

## Graphical Data Test Circuits for the NCP1650

Prepared by  
**Alan Ball**  
 ON Semiconductor Applications Engineering

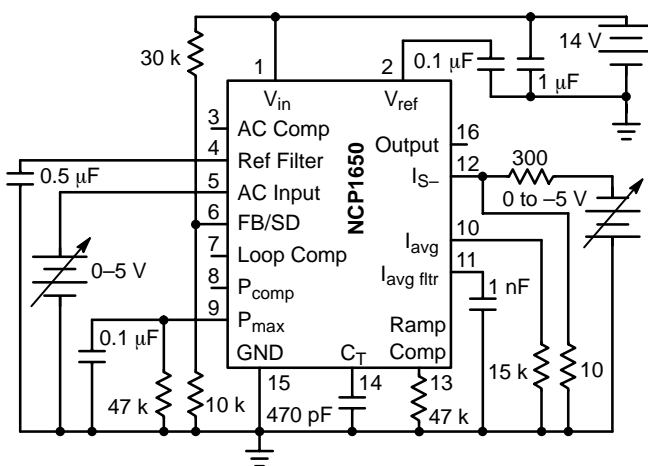


**ON Semiconductor™**

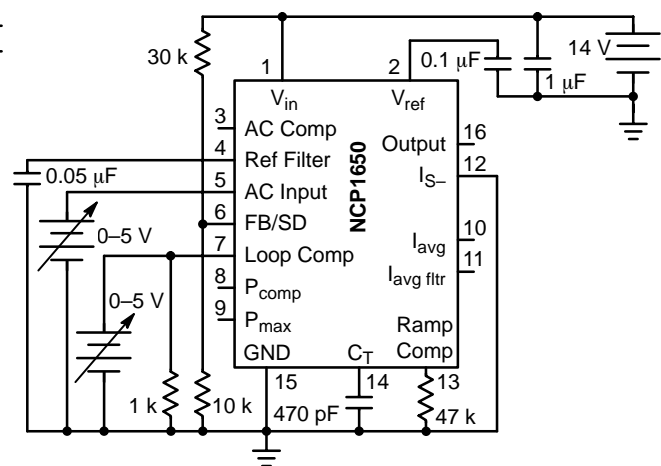
<http://onsemi.com>

The following circuits are the test configurations that were used to obtain the data for the graphical section of the NCP1650/D data sheet. Each graph has a schematic associated with it and in some cases a description of the procedure.

### APPLICATION NOTE

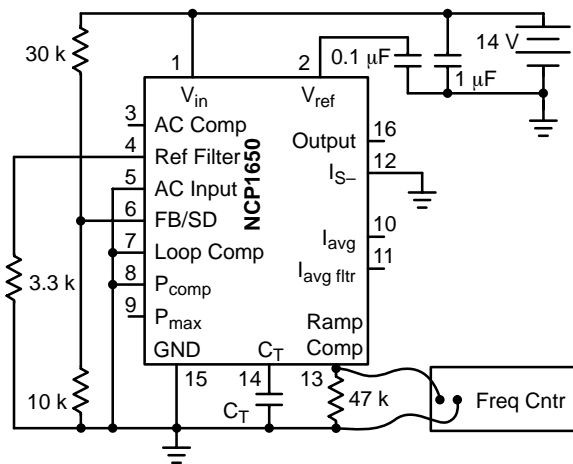


**Figure 1. Power Multiplier Family of Curves**  
 Re: NCP1650/D data sheet, Figure 3



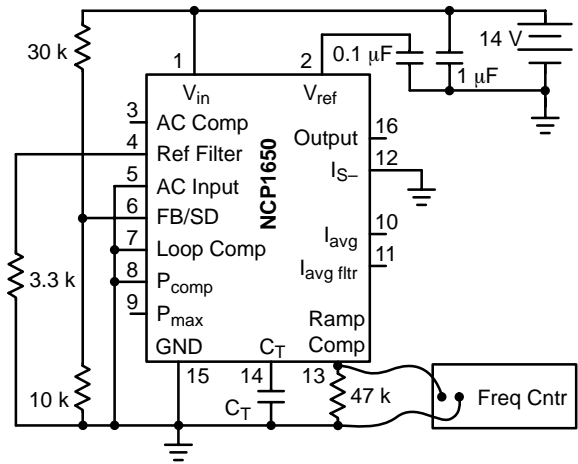
**Figure 2. Reference Multiplier Family of Curves**  
 Re: NCP1650/D data sheet, Figure 4

