

# LB-48

*LB-48 Simple Voltmeter Monitors TTL Supplies*



Literature Number: SNOA700

# Simple Voltmeter Monitors TTL Supplies

National Semiconductor  
Linear Brief 48  
Michael Maida  
February 1980



Simple Voltmeter Monitors TTL Supplies

Using a National Semiconductor LM3914 bar/dot display driver chip, a few resistors and some LEDs, a simple expanded-scale voltmeter is easily constructed. Furthermore, it runs from the same single  $5V \pm 10\%$  supply it monitors and can provide TTL-compatible undervoltage and overvoltage warning signals.

The complete circuit is shown in Figure 1. Resistors R1 and R2 attenuate  $V_{CC}$  by a factor of three at the LM3914 signal input, ensuring proper biasing of the IC with  $V_{CC}$  as low as 4V. The IC's internal reference sets the voltage across the series combination of R3, R4 and R5 at 1.25V, establishing a reference load current of about 1 mA. This current is joined by the small, constant current from the reference adjust pin (75  $\mu A$ , typ) and flows to ground through R6 and R7, developing a voltage drop. Adjusting R6 varies this voltage drop and, consequently, the voltage at pin 7, nominally 1.803V ( $= 5.41V/3$ ).

Pin 7 is connected to the top of the LM3914's internal ten-step voltage divider (pin 6). The bottom of this divider (pin 4) is connected to the center tap of potentiometer R4. By varying the pot setting this voltage can be set to 1.47V ( $= 4.41V/3$ ) without significantly affecting the potential at

pin 7. The optional diode D1 protects against damaging the IC by connecting the leads backwards.

In operation, the LM3914's ten internal voltage comparators compare the signal input,  $V_{CC}/3$ , to the reference voltage on the divider, lighting each successive LED for every 100 mV increase in  $V_{CC}$  above 4.5V as shown. The LM3914 regulates the LED currents at 10 times the reference load current, here about 10 mA, so external current-limiting resistors are not required. With pin 9 left open circuit, the LM3914 functions in Dot mode (only one LED on at a time). If desired, a Bar mode display could be obtained by connecting pin 9 to  $V_{CC}$ , but the dot display seems more suitable in this application.

To calibrate, set  $V_{CC}$  at 5.41V and adjust R6 until LED #9 and LED #10 are equally illuminated. (A built-in overlap of about 1 mV ensures all LEDs won't go out at a threshold point.) There's no need to vary the system supply voltage to perform this adjustment. Instead, disconnect R1 from  $V_{CC}$  and connect it to an accurate reference. Then, at 4.5V, adjust R4 until LED #1 just barely turns on. There is a slight interaction caused by the finite resistance (10k, typ) of the LM3914's voltage divider, so that repeating the above procedure once is advised.

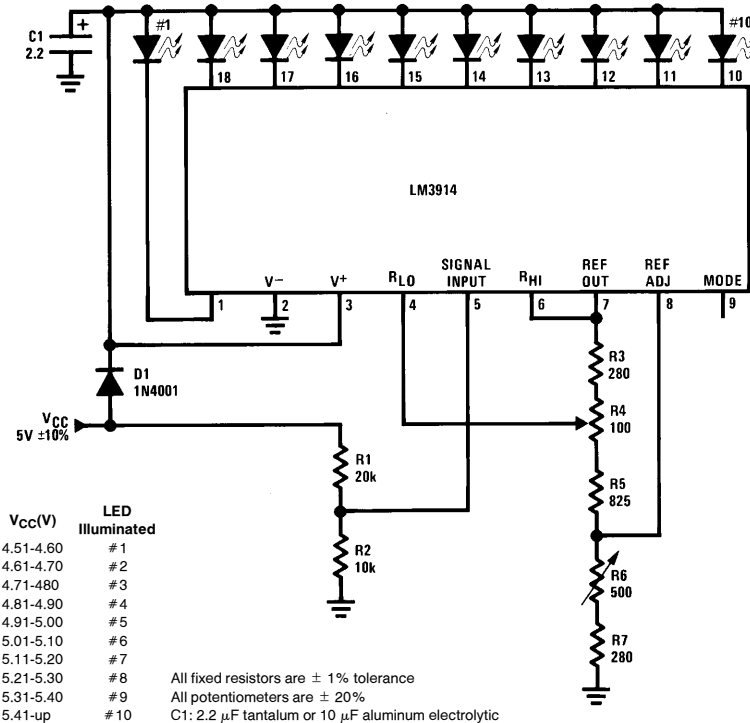


FIGURE 1. 5V Power Supply Monitor

TL/H/8496-1

The LED driver outputs can directly drive a TTL gate, so that the LED #1 and LED #10 outputs may be used for undervoltage and overvoltage warning signals. These may be used to initiate a soft shutdown or summon an operator, for example. The interfacing circuitry is shown in Figure 2. The 470Ω resistor R8 ensures that the LM3914 output will saturate to provide the proper TTL low level. Pull-up resistor R9 provides the logic high level.

