Circuit Description

The power supply is designed around the ON Semiconductor NCP1014 monolithic current mode controller with integrated Mosfet in a discontinuous mode (DCM) flyback converter topology. The design includes a pi-network differential mode input EMI filter and resistive turn-on inrush current limiting. The 5 and 14 volt outputs are implemented using a stacked, interleaved secondary winding scheme on the flyback transformer, and summed output sensing through resistors R8 and R9. This sense implementation vastly improves cross regulation between the two outputs. The outputs are sensed, amplified and fed back to the primary controller via the commonly used TL431 and optocoupler circuit scheme. Plots of the minimal cross regulation interaction are shown in the graphs below. Schottky rectifiers are used for output diodes for maximum efficiency. The NCP1014 controller contains inherent over-current and over-temperature protection in addition to over-voltage protection in the event of an optocoupler failure.

Key Features

- Simple, low cost, yet effective dual output off-line switcher design.
- Input EMI filter.
- Stacked secondary windings and output sense summing for excellent cross regulation.
- High efficiency Schottky rectifiers on output.
- Auxiliary Vcc winding on transformer for very low standby (no load) input power.

Other Specifications

<table>
<thead>
<tr>
<th>Output Voltage</th>
<th>Output 1</th>
<th>Output 2</th>
<th>Output 3</th>
<th>Output 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Vdc</td>
<td>75 mA</td>
<td>14 Vdc</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>2%</td>
<td>10 µA</td>
<td>2%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>350 mA</td>
<td>500 mA</td>
<td>75 mA</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>700 mA</td>
<td>500 mA (16 ms)</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>10 µA</td>
<td>10 µA</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

PFC (Yes/No) | No
Minimum Efficiency | 70%
Operating Temp. Range | 0 to +60 °C
Cooling Method/Supply Orientation | Convection

Others

Tight output cross regulation to +/- 5%
NOTES:
1. L1 is Coilcraft RFB0807-681L 680 uH, 350 mA inductor.
2. See Magnetics Data Sheet for T1 construction details.
3. U1 is 100 kHz, SOT-223 version of NCP1014 controller. Pin 4 tab should be soldered to copper clad ground plane for best heatsinking.
4. R1 is optional inrush limiter resistor.
5. U2 is Vishay H11A817A optocoupler or equivalent.
6. D1 is Vishay DF06M bridge rectifier (1A, 600V, DIP-4 package) or similar.
7. Output voltage sensing is summed via R8, R9, R10.
Cross Regulation (measured at 120 Vac input)

Cross Regulation: 5 Vout = 350 mA

Cross Regulation: 5 Vout = 700 mA

Line Regulation
Less than 20 mV change in any output under any load condition from 90 to 270 Vac.

Efficiency
5V@350mA, 14V@75mA – 78% at 120Vac in; 70% at 230Vac
5V@700mA, 14V@500mA – 78% at 120Vac in; 78% at 230Vac

No-load Input Power
285 mW @ 230 Vac
216 mW @ 115 Vac
MAGNETICS DESIGN DATA SHEET

Project / Customer: ON Semiconductor - NCP1014 dual output supply
Part Description: 10 watt flyback transformer; dual output, universal input
Schematic ID: T1
Core Type: E25/10/6 (E24/25); 3C90 material or similar
Core Gap: Gap for 1.4 mH
Inductance: L = 1.4 mH +/- 5%
Bobbin Type: E24-25 PCB1-10 (10 pin horizontal pc mount)

Windings (in order):

<table>
<thead>
<tr>
<th>Winding # / type</th>
<th>Turns / Material / Gauge / Insulation Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vcc (1 - 2)</td>
<td>9 turns of #32HN spiral wound over window with 2 mm (approx) end margins. Tape insulate to 1 kV. Self-leads to pins.</td>
</tr>
<tr>
<td>Primary (10 - 9)</td>
<td>68 turns of #32HN over 2 layers, 34 TPL. Cuff winding ends with tape and insulate for 3 kV to next winding.</td>
</tr>
<tr>
<td>5 /14V Secondaries (3 - 8, 4 - 7, 5 - 6)</td>
<td>4 turns trifilar of #26 HN (3 strands, each a different color) with the last turn of one strand removed (for a total of 3 turns with this strand). Allow approx 2.5 mm end margins and terminate leads to pins as shown in diagram below. 3 turn winding should terminate to pins 5 and 6. Insulate with mylar tape.</td>
</tr>
</tbody>
</table>

Vacuum varnish assembly.

Hipot: 3 kV from 5/14V secondaries to primary/Vcc for 1 minute.

Proto xfmrs available from Mesa Power Systems, Escondido, CA. 1-800-515-8514
Mesa part number: 13-1298

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Design note created by Frank Cathell, e-mail: f.cathell@onsemi.com