Power up chip. Set  $I_{S-}$  between 0 and  $-200$  mV in  $50$  mV increments. For each value of  $I_{S-}$  set the ac input (pin 5) to various values from 0 to  $3.8$  volts. Record output  $P_{max}$  (pin 9).



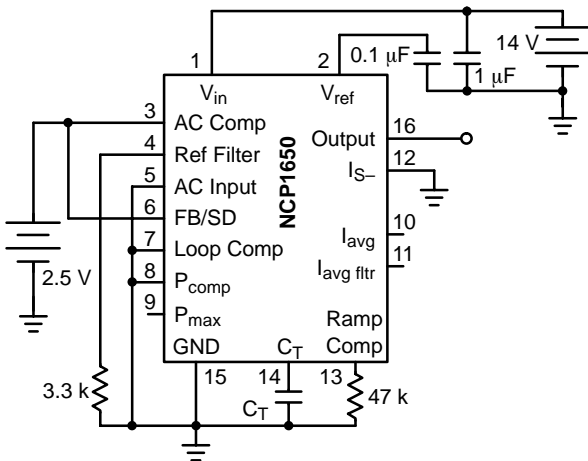
**Figure 3. Frequency versus  $C_T$**   
 Re: NCP1650/D data sheet, Figure 5

Bias device per the above figure. Install various values of  $C_T$ , and measure the frequency at pin 13. Do not measure directly from pin 14, as the impedance of the measuring device will cause errors in the reading.



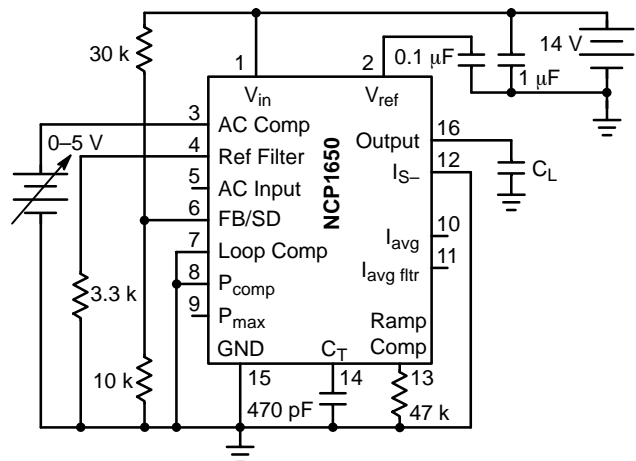
**Figure 4. Ramp Peak versus Frequency**  
 Re: NCP1650/D data sheet, Figure 6

Bias device per the above figure. Install various values of  $C_T$ , and measure the frequency at pin 13. Measure amplitude at pin 14 with an oscilloscope.



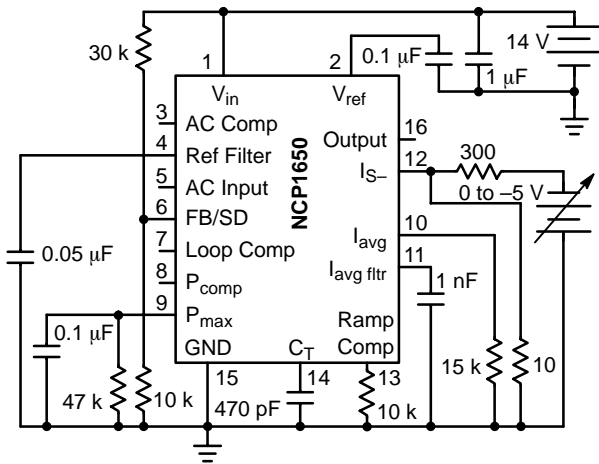
**Figure 5. Max Duty Cycle versus Frequency**  
 Re: NCP1650/D data sheet, Figure 7

Measure frequency and duty cycle for various values of  $C_T$ .

