

# ON Semiconductor

## Is Now

# onsemi™

To learn more about onsemi™, please visit our website at  
[www.onsemi.com](http://www.onsemi.com)

---

**onsemi** and **onsemi** and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi** product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner. Other names and brands may be claimed as the property of others.



ON Semiconductor

DN06017/D

Design Note – DN06017/D

# Efficient, Low Cost, Low Standby Power (<100 mW), 2.5 W Cell Phone Charger

Device	Application	Input Voltage	Output Power	Topology	I/O Isolation
NCP1011	Cell Phone Charger	90 – 270 Vac	2.5 W	Flyback	Yes

Other Specifications				
	Output 1	Output 2	Output 3	Output 4
Output Voltage	5.0 V (adjustable)	N/A	N/A	N/A
Ripple	100 mV max	N/A	N/A	N/A
Nominal Current	500 mA	N/A	N/A	N/A
Max Current	620 mA	N/A	N/A	N/A
Min Current	Zero	N/A	N/A	N/A

PFC (Yes/No)	No
Minimum Efficiency	65%
Inrush Limiting / Fuse	Yes
Operating Temp. Range	0 to +50°C
Cooling Method/Supply Orientation	Convection
Signal Level Control	No

<b>Others</b>	Standby (no load) input power = 90 mW @ 230 Vac
---------------	---

## Circuit Description

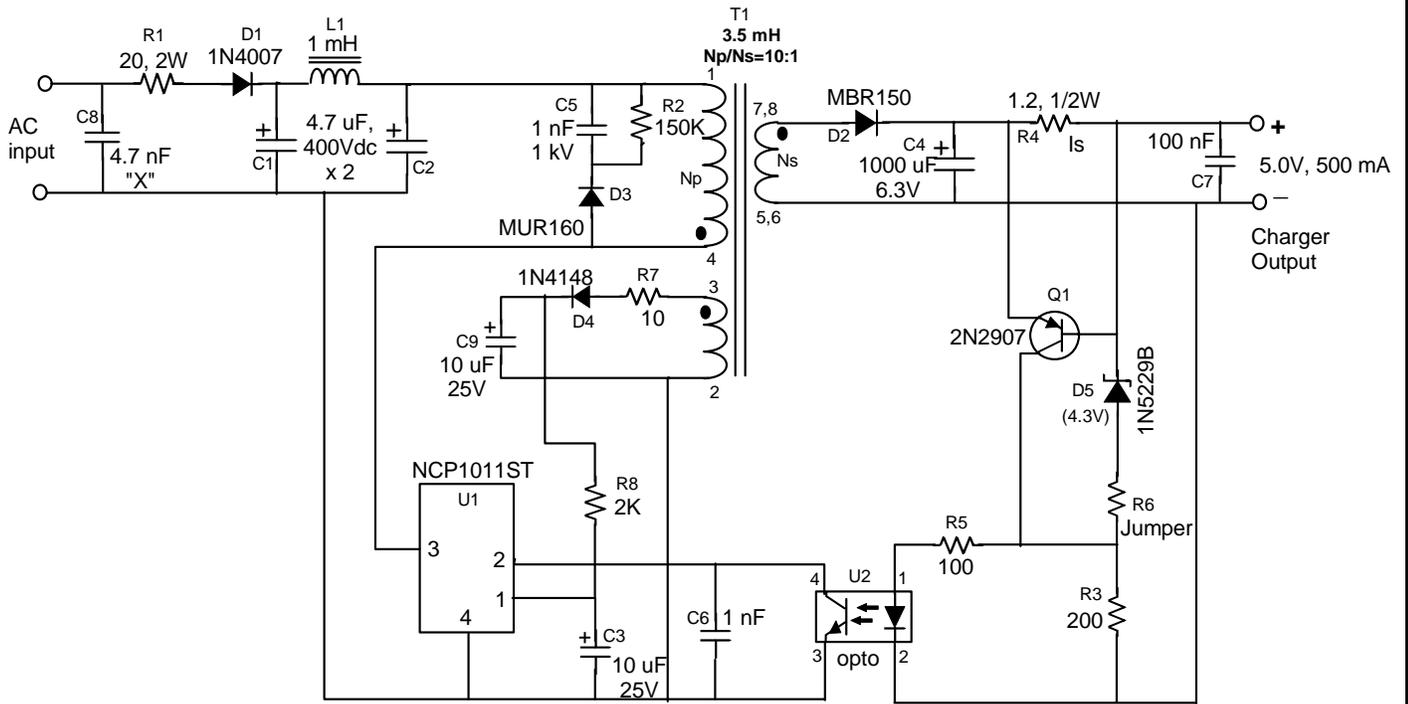
This design note features a very simple, yet highly effective low power cell phone charger designed around ON Semi's NCP1011 very high voltage switching regulator. The topology is a discontinuous mode flyback with a constant current – constant voltage (CCCV) output profile with better than 100 mA current regulation and 2 % voltage regulation. Plots of the efficiency curves and output current/voltage profile are shown on page 4 of this document. The circuit also includes an input pi filter for conducted EMI compliance. The existing circuit can easily be modified to accommodate other voltage and current combinations and is applicable up to 5 watts output if the NCP1014 is used for U1 with the appropriate rating and/or value changes to C4, D2, D5, R4 and R6.

