

# NCP1421

## Product Preview

### 500 mA Sync-Rect PFM Step-Up DC-DC Converter with True-Cutoff and Ring-Killer

NCP1421 is a monolithic micropower high frequency step-up switching converter IC specially designed for battery operated hand-held electronic products up to 500 mA loading. It integrates Sync-Rect for improving efficiency as well as eliminating the external Schottky Diode. High switching frequency (up to 800 kHz) allows low profile inductor and output capacitor being used. When the IC is disabled, internal conduction path from LX or BAT to OUT is blocked, OUT pin is isolated from the battery. This achieves True-Cutoff. Ring-Killer is also integrated to eliminate the high frequency ringing in discontinuous conduction mode. Low-Battery Detector, Logic-Controlled Shutdown, Cycle-by-Cycle Current Limit and Thermal Shutdown provide value-added features for various battery operated application. With all these functions ON, the quiescent supply current is only 15  $\mu$ A. This device is available in compact Micro8™ package.

#### Features

- High Efficiency: 94% for 3.3 V Output at 200 mA from 2.0 V Input
- 84% for 3.3 V Output at 500 mA from 2.5 V Input
- High Switching Frequency, up to 800 kHz (Not Hitting Current Limit)
- True-Cutoff: OUT Pin is Isolated from BAT or LX Pin during IC Disabled
- High Accuracy Reference Output, 1.18 V  $\pm$  0.6% @ 25°C, Can Supply 2.5 mA when 3.0 V VOUT > 3.3 V
- Low Quiescent Current of 15  $\mu$ A
- Ring-Killer for Discontinuous Conduction Mode
- 1.0 V Startup at No Load Guaranteed
- Output Voltage from 1.5 V to 5.0 V Adjustable
- Low-Battery Detector
- Logic-Controlled Shutdown
- Thermal Shutdown
- 1.5 A Cycle-by-Cycle Current Limit
- Open Drain Low-Battery Detector Output
- Output Current up to 500 mA

#### Typical Applications

- Personal Digital Assistants (PDA)
- Handheld Digital Audio Product
- Camcorders and Digital Still Camera
- Hand-Held Instrument
- Conversion from One NiH or NiCd or One Lithium-ion Cells to 3.3 V/5.0 V

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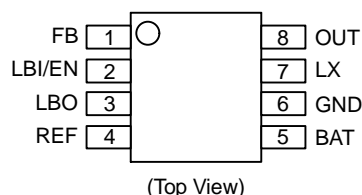
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#### MARKING DIAGRAM



A = Assembly Location  
WL, L = Wafer Lot  
YY, Y = Year  
WW, W = Work Week

#### PIN CONNECTIONS



(Top View)

