

# NCP1530

## Product Preview

### 600 mA PWM/PFM Step-Down Converter with External Synchronization Pin

The NCP1530 is a PWM/PFM non-synchronous step-down (Buck) DC/DC converter for usage in systems supplied from 1-cell Li-ion, 2 and more cells Alkaline/NiCd/NiMH batteries. It can operate in Constant-Frequency PWM mode or PWM/PFM mode in which the controller will automatically switches to PFM mode operation at low output loads for higher efficiency. The switching frequency can also be synchronized to external clock between 600 kHz and 1200 kHz. A maximum output current is up to 600 mA. Applying an external synchronizing signal to SYN pin can supersede the PWM operation.

The NCP1530 consumes only 47  $\mu\text{A}$  (typ.) of supply current ( $V_{\text{OUT}} = 3.0\text{ V}$ , no switching) and can be forced to shutdown mode by bringing the enable input (EN) low. In shutdown mode, the regulator is disabled and the supply current is reduced to 0.5  $\mu\text{A}$  (max) while  $V_{\text{OUT}}$  is internally pulled to ground with output capacitor discharged. Other features include built-in undervoltage lockout, internal thermal shutdown, an externally programmable soft start time and output current limit protection. The NCP1530 operates from a maximum input voltage of 5.5 V and is available in a space saving, low profile Micro8™ package.

#### Features

- High Conversion Efficiency, up to 92% at  $V_{\text{IN}} = 4.0\text{ V}$ ,  $V_{\text{OUT}} = 3.3\text{ V}$ ,  $I_{\text{OUT}} = 500\text{ mA}$
- Current-Mode PWM Control
- Automatic PWM/PFM Mode for Current Saving at Low Output Loads
- Internal Switching Transistor Support 600 mA Output Current ( $V_{\text{IN}} = 5.0\text{ V}$ ,  $V_{\text{OUT}} = 3.3\text{ V}$ )
- High Switching Frequency (600 kHz) Support Small Inductor and Capacitor Size
- Synchronizable to External Clock Signal up to 1.2 MHz
- 100% Duty Cycle for Maximum Utilization of the Supply Source
- Programmable Soft-Start Time through External Chip Capacitor
- Output Current Limit Protection
- Built-In Input Undervoltage Lockout
- Power Saving Shutdown Mode
- Automatic Output Capacitor Discharge while in Shutdown Mode
- Space Saving, Low Profile Micro8 Package

#### Typical Applications

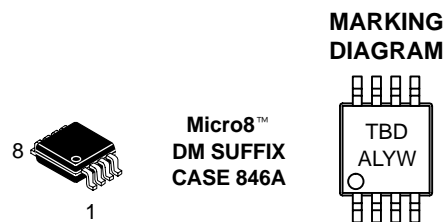
- PDAs
- Digital Still Camera
- Cellular Phone and Radios
- Portable Test Equipment
- Portable Scanners
- Portable Audio Systems

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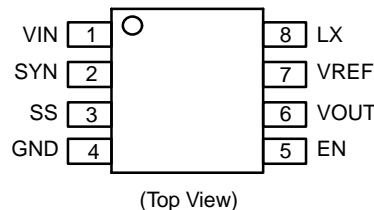
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A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week

