

OWNER'S MANUAL

THE DAVID BERNING COMPANY

micro-ZOTL

PERSONAL AMPLIFIER

The David Berning Company

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WARNING: For safety, the cover of this amplifier should be secured at all times. DC voltages as high as 450V and peak AC voltages as high as 800V are present inside. The service information contained in this manual is intended for trained service personnel. Furthermore, this amplifier generates radio-frequency energy that can interfere with communications equipment if the cover screws are not tightly secured. **If this unit is to be operated from a battery, it is most important to read and follow the special instructions pertaining to battery safety outlined in this manual.**

Introduction

MicroZOTL is a low-powered “personal amplifier” that was originally developed as a high-quality amplifier for bedroom or office use where modest listening levels are appropriate. Additional uses of microZOTL include headphone driver, tweeter amp, computer multimedia speaker driver, and high-efficiency horn-loaded-speaker driver. MicroZOTL can be powered either by a 12-volt rechargeable battery, or by universal 100VAC to 240VAC power. MicroZOTL can even be used to provide high-quality sound at modest levels in a car.¹

Power Sources

MicroZOTL can be powered from either universal 100VAC to 240VAC line input, or from a 12-volt dc source such as a rechargeable battery. The AC/DC switch on the top of microZOTL selects the power source that is to be used. This switch is used as an on-off switch by connecting only one source of power to microZOTL.

The universal input features automatic voltage selection, and requires no rewiring to change from 100VAC to 240VAC, or from 50Hz to 60 Hz. Power consumption is 33 watts.

The 12-volt DC input connector is a standard 5.5 mm male power jack with a 2.5 mm pin. These connectors come in several pin sizes, and are used on many small battery-powered electronic items, or items using wall-mounted transformers. Plugs are available at many retail electronic supply stores. In microZOTL, the center pin of this connector is **positive**. **Do not reverse this polarity. Doing so will blow the internal fuse and may damage microZOTL. Reversal of the polarity voids the warranty.**

If a 12-volt DC power source is used, the current draw is 2.1 amps, and the power consumption is 25.2 watts. If a rechargeable battery is used, the amp-hour rating of the battery can give an indication of the run time. It should be noted, however, that amp-hour ratings are not absolute, and are measured at current draws that are likely different from the 2.1-amp draw of microZOTL. For example, it is common practice to rate a lead-acid (or gel-cell) based on a 20-hour discharge time. Only a 42-amp-hour battery discharging at a 2.1-amp rate would satisfy the 20-hour discharge time when running microZOTL. Lead-acid batteries with ratings less than 42-amp hours will, in general, not meet their amp-hour rating when running microZOTL. For example, it might be expected that a 10.5-amp-hour battery would run microZOTL for 5 hours based on the amp-hour rating. But in reality, this battery may only be able to produce 12 volts for 3 hours.

¹ A dropping resistor must be inserted in line to bring the typical 13.8 battery-charging voltage down to 12V. A 0.9-ohm, 10-watt resistor is recommended, but it is advisable to check the voltage with a meter while the car engine is running at normal driving RPM.

Do not energize microZOTL from a battery while it is being recharged, or from a battery charger, as typical charging voltage is 13.8V. **Application of voltage in excess of 12V to microZOTL voids the warranty.** (See footnote.)

Different battery types vary in terms of rated discharge rates and recommended charging techniques. Lead-acid types should be recharged before they are depleted, whereas nickel cadmium should be discharged before being recharged.

It is expected that most applications for powering microZOTL with a battery will be in a home environment where physical battery size and weight are not important. These applications are frequently driven by the desirability of avoiding the influence of bad power quality on the sound in systems with high-efficiency speakers. Large 40+ amp-hour lead-acid gel cells of the type used in uninterruptible power supplies for computers are not expensive and should provide good service. There are a number of new battery technologies that come at a higher price if a small battery with a high discharge rate is desired for portable applications.

Battery Safety

There are several issues that need to be considered when deciding whether it may be desirable to use a battery for powering microZOTL. In most cases, using microZOTL with the built-in power supply will provide the listener with all of the enjoyment that is possible in the average home environment. MicroZOTL is remarkably free of hum and noise when used in this normal way. All types of batteries present environmental concerns, as they use **hazardous materials and need to be disposed of properly** when they are at the end of their service life.

Large batteries store a lot of energy, and this energy will be rapidly released if the battery is short-circuited. If a large battery is short-circuited, several things can occur which can cause bodily harm. **The battery can explode, or the wires connecting the battery can explode or burn violently, or become so hot so as to start a fire.**

When using a battery to power microZOTL, **it is most important to use a fuse** in line with the positive wire connecting the battery to microZOTL. This fuse must be located at the positive battery terminal for maximum protection, and should have a rating of 2.5A. The output from the battery charger should go to the battery terminal directly, without going through this fuse. Any instructions provided with the battery charger should be followed regarding its connection and use. A means will need to be provided that allows the battery to be safely disconnected from the charger when the battery is powering microZOTL. If there is any possible chance that the battery can accidentally be shorted when moving these connections, an additional fuse must be used in any line where such a short can develop. This fuse should carry a rating that is appropriate for the charging current from the charger.

A female 2.5mm plug is provided for connecting the 12-volt battery to microZOTL. The connections inside this plug are small terminals, and only small-gauge wire, such as

AWG 24 or 26 should be used. The shortest wires possible should be used to keep the resistance low. The outside diameter of the wire should be small so as to maintain its flexibility. A twisted pair, consisting of a red wire for positive and a black one for negative is a good choice. The red positive should be connected to the center pin on this plug, and the black negative should be connected to the outer support. Do not attempt to use either heavy-gauge wire, or wire with a stiff, oversized jacket that is commonly used by audiophiles for system hook-up. Stiff wire will likely cause the solder terminals in the plug to flex and break, or short-circuit. **If there is no fuse on the battery, a meltdown and fire will likely occur.**

Operation

Operation of microZOTL is straightforward. MicroZOTL can be used with a high-level source such as a CD player directly, and the level control on microZOTL can be used as a volume control. This control can be turned to full volume if the amplifier is used with a preamp.

Both the headphone output and the speaker outputs are active at all times. The headphone jack takes a standard ¼ inch stereo phone plug, and has a release-lock feature to better secure the plug.

The AC-DC switch is used as an on-off switch. If microZOTL is powered from a 12-volt source, it will be powered up when the switch is in the DC position and off when the switch is in the AC position. Likewise, if microZOTL is powered from an AC source, it will be on when the switch is in the AC position and off when the switch is in the DC position.

Technology

In 1996 Berning introduced a radically new technology (US patent no. 5,612,646) for tube amplifiers that eliminated the problematic audio-output transformer. The first product to use this technology was the ZH270, a dual 70-watt push-pull design. A year later, the single-ended Siegfried was introduced. MicroZOTL is the third product of this series of Zero-Hysteresis Output-Transformerless amplifiers.

These amplifiers use radio frequency to change the voltage-current transfer characteristics of the output tube from its normal impedance plane to one suitable for driving a dynamic loudspeaker. The radio-frequency remapping is implemented using special high-frequency power-conversion techniques. The high-voltage, low-current tube impedance plane is remapped to the high-current speaker impedance plane through special transformers operating at a constant RF carrier frequency of 250kHz. Because the audio signal is riding on a carrier, it is not subject to parasitic elements of the transformer that would distort the audio signal. Unlike the conventional audio-output transformer, this impedance transformation operates on both the ac and dc components of the signal.

In the transformer-coupled amplifier, the turns ratio of the output transformer determines the impedance matching between the output tube(s) and the speaker. There are practical limits to how large this ratio can be made because of the parasitic elements of the windings, and it is difficult to make an output transformer with more than a 25:1 ratio.

With the ZH technology, the impedance matching is determined by the effective turns ratio of the RF converter transformers. Without the parasitics to affect the audio, these RF transformers can have much higher effective ratios, opening the door to using various tubes under unusual operating conditions that cannot be implemented with output transformers.

In microZOTL, the effective (plate to plate) turns ratio is 168 to 1, making it possible to use a tube for output that is normally used for input or intermediate gain stages. The 6SN7 is respected for its linearity, but prospects for making a high-fidelity output transformer for this tube are dim indeed. With the high effective turns ratio in microZOTL, the 6SN7 works well, and a 2-ohm output impedance is achieved without using negative feedback.

