NCP3065, NCV3065

Up to 1.5 A Constant Current Switching Regulator for LEDs

The NCP3065 is a monolithic switching regulator designed to deliver constant current for powering high brightness LEDs. The device has a very low feedback voltage of 235 mV (nominal) which is used to regulate the average current of the LED string. In addition, the NCP3065 has a wide input voltage up to 40 V to allow it to operate from 12 Vac or 12 Vdc supplies commonly used for lighting applications as well as unregulated supplies such as Lead Acid batteries. The device can be configured in a controller topology with the addition of an external transistor to support higher LED currents beyond the 1.5 A rated switch current of the internal transistor. The NCP3065 switching regulator can be configured in Step−Down (Buck) and Step−Up (boost) topologies with a minimum number of external components.

Features

- Integrated 1.5 A Switch
- Input Voltage Range from 3.0 V to 40 V
- Low Feedback Voltage of 235 mV
- Cycle−by−Cycle Current Limit
- No Control Loop Compensation Required
- Frequency of Operation Adjustable up to 250 kHz
- Operation with All Ceramic Output Capacitors or No Output Capacitance
- Analog and Digital PWM Dimming Capability
- Internal Thermal Shutdown with Hysteresis
- Automotive Version Available

Applications

- Automotive and Marine Lighting
- High Power LED Driver
- Constant Current Source
- Low Voltage LED Lighting
  (Landscape, Path, Solar, MR16 Replacement)

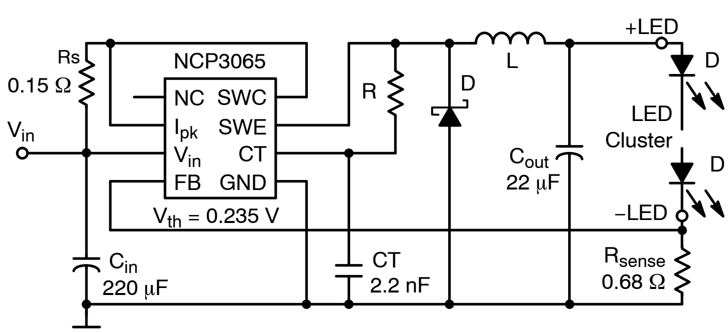
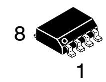


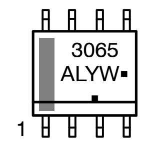
Figure 1. Typical Buck Application Circuit

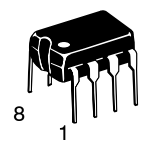
ON Semiconductor®

MARKING DIAGRAMS

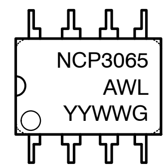


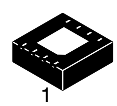
SOIC−8
D SUFFIX
CASE 751



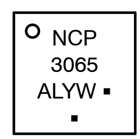


PDIP−8
P, P1 SUFFIX
CASE 626





DFN−8
MN SUFFIX
CASE 488



NCP3065	=	Specific Device Code
A	=	Assembly Location
L, WL	=	Wafer Lot
Y, YY	=	Year
W, WW	=	Work Week
G or ▪	=	Pb−Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 15 of this data sheet.

MAXIMUM RATINGS (measured vs. pin 4, unless otherwise noted)

Rating	Symbol	Value	Unit
V_{CC} (Pin 6)	V_{CC}	0 to +40	V
Comparator Inverting Input (Pin 5)	V_{CII}	−0.2 to $+V_{CC}$	V
Darlington Switch Collector (Pin 1)	V_{SWC}	0 to +40	V
Darlington Switch Emitter (Pin 2) (Transistor OFF)	V_{SWE}	−0.6 to $+V_{CC}$	V
Darlington Switch Collector to Emitter (Pins 1−2)	V_{SWCE}	0 to +40	V
Darlington Switch Current	I_{SW}	1.5	A
I_{pk} Sense (Pin 7)	V_{IPK}	−0.2 to V_{CC} + 0.2	V
Timing Capacitor (Pin 3)	V_{TCAP}	−0.2 to +1.4	V
Power Dissipation and Thermal Characteristics			
PDIP−8 (Note 5) Thermal Resistance Junction−to−Air	$R_{\theta JA}$	100	°C/W
SOIC−8 (Note 5) Thermal Resistance Junction−to−Air	$R_{\theta JA}$	180	°C/W
DFN−8 (Note 5) Thermal Resistance Junction−to−Air Thermal Resistance Junction−to−Case	$R_{\theta JA}$ $R_{\theta JC}$	78 14	°C/W
Storage Temperature Range	T_{STG}	−65 to +150	°C
Maximum Junction Temperature	$T_{J(MAX)}$	+150	°C
Operating Junction Temperature Range (Note 3) NCP3065, NCV3065	T_J	−40 to +125	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. This device series contains ESD protection and exceeds the following tests:
   Pin 1−8: Human Body Model 2000 V per AEC Q100−002; 003 or JESD22/A114; A115
   Machine Model Method 200 V
2. This device contains latch−up protection and exceeds 100 mA per JEDEC Standard JESD78.
3. The relation between junction temperature, ambient temperature and Total Power dissipated in IC is $T_J = T_A + R_{\theta} \bullet P_D$
4. The pins which are not defined may not be loaded by external signals
5. 1 oz copper, 1 in^2 copper area

ELECTRICAL CHARACTERISTICS (V_{CC} = 5.0 V, T_J = −40°C to +125°C, unless otherwise specified)

Characteristic	Conditions	Symbol	Min	Typ	Max	Unit
OSCILLATOR						
Frequency	(VPin 5 = 0 V, CT = 2.2 nF, T_J = 25°C)	f_{OSC}	110	150	190	kHz
Discharge to Charge Current Ratio	(Pin 7 to V_{CC}, T_J = 25°C)	I_{DISCHG} / I_{CHG}	5.5	6.0	6.5	–
Capacitor Discharging Current	(Pin 7 to V_{CC}, T_J = 25°C)	I_{DISCHG}		1650		μA
Capacitor Charging Current	(Pin 7 to V_{CC}, T_J = 25°C)	I_{CHG}		275		μA
Current Limit Sense Voltage	(T_J = 25°C) (Note 7)	$V_{IPK(Sense)}$	165	185	235	mV
OUTPUT SWITCH (Note 6)						
Darlington Switch Collector to Emitter Voltage Drop	(I_{SW} = 1.0 A, T_J = 25°C) (Note 6)	$V_{SWCE(DROP)}$		1.0	1.3	V
Collector Off−State Current	(V_{CE} = 40 V)	$I_{C(OFF)}$		0.01	100	μA
COMPARATOR						
Threshold Voltage	T_J = 25°C	V_{TH}		235		mV
	T_J = 0 to +85°C			±5		%
	T_J = −40°C to +125°C	V_{TH}	−10		+10	%
Threshold Voltage Line Regulation	(V_{CC} = 3.0 V to 40 V)	REG_{LiNE}	−6.0		6.0	mV
Input Bias Current	(V_{in} = V_{th})	$I_{CII\ in}$	−1000	−100	1000	nA
TOTAL DEVICE						
Supply Current	(V_{CC} = 5.0 V to 40 V, CT = 2.2 nF, Pin 7 = V_{CC}, VPin 5 > V_{th}, Pin 2 = GND, remaining pins open)	I_{CC}			7.0	mA
Thermal Shutdown Threshold				160		°C
Hysteresis				10		°C

6. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient temperature as possible.
7. The $V_{IPK(Sense)}$ Current Limit Sense Voltage is specified at static conditions. In dynamic operation the sensed current turn−off value depends on comparator response time and di/dt current slope. See the Operating Description section for details.
8. NCV prefix is for automotive and other applications requiring site and change control.

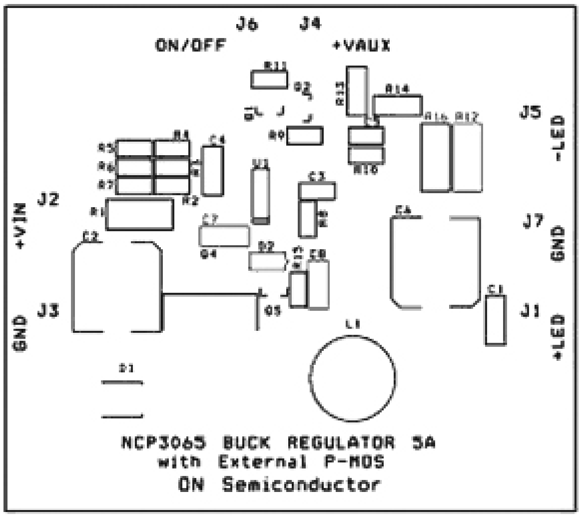


Figure 26. 3 A Buck Demoboard Layout

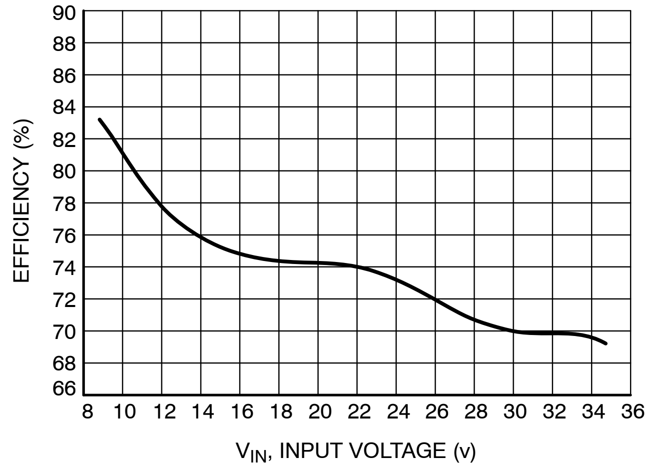


Figure 27. Efficiency vs. Input Voltage for the 3 A Buck Demo Board at I_{OUT} = 3 A, V_{OUT} = 4 V, T_A = 25°C