#### PIN CONNECTIONS



#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

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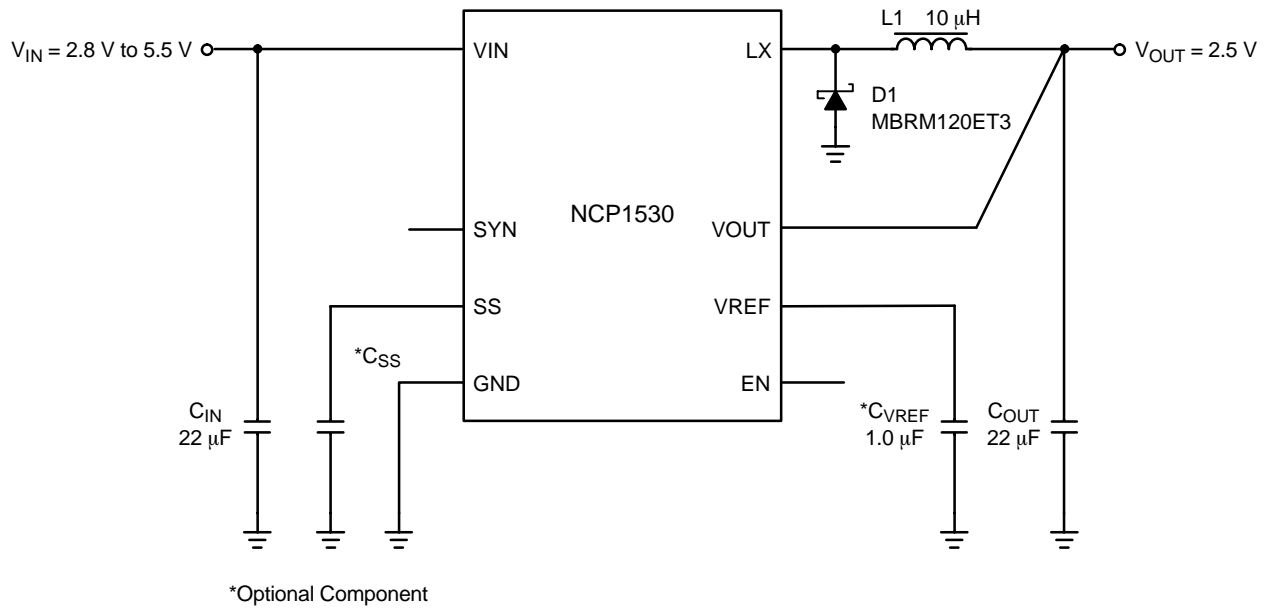