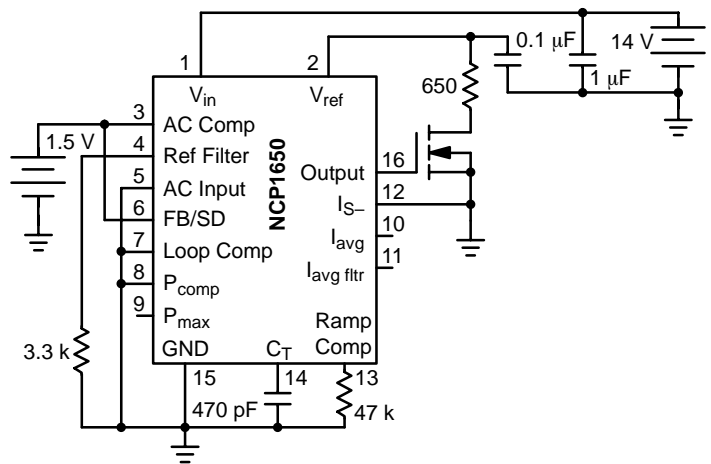


**Figure 6. Drive Rise and Fall Time versus Capacitance**  
 Re: NCP1650/D data sheet, Figure 8

Adjust the voltage on pin 3 for approximately 50% duty cycle from the output driver. Measure the waveform on pin 16 with an oscilloscope and measure the rise and fall times at the 10% and 90% levels. Change  $C_L$  as required.