## Key Features

- Constant current – constant voltage output profile suitable Lithium Ion batteries
- Over-current, over-voltage and over-temperature protection
- Conducted EMI filter
- Simple half-wave input rectifier
- < 100 mW input standby power when auxiliary winding on transformer used
  - 90 mW @ 230 Vac
  - 75 mW @ 120 Vac
- Very low cost components
- Circuit easily tailored for other voltage/current combinations

# DN06017/D

## Schematic



### Notes:

1. D5 and R6 sets  $V_{out}$  ( $R6 = \text{jumper for } 5V$ ;  $R6$  increases voltage)
2.  $R4$  sets  $I_{max}$  ( $I_{max} = .65/R4$ )
3. U1 is SOT223, 100 kHz version of NCP1011
4. L1 is Coilcraft RFB0807-102L (1 mH, 300 mA)
5. U2 is Vishay SFH-615A-4 or similar optocoupler

**NCP1011 CVCC Cell Phone Charger**  
**5.0 Vout, 500 mA**

**MAGNETICS DESIGN DATA SHEET**

Project / Customer: ON Semiconductor - NCP1011/1014 Generic CP charger

Part Description: 5 watt flyback transformer, 4 - 9 volts out (REV 3)

Schematic ID: T1

Core Type: EF16 (E16/8/5); 3C90 material or similar

Core Gap: Gap for 3.5 mH

Inductance: 3.5 mH +/-5%

Bobbin Type: 8 pin horizontal mount for EF16

Windings (in order):

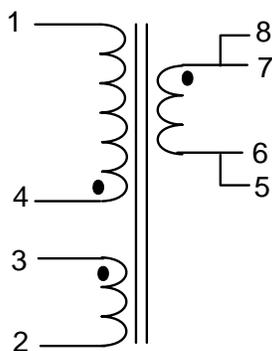
Winding # / type	Turns / Material / Gauge / Insulation Data
Vcc/Boost (2 - 3)	28 turns of #35HN spiral wound over 1 layer. Insulate with 1 layer of tape (500V insulation to next winding)
Primary (1 - 4)	150 turns of #35HN over 3 layers. Insulate for 3 kV to the next winding.
5V Secondary (5, 6 - 7, 8)	14 turns of #25HN spiral wound over one layer with 0.050" (1.3mm) end margins.

Vacuum varnish assembly.

Hipot: 3 kV from boost/primary to secondary for 1 minute.

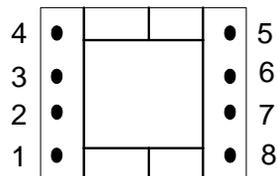
Vendor for xfmr: Mesa Power Systems (Escondido, CA) part # 131296