In the previous circuit the undervoltage LED goes out when V<sub>CC</sub> is less than 4.51V, a deficiency that is corrected here, Transistors Q1 and Q2 shut off LED #1 whenever any other LED is turned on by the LM3914. Q2's output will directly drive TTL.

Calibration procedure is the same as before. The LM3914 output thresholds have been shifted up by 100 mV and output #10 is or-tied with output #9. Other outputs may be wire-or'd together if 100 mV resolution is not necessary. If desired, the outputs can be color coded by making LED #1 and LED #10 red, LED #2 and LED #9 amber, and the rest of the LEDs green to ease interpretation.

This circuit is useful where quick and easy voltage adjustments must be made, such as in the field or on the production line. The circuit's low cost makes it feasible to incorporate it into the system, where the overvoltage and undervoltage warning signals provide an attractive extra. Of course, these techniques can be used to monitor any higher voltages, positive or negative.

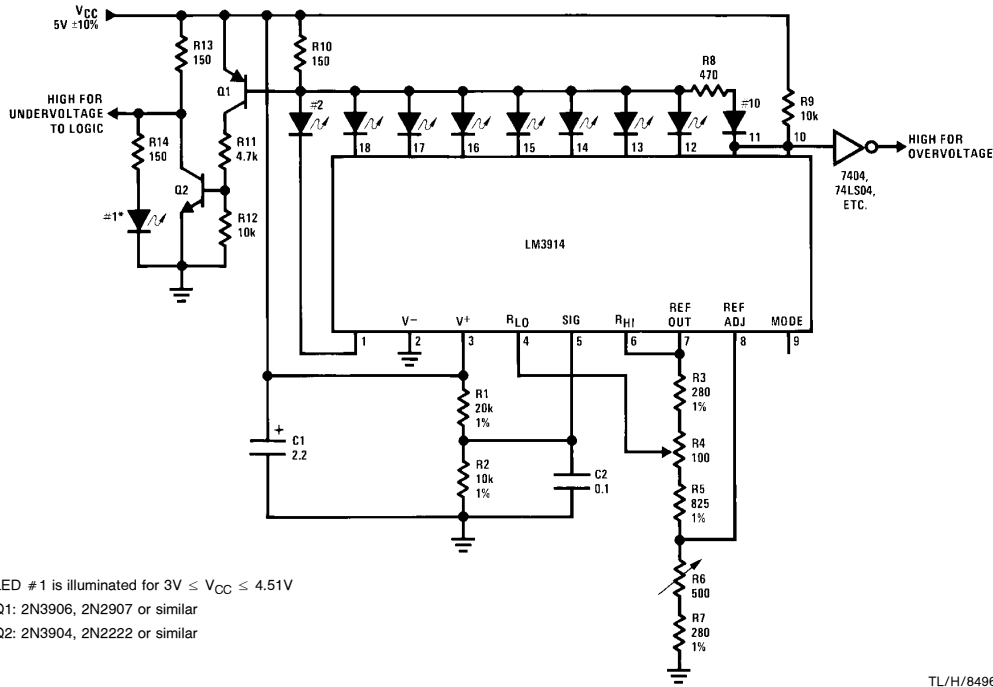


FIGURE 2. Power Supply Monitor with TTL Interface and Extended Undervoltage Range

**LIFE SUPPORT POLICY**

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



**National Semiconductor Corporation**  
 1111 West Bardin Road  
 Arlington, TX 76017  
 Tel: 1(800) 272-9959  
 Fax: 1(800) 737-7018

**National Semiconductor Europe**  
 Fax: (+49) 0-180-530 85 86  
 Email: cnjwge@tevm2.nsc.com  
 Deutsch Tel: (+49) 0-180-530 85 85  
 English Tel: (+49) 0-180-532 78 32  
 Français Tel: (+49) 0-180-532 93 58  
 Italiano Tel: (+49) 0-180-534 16 80

**National Semiconductor Hong Kong Ltd.**  
 19th Floor, Straight Block,  
 Ocean Centre, 5 Canton Rd.  
 Tsimshatsui, Kowloon  
 Hong Kong  
 Tel: (852) 2737-1600  
 Fax: (852) 2736-9960

**National Semiconductor Japan Ltd.**  
 Tel: 81-043-299-2309  
 Fax: 81-043-299-2408

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Mobile Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Transportation and Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

TI E2E Community Home Page

[e2e.ti.com](http://e2e.ti.com)

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2011, Texas Instruments Incorporated