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 μA (typ.) of supply current (V_{OUT} = 3.0 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 μA (max) while V_{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_{IN} = 4.0 V, V_{OUT} = 3.3 V, I_{OUT} = 500 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_{IN} = 5.0 V, V_{OUT} = 3.3 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

This document contains information on a product under development. ON Semiconductor reserves the right to change or discontinue this product without notice.

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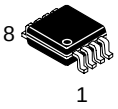
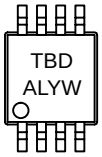
MARKING DIAGRAM

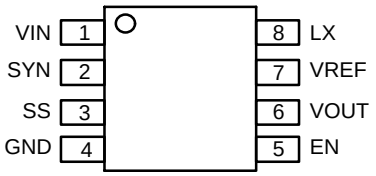


Micro8™
DM SUFFIX
CASE 846A



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

PIN CONNECTIONS



(Top View)

ORDERING INFORMATION

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

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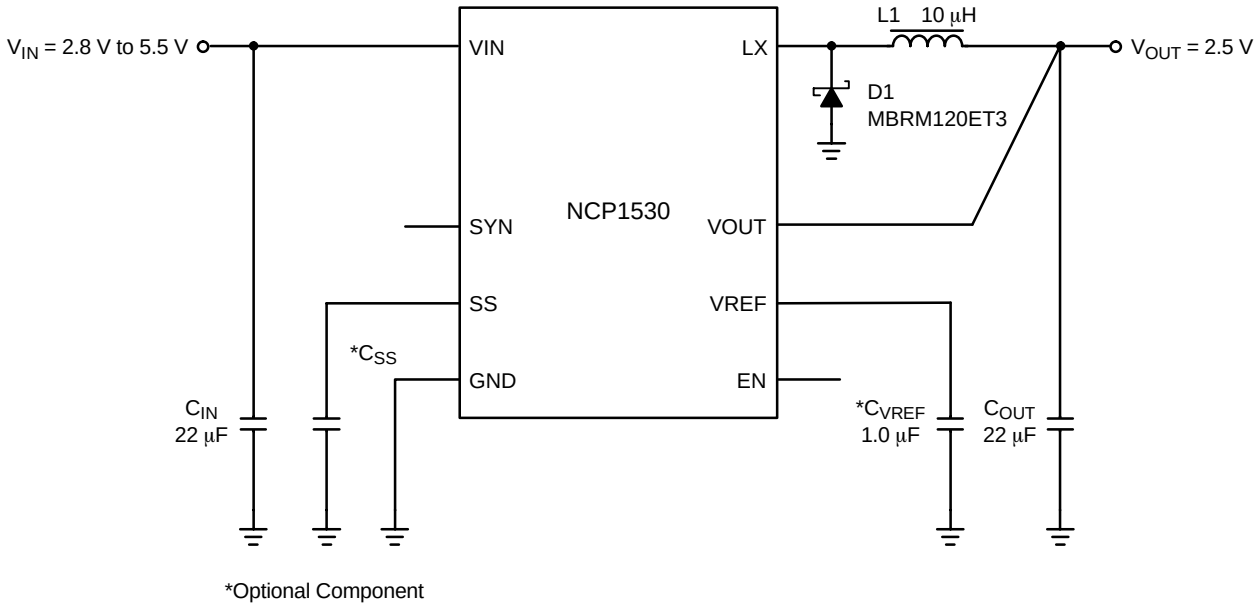