#### ORDERING INFORMATION

Device	Package	Shipping
NCP1421DM	Micro8	4000 Tape & Reel

# NCP1421

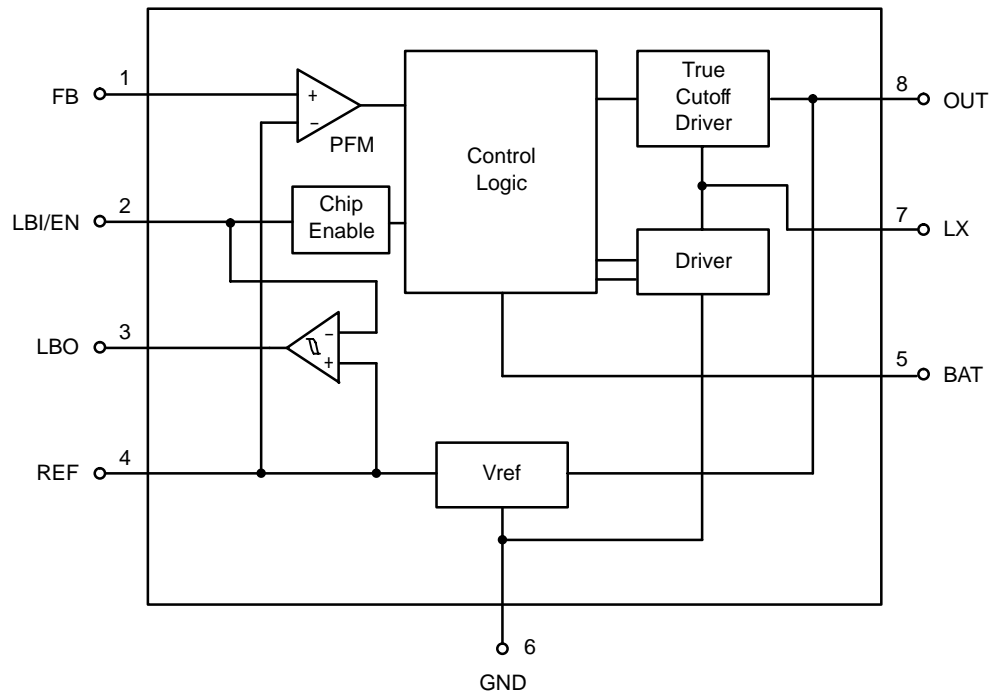


Figure 1. Simplified Block Diagram

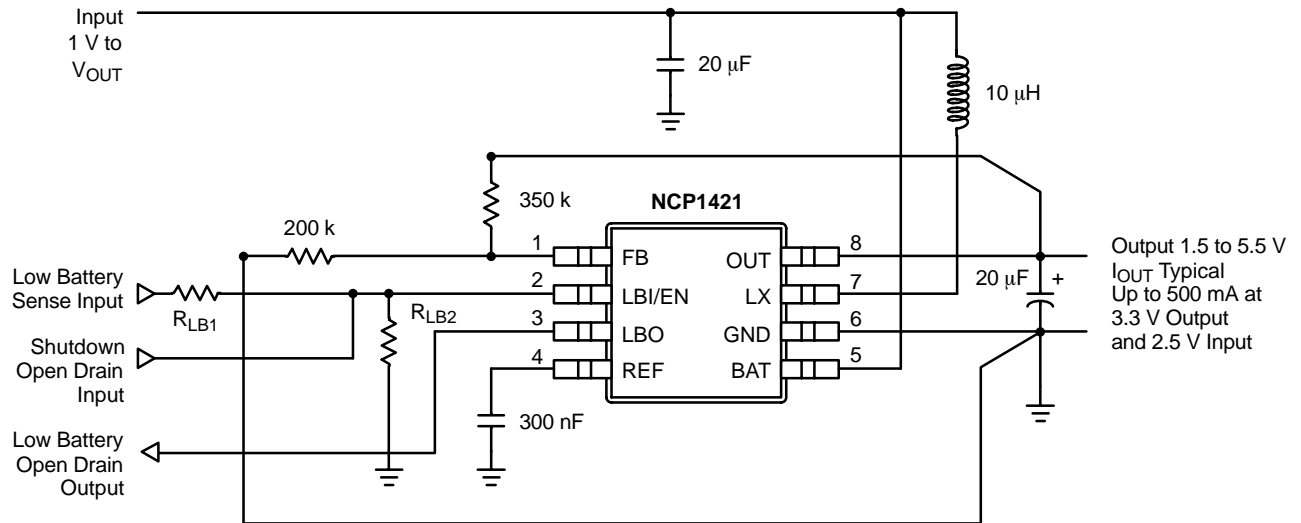


Figure 2. Typical Operating Circuit

# NCP1421

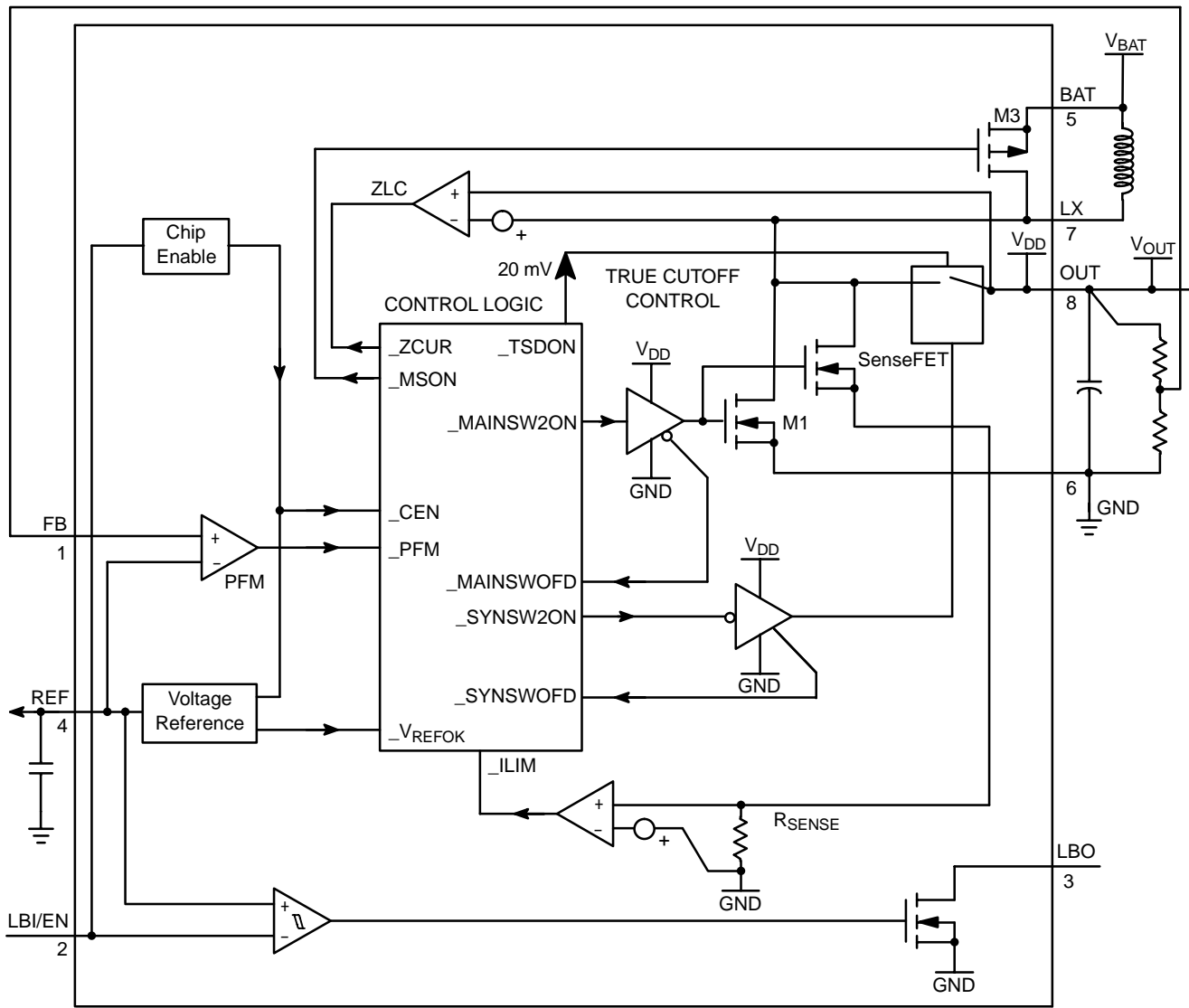


Figure 3. Detailed Block Diagram

## PIN FUNCTION DESCRIPTIONS

Pin	Symbol	Description
1	FB	Output Voltage Feedback Input.
2	LBI/EN	Low-Battery Detector Input and IC Enable.
3	LBO	Open-Drain Low-Battery Detector Output. Output is LOW when VLBI is < 1.180 V. LBO is high impedance shutdown.
4	REF	1.180 V Reference Voltage Output, bypass with 150 nF capacitor if this pin is not loaded, bypass with 1.0 $\mu$ F if this pin is loaded up to 2.5 mA @ Vout = 3.3 V.
5	BAT	Battery input connection for internal ring-killer.
6	GND	Ground.
7	LX	N-Channel and P-Channel Power MOSFET Drain connection.
8	OUT	Power Output. OUT also provides bootstrap power to the device.

# NCP1421

## MAXIMUM RATINGS (T<sub>C</sub> = 25°C unless otherwise noted.)

Rating	Symbol	Value	Unit
Power Supply (Pin 8)	V <sub>OUT</sub>	−0.3, 5.0	V
Input/Output Pins Pin 1–5, Pin 7	V <sub>IO</sub>	−0.3, 5.0	V
Thermal Characteristics Micro8 Plastic Package Thermal Resistance Junction-to-Air	P <sub>D</sub> R <sub>θJA</sub>	520 240	mW °C/W
Operating Junction Temperature Range	T <sub>J</sub>	−40 to +150	°C
Operating Ambient Temperature Range	T <sub>A</sub>	−40 to +85	°C
Storage Temperature Range	T <sub>stg</sub>	−55 to +150	°C

