} = 0.6 V)	V_{LX}				mA
Device Suffix: 19T1		350	400	–	
27T1		550	600	–	
30T1		550	600	–	
33T1		550	600	–	
50T1		600	650	–	
Current Limit	I_{LXLIM}	700	750	800	mA
Off–State Leakage Current (V_{LX} = 6.0 V, T_A = –40 to +85°C)	I_{LKG}	–	0.5	1.0	mA
LBI (PIN 1)					
LBI Threshold Voltage Falling	V_{LBI}	0.396	0.400	0.404	V
LBI Hysteresis	V_{HYS}	–	30	–	mV
LBI Input Current	I_{LBI}	–	1.5	8.0	nA
LBO (PIN 5)					
LBO Low Output Voltage	$V_{LBO(low)}$	–	–	0.05	V
LBO Off–State Leakage Current	I_{LBOLKG}	–	1	100	nA
TOTAL DEVICE					
Supply Voltage	V_{DD}	0.8		5.5	V
Output Voltage	V_{OUT}				V
Device Suffix: 19T1		1.853	1.9	1.948	
27T1		2.632	2.7	2.768	
30T1		2.925	3.0	3.075	
33T1		3.218	3.3	3.383	
50T1		4.875	5.0	5.125	
Output Voltage Temperature Coefficient (T_A = –40 to +85°C)	ΔV_{OUT}	–	100	–	ppm/°C
Operating Current (V_{OUT} = V_{SET} × 0.96, V_{DD} = V_{SET} × 0.6) (Note 5)	I_{DD1}	–	220	300	μA
No Switching Operating Current (V_{OUT} = V_{SET} + 0.5 V)	I_{DD2}	–	40	55	μA
No Load Operating Current (V_{DD} = V_{SET} × 0.6, I_{OUT} = 0 mA) (Note 7)	$I_{DD(no\ load)}$	–	65	80	μA
Maximum Output Current (V_{DD} = V_{OUT}, V_{IN} = V_{SET} × 0.8, Voltage Regulation < 3%)	I_{OUT}				mA
Device Suffix: 19T1		150	200	–	
27T1		300	350	–	
30T1		300	350	–	
33T1		300	350	–	
50T1		350	400	–	

4. V_{SET} means setting of output voltage.
5. Operating current is the current consumption of the device in PWM mode.
6. No switching operating current is the current consumption of the device when there is no switching.
7. No load operating current is the current consumption of the device in PFM mode at no load.

Other Application Circuit

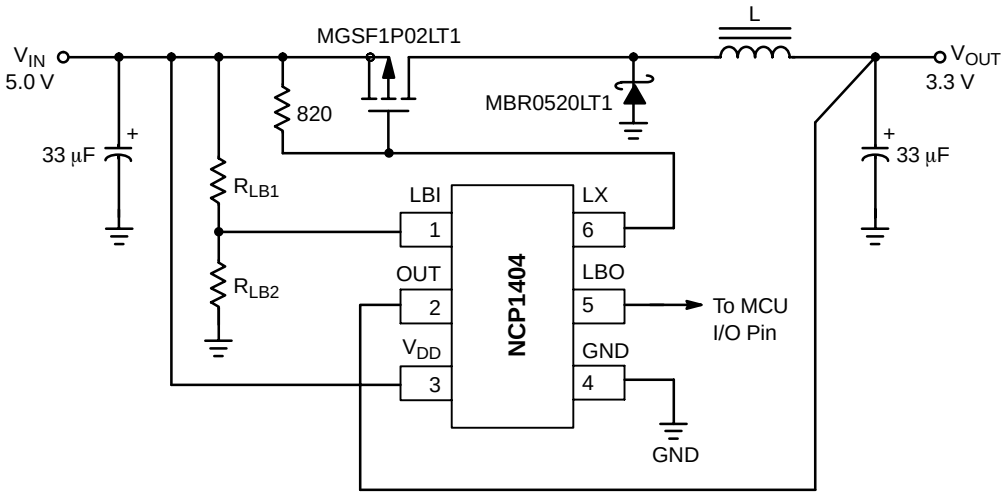
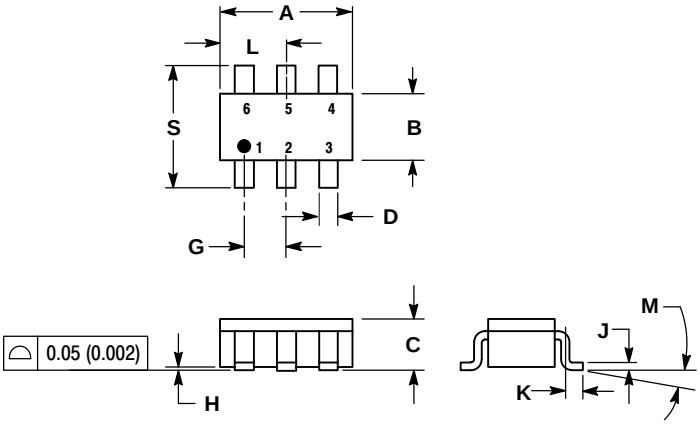


Figure 3. Step−down Application

PACKAGE DIMENSIONS

TSOP–6
CASE 318G–02
ISSUE H



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	2.90	3.10	0.1142	0.1220
B	1.30	1.70	0.0512	0.0669
C	0.90	1.10	0.0354	0.0433
D	0.25	0.50	0.0098	0.0197
G	0.85	1.05	0.0335	0.0413
H	0.013	0.100	0.0005	0.0040
J	0.10	0.26	0.0040	0.0102
K	0.20	0.60	0.0079	0.0236
L	1.25	1.55	0.0493	0.0610
M	0°	10°	0°	10°
S	2.50	3.00	0.0985	0.1181

Notes

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