Figure 1. Typical Step–Down Converter Application

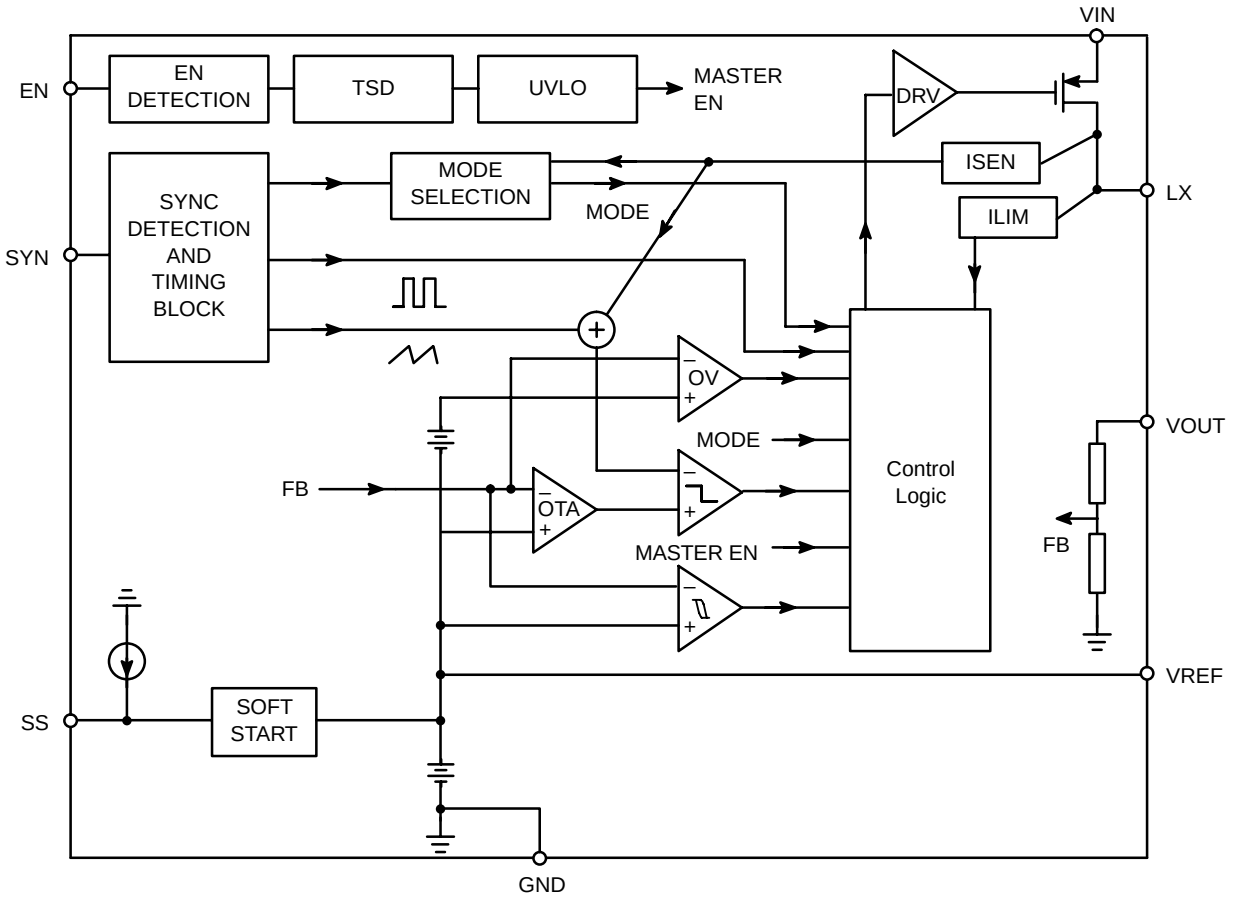


Figure 2. Representative Block Diagram

PIN FUNCTION DESCRIPTIONS

Pin	Symbol	Description
1	VIN	Unregulated Supply Input.
2	SYN	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 μs (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 μA. This pin is internally pulled to VIN.
6	VOUT	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_{IN}	–0.3 to 6	V
Input/Output Pins Pins 2–4 & Pins 7–8	V_{IO}	–0.3 to 6	V
Thermal Characteristics Micro8 Plastic Package Thermal Resistance, Junction–to–Air	$R_{\theta JA}$	240	°C/W
Operating Junction Temperature Range	T_J	–40 to +150	°C
Operating Ambient Temperature Range	T_A	–40 to +85	°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 (V_{IN} = 1.2 x V_R, T_A = 25°C for typical value, –40°C ≤ T_A ≤ 85°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 ± 1.5 %	–	V
Input Voltage	V_{IN}	1.1 V_R	–	5.5	V
Maximum Output Current (V_{OUT} = 3.0 V)	I_{OUT} (max)	600	–	–	mA
Supply Current (V_{IN} = V_R x 1.2, No Load, V_{OUT} = 3.0 V)	I_{IN}	–	48	–	μA
Shutdown Supply Current (No Load, V_{EN} = 0 V)	I_{SHDN}	–	0.1	6.0	μA
L_X Pin Leakage Current (No Load, V_{EN} = 0 V)	I_{LX}	–	1.0	–	μA
L_X Pin ON Resistance (V_{IN} = V_R x 1.2, I_L = 150 mA)	$R_{DSON(LX)}$	–	0.3	–	Ω