## ELECTRICAL CHARACTERISTICS (V<sub>OUT</sub> = 3.3 V, T<sub>A</sub> = 25°C for typical value, −40°C ≤ T<sub>A</sub> = 85°C for min/max values unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Operating Voltage	V <sub>IN</sub>	1.0	–	5.0	V
Output Voltage Range	V <sub>OUT</sub>	1.5	–	V <sub>IN</sub>	V
Reference Voltage	V <sub>REF</sub>	1.173	1.180	1.187	V
Reference Voltage Temperature Coefficient	TC <sub>VREF</sub>	–	0.03	–	mV/°C
Reference Voltage Load Current (V <sub>OUT</sub> = 3.3 V, V <sub>REF</sub> = V <sub>REF_NL</sub> ± 1.5% C <sub>REF</sub> = 1.0 μF) (Note 5)	I <sub>REF</sub>	–	2.5	–	mA
Reference Voltage Load Regulation (V <sub>OUT</sub> = 3.3 V, I <sub>LOAD</sub> = 0 to 100 μA, C <sub>REF</sub> = 1.0 μF)	V <sub>REF_LOAD</sub>	–	0.05	1.0	mV
Reference Voltage Line Regulation (V <sub>OUT</sub> from 1.5 V to 5.0 V, C <sub>REF</sub> = 1.0 μF)	V <sub>REF_LINE</sub>	–	0.05	1.0	mV/V
FB, LBI Input Threshold (I <sub>LOAD</sub> = 0 mA)	V <sub>FB</sub>	1.168	1.180	1.192	V
Internal NFET ON-Resistance	R <sub>DS(ON)_N</sub>	–	0.3	–	Ω
Internal PFET ON-Resistance	R <sub>DS(ON)_P</sub>	–	0.3	–	Ω
LX Switch Current Limit (N-FET)	I <sub>LIM</sub>	–	1.5	–	A
Operating Current into OUT (V <sub>FB</sub> = 1.4 V, V <sub>OUT</sub> = 3.3 V)	I <sub>Q</sub>	–	15	–	μA
LX Switch MAX. ON-Time (V <sub>FB</sub> = 1.0 V, V <sub>OUT</sub> = 3.3 V)	t <sub>ON</sub>	0.66	1.06	1.59	μs
LX Switch MIN. OFF-Time (V <sub>FB</sub> = 1.0 V, V <sub>OUT</sub> = 3.3 V)	t <sub>OFF</sub>	–	0.19	–	μs
FB Input Current	I <sub>FB</sub>	–	1.0	–	nA
True-Cutoff Current into BAT (LBI/EN = GND, V <sub>OUT</sub> = 0, V <sub>IN</sub> = 3.3 V, LX = 3.3 V)	I <sub>BAT</sub>	–	50	–	nA
BAT to LX Resistance (V <sub>FB</sub> = 1.4 V, V <sub>OUT</sub> = 3.3 V)	R <sub>BAT_LX</sub>	–	100	–	Ω
LBI/EN Input Current	I <sub>LBI</sub>	–	1.5	8.0	nA
LBO Low Output Voltage (V <sub>LBI</sub> = 0, I <sub>SINK</sub> = 1.0 mA)	V <sub>LBO_L</sub>	–	0.2	–	V
Soft Start Time	T <sub>SS</sub>	–	TBD	–	ms
LBI/EN Pin Shutdown Threshold	V <sub>SHDN</sub>	0.55	0.6	0.65	V

- This device 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.
- The maximum package power dissipation limit must not be exceeded.

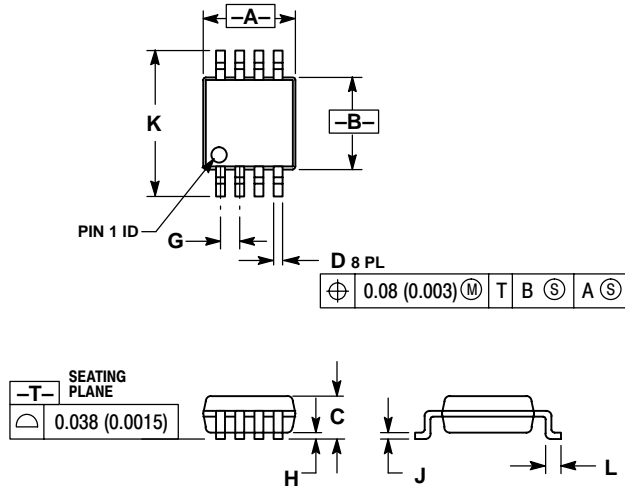
$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

- Latch-up Current Maximum Rating: ±150 mA per JEDEC standard: JESD78.
- Moisture Sensitivity Level: MSL 1 per IPC/JEDEC standard: J-STD–020A.
- Loading capability decreases with V<sub>OUT</sub>.

# NCP1421

## PACKAGE DIMENSIONS

Micro8  
DM SUFFIX  
CASE 846A-02  
ISSUE E




### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.90	3.10	0.114	0.122
B	2.90	3.10	0.114	0.122
C	---	1.10	---	0.043
D	0.25	0.40	0.010	0.016
G	0.65 BSC		0.026 BSC	
H	0.05	0.15	0.002	0.006
J	0.13	0.23	0.005	0.009
K	4.75	5.05	0.187	0.199
L	0.40	0.70	0.016	0.028

## **Notes**

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