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

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 ±300mA 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 ±24V, while transistors Q3 and Q4 provide the high current output drive. R3 and R4 form an output voltage gain stage whose gain, Av=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 (Av=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 Vce 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. 22μF low ESR electrolytic capacitors on the supply rails to ground are highly recommended. The 990Enh-Ticha opamp has 0.1μF 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. ±50 Volt Low Noise Operational Amplifier
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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 DA400
- FAX Audio FA-100
- Analog Devices 111

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

Package Diagram:

Connection Diagram: