



Model 990Enh-Ticha Discrete OpAmp Application Note AN-10

Richard Ian Doporto
Design Engineer
OCTOBER 2011

The 990Enh-Ticha is a high performance discrete operational amplifier designed for professional audio applications and areas where ultra-low noise and low distortion is required.

A 990Enh-Ticha discrete opamp provides a low noise front end for this amplifier, which is capable of delivering over $\pm 300\text{mA}$ to a load with a 90V peak-to-peak output swing. Transistors Q1 and Q2 are series regulators stepping down the supply voltage for the 990Enh-Ticha opamp to approximately $\pm 24\text{V}$, while transistors Q3 and Q4 provide the high current output drive. R3 and R4 form an output voltage gain stage whose gain, $A_v=3$, is reduced to unity at high frequencies by C1 to maintain stability. The overall gain is set by R1 and R2. In the circuit example shown in **Figure 1**, the overall gain is 26dB ($A_v=20$) with C2 setting the upper bandwidth 3dB point at 100kHz.

Q1 and Q2 should be capable of a continuous current of 100mA and a V_{ce} of at least 50V. For a margin of safety, attention should be paid to the transistors' safe area operating regions. Q3 and Q4 are high current power transistors that will require heatsinks depending on load resistance. Several part types are called out in the schematic.

Power supply decoupling capacitors are not shown in the circuit diagram for operational clarity. 22 μF low ESR electrolytic capacitors on the supply rails to ground are highly recommended. The 990Enh-Ticha opamp has 0.1 μF capacitors at its VCC and VEE pins internally. Adding a small capacitor (100pF-1nF) across R6 and R7 can be helpful if the supply rails have ripple on them. It is usually best to eliminate noise and ripple on the power supplies rather than band-aid[®] the circuit being affected.

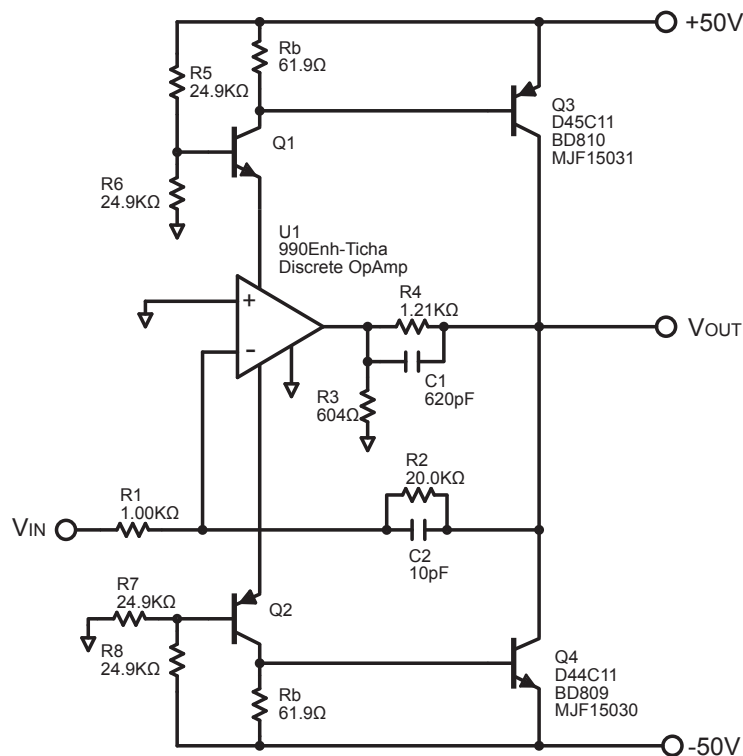


Figure 1. $\pm 50\text{V}$ Low Noise Operational Amplifier



High Performance Audio Electronics

Model 990Enh-Ticha Discrete OpAmp Application Note AN-10

Richard Ian Doport
Design Engineer
OCTOBER 2011

The 990Enh-Ticha is a high performance discrete operational amplifier designed for professional audio applications and areas where ultra-low noise and low distortion is required. It was designed as an enhanced specification upgrade replacement. The pinouts conform to the 990/2520 package, allowing direct replacement. See **Table 1.** below for additional discrete opamps which can be upgraded. Complete specifications datasheet for the 990Enh-Ticha can be downloaded from www.sonicimagerylabs.com

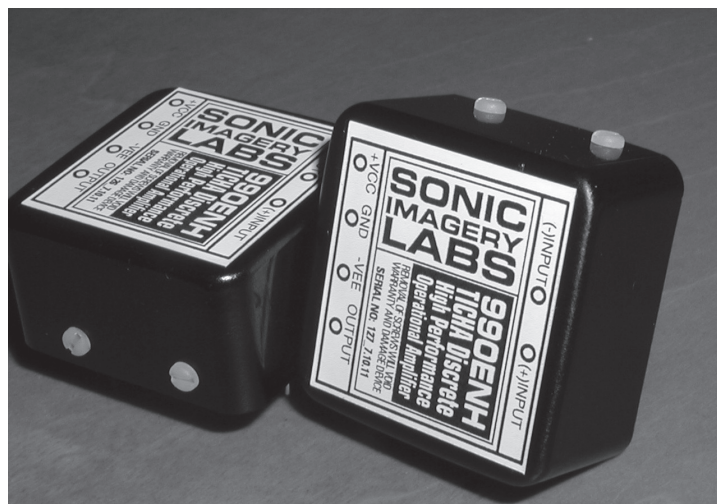
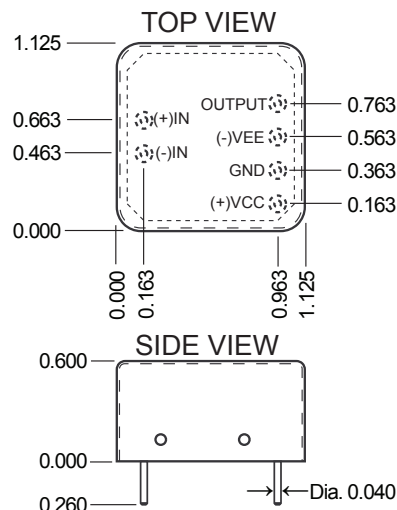