Schematic



Lead Breakout / Pinout

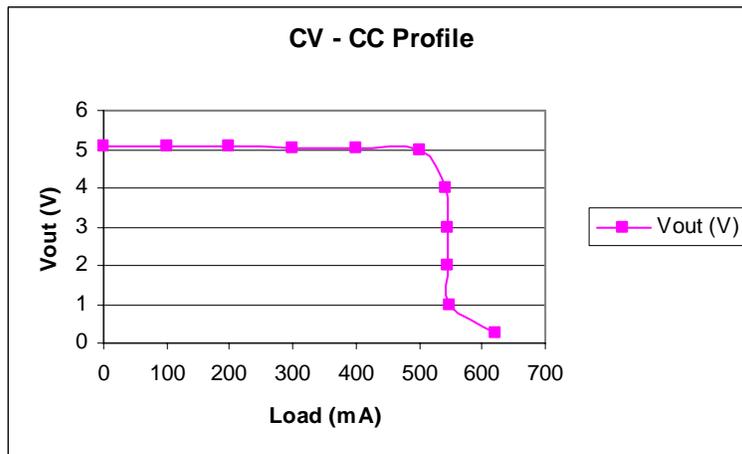
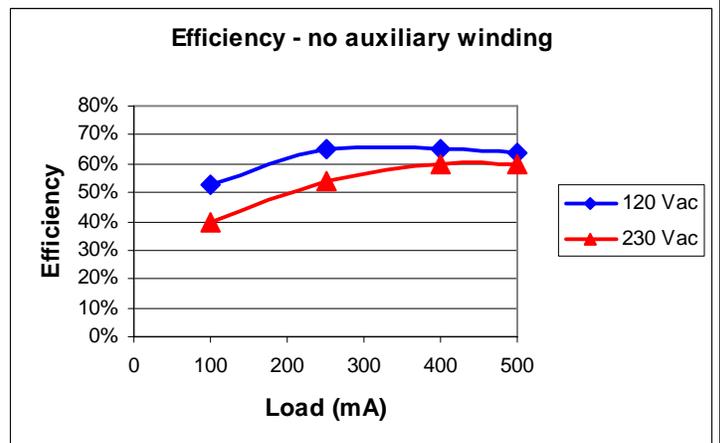
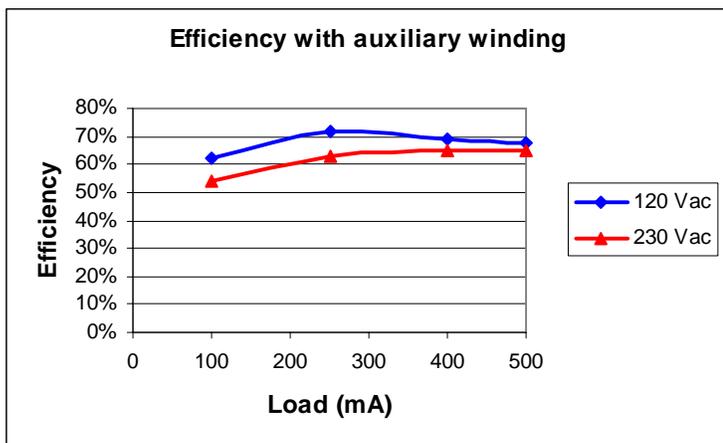
(Bottom View - facing pins)



## Test Results

### Results

- Configuration: Half-wave input rectifier; no EMI inductor
- Transformer Np/Ns: 10:1; L<sub>primary</sub> = 3.5 mH
- V<sub>out</sub> nominal: 5.065 V
- Current limit : 530 mA (V<sub>out</sub> at 4.90 V)
- I short circuit: 620 mA @ 120 Vac; 606 mA @ 230 Vac
- Vac regulation dropout: 85 Vac with 500 mA load; V<sub>out</sub> = 4.90 V
- Output Ripple (500 mA load): 90 mV p/p
- Standby Input Power: < 100 mW
  - 90 mW @ 230 Vac
  - 75 mW @ 120 Vac



© 2006 ON Semiconductor.

**Disclaimer:** ON Semiconductor is providing this design note "AS IS" and does not assume any liability arising from its use; nor does ON Semiconductor convey any license to its or any third party's intellectual property rights. This document is provided only to assist customers in evaluation of the referenced circuit implementation and the recipient assumes all liability and risk associated with its use, including, but not limited to, compliance with all regulatory standards. ON Semiconductor may change any of its products at any time, without notice.

Design note created by Frank Cathell, e-mail: [f.cathell@onsemi.com](mailto:f.cathell@onsemi.com)