Features

Audio-output-transformer coupled amplifiers should not be operated without a load connected because the inductance of the transformer's primary winding can cause the plate voltage on the tube to reach a sufficiently high voltage to break down insulating materials, resulting in amplifier failure and even fire. MicroZOTL can, however, be operated safely without a load, as the voltages cannot exceed their normal designed-in values.

Selected high-impedance portions of microZOTL are hand wired, as opposed to using circuit board connections. This is done to achieve a higher quality of sound reproduction than would be obtained otherwise.

Unusually high-quality input and output connectors are used on microZOTL. Connectors of this quality are not generally found on products costing several times that of microZOTL.

MicroZOTL incorporates a regulated power supply, assuring consistent operation under less than ideal line conditions. There is no regulation for the 12V input.

Unlike other OTL amplifiers, microZOTL delivers more power with a 4-ohm load than it does with an 8-ohm or 16-ohm load. This property provides an opportunity to obtain more power by bridging the channels to obtain a single-channel amplifier. To operate in a bridged mode, a true balanced signal source is required. The plus signal is fed into one channel of microZOTL and the minus signal is fed to the other channel. The output is then taken between the two positive speaker posts of both channels. To maintain polarity, the positive speaker lead is connected to the same channel that is supplied with the plus input signal. Bridging results in about 2 watts output into 8 ohms.

Amplifier Maintenance

MicroZOTL is self-biasing, and has no adjustments. Vacuum tubes are expected to give 10-20 years service based on several hours of use per day. MicroZOTL contains two fuses, both of the 5mm type. There is a 2.5A fuse on the audio board just behind the power connector. There is a 4A fuse on the power supply board.

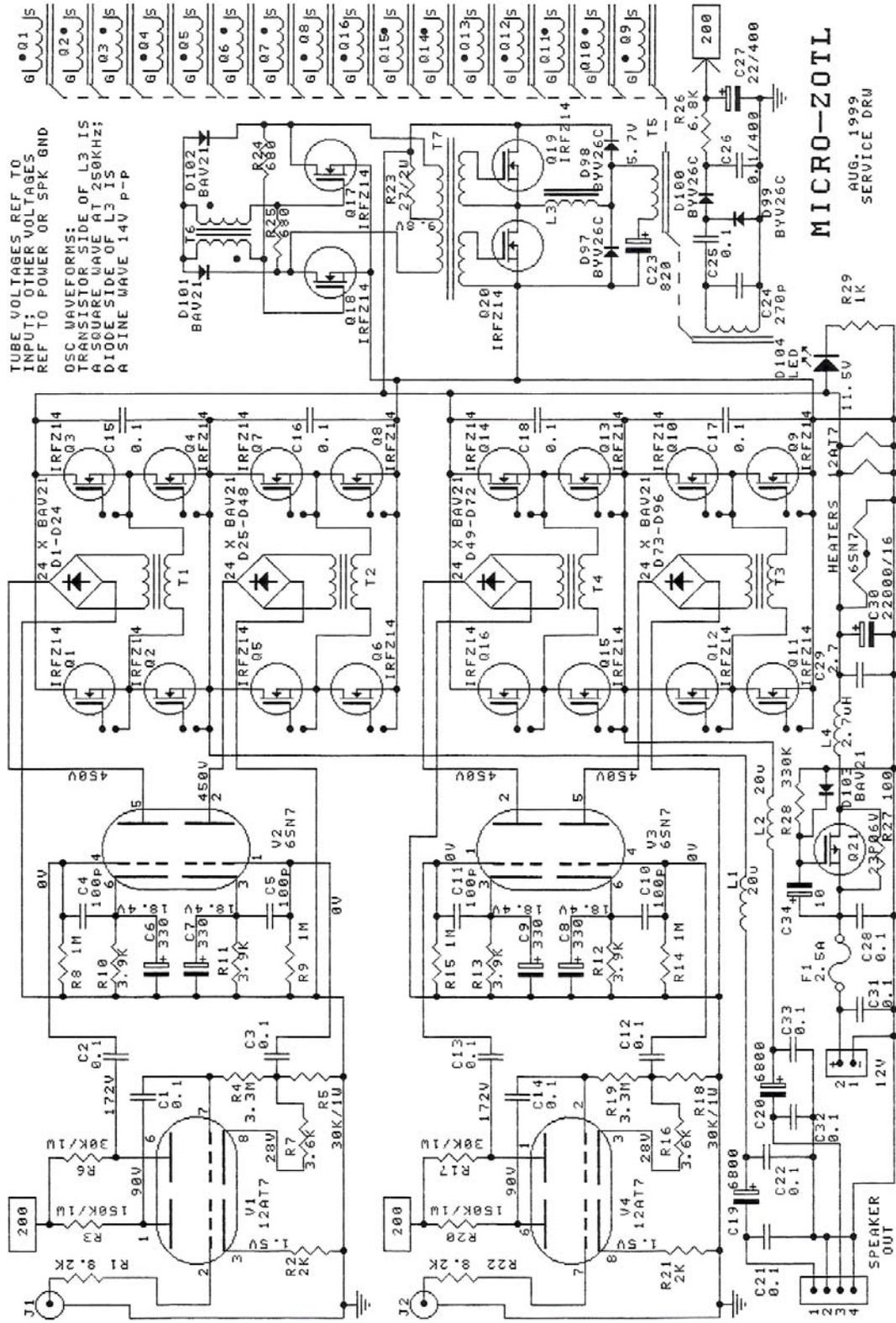
Specifications (Typical Performance Values)