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 x 1.2, V_{OUT} = 3.0 V, L = 10 μH, C_{OUT} = 22 μF)	$I_{PFM–PWM}$	–	110	–	mA
Loading Current for PWM to PFM (V_{IN} = V_R x 1.2, V_{OUT} = 3.0 V, L = 10 μH, C_{OUT} = 22 μF)	$I_{PWM–PFM}$	–	60	–	mA
Efficiency (V_{IN} = V_R x 1.2, Iload = 100 mA)	η	–	92	–	%
Undervoltage Lockout Threshold	V_{UVLO}	1.8	2.0	–	V
Reference Voltage (C_{VREF} = 1.0 μF, T_A = 25°C, V_{IN} = 3.5 V)	V_{REF}	1.173	1.18	1.187	V
Reference Voltage Temperature Coefficient (C_{VREF} = 1.0 μF, V_{IN} = 3.5 V)	TC_{VREF}	–	0.03	–	mV/°C
Reference Voltage Load Current (C_{VREF} = 1.0 μF, V_{IN} = 3.5 V) (Note 4)	I_{VREF}	–	2.0	–	mA
Shutdown Input Logic High Threshold Voltage (V_{IN} = 3.5 V, V_{OUT} = 0 V)	V_{IH}	1.75	–	–	V
Shutdown Input Logic Low Threshold Voltage (V_{IN} = 3.5 V, V_{OUT} = 0 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 V, SS Pin Floated)	T_{SS}	–	200	–	μsec
Thermal Shutdown Threshold (V_{IN} = 3.5 V)	TH_{SHD}	–	145	–	°C
Thermal Shutdown Hysteresis (V_{IN} = 3.5 V)	TH_{HSYS}	–	15	–	°C

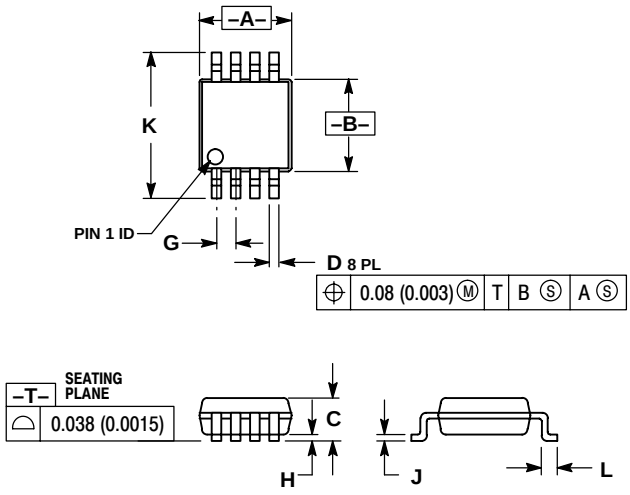
4. *Loading capability decreases with V_{OUT}.

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		

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.

	MILLIMETERS		INCHES	
DIM	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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