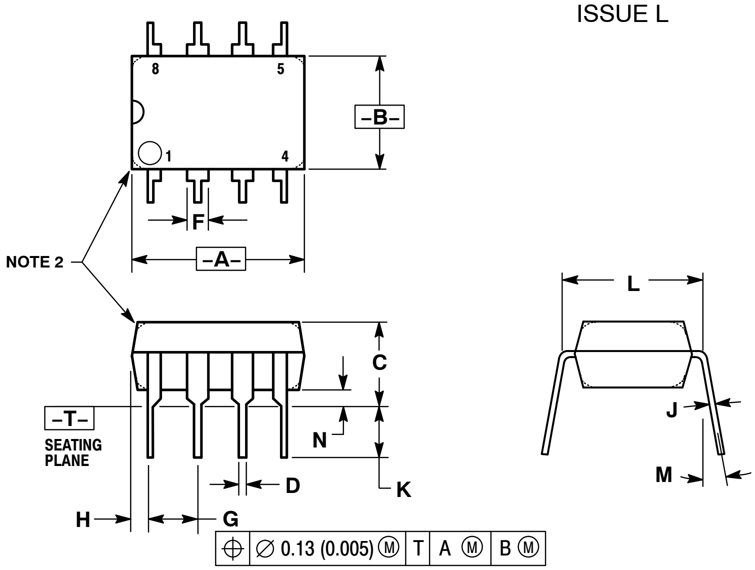
ORDERING INFORMATION

Device	Package	Shipping†
NCP3065MNTXG	DFN−8 (Pb−Free)	4000 Units / Tape & Reel
NCP3065PG	PDIP−8 (Pb−Free)	50 Units / Rail
NCP3065DR2G	SOIC−8 (Pb−Free)	2500 Units / Tape & Reel
NCV3065MNTXG	DFN−8 (Pb−Free)	4000 Units / Tape & Reel
NCV3065PG	PDIP−8 (Pb−Free)	50 Units / Rail
NCV3065DR2G	SOIC−8 (Pb−Free)	2500 Units / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

PACKAGE DIMENSIONS

8 LEAD PDIP
CASE 626−05
ISSUE L



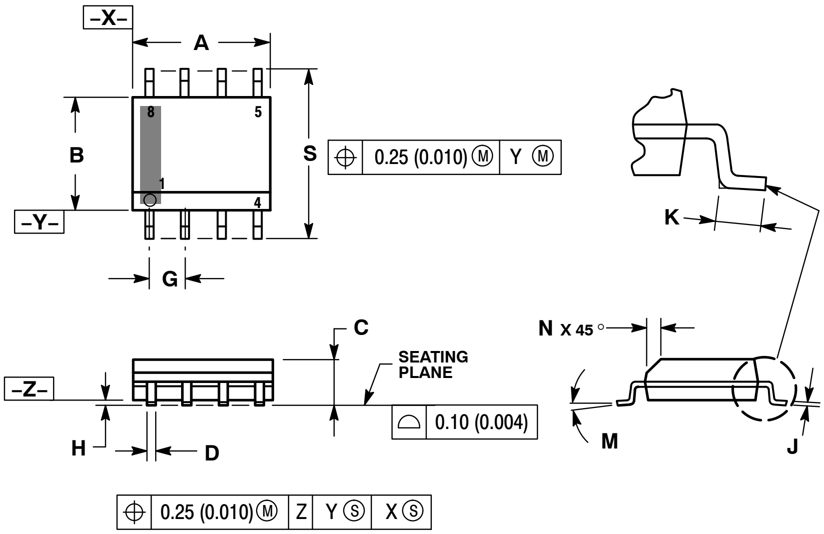
NOTES:
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	---	10°	---	10°
N	0.76	1.01	0.030	0.040

STYLE 1:
PIN 1. AC IN
2. DC + IN
3. DC − IN
4. AC IN
5. GROUND
6. OUTPUT
7. AUXILIARY
8. V_{CC}

PACKAGE DIMENSIONS

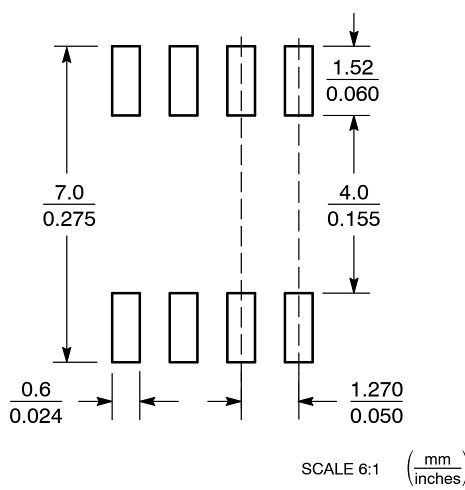
SOIC−8 NB
CASE 751−07
ISSUE AH



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751−01 THRU 751−06 ARE OBSOLETE. NEW STANDARD IS 751−07.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0 °	8 °	0 °	8 °
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

SOLDERING FOOTPRINT*



*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.