- Sensitivity: 0.6V RMS for full output.
- Output impedance (measured at 0.5A, 60 Hz): 2 ohms.
- Input impedance: 50k.
- 100V / 120V / 240V operation: Auto-switching.
- Hum and noise: 60 μ V RMS or 90dB below full output (20Hz-20kHz).
- Carrier: -50dB (250kHz).
- Current draw from 12V dc source: 2.1A.
- Power consumption from ac power source: 33W.
- Power output with 4-ohm load: 1W, 1% THD.
- Power output with 14-ohm load: 0.5W, 1% THD.
- Channel separation (4-ohm loads): 46dB, 100Hz-10kHz.
- Channel separation (14-ohm loads): 54 dB, 100Hz-10kHz.
- Frequency response (4-ohm load): +0, -1dB 10Hz-20kHz, full power.
- Frequency response (14-ohm load): +0, -1dB 5Hz-50kHz, full power.
- Amplifier class: Push-pull Class A, no feedback.
- Voltage gain (4-ohm load): 10.3dB.
- Voltage gain (14-ohm load): 12.4dB.
- Size: 30.5cm (12 inches) wide, 11.5cm (4.5 inches) high, 14.6cm (5.75 inches) deep, not including connectors, controls and feet. Add 5cm to height and 3cm to depth for these.
- Net weight: 1.8kg (4lb).
- Finish: Aluminum case (various colors) with window.
- Tube complement per channel: 12AT7 input, phase splitter, 6SN7 p-p output.

Limited Two-Year Warranty*

1. Your new Berning product is covered by a limited two-year warranty against defects in material and workmanship. Any repairs required will be made at no charge within the first two years after purchase as a new unit.
2. Any units returned for warranty repair must be shipped prepaid after receiving return authorization from the David Berning Company. For safe handling, and if at all possible, the unit should be shipped in its original carton. If such is not possible, the unit should be well packed with particular attention paid to protection of all corners and avoidance of any looseness in the carton. The David Berning Company will pay return transportation.*
3. This warranty does not apply to damage resulting from physical abuse or unauthorized alterations or repairs; or damage to exterior finish resulting from careless use. The warranty is void if the serial number has been removed, altered, or defaced.
4. This warranty is void if improper voltage is applied to any input or output, or if proper polarity for the dc power input is not observed.
5. The David Berning Company reserves the right to improve or change its products without obligation to modify previously manufactured units.

* Applicable for domestic sales only. Handling and shipping costs preclude extension of this warranty to overseas sales.



TUBE VOLTAGES, REF TO INPUT; OTHER VOLTAGES REF TO POWER OR SPK GND

OSC WAVEFORMS:
 TRANSISTOR SIDE OF L3 IS A SQUARE WAVE AT 250KHz;
 DIODE SIDE OF L3 IS A SINE WAVE 14V P-P

MICRO-ZOTL

AUG. 1999
 SERVICE DRW

BERNING MicroZOTL OFF-BOARD (COMPLETE AMP VERSION)

DEC 1999