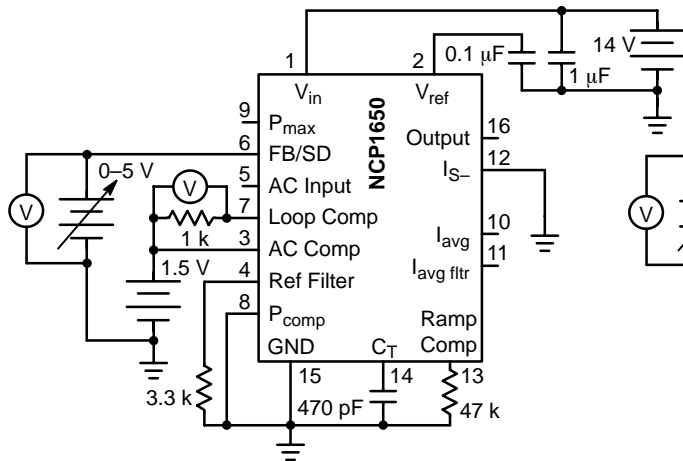


**Figure 7. Current Sense Amplifier Gain**  
Re: NCP1650/D data sheet, Figure 9

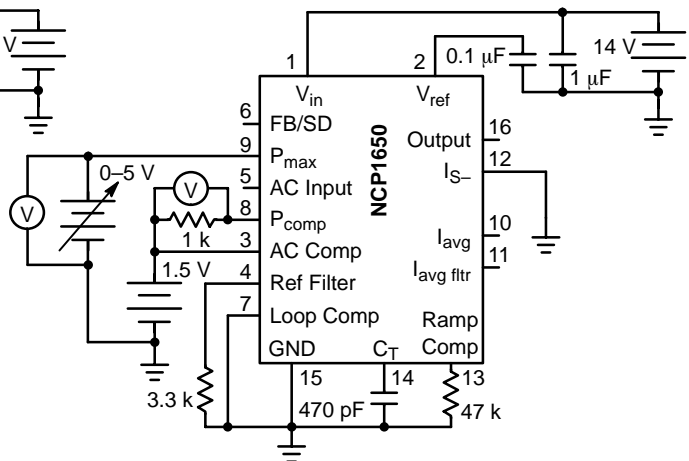


**Figure 8. V<sub>ref</sub> Transient Response**  
Re: NCP1650/D data sheet, Figure 11

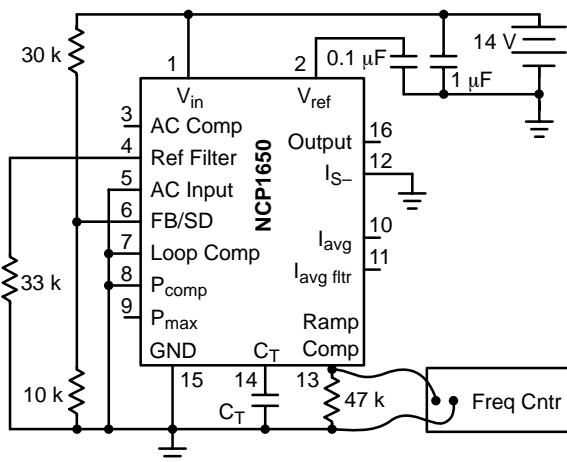
Adjust voltage at pin 12, and read values at pins 10 & 11.



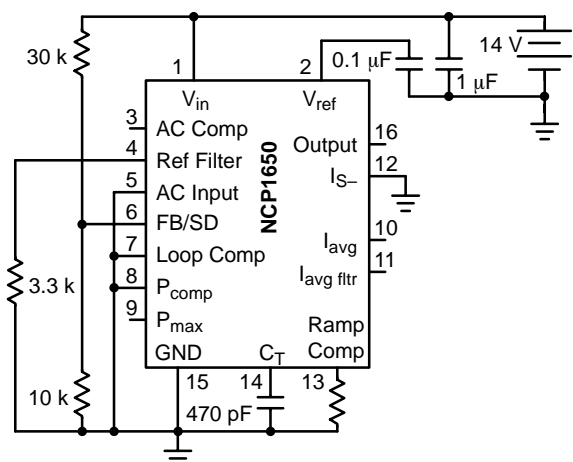
**Figure 9. Voltage Error Amplifier Gain**  
Re: NCP1650/D data sheet, Figures 12 & 13