Table 1. Compatible Upgrade Table

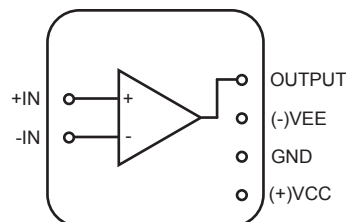
The Model 990Enh-Ticha can be used to upgrade and/or replace these obsolete or end of life discrete operational amplifiers. This list is by no means comprehensive. Contact Sonic Imagery Labs for additional information.

Jensen JE990 Series
Automated Processes Inc. API-2520, 2520H, 2525
John Hardy Co. 990A-990C
FiveFish Studios DOA series
Avedis Audio 1122
Seventh Circle Audio SC10, SC25, SC99
Sound Skulptor SK25, SK99, SK47
Yamaha NE80100, NE80200
TOA PC2011
ProTech Audio Model 1000
Purple Audio KDJ3, KDJ4
Modular Devices 1731, 1757
Modular Audio Products (MAP) 5000 Series, 1731 1731A
Melcor 1731
JLM Audio 99V
Inward Connections SPA690
BTI OA400
FAX Audio FA-100
Analog Devices 111

Package Diagram:



Connection Diagram:



Features:

- Ultra Low Total Harmonic Distortion, 0.00055 THD+N @ 1kHz
- Ultra Low Noise <1nV/rtHz
- High Current Output Drive (250mA into 75 ohms)
- +25dBu Output Levels (into 600 ohms)
- Standard Gain Block Footprint
- Operates over ±10V to ±24V supply rails
- Lower output offset voltage than existing counterparts
- Lower input leakage current than existing counterparts
- Particular emphasis on audio performance
- Designed, assembled and produced in the USA
- 3 Year Warranty



**Sonic
Imagery
Labs**

Model 990Enh-Ticha Discrete Operational Amplifier

Professional Audio Products Application Note AN-10

High Performance Audio Electronics

Model 990Enh-Ticha Discrete OpAmp Application Note AN-10

Richard Ian Doporto
Design Engineer
OCTOBER 2011

THE CONTENTS OF THIS DOCUMENT ARE PROVIDED IN CONNECTION WITH Sonic Imagery Labs PRODUCTS. Sonic Imagery Labs MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE ACCURACY OR COMPLETENESS OF THE CONTENTS OF THIS PUBLICATION AND RESERVES THE RIGHT TO MAKE CHANGES TO SPECIFICATIONS AND PRODUCT DESCRIPTIONS AT ANY TIME WITHOUT NOTICE. NO LICENSE, WHETHER EXPRESS, IMPLIED, ARISING BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT.

TESTING AND OTHER QUALITY CONTROLS ARE USED TO THE EXTENT Sonic Imagery Labs DEEMS NECESSARY TO SUPPORT Sonic Imagery Labs PRODUCT WARRANTY. TESTING OF ALL PUBLISHED PARAMETERS AND SPECIFICATIONS OF EACH PRODUCT IS PERFORMED BEFORE SHIPMENT. Sonic Imagery Labs ASSUMES NO LIABILITY FOR APPLICATIONS ASSISTANCE OR BUYER PRODUCT DESIGN. BUYERS ARE RESPONSIBLE FOR THEIR PRODUCTS AND APPLICATIONS USING Sonic Imagery Labs PRODUCTS. PRIOR TO USING OR DISTRIBUTING ANY PRODUCTS THAT INCLUDE Sonic Imagery Labs COMPONENTS, BUYERS SHOULD PROVIDE ADEQUATE DESIGN, TESTING AND OPERATING SAFEGUARDS.

EXCEPT AS PROVIDED IN Sonic Imagery Labs TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, Sonic Imagery Labs ASSUMES NO LIABILITY WHATSOEVER, AND Sonic Imagery Labs DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY RELATING TO THE SALE AND/OR USE OF Sonic Imagery Labs PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

LIFE SUPPORT AND CRITICAL COMPONENTS POLICY

Sonic Imagery Labs PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR CRITICAL SYSTEMS WITHOUT THE EXPRESS PRIOR WRITTEN APPROVAL OF THE CHIEF EXECUTIVE OFFICER AND GENERAL COUNSEL OF Sonic Imagery Labs. As used herein:

Life support devices or systems are devices 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. A critical component is any component in 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.