Figure 1. Typical Step-Down Converter Application

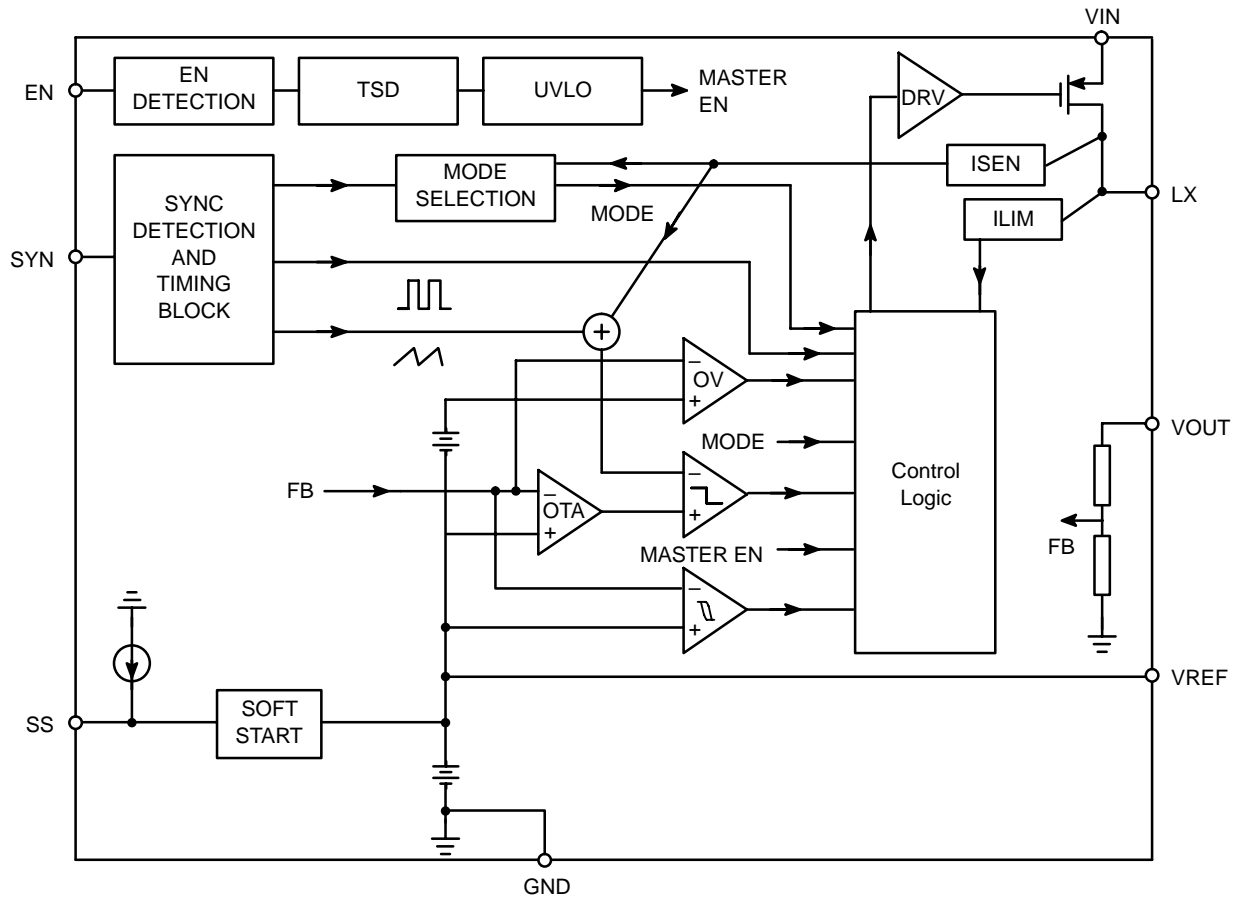


Figure 2. Representative Block Diagram

## PIN FUNCTION DESCRIPTIONS

Pin	Symbol	Description
1	VIN	Unregulated Supply Input.
2	SYNC	Oscillator Synchronization and Mode Selection Input. SYNC = GND (Automatic PWM/PFM mode) The converter operates at 600 kHz fixed-frequency PWM mode primarily, and automatically switches to variable-frequency PFM mode at small output loads for current saving. SYNC = VIN (Constant-Frequency PWM mode) The converter operates at 600 kHz fixed-frequency PWM mode always. SYNC = External clock signal between 600 to 1200 kHz. The converter will be synchronized with the external clock signal. The SYNC pin is internally pulled to GND.
3	SS	Soft-Start Input. An external soft-start capacitor is connected to this pin if extended soft-start is required. A 50 nA current will be sourced from this pin to charge up the capacitor during startup and gently ramps the device into service to prevent output voltage overshoot. Built-in 200 $\mu$ s (typ.) soft-start can be activated if the pin is floated.
4	GND	Ground Terminal.
5	EN	Active-High Enable Input. Active to enable the device. Bring this pin to GND, output capacitor will be discharged to ground and the quiescent current is reduced to less than 0.5 $\mu$ A. This pin is internally pulled to VIN.
6	VOOUT	Feedback Terminal. The output voltage is sensed by this pin and regulated. The output capacitor connected to this pin will be discharged by internal switch to ground when the converter is in shutdown mode.
7	VREF	Connected to voltage reference decoupling capacitor. For noise non-sensitive applications, the internal voltage reference can operate without decoupling capacitor.
8	LX	Inductor Terminal. This pin is connected to the drains of the internal P-channel switching transistors. The inductor must be connected between this pin and the output terminal.

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply (Pin 1)	V <sub>IN</sub>	-0.3 to 6	V
Input/Output Pins Pins 2-4 & Pins 7-8	V <sub>IO</sub>	-0.3 to 6	V
Thermal Characteristics Micro8 Plastic Package Thermal Resistance, Junction-to-Air	R <sub>θJA</sub>	240	°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

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

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**ELECTRICAL CHARACTERISTICS** ( $V_{IN} = 1.2 \times V_R$ ,  $T_A = 25^\circ\text{C}$  for typical value,  $-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$  for min/max values unless otherwise noted.) \* $V_R$  is the factory-programmed output voltage setting. Test circuit, refer to Figure 1.

Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage	$V_{OUT}$	–	$V_R \pm 1.5\%$	–	V
Input Voltage	$V_{IN}$	$1.1 V_R$	–	5.5	V
Maximum Output Current ( $V_{OUT} = 3.0\text{ V}$ )	$I_{OUT}(\text{max})$	600	–	–	mA
Supply Current ( $V_{IN} = V_R \times 1.2$ , No Load, $V_{OUT} = 3.0\text{ V}$ )	$I_{IN}$	–	48	–	$\mu\text{A}$
Shutdown Supply Current (No Load, $V_{EN} = 0\text{ V}$ )	$I_{SHDN}$	–	0.1	6.0	$\mu\text{A}$
$L_X$ Pin Leakage Current (No Load, $V_{EN} = 0\text{ V}$ )	$I_{LX}$	–	1.0	–	$\mu\text{A}$
$L_X$ Pin ON Resistance ( $V_{IN} = V_R \times 1.2$ , $I_L = 150\text{ mA}$ )	$R_{DS(on)(LX)}$	–	0.3	–	$\Omega$
Oscillator Frequency (SYNC Pin Pulled to GND Internally)	$f_{OSC}$	–	600	–	kHz
Maximum PWM Duty Cycle	$D_{MAX-PWM}$	–	–	100	%
Loading Current for PFM to PWM ( $V_{IN} = V_R \times 1.2$ , $V_{OUT} = 3.0\text{ V}$ , $L = 10\text{ }\mu\text{H}$ , $C_{OUT} = 22\text{ }\mu\text{F}$ )	$I_{PFM-PWM}$	–	110	–	mA
Loading Current for PWM to PFM ( $V_{IN} = V_R \times 1.2$ , $V_{OUT} = 3.0\text{ V}$ , $L = 10\text{ }\mu\text{H}$ , $C_{OUT} = 22\text{ }\mu\text{F}$ )	$I_{PWM-PFM}$	–	60	–	mA
Efficiency ( $V_{IN} = V_R \times 1.2$ , $I_{load} = 100\text{ mA}$ )	$\eta$	–	92	–	%
Undervoltage Lockout Threshold	$V_{UVLO}$	1.8	2.0	–	V
Reference Voltage ( $C_{VREF} = 1.0\text{ }\mu\text{F}$ , $T_A = 25^\circ\text{C}$ , $V_{IN} = 3.5\text{ V}$ )	$V_{REF}$	1.173	1.18	1.187	V
Reference Voltage Temperature Coefficient ( $C_{VREF} = 1.0\text{ }\mu\text{F}$ , $V_{IN} = 3.5\text{ V}$ )	$TC_{VREF}$	–	0.03	–	mV/ $^\circ\text{C}$
Reference Voltage Load Current ( $C_{VREF} = 1.0\text{ }\mu\text{F}$ , $V_{IN} = 3.5\text{ V}$ ) (Note 4)	$I_{VREF}$	–	2.0	–	mA
Shutdown Input Logic High Threshold Voltage ( $V_{IN} = 3.5\text{ V}$ , $V_{OUT} = 0\text{ V}$ )	$V_{IH}$	1.75	–	–	V
Shutdown Input Logic Low Threshold Voltage ( $V_{IN} = 3.5\text{ V}$ , $V_{OUT} = 0\text{ V}$ )	$V_{IL}$	–	–	0.45	V
PWM Minimum On-Time	$T_{PWM-ON}$	–	100	–	nsec
PWM OV Protection Level	$\%V_{OV}$	–	3.5	6.0	%
PWM Cycle-by-Cycle Current Limit	$I_{LIM}$	–	1.5	–	A
Built-in Soft-Start Time ( $V_{OUT} = 3.0\text{ V}$ , SS Pin Floated)	$T_{SS}$	–	200	–	$\mu\text{sec}$
Thermal Shutdown Threshold ( $V_{IN} = 3.5\text{ V}$ )	$TH_{SHD}$	–	145	–	$^\circ\text{C}$
Thermal Shutdown Hysteresis ( $V_{IN} = 3.5\text{ V}$ )	$TH_{HSYS}$	–	15	–	$^\circ\text{C}$

4. \*Loading capability decreases with  $V_{OUT}$ .

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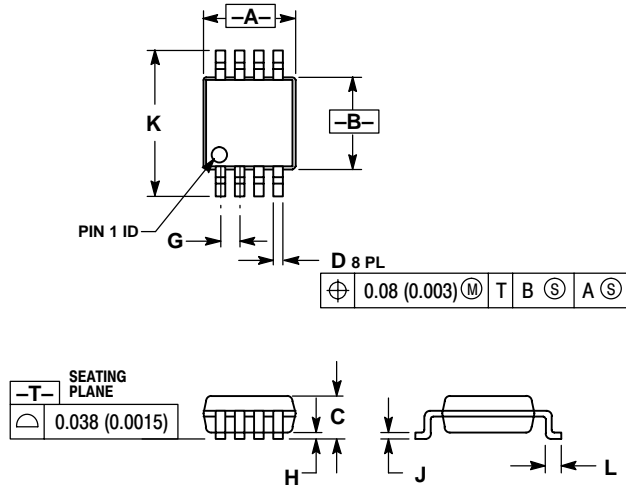
### ORDERING INFORMATION

Device	Output Voltage	Frequency	Device Marking	Package	Shipping
NCP1530DM25R2	2.5 V	600 kHz	TBD	Micro8	4000 Units Per 7 Inch Reel
NCP1530DM27R2	2.7 V		TBD		
NCP1530DM30R2	3.0 V		TBD		
NCP1530DM33R2	3.3 V		TBD		

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## 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

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