**Figure 10. Power Error Amplifier Gain**  
Re: NCP1650/D data sheet, Figures 14 & 15

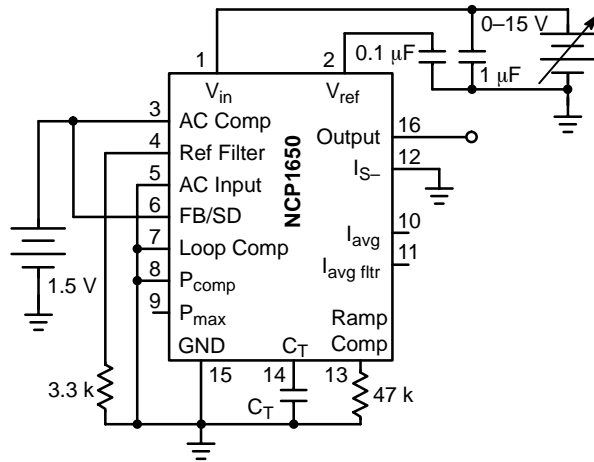


**Figure 11. Frequency versus C<sub>T</sub>**  
Re: NCP1650/D data sheet, Figure 16

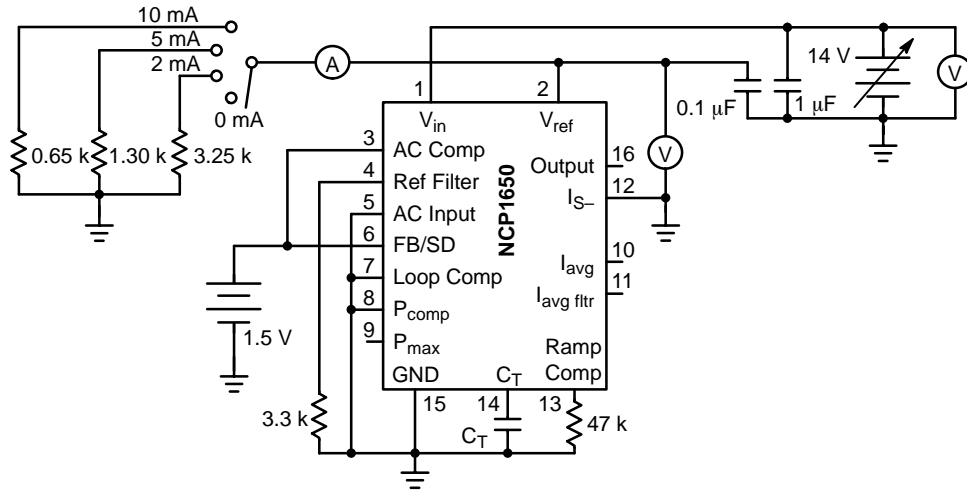


**Figure 12. Ramp Peak versus Temperature**  
Re: NCP1650/D data sheet, Figure 17

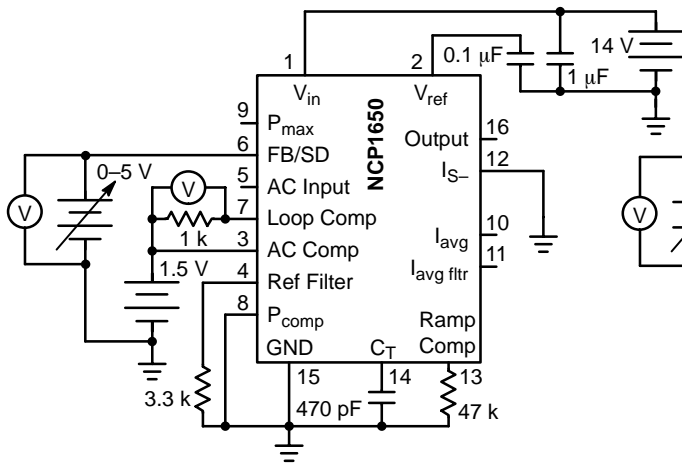
# TND307



**Figure 13. UVLO Turn On/Turn Off**  
 Re: NCP1650/D data sheet, Figure 18

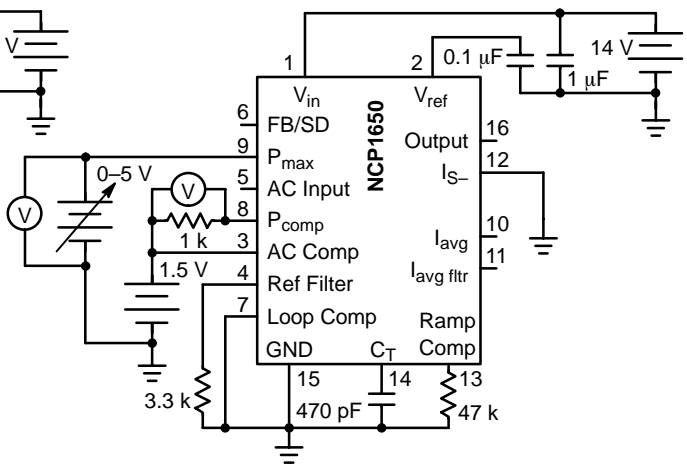


**Figure 14.  $V_{ref}$  Line/Load Regulation in Operating Mode**  
 Re: NCP1650/D data sheet, Figures 19 & 20



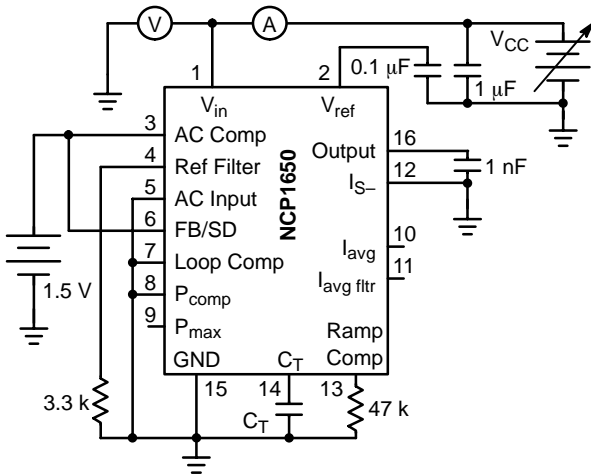
**Figure 15. Voltage Error Amplifier Gain**  
Re: NCP1650/D data sheet, Figure 21

Energize unit by applying 14 volt supply. Using a precision supply with resolution of 1 mV or less, adjust the voltage at pin 6 for zero current out of pin 7. The voltage at pin 6 will be the effective 4.0 V reference voltage.

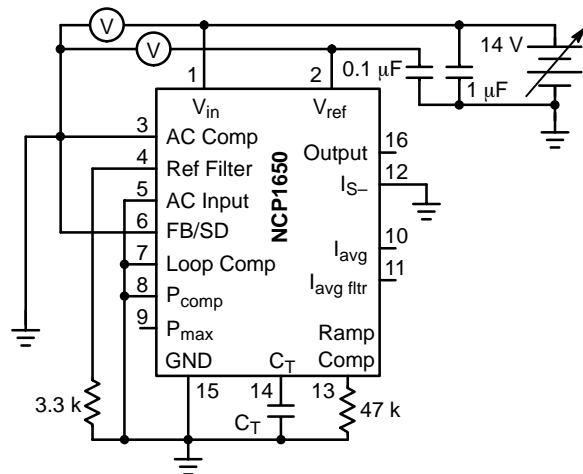


**Figure 16. Power Error Amplifier Gain**  
Re: NCP1650/D data sheet, Figure 22

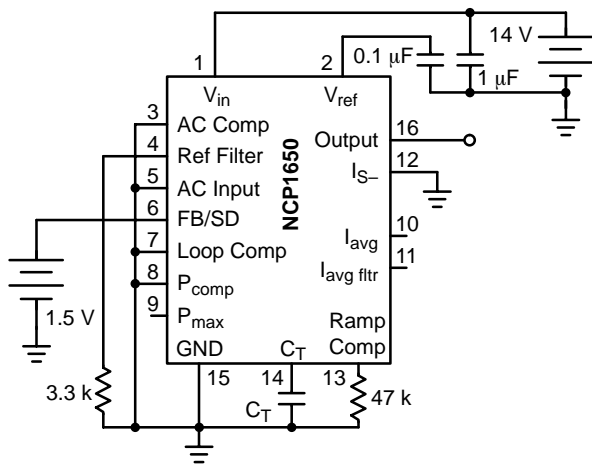
Energize unit by applying 14 volt supply. Using a precision supply with resolution of 1 mV or less, adjust the voltage at pin 9 for zero current out of pin 8. The voltage at pin 9 will be the effective 2.5 V reference voltage.



**Figure 17. Bias Current versus V<sub>CC</sub>**  
Re: NCP1650/D data sheet, Figure 23



**Figure 18. V<sub>ref</sub> versus V<sub>CC</sub> in Shutdown Mode**  
Re: NCP1650/D data sheet, Figure 24



**Figure 19. Minimum Duty Cycle versus Frequency**  
 Re: NCP1650/D data sheet, Figure 25

Apply power to 14 V supply and then to 1.5 V supply. Measure on time, and period at pin 16 using an oscilloscope. Vary capacitor value from 2000 pF to 100 pF for frequency range of 25 kHz to 300 kHz.

**Notes**

**ON Semiconductor** and  are trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC 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. "Typical" parameters which may be provided in SCILLC 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. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC 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 SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer.

## PUBLICATION ORDERING INFORMATION

### Literature Fulfillment:

Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** ONlit@hibbertco.com

**N. American Technical Support:** 800-282-9855 Toll Free USA/Canada

**JAPAN:** ON Semiconductor, Japan Customer Focus Center  
4-32-1 Nishi-Gotanda, Shinagawa-ku, Tokyo, Japan 141-0031  
**Phone:** 81-3-5740-2700  
**Email:** r14525@onsemi.com

**ON Semiconductor Website:** <http://onsemi.com>

For additional information, please contact your local